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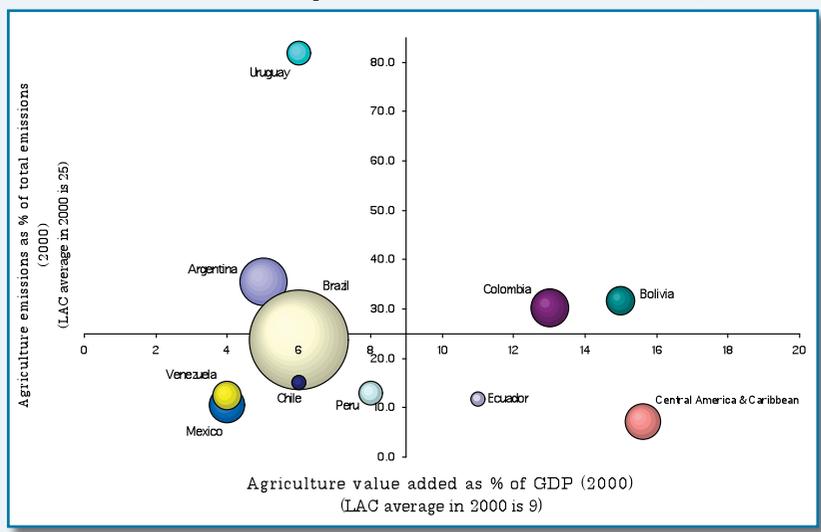
# BRAZIL

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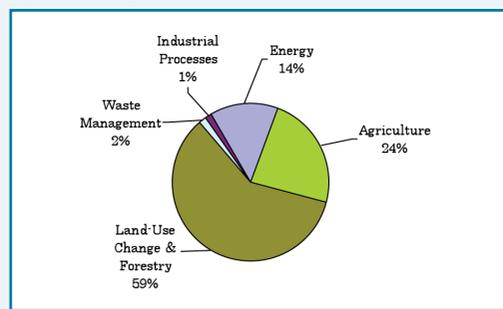
### Country Note on Climate Change Aspects in Agriculture

This Country Note briefly summarizes information relevant to both climate change and agriculture in Brazil, with focus on policy developments (including action plans and programs) and institutional make-up.

Contribution of agriculture (without LUCF) to the economy and to emissions in LAC countries (size of bubble in MTCO<sub>2</sub> of LUCF emissions; axes cross at LAC average)

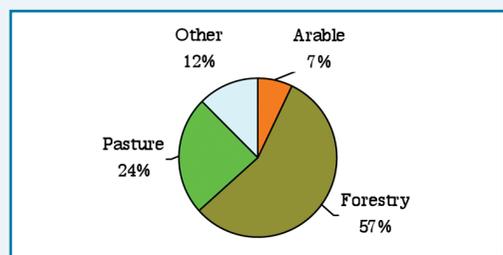


Percent of GHG emissions in CO<sub>2</sub> equivalent, by sector (2000)



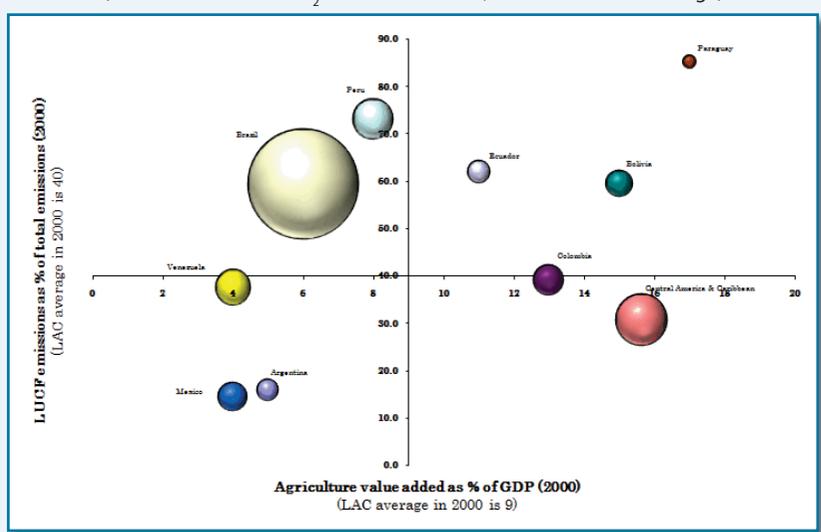
Source: World Resources Institute <http://cait.wri.org>

Land use (2005)



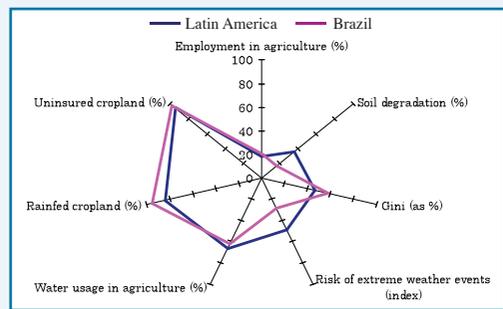
Source: World Development Indicators

Contribution of agriculture to the economy and of LUCF to emissions in LAC countries (size of bubble in MTCO<sub>2</sub> of LUCF emissions; axes cross at LAC average)



Note: In the first bubble graph, the total emissions for Uruguay do not account for the positive effects of LUCF (i.e. afforestation efforts). If they are considered, agriculture represents 22% of total emissions. Because of afforestation efforts in Uruguay and Chile, land use change and forestry (LUCF) is not a net contributor to emissions; hence the countries do not appear in the second bubble graph, but are considered in the calculation of the average in the vertical axis.

Vulnerability Indicators



Note: Employment in agriculture (% of total employment)\*; Rainfed cropland (% of total cropland)\*; Gini\*; Water usage in agriculture (% of total annual fresh water 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; \*\*IADB, IICA, 2002/2003 figures; \*\*\*FAO AGL 2005<sup>1</sup>; \*\*\*\*Germanwatch

<sup>1</sup> <http://www.fao.org/landandwater/agll/glasod/glasodmaps.jsp?country=BRA&search=Display+map+%21>

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## Summary

In Brazil, the 5<sup>th</sup> largest emitter of greenhouse gases in the world, agriculture (including land use change and forestry) is the largest contributor to GHG emissions. The emission reduction potential of the agricultural sector (including land use change and forestry) is significant and not yet sufficiently explored. Brazil currently counts with 30 CDM projects in the agricultural sector (targeting only methane emission reductions and biomass generation), while there are no registered CDM projects in the country under the “afforestation and reforestation” category. Agriculture is highly vulnerable to climate variability, particularly in the Brazilian semi-arid Northeast where droughts have had a significant impact on crop yields and people’s livelihood. The extension and improvement of both irrigation infrastructure and climate-sensitive insurance coverage for agricultural production, as well as addressing the problems of severe land degradation, can reduce some of the observed vulnerabilities in the country. Reducing poverty and inequality in rural areas, and particularly in those areas already vulnerable to climate risk, can also contribute to minimizing the negative impacts of future weather variability.

## Working definitions

**Agriculture** is defined as a managed system of crops, livestock, soil management, forest resources (productive use, goods & services) and water resources (irrigation), including land use and land use change. **Climate change** encompasses both **mitigation** and adaptation activities within the agricultural sector. On the mitigation side, the focus is on the potential to reduce green house gas emissions by the different sub-sectors. On the **adaptation** side, the focus is on the potential to build resilience to climate and to increase the adaptive capacity through sustainable management of agriculture and other complementary factors (e.g. financial instruments). There is no specific **time frame** used in the country notes. An effort was made to collect the most recent available information on country indicators and policy matters.

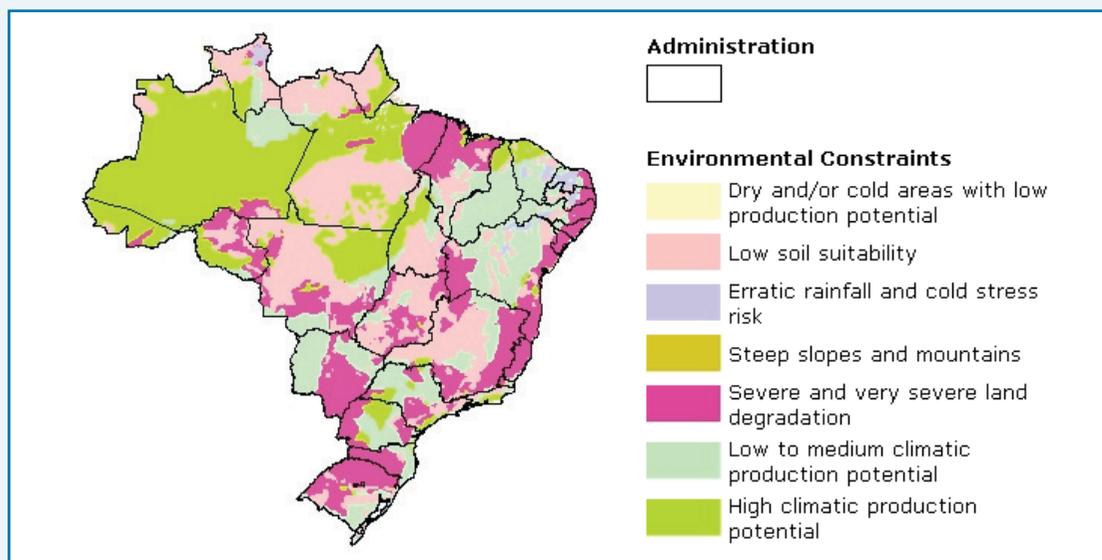
### Acknowledgments:

This *Country Note* was produced by a World Bank team of specialists (in agriculture, forestry, social development, risk and knowledge management) from the Latin America and the Caribbean region and other units of the World Bank. The team is very grateful for all the comments and suggestions received from the focal points on climate change and agriculture in many of the countries.

## 1. The Climate Context

The baseline map provides a visual characterization of Brazil's agricultural potential given current environmental constraints and their regional distribution. Around 31% of Brazil's land is used for agriculture (24% for pasture and 7% for cultivation), with forestry occupying 57% of the land in the country (WDI, 2005).

### Baseline map: Current Major Environmental Constraints related to Agricultural Potential



Source: FAO Note: For more maps on Brazil and agricultural resources, go to <http://www.fao.org/countryprofiles/Maps/BRA/04/ec/index.html>

### 1.1. Country Projections

Based on climate scenarios for the years 2020, 2050 and 2070 the following climatic changes with relevance to the agricultural sector can be expected in Brazil:

- a) **increases in temperature** – it is probable that the temperature will increase by 2 to 5.4°C by 2100 according to the A2 (more pessimistic) scenario and by 1.4 to 3.8°C according to the B2 (more optimistic) scenario.;
- b) **changes in the precipitation regime** – in Southeastern Brazil such changes will be reflected in the decrease of crop yields and in increased flood frequency and intensity; in Northeastern Brazil rainfall will likely be reduced by 15-20% under the A2 scenario. Generally, possible impacts might include: i) high frequency of dry spells and evaporation rates and low soil moisture levels affecting levels of channels and water reservoirs; ii) losses in natural ecosystems such as the “caatinga”; iii) tendency towards aridization and desertification in the semiarid region; iv) water scarcity; v) climate induced migration to large cities, aggravating social problems; vi) impacts on human health.
- c) **rising sea levels** will have an impact on the mangrove ecosystems of Brazil.

In recent years (between 2000 and 2007), floods and droughts have had the highest human and economic impact in Brazil, with losses for the period 1997-2006 averaging 0.04% of GDP – 823,810 people have been affected by floods (4 events) with the cost of damages reaching US\$ 4.7 billion, and 2 million people have been affected by droughts (2 events) with damages reaching US\$ 1.7 billion<sup>2</sup>. Additionally, in 2004 for the first time ever, Brazil was hit by a hurricane on its South Atlantic offshore coast.

<sup>2</sup> [http://www.emdat.be/Database/CountryProfile/countryprofile.php?disgroup=natural&country=bra&period=1999\\$2008](http://www.emdat.be/Database/CountryProfile/countryprofile.php?disgroup=natural&country=bra&period=1999$2008)

## 1.2. Agriculture-Related Impacts

The impact of climate variability and extreme events is most noticeably seen on Latin America's subsistence agriculture. For example, northeast Brazil has seen reductions of agricultural GDP of up to 25% for years of severe drought, which resulted in displacements of up to a few million low income rural people<sup>3</sup>. The growth in emissions from agriculture has been increasing faster than that of Amazon clearing in the past 15 years. The steady expansion of arable crops, the even faster increase in the production of sugar cane, as well as rising numbers of cattle, pigs and poultry are making an increasing contribution. Although many of the cattle displaced from the south and west by the advance of arable crops and cane have moved into Amazonia, there are signs that this process has started to slow as it becomes more attractive for farmers to raise cattle in tandem with other crops in more traditional areas.

According to a study performed in 1992, 95% of losses registered in the Brazilian agriculture were due to droughts or intense precipitations<sup>4</sup>. Rising temperatures will lead to an increased evapotranspiration process and, consequently, to a water deficit, thus increasing the number of hectares with high climate risk for various crops. For example: i) cotton: the area suited for the cultivation of cotton will decrease by 11% by 2020 and by 16% by 2070, ii) rice: a reduction of the low risk cultivation area of around 12.5% will be observed by 2050 and around 14% by 2070, iii) coffee: the area suited for cultivation of coffee will decrease by 6.75% by 2020, 18.3% by 2050 and 27.39% by 2070 and iv) soybeans: this will be the most affected crop by temperature increases with a 40% reduction in the area suited for its cultivation by 2070<sup>5</sup>. For example, the droughts of 2004-2006 lead to reductions of 65% in soybean and 56% in maize production in the state of Rio Grande do Sul<sup>6</sup>.

The government's agricultural research agency (EMBRAPA) has recently conducted simulations with data from the IPCC to predict the impact of climate change on five crops: soybeans, maize, coffee, rice and beans. The results of scenarios with temperature increases of 1.3 to 5.8°C and 5, 10 and 15 percent increases in rainfall revealed the need for a dramatic geographical reorganization of the country's agricultural production. In the coming decades, grain crops will be increasingly difficult to grow in Southern Brazil, while perennials like coffee will tend to prefer zones with more moderate temperatures, which implies that the centre of production could shift to the South. Excessive heat in the southern hemisphere summer will likely push production of crops like rice, beans, maize and soy towards Brazil's central-west<sup>7</sup>.

According to an experiment performed by **The Environmental Research Institute on the Amazon**<sup>8</sup> (**IPAM**, Portuguese acronym) in partnership with EMBRAPA called *Dry Forest (Seca Floresta)*<sup>9</sup>, whereby a drought, projected to occur in this area in the future, is simulated on one hectare of the National Forest of Tapajos in Para, this forest proved to be very resistant to drought due to the trees' capacity to access water stored deep under the soil, though this resistance has a limit. After three consecutive years of drought, a decreased growth in trees was observed which implies a decreased carbon absorption capacity.

To date, Brazil has submitted one **National Communication**<sup>10</sup> to the **United Nations Framework Convention on Climate Change (UNFCCC)**<sup>11</sup> in December 2004. The Communication established the First National GHG Inventory for the period 1990-1994 including the agricultural sector and land-use change and forestry. It also gives a description of the programs and policies currently active in the country containing a climate change component. Finally, it contains a part on the integration of the climate change issue in future medium term and long term planning, in terms of environmental

## 2. The Policy Context

<sup>3</sup> [http://unfccc.int/files/adaptation/adverse\\_effects\\_and\\_response\\_measures\\_art\\_48/application/pdf/200609\\_background\\_latin\\_american\\_wkshp.pdf](http://unfccc.int/files/adaptation/adverse_effects_and_response_measures_art_48/application/pdf/200609_background_latin_american_wkshp.pdf)

<sup>4</sup> Assad E., Pinto Silveira H., Aquecimento Global e a Nova Geografia da Produção Agrícola no Brasil, August 2008, EMBRAPA, UNICAMP

<sup>5</sup> Assad E., Pinto Silveira H., Aquecimento Global e a Nova Geografia da Produção Agrícola no Brasil, August 2008, EMBRAPA, UNICAMP

<sup>6</sup> Magrin, G., C. Gay Garcia, D. Cruz Choque, J.C. Gimenez, A.R. Moreno, G.J. Nagy, C. Nobre and A. Villamizar, 2007: Latin America. Climate Change Impacts 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 581-615

<sup>7</sup> Assad E., Pinto Silveira H., Aquecimento Global e a Nova Geografia da Produção Agrícola no Brasil, August 2008, EMBRAPA, UNICAMP

<sup>8</sup> [www.ipam.org.br](http://www.ipam.org.br)

<sup>9</sup> <http://www.climaedesmatamento.org.br/mudanca#>

<sup>10</sup> <http://unfccc.int/resource/docs/natc/brazilnc1s.pdf>

<sup>11</sup> [www.unfccc.int](http://www.unfccc.int)

legislation, measures against deforestation and research programs on climate change topics. A **Second National Communication** is in the works and will include a renewed National GHG Inventory with 2000 as its base year.

The **Climate Change Performance Index**<sup>12</sup> gives Brazil a fairly high rank – 8<sup>th</sup> among the 56 countries responsible for more than 90 percent of global energy-related CO<sub>2</sub>. Though the index does not explicitly incorporate the role of agriculture and land use change on emissions, it does recognize Brazil's commitment to addressing climate change issues, as one of the components of this index represents the country's domestic and international climate policy. Brazil deserves special attention, in that it needs to be supported in its effort to reduce emissions from land-use change, as they represent an 80% share of world land use change emissions.

In November 2009, Brazil created a **Brazilian Panel on Climate Change (PBMC)**, Portuguese acronym) through an ordinance involving 2 ministries: Science and Technology and Environment. It is meant to replicate the model of the Intergovernmental Panel on Climate Change (IPCC) at the country level. The function of the new body will be to equip the government with scientific information on the risks of climate change in the country. Like the IPCC, the PBMC will have a Brazilian board and a scientific committee. There will be four working groups that together involve around 100 researchers and scientists, linked to national research institutions and specializing in climate-related research. The aim is to organize the Brazilian scientific information on climate to guide government action.

## 2.1. National Climate Change Plans, Strategies and Programs

The **National Climate Change Program**<sup>13</sup> was created in June 1996 with funds from the Global Environment Facility (GEF) and through a bilateral agreement with the United States under the "U.S. Country Studies Program" with the objective to support the development of scientific information related to greenhouse gas emissions as the basis for the creation of a policy for responding to climate change.

A **National Climate Change Plan**<sup>14</sup> (**PNMC**, Portuguese acronym) was finalized in December 2008 by the Federal Government after a preliminary version of it was made available online for public consultation with the objective of better involving the public sector and society in the elaboration of it. Its objective is to identify, coordinate and plan the actions and measures to be taken to mitigate the emissions of GHG in Brazil as well as those to adapt to future climate change. It also targets to reduction of the deforestation rate in the Amazon.

## 2.2. Agricultural Sector Initiatives

The **Agriculture and Livestock Plan 2008/2009**<sup>15</sup> of the **Ministry of Agriculture, Livestock and Food Supply**<sup>16</sup> (**MAPA**, Portuguese acronym) is published annually with the purpose of strengthening the agricultural sector. It is also meant to aid in reducing the negative effects of climate adversities with the help of the **Climate Risk Zoning Program** that came into effect in 1996. This is a computer program that helps define the planting calendar for the most common crops (around 30 crops) in the country from more than 5,000 Brazilian municipalities allowing producers to know what, when and where to plant based on simulation of cumulative water balance.

The state of São Paulo counts with a climate change law, which commits the state to 20% greenhouse gas reduction by 2020 from 2005 level. The comprehensive policy covers land use, industry, commerce, environmental licenses, sustainable transport, water resources, waste management, and disaster preparedness.

<sup>12</sup> <http://www.germanwatch.org/klima/ccpi2008.pdf>

<sup>13</sup> <http://ftp.mct.gov.br/clima/ingles/brasil/ppa01.htm>

<sup>14</sup> [http://www.mma.gov.br/estruturas/169/\\_arquivos/169\\_29092008073244.pdf](http://www.mma.gov.br/estruturas/169/_arquivos/169_29092008073244.pdf)

<sup>15</sup> <http://www.agricultura.gov.br/>

<sup>16</sup> <http://www.agricultura.gov.br/>

### 3. The Institutional Context

The **Ministry of Environment**<sup>17</sup> (MMA, Portuguese acronym) through its **Climate Change Unit**<sup>18</sup> (DEMC, Portuguese acronym) is responsible for the development of policies and strategies for mitigation of GHG emissions and for adaptation to climate change effects. It also is in charge of coordinating the **Executive Group for Climate Change** (GEx, Portuguese acronym) responsible for the elaboration and implementation of the National Climate Change Program.

#### 3.1. Inter-Sectoral Coordination

The **National Coordination of Global Climate Changes**<sup>19</sup> (CGMCG, Portuguese acronym) is a unit created in August 1994 within the **Ministry of Science and Technology**<sup>20</sup> (MCT, Portuguese acronym) with the objective to advise the Ministry on global climate change issues, to coordinate the implementation of Brazil's commitments to the UNFCCC, to promote and support events related to climate change in the different areas related to this theme by publishing and distributing relevant information and to actively promote awareness programs and actions on the issue of climate change. A webpage with climate change information for Brazil was created within the Ministry to facilitate the integration of all specialists and institutions: [www.mct.gov.br/clima](http://www.mct.gov.br/clima).

The **Inter-Ministerial Committee on Global Climate Change**<sup>21</sup> (CIMMCG, Portuguese acronym) was created in July 1999 to mainstream climate change in development policy and it serves as the **Designated National Authority** (DNA) of Brazil on climate change and in particular on the **Clean Development Mechanism** (CDM). The Committee is comprised of representatives from various Ministries, including the Ministry of Agriculture, Environment, Science and Technology. The Committee is responsible for producing proposals for sectoral policies and legal instruments that contain a relevant climate change mitigation and adaptation component and for evaluating and approving projects aimed at GHG emission reductions eligible for the CDM. It is also responsible for the elaboration and monitoring of the National Climate Change Plan through its Executive group on Climate Change and coordinated by the Ministry of Environment.

The **Brazilian Climate Change Forum**<sup>22</sup> (FBMC, Portuguese acronym) was created in 2000 and it is presided by the President of the Republic with the purpose of promoting awareness and mobilizing the Brazilian society on issues of climate change and its causes and consequences through the development of various activities.

The **Brazilian Research Network on Climate Change** (RedeCLIMA, Portuguese acronym) was created in 2007 by the Ministry of Science and Technology. It has the objective to generate and disseminate knowledge to enable Brazil to better respond to future climate change impacts, to realize vulnerability studies about the impact of climate change in the various sectors of the economy, including agriculture, to identify adaptation measures to climate change and to research the effects of climate variability on land-use in the country.

#### 3.2. Agricultural Sector Institutions

The **Ministry of Agriculture, Livestock and Food Supply** is responsible for the formulation of all policies related to livestock and agriculture in Brazil, as well as for the elaboration of the Agriculture and Livestock Plan which contains a climate risk component.

The **Center for Weather Forecasting and Climate Studies**<sup>23</sup> (CPTEC, Portuguese acronym) of the **National Institute for Spatial Research**<sup>24</sup> (INPE, Portuguese acronym), through its Research Group on **Climate Change**<sup>25</sup> (GPMC, Portuguese acronym) produces studies on climate change, vulnerability in various sectors, such as agriculture and forestry, as well as climate projections based on future climate scenarios. The Research Group also collaborates with the National Program on Climate Change. Another initiative has been the implementation of **Regional Climate Change Scenarios**

<sup>17</sup> [www.mma.gov.br](http://www.mma.gov.br)

<sup>18</sup> <http://www.mma.gov.br/index.php?ido=conteudo.monta&idEstrutura=141>

<sup>19</sup> <http://ftp.mct.gov.br/clima/fconosco/quem.htm>

<sup>20</sup> <http://www.mct.gov.br>

<sup>21</sup> <http://ftp.mct.gov.br/clima/cjgmc/default.htm>

<sup>22</sup> <http://ftp.mct.gov.br/clima/ingles/brasil/forum.htm>

<sup>23</sup> <http://www7.cptec.inpe.br/>

<sup>24</sup> <http://www.inpe.br/>

<sup>25</sup> [http://www.cptec.inpe.br/mudancas\\_climaticas/](http://www.cptec.inpe.br/mudancas_climaticas/)

**for South America (CREAS).** CREAS was established by CPTEC for studies on impacts of climate change in natural ecosystems in Brazil. CPTEC has also been engaged in training Brazilian Regional Meteorological Centres on installation and operation of meteorological networks.

Given the experience in model development and the generation of regional climate change scenarios, and considering the computing facilities and expertise, the Brazilian CPTEC is proposed to function as the focal point for: running regional climate models to produce climate change scenarios for the future and then make them available to other countries in the region; training and capacity-building in downscaling both statistical and dynamic (regional climate modeling) in South and Central America; and training in the use of visualization tools and statistical analyses of regional climate change scenarios. CPTEC could act as a centralized facility that builds up human and technical capacity in core activities (advanced computational infrastructure, training, and internships) but could also engage in collaborations with other universities and government agencies on applied regional projects, with outreach to rural and agricultural communities at the level of individual farmers<sup>26</sup>.

The **Brazilian Institute for Agricultural Research**<sup>27</sup> (EMBRAPA, Portuguese acronym) linked to the Ministry of Agriculture, Livestock and Supply was created in April 1973 with the mission of finding viable solutions to sustainable development in the rural sector. One of its units, the **Weather and Agriculture Monitoring System**<sup>28</sup> (AGRITEMPO, Portuguese acronym) produces climate change maps showing the cultivation suitability of a certain crop depending on increases in temperature or precipitation or various types of soils. It also produces publications on climate change and its impact on agriculture.

The **Ministry of National Integration**<sup>29</sup> (MI, Portuguese acronym) through its **Secretariat for Water Infrastructure** is in charge of irrigation programs. It consists of three executing agencies in charge of irrigation projects in the different regions of the country: i) **CODEVASF**, in charge of irrigation projects in the São Francisco River basin; ii) The Office of the Superintendent for the development of the Northeast Region (**SUDENE**) in charge of programs in the Northeast and iii) the Office of the Superintendent for the Development of the Amazon region (**SUDAM**) which implements programs targeted to the Northern Region.

The **Brazilian Institute of Environment and Renewable Natural Resources**<sup>30</sup> (IBAMA, Portuguese acronym) acts as the enforcement agency of the Ministry of Environment. Among others, it acts in the area of deforestation with the help of three systems (**PRODES** - Monitoring of land cover: the project for gross deforestation assessment in the Brazilian legal Amazon, **DETEX** and **DETER**) designed to monitor the Amazon forests in real time and to detect deforestation activities.

The **Chico Mendes National Institute for Conservation of Biodiversity** (ICMBio, Portuguese acronym) is dedicated to managing the federal protected area system and promoting the conservation of biodiversity, particularly of endangered species.

### 3.3. Fostering Capacity to Deal with Climate Change

**Emission Inventory:** To date, Brazil counts with one National GHG inventory with 1994 as its base year. The inventory includes information on emissions from agriculture, land-use change and forestry, providing disaggregated information by type of emission and type of agricultural resource (ex: rice cultivation, livestock, etc.). Some states have realized their own inventories: the state of Rio de Janeiro completed its inventory in 2007 with 2005 as a base year, the state of Minas Gerais will complete its inventory by the end of 2008 with 2005 as its base year and the state of São Paulo already started its studies and should soon have its inventory completed. Most Amazonian states have no robust estimate of their greenhouse gas emissions, even though the region is said to emit around 60% of

<sup>26</sup> [http://unfccc.int/files/adaptation/adverse\\_effects\\_and\\_response\\_measures\\_art\\_48/application/pdf/200609\\_background\\_latin\\_american\\_wkshp.pdf](http://unfccc.int/files/adaptation/adverse_effects_and_response_measures_art_48/application/pdf/200609_background_latin_american_wkshp.pdf)

<sup>27</sup> [www.embrapa.org.br](http://www.embrapa.org.br)

<sup>28</sup> [www.agritempo.gov.br](http://www.agritempo.gov.br)

<sup>29</sup> [www.integracao.gov.br](http://www.integracao.gov.br)

<sup>30</sup> [www.ibama.gov.br](http://www.ibama.gov.br)

the GHG in the country. The World Bank is assisting the preparation of a national scenario for GHG emissions for Brazil for the year 2030, which Brazil hopes to have ready to forward to UNFCCC in 2009. The Brazilian team includes the Ministry of Science and Technology, **São Paulo State Environmental Agency**<sup>31</sup> (CETESB, Portuguese acronym) and the Brazilian office of the UN Development Program<sup>32</sup>.

**Studies related to climate change and agriculture:** various vulnerability studies on climate change and its impact on agriculture have been performed by the different research institutes and universities in the country: i) “*Global warming and future scenarios in the Brazilian agriculture*” realized by researchers from EMBRAPA and the agriculture department of the Campinas State University (UNICAMP); ii) *Vulnerability studies*: coastal area of Rio de Janeiro and the impact of climatic variability, impact on the Atlantic Rainforest (Mata Atlantica) biome due to climate change; iii) a regional study, financed by START-AIACC and USAID, was finalized in 2006 by the national research organizations of Argentina, Brazil and Uruguay: “Development and implementation of a system for impact assessment of the variability of weather and climate change in the agricultural production systems of Argentina, Brazil and Uruguay, and the identification of potential adaptive responses”.

A study just released by the National Institute for Spatial Research (INPE, Portuguese acronym) titled “Estimates of CO<sub>2</sub> emissions from Deforestation in the Brazilian Amazon” reported that the overthrow of the Amazon has contributed significantly to the increase in global CO<sub>2</sub> emissions.

The World Bank published a flagship document for the entire region of Latin America and the Caribbean titled “Low carbon, High Growth: Latin American Responses to Climate Change”<sup>33</sup>, encompassing information on climate change impacts in the region, on the potential contribution to mitigation efforts as well as a listing of future low carbon-high growth policies.

## 4. The Impact of Agriculture on Climate Change - Mitigation Measures

**B**razil is the 4<sup>th</sup> largest emitter of CO<sub>2</sub> from fossil fuels in the world (accounting for 5.37% of global emissions in 2000, excluding other GHGs) and 1<sup>st</sup> in LAC<sup>34</sup>. This is mainly due to deforestation activities<sup>35</sup>. According to the National GHG Inventory for 1994, land use change and forestry accounted for 75% of total CO<sub>2</sub> emissions and livestock accounted for 77% of all methane (CH<sub>4</sub>) emission that same year. Brazil’s per capita emissions of CO<sub>2</sub> (in tCO<sub>2</sub>) in 2004 stand at 1.8tCO<sub>2</sub>/capita, representing 1.1% of global emissions. This is lower than the Latin America average of 2.6tCO<sub>2</sub>/capita and the world of 4.5tCO<sub>2</sub>/capita<sup>36</sup>.

One of the main problems that the country faces is deforestation of the rainforest to clear space for agricultural land, currently representing 60% to 70% of all deforestation activities. To date, 65 million hectares of forest, corresponding to twice the State of São Paulo, have been removed to create pastureland of low productivity, a third of this being currently abandoned<sup>37</sup>.

### 4.1. Action Frameworks

#### 4.1.1. Forestry and Land Use Change

Brazil has the second largest forest areas in the world. Forests cover 57% of the national territory. The average annual deforestation rate between 1990 and 2005 for Brazil was approximately 0.4%. During this same period, the savannah area of Brazil (Cerrado) lost 20% of the initial forest coverage and the Atlantic rainforest (Mata Atlantica) lost 8% of it<sup>38</sup>. Over 65% of São Paulo’s Atlantic Forest has been primarily cleared for agricultural production (particularly for soybeans), where forests are typically slashed and burned<sup>39</sup>. Coffee growers, sugarcane farmers, and cattle ranchers are some of the major groups responsible for illegal deforestation. Other major causes for deforestation are illegal logging and inefficiencies in the forest industry. This continues, despite government regulations to preserve it. According to the Federal Government, around 18% of Amazonia has already been deforested. The

<sup>31</sup> <http://www.cetesb.sp.gov.br/>

<sup>32</sup> <http://www.pnud.org.br/home/>

<sup>33</sup> [http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/02/27/000334955\\_20090227082022/Rendered/PDF/476040PUBLow0101Official0Use0Only1.pdf](http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/02/27/000334955_20090227082022/Rendered/PDF/476040PUBLow0101Official0Use0Only1.pdf)

<sup>34</sup> [http://www.ai.org.mx/archivos/sem\\_cambio\\_clim/Dr.%20Carlos%20Gay%20G.pdf](http://www.ai.org.mx/archivos/sem_cambio_clim/Dr.%20Carlos%20Gay%20G.pdf)

<sup>35</sup> Assad E., Pinto Silveira H., *Aquecimento Global e a Nova Geografia da Produção Agrícola no Brasil*, August 2008, EMBRAPA, UNICAMP

<sup>36</sup> [http://hdrstats.undp.org/countries/country\\_fact\\_sheets/cty\\_fs\\_bra.html](http://hdrstats.undp.org/countries/country_fact_sheets/cty_fs_bra.html)

<sup>37</sup> <http://www.climaedesmatamento.org.br/clima#>

<sup>38</sup> [http://www.mma.gov.br/estruturas/169/\\_arquivos/169\\_29092008073244.pdf](http://www.mma.gov.br/estruturas/169/_arquivos/169_29092008073244.pdf)

<sup>39</sup> The World Bank, 1997

Legal Amazonia, which has 83% of its total surface covered by forests, accounts for 39% of the national soybean cropland<sup>40</sup>.

According to the National GHG Inventory, the land-use change and forestry sector in 1994 accounted for 75% of CO<sub>2</sub> emissions, 14% of methane (CH<sub>4</sub>) emissions and 2% of nitrous oxide (N<sub>2</sub>O) emissions. Regarding CO<sub>2</sub> emissions from this sector, 96% of them are due to conversion of forests into cropland and land for grazing of livestock and the remaining 4% are due to carbon alterations in soils. Furthermore, this sector registers a reduction of 6% of CO<sub>2</sub> emissions due to carbon sequestration from forest plantations. Methane and nitrous oxide emissions from this sector are due to the burning of biomass in deforested areas.

Brazil has a **National Forest Program** established in 2000. The Program aims at promoting the sustainable development of forests by expanding to 50 million ha the area covered by National Forests in the Legal Amazon by 2010. It also counts with an **Action Plan for Prevention and Control of Deforestation in Legal Amazonia (PPCDAM)**, Portuguese acronym) aimed at reducing the illegal deforestation of the Amazon. It has achieved a 59% reduction in the annual deforestation rate for three consecutive years from 2004 to 2007.

Other action programs in the forestry sector are: i) **The National System of Combating and Preventing Forest Fires (PREVFOGO)**, Portuguese acronym), in place since 1989, consists of actions aimed at organizing and putting into practice of activities related to education, research, prevention and control of forest fires under IBAMA's coordination; ii) **Program for Prevention and Control of Forest Fires in the Deforestation Arch (PROARCO)** launched in 1998, with the objective to prevent and combat the occurrence of forest fires on a large scale in the Legal Amazon, especially in the "deforestation arch" (the southern part of the Amazon); iii) **Pilot Program for Tropical Forests Protection in Brazil<sup>41</sup> (PPG7)**, coordinated by the Ministry of Environment and financed partly by the G7 group of countries, the European Union and the Netherlands, aimed at preserving the tropical forests of Brazil and reducing the GHG contribution of the tropical forests through the development of a methodology for sustainable development resulting in a reduction of deforestation activities in the Amazon.

One mitigation initiative identified is the practice of agriculture without burning, or "tipitamba" in the language of the local indigenous population. This consists of crushing of the secondary vegetation that is normally burned in order to clear the space for cropland or pasture. This practice leads to a five time reduction of emission of CO<sub>2</sub> equivalent<sup>42</sup>.

Additional to existing programs at the national level, there are programs at the state level that offer incentives for commercial forest plantations such as: i) **State Forestry Program Proflora<sup>43</sup>** for the state of Rio Grande do Sul that offers credits for commercial forest plantations; ii) **Forest Defense Program<sup>44</sup>** for the state of Espírito Santo whose objective is the protection of the remaining forests of the Atlantic Rainforest (Mata Atlantica) through control of activities with degradation potential.

Brazil supports the World Bank's Forest Carbon Partnership Facility (FCPF) by sharing knowledge on forest inventories, monitoring and remote sensing techniques. However, Brazil is not an official participant in the FCPF.

The government of Brazil has undertaken policies to reduce clearing of the Amazon rainforest by 80% by 2020 and has proposed to cut carbon emissions by at least 36%. About 17% of Amazon rainforest has been cut down, with clearing that is responsible for slightly more than half of Brazil's carbon dioxide (CO<sub>2</sub>) emissions, estimated at about 2.1 billion tons a year. If the promised reduction in Amazon clearing of 80% by 2020 were achieved, Brazil's total emissions would be reduced by 20%.

<sup>40</sup> Assad E., Pinto Silveira H., *Aquecimento Global e a Nova Geografia da Produção Agrícola no Brasil*, August 2008, EMBRAPA, UNICAMP

<sup>41</sup> <http://www.mma.gov.br/index.php?ido=conteudo.monta&idEstrutura=63>

<sup>42</sup> Assad E., Pinto Silveira H., *Aquecimento Global e a Nova Geografia da Produção Agrícola no Brasil*, August 2008, EMBRAPA, UNICAMP

<sup>43</sup> <http://www.saa.rs.gov.br/portal/index.html>

<sup>44</sup> [http://www.seag.es.gov.br/?page\\_id=549](http://www.seag.es.gov.br/?page_id=549)

The state of Amapa, Amazonas, Mato Grosso and Para joined the US states of California, Wisconsin and Illinois and the Indonesian Provinces of Aceh and Papua in signing a Memorandum of Understanding (MoU) that provides the foundation for future cooperation on a number of issues related to climate policy, financing, technology exchange and research. For 2009 and 2010, the parties have agreed to focus on the MoU forest sector provisions with the objective of promoting capacity building and developing recommendations for policymakers that are considering whether and how to incorporate reduced GHG emissions from deforestation and forest degradation (REDD). The MoU expressly calls for a Joint Action Plan which identifies three primary objectives for 2009-2010, one being the establishment of the Governor's Climate and Forest Task Force<sup>45</sup> responsible for developing recommendations for implementing the MoU's forest sector provisions.

#### 4.1.2. Livestock

According to the First National Communication, the agriculture sector in Brazil is responsible for 77% of methane (CH<sub>4</sub>) emissions in 1994, the main source of these being the enteric fermentation from livestock, mainly from bovines (92% of total). The remaining 8% of CH<sub>4</sub> emissions come from handling of animal manure, from irrigated rice cultivations and from burning of agricultural waste. Moreover, livestock has a direct role to play in the deforestation of the Brazilian Amazon. According to the **Brazilian Institute of Geography and Statistics**<sup>46</sup> (IBGE, Portuguese acronym), 73% of the livestock from the Amazon region occupy previously forested areas.

Some of the mitigation measures identified in the sector are the creation of agro-pastoral or agro-sylvo-pastoral systems where farmland is integrated with land for grazing of livestock and/or with forests (especially with Eucalyptus trees which have a high capacity of carbon sequestration). Another measure would be improving the maintenance of pastures by enriching them organically. This would not only lead to a reduction in methane emissions from livestock, but also an organically enriched pasture is capable of a higher carbon sequestration.

Furthermore, the introduction of legumes in pasture destined for cattle grazing is being studied as a measure of methane reduction in Brazil. Studies on methane emission from grazing dairy cattle in tropical Brazil show that cattle feeding on grass produce more methane than those that feed on legumes or grains. They also show that improving milk production per cow leads to less methane emission per unit of product<sup>47</sup>.

Other studies suggest as mitigation measures the increased use of sugar cane as supplementary diet when the fodder availability from pastures is low and an improved diet associated with an animal genetic improvement, both leading to reduced methane emissions<sup>48</sup>.

Efforts are already being made to make better use of the 180 million tons of manure produced each year. The resulting methane gas, more damaging than CO<sub>2</sub>, can be converted into fertilizer, thus reducing pollution of watercourses. Farmers are being encouraged to combine raising cattle with growing crops, improving pasture quality and allowing animals to mature more rapidly, reducing methane emissions from meat production. Leading beef packers and exporters have followed the example set by oilseed crushers and have decided to not handle cattle raised on land cleared illegally in Amazonia, or for which occupiers do not have a clear title.

#### 4.2. Carbon Trading and Agriculture

Under the Clean Development Mechanism (CDM), developed (also referred to as Annex I) countries can implement project activities that reduce emissions in developing (non-Annex I) countries. Though the CDM is expected to generate investment in developing countries, especially from the private sector, and promote the transfer of environmentally-friendly technologies in that direction,

<sup>45</sup> <http://www.energy.ca.gov/2009publications/GCTF-1000-2009-031/GCTF-1000-2009-031.PDF>

<sup>46</sup> <http://www.ibge.gov.br/home/>

<sup>47</sup> <http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/agriculture/AG065.pdf>

<sup>48</sup> <http://cdm.unfccc.int/Statistics/Registration/RegisteredProjByScopePieChart.html>

the global share of agricultural sector projects (including afforestation and reforestation) is very small (5.71% of total registered projects globally as of December 2009)<sup>47</sup> and the potential is country-specific. Latin America, as a region, currently holds the largest share of registered agricultural projects globally, 61% (75 projects). In comparison to other countries, Brazil is actively engaging in carbon trading in agriculture, with 28% of all registered agricultural projects globally and 47% of all registered agricultural projects in LAC<sup>49</sup>.

As of December 2009, there are 165 registered projects in Brazil, representing the largest share of projects (37%) in LAC, followed by Mexico (with 27% share of all LAC projects). Brazil also holds 8.66% of the global share of projects, third after India and China, with 24.61% and 35.15%, respectively<sup>50</sup>. Of the registered CDM projects in Brazil, 35 are classified as being related to agriculture (or 21% of all registered CDM projects in the country). All the registered agricultural projects address either biomass electricity generation or GHG reductions from improved animal waste management systems in confined animal feeding. Currently, there are no registered CDM projects in Brazil under the "afforestation and reforestation" category<sup>51</sup>.

The World Bank has mobilized a fund to demonstrate projects that sequester or conserve carbon in forest and agro-ecosystems. The BioCarbon Fund, a public/private initiative administered by the World Bank, aims to deliver cost-effective emission reductions, while promoting biodiversity conservation and poverty alleviation. In principle, the BioCarbon Fund can consider purchasing carbon from a variety of land use and forestry projects; its current portfolio includes Afforestation and Reforestation, Reducing Emissions from Deforestation and Degradation and the Fund is currently exploring innovative approaches to account for agricultural soil carbon.

## 5. Impact of Climate Change on Agriculture - Adaptation Measures

**B**razil has initiated a number of vulnerability studies and assessments and a climate change plan is under preparation to design local responses to climate change, including adaptation measures by sector. The following two vulnerability studies have been completed: i) coastal ecosystems in the state of Rio de Janeiro and ii) impact on the Atlantic Rainforest (Mata Atlantica) biome.

### 5.1. Action Frameworks

Among the areas identified for adaptation in the National Climate Change Plan, currently under public consultation, are the water sector, with the adoption of more efficient irrigation systems, particularly in the semi-arid zone of Brazil and land management with adoption of zero tillage practices and the adoption of integrated systems such as the agro-sylvan-pastoral or agro-sylvan systems.

#### 5.1.1. Land Management

The main cause for soil erosion in Brazil is deforestation. This also causes depletion of nutrients in an already poor nutrient soil. For example, about 40% of the soil in São Paulo is classified as severely erodible<sup>52</sup>. Resource-poor farmers cannot afford to replenish nutrients with fertilizer, causing them to abandon their land and clear another section of forest. Such new cropland is often marginal and less productive. This is a vicious cycle of deforestation, cultivation, soil degradation, and deforestation. Small-scale coffee farmers in the State of Minas Gerais, for example, can only cultivate on their lands for 20 years<sup>53</sup>.

The extent of soil erosion varies by state and the causes are multiple. In Paraná, conversion from coffee plantation to soybean-wheat rotation has increased erosion. With tillage on the contour, losses up to 40,000 t/km<sup>2</sup>/year were recorded. In the Brazilian Northeast, land clearing and mechanization have led to compacting and to increased soil erosion<sup>54</sup>. As temperature rises, the suitability for grain

<sup>49</sup> <http://cdm.unfccc.int/Projects/projsearch.html>

<sup>50</sup> <http://cdm.unfccc.int/Statistics/Registration/NumOfRegisteredProjByHostPartiesPieChart.html>

<sup>51</sup> <http://cdm.unfccc.int/Projects/projsearch.html>

<sup>52</sup> The World Bank, 2005

<sup>53</sup> Watson, K. 2001. Deforestation, coffee cultivation and land degradation: The Challenges of developing a sustainable land Management strategy in Brazil's Mata Atlantica Rainforest. (thesis). [Lund, Sweden]: Lund University. P.1-37

<sup>54</sup> <http://home.alltel.net/bsundquist1/se0.html>

production of regions having sandy soils will decline much faster than that of regions with medium and clay soils. An increase of 5.8°C will decrease the suitability for grain production drastically in spite of soil texture. Apart from the reduction of suitable areas for coffee production, according to climate requirements, coffee cultivation will tend to move South and uphill where farmers, soils and infrastructure are less suitable for an economically efficient production.

Some of the adaptation measures identified in the sector are:

- the adoption of no-tillage practices capable of producing the mitigation of 9 million tons of carbon per year. Brazil has a high potential of carbon sequestration through no till practices. Based on current Brazilian carbon sequestration rate of 0.5-1 tC/ha/year and considering the current no-tillage area of 22 million hectares, the sequestration potential resulting from no-till practices averages 11-22 Mt C/year. Due to current increases in no-till areas in Brazil, there is high potential for this practice to further mitigate carbon emissions, which could represent more than US\$ 1 billion of carbon credits for the next 20 years<sup>55</sup>.
- the reduction of use of nitrogen based fertilizers.
- integration of farmland with pastures: rotation of pasture with a three to five year cycle of intensive crop plantation
  - ◆ there are around 54 million hectares of low productivity pastureland currently in the savannah region (Cerrado) that could be re-fertilized by planting crops; soybean is a good crop in this sense as it fixates nitrogen from the air leaving aside the necessity to fertilize. The recuperation of degraded pastureland with planting of crops could increase its production by 10 times.
- cultivation of local plants resistant to dry conditions (local cotton, local manioc varieties) in the semi-arid Northeast is recommended to replace the currently introduced to this area non-native ones
- genetic improvement of crops such as soybean, millet, beans and coffee and some fruit more tolerant to water deficit or high temperatures
- better management of rice fields through improved water control (avoiding of flooding)

The **Agribusiness Sustainable Production Program** finances the recovery of degraded pastureland and their reintroduction in the productive process. Financial resources are applied toward the adoption of sustainable agricultural practices such as that of agro-sylvan-pastoral systems or soil management practices in rural areas.

The **“Hora de Plantar” Program**<sup>56</sup> in the State of Ceara was established in 1988 and aimed at providing poor subsistence farmers with high quality seeds in exchange for giving the government grains harvested during the previous season. The rationale for this is to supply farmers with high quality seeds but distribute them only when planting conditions were appropriate thus reducing their vulnerability to climate variability.

### 5.1.2. Water Use

Brazil is a country rich in water but with an uneven distribution of it across the country resulting in an uneven distribution of irrigation systems as well. Of the total area suitable for agriculture (120 million hectares), only about 3% (3.5 million ha) is currently under irrigation, although estimates show that 29 million ha are suitable for this practice. The total area actually equipped for irrigation of the total cultivated area is 4.4%. In terms of equipment, flood irrigation for rice paddies accounts for 42% of the total irrigated agricultural area, 6% use furrows or other gravity methods, 22% use mobile sprinkler, 23% use mechanized sprinkling, and 6% use local irrigation (drip or micro-sprinkling systems). The main water source for irrigation is surface water (95% of total). In terms of salinity as a

<sup>55</sup> <http://www.fcmc.es.gov.br/download/ArtigoProtocolodeQuiotoFinal.pdf>

<sup>56</sup> Lemos, Maria Carmen, “Drought, Governance and Adaptive Capacity in North east Brazil: A Case Study of Ceara”, Human Development Report 2007/2008, University of Michigan

result of improper irrigation, the area affected by it is mainly located in the semi-arid Northeast and is estimated at 15,000 ha, affecting 40% of the irrigated land<sup>57</sup>.

A study on water stress in the semi-arid Northeast using general circulation models (GCM) shows that future reduction in precipitations in the already vulnerable area, as projected by one of the models, will result in an increased imbalance between water supply and demand by 2025 affecting agricultural production due to insufficiency of water supply for irrigation<sup>58</sup>.

Some of the water programs identified at the national level and aimed at improving the current irrigation system in the country are:

- a) **Development of Irrigated Agriculture Program**<sup>59</sup>, a decentralized program executed at the municipal or state level which supports irrigation projects aimed at improving agricultural production.
- b) **Efficiency in Irrigated Agriculture Program**<sup>60</sup>, executed in partnership with state governments and municipalities, consist of a series of actions aimed at rehabilitation and modernization of irrigation systems, among others.
- c) **Pro-Water Semi-Arid Program**<sup>61</sup>, aimed at enlarging the offer for water of good quality for the semi-arid region of Brazil, as well as promoting the rational use of this resource in a region where it is scarce.
- d) **The National Action Program to Combat Desertification and Mitigate the Effects of Drought**<sup>62</sup> (**PAN-Brasil**) launched in 2004 by the Secretariat for Water Resources of the Ministry of Environment, and whose main objective is to reduce the areas affected by desertification through a variety of actions of mitigation of drought effects in eleven states of the country. To date, two studies about desertification have been performed in the state of Espirito Santo, with more to come.

Programs at the state level are described below:

#### Ceara:

- a) Participatory Mapping for Planning (**Projeto Maplan**)<sup>63</sup>: undertaken by the State of Ceara to increase adaptive capacity of communities and bridge society-political divide in the face of drought
- b) **Community Action Groups and Committees for Civil Defense for Drought Relief in Ceara state**: established in 1990 and composed of representatives from the church, rural labor unions and other local organizations in order to identify priority municipalities to receive relief.
- c) Among other approaches to respond to drought, the State is trying new initiatives such as small farming crop insurance for those who lose 50% or more of their crops to drought, access of small farmers to rural extension services and more lucrative crops targeting export markets. Another initiative is related to the use of weather forecasting. During 1992, based on the forecast of dry conditions in Ceara, it was recommended that crops better suited to drought conditions should be planted and this led to reduced grain production losses (67% of the losses recorded for 1987, a year with similar rainfall but without climate forecasting). The production of vegetable oils from native plants (e.g. castor bean) to supply the bio-diesel industry has been proposed as another adaptation measure.
- d) Recently, the Brazilian Government launched an **Action Plan for Adapting to Drought in the State of Ceara**, targeting 152 of the 177 municipalities in the State. These municipalities were chosen by the National Civil Defense, based on the **Municipal Alert Indicator (MAI)**. The MAI takes into account harvest losses, productivity, climate, distribution of precipitation,

<sup>57</sup> [http://en.wikipedia.org/wiki/Irrigation\\_in\\_Brazil](http://en.wikipedia.org/wiki/Irrigation_in_Brazil)

<sup>58</sup> <http://www.iemss.org/iemss2004/pdf/scenario/krolinte.pdf>

<sup>59</sup> [http://www.mi.gov.br/programas/infrastrukturahidrica/index.asp?area=sih\\_desenvolvimento](http://www.mi.gov.br/programas/infrastrukturahidrica/index.asp?area=sih_desenvolvimento)

<sup>60</sup> [http://www.mi.gov.br/programas/infrastrukturahidrica/index.asp?area=sih\\_eficiencia](http://www.mi.gov.br/programas/infrastrukturahidrica/index.asp?area=sih_eficiencia)

<sup>61</sup> [http://www.mi.gov.br/programas/infrastrukturahidrica/index.asp?area=sih\\_semi\\_arido](http://www.mi.gov.br/programas/infrastrukturahidrica/index.asp?area=sih_semi_arido)

<sup>62</sup> <http://www.fcmc.es.gov.br/default.asp>

<sup>63</sup> [www.projetomoplan.com](http://www.projetomoplan.com)

water storage, soil aridity and families targeted by social programs as its main indicators for prioritizing action. The Action Plan includes immediate responses to drought as well as more medium-term responses - it guarantees food and hydrological security and it dedicates funds to the construction, enlargement or renovation of dams, wells, cisterns and canalizations across the 152 municipalities.

**Bahia:**

- a) **Pintadas Solar Energy Project<sup>64</sup>**: a project using alternative methods to adapt to drought, implemented by four Brazilian and one Italian NGOs in the Northeast town of Pintadas. The project foments the use of solar energy to power drip irrigation systems and boost production in this arid zone. The project is realized by farmer's cooperatives.

**Paraná:**

- a) **Nocturnal Irrigation Program**: administered by the Ministry for Agriculture, Livestock and Food Supply with the objective to stimulate the use of irrigation, thus increasing farm productivity, for poor farmers by offering a discount for electricity during the night hours to be used for nocturnal irrigation.

At the regional scale, the **Framework Program for Sustainable Management of Water Resources of the Plata River Basin** aims at assisting the governments of Argentina, Bolivia, Brazil, Paraguay and Uruguay in the integrated management of water resources in the Plata River Basin in relation with climate change effects. The program is administered by the Ministry of Water resources on the Brazilian side. The Plata River Basin encompasses the Brazilian Pantanal (swampland) ecosystem. Some of the components of this program are: i) implementation of a hydro-climatic forecasting system of the Plata Basin and adaptation to the hydrologic effects of variability and climate change, ii) monitoring of water quality, iii) integrated management of underground water resources, iv) control of soil degradation and v) identification of opportunities for sustainable development.

## 5.2. Social Aspects and Interventions

Brazil has high levels of inequality in terms of income and in terms of land tenure, human development and hence livelihood options. With a Gini index of 0.57, Brazil is the third most unequal country in Latin America, after Colombia and Paraguay. Inequality in some of the poorest Northeastern states is very high, reaching a Gini of 68 in the State of Ceara. In areas with high climate change vulnerability, such as the drought-prone Northeast region, illiteracy along with poverty is a key determinant of the population's low adaptive capacity<sup>65</sup>. About 60% of Brazil's poor and 70% of rural poor live in the semi-arid Northeast. Rural institutions are generally weak and face financial constraints.

Some of the rural adaptation initiatives in the sector are identified as follows:

- a) **Bolsa Familia**, launched in 2003, is the principal social protection program in the country. It offers cash transfers that average R\$75 per family, according to the family's per capita income and number of children of school age. Benefits are offered on the condition that children continue to attend school and complete all required health check-ups. Bolsa Familia united in one single Registry the beneficiaries of federal as well as state or municipal social transfers<sup>66</sup>. Currently, Bolsa Familia operates in 26 states and the Federal District, reaching the poorest 40 percent of the population.
- b) **Zero Hunger Program**, adopted in 2003 and targeting poor and rural regions, offers food stamps and nutritional education along with incentives for household farming through micro-credits, government guarantees to buy part of the produce and construction of cisterns for drinking water. Eligible farmers can not employ more than two workers, have to live on

<sup>64</sup> <http://pintadas-solar.org/default.aspx> and [pintadas-solar.org/Documents/PINTADAS%20Solar\\_ingles.doc](http://pintadas-solar.org/Documents/PINTADAS%20Solar_ingles.doc)

<sup>65</sup> Magalhães (1996) cited in [http://www.grida.no/climate/ipcc\\_tar/wg2/651.htm](http://www.grida.no/climate/ipcc_tar/wg2/651.htm)

<sup>66</sup> [http://www.presidencia.gov.br/espanhol/principales\\_programas/crecimiento/principaisprogramas\\_view/](http://www.presidencia.gov.br/espanhol/principales_programas/crecimiento/principaisprogramas_view/)

the land they farm, earn at least 80% of their income from the land and be beneficiaries of the national Family Agriculture Support Program<sup>67</sup>.

- c) **National Program for Strengthening of Family Agriculture (PRONAF)**<sup>68</sup> is implemented by Banco do Brasil to finance farming and non-farming activities (tourism, crafts, fishery, and other agribusiness activities) that directly employ farmers and their families.

### 5.3. Insurance Instruments

Agricultural insurance contracts in Brazil may not all be related to climate risks. Most of the agricultural insurance policies offered in the country are for multi-peril insurance contracts (although some index based insurance has been introduced in the country in recent years) as well as some transport risk for the case of sugar (multi-peril insurance contracts include not only climate risks, but also potential losses due to plant disease, fire, etc.).

There are nine private agricultural insurance companies in Brazil, covering a volume of agricultural insurance premiums of US\$73,000,000, representing 0.3% of total insurance premiums. The area covered by these agricultural policies is of 2,100,000 hectares, representing 3.2% of the total cultivated area. The following are the risks covered for agriculture: hail, theft, fire, and plant life (multi-peril), as well as rainfall index and area yield. The crops covered are cereals, tobacco, forages, citrus, olives and vegetables. The main insurance company is closely related with the national bank and accounts for 51% of the total market. More than half of all premiums were received by private insurers, of which 64% were for agricultural insurance and were on policies written in São Paulo. A further 11 % were received from the southern states of Rio Grande do Sul, Santa Catarina, and Paraná, where 27 % of premiums were for agricultural insurance. Coverage is negligible in the remainder of the country.

The Government of Brazil has 2 main instruments (programs) in place that support the agricultural sector in managing climate risks. Both instruments require public (federal or provincial) budgetary resources to operate:

- a) **Agricultural Credit Guarantee Program (PROAGRO)**, Portuguese acronym) is a program supported by the Federal Government that provides guarantees for agriculture credit. The program requires beneficiaries to have agricultural insurance and therefore is a main aspect of the demand for such insurance instruments in the country.
- b) “Fondo de Estabilidad del Seguro Rural” (FESR): This fund supports agriculture insurance covers catastrophic losses incurred by agriculture insurance companies.
- c) Premium subsidies: some state governments of Brazil have implemented subsidy programs for partially covering insurance premiums for small farmers. Such programs vary, but the main states currently offering subsidies are Rio Grande do Sul, Rio de Janeiro, Minas Gerais, and São Paulo.

A number of government entities and donors are involved in initiatives related to climate risk management in agriculture:

- a) Pilot programs are under implementation by Banco do Brasil, a Government owned development bank. Banco do Brasil is the only one to guarantee/insure CPRs (Cedulas do Produtor Rural), a warehouse receipt-type paper. Banco do Brasil also provides extensive training to staff on new methods of agricultural insurance as it owns about 60% of an insurance company, Alliansa, which could assist in introducing new instruments and enable their joint marketing with traditional lending instruments.
- b) Some of the subsidy programs for small farmers have been funded and driven by provincial governments.

<sup>67</sup> Belik and Del Grossi. 2003. “Brazil’s Zero Hunger Program in the Context of Social Policy” International Conference of Agricultural Economists in Durban, South Africa and [http://www.paho.org/english/dd/pin/Number20\\_article05.htm](http://www.paho.org/english/dd/pin/Number20_article05.htm)

<sup>68</sup> [http://www.bndes.gov.br/english/pronaf\\_in.asp](http://www.bndes.gov.br/english/pronaf_in.asp)



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