

Low-Carbon Agriculture in Brazil

The Environmental and Trade Impact of Current Farm Policies

By **Marcelo Marques de Magalhães**, Universidade Estadual Paulista, São Paulo, Brasil
Divina Aparecida Leonel Lunas Lima, Universidade Estadual de Goiás

ICTSD
International Centre for Trade and Sustainable Development

Issue Paper No. 54

Low-Carbon Agriculture in Brazil

The Environmental and Trade Impact of Current Farm Policies

By **Marcelo Marques de Magalhães**, Universidade Estadual Paulista, São Paulo, Brasil
Divina Aparecida Leonel Lunas Lima, Universidade Estadual de Goiás

ICTSD

International Centre for Trade and Sustainable Development

Issue Paper 54

Published by

International Centre for Trade and Sustainable Development (ICTSD)
International Environment House 2
7 Chemin de Balexert, 1219 Geneva, Switzerland
Tel: +41 22 917 8492 Fax: +41 22 917 8093
E-mail: ictsd@ictsd.ch Internet: www.ictsd.org

Publisher and Director: Ricardo Meléndez-Ortiz
Programme Team: Jonathan Hepburn and Paolo Ghisu

Acknowledgments

ICTSD wishes to gratefully acknowledge the support of its core and thematic donors, including the UK Department for International Development (DFID); the Swedish International Development Cooperation Agency (SIDA); the Netherlands Directorate-General of International Cooperation (DGIS); the Ministry of Foreign Affairs of Denmark, Danida; the Ministry for Foreign Affairs of Finland; and, the Ministry of Foreign Affairs of Norway.

ICTSD and the author are grateful to all those who commented on, or otherwise contributed to, earlier drafts of the paper, including Pedro de Camargo Neto, Christophe Bellmann, Ammad Bahalim and Jonathan Hepburn.

For further information on ICTSD and other work in this theme see www.ictsd.org

Comments and feedback on this publication can be sent to the programme manager, Jonathan Hepburn (jhepburn@ictsd.ch) or to ICTSD's Managing Director for Communications and Strategy at acrosby@ictsd.ch

Citation: Marques de Magalhães, Marcelo; Lunas Lima, Divina Aparecida Leonel; (2014); *Low-Carbon Agriculture in Brazil: The Environmental and Trade Impact of Current Farm Policies*; Issue Paper No. 54; International Centre for Trade and Sustainable Development, Geneva, Switzerland, www.ictsd.org.

ISSN 1817 356X

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

ABC	Low-Carbon Agriculture
AU	Animal Unit
BB	Bank of Brazil
BNDES	National Bank for Economic and Social Development
CO2eq	Carbon Dioxide Equivalent
CONAB	National Supply Company
COP-15	15th Conference of the Parties of the United Nations
CONDEL/FCO	Executive Council of the FCO Fund
EMBRAPA	Brazilian Agricultural Research Corporation
FCO	Central-West Constitutional Fund
FGV	Getúlio Vargas Foundation
GDP	Gross Domestic Product
GHG	Greenhouse Gases
iLP	Crop-Livestock Integration
iLPF	Crop-Livestock-Forestry Integration
IPCC	Intergovernmental Panel on Climate Change
MAPA	Ministry of Agriculture, Livestock and Food Supply
Mt	Megaton or millions of tons
PNMC	National Policy on Climate Change
PROPFLORA	Program for Commercial Planting of Forests
PRODUSA	Incentive Program for Sustainable Agricultural Production
UN	United Nations Organization
UNFCCC	United Nations Framework Convention on Climate Change
URT	Technical Reference Units

FOREWORD

Brazil's continuous economic expansion over the preceding decade has brought millions out of poverty and dispersed the fruits of its bounteous natural resources. Agriculture has been pivotal in this transformation and government policies have played a critical role.

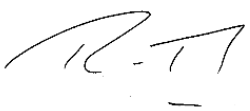
Brazil's status today, agriculturally, can be traced back to decisions taken decades ago, when the government invested in infrastructure and research through its agricultural and rural development policies while others did just the opposite. The productivity that followed turned a net food importer into one of the largest exporters of agricultural commodities in the world. Regrettably, smallholder farmers may not have benefitted equally from the country's stature as an agricultural behemoth. Family farmers, however, through both governmental and non-governmental programmes have taken an interest in recent attempts to sustainably intensify their production, allowing them to do more with less. As is often the case in countries with growing economies, spending also tends to increase. However, policy design and implementation will be critical for the attainment of social, environmental and economic objectives.

Unlike policy making process in other large producers, Brazil does not have a single and uniform undertaking on agriculture. Several ministries and government agencies collaborate to respond to constituent needs and to devise forward-looking plans. The export orientation of many producers and the linkages between key outputs, such as biofuels, are critical concerns for many Brazilians and the country's trading partners. These interactions make it critical that the country be understood with both internal and external considerations in mind.

Domestically, smallholders produce a substantial share of local and regional consumption of some goods, such as fruits and vegetables. Additionally, policy makers must carefully weigh food security, deforestation and social protection needs as an important component of the policy making process. As governments across the world contend with changing climatic trends, and seek to preserve the environment while achieving economic and social objectives, Brazil's efforts can be a useful contribution debates in these areas, offering tangible policy tools. Moreover, enhancing domestic understanding of international processes and successes, and vice versa, can perhaps lead to improved development outcomes.

The paper that follows is the fruit of an ICTSD effort to understand agricultural policy making in both a national and international context. Earlier papers in this area have been published on the EU, China, India, and the US. In particular, this paper evaluates how successful Brazil's current climate policies in the area of agriculture have been, looking at how these may affect trade, and how successful they have been in achieving broader public policy objectives such as reducing greenhouse gas emissions.

We hope that this analysis will provide a useful contribution to the broader debate over how agricultural trade policies can best support environmental goals.



Ricardo Meléndez-Ortiz
Chief Executive, ICTSD

EXECUTIVE SUMMARY

This study aims to provide Brazilian and international policy-makers and other stakeholders with an impartial, evidence-based assessment of how effective Brazil's current climate policies in the area of agriculture have been, looking at how these may affect trade, and how successful they have been in achieving broader public policy objectives such as reducing greenhouse gas emissions. In particular, this study assesses the goals of Brazil's Low-Carbon Agriculture Plan (ABC Plan) and the implementation of the related Program for Reducing Greenhouse Gas Emissions in Agriculture (ABC Program).

The government of Brazil has increasingly invested in agricultural infrastructure and research in recent years. This effort, together with related policies, led to gains in agricultural productivity that have transformed the country from being a net food importer into one of the world's largest food exporters, in a context where agricultural commodity demand increased to meet food and energy needs. Moreover, the agriculture sector has been fundamental to Brazil's economic growth, along with helping sustain employment levels, ensure price stability, and create a foreign trade surplus.

In the coming years, Brazil will face the challenge of maintaining these productivity gains, while also ensuring that these do not worsen climate change's adverse effects. From 1994 to 2005, for instance, Brazil's greenhouse gases (GHG) emissions increased by almost 50% - against a global average of 17%. Agriculture accounted for about one third of this increase, mainly through fossil fuel consumption and as a result of its own biological production process.

The Brazilian government, in an effort to address this challenge, has undertaken a series of efforts at both the national and international levels. Domestically, it has adopted some specific policies along with mechanisms for mobilizing financial resources for mitigation-oriented investments.

At the global level, Brazil made a voluntary commitment to reducing its GHG emissions during the 15th United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties (COP-15) in 2009. Brazil then formalized these reduction targets - which involved voluntary cuts of 36.1-38.9% relative to 2020 emissions projections – when it adopted its National Policy on Climate Change.

Brazil then instituted the ABC Plan - a set of sectoral plans and concrete actions to reduce or avoid GHG emissions - in 2009, and later incorporated the ABC Program into its framework. The latter involves a new agricultural model focused on GHG emissions mitigation, together with the recovery of degraded lands and activities to reduce deforestation and increase the land area of cultivated forests. Moreover, the program aims to promote the protection and improved management of natural resources, namely through practices aimed at improving production efficiency.

This study suggests that despite some initial difficulties and a relatively slow implementation process, these policies may be able to attain the goals of increasing agricultural productivity and efficiency while simultaneously reducing GHG emissions, as promised by the Brazilian government during COP-15. In fact, through the ABC Plan, Brazil has adopted a mid-term strategic plan for an environmental policy applied to agriculture and has been promoting the convergence of environmental policies.

Low-carbon agriculture is now part of a long-term strategy for positioning Brazilian agriculture in the international market. To achieve this, the government allocated 197 billion Real to the ABC Plan between 2011 and 2020, part of which was made immediately available in 2010.

The ABC Program also foresees the application of subsidized interest and a grace period to promote investment in new and greener technology in the agricultural sector, with the goal of contributing to GHG emissions mitigation. The support offered through the Program seems not directly to affect agriculture prices or the commercialization of agricultural commodities. Moreover, subsidies provided through the ABC Program have objectives pertaining to environmental protection, animal and plant well-being, and more broadly rural development. From the standpoint of the existing regulatory framework in international trade, the ABC Program appears to conform to the subsidy policies of the green box discipline under the World Trade Organization.

INTRODUCTION

The production estimates for the Brazilian grain harvest for 2012/13 from the National Supply Company point to a volume of 186.1 million tons, to be harvested from 53.3 million hectares. The production represents a record volume, about 12% higher than that obtained in the 2011/2012 harvest, while the harvested area grew about 3%. The preliminary estimate for average productivity in this harvest could reach 3.49 tons/ha, almost 11% higher than in the previous harvest (Conab, 2013).

Agriculture has shown increasing productivity in recent years, corresponding to the need for expanding production as a function of the growing demand for food and energy. The challenge for the sector is to match the gains in agricultural productivity to the concerns about the adverse effects of climate change. Agriculture contributes to greenhouse gas emissions both through consumption of fossil fuels and through its own biological process of production, including the processes of anaerobic decomposition in wetland farming systems and animal residues. In recent years the Brazilian agricultural sector has shown systematic increases in the net emissions of greenhouse gases (GHG) (Mozzer, 2011).

The international discussion about the environmental costs of agricultural practices is already on the agenda to be incorporated into international trade negotiations. The USA and European Union are wading into the debate on mechanisms for border adjustments (taxes and subsidies) to deal with the problem of shifting production to countries where the cost of polluting is lower (leakage effect). For now, there is still no multilateral trade agreement on the incorporation of liabilities created by greenhouse gas emissions. However fragile, that context of the debate on adverse effects of climate change has given rise to voluntary initiatives for the creation of a regulatory framework at a national level, to allow the application of environmental laws and the mobilization of funds for investments in the mitigation of GHG emissions. International trade still faces the unresolved issue of dealing with the costs of adopting practices for reducing GHG emissions, without a common mechanism for equalizing prices at the border, adjusted according to the concepts of adaptation, mitigation, and efficiency (Seroa da Motta, 2011).

Agriculture is a key sector in policy-making for purposes of reducing carbon emissions and sequestration. Brazil is among the countries that voluntarily committed to reducing GHG emissions at the 15th Conference of the Parties of the UN (COP-15) in 2009. This was reaffirmed the following year, at the COP-16. The Brazilian strategies for reaching the targets agreed to in the COP-15 were approved by Law No. 12.187, through which the National Policy on Climate Change (PNMC) was established. The mitigation strategies for the agricultural sector were laid out in the Sectorial Plan for Mitigation and Adaptation to Climate Changes, aimed at the development of the Low-Carbon Agriculture Plan (ABC Plan). This plan gave rise to the Low-Carbon Agriculture Program (ABC Program), implemented in 2010. That program is the result of an effort to adopt a new agricultural model that seeks to mitigate GHG emissions, combining the restoration of degraded lands, protection and improved management of natural resources through practices aimed at improving production efficiency.

The aim of this study is to evaluate the goals of the ABC Plan in terms of their potential for reducing emissions and the implementation of the ABC Program. This analysis is carried out using secondary data sources.

Section 2 introduces the goals, their sectorial distribution and the role of agriculture in the National Policy on Climate Change (PNMC). Next, there is an in-depth look at the targets for the agricultural sector, established by the Low-Carbon Agriculture Plan (ABC Plan). The potential for emissions reduction from these targets is discussed in Section 4, followed by an analysis of the budgetary implementation of the Low-Carbon Agriculture Program (ABC Program) in Section 5. Section 6 seeks to analyze the ABC Program as a function of the regulatory framework for multilateral agricultural negotiations of the World Trade Organization (WTO), with a special focus on their qualifying criteria among the domestic subsidies of the green box. The final section presents the conclusions.

1. NATIONAL POLICY ON CLIMATE CHANGE

The National Policy on Climate Change (PNMC) formalized the voluntary targets for reduction of GHG emissions proposed at the United Nations Framework Convention on Climate Change (UNFCCC), which are in the range of 36.1% to 38.9%, in relation to the emissions projected for 2020. On the other hand, the PNMC has autonomy in relation to international agreements on global trade and climate change. Besides the targets, the PNMC establishes a legal benchmark for regulation of the country's mitigation and adaptation actions, defining principles, guidelines and tools to strengthen a low-carbon consumption economy. The PNMC regulations defined the distribution of targets and parameters for the projection of targets and for formulation of sectorial plans for emissions mitigation.

The portion to be mitigated in 2020 is between 36.1% and 38.9% of the total annual emissions, which corresponds in absolute terms to the values of 1,168 and 1,259 million tons of CO¬2-eq. Subtracting the proposed reduction, the volume of CO2-eq emitted in 2020 would be between 2,068 and 1,977 million metric tons. Relative to the volume of emissions in 2005, the reduction would be between 6% and 10%.

The actions for mitigation aimed at the 2020 targets are distributed among four sectorial plans – change in the use of land and forests, agriculture, energy and the set of industrial processes, and waste treatment. The projection for emissions and the sectorial distribution of the targets for reduction are shown in Table 1 below. This presents two targets, given in terms of two scenarios for the growth trend in the economy for 2020.

Table 1. Voluntary agreements for the reduction of GHG

Sectors	Emissions (millions t CO_2eq)			Total Reduction (%)		Reduction (millions t CO_2eq)	
	Estimate 2005	Projection 2020	Variation (%)	Target 36.1%	Target 38.9%	Target 36.1%	Target 38.9%
Change in land and forest use	1,268	1,404	10.7	24.7	24.7	801	801
Agriculture	487	730	49.7	4.9	6.1	159	199
Energy	362	868	139.8	6.1	7.7	199	248
Industrial processes, waste treatment	86	234	172.0	0.3	0.4	10	12
Total	2,203	3,235	46.8	36.1	38.9	1,168	1,259

Source: Brasil (2009a, 2010).

The emissions projection for changes in land use, of 1,404 million tons of CO2-eq takes into account that 68% corresponds to the Amazon, 23% to the Cerrado and 9% to the Atlantic Forest, Pantanal and Caatinga. In the other sectors, the projections were of 730 million tons of CO2-eq for agriculture, 868 million tons of CO2¬- eq for energy and 234 million tons of CO¬2-eq for industrial processes and waste treatment. The breakdown of the targets attributed greater weight to reducing emissions for changes in land use (24.7%), which translates into a greater control over deforestation, through which total emissions could be reduced to 801 million tons of CO2-eq. Factoring in respectively the scenarios for lowest and highest economic growth by sector, the distribution of the remaining targets in the other sectors is of 4.9% and 6.1% for agriculture, 6.1% and 7.7% for energy, 0.3% and 0.4% for industrial processes and waste treatment.

The projection for agricultural emissions in 2020 corresponds to an increase of 50% relative to emissions in 2005, the lowest among the production sectors. Agriculture, in addition to

being among the sectors that make the greatest contribution to the country's growth, also transfers part of the environmental efficiency to the energy sector by substituting consumption of biofuels for fossil fuels (Cerri et al., 2010). Since the highest burden in the reductions is in controlling deforestation, a greater effort must be undertaken by agriculture relative to the other sectors. The challenge will be to put in place sustainable growing systems that maintain the gains in productivity in the sector (Mozzer, 2011).

2. LOW-CARBON AGRICULTURE

One of the points that makes agriculture a key sector with respect to mitigation policies for the adverse effects of climate change is food security. Along with the growing demand for food products, agriculture must also meet the demand for biofuels. This pressure for expanding production is restricted by the limits on contribution to GHG emissions, which imply limits on the expansion of agricultural land on native vegetation.

The measures for mitigating the adverse effects of climate change make use of two complementary mechanisms, the reduction in emissions itself and the sequestration of carbon in the soil and the plant mass. The pressure to maintain productivity gains will necessitate better efficiency in the use of inputs, resulting in better management of the natural resources. Measures for recovery of degraded lands, in particular pastures, connected to development of productive efficiency, will reduce the pressure on native vegetation areas, thereby helping to control deforestation. On the other hand, the agricultural sector, as a result of its characteristics and sensitivity, is extremely vulnerable to the negative effects of climate change, distinguishing it from the other sectors. Thus, the organization and planning of actions leading to the adoption of sustainable growing technologies in the field also aims to reduce the sector's vulnerabilities. The potential spillover effects of positive results of implementing a growing model combining agricultural productivity and sustainability emphasize the positive role this sector plays in mitigating GHG emissions.

The importance of voluntary mitigation actions to involvement in international trade are in cancelling out the impacts of border adjustment measures that transfer the costs of mitigating GHG emissions.

By emphasizing the importance of sustaining agricultural production levels, developed countries curb the exchange of the negative effects of emissions-mitigating actions on agricultural productivity. Tied to this pressure, there is an expectation to set up unilateral measures for shifting the costs of adopting GHG emissions-reducing practices in specific sectors, through non-tariff policies (Seroa da Motta, 2011).

There is still a need for the UNFCCC to recognize the contribution of measures for reducing agricultural emissions to the integrity of the global climate system. The specific mechanisms for the sector should factor in the contribution of reducing deforestation and of sustainable growing systems, and the added contributions of the effects of mitigation, among them carbon sequestration in the soil and biomass.

In the absence of an international agreement, the countries with the greatest share of emissions move forward with the introduction of sector-specific methods for mitigation. The absence of a multilateral agreement leaves space for the unilateral application of mechanisms for equalizing prices in the domestic market in relation to the international one. The actions to establish a low-carbon agricultural model should contribute to minimizing the impact of border adjustment measures on Brazilian competitiveness in the international market for agricultural products.

The Low-Carbon Agriculture Plan (ABC Plan) was instituted in 2010 and consists of a set of sectorial plans from the PNMC. Besides the actions to reduce or avoid GHG emissions, it established a support component for training technicians and farmers, financing for research and development, and monitoring of activities and results (Brasil, 2010).

In terms of physical targets, the ABC Plan has the following objectives: (i) to promote the recovery of 15 million of the current 60 million hectares of degraded pastures; (ii) to promote systems of crop-livestock-forestry integration on 4 million hectares; (iii) to increase the practice of no-till planting on 8 million, above the current 25 million hectares; (iv) to increase the use of the

technique of biological nitrogen fixation on an additional 5.5 million hectares; (v) to plant 3 million hectares with planted forests, alongside the sectorial plan that forecasts 5 million more hectares for steel mills; and (vi) to promote the treatment of 4.4 million m¬¬3 of wastes from animal husbandry.

In 2010, the ABC Plan already was counting on funding from the federal government to finance investments, within the Agriculture and Livestock Plan (2010/11 Harvest Plan) from the Ministry of Agriculture, Livestock, and Food Supply (MAPA). Starting in 2011, the measures of the ABC Plan incorporated the Program for Reducing Greenhouse Gas Emissions in Agriculture (ABC Program), into the 2011/12 Harvest Plan.

The goals of the ABC Program are: (i) to reduce greenhouse gas emissions stemming from agricultural activities; (ii) to reduce deforestation; (iii) to bring rural properties into compliance with environmental legislation; (iv) to increase the land area of cultivated forests; (v) to stimulate the recovery of degraded lands. Although some goals are not strictly directed at reducing emissions, such as recovery of degraded pastures, this can increase the efficiency of natural resource usage, minimizing the pressure on lands containing native vegetation.

The ABC Program finances agricultural projects with the following aims: (i) recovery of degraded pastures (ABC Recovery); (ii) establishment and improvement of organic systems of agricultural production (ABC Organic)[1]; (iii) establishment and improvement of systems for no-till planting (ABC No-Till Planting); (iv) establishment and improvement of systems of crop-livestock integration (iLP), livestock-forest or crop-livestock-forestry (iLPF) integration and of agroforestry systems (AFS) (ABC Integration); (v) establishment, maintenance and improvement of management of commercial forests, including those destined for industrial use or for charcoal production (ABC Forests); (vi) adaptation or regularization of rural lands in compliance with environmental legislation, including recovery of legal reserves and of permanent preservation areas, recovery of degraded lands and establishment and improvement of plans for sustainable forest management (ABC Environmental); (vii) treatment of wastes and residues resulting from animal production for generation of energy and for composting (ABC Waste Treatment); (viii) establishment, improvement and maintenance of oil palm forests, particularly on degraded agricultural lands (ABC Dendê); (ix) promotion of the use of biological nitrogen fixation (FBN) (ABC Biological Nitrogen Fixation).

The current objectives and lines of financing are the result of changes introduced with the development of the Program.

In 2012, specific lines of financing were introduced for costing, commercialization and investments in organic systems of production. The establishment and maintenance of oil palm forests with a focus on recovery of degraded farm lands also became part of the program. This activity also is part of the Program for Sustainable Growth of Oil Palm in Brazil, launched in 2010.

At the beginning of the ABC Program, the interest rate was 5.5%, lowering to 5% in the 2012/13 harvest, with the goal of decreasing the difference relative to existing rates in alternative programs.

3. POTENTIAL FOR REDUCING EMISSIONS

Most of Brazil's GHG emissions in the first decade of this century were produced by deforestation, in order to make room for agriculture and livestock farming, mainly in the Amazon. Cerri et al. (2009, 2010) analyzed the effective and shared contribution of agricultural activities with the goal of identifying the best mitigation options for Brazil. First are shown the main sources and the estimates of their contribution to emissions. Next, there is an evaluation of the mitigation potential of selected agricultural and livestock practices, including integrated growing systems.

3.1 Main Sources of Brazilian GHG Emissions

The analysis of emission sources carried out by Cerri et al. (2009, 2010) referred to the methodology of the Intergovernmental Panel on Climate Change (IPCC) for the inventory of GHG emissions, which considers agriculture as part of the Land Use, Land Use Change and Forestry (LULUCF) sector. This sector is subdivided into two subsectors: (i) Land Use and Forestry and (ii) Agriculture. The first represents emissions and the removal of native vegetation through deforestation, changes in the stock of wood biomass, abandonment of managed forest lands and land stock. The agriculture subsector represents GHG emissions from enteric fermentation, waste management, wetland crops, burning of agricultural residues and losses in the stock of agricultural soil. Emissions from the use of chemical fertilizers, organics, animal urine and manure, and vegetable residues are tracked in agricultural soils.

The first Brazilian report on greenhouse gas emissions refers to the period from 1990 to 1994, in which emissions were estimated to be 1,728 million tons of CO2-eq. The main sources identified were: (i) deforestation, responsible for more than half of the Brazilian GHG emissions (56.3%); (ii) fossil fuels (15.8%); (iii) enteric fermentation (13%); and agricultural soils (9.8%).

Global GHG emissions increased 17% in the period from 1994 to 2005. Brazilian emissions increased 48.9%, in China they increased 88.8% and in India, 62.1%. The change in Brazilian GHG emissions estimated in absolute terms was 294.3 million tons of CO2-eq in the same period. The subsectors that made the greatest contribution to this change were fossil fuels (36% of the increase), agriculture (33%) and changes in land use and forestry (24%). Within the agriculture subsector, enteric fermentation and agricultural soils were responsible for 99% of the emissions, with 53% coming from the former and 46% from the latter.

Agriculture plays a key role in reducing emissions by contributing directly or indirectly to mitigation in other sectors. The increased productivity in the field reduces the pressure for deforestation and the production of biofuels increases the range of renewable sources that can be substituted for fossil fuels. The results of academic studies and research and development presented below offer a brief assessment of the contribution of agricultural practices and activities that combine sustainability and productivity, among them no-till planting, sugar-alcohol production, recovery of degraded pastures, and livestock intensification.

3.2 No-Till Planting

The no-till planting system aims to avoid compaction of the bottom layer of soil by aerating it. The reduced movement in the soil would eliminate carbon losses, lowering emissions when compared to conventional planting.

The soil's capacity for carbon sequestration is subject to a series of environmental and technical factors. The region's predominant climate type, the climatic variation, variations in the practices used, the variation in the quantity and quality of plant residues (carbon-to-nitrogen ratio) are among the factors that affect the process of carbon fixation in the soil. It must be noted that the quantity that can be accumulated has a ceiling, given by an

equilibrium state that limits the sequestration process. The depth considered in the evaluation of the soil stock also can report incompatible results among different studies. Finally, the gains by carbon fixation in the soil are reversible as a function of the variation in those same factors mentioned previously (Smith et al., 1998; apud Cerri et al., 2009:839).

The estimates for carbon accumulation in the soil presented in Carvalho et al. (2010), indicate that in the Cerrado, no-till planting can sequester 1.47 Mg of carbon per hectare per year. No-till planting combined with the crop-livestock-forestry integration system can retain between 0.8 and 2.8 Mg of carbon per hectare per year.

3.3 Sugar-Alcohol Industry

The sugar and ethanol production industry can contribute to reduced emissions in three different processes.

The first process pertains to the substitution of ethanol for gasoline, which has the greatest impact of the three processes. While fuel consumption has increased from 1994 to 2005, the estimate of the effect of substitution was 10 million tons of carbon that were not released per year over this period.

The second refers to the use of sugarcane bagasse as a fuel for the production of steam and electricity. The effect of substituting bagasse energy for conventional energy was estimated at 8 million tons that would not be emitted in 1998 (Cerri et al., 2009). Vinasse is a second by-product that can be used to produce methane gas, avoiding the emission of 0.05 million tons of carbon per year (Macedo 1998; apud Cerri et al., 2009).

The third process contributing to the mitigation of GHG emissions is the mechanization of sugarcane harvesting in place of the practice of field burning. Restrictions on burning in the State of São Paulo began in 2000 and it is hoped that by 2020 more than 80% of fields will be harvested mechanically. In addition to avoiding the burning of organic matter in the topsoil, mechanical harvesting leaves the residual straw on the soil. A counterpoint is given by cane field restoration carried out every 6 or 7 harvests, which can reduce the carbon accumulated in the previous years. Net sequestration in soil planted with sugarcane is estimated at 0.48 MtC per year (Feller, 2001; apud Cerri et al., 2009).

Factoring in the estimated 1.5 million hectares (end of the last decade) for mechanical harvesting, the combination of reductions in the three processes lowered emissions by 18.5 million tons per year, which corresponds to 67.9 million tons of CO2-eq annually.

3.4 Recovery of Degraded Pastures and Livestock Intensification

The average rate of Brazilian pasture occupation is 0.9 animal units (AU) per hectare. From the environmental perspective, the importance of increasing the occupancy rate in livestock farming is to reduce the pressure on lands with native vegetation. To pursue the goals of pasture use intensification in conjunction with improved competitiveness, the logic of livestock production management must replace the evaluation of returns per animal unit with the returns per land unit.

The quality of pastures has been the major challenge for livestock farming in the face of advances already obtained through genetic improvement, increases in animal resistance to pathogens and improvement in quality of the final product. Pedreira and Zimmer (2011) show that the recovery of pastures can raise animal capacity from 0.76 AU/ha to an occupancy rate of 2 UA/ha, increasing the net margin from R$ 19/ha to R$ 360/ha (data referring to the recovery of pastures in the State of Mato Grosso, 2006).

In the integrated crop-livestock system, the introduction of agriculture into the pasture recovery operation appears to be a technically viable strategy for transitioning from a conventional system to a low-cost integrated

system producing high quality pastures (Cerri et al., 2009). Forages with low nutritive value increase the demand for greater volumes of foods, creating additional pressure to increase the occupied area.

Herd management on feedlots is a technique that permits intensification of livestock production, both in relation to occupied area and time to slaughter. In this system, better use is made of the pasture in the dry season. In turn, early slaughter, by reducing the time animals remain on the feedlot, contributes to a reduction in GHG emissions caused by enteric fermentation. A complementary strategy for reducing fermentation is the use of dietary supplements, but this is restricted due to its causing side effects in the animals.

Carvalho et al. (2010) presented estimates for the contribution of recovery of degraded pastures in the Amazon and in the Cerrado to the mitigation of carbon emissions. In the Amazon, the soils can accumulate from 2.7 to 6.0 Mg of carbon per hectare per year. In the Cerrado, the accumulation can be 0.94 Mg of carbon per hectare per year.

3.5 Crop-Livestock-Forestry Integration Systems (iLP, iLPF)

The Brazilian Agricultural Research Corporation (EMBRAPA) continues researching and developing solutions adapted for crop-livestock-forestry integration in experimental fields in Technical Reference Units (URT/iLPF). These are distributed in 5 macroregions of Brazil. Part of the preliminary results compiled are summarized below.

Wruck (2011) evaluated the results of a crop-livestock-forestry integration system combining winter and summer planting of soy, rice, corn/sorghum and millet/crotalaria. The stocking rate reached 5 AU/ha in the rainy season, occupying 40 ha and 2 AU/ha in the dry for 100 ha. In the end, the average stocking rate remained at 1.1 AU/ha, but with a weight gain from 200 to 210 Kg from 8-9 to 15-16 months and soy productivity around 60 bags of 60 Kg/ha and of rice between 25 and 50 Kg/ha, factoring in the seasonal variation between the dry and rainy seasons.

Pedreira and Zimmer (2011) evaluated the profits from an integrated crop-livestock-forestry system in its first years of implementation. The system integrated cultivation of rice, soy and eucalyptus with livestock farming, with the late introduction of the latter activity. The net income of the integrated system (only farming and forestry) was 49% higher than crop cultivation alone in the first year. In the following two years, climatic hardships negatively affected production of both systems, lowering the profit margin. Additionally, problems were noted in the adjustment of the spacing between rows of plants. The planting system still needs research and development to adapt technology according to regional soil and climate conditions. There were no estimates for mitigation.

Salton (2005) apud Carvalho (2010), evaluated carbon sequestration in agricultural production systems in the Cerrado and observed greater stocks of carbon in the presence of forages. The decreasing order of the accumulated carbon stock according to production system is given by: permanent pasture, crop-livestock integration in no-till planting, no-till planting, conventional planting.

4. FINANCING OF LOW-CARBON AGRICULTURE

The total volume of funds to be allocated to the ABC Plan between 2011 and 2020 is R$197 billion, of which R$157 billion must be made available through rural credit to reach the program's fiscal targets (budgetary sources or lines of credit). The others are financial resources coming from varied sources (BNDES, private funds from private banks).

The first funds for the ABC Plan were already available in 2010, with the creation of the agricultural line of credit for financing sustainable technologies under the auspices of the ABC Program, corresponding to the volume of R$ 2 billion, with interest of 5.5% per year. Those funds were not mobilized until the end of 2010.

The allocation of initial funds in the National Bank for Economic and Social Development (BNDES) may have complicated their application, in part due to its own funding caps per project given by the rules of the program (R$ 1 million). The BNDES has low capillarity and perhaps more efficiency in managing higher value contracts. The entry of the Bank of Brazil into the operation of the program starting in the 2011/12 harvest caused an increase in the number of contracts and the resulting total amount allocated.

The capillarity of the Bank of Brazil in terms of the distribution of agencies practically throughout the entire national territory (5,130 municipalities), combined with local relationships with the institutions representing the growers (farmer's union) and the partnership with the public and private networks of agricultural technicians are characteristics that contributed to the advancement of the program. This period was also accompanied by the incorporation of the Produsa and Propflora Programs (contracts implemented by the BNDES) into the ABC Plan and by a slight reduction in the interest rate, from 5.5% to 5.0% per year. A more aggressive cut in the interest rates could have contributed further to expanding the program's action.

Up to May 2013, R$ 4.3 million were applied, for about 16,400 contracts (Table 2). The average value per project was R$ 261,200, but it showed a growing trend over time, reaching R$ 288,900 in the 2012/13 harvest. Allocating R$ 157 billion over 10 years would imply contracting an average amount of R$ 15.7 billion per year. Considering the average value of the current contracts, about 530,000 contracts per year would be needed to reach the program's 2020 target for the application of funds. For the program to progress, in addition to awareness, technical training and developing the capacity for technological absorption, it might be necessary to increase the maximum value per contract, from the interest rate and term, to the repayment ability of the contracted party, which is directly dependent upon the income profile of the financed activities, in the short and long term. The average value of the contracts could increase as a result of that adjustment, allowing a full realization of the targets within the proposed time frame.

Table 2. Planned and actual application of ABC Plan funds from 2009/10 to 2012/13

Harvest (1)	Planned (millions of $R)	Actual Application (millions of $R)	Relative Disbursement (%)	Number of contracts	Average Value (thousands of $R)
	(a)	(b)	(b/a)	(c)	(b/c)
2009/10	2,000.0	-	-	-	-
2010/11	3,150.0	418.5	13.3	2,910	143.8
2011/12	3,150.0	1,127.5	35.8	4,015	280.8
2012/13	3,400.0	2,736.6	80.5	9,473	288.9
2013/14	4,000.0	-	-	-	-

Notes: (1) Refers to the harvest year, from July to May of the following year.

Source: MAPA from BNDES and BB data (2013).

Clearly there is room to grow in terms of the number of applications and the amount contracted per application. On the other hand, the interest rates of 5.5% are relatively high compared to interest rates for alternative programs, like the Central-West Constitutional Fund (FCO), which offers funds for agricultural investments with interest of 3.0% and 4.1% per year. Starting in 2012, the Central-West Constitutional Fund began to rely on a dedicated line for financing of ABC Program projects. There are two modalities, nature conservation and crop-livestock-forestry integration projects. In addition to accelerating the adherence to the ABC Program projects, this measure can help strengthen the use of funds in the Central-West region, encouraging less pressure to occupy the boundary of the reserves of the Cerrado biome.

The distribution of funding according to the lines of financing of the ABC Program, taking into account the data available for the first six months of the 2012/13 season, showed the concentration of investments in recovery of degraded pastures (77% of the total applied), a small portion applied to no-till planting (7%), nature conservation via FCO (6%), forestry (4.6%), crop-livestock-forestry integration (4.1%) and less than 1% in waste treatment, organic farming and environmental preservation projects via ABC (FGV, 2013 from Bank of Brazil data).

The regional distribution of funds for the ABC Program does not appear to follow scientific logic for the greatest impact on mitigating emissions and sequestration of greenhouse gases (Table 3). The South and Southeastern regions are the ones receiving the largest part of the funds and where the majority of the contracts are concentrated. Taking into account the end goals of the program, it would be more interesting if the funds were focused on the North, Northeast and Central-West regions – the regions most vulnerable to global climate changes. (Féres, Reis e Speranza, 2011).

The adoption of technology promoted by the ABC Program finds itself concentrated in the macroregions of the South and Southeast. That concentration could contribute to the deepening of the regional inequalities in the not so distant future, as happened with the diffusion of technology in the process of modernizing agriculture in the 1970s.

Table 3. Disbursements from the ABC Program by macro regions in the first half of the 2012/13 harvest

Region	Number of contracts		Disbursement		Average Value
	(unit value)	(%)	(R$ thousands)	(%)	(R$ thousands)
Central-West	732	16.0	383,134.9	22.3	523.4
Northeast	205	4.5	87,966.6	5.1	429.1
North	176	3.9	69,023.2	4.0	392.2
Southeast	2,100	46.0	784,288.3	45.7	373.5
South	1,350	29.6	392,598.8	22.9	290.8
Total	4,563	100.0	1,717,011.8	100.0	376.3

Source: FVG (2013) from MAPA data.

5. LOW-CARBON AGRICULTURE AND TRADE POLICIES

Why is it important to discuss agricultural subsidy policies for low-carbon agriculture from the perspective of the international market? The ABC Program aims to contribute to the mitigation of GHG emissions in the agricultural sector. This creates benefits that go beyond the geographic limits of the country. Its implementation requires the use of new growing technologies with the view towards positive results only over the long term, which justifies the application of subsidized interest and a grace period for the initial development of the investment. The problem of climate change is an issue for the international forum, voluntarily internalized through standards and public policy instruments of domestic support. On the one hand, the international nature of climate change is given by the very nature of the problem. On the other hand, government intervention to implement policies for mitigating GHG emissions requires domestic subsidies for initial investments. Although it does not directly affect prices in the short term, the ABC Program, as with other environmental programs in European and American agriculture, introduces a potential competitive advantage over the long term.

The actual regulatory trade framework for multilateral agricultural negotiations is given by the Agricultural Agreement (AoA) of the World Trade Organization (WTO), in effect since 1995 (Uruguay Round). The principal rules for the multilateral agricultural negotiations were established by way of the following modalities: (i) access to the market, which refers to the degree of openness to foreign products, established through barriers, trade restrictions among other regulatory measures on imports; (ii) domestic support, or modality of domestic subsidies, which include the measures adopted to support and protect the national production through price subsidies or direct payments to the producers; and (iii) export subsidies, through which are established the rules for reducing the export levels, physical and financial, for developed and developing countries. Beyond the modalities, the Agricultural Agreement established instruments for negotiating exceptions, with limits for reducing investments in developing countries, the Special Protection Measure for protecting domestic production in the case of a significant surplus of imports (Jank e Araújo, 2003).

The modality of domestic support for agriculture classifies the domestic subsidies into three boxes. The amber box contains those policies of domestic support with the potential to distort international agricultural trade, are subject to revision of the agreements to reduce the subsidies and limit their use during a specified period of time. The green box includes domestic policies that minimally distort or cause no distortion of international agricultural trade, are not linked to price policies and are exempt from commitments for reducing the subsidies used. In the blue box, however, are the subsidy policies that offer the potential to distort the international market, and are tied to programs that limit agricultural production, resulting in temporary exemption from commitments for reducing subsidies.

The ABC Program is an instrument of domestic support for agricultural production, with the goals of recovery and conservation of natural resources without direct effects on agricultural prices or on commercialization. In a voluntary manner, it merely offers a domestic subsidy for the introduction of practices for mitigating GHG emission in agricultural production. It does not offer export subsidies, and does not aim to establish restrictions or barriers to the import of foreign products. The Program uses public funds exclusively for its financing. From the standpoint of the existing regulatory framework for multilateral agricultural negotiations, this program conforms to the subsidy policies of the green box. This category includes only subsidies with objectives pertaining to environmental, social, food security, animal and plant health, animal well-being and for rural development (Camargo Neto e Henz, 2009).

The contrast between developed and developing

countries also is evident in the strategy for formulating their policies of agricultural support and protection. The most developed countries, in addition to having a larger agricultural sector, use more green box subsidies than the less-developed countries, with the exception of Brazil, China, Korea, and Thailand. In the period from 1999 to 2005, while the United States, Japan and the European Union had a budget over US $20 billion per year, the developing nations used less than US$1 billion individually. Brazil employed about US $2.2 billion annually in the green box, which corresponded to about 4% of the agricultural gross domestic product (USD$ 56 billion), while the USA used about 14% of agricultural GDP (US$ 250 billion). The analysis of green box subsidies at the Program level reveals the differences between the countries. The developing countries use the subsidies from the green box in food-stocking programs for food security, food distribution, emergency transfer for natural disasters and support for investments for structural changes. The developed countries distribute the subsidies in a more diversified manner. The subsidies to programs supporting food assistance are predominantly in the North American green box, whereas the European Union countries target more subsidies at environmental programs, regional assistance, and support for structural modifications (Nassar et al., 2009)

The environmental programs are subject to debate with respect to the improper use of the green box, such as subsidy policies for general agricultural services (research, training, rural extension, sales promotion, infrastructure, such as irrigation and drainage), subsidies for stocking of foods, fighting poverty, food security, emergency support for natural disasters and support for investments resulting from structural changes in agriculture.

The analysis of the distortion potential of direct transfers to producers through environmental programs in agriculture is relatively complex. The first difficulty concerns the measurement of the trade-off between the gains of environmental protection and the distortions in international trade. On the one hand, the negative externalities caused by existing agricultural production indicate the need to introduce new agricultural practices. On the other hand, the simultaneous subsidies employed in environmental and income support programs for agricultural producers in developed countries, such as the USA and countries of the EU, do not offer empirical evidence of gains that can be attributed exclusively to the environmental programs. In the developed countries, voluntary programs predominate, those that offer direct payments to producers (unlinked to price and quantity). Those programs are rare in developing countries, and when they exist, they are largely mandatory and punitive. They tend to restrict agricultural production and offer little or no compensation for the restriction on the use of natural resources (Nassar et al., 2009).

That context of uncertainty with respect to the effects of environmental programs on agriculture, as well as the different logical framework of environmental policies among developed nations and developing nations, point to a scenario of market distortion over the long term, with loss of competitiveness for less-developed countries. Whereas farmers in developed countries use subsidies for environmental recovery and preservation, those in the developing world, besides practically receiving no subsidies, face the environmental costs in a mandatory manner.

The mandatory and punitive instruments are indispensable for regulating the use of natural resources. On the other hand, the ABC Program offers a structure of incentives that contributes to a new logic in the use of subsidies to promote recovery and environmental conservation.

6. CONCLUSION

The Low-Carbon Agriculture Plan may be able to attain the goals of reducing greenhouse gas emissions as established voluntarily at the COP-15 meeting. Its implementation showed difficulties at the beginning and has been relatively slow, but there is still enough time to regain the rhythm in pursuit of the plan's objectives.

Besides the merits given by the very nature of the targets sought, the ABC Plan has strengths implicit in its own formulation. First, there is a voluntary motivation, but with a mid-term strategic plan for an environmental policy applied to agriculture. It promotes the convergence of environmental policies that are characterized by a broad spectrum of goals. The plan does not explicitly offer tools for organizing land use, but can contribute by organizing agricultural expansion in the Central-West and the Amazon.

In terms of trade policy, Low-Carbon Agriculture is part of a long-term strategy for positioning in the international market, with respect to the non-trade conditions agreed to in the multilateral agreements.

Although Brazil has worked for an articulation among developing countries in the southern hemisphere (Brazil, India, South Africa and China), the environmental issue is still progressing towards the formation of a more suitable position for Brazilian foreign policy.

From the domestic perspective, the international environmental agenda cannot be interpreted in a narrow way, only as a protectionist argument for the developed countries to bar Brazilian exports. That interpretation creates a mistakenly defensive position. On the contrary, the environmental agenda is the result of a voluntary agreement, the fruit of societal pressure. The government plan for low-carbon agriculture discussed in this paper is only one of the tools for achieving the agreed-upon targets.

The plan is based on promoting techniques for reducing emissions and sequestration of carbon, developing productivity and the resulting reduction in pressure for deforestation of native vegetation. The issue of acknowledging practices of traditional populations and of agro-ecological systems may be deepened as the plan develops, resolving regional issues according to their productive capacity and suitability among the projects and requirements for their development.

In the international trade balance, Brazil could be considered an environmental creditor. The Brazilian biomes – Amazon Forest, Pantanal, Cerrado, Caatinga, Atlantic Forest – contribute to the preservation of genetic resources of global interest and create environmental services of climate regulation, which are environmental issues of global importance. Although acknowledged, the compensation for these services is not being carried out effectively. The effective recognition of that compensation passes necessarily through the regulatory framework of the multilateral agricultural negotiations. Although the environmental issues are not on the agenda of the current round, the ABC Program, though an environmental agricultural policy, finds itself in conformity with the Agricultural Agreement, embracing subsidies of domestic support within the green box. This is one more virtue of the Program that on the one hand it meets international environmental demands, and on the other, it complements the mandatory and punitive logic of the traditional environmental policies for regulating the use of natural resources.

The interpretation of the environmental issue cannot be viewed strictly as a problem. In addition to the gains from increasing productivity and efficiency in agriculture, the environmental issue combined with the trade policies can yield social and economic benefits for Brazil.

ENDNOTES

1 There are still no conclusive studies on the differential effects of organic systems of production on GHG emissions (FGV, 2013). On the other hand, organic systems are characterized by small-scale production, low intensity in the use of external inputs and high degree of the manual labor usage. These can be an alternative for small growers, with limited access to land and high availability of family labor.

REFERENCES

BRASIL. Inventário brasileiro das emissões e remoções antrópicas de gases de efeito estufa: informações gerais. [Brazilian inventory of emissions and anthropic removals of greenhouse gases: general information. Brasília: Ministério da Ciência e Tecnologia [Ministry of Science and Technology], 24/nov./2009. 2009a.

BRASIL. Lei Federal nº 12.187, de dezembro de 2009.[Federal Law No. 12.187, of December 2009] Politica Nacional das Mudanças Climáticas [National Policy on Climate Change] Brasília: Congresso Naciona l [National Congress]. 2009b.

BRASIL. Decreto no 7.390, de 9 de dezembro de 2010. Regulamenta os Artigos 6o, 11 e 12 da Lei nº 12.187, de 29 de dezembro de 2009, que institui a Politica Nacional sobre Mudança do Clima (PNMC), e dá outras providencias [Decree No. 7.390, of December 9, 2010. Regulation of Articles 6o, 11 and 12 of Law No. 12.187 of December 29, 2009, which establishes the National Policy on Climate Change (PNMC) and gives other measures]. Brasília: Presidência da República. 2010.

Carvalho, J. L. N.; Avanzi, J. C.; Silva, M. L. N.; Mello, C. R.; Cerri, C. E. P. Potencial de sequestro de carbono em diferentes biomas do Brasil [Potential for carbon sequestration in different biomes of Brazil]. Revista Brasileira Ciências do Solo [Brazilian Soil Science Magazine]. 2010, vol.34, n.2, pp. 277-290. 2010.

Cerri, C. C.; Maia, S. M. F.; Galdos, M. V.; Cerri, C. E. P.; Feigl, B. J.; Bernoux, M. Brazilian greenhouse gas emissions: the importance of agriculture and livestock. Sci. Agric. Piracicaba: ESALQ. v.66, n.6, p.831-843. Nov./Dec. 2009.

Cerri, C. C.; Bernoux, M. Maia, S. M. F.; Cerri, C. E. P.; Costa Junior, C.;Feigl, B. J.; Frazão, L. A.; Mello, f. F. C.; Galdos, M. V.; Moreira, C. S.; Carvalho, J. L. N. Greenhouse gas mitigation options in Brazil for land-use change, livestock and agriculture. Sci. Agric. Piracicaba: ESALQ. v.67, n.1, p.102-116. Jan./Feb. 2010.

CONAB. Acompanhamento de safra brasileira: grãos, décimo primeiro levantamento, agosto/2013 [Update on Brazilian harvest: grains, eleventh survey, August/2013. Brasília: CONAB. 2013. 29p.

CONDEL/FCO. Fundo Constitucional de Financiamento para o Centro-Oeste: programação para 2012 [Central-West Constitutional Fund: programming for 2012]. 1a. edição [1st edition], Brasília: Ministério da Integração Nacional [Ministry of National Integration]. 2012. 57p.

Féres, Reis, Speranza. Impactos das mudanças climáticas no setor agrícola brasileiro [Impacts of climate change on the Brazilian agricultural sector]. In: Seroa da Motta, R.; Hargrave, J.; Luedermann, G.; Gutierrez, M. B. S. (ed.). Mudança climática no Brasil: aspectos econômicos, sociais e regulatórios [Climate change in Brazil: economic, social and regulatory aspects]. Rio de Janeiro: IPEA. P.301-311. 2011.

FGV. Agricultura de baixa emissão de carbono: a evolução de um novo paradigm [Low-carbon agriculture: evolution of a new paradigm]. São Paulo: FGV. 204p. (Relatório de pesquisa) Observatório ABC [(Research report) ABC Observatory - Centro de Agronegócio da Escola de Economia de São Paulo, FGV [FGV Agribusiness Center at the São Paulo School of Economics. 2013.

Mozzer, G. B. Agropecuária no contexto da economia de baixo carbon [Agriculture in the context of low-carbon economy. In: Seroa da Motta, R.; Hargrave, J.; Luedermann, G.; Gutierrez, M. B. S. (ed.). Mudança climática no Brasil: aspectos econômicos, sociais e regulatórios [Climate change in Brazil: economic, social and regulatory aspects]. Rio de Janeiro: IPEA. p.111-125. 2011.

Pedreira, B. C.; Zimmer, A. H. Estratégias de recuperação de pastagens [Strategies for pasture recovery]. Cuiabá: Embrapa Agrossilvipastoril e Embrapa Gado de Corte [Embrapa Agroforestry and Embrapa Beef Cattle], nov./2011. 164p. (mimeo)

Seroa da Motta, R. A política nacional sobre mudança do clima: aspectos regulatórios e governance [National policy on climate change: regulatory aspects and governance]. In: Seroa da Motta, R.; Hargrave, J.; Luedermann, G.; Gutierrez, M. B. S. (ed.) (2011). Mudança climática no Brasil: aspectos econômicos, sociais e regulatórios [Climate change in Brazil: economic, social and regulatory aspects]. Rio de Janeiro: IPEA. p.31-40. 2011

Seroa da Motta, R. Desafios ambientais da economia brasileira [Environmental challenges for the Brazilian economy]. Texto para discussão n. 509. Rio de Janeiro: IPEA. 1997. 28p. ISSN 1415-4765.

Wruck, F. J. Conceitos de integração lavoura-pecuária-floresta (iLPF) [Crop-livestock-forestry integration models]. Cuiabá: Embrapa Arroz e Feijão [Embrapa Rice and Beans], nov./2011. 35p. (mimeo)

Other Publications from the Agriculture theme include:

- Food Security and WTO Domestic Support Disciplines post-Bali. By Alan Matthews. Issue Paper No. 53, 2014.
- The 2014 Agricultural Act: U.S.Farm Policy in the context of the 1994 Marrakesh Agreement and the Doha Round. By Vincent H. Smith. Issue Paper No. 52, 2014.
- Public Stockholding for Food Security Purposes: Scenarios and Options for a Permanent Solution. By Raul Montemayor. Issue Paper No. 51, 2014.
- Agricultural Export Restrictions and the WTO: What Options do Policy-Makers Have for Promoting Food Security? By Giovanni Anania. Issue Paper No. 50, 2013.
- India's Agricultural Trade Policy and Sustainable Development. By Anwarul Hoda and Ashok Gulati. Issue Paper No. 49, 2013.
- Global Biofuel Trade: How Uncoordinated Biofuel Policy Fuels Resource Use and GHG Emissions. By S. Meyer, J. Schmidhuber, J. Barreiro-Hurlé. Issue Paper No. 48, 2013.
- Agricultural Domestic Support and Sustainable Development in China. By Ni Hongxing. Issue Paper No. 47, 2013.
- The 2012 US Farm Bill and Cotton Subsidies: An assessment of the Stacked Income Protection Plan. By Harry de Gorter. Issue Paper No. 46, 2012.
- Potential Impact of Proposed 2012 Farm Bill Commodity Programs on Developing Countries. By Bruce Babcock and Nick Paulson. Issue Paper No. 45, 2012.
- US Farm Policy and Risk Assistance. The Competing Senate and House Agriculture Committee Bills of July 2012. By Carl Zulauf and David Orden. Issue Paper No. 44, 2012.

About the International Centre for Trade and Sustainable Development, www.ictsd.org

Founded in 1996, the International Centre for Trade and Sustainable Development (ICTSD) is an independent think-and-do-tank based in Geneva, Switzerland and with operations throughout the world, including out-posted staff in Brazil, Mexico, Chile, Senegal, Canada, Russia, and China. By enabling stakeholders in trade policy through information, networking, dialogue, well-targeted research and capacity-building, ICTSD aims to influence the international trade system so that it advances the goal of sustainable development. ICTSD co-implements all of its programme through partners and a global network of hundreds of scholars, researchers, NGOs, policymakers and think-tanks around the world.