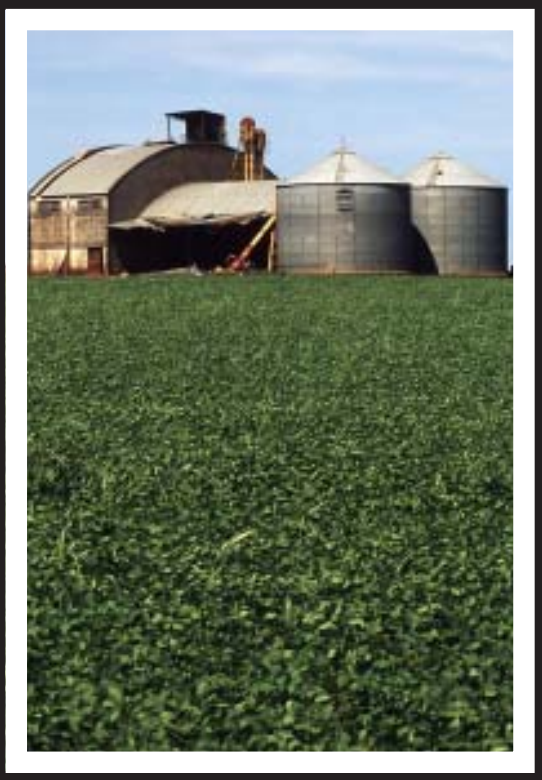
SUSTAINABILITY ASSESSMENT



OF EXPORT-LED GROWTH IN SOY PRODUCTION IN BRAZIL

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SUSTAINABILITY ASSESSEMENT OF EXPORT-LED GROWTH IN SOY PRODUCTION IN BRAZIL

Contents

3. EFFECTS OF FISCAL AND INTERNATIONAL TRADE POLICIES ON SOY EXPANSION

3.1 Taxation Policies and the Soy Sector
3.1.1 The tax structure in the soy sector
3.1.2 Recent changes in the ICMS
3.1.3 The trade and economic impacts of the current fiscal system on the soy sector
3.1.4 Fiscal policy and sustainability in the soy sector
3.2 International Trade and Sustainability in the Soy Sector
3.2.1 Market access and sustainability of the soy complex in Brazil
3.2.2 Brazil's Negotiating Position in International fora
3.2.3 Brazil and the United States on FTAA issues
3.2.4 Mercosur – European Union Negotiations
3.3 Specialization standards in the soy production sector
3.3.1 Tariff escalation
3.3.2 European Union's Common Agricultural Policy and the BSE crisis
3.3.3 China's Ascension to WTO
3.3.4 Tax policy in Argentina
3.4 Expansion of the production area and soy sustainability in Brazil
3.4.1 Structural effects
3.4.2 Scale effects
3.4.3 Geographical effects
3.4.4 Technological effects
3.4.5 Regulatory effects
3.4.6 Institutional effects
3.4.7 Physical infrastructure
3.5 Fiscal System, International Trade and Sustainability

4. ENVIRONMENTAL SUSTAINABILITY OF SOY PRODUCTION IN BRAZIL

4.1 The nature of soy expansion into the Cerrado
4.1.1 Physical environment, vegetation and diversity in the Cerrado
4.1.2 Biodiversity conservation in the Cerrado
4.1.3 Conversion of the Cerrado for agriculture and ranching and climatic impacts
4.2 Environmental impacts in established agricultural regions in the Cerrado
4.2.1 Water and soil management
4.2.2 Pest prevention and control
4.3 Export corridors and the expansion of soy cultivation
4.4 Social impacts of soy production

LIST OF FIGURES

LIST OF TABLES

LIST OF BOXES

LIST OF ACRONYMS

ABIOVE	Associação Brasileira de Industrias de Óleos Vegetais (National Association of Vegetal Oil Industries)
APP	Área de Produção Permanente (Area of Permanent Protection)
BMP	Best Management Practices
BSE	Bovine Spongiform Encephalopathy ("mad cow" disease)
CONAB	Companhia Brasileira de Abastecimento (Brazilian Food Supply Company)
CIARA	Cámara de la Industria Aceitera de la Republica Argentina (Oil Commercial Chamber of Republic of Argentina)
CNA	Confederação Nacional de Agricultura (National Agricultural Confederation)
COFINS	Contribuição para o Financiamento da Seguridade Social (Contribution for the Financing of Social Security)
CPMF	Contribuição Provisória sobre a Movimentação Financeira (Provisional Tax on Financial Transactions)
CTNBio	Comissão Técnica Nacional de Biosegurança (National Biosafety Technical Commission)
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária (Brazilian Agricultural Corporation)
EU	European Union
FETHAB	Fundo Estadual de Transporte e Habitação do Mato Grosso (Transport and Housing Fund for the State of Mato Grosso)
FTAA	Free Trade Area of the Americas
FUNDERSUL	Fundo para o Desenvolvimento Rodoviário para o Mato Grosso do Sul (Development Fund for the Mato Grosso do Sul Roadway System)
FUNRURAL	Contribuição Previdenciária Rural (Rural Social Security Tax)

GDP	Gross domestic product
GMO	Genetically modified organism
ha	Hectares
ICMS	Imposto Sobre Circulação de Mercadorias e Serviços (Tax on Commodity and Service Distribution)
INCRA	Instituto Nacional de Colonização e Reforma Agrária (National Institute for Agrarian Reform)
IPEA	Instituto de Pesquisa Econômica Aplicada (Institute for Applied Economic Research)
MERCOSUR	Southern Common Market Agreement
NAFTA	North America Free Trade Agreement
NGO	Non-governmental organization
OECD	Organisation for Economic Cooperation and Development
PIS	Programa de Integração Social (Social Integration Program)
PRONAF	Programa Nacional da Agricultura Familiar (National Family Agriculture Program)
WTO	World Trade Organization
WWF	World Wide Fund for Nature

EXECUTIVE SUMMARY

1. INTRODUCTION

This report was undertaken by WWF Brazil as part of a three-year project on Sustainability Assessment (SA) of trade led in partnership by WWF International and WWF US. As part of the SA Project, WWF initiated this case study to examine the impacts of liberalisation on soy agriculture in Brazil.

This case study highlights the major factors associated with growth in the sector, including the development of increasing export markets for Brazilian soy grain in Europe and elsewhere, which are leading to unprecedented intensification and expansion of production. It assesses, from a sustainability perspective, the methods of expansion, including production practices and conversion of land for agriculture, with a particular focus on the vulnerable ecosystems in the Centre-West region of Brazil: the Cerrado, the Pantanal and the Amazon.

This case study was considered timely for a number of reasons:

- Agriculture, and soy in particular, is a critical export sector for Brazil, and stands to be impacted by current World Trade Organisations (WTO) negotiations around the Agreement on Agriculture.
- Brazil, as a leading country in MERCOSUR, is engaged at present in negotiations with the EU. The EU is the most important export market for Brazilian soy and much of the Brazilian production is exported directly in its unprocessed form to the EU.
- Negotiations in support of a Free Trade Area of the Americas (FTAA) will conclude in the coming years with potential impacts on Brazilian agriculture, and in particular trade in soy vis-a-vis relations with Brazil's most important competitor for soy grain exports, the United States.

This study examines the current state of domestic oversight, production and trade of soy and soy products in Brazil. It concludes that the soy sector in Brazil is at a critical stage in its development. In the context of increasing efforts to liberalise agricultural trade in a number of fora, it is vital that decisions taken by the Brazilian government, both at home and in an international context, place the soy sector on a solid path to sustainability. The study identifies a number of trade-related and non-trade related policies that could contribute to achieving this goal.

2. SOY IN BRAZIL

Rates of growth in the soy sector in Brazil have outpaced growth of any major crop, anywhere in the country, this century**.** Soy is a core component of the Brazilian economy, representing six per cent of gross domestic product (GDP) and employing close to five and a half million

people. It is also a major export crop. Brazil stands second only to the United States in exports of soy grain and second to Argentina in exports of soy meal.

Expansion in soy is being driven by a number of factors; some domestic and some associated with international trade and behaviour in major export markets. The consumption of soy and its derivative products in Brazil has been growing steadily throughout the 1990s, but the vast majority of production is exported in the form of soy grain or, to a lesser extent, as “first level” processed by-products (meal and oil). Production is likely to increase to meet this demand, fuelled in part by an increase in demand for animal protein such as chicken, pork and beef, much of which is fed a staple diet that includes high concentrations of soy meal. In addition, demand from European markets has grown as a result of protein substitution from meat and bone towards soy and other proteins. This is due in part to bans on the use of meat and bone meal in animal food in the European Union (EU) as a result of recent outbreaks of *Bovine Spongiform Encephalopathy* (BSE/”mad cow” disease). Following its accession to the World Trade Organisation (WTO) China is poised to become a major importer of Brazilian soy, which could put further pressure on the sector and encourage unsustainable production practices.

Increased demand, particularly in export markets, has been met by increasing production of soy and increasing exports of soy grain. A number of policies in Brazil and in its major trading partners favour this specialization in grain. First, Brazil’s processing industry is not as competitive as the industries of its main rival Argentina, which benefit from a favourable tax climate for processors and employ state-of-the art technology. Second, grain destined for the processing industry is subject to taxes that reduce profit margins in the soy-crushing industry in Brazil. These taxes are not imposed on grain and therefore encourage production of grain, which is exported. Third, tariff escalation policies on processed soy products in importing countries favour the export from Brazil of grain, rather than meal and oil. These factors have combined to put downward pressure on investment in the processing industry in Brazil, which in turn, further reduces competitiveness of processed soy products.

3. THE CENTRE-WEST REGION

The rapid growth in soy production took place initially in the southern states in Brazil. Since the 1990s, this production has expanded and over half the soy is now produced in the region of the Cerrado in the Centre-West region of Brazil, which is well suited for soy cultivation with a favourable geography and climate. However, much of the Cerrado is also ecologically sensitive and home to an exceptionally high level of biodiversity and will be impacted by both the rate and the means of expansion.

The expansion of soy cultivation is characterized by increasingly large production units designed to take advantage of economies of scale. These large farms are typically established by buying

parcels of land from small landowners. However, it also involves expansion into significant areas of new land, which must be cleared and prepared for soy production. Side effects of this process include deforestation, the destruction of species and habitats, removal of natural vegetation and the loss of ecosystem functions and services. Not only does the natural vegetation protect and sustain biodiversity, it also plays a role in regulating climate and hydrological cycles. Studies on tropical forests have shown that large-scale deforestation can lead to a drop in precipitation and a rise in temperature. Among the most worrisome impacts are on the "gallery" forests in the Cerrado, which are home to half of Brazil's endemic species and a quarter of its threatened species. Expansion into such ecologically complex ecosystems could have impacts that are irreversible.

The concentration of land ownership into large production units also has important social impacts. It encourages small landowners to sell their land and thus effectively lose their livelihoods. The production of soy is not labour intensive and many of these farmers are forced to migrate to large urban centres, contributing to problems in cities associated with urbanization. Other farmers engage in speculative purchases of land further west into the Cerrado or north into the Amazon, which they clear and re-sell.

Production has not only come about as a result of expansion of the area in production. There have also been significant increases in yields in Brazil, brought about by quicker and more efficient diffusion of technology including seeds, agrochemicals and other cultivation materials (such as lime and fertilizer). Increasing yields relieve pressure on land, but they also have negative employment effects. In addition, production practices, including conventional tillage techniques and the use of machinery, cause erosion and degrade the nutrient quality in the soil. Pesticides are commonly used to control weeds and pests. This can have impacts on the environment through contamination of the land and water, and can also impact human health if methods for application are not carefully controlled.

Policies directed towards improving the transportation infrastructure in the Centre-West region of Brazil also drive the expansion of production. Major infrastructure projects are being undertaken to develop new export corridors to improve transport of grain between production areas in the Centre-West part of the country, the processing facilities (located close to large urban centres) and ports. However, as transportation infrastructure develops, there is a danger that expansion will be encouraged even further north into areas of the Amazon that have, until now, not been economically viable for exploitation. Coupled with an expectation that domestic demand for soy products will continue to grow, it is critical that policies to enhance infrastructure to service the large plantations in the Cerrado be accompanied by policies that will temper the effects of this infrastructure in encouraging growth into new, and particularly vulnerable, regions. Policies should be put in place to prevent unfettered expansion into sensitive areas and protect key ecosystems in the Cerrado, the Pantanal and the Amazon and encourage any

additional production to occur on tracts of land that are already degraded, employing technologies maximise the continued productivity of the natural resources.

4. TRADE IN SOY AND SOY PRODUCTS

The Brazilian government is engaged in a number of international negotiations on trade liberalization that will impact the soy sector. Typically, government negotiators seek to gain market access and eliminate discriminatory practices such as domestic support and tariff escalation in competitor countries (such as the United States). If these policies are achieved, they will increase the competitiveness of Brazilian soy and might encourage the export of larger quantities of processed production. This could have positive effects for sustainability by adding value to the product and increasing employment in urban areas. By increasing overall earnings in the sector, a shift from unprocessed to processed soy products could help to stem the pressure to increase total soy production, thus relieving pressure on the vulnerable areas of the Cerrado, Pantanal and the Amazon. There might also be opportunities associated with continued refusal to adopt the widespread use of genetically modified organisms (GMOs). The "GMO-free" status of Brazilian soy could give Brazil a competitive advantage in some markets (such as the EU), as the soy industries in its major competitors, Argentina and the United States, are now inextricably linked to GMOs.

At the same time, increased liberalisation in the soy sector is likely to encourage existing trends in production, with potential negative environmental and social effects. While opportunities offered by trade negotiations to eliminate these policies that are barriers to greater sustainability in the soy sector should be seized, the Brazilian government also needs to develop and enforce policies to manage the expansion of soy production and promote more sustainable cultivation practices in parallel with efforts to promote exports. This will require, *inter alia*, strong and effective environmental and social policies.

5. SUMMARY OF POLICY RECOMMENDATIONS

Further to the issues raised by the expansion of soy, in Brazil and elsewhere, this study proposes specific policy measures that can be pursued by the government of Brazil, producers, and civil society to ensure that opportunities for growth presented by increasing demand for, and trade in, soy and soy products are pursued in a way that respects environmental integrity and social responsibility and ultimately contributes to sustainable development. Given that the soy sector is likely to continue to expand, the question is how to ensure that there is adequate management of environmental and social impacts. The case-study emphasises three types of policies:

- **POLICIES AT THE INTERNATIONAL LEVEL: TRADE AND SUBSIDY-RELATED POLICIES**

The first set of policy recommendations includes actions that can be taken at the international level through the various negotiating fora in which Brazil participates. Proposed recommendations focus on changing the terms of trade for soy and products in the soy complex to encourage Brazil to develop increased value-added in its exports, particularly with respect to the EU, Mercosur and the FTAA. As follows:

- Practices of tariff escalation by importing countries for Brazilian soy should be removed;
- Production related subsidies in industrialized countries should be removed;
- Export-led growth in soy production should be sustainably managed;
- Sustainability assessment of trade agreements should be included;
- Genetically modified soy should not be produced in Brazil.

- **DOMESTIC POLICIES RELATED TO THE SOY SECTOR**

The second set of policy recommendations includes domestic policies that can be implemented in Brazil to pursue various goals, ranging from promoting more sustainable land use at the national level to encouraging best practices at the farm level. These policies rely on a combination of economic incentives and command and control measures for their implementation and include, *inter alia*:

- Zoning and land-use planning;
- Tax related policies;
- Best management environmental practices in agriculture;
- Legal Reserves and Protected Areas;
- Water management;
- Employment;
- Rural settlement and socio-development;
- Research and development.

- **CROSS-CUTTING POLICIES**

The third set of policy recommendations includes cross-cutting policies that are relevant for all sectors, including soy. They include:

- Awareness raising and education;
- Governance.

The analysis in this study suggests that the soy sector is likely to continue to expand in Brazil, especially in Cerrado areas of the mid-west and southern Amazon. It is critical to ensure that there is an adequate management of environmental and social impacts associated with this expansion to enhance sustainability.

SUSTAINABILITY ASSESSMENT OF EXPORT-LED GROWTH IN SOY PRODUCTION IN BRAZIL

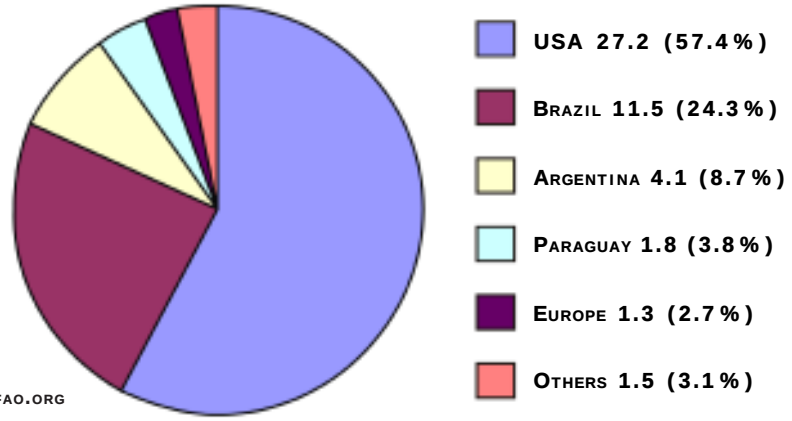
1. THE HISTORY OF SOY IN BRAZIL: 1960 - 2000

The history of soy production in Brazil is short but intense. In just three decades, soy has moved from being a marginal agricultural crop to one of Brazil's leading export commodities.

At the end of the 1960s, information on cultivated areas, soy production and yields was difficult to find, even in the Brazilian agricultural census. Encouraged by an increase in international demand in the 1970s, soy production began to expand. By 1999, 15 out of Brazil's 27 states were engaged in soy cultivation. In the course of the twentieth century no major crop in Brazil expanded at a rate rivalling soy. Between 1970 and 1995 alone, Brazilian soy production grew from 1.5 million tons to around 26 million tons (Warnken 1999).

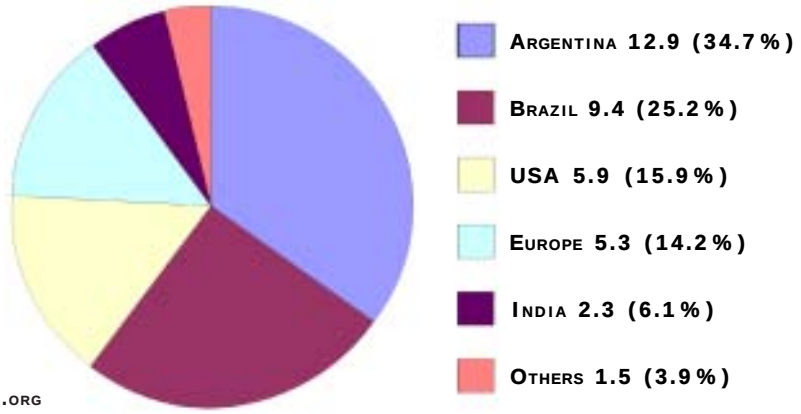
The rapid growth in soy production during the 1970s was accompanied by expansion of the soy-grain-crushing industry. In 2000, Brazil was the second world leader in soy meal and in soy grain exports (Figures 1.1 and 1.2) and contributed 20 percent of the soy grain and derivatives market, which is valued, worldwide, at US$17.38 billion. Figure 1.3 shows Brazil as the third largest global exporter of soy oil in 2000 with 14.9 percent of the world volume, behind Argentina (41.5 percent) and EU (22.9 percent).

FIGURE 1.1 SOY GRAIN EXPORTS WORLDWIDE, 2000 (MILLIONS TONS AND PERCENTAGE)



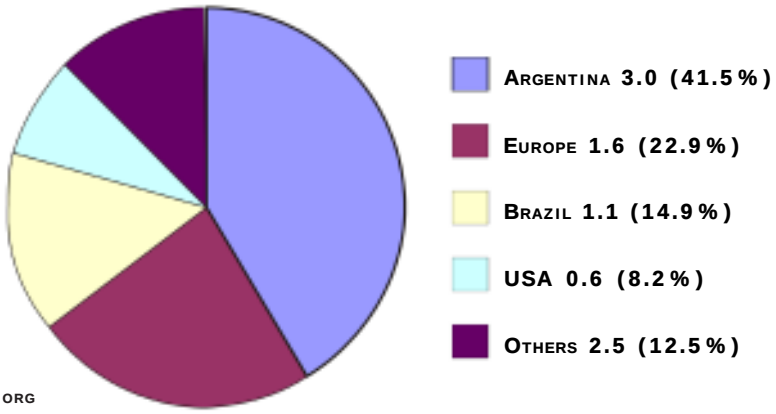
SOURCE: WWW.FAO.ORG

FIGURE 1.2 SOY MEAL EXPORTS WORLDWIDE, 2000 (MILLION TONS AND PERCENTAGE)



SOURCE: WWW.FAO.ORG

FIGURE 1.3 SOY OIL EXPORTS WORLDWIDE, 2000 (MILLION TONS AND PERCENTAGES)



SOURCE: WWW.FAO.ORG

At a national level, the soy complex in Brazil generates around US$32 billion per year, or 16 percent of the total value of Brazilian agri-business (US$195 billion) and six percent of Brazilian Gross Domestic Product (GDP). For each job generated in the agricultural sector in Brazil, an estimated six more are created in the agri-business complex. Taking into account the 1985 agricultural census it was estimated that 1.5 million people were directly involved in soy production at the time (Stulp and Plá 1992). However, this number has dropped due to technological innovations in the 1990s and especially since soy production expanded into Brazil's Centre-west region where production is carried out on a large-scale with reduced labour requirements. In 2000, an estimated 5.4 million people were employed in the soy complex in Brazil of which 0.9 million were producers (Roessing 2000).

Soy is an important generator of foreign exchange in Brazil where agricultural products represent 35 percent of the value of total exports. Of this, soy accounts for 7.8 percent of the total, earning between US$4 and US$5 billion per year between 1995 and 1998. However, the relative

contribution made by the soy complex to Brazil's total export revenue was higher in the mid-1970s due to a greater contribution, in the past, of value-added by the soy crushing sector. The causes for this relative drop in importance of the soy-processing sector are discussed in this study.

The economic and social importance of soy in the Brazilian economy is evident. The high level of development in this sector in a relatively short period of time has brought about significant economic, social and environmental imbalances that will be analyzed in this study

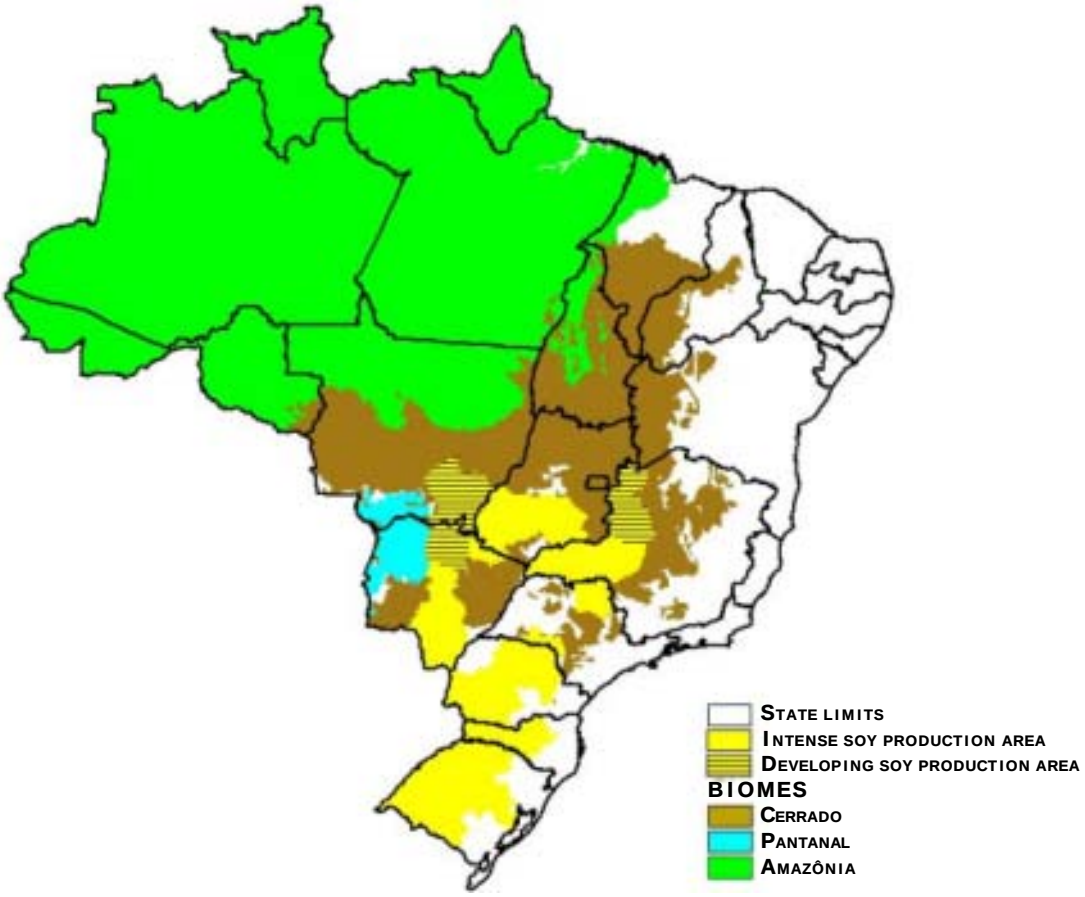
1.1 THE EVOLUTION OF SOY PRODUCTION IN BRAZIL

1.1.1 INITIAL PHASE: PRODUCTION IN THE SOUTH OF BRAZIL

As a result of increased demand, particularly at the international level, soy cultivation in Brazil started to grow rapidly during the second half of the 1970s. This expansion typically occurred in states in the south of the country, in traditional agricultural zones where soy was cultivated in areas once used for other crops or as grazing land. Indeed, soy cultivation in the state of Rio Grande do Sul started as a rotation crop for wheat. After becoming established in this state, it expanded north towards the states of Santa Catarina, Paraná and São Paulo.

In 1980, more than 80 percent of land planted with soy occurred in the southern states as shown in Figure 1.4. The same southern states were responsible, that year, for around 85 percent of the total area under soy grain cultivation in Brazil (8.8 million ha) and around 86 percent of total Brazilian production (around 15.2 million tons).

FIGURE 1.4 MAP OF THE CONCENTRATED AREAS OF SOY PRODUCTION IN BRAZIL, 1980

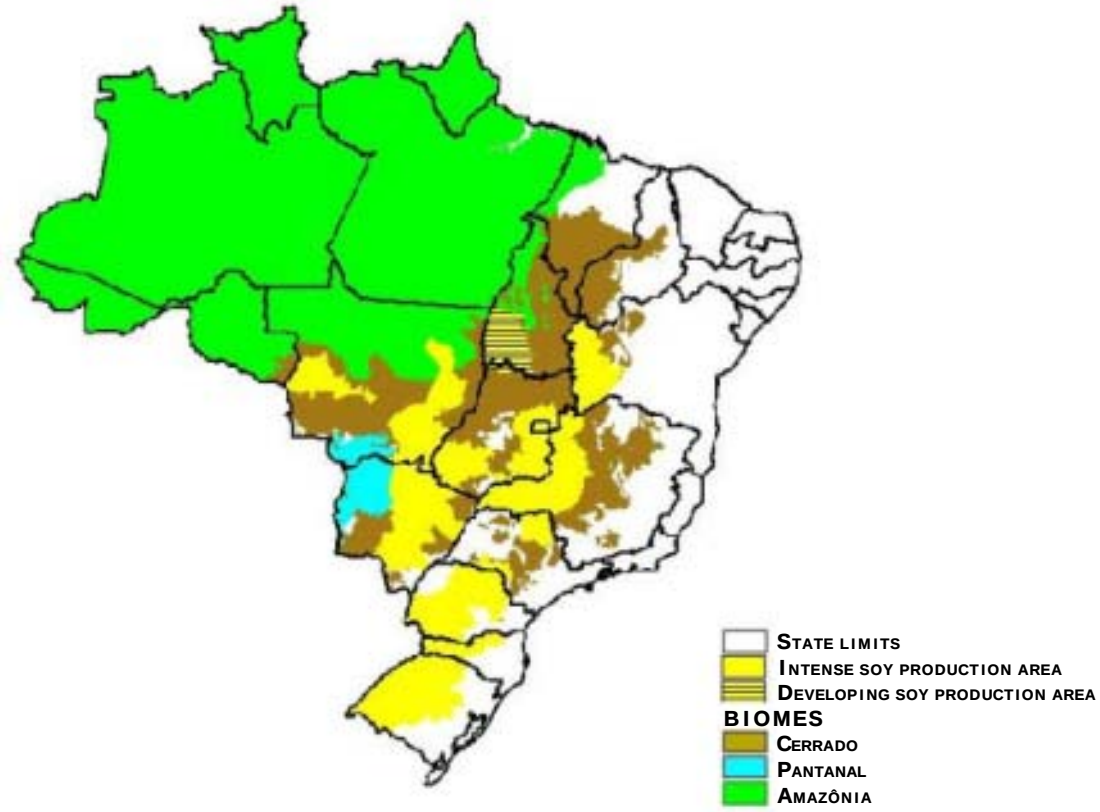


At this time, soy production was not yet extensive in the Cerrado. The remaining 15 percent of the total area under soy cultivation was in Mato Grosso do Sul, the south of Goiás and the Mineiro Triangle Region. However, soy production started to expand in the Cerrado areas of the Mineiro Triangle and in the western part of the state of Minas Gerais, encouraged by the Cerrado's development program launched by the government of the State of Minas Gerais.

1.1.2 THE 1980s AND 1990s: SOY PRODUCTION IN THE CERRADO

Throughout the 1980s, soy production continued to be concentrated in the southern states although there were marked advances into the Cerrado. In 1990, these southern states were responsible for around 58 percent of the total area under soy cultivation (11.6 million ha). However, a great expansion of soy production was observed in the Cerrado. The 1990 data shows the clear development of new areas, almost all of which were located in the Cerrado. Figure 1.5 highlights the areas where, in 1990, over 80 percent of the land was under soy production. During this period Mato Grosso was already the third largest soy producing state in Brazil with around 1.6 million ha under cultivation, outpaced only by Rio Grande do Sul and Paraná.

FIGURE 1.5 MAP OF THE CONCENTRATED AREAS OF SOY PRODUCTION CONCENTRATION AREAS IN BRAZIL, 1990



The State of Mato Grosso do Sul was Brazil's fourth largest producer of soy in 1990 (1.3 million ha under cultivation). By then the crop had spread throughout the state with the exception of the Pantanal region in the west. In the state of Goiás, the fifth largest producer (around 1 million ha in 1990), soy also occupied areas of the Cerrado, particularly in the western part of the state

The expansion and consolidation in soy cultivation also occurred in the Mineiro Triangle, in the centre-west of Minas Gerais, and in western Bahia, areas that were not major producers in 1980. In these states, soy cultivation occurred primarily in the Cerrado zones. Finally, soy production began to be developed in southwestern areas of the State of Tocantins.

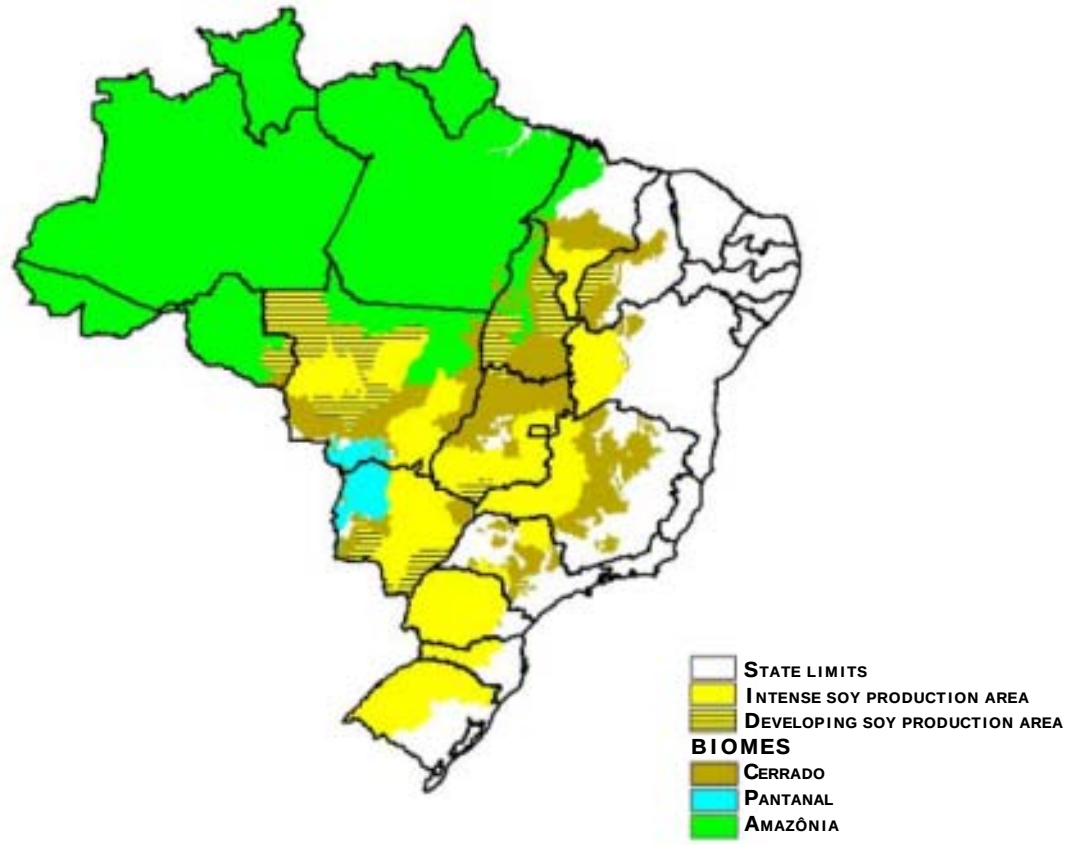
In addition to the expansion of the area under soy cultivation, signs of growing concentration of soy production were observed in the Cerrado region. A closer look at the expansion of soy into that region indicates that it was strongly influenced by the Cerrado's natural conditions, the development of technologies that made cultivation viable in an agro-system previously considered inhospitable, and by investment in transportation infrastructure. These factors influenced the spatial patterns of expansion in soy production in the 1990s.

In 2000, a number of new zones dedicated to soy production had emerged and the traditional producer states in the south were responsible for only around 49 percent of the total area under

cultivation. The remaining production (51 percent or just over 7 million ha) was located almost exclusively in the Cerrado. The State of Rio Grande do Sul continued to be the largest producer (3 million ha), however, Mato Grosso had become the second largest producer in terms of area under cultivation (2.9 million ha), slightly ahead of Paraná (2.86 million ha). Other large producers included states that covered significant areas of the Cerrado, such as Goiás (1.5 million ha), Mato Grosso do Sul (1.1 million ha), Bahia (0.63 million hectare), and Minas Gerais (0.6 million hectare). The states of São Paulo and Santa Catarina showed only modest areas under soy cultivation in 2000.

Figure 1.6 illustrates the consolidation of soy production in the centre of Brazil in zones of the Cerrado. Compared with data in Figure 1.5, Figure 1.6 indicates that the states where production had been in its relative infancy in 1990 were, by 2000, established producers. It also shows clearly the development of new zones dedicated to soy production.

FIGURE 1.6 MAP OF THE CONCENTRATED AREAS OF SOY PRODUCTION IN BRAZIL, 2000



1.1.3 BRAZILIAN PRODUCTION IN 2000

Soy production in Brazil has evolved from its initial cultivation in four southern states to increasing concentration in the Centre-West region of Brazil and, in particular, in the states of Mato Grosso do Sul, Mato Grosso and Goiás. In 1999, the main producer states were:

- Mato Grosso (7.6 million tons or 25 percent of total Brazilian production);
- Paraná (7.1 million tons or 22 percent of total production);
- Rio Grande do Sul (6 percent of total production);
- Goiás (12 percent of total production);
- Mato Grosso do Sul (7 percent of total production);
- Minas Gerais (4 percent of total production).

The Centre-West region of Brazil contributed just over 44 percent of the total 1999-2000 soy crop, while the traditional region in the Centre South of the country contributed just over 40 percent of the total.

Box 1 - Domestic and international factors influencing soy expansion in Brazil

During the 1970s and 1980s six goals formed the basis of the official policy for soy in Brazil led by a strong demand from the external market:

1) To economize foreign currency by reducing imports;
2) To increase foreign exchange revenue through exports;
3) To improve the level of nutrition in Brazil;
4) To encourage industrial development;
5) To maintain food costs; and,
6) To occupy national territory.

Source: Roessing & Guedes 1993; Warnken 1999.

The expansion of the area under soy production into the Centre-West and Northern regions of Brazil has led to land conversion, the replacement of other crops with soy, and the expansion of the agricultural frontier northwards into the Amazon.

Increases in both areas under cultivation and yields have played an important role in growing soy production. The growth in yields has been encouraged by government incentives including preferential credit concessions and technical support, notably through financing and investment in research and technology on seeds and soy varieties, by EMBRAPA, the Brazilian Agricultural Research Corporation.

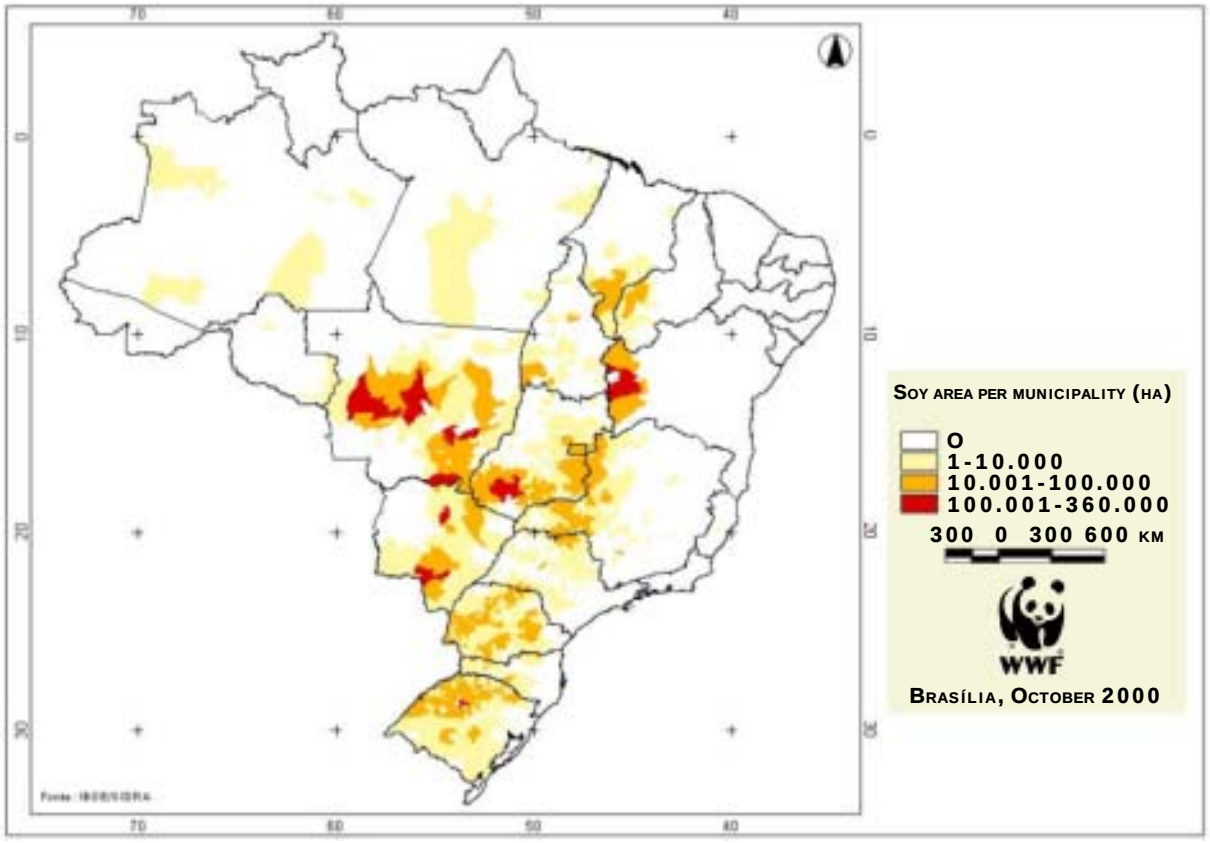
In Rio Grande do Sul the soy yield increased from 1.438 kg/ha in 1980 to 2.000 kg/ha in 2000-2001. In Paraná, the crop yield increased from 2.240 kg/ha to 2.740 kg/ha during the same period. The recent performance of the Centre-West region where substantial portion of soy production is concentrated is notable. The region's average for the 2000-2001 harvests was

2.845 kg/ha, well above national average. In this harvest, Mato Grosso's yield (3.050 kg/ha) was the highest in the country and one of the highest in the world. The adoption of technology to increase productivity and reduce costs was essential to counteract the high costs of transporting soy in the new Cerrado zones and to ensure that Brazilian producers are can compete with those from the United States.

1.2 SOY IN FRONTIER REGIONS: THE CERRADO, THE PANTANAL AND THE AMAZON

The expansion of soy production into particularly sensitive regions deserves attention in this study. Such expansion has been facilitated by readily available land with good topographical and climatic conditions, as well as the increasing availability of technology for soy cultivation in tropical regions. Availability of land has also encouraged production in larger units with higher profit margins. These advances have raised a number of concerns, especially vis-à-vis soy expansion into ecosystems in the Cerrado, the Pantanal and the Amazon. Figure 1.7 highlights the distribution soy in Brazilian municipalities, in 2000.

FIGURE 1.7 SOY DISTRIBUTION IN BRAZILIAN MUNICIPALITIES, 2000



SOURCE: INCRA / SIDRA

Soy is being cultivated in parts of the Upper Paraguay Basin (in the Pantanal's streams) but remains almost non-existent in the interior the ecosystem. The nature of this region's soils, and the hydrological cycles of the region, makes mechanized monoculture almost impossible. Deforestation in parts of the region, which began in the 1970s, is associated with the opening up of lands, in part due to fiscal incentives. Until 1997 deforestation in the western regions of the Pantanal was approximately 364 thousand ha in the State of Mato Grosso do Sul and 180 thousand ha in the in the State of Mato Grosso (Silva et al. 1998).

The area under soy cultivation in the northern region of Brazil, which covers a great part of the Brazilian Amazone, is still relatively small, approximately 73 thousand hectare in 2000. It is unlikely that soy production is a direct cause of the extensive deforestation in the Brazilian Amazon, which took place in the 1990s. More intensive use of land for soy cultivation depends crucially on the development of transportation infrastructure, which is still relatively undeveloped in the region. The prospect that soy production will expand into the states in Brazil's northern region, and in the northern areas of the State of Mato Grosso, deserves early attention from a sustainability perspective.

1.2.1 THE STATES OF MINAS GERAIS AND GOIÁS

The adaptation of soy in lands in the southern region of Brazil and the growing demands of the domestic and external markets stabilized the prices of the product thus providing incentives for the expansion of the production area. In the 1980s, EMBRAPA already made available specific technologies suitable to soil and climatic conditions of the country and it was also the first genuinely Brazilian soy cultivar—the *Doko*—which rendered feasible the production of soy in tropical regions, specially the Cerrado, where it did not grow before. In 1975, the States of Minas Gerais and Goiás produced 48 and 82 thousand tons of soy, respectively. In 1985 these figures were 639 and 1.158 thousand tons, and in 1996, 865 and 1.960 thousand tons, respectively.

1.2.2 THE STATE OF MATO GROSSO DO SUL AND THE SOUTHERN REGION OF MATO GROSSO

The development of soy in Minas Gerais, and especially in Goiás, stimulated agricultural expansion into the Pantanal, initially in Mato Grosso do Sul, and in Mato Grosso a little later. Based on the agricultural census of 1975, Mato Grosso do Sul produced 67 percent of the soy in the Centre-West region while Mato Grosso's production was still insignificant. In 1985, Mato Grosso do Sul produced 39 percent of the regional crop and Mato Grosso reached 35 percent. In 1996, Mato Grosso was the leading producer, with 54 percent of the total crop, while Mato Grosso do Sul harvested 22 percent (4.4 and 1.8 million tons, respectively).

1.2.3 THE NORTHERN REGION OF THE STATE OF MATO GROSSO

A large part of the area under soy cultivation in Mato Grosso reaches the Cerrado ecosystem. There is no record of expanded soy production in the northern part of the state, in the 1990s. Soy production was heavily dependent on subsidies and generous terms of financing from the Federal Government, which no longer exist. The main obstacles to the expansion of soy in this region include transportation problems, and inadequate storage facilities and marketing. Yet, any increased investment in transportation infrastructure could lead to conditions that will once again encourage soy expansion in this region.

1.2.4 THE STATE OF TOCANTINS

Although officially located in the northern part of Brazil, only the extreme northern areas of Tocantins have Amazonian characteristics. In 2000, the area under soy cultivation in the state - almost all of which are in the Cerrado - totalled a little less than 58 thousand ha, and 30 thousand ha in 1990.

1.2.5 THE STATE OF PARÁ

In 2000, the area under soy cultivation in the State of Pará was only 1,200 ha. However, since 1994, the state government has sought to encourage grain production, initially in Cerrado areas to the south of the state. Later it was transferred to areas covered by degraded grazing lands in the mid-Amazon regions, near Santarém, (PA), and the Belém-Brasília highway in close proximity to the Carajás-São Luis do Maranhão railway. However, substantial progress in soy production in these areas requires large investments in infrastructure, which have been delayed by the state and federal governments due to lack of resources.

1.2.6 THE STATE OF AMAZONAS

The state of Amazonas contains the most significant areas of tropical rain forests not yet affected by human intervention. Soy cultivation is still almost non-existent in Amazonas. In 2000, the area under soy cultivation was a little over 1,000 ha. However, the waterway Madeira that links Porto Velho with the Itacoatiara terminal on the Amazon River increases the likelihood of expanded soy cultivation in response to increasing market demand. Any such expansion is most likely to occur in natural fields and on previously degraded lands (from failed livestock rearing projects, for example), thus avoiding new clearings in tropical rain forest zones.

1.2.7 THE STATE OF RONDÔNIA

Soy cultivation in this state, which includes areas of the Cerrado in its southern territory, covered around 12 thousand ha in 2000. However, given increased demand and developments in transportation infrastructure the crop could be viably extended into southern Rondônia and northwestern Mato Grosso. Of particular potential importance is the export corridor comprised of the complex that includes the BR364 (Rio Madeira waterway- Port of Itacoatiara - Atlantic Ocean).

1.2.8 THE STATE OF RORAIMA

In Roraima there are approximately 1.5 million ha of Cerrado where soy could be grown. Nevertheless, the area under soy cultivation was minimal in 2000. Elements discouraging the expansion of soy in this state include difficulties associated with clear legal titles for land ownership, a lack of transportation infrastructure, high input costs, reduced storage capacity and ineffective marketing. At the same time, positive factors that could outweigh these shortcomings include low land prices, tax exemptions available to purchase machinery and inputs, preferential access to markets in Venezuela, and access to the Port of Itacoatiara. In addition, production occurs during a different season from the rest of Brazil since Roraima is situated in the Northern Hemisphere.

1.3 THE SOY PROCESSING SECTOR IN BRAZIL

Incentive-based policies to encourage industrialization in the 1970s led to the rapid expansion of the soy-crushing industry increasing the production of soy oil and soy meal. The same policies also led to the creation of considerable excess production capacity. In keeping with the locations of soy production and the large domestic markets, crushing units were originally located in the states of Paraná, Rio Grande do Sul and São Paulo. Over time, processing units in other states were established. By 1997, the three original states were still responsible for 66 percent of Brazil's crushing capacity (FGV 1998).

The soy processing industry started on the basis of relatively small production units. However, after the removal in the 1990s of government support and subsidies several small units or units located far from production or consumption centres, began to close. Today, the industry is made up primarily of large multinational companies such as Bunge International, Cargill, ADM and Louis Dreyfuss. The Brazilian processing units have scaled down their production suffers from lack of competitiveness.

Brazil, once a large exporter of soy meal, was primarily an exporter soy grain in 2000. The processing sector produces soy oil and soy meal largely for the domestic market. Soy meal

serves particularly as a critical input into poultry and pork production and for input into other Brazilian exports. Section 3 examines the factors associated with this shift, due mainly to recent changes in the tax code. It also addresses the role of subsidies, tariff escalation and other restrictions imposed by importing countries, on different segments of the soy sector.

1.4 SOY WORKERS AND PRODUCERS IN BRAZIL

Reliable data on the number of workers employed in soy production in Brazil in the 1990s is not available. However, estimates indicate that 22 percent of the economically active population participates either directly or indirectly in activities related to the overall Brazilian agro-industrial complex. Estimates focused specifically on agricultural activities show that in 1996, there were more than 6.7 million workers employed in the production of seasonal crops in Brazil. At the time, the number of small rural establishments producing seasonal crops was around 1.8 million, of which 243 thousand (13 percent) cultivated soy as the sole or a main crop. Based on this information, it is estimated that, in 2000, between 890 thousand and 1 million people were employed directly in soy production in Brazil. Taking into account the whole soy agri-business complex, the number of workers totalled approximately 5.4 million persons (Roessing 2001).

Individuals run the vast majority of production units in this sector. They are essentially modern entrepreneurs from the south of the country or from São Paulo, strongly motivated by profits and accustomed to working with advanced methods and technologies. This stands in stark contrast to the rural oligarchies that dominated Brazilian agriculture in the past. According to the Agri-business Census of 1995-1996, the average soy producer cultivated an area of 38.0 ha and produced 88.8 tons of grain, with a yield of 2.273 kg/ha. Out of all soy producers, 82 percent were individual owners accounting for 85 percent of total production and owing 85 percent of the total area cultivated with soy. Tenant farmers made up close to 9 percent of all producers while partners and sharecroppers represented close to 6 percent.

These averages tend to hide significant regional discrepancies. According to the 1995-1996 census, 90 percent of producers from the states of Rio Grande do Sul and Paraná, cultivated less than 1,000 ha. However, in the Centre-West region large production units were predominant. In Mato Grosso, 64 percent of soy farms were larger than 1,000 ha while in Mato Grosso do Sul this proportion was 42 percent, and 50 percent in Goiás. These figures demonstrate two important characteristics associated with soy production in Brazil in recent years:

- The frontier zones are being occupied by large-scale producers whose cultivation typically covers more than 1,000 ha of soy per farm, and,
- By trying to remain more competitive producers in the southern parts of Brazil are beginning to increase the average size of their establishments.

2. POLITICAL ECONOMY OF THE SOY COMPLEX: MAIN ACTORS

The soy complex involves all stages of the soy production chain. It is made up of a set of operations for production, processing, storage, distribution and marketing of materials and soy grain derivatives. This includes a number of interactive components, production systems, material and service suppliers, crushing and processing industries, distribution and marketing agents as well as the final consumers. The most important components in the soy complex are:

- The consumer market, made up of individuals who consume the final and derivatives soy products;
- The network of wholesalers and retailers;
- The processing and/or transforming industry for the product;
- Agricultural properties with their diverse production systems; and,
- Material suppliers (fertilizers, pesticides, machinery, implements and other services).

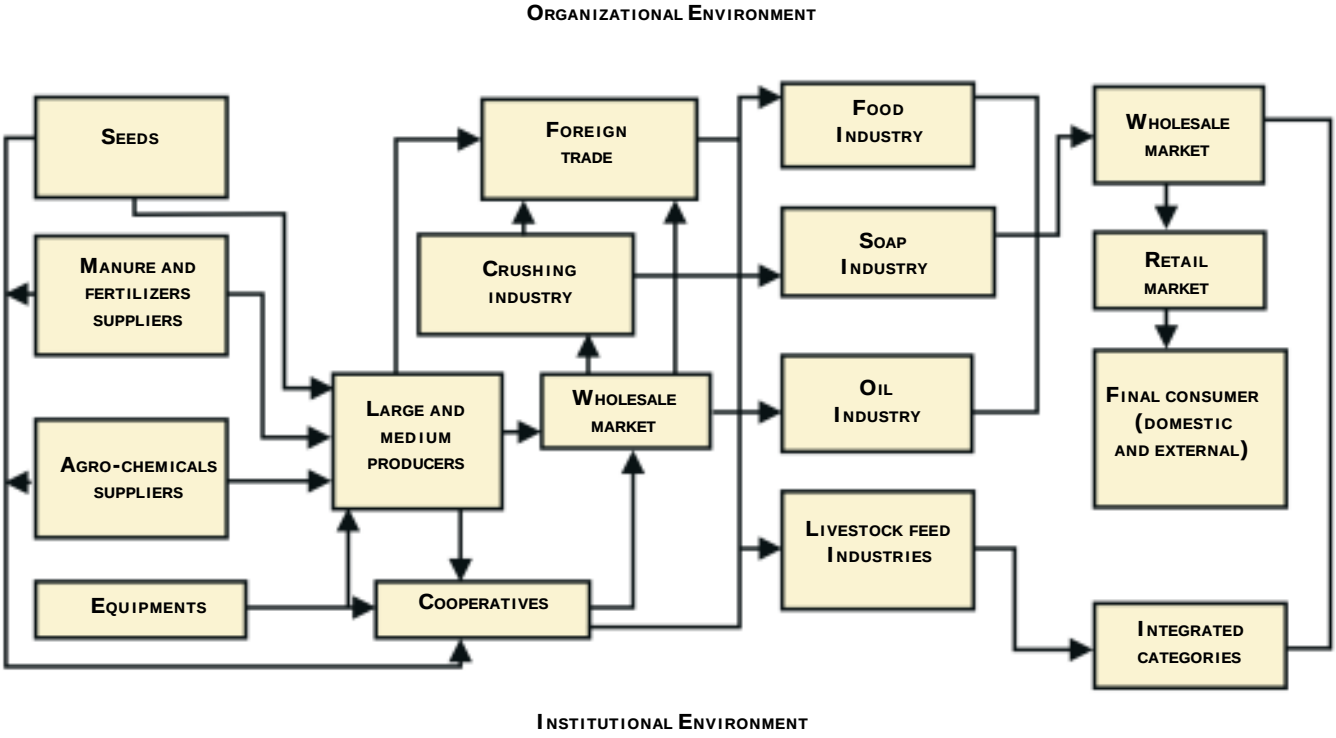
These components are immersed in institutional (laws, standards, and standard-setting institutions) and organizational (governmental, credit, research and technical assistance institutions) characteristics which, taken together, influence the soy complex to create a sophisticated system of public and private interests both at the national and international levels. Ideally, the performance objectives sought by the soy complex and by its individual components, are: efficiency, quality, competitiveness, sustainability and equity. The political economy of this production chain should identify which of such objectives should receive the most attention, which standards should be achieved and which instruments and mechanisms should be adopted.

Based on this general framework, the components of the soy complex are qualified and quantified, and the economic relations and political conflicts among them are considered. Criteria for evaluating the performance of the production chain are defined by focusing specifically on efficiency, quality and competitiveness. The present analysis was developed taking into account the flow that starts with the final consumer, moving down the supply chain to the suppliers of input materials. Once the performance was defined for the main components an effort was made to explain trends and the expectations of the major actors vis-à-vis the soy complex.

With a view to developing this analysis, it was essential to develop an outline of the actual system in such a way so as to understand its overall performance. The most important elements were defined as its aims, limits, inputs, outputs, components, segments, material and capital flows. Another aspect of the analytical process was to describe elements of the external environment relevant to the production chain (including the organizational context), which generate positive or negative influences on the performance of the various components.

A useful instrument for this purpose is the flow chart in Figure 2.1. The model presented in Figure 2.1 illustrates, albeit in a summarized manner, the way in which the soy production chain works in Brazil. The arrows indicate the flow of materials occurring among the organizations and social groups, which make up segments of the production chain, and which are represented by boxes. The chart indicates a capital flow that occurs in the opposite direction of material flows, characterizing both formal and informal commercial transactions in the production chain.

FIGURE 2.1 FLOW CHART OF THE SOY PRODUCTION CHAIN



Within the soy production chain, the final consumer stands out. This category is made up of agents who use oil, in addition to other soy product derivatives. These derivatives include elements from related integrated production chains that use soy sub-products as inputs, for example, in poultry and egg, beef, and pork production. The final consumer can also be classified according to domestic and external consumers, comprising the domestic and external market for soy products, sub-products and derivatives.

A wholesale and retail marketing structure interlinked with the agro-industrial segments exists for the distribution of these products, to make them available to the final consumer. Each ton of crushed soy produces approximately 0.78 tons of soy meal and 0.19 tons of soy oil (Zylbersztajn et all.1999). In Brazil, the main product consumed is soy oil, which is distributed to the final consumer through supermarket chains in large urban centres and to supermarkets and open-air

markets in smaller communities. At the same time, soy is the raw material for different industrial branches, such as the margarines and mayonnaise industry. This is one of the most important components in the production chain and in 1999 it produced US$ 2.7 billion, of which exports were responsible for one-third of the total. Another industrial segment in the production chain is the soap and cosmetic industry that uses not only soy oil but also other vegetable oils and animal fats. This segment of the production chain is not as economically dense as other segments (Agrianual 2000).

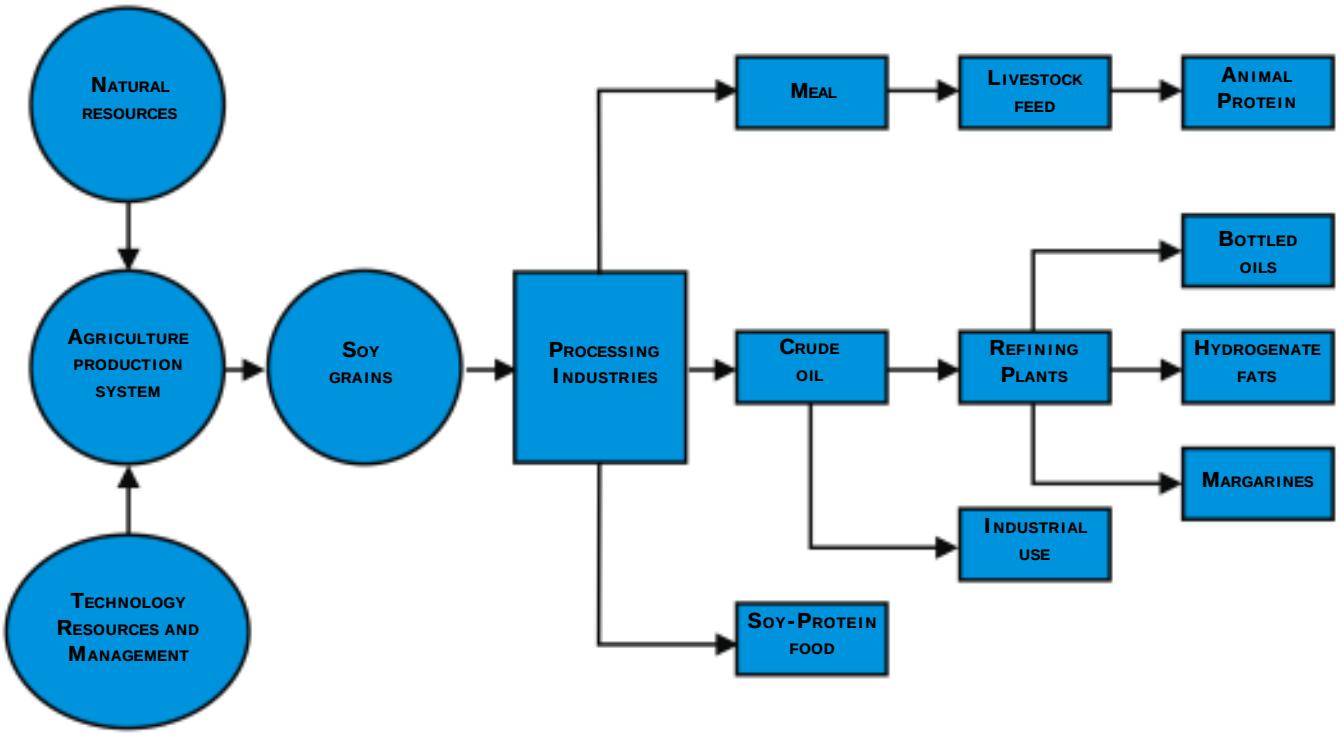
The livestock feed industries are also major consumers of soy. The soy meal acquired by the feed industry for poultry, pork and fisheries is incorporated into other production chains for producing meats and eggs. Between 1999 and 2000 Brazilian soy hull exports increased from 7.5 to 9.4 million tons totalling approximately US$ 1.6 billion in 2000.

There is also a wholesale segment made up of warehouse holders, brokers and the trading, organizations that transact directly with grain producers, the soy crushing agro-industry and the external market. This segment buys, stores, and undertakes production movement either to the soy crushing market or to the external grain market. In the case of exports, marketing is undertaken mainly through trading organizations. Many cooperatives and crushing companies have marketing departments but they interact with trading companies for their exports. There are also large producers that operate as buyers, mediating marketing since they make up larger groups for raw materials. In general, these producers have soy storage structures.

The agro-industrial sector in the chain is the soy crushing industry. Grain derivatives are extracted, refined and processed by this segment. Its main products are crude oil, refined oil and soy meal. All the same, there are many other products already on the production line or potential future ones. In terms of future competitive performance in the production chain, it is in this sector that there is great potential given the possibilities for differentiation and the consequent value added. The possible opportunities to add value to the Brazilian soy point to the following derivatives: 1. non-fat flour; 2. full-fat flour; 3. 50 percent textured protein; 4. 70 percent textured protein; 5. food-grade concentrated protein; 6. feed grade concentrated protein (for aquaculture); 7. soy separated protein (normal molecular weight and low molecular weight); 8. dietetic fibre; 9. tocopherol (8 to 35 percent) for the production of vitamin E; 10. isoflavone concentrate; 11. hydrogenated and esterified vegetal oils; and 12. natural and modified lecithin (Zílio 1998).

At present, soy grain generates a diversified range of products. The main products are presented in Figure 2.2 (based on Trigueirinho 1998).

FIGURE 2.2 SOY PROCESSING AND ITS MAIN PRODUCTS



The agricultural production sector in the production chain is made up of medium and large-scale establishments whose production is generally geared towards the market. Depending on where they are located, they can produce soy alone, or in rotation with other grains. This segment is linked to the materials industry in that it buys materials and equipment necessary for production. It also interacts with agents, traders, cooperatives and crushing industries in order to sell its produce.

The material sector is made up of commercial and industrial organizations that provide machinery (such as tractors, harvesters, and sprinklers), fertilizers, agricultural tools, insecticides, fungicides, herbicides, seeds and other agricultural products. The segment's impact on production is substantial, specifically in the agricultural frontier regions, where supply of these inputs is limited.

2.1 THE CONSUMER MARKET

The agricultural production chain should supply the final consumer with quality products compatible with their needs and at competitive prices. The influence of the final consumer on the components of the production chain is strong and it is important to gauge the consumers' market demands. Consumption of soy and its derivatives increased steadily during the 1990s, although not as rapidly as the consumption of soy meal, which recorded an increase of 102

percent. Grain consumption grew by around 35 percent and oil by around 29 percent during the same period. The increase in domestic grain consumption between 1990 and 1998 was approximately 5.8 million tons (Table 2.1).

Consumption per capita has shown similar gains, with soy meal growing most rapidly during this period (82 percent), followed by grains (21 percent) and soy oil (16 percent). Consumption performance statistics for the 1990s are presented in Table 2.1.

TABLE 2.1 EVOLUTION OF SOY, MEAL AND OIL TOTAL AND PER CAPITA DOMESTIC CONSUMPTION IN BRAZIL, 1990, 1994, AND 1998

Product	Total Consumption (1000 t)			Per capita Consumption (Kg / inhab / year)		
	1990	1994	1998	1990	1994	1998
Grain	16.667.1	23.234.0	22.482.0	115.2	150.0	139.5
Meal	2.915.7	4.460.0	5.900.0	20.1	29.2	36.6
Oil	2.130.5	2.425.0	2.740.0	14.7	15.9	17.0

SOURCE: AGRIANUAL 2000.

The extraordinary growth in soy meal consumption per capita is not explained only by a population increase. It is likely that the growth is related to the economic recovery given the end of high inflation rates in Brazil, which led to an improvement in income distribution. This generated an increase in the demand for animal protein such as chicken, pork and beef.

All these production chains, particularly poultry, use soy meal as a food staple. Between 1989 and 1997, per capita Brazilian consumption of eggs increased from 83 to 104 units/inhabit/yr, per capita consumption of chicken increased from 12.4 to 23.0kg/inhab./yr, pork increased from 6.6 to 9.1 kg/inhabit/yr, and beef increased from 24.7 to 29.6 kg/inhabit/yr. In 1997, broiler rearing used 2.871 tons of hull, egg farming accounted for 476 tons, and pig farming consumed 1.529 tons. In the same year, soy meal accounted for 20 percent of animal feed prepared in Brazil (ABIOVE 1997).

These figures indicate the potential for growth in consumption in Brazil. A doubling in the per capita rate of meal consumption would be around 72 kg/inhabit/yr. This doubling would still leave per capita consumption in Brazil well below levels in the United States, which was approximately 25.9 kg of oil and 101 kg of soil meal, in 1998.

From the perspective of world consumption, efforts have been favourable for expanding the production chain in Brazil, particularly in terms of agricultural production. The indicators show that this growth trend should continue in the coming years, Brazil is one of the key countries with the capacity to respond to this stimulus.

Brazilian exports of soy grain and oil were, in 2000, approximately 56 percent for grain and 19 percent for oil. The most significant gain has come in the soy grain market. Nevertheless, the soy complex has also made progress in oil, despite the fact that as a value-added product, it is still heavily protected by high tariffs in important markets such as the United States and Japan.

2.2 INDUSTRIES AND AGRO-INDUSTRIES

Soy grain appears in a diverse range of products. In the agro-industrial segment of the production chain soy can be transformed into meal, crude oil and protein-based foods using different industrial processes. In the first process, grain crushing produces soy meal, which is included as a protein component in feed formula for poultry, pork and fish and then becomes part of other production chains for meat and eggs. In a second process, crude or purified oil is extracted from the grain for industrial purposes or the oil is refined and used for bottled oil for the hydrogenated fats industry or margarine production. In a third process, soy is used in the protein-based food industry.

The industrial processes vary for each one of these industrial products. Crude soy oil and soy meal are produced through a 5-step process: supply, soy preparation, oil extraction through solvent use, oil purification and soy meal preparation. Purified oil, margarines, hydrogenated fat and mayonnaise are produced from crude oil by means of three industrial processing stages: neutralization, whitening and deodorization-deacidification (Souza 1997).

A discussion of the installed capacity of the industry, along with the actual capacity used in processing, as well as its geographical location is essential. For companies, the location of industries is decided based on commercial strategies. Determining factors for this decision-making include the search for increased profits, the final destination of the product (in either the domestic market or for export), access to raw materials and the availability of a transportation infrastructure.

The production of edible vegetable oils occurs through a combination of two industrial sectors, processing or crushing of oil seeds (to obtain crude oil), and refining. Most soy oil is destined for the domestic Brazilian market where demand is driven by the food industry and the retail market.

The capacity for oilseed processing in Brazil expanded in the 1990s from 103,151 tons per day in 1989, to 116,289 tons per day in 1995, and then to 125,560 tons per day in 2000 (Barbosa and Assumpção 2001). However, there were important regional differences. In 1989, 82 percent of the total was concentrated in the traditional region (Rio Grande do Sul, Paraná, Santa Catarina and São Paulo). The frontier region (Goiás, Mato Grosso and Mato Grosso do Sul) accounted for 11 percent. In 2000, the relative participation of the traditional region dropped to 69 percent of the Brazilian total while the Centre-West accounted for 22 percent of fixed

capacity (Mato Grosso accounted for 10,520 tons per day; Goiás 9,760 tons per day and Mato Grosso do Sul 7,530 tons per day).

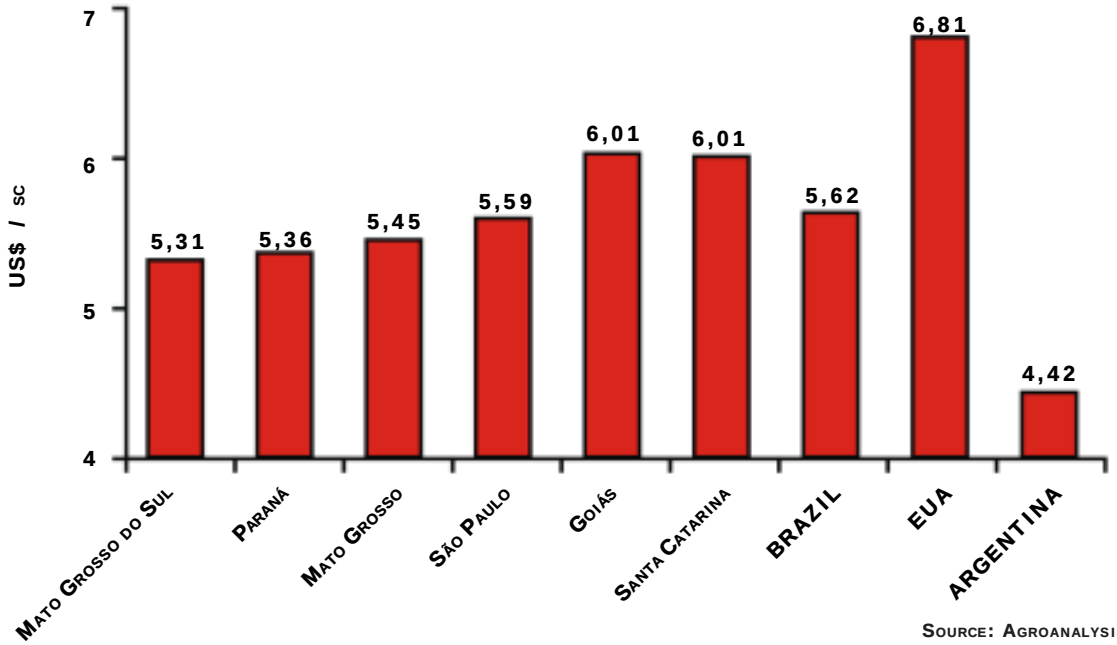
The unused capacity in Brazil's crushing sector, which stood at around 40 percent for oil seed grinding in 1996 and around 43 percent in 2000 (Barbosa and Assunção 2001), is linked to public incentive policies that encourage industrialization and value-added exports, factors which favour the building of large-scale factories (Warken 1999).

Typically, the factories that refine vegetable oil are located close to large urban centres, in contrast to processing industries that tend to be located near to the raw materials. In 2000, Brazil had a vegetable oil refining capacity of 15,252 tons per day. Of this, 5,720 tons per day (38 percent) was located in the State of São Paulo, followed by Paraná (17 percent) and Rio Grande do Sul (13 percent). In the frontier region, the state of Goiás represents the largest installed capacity at 1,420 tons per day, followed by Mato Grosso do Sul with 490 tons per day.

2.3 GRAIN PRODUCTION

There is some agreement among analysts who specialize in the soy complex, that Brazil shows excellent competitiveness indicators as an agricultural producer of soy (Wedekin *et al*. 2002). In comparing production costs among the three large soy producers - Argentina, Brazil and the United States - future prospects for soy production in Brazil can be assessed. Argentina has the lowest operational costs (US$4.42/60kg sack), approximately 35 percent below US costs and 21 percent lower than Brazil's average (Figure 2.3).

FIGURE 2.3 SOY: TOTAL COSTS PER UNIT PRODUCED AMONG PRODUCTION REGIONS, 2002 (US$/60KG SACK)



SOURCE: AGROANALYSIS 2002.

A breakdown of information on production costs according to Brazilian producer states shows that states with the lowest operational costs per unit were Mato Grosso do Sul (US$5.31/60kg sack), Paraná (US$5.36/60kg sack) and Mato Grosso (US$5.45/60kg sack). Slightly higher values are found in Goiás and Santa Catarina, but in all cases, the costs are significantly below the US average.

For the production sector the most important limitations to the future of soy in Brazil lie beyond the control of rural producers and are related to infrastructure (mainly transportation), the Brazilian taxation system and, in particular, to protectionist tendencies among key international competitors.

Table 2.2 indicates that the performance of soy production systems present greater efficiency (calculated as the relation between inputs and outputs) given growth in average production levels—for a cost increase of US$84,45 among the most efficient systems with the lowest costs, there is an income increase of around US$162 per ha. There are also considerable profit margins. Levels of investment in technology appear to guarantee a return of 12 percent, implying an additional profit per ha, of US$9.25 on average. The impact of the increase in productivity on the cost of soy production varies from US$148 to US$125 per ton, when productivity varies from 2000 to 3000 kg/ha, respectively. The adoption of improved technology for soil management can represent a gain of up to US$24 per ton produced, which contributes to the product's competitiveness.

Table 2.2 Cost of Soy Production at Different Productivity Levels in Brazil

DESCRIPTION	Production costs (US$/ha)			
	2000 KG/HA	2500 KG/HA	3000 KG/HA	3000 KG/HA*
1 – Operations (sub-total)	**90.56**	**105.32**	**120.85**	**95.74**
Soil Conservation	2.50	5.00	10.00	10.00
Soil Preparation	15.99	24.10	28.14	3.79
Planting	18.15	18.56	18.97	18.97
Treatment	23.01	23.31	25.96	28.20
Harvesting	30.91	34.35	37.78	34.78
2 – Inputs (sub-total)	**140.61**	**175.66**	**218.68**	**234.54**
Planting Manure	45.73	54.87	64.02	64.02
Agricultural Correctives	15.83	21.10	21.10	21.10
Seeds/cuttings	19.66	20.75	21.85	21.85
Other plant inputs	1.46	1.46	1.46	1.46
Ant control chemicals	6.33	6.33	6.33	6.33
Fungicides	0.00	1.39	1.39	1.39
Herbicides	31.43	53.55	77.55	93.41
Insecticides	12.72	8.76	17.53	17.53
Other agro-chemicals	7.45	7.45	7.45	7.45
3 - ADMINISTRATION (sub-total)	**51.65**	**23.94**	**21.84**	**21.84**
Administrative staff	28.48	10.69	4.28	4.28
Technical Assistance	2.29	0.81	2.85	2.85
Accounting and office work	6.79	1.63	0.77	0.77
Conserv./deprec./benefit. Travel	0.04	0.02	0.02	0.02
Taxes/fees (% revenue)	5.20	0.78	0.35	0.35
	8.85	10.01	13.57	13.57
Post-Harvest (sub-total)	**13.37**	**19.10**	**19.27**	**19.27**
Transport/ storage	4.55	8.47	6.82	6.82
Handling costs	1.10	1.37	1.37	1.37
Pre-cleaning	1.19	1.49	1.78	1.78
Drying	4.08	4.75	5.70	5.70
Off-Unloading	0.61	0.76	0.92	0.92
Warehouse	0.97	1.21	1.45	1.45
Administrative tariffs	0.87	1.05	1.23	1.23
Total Cost (US$/ha)	**296.19**	**324.02**	**380.64**	**371.39**
Total Cost (US$/sack)	**8.89**	**7.78**	**7.61**	**7.43**
Total Cost (US$/ton)	**148.10**	**129.61**	**126.88**	**123.80**
Revenue (US$/ha)	**310**	**388**	**465**	**465**
Margin (%/ha)	**4.46**	**16.49**	**18.14**	**20.13**
Efficiency (Output/Input)	**1.05**	**1.20**	**1.22**	**1.25**

(*) No-tillage.

Source: adapted from Agrianual 2000.

The general data in Table 2.2 suggest that the solid performance of the soy complex in Brazil arises from management of the interaction between the soil and the plants. Nevertheless, it is important to analyze this more comprehensively by considering local performance in soy production systems in frontier regions and by comparing this performance with performance in other production systems located in traditional production regions of Brazil. The comparative advantage of Brazil can also be linked to a longer growing period, which permits the plants to produce more pods and, consequently, more grain. For example, in the United States the growing period varies from 90-95 days while in Brazil it varies from 130-150 days.

Soy in the Cerrado is based on sound technological processes, developed by the EMBRAPA system. Among cost factors (which reflect technology applied) manure and other fertilizers, herbicides and seeds as well as cultivation materials are the most relevant elements contributing to between 47 percent and 63 percent of total costs.

2.4 MATERIAL USE AND PRODUCTION

The cost components highlighted above are illustrated Tables 2.3 and 2.4. The tables compare production costs as a percentage of total costs between Brazil, Argentina and the United States. The weighting of materials in total cost is most marked for Brazilian and US states. In Argentina, expenses associated with fertilizers and inoculating agents are much lower due to the naturally superior fertility of the soil. Expenditure on agricultural pesticides in Argentina is also much lower that it is in Brazil and the United States.

Table 2.3 Soy: Breakdown by production costs among production regions (% of Total cost)

Items	São Paulo	Santa Catarina	Paraná	Goiás	Mato Grosso	Mato Grosso do Sul	Brazil	United States	Argentina
Seeds	7.7	6.1	5.6	9.5	9.1	8.3	7.7	13.0	12.3
Fertilizers. lime and inoculants	26.9	24.5	19.1	29.5	37.4	30.1	27.9	17.3	0
Pesticides	24.0	28.1	31.2	23.8	27.0	33.3	27.9	24.5	13.1
Machinery and vehicle operations	29.0	28.9	26.0	27.5	15.8	15.8	23.8	9.2	38.9
Labour	2.9	2.0	3.0	2.2	0.4	3.0	2.3	14.4	4.7
General expenses	9.5	10.4	15.1	7.5	10.3	9.5	10.4	21.6	31.1

Source: Agronalysis. 2002.

Machinery and vehicle operations are extremely relevant in Argentina, accounting for 39 percent of the operational costs of soy production. In the United States such costs represent approximately 9 percent and in Brazil 24 percent. Soy producers in the United States spend most on seed purchases, machine and equipment depreciation, and land cost (rent). These cost components are relatively low in Brazil. Table 2.4 indicates that the US soy producer has

cost variables that are, on average, lower than those in Brazil and Argentina. However, fixed costs in Brazil (including in the frontier states such as Mato Grosso) are substantially lower than those of its international competitors.

Table 2.4 Soy: A comparison of production costs among production countries (US$)

Items	USA	Brazil [1]		Argentina
	Centre-West	Paraná	Mato Grosso	Pampa
	2000/01	2001/02	2001/02	Unida1998/99
Variable costs (sub-total)	**187.45**	**189.10**	**224.70**	**238.34**
Seeds	45.30	14.01	11.21	*
Fertilizers	20.57	39.50	82.28	*
Agro -chemicals	55.89	60.67	67.15	*
Mechanized and repair operations	57.20	46.46	38.12	*
Interests on capital	5.15	9.80	12.60	*
Hired labour	3.34	15.37	9.33	*
Miscellaneous	0	3.29	4.01	*
Fixed Costs (sub-total)	**404.93**	**108.67**	**87.29**	**253.64**
Machine and equipment depreciation	126.14	34.85	40.97	47.33
Land cost (rent)	224.38	29.93	7.08	155.25
Taxes and insurances	17.43	7.80	8.74	*
Administrative expenses	36.98	36.09	30.50	51.16
Total production costs	**592.38**	**297.77**	**311.99**	**491.98**
Productivity (sacks/ha)	**50.50**	**45.00**	**50.00**	**56.80**
Variable cost per sack	**3.71**	**4.20**	**4.49**	**4.20**
Fixed cost per sack	**8.02**	**2.41**	**1.75**	**4.46**
Total cost per sack	**11.73**	**6.62**	**6.24**	**8.66**

[1] Data on Brazil were obtained from CONAB. Data from May 2001. When the exchange rate was R$2.36/US$.
* data not supplied.

Source: Agroanalysis 2002.

It is evident that the use of agro-chemicals, such as fertilizers and pesticides are an important factor explaining the major cost variations in the soy sector. A comparison between production systems with lower efficiency indexes and those with higher indexes as shown in Table 2.2, indicates a difference of US$62 per ha due to investment in herbicides and a difference of US$18 per ha for investments in fertilizers. These materials are important not only in terms of their economic costs but also for their environmental impacts.

Variations among the other cost components in soy production in Brazil are less pronounced, with the exception of costs for soil preparation in the no-tillage system as well as in other systems. In no-tillage systems, lower soil preparation costs correspond with a substantial increase in herbicide costs. Yet, this increase is offset by increases in productivity and efficiency gains.

In order to evaluate the importance of demand from soy producers for materials, some information on the States of Mato Grosso, Rondônia, Tocantins and Maranhão is available. The quantities and values of materials used in cultivation in frontier zones, especially in Mato Grosso but in Rondônia, Tocantins and Maranhão as well, are extraordinary. From the estimated value of US$417 million invested by these states in the main materials for soy cultivation in 1999, Mato Grosso accounts for US$385 million (Castro *et al*. 2001). This performance occurred despite logistical difficulties associated with infrastructure and transportation (BNDES 2000).

In the State of Mato Grosso the structure for material marketing is made up of warehouses for manufacturers of agricultural products, manure and pesticides as well as resellers and agents. In the other frontier states the structure is, for the most part, supported by resellers and agents. Price differences in materials among regions in Brazil are related to manure, lime, pesticides, machinery and equipment and they range from between 20 and 40 percent with differences among sectors.

Foreign capital input was hardly significant in Brazilian agricultural production overall in 2001 (Table 2.5). However, the infusion of international capital was significant through these companies' suppliers. In 2000, foreign companies accounted for up to 95 percent of the agro-chemical market and 60 percent of the fertilizer market.

TABLE 2.5 DIRECT EXTERNAL INVESTMENTS IN BRAZIL: DISTRIBUTION BY ECONOMIC ACTIVITY, 2001 (%)

SECTORS	2001
AGRICULTURE. LIVESTOCK AND MINERAL EXTRACTION	**5**
INDUSTRY	**29**
FOOD AND BEVERAGE	2
AUTOMOBILES AND SHIPPING	8
ELECTRICAL MATERIAL	1
MECHANICS	2
NON-METALLIC MINERALS	1
CHEMICALS AND PHARMACEUTICS	8
OTHER INDUSTRIES	7
SERVICES	***66***
FINANCIAL MEDIATION ("MIDDLE-MAN" SERVICES)	15
TRADE	6
COMMUNICATION	19
INFORMATION TECHNOLOGY AND LINK-UP ACTIVITIES	4
PUBLIC UTILITY – ELECTRICITY AND GAS	9
INSURANCE AND PRIVATE RETIREMENT FUNDS	5
OTHER SERVICES	8

SOURCE: BNDES 2000.

One sector that reflects the trends among multinational agricultural supply companies is the seed sector. Since 1994, changes in the seed industry, which started in the 1980s, have become more pronounced. These changes began as a result of mergers and acquisitions by large agro-chemical and biotechnology companies. Convergence of interests increased the potential impact of biotechnologies on production. Agricultural biotechnology firms dealing in seeds and agro-chemicals are in the process of undergoing a number of mergers and acquisitions, based on the recognition that these technologies are complementary. The biotechnology sector is becoming a critical component in the evolution and execution of strategies from "life science" companies establishing relations with this downstream industry in order to add value to food industry markets (Wilkinson and Castelli 2000).

During the merger and acquisition process, the seed industry has been characterized by structural changes. As a result, some mega-firms have emerged which combine expertise in the field of biotechnology, agro-chemicals and seeds, and which are vying for ground in the area of plant genomes. The restructuring of the seed industry at the end of the 1990s has resulted in Monsanto (United States) acquiring 29 seed companies (four from Brazil), DuPont (United States) acquiring five (including one from Brazil), Novartis (Switzerland) acquiring 16, Aventis (Germany/France) acquiring nine (including four from Brazil), Dow AgroScience (United States) acquiring 13 (including five from Brazil), Sakata Seed Crop (Japan) and Savia S.A. (Mexico) acquiring 31 seed companies (including three from Brazil).

At least 22 Brazilian firms have been purchased by foreign multinationals (Wilkinson and Castelli 2000).[1]

2.5 AGRO-INDUSTRY RESEARCH

The soy complex benefits from more research than many other sectors in Brazil. The expansion of soy production into tropical regions is due mainly to work in agricultural research, particularly that of EMBRAPA and various universities. The development of cultivars and specific management practices for the Cerrado made progress in soy production possible in the States of Mato Grosso, Rondônia, Tocantins and Maranhão (Agroanalysis 1998).

[1] These changes are most evident in the case of corn. Until 1997, the number of companies was more diversified. The four large ones (Agroceres, Cargill, Pioneer and Novartis) held 77 percent of the seed market. In 1999, an increase in concentration and changes in relative positions were observed. The four largest companies, all of them transnationals, held 90 percent of the corn-seed market. Monsanto, through its branch. Monsoy, has taken over Agroceres, Cargil, and Braskalb shares and at present holds absolute control with 60 percent of the market. Pioneer is the second largest company and DuPont controls it, with 14 percent, followed by Novartis with 11 percent and Dow (which bought Dinamillho Carol) with 5 percent. The rest of the market is divided among Zeneca (3 percent), Agr-Evo (2 percent) and Unimilho — the only national company — which brings together 17 hybrid production companies in partnership with EMBRAPA and holds 5 percent of the market.

State research companies carry out the development of soy-related technologies in various research centres at national and regional levels. Taken together, they make up a considerable research network through partnership projects for research and development (R&D). Some with particular influence in the 1980s and 1990s include EMBRAPA Soy (in Londrina,PR), EMBRAPA Cerrados (in Planaltina, DF), EMBRAPA West Cattle-Rearing (in Dourados, MT), EMBRAPA East Amazonia (in Belém, PA), and the Research and Technical Assistance Company for Mato Grosso and Mato Grosso do Sul. In addition, some companies or groups of companies have participated directly in the R&D process (particularly in the development of cultivars in Mato Grosso, Rondônia and Pará) or by financing projects in the public research network through foundations. Some examples include the Cerrado Foundation (DF), Fapsem Foundation (Balsas), Mato Grosso Foundation (Mato Grosso), Bahia Foundation (Barreiras) and Support Foundation for Livestock Rearing Research for the Triangle and Alto Paraíba (Goiania) (Agroanalysis 1998).

This situation could reflect the position of business groups in the production chain that stressed the need to make more resources available in order to apply to new technologies, including private investment funds, using resources from producers to revolutionize the process of production gains and cost reduction.

A solid technological base has therefore been developed for soy production in the Cerrado. This base not only made soy production viable in this agro-system but it also made it competitive by virtue of the high levels of efficiency achieved. This technological base is founded on over 80 cultivars developed over 20 years of research with biological control and management systems adapted to different cultivation scenarios, which are followed closely by the producers.

Finally, agricultural research has played an important role in achieving and maintaining competitiveness in the soy production chain. It is critical for producers to maintain competitive gains given that competitor countries continue to improve their production processes and structures, or subsidize their producers. Multiple challenges are emerging. In the older production areas overcoming these challenges will involve pursuing policies to maintain competitiveness by improving production system management at lower costs. It is possible that new techniques, such as precision agriculture, will be developed, and possibly the even more controversial approach using transgenics in the development of cultivars.

Producers and specialists from public and private agencies have highlighted some limiting factors affecting competitiveness in the soy production chain. In the expansion area, the problem with new cultivars is linked to the production cycle being adapted to local climatic conditions. The issue of mineral nutrition for soy is relevant since as a general rule, soils in the frontier region are characterized by low levels of potassium and phosphorous, high levels of aluminium and iron, high acidity, and heightened fragility when submitted to stressful situations. This means that they require both lime and manure, and soil and water conservation techniques

for effective production. Given that expenses associated with fertilizers and pesticides in these areas are among the highest in comparison with other cost components, competitiveness in the production chain stands to benefit from technologies that reduce these items in terms of overall soy costs. Argentinean soy, a direct competitor of Brazilian soy, costs only around US$2 per ton for fertilizers and pesticides, while expenditures in Brazil is estimated at around US$ 39 per ton (Silva 1994).

2.6 TRANSPORTATION

There is a trend in Brazil to concentrate soy transport along roadways (67 percent of the total). US soy is typically transported on waterways (61 percent). Rail transport accounts for 23 percent and 28 percent of soy transportation in Brazil and United States, respectively. The Brazilian disadvantage lies in the fact that transporting large volumes over great distances is cheaper by river than by road, which gives the US production chain a competitive advantage over Brazilian soy. A study conducted in 1993 by the Instituto de Pesquisa Econômica Aplicada (Institute for Applied Economic Research - IPEA) estimated costs in both countries to travel 1,500 kilometres at approximately US$7/t in the United States and US$30/t in Brazil (Silva 1994).

In the Brazilian frontier region the average cost can be even higher. Prices paid at the Paranaguá Port and in Mato Grosso for one ton of soy indicate a movement cost of more than R$70/t (Table 2.6). Included in this difference are all the costs and duties for short and long distance transport as well as costs for drying and storing the raw material.

TABLE 2.6 SOY TRANSPORTATION COSTS IN SELECTED REGIONS IN BRAZIL (R$)

ORIGIN	DESTINATION	KM	R$/T	R$/T/KM
ALTO GARÇAS (MT)	PARANAGUÁ (PR)	1499	57.5	0.0384
A. CHATEAUBRIAND (PR)	PARANAGUÁ (PR)	628	23	0.0366
BOA ESPERANÇA (MT)	PARANAGUÁ (PR)	1862	78	0.0412
CAMPOS NOVOS DOS PARECIS (MT)	PARANAGUÁ (PR)	2100	75.5	0.0360
CÂNDIDO MOTA (SP)	SANTOS (SP)	480	23.1	0.0481

SOURCE: *HTTP://SIFRECA.ESALQ.USP.BR*, SISTEMA DE INFORMAÇÃO DE FRETES PARA CARGAS AGRÍCOLAS (FREIGHT INFORMATION SYSTEM FOR AGRICULTURAL CARGO).

In Mato Grosso, soy production is transported mainly along highways to the ports of Paranaguá and São Luiz, with a small amount destined for the Porto de Itacoatiara. There is evidence of reduced profitability of Brazilian soy due to costs associated with inadequate infrastructure, particularly transportation as shown in Table 2.7. For example, the cost of transportation from Campos Novos dos Parecis (Mato Grosso) to the Paranaguá Port (Paraná) is R$75.50/t, or around 30 percent of soy's historical "free on board" (FOB) prices—that is, the price of soy when all costs (such as purchase, handling, taxes and fees) have been paid and it is loaded on

the boat for export. Transportation and port infrastructure are essential to make future expansion opportunities possible for soy production in Brazil.

TABLE 2.7 SOY GRAIN EXPORT COSTS PER PRODUCTION COUNTRY (US$)

DESCRIPTION	BRAZIL	USA	ARGENTINA
FOB COLLECTION AT PORT	250.00	250.00	250.00
FREIGHTAGE TO PORTS	33.00	15.00	17.00
PORT EXPENSES	8.00	3.00	3.00
EXPORT TARIFF	0.00	0.00	8.00
NET INCOME	209.00	232.00	222.00
INCOME/PRICE	84%	93%	89%

SOURCE: SOUZA 1997.

2.7 TAXES

The first finding in relation to the issue of taxes on components in the soy production chain in Brazil is that there is dissatisfaction among the actors involved regarding existing domestic policy and protectionism in developed countries. This exists in juxtaposition to the current discourse that promotes trade liberalization while it breaks down added value and job generation in the country (Agroanalysis 1998).

In establishing a 12 percent ICMS tariff on soy movement among states, even when the raw material will be processed by Brazilian industries to be exported as oil or meal, incentives to export soy in its raw state are created, while Brazilian processing industries are discouraged. The closing of soy crushing factories is linked to the combined impact of these factors. It is estimated that about R$200m in ICMS will be charged on soy sent by other producer states for processing in industries in Paraná and São Paulo (Agroanalysis 1998). Moreover, the recent tax exemption on agricultural exports has only aggravated this situation because in practice exemptions on soy grain exports are observed while those on products from the soy crushing industry are not observed.

Another challenge facing the soy complex is the existence of tariff barriers in consumer countries to protect their domestic processing industries. This protectionism affects the Brazilian production chain since it makes it more attractive to export raw soy grain than processed oil (where tariffs are higher in many countries).

3. EFFECTS OF FISCAL AND INTERNATIONAL TRADE POLICY ON SOY EXPANSION

This section addresses the fiscal regime and the trade policy context affecting the Brazilian soy sector, and their implications for its sustainability. First, it reviews the main taxes applied at various stages of the soy production chain and discusses the economic, social and

environmental effects that could stem from proposed changes in the taxation regime. Second, it describes the different trade negotiation processes that Brazil is engaged in and presents the position of the Brazilian government. The outcome of these negotiations is likely to shape the future market for soy. A methodological framework is developed to assess the sustainability impacts associated with important trade policies/processes and it is applied to the Brazilian soy sector. Base on this preliminary analysis, and further discussions on environmental and social impacts, recommendations for enhancing the contribution to sustainability of fiscal and trade policies are presented.

3.1 TAXATION POLICIES AND THE SOY SECTOR

Fiscal regimes in general and the tax structure in particular are key public policy instruments that can be employed to pursue sustainable development. Levels of taxation change relative prices within and across sectors of the economy affecting the allocation of productive resources and investment decisions. This can have profound implications on the use of natural resources, employment opportunities, and the competitiveness of different economic sectors.

The sustainability of a fiscal regime has to be assessed not just in terms of balanced public accounts and fiscal equilibrium, but also taking into account the distributive impact of taxes, their impact on employment (social dimension), effects on competitiveness and the scale of the economic activity (economic dimension), and the impacts on the use of natural resources and biodiversity (environmental dimension).

Until the mid-1980s the Brazilian government pursued a policy aimed at expanding the scale of agricultural production, and particularly soybeans, in the Centre-West region of the country. A number of agricultural development programs, research initiatives, fiscal incentives and subsidies were directed to that purpose. The use of this combination of public policy instruments enjoyed significant success in encouraging the occupation of vast areas of the Cerrado.

As a result of the financial crisis of the late 1980s, support for the agricultural sector was slowly phased out and a shift occurred in fiscal policy directed at soy - the sector moved from being a net recipient of public funds to become a net taxpayer. Some argue that as a result of the tax burden imposed on the soy sector (and other export-oriented sectors) it was losing competitiveness, especially vis-à-vis foreign markets. This was particularly acute with respect to processed soy products (soy meal and oil), which received a higher tax burden than soy grain, creating distortions in the soy sector and making the production of soy grain more attractive than production of its processed derivatives. The Kandir Law, passed in 1996, sought to ease the tax burden on agricultural and manufactured products for export, by effectively removing export taxes for soy, although soy production for the domestic market is still taxed. Nevertheless, the overall tax burden on the soy complex continues to be significant

and most importantly continues to produce distorting impacts, effectively penalizing the processing of soy. These distortions caused by the tax system have significant implications for sustainability.

3.1.1 THE TAX STRUCTURE IN THE SOY SECTOR

The tax burden imposed on the soy sector amounts to around 10 percent and is distributed among various taxes. Among these, the ICMS stands out. It is a tariff that is governed by federal legislation and applied at the state level. The ICMS is a value-added tax so that each stage in the processing of raw materials and marketing of the final product is taxed based on the prior production stage. It is the most significant tariff imposed to the agriculture sector for its ample base of application, the system of minimum guidelines (minimum valuation for ends of calculation of taxes) and other collecting methods.

In addition to the ICMS, there are other taxes on the soy complex including the PIS[2] and the COFINS.[3] These taxes disproportionately burden the soy crushing industry and impact competitiveness. Given the distortion caused by these taxes, the government decided to grant partial reimbursement on values paid in both cases in industrial production for export. There is still a 2 percent tax charged on grain trade, the FUNRURAL (Rural Social Security Tax). This tax is charged to the producer through a discount on the sale price and it is neutral in terms of the final destination of the grain. Another important tax is the CPMF, which is charged on all financial transactions.[4] In spite of the government's intention to extend exemptions to all exports, there is no reimbursement program for these taxes. The CPMF has a cascading effect - it is charged on all payments and financial operations along all the links in the soy production chain. Given the overall effect of the existing taxation system that discourages industrial processing, there is excess soy grain available for export while processing industries face difficulties exporting meal and oil.

In addition to general taxes, two Centre-West states charge taxes related to the transportation of soy. These taxes, the FUNDERSUL (Development Fund for the Mato Grosso do Sul Roadway System) and FETHAB (Transport and Housing Fund for the State of Mato Grosso), are relatively neutral in that they do not differentiate based on the final destination of the grain (for export or for domestic processing).

[2] PIS - Social Integration Program - charges the industries 'gross revenues at a 0.65 percent rate for the workers' social programs.

[3] COFINS - Contribution for Social Funds - charges gross revenues at a 3 percent rate and it is applied for social welfare such as health and social assistance in general.

[4] CPMF - Temporary Contribution on Financial Transactions - a 0.38 percent charge on all financial operations was created to generate resources for the health sector and today is one of the major tax sources for the Government.

3.1.2 RECENT CHANGES IN THE ICMS

Among the taxes applied to the soy sector, the ICMS imposes the heaviest burden. The Kandir Law (Additional Law. nº 87. dated 13/09/96) effectively exempted agricultural and manufactured products for export from duties. According to the law, the ICMS no longer applies to exports of soy. However, the tariff continues to be imposed on transactions in the domestic market through the so-called "interstate tax on soy". The Kandir Law is consistent with global trends exempting exports from duty.

Despite the Kandir Law, the state of Goiás still charges a 12 percent ICMS on exports of soy, alleging that part of the soy destined for export markets will, in fact, end up in the domestic market. This has prompted other states to try to reintroduce the ICMS on soy exports, a measure that is widely opposed by soy producers.

A conflict is emerging in the Centre-West region of Brazil, between state governments and soy producers and processors. State governments, already under significant pressure to keep public accounts in balance, would like to reintroduce the duty or, alternatively, obtain new federal transfers to offset the loss in revenue from the phase-out of the application of the ICMS to exports. Organized agricultural interests are resisting any backward movement that reverses the reduced tax burden on primary and semi-processed products for export. Represented by the National Agricultural Confederation (Confederação Nacional da Agricultura - CNA) and other organizations, soy producers argue that the reintroduction of taxation on primary products would not only jeopardize rural producers but would put the country at a disadvantage, since it would lose competitiveness in international markets. This conflict is unresolved and the Kandir Law remains in force. Given the political weight of soy producers and exporters, it is unlikely that states will re-introduce the duty in the short term.

Beyond the political interests, it is important to consider the impacts of the removal of the export duty and what the effects might be of reintroducing it. Available estimates indicate that the Kandir Law has meant that soy producers throughout Brazil have not paid around US$1.39 billion per year in ICMS on exports (CNA 2000). This helps make Brazilian produces more competitive in foreign markets.

In light of this, reintroducing the tax would result in a drop in revenue for soy producers and exporters and an increase in revenue for state governments. Other factors being equal, this would negatively affect the competitiveness of soy exporters in international markets and might reduce the amount of soy exported. In re-distributional and social terms, the effect of re-introducing the export duty depends on two factors: the number of jobs that stand to be lost as a result of the burden on the soy sector, and how the revenue obtained from taxing soy

exports is used (and in particular whether it benefits poor rural communities). Lack of data makes it difficult to assess whether the overall effect would be positive or negative.

In environmental terms reintroducing the export duty would bring about a significant reduction in the area under soy cultivation in the Cerrado (the region most affected by high transportation costs). This could reduce the pressure to expand soy plantations into new areas. However, producers may adopt cost-reducing technologies to offset losses in income from taxation. This would neutralize the effect of the tax. In fact, it is possible that production would increase in the Cerrado from its current level of 51 sacks/ha up to 70 sacks/ha. A new generation of technologies that is increasingly available relies on 'precision cultivation'. In the short term, however, given the possibility of the re-introduction of ICMS on exported grain, soy exports will most likely constrict, putting pressure on prices and production.

3.1.3 THE TRADE AND ECONOMIC IMPACTS OF THE CURRENT FISCAL SYSTEM ON THE SOY SECTOR

In order to examine the relationship between the fiscal regime and the sustainability of the soy sector, it is useful to first map out the main economic and trade impacts of the current tax regime. These economic and trade impacts have been most significant in five areas:

- The destination of soy production (domestic versus export markets);
- Investment in processing capacity;
- Competitiveness;
- Geographical location of industrial activities; and,
- Scale (i.e., total production).

Fiscal policy directed towards the soy sector in Brazil has had an influence on patterns of development and specialization. Available research indicates that the tax structure affecting the soy sector favours the production of grain for export and discourages the processing products (meal and oil) by reducing the profit margins in the crushing industry (Rabobank 2000). There is evidence that the tax burden has led to the closure of processing plants in Brazil.

The tax structure has also discouraged investment in the processing sector in Brazil. The federal and state taxation systems have created an adverse climate for investments in the vegetable oil industry in the Cerrado and in other parts of Brazil. By comparison, in Argentina where no taxes are applied, processing capacity has doubled and plants employ state-of-the-art technology for soy grain crushing. Plants in Argentina crush between 5 and 12 thousand tons of soy per day while Brazilian factories crush between 1.5 and 3 thousand tons per day.

The fiscal regime has had an effect on the overall competitiveness of the soy sector. The direct tax burden on the soy sector exceeds 10 percent and this does not take into account the cascading effect of taxes. By taking as a base the average production costs estimated by CONAB for 2000-2002, the joint cost incurred from ICMS and other taxes on total soy production cost was 8.9 percent in Mato Grosso. 8.5 percent in Goiás and 8.8 percent in Mato Grosso do Sul. Added to these there is the 2 percent Rural Social Security Tax (FUNRURAL) on the final product. This last tax is imposed on the value of the marketed product and the purchaser or the consignee is responsible for it. The tax burden increased recently due to a rise in the COFINS from 2 percent to 3 percent and in the CPMF from 0.28 percent to 0.38 percent. The industrial processing sector has not benefited from ICMS credits that accumulate, thus leading to the stagnating of rotating capital in reduced net assets (LMC 2001). This reduces profit margins in the industry, which according to some estimates, are not large enough to allow processors to compete successfully in international markets (Rabobank 2000).

Moreover, the tax burden on the soy sector has not been evenly spread across the country as there is no harmonized fiscal system that applies to all Brazilian states. Mato Grosso's FETHAB and Mato Grosso do Sul's FUNDERSUL charge a duty on the tonnage value of soy transported. In these states, taxation occurs on internal movements of raw materials to industries. Mato Grosso has the Program for Fomenting Industrial Development (Prodei), which grants tax incentives through the deferral or financing of ICMS up to a value of 75 percent of the tax owed for payment in the long term. This system has been used by many states as a "tax incentive" in other sectors of their economic activities. As the ICMS is deferred or financed, conditions are disadvantageous since the burden remains. This is why the program did not succeed in attracting industry to the state. The state of Goiás has been making demands so as to fit the Kandir Law into its soy sale operations. For example, the purchaser/exporter has to adhere to what is called a "special regime" by which they are obliged to dedicate 50 percent of the volume acquired to taxable operations, even when the company only conducts export operations. This partial charging on exports has been identified as a limiting factor in the growth of soy production in the state. As a result, the tax regime may influence the spatial distribution of industrial activities associated with the soy sector in the future. In particular, there is a chance that the tax structure will influence the location of processing plants as the industry searches for "tax havens". Should the current situation persist, it is likely that vegetable oil industries may be set up in the large producer states (such as Mato Grosso and Mato Grosso do Sul), which do not yet have large-scale industrial facilities. This could encourage a shift away from soy produced for export markets towards soy used for further processing.

Finally, the effects of the fiscal regime on the scale of production need to be considered. All other factors being equal, existing estimates of the impact of removing the ICMS, PIS, COFINS and FUNRURAL indicate that soy supply could increase by 11.6 million tons. In other words, Brazil could move from its current production level of 37 million tons to almost 50 million tons,

and a greater proportion of its production would be transformed into soy meal and oil for exports.

3.1.4 FISCAL POLICY AND SUSTAINABILITY IN THE SOY SECTOR

This section discusses the effects of the current fiscal regime on the sustainability of the soy sector, in terms of economic, social and environmental impacts.

In economic terms, these taxes tend to reduce profits and competitiveness. In an international context, where major soy producers like the United States are subsidizing the production of soybeans, even small taxes may put Brazilian producers at a greater competitive disadvantage. In other words, the economic impacts of taxation cannot be isolated from conditions prevailing in other international markets, especially in major producing countries (Argentina and the United States), and consumer markets in the European Union. Existing US subsidies in the soy sector and protectionist measures in the EU towards processed soy products have depressed soybean prices making it more difficult for Brazilian producers to compete in a global market.

In this context, one could argue that a tax burden of 10 percent on the soy sector is not excessive, given that it is very capital intensive, rather than labour intensive, and that it generates important environmental impacts. A major factor is the effect of the current fiscal system in discouraging processing of soybeans, which has economic impacts and also generates negative social and environmental impacts.

In terms of the social impact, key issues include employment and the impact of the tax system on the redistribution of income. The potential of the soy sector to generate employment is greatly reduced as a result of the disincentive toward further industrialization in the sector. The current tax regime encourages the export of unprocessed soybeans, as opposed to adding greater value to processed soybeans. Given that soy plantations are not labour intensive, the processing of soybeans would create employment in urban areas where processing plants are located. Issues of employment and income distribution could usefully be elaborated in future studies on sustainability in this sector.

Finally, the environmental impacts of the tax regime need to be considered. Typically, there are three types of impacts: 1) those stemming from the scale of production; 2) impacts associated with related sectors; and 3) impacts related to changes in technologies.

The expansion of planted area could occur on degraded land and/or land which is not valuable in terms of biodiversity and environmental services. However, there is no guarantee that this would occur. On the contrary, it is more likely that a substantial part of the expansion would be met through occupation in the agricultural frontier, converting valuable habitats and forests

into soybean plantations. The conversion of forests and other habitats is most likely to take place in transition areas between the Cerrado and the Amazon in what is known as the “arc of deforestation”. Without appropriate land use policies and effective implementation of existing legislation, the environmental impacts of production increases encouraged by fiscal incentives (such as tax relief) could be significant.

3.2 INTERNATIONAL TRADE AND SUSTAINABILITY IN THE SOY SECTOR

One of the most important environmental challenges facing the international trading system is the development of sustainable systems of trade for commodities such as soybeans. At the global level, the projected increase in demand for crops in oilseeds in the coming decades will require a significant expansion of planted agricultural area, despite increases in productivity. Expansion of the agricultural frontier, if not properly managed, will result in environmental damage such as deforestation, destruction of critical habitats and loss of biodiversity, some of which might prove to be irreversible. Some estimates indicate that over the next 25 years, 250-300 million ha of tropical forest are likely to be converted into agricultural land. Unless effective policies are adopted, part of this conversion is likely to take place in Brazil, the country with the largest remaining tropical forests in the world.

Although increasing demand for soy at the domestic level in Brazil is an important factor driving increased agricultural production, international demand and trade are likely to be more relevant. This is particularly true if the ongoing negotiations at the WTO and in other regional and bilateral fora, including the FTAA and the EU-Mercosur negotiations succeed in reducing tariffs, non-tariff barriers, and domestic support for agriculture, thereby increasing market access opportunities for Brazilian exporters of soy.

3.2.1 MARKET ACCESS AND SUSTAINABILITY OF THE SOY COMPLEX IN BRAZIL

From an environmental perspective the major concerns associated with the expansion of the agricultural frontier are the protection of critical ecosystems, including forest ecosystems, the preservation of wildlife habitat and the protection of biodiversity. These are not in themselves production factors and so measures to protect them can, in principle, be taken without distorting markets.

Increased market access will present new production and trade opportunities for the soy sector and it is likely to generate economic benefits and trade surpluses thus contributing positively to the Brazilian economy. A key question is how to manage a potential surge in soy production while minimizing negative environmental and social effects. An alternative would be to ensure, through agro-ecological zoning, the establishment of new soy plantations on environmentally low-valued land that is suitable for farming.

In Brazil there are large tracts of degraded land that could be used to plant soybeans. If soy production occurs in these areas, there are likely to be both economic benefits (incorporating land to production) and environmental gains (reducing the pressure to expand the agricultural frontier). If, however, increased production comes at the expense of virgin, ecologically sensitive land the environmental impacts will be very high and often irreversible.

The level of market access negotiated for Brazilian soybean exports is not going to determine where (in degraded land or in valuable habitats) or how (using clean or polluting technologies) soy is produced. There are other policy instruments available to spatially manage the expansion of soy production and to reduce on-farm environmental impacts. However, greater market access and increased production without an appropriate and enforceable policy framework to govern the expansion of soy production away from critical habitats will inevitably bring about environmental damage. The combination of greater market access and a lack of policies to manage the expansion of soy production will result in the worst-case scenario for sustainability in the soy sector. On the other hand, greater market access accompanied by effective and enforceable policies to manage expanded production can contribute to a scenario where economic, environmental and social benefits reinforce each other.

3.2.2. BRAZIL'S NEGOTIATON POSITION IN INTERNATIONAL FORA

Agriculture has always been a priority in Brazil's trade policy agenda and the government is committed to obtaining greater market access for its agricultural products. This requires that Brazil's trading partners reduce import tariffs and quotas, phase out domestic support measures and dismantle non-tariff measures that hamper the export of agricultural products. These issues are very important for the soy sector.

In terms of market access, priority is given to a number of specific product groups. The first group of products includes sugar and alcohol, orange juice and tobacco. The second includes meats (bovine, swine and chicken). Soy is situated in the third group of products together with cellulose (wood pulp), fruits, coffee and cocoa and leathers. Products in the soy complex are given high priority in terms of market access, not least because they are still subject to quotas, tariff peaks, and tariff escalation (for soy meal and oil).

Increased domestic support in the soy sector in various countries affects Brazilian exports. The reduction and eventual removal of subsidies is a priority for Brazilian trade negotiators (where there is greater consensus among the Cairns Group - of which Brazil is a member - and the WTO) and then moving to domestic subsidies. Although domestic support measures are more difficult to negotiate, their importance has increased due to their depressing effects on international prices and subsidies are now considered as important for Brazilian negotiators as tariff reductions.

3.2.3. BRAZIL AND THE UNITED STATES ON FTAA ISSUES

Discussions between the United States and Brazil are critical for Brazilian negotiators. The main issue at stake for Brazil is market access and the reduction of US subsidies in the soy sector.

Despite decisions reached on subsidy reduction at the WTO Doha Ministerial Conference, the US Administration approved a package of subsidies for the agricultural sector, the 2002 Farm Act that will provide for an additional $82.8 billion over ten years in addition to expenditure already committed previously (which granted subsidies of US$107.6 billion for the period 2002-2011). The total expenditure for 2002 will, therefore, stand at US$190 billion and includes subsidies to the soy sector. The sector had already received a record sum of US$2.86 billion in 2000, which in value terms is equivalent to two-thirds of the total value of Brazilian soy exports in the same period.

Another problem faced by the Brazilian soy agro-business (especially the oil sector) is that of export subsidies. If the United States were to remove its export subsidies, mainly those under the Export Enhancement Program (EEP), it would substantially improve Brazilian soy competitiveness in the region as well as in markets in developing countries.

The Brazilian government's position in the context of the FTAA is to exclude soy from the group of products subject to tariff escalation. While the United States imposes a zero-tariff for soy grain imports, an *ad valorem* tariff of 19.1 percent exists for soy oil. There is also a specific tariff of US$4.5 /t for soy meal. The practice of tariff escalation in the United States and other countries has affected Brazilian soy meal and oil exports.

3.2.4. MERCOSUR- EUROPEAN UNION NEGOTIATIONS

Negotiations for an inter-regional agreement between Mercosur and the EU have been proceeding steadily since 1999. They include political and economic cooperation, as well as trade liberalization. Negotiations have now entered their final stage. An ambitious work plan for the negotiations was put forward at a Ministerial Conference in Rio de Janeiro, in July 2002, where it was agreed that a final text would be negotiated by 2003.

In terms of the trade negotiations, the EU has presented a list of sensitive products. Brazil complained of tariff escalation with respect to the soy complex. Crude soy oil and refined soy oil are subject to import tariffs of 5.2 percent and 7.8 percent, respectively.

The EU has tabled an initial proposal regarding the pace of linear tariff relief over a four-year period for crude and refined soy oil. Private sector agri-businesses in Mercosur (ABIOVE in Brazil and CIARA in Argentina) presented a counter-proposal representing the interests of the

soy-processing sector. It proposes that both products be included in Category A (products that will receive immediate tariff reduction) rather than in Category B (products that will receive linear tariff reduction over a four-year period, as proposed by the EU). The ABIOVE-CIARA counter-proposal suggested the imposition of "level playing field" (a "zero for zero" policy) for tariffs on all oilseed complexes. The proposal offered immediate tariff removal for crude and refined soy oils in Mercosur, which are subject to a Mercosur Common External Tariff of 10 percent and 12 percent, respectively. In exchange, the proposal asked for immediate tariff relief on soy oil exported to the EU. CIARA further proposed the removal of subsidies on exports and on oilseed production in the European Union (CIARA 2001).

Another aspect of the negotiations, which is relevant to the soy sector, is the debate on GMOs. It is widely known that EU consumers are reluctant to consume genetically modified (GM) products. This consumer preference leads to a high European demand for soy produced through non-transgenic varieties. This is especially true after the bovine spongiform encephalopathy (BSE / "Mad cow") crisis in Europe, when vegetable proteins (mainly soy) became a substitute for animal protein in animal feed production.

One of the central issues to the genetically modified organisms (GMO) debate is that of labelling and tracing of GM content through the production chain. The origin of imported products, production site, the so-called "production procedures ", and how they are industrially processed and packaged are essential for its effectiveness. The preference for GM-free soy guarantees a relative preference for soy produced in the Cerrado, where there is an effort to maintain soy as GM-free.

In terms of labelling, the main issue is that soy is used mainly to produce other products such as livestock (through animal feed), margarine, and cosmetics (through soy oil). Most of the soy reaches the final consumer as a component in other products. Labelling GM-free soy, therefore, requires control over soy products and sub-products, as well as over other products where soy is an input (such as poultry and pork fed on soy meal).

The EU's preference for GM-free and labelled soy has implications for the soy complex in Brazil. If the EU position becomes generalized (Japan and China have similar positions), it might be possible that a strong preference for Brazilian soy will be maintained, which in turn may lead to an enormous environmental impact if a surge in demand results in expansion of the agricultural frontier into environmentally sensitive areas.

The European Commission estimates that 2.3 million extra tons of soybeans will need to be imported into Europe every year to provide protein for livestock (substituting for bone-and-meat animal feed) (EC 2001). An area of 0.9 million ha is required to produce such quantity of soybeans, which is the equivalent of four times the area of Luxembourg. Whether that production happens in environmentally sensitive areas or not is an issue of concern.

3.3 SPECIALIZATION STANDARDS IN THE SOY PRODUCTION SECTOR

The Brazilian soy sector is specializing in the production of soy grains as opposed to the processing of soy into meal and oil. Such specialization has important implications for the economic dimension of sustainable development as it generates lower value-added. Two major factors explain this specialization: tax and agricultural trade policies prevailing in Brazil's trading negotiation partners. With respect to the latter, the most important issues are associated with tariff escalation, the EU's agriculture policy, China's accession to the WTO, and the economic policy in Argentina. Forthcoming changes in international liberalization fora could affect Brazil's specialization standards in the future.

3.3.1 TARIFF ESCALATION

Table 3.1 compares import tariffs on processed and non-processed soy products. Tariff escalation in the EU, China, and Japan harms the export of value-added soy products, including soy meal and oil from Brazil.

TABLE 3.1 SOY IMPORT TAXES IN SOME COUNTRIES (%)

COUNTRY	SOY OIL	SOY GRAIN
CHINA	13.0	3
JAPAN	25.0[1]	0
EUROPEAN UNION	5.4	0[2]

[1] APPROXIMATE VALUE, EQUIVALENT TO 10.9 YEN/KG.
[2] INCLUDES REDUCTION FROM THE GENERAL SYSTEM OF PREFERENCES.

The main consequence of tariff escalation is in the specialization of trade standards. In the medium to long term it also affects investment standards of countries. For example, while Argentina has been investing in state-of-the-art crushing plants (reflecting their specialization in meal and oil exports), Brazil has "specialized" in grain exports, with marginal investments to build and upgrade processing capacity.

3.3.2 EUROPEAN UNION'S COMMON AGRICULTURAL POLICY AND THE BSE CRISIS

Consistent with the reform process in Europe associated with the Common Agricultural Policy (CAP) there will be reductions in subsidies to European production sectors including cereals and oilseeds. In accordance with the CAP, subsidies per ha to be paid directly to producers should be harmonized both for grains and oilseeds. In the case of grains, the subsidy increases from US$ 231/t for the 1999-2000 crops to US$ 268/t for the 2002-2003 crops. Support for oilseeds, however, will be reduced from US$ 429/t for the 1999-2000 crops to US$ 268/t as from 2002-2003, a 38 percent decline.

This reduction in direct support will have significant effects on domestic oilseed production in Brazil thus creating better opportunities for soy sub-products to enter the European market. It is likely that there will be annual increases in future European imports of Brazilian soy, continuing the trend from past years.

The outbreak of BSE and foot-and-mouth disease in Europe led to bans on the use of meat and bone meal in animal feed in the EU. This has increased demand for vegetable-based protein feed, among which soy has the highest protein content. The effect of such increase is being felt in the Centre-West region of Brazil and as a result demand for soy grain is expected to continue to out-pace demand for other sub-products in the soy complex.

3.3.3 CHINA'S ACCESSION TO THE WTO

China is one of the largest importers of soy in the world. In recent years, it has expanded its imports due to changes in consumer habits and a rise in *per capita* income. It is expected that these factors will continue to encourage increasing demand for oils, soy grain and meal, roughly in that order. In addition, the domestic production of animal proteins has grown, increasing demand for protein meals.

China imposes barriers in the form of tariff quotas. In the case of soy oil, the tariff within the quota is 13 percent but the over-quota tariff reaches 122 percent. Table 3.2 shows China's protection of its domestic production and crushing markets.

TABLE 3.2 CHINA'S IMPORT DUTIES ON SOY AND VEGETABLE OILS (%)

PRODUCT	QUOTA (%)	OVER-QUOTA (%)	VAT (%)
CRUDE SOY OIL	13	122	13
REFINED PALM OIL	10	30	13
CRUDE PALM OIL	9	30	13
SOY GRAIN	3	114	13
SOY MEAL	0	5	13

The preferential tariff applied to palm oil in the Chinese market further discourages opportunities for Brazilian oil exports. Such preference has provoked demands from soy exporting countries for the removal of preferential treatment for palm oil.

China's accession to the WTO is expected to bring about further opening in its market, particularly if there is a shift away from a tariff quota system to a fixed tariff. This could result in the removal of the quota regime and a reduction in the over-quota tariff. Following China's accession to the WTO, the removal of quotas will be obligatory for soy oil and the tariff will be reduced gradually from 13 to 9 percent. The protocol for China's entry into the WTO establishes a tariff quota of 1.7 million tons of soy oil for the first year. This will be increased to 3.3 million tons in

2005, and as of January 2006 all quantitative restrictions on soy oil will be removed. Soy oil entering the Chinese market will only be charged a 9 percent tariff, which is a significant change.

The opening up of the Chinese market should imply an increase in supply from producer countries, including Brazil. China will be able to maintain its position as the largest soy importer in the world, with a volume of over 10 million tons per year. However, soy oil faces competition from other oils in the Chinese market, including rapeseed, palm and sunflower oils. In terms of rapeseed oil there will be an increase in the quota from 600 thousand/tons in 2001 to 1.1 million/tons in 2005. As of 2006 a 9 percent duty will be applied in the Chinese market as opposed to the initial 85 percent. In January 2006, all quantitative restrictions will be removed. Available estimates indicate that if China were to completely remove existing restrictions on trade, oil and meal imports would increase between 6.5 and 13.5 million tons, just to meet existing demand, excluding the effect of reduced prices, which would stimulate the import market even more (LMC 2001).

In summary, it is estimated that China's accession to the WTO will create an opportunity for Brazil to increase its share in the Chinese market for processed soy products. Brazil may be able to increase its oil and meal exports to China and at the same time, maintain high levels of soy grain exports.

3.3.4 TAX POLICY IN ARGENTINA

The tax policy with respect to soy exports in Argentina has an impact on prices in Brazil. Argentina adopts a differential taxation mechanism for exports. A 3.5 percent duty is charged on soy exports while reimbursement (*reintegro*) is paid on soy oil exports through domestic taxes. Such reimbursement is currently fixed at 1.4 percent of the corresponding export price for crude oil and 3.2 percent for refined oil exports (in bulk). A reimbursement of 10 percent is applied to the value of exports of refined bottled oil. The goal of the differential tax treatment is the expansion of processed soy products exports with value-added. Given this policy Brazil will become further removed from the market for soy meal and the trend in Mercosur towards specialization in the soy sector will become clear - Brazil is an exporter of grain and Argentina is an exporter of meal and oil.

3.4 EXPANSION OF THE PRODUCTION AREA AND SOY SUSTAINABILITY IN BRAZIL

Trade policies and agreements affect sustainability in the soy sector in a variety of ways. Some impacts are direct, such as those stemming from the transportation of soybeans (for example, the erosion of riverbanks and impacts caused by the development of infrastructure) while others stem from the economic changes brought about by trade liberalization. Likewise,

some impacts may be transitional and others are structural. The trade policy pursued by the Brazilian government is intended to have profound and enduring structural impacts on the Brazilian economy in general and the soy sector in particular. These potential impacts include:

- Shifts in the relative importance of economic sectors (structural effects);
- The expansion of the soy sector (scale effects);
- Spatial distribution (geographical effects);
- Changes in the rates and composition of natural resource use and pollution capacity of the sector (technological effects).

At least three additional types of effects should also be considered:

- Regulatory effects;
- Institutional effects;
- Impacts of physical infrastructure.

This section discusses each area of potential impact. Further research should be carried out to quantify them where possible.

3.4.1 STRUCTURAL EFFECTS

The political economy of the soy sector is intimately related to the position of the sector in international markets. Market opening strategies followed by the Brazilian government, the withdrawal of past government programs supporting the expansion of soy production in the Cerrado and the existence of market distortions (such as subsidies) in international markets taken together have forced the soy sector to become increasingly competitive.

Trade policies have also led to a very specific type of specialization in the soy sector. International preference for soy grain, mainly due to tariff escalation policies pursued by several importing countries, has led to the specialization in grain production. As a result, there have been no large-scale investments in soy meal and oil production among the economic initiatives that have occurred in the Cerrado. At present, this is the main sector-related effect derived from trade policy.

There has also been consolidation in the soy sector where thousands of rural enterprises in the Cerrado have kept growing, mastering cultivation technologies and have achieved a high level of sophistication in management and techniques. This consolidation is apparent in the fact that many such enterprises are now seeking investment opportunities in strategic areas of agri-business.

Whether the soy sector will become more industrialized depends on a number of factors such as success of the WTO negotiations in removing tariff escalation, China's increased demand for soy oil, and changes in Brazil's tax policy. Specializing in greater value-added soy products would bring increased economic benefits to the country. Furthermore, additional benefits, such as increased employment opportunities in urban areas and increased reliance on processing industries, would accrue.

However, whether industrialization of the soy sector actually brings any environmental and social benefit the adoption of policies and measures which go beyond the realm of trade policy are needed. Policies that should be implemented in parallel with trade liberalization include, *inter alia*, those that promote:

- Rational land use planning as to where soy should be produced, respecting environmentally sensitive areas;
- The adoption of clean technologies, both for production and processing;
- Attention to impacts on the labour market.

3.4.2 SCALE EFFECTS

Scale effects are associated with the overall level of soy production, and its relation to sustainability. It is increasingly acknowledged that economic growth does not assure automatically environmental protection and social improvement. Increasing importance is being placed on ensuring that environmental and socio-developmental costs are permeated throughout the economy, including implementing appropriate regulations and policies at the domestic level.

Between 1995-1996 and 2001-2002, Brazilian production of soybeans increased from around 23 million tons to over 40 million tons, with an expansion of planted area in the same period from 11 million ha to over 16 million ha. There are positive effects at the economic activity level resulting from increased production. For example, soy has had ripple economic effects in other agro-industry sectors, creating and enhancing value chains. Moreover, exports from the soy sector are the main item on the export agenda of the Brazilian agro-industry. The nature of such increased production must be examined to accurately determine any potential negative environmental and social impacts.

3.4.3 GEOGRAPHICAL EFFECTS

The geographical areas where new soybean plantations will be located are of critical importance for assessing sustainability impacts. These effects will be negative when incentives are placed in regions with fragile ecosystems or where expansion is carried out through the occupation of areas covered by native vegetation. However, these effects can be positive if

expansion occurs in already degraded areas, and where the cultivation of soy contributes to restoring the land.

In parts of the Cerrado, soy expansion occurs in degraded areas such as fallow grazing lands. However, a large part of soy cultivation took place in areas of valuable habitats and ecosystems. Expansion into such fragile ecosystems leads to the loss of fauna and flora. Given the presence of agrochemical substances human health problems were also recorded. Water pollution is another impact resulting from excessive use and/or misuse of agrochemical products.

Demand for Brazilian soy is likely to increase if consumers in Europe, and elsewhere, continue to demand GM-free soy and if effective tracing and labelling mechanisms are implemented. Under some scenarios (such as increasing demand from China) increases in demand could be significant. A recent Brazilian study carried out by Grupo de Estudos de Integração Política de Transportes - GEIPOT (Transport Political Integration Study Group) on 16 soy producing units has estimated that soy production will triple between 2000 and 2015. Irreversible environmental damage might occur if the surge in production is not properly managed, notably by limiting and avoiding expansion of the agricultural frontier into environmentally sensitive areas (such as rainforests and savannas).

3.4.4 TECHNICAL EFFECTS

Trade liberalization often affects cultivation practices and technologies used when production is intensified due to trade patterns. The opening of the market resulting from trade negotiations can either result in increased use technologies that rely on the application of high levels of agro-chemicals or can favour more sustainable practices, such as soil management. Direct cultivation technologies have been introduced in the soy sector and may reduce environmental impacts, especially when compared to more conventional agricultural practices.

3.4.5 REGULATORY EFFECTS

The regulatory effects of trade liberalization agreements relate to the legal and policy effects on environmental, social and health regulations, standards and other measures (WWF 2000). The Organization for Economic Cooperation and Development (OECD) argues that positive regulatory effects result when a “trade...agreement sees to it that the ability of governments to pursue appropriate and effective environmental policies are maintained” (OECD 2000). Similarly, negative regulatory effects would arise when provisions of trade agreement or associated policies undermine the ability of governments to regulate for environmental and social protection. In this regard, the following two aspects need to be taken into account:

- Sector-related and environmental deregulation to attract investments, and

- The impact of trade liberalization rules on a country's capacity to initiate and enforce environmental regulations.

In the Brazilian soy sector it can be argued that the surge in production has been significant and its environmental impacts have not been managed properly. The most significant environmental effect comes from the conversion of natural habitats in the Cerrado. There has been no spatial planning to determine which areas are most suitable for agricultural activities, and which areas should be maintained for their inherent environmental value. Although trade liberalization itself is not the cause of lack of spatial planning trade-led production has increased the economic incentives for the clearing of natural habitats and plant soy.

3.4.6 INSTITUTIONAL EFFECTS

Whether trade-induced economic growth leads to environmental impacts depends to a large extent on the existence of appropriate environmental policies and regulatory frameworks at the national level. Where environmental externalities are not internalized, market prices do not reflect true social values, causing allocation inefficiency. In such circumstances, increased economic activity from liberalized trade will exacerbate rather than solve existing environmental problems, particularly in environmentally sensitive sectors such as soy.

A fundamental issue is the institutional impact of trade liberalization and whether liberalization can reinforce the role of existing institutions to implement environmental and sustainable development policies. None of the trade negotiations that Brazil is engaged in contemplates the creation or strengthening of institutions responsible for promoting sustainable development policies in the soy sector. Without efforts to ensure coherence and mutual supportiveness between trade liberalization measures and the need to protect natural resources in rural areas, it is likely that trade will undermine, rather than strengthen, institutional capacity to prevent environmental degradation linked to the expansion of soy production.

3.4.7 PHYSICAL INFRASTRUCTURE

Trade liberalization often reinforces the need for better infrastructure development to support export activities. Of particular importance is the construction of new physical infrastructure such as roads, railways, airports, ports, telecommunications, dams, bridges, and irrigation channels. Shifts in transportation patterns and production concentration in areas incapable of absorbing new traffic demands and other production-related environmental stresses are key considerations. In addition, requirements for environmental impact assessment (EIA) and their effective enforcement should be considered.

In the Brazilian soy sector the construction or upgrading of transportation infrastructure is perhaps the most sensitive issue from an environmental perspective in the present decade. The justification to pave roads and establish multi-modal systems of transport (including waterways. railways and roads) is that transportation costs associated with the export of soy need to be reduced to make it more competitive in international markets. An export-oriented model of soy production is the underlying cause of the expansion of infrastructure into highly sensitive environmental areas such as the Amazon.

3.5 FISCAL SYSTEM, INTERNATIONAL TRADE AND SUSTAINABILITY

Forecasts of demand and prices for products in the soy complex are expected to be stable in the coming decade (USDA 2000, OECD 2000). Such forecasts indicate that by the end of the decade prices and demand may increase moderately but stable market conditions are predicted in the future.

Analyses presented in this section show that domestic taxes burden the soy grain producing sector, and limit expansion of planted area. Taxes have replaced past subsidies and there are no longer sector-related policies (minimum prices, marketing loans, direct subsidy policies) that compensate for high levels of taxation.

It is estimated that removal of taxes, such as the ICMS, PIS, COFINS and FUNRURAL, could have a significant impact on production, raising it to around 50 million tons, taking into consideration the readiness of the production sector to address an eventual tax reduction of 1.2 percent. This would lead to an expansion of soy production into the Cerrado and to other regions of the country. Without effective policies to manage such expansion it is likely that irreversible environmental damage will occur. The most severe impacts would result from the loss of habitats and biodiversity. However, there appears to be little chance of reducing the tax burden on various stages of the soy production chain, particularly in the short term.

Domestic discrimination against the processing of soy is reinforced by agricultural and trade policies of some of Brazil's main trading partners. This situation may change in the light of ongoing negotiating processes. For instance, EU-Mercosur negotiations could have a positive impact in terms of soy meal exports. There is little chance of progress in the principal negotiation fora (FTAA and WTO) in terms of international trade. As for the timeframes, methods and modalities for tariff reduction, progress in negotiations has been slow. Therefore, there is no reason to believe that such negotiations will encourage the export of soy and its derivatives.

The most important measure with the potential for short-term implementation is the effort to reimburse the ICMS credit to eliminate the problem of double taxation on soy grain, meal and oil production activities. This problem affects both soy markets, domestic and exports, when soy

is charged as it happens in Goiás. However, any proposals to implement such a move face strong resistance from state finance officials.

There have been efforts to convince state governments in the Centre-West region that double taxation should be eliminated, for example, using a "tax credit" calculated according to an estimate of production costs for representative establishments, crediting the ICMS paid on materials to the producer. With this credit, the producer would pay less ICMS in domestic marketing.

Technically, this proposal involves developing cost production structures to determine the proportion of material costs (such as seeds, pesticides and fertilizers) and estimating taxes paid in marketing these materials. Based on such estimates a tax credit, equivalent to the present amount that producers pay in es and r environmental and social protectione top followed by the paragraph that you now have under ACKNOWLEDGEMENTSICMS on the product in the domestic market, would be offered. If this is adopted there will be a substantial increase in competitiveness of products in the soy complex.

The majority of states in the Centre-West region have tax incentive programs for the establishment of new industries, which involve exemptions to, or reductions in, ICMS. However, since the introduction of such incentives, only one new factory was opened given that incentives do not have a direct effect on exports since this tax is not charged. The "tax war" among Brazilian states, which seek greater relative advantages for their state development plans, has not brought benefits to the industrial sectors in the soy complex. Harmonization in ICMS legislation could change the situation and new investments might be encouraged in the soy crushing industry. This would lead to production expansion in soy grain, meal, and oil and in other sectors that use these as raw materials.

Financing for exports is a point that must be considered. The financial system has not offered credit lines for exporting products in the soy complex. Given the lack of financing, Brazil tends to sell soy-based products through cash sales while its competitors in the United States, for example, have access to financing programs and credit guarantees.[5]

Various approaches have been made towards federal banks seeking to include soy sub-products in programs to encourage exports. To date, exporters have been offered market credit lines, such as the Advance on the Exchange Contract (Adiantamento do Contrato de Câmbio - ACC) bearing market-based levels of interest.

[5] Such programs include PL 480 (20-year plan financing) and GMS 102 (3-year term credit guarantee for exports).

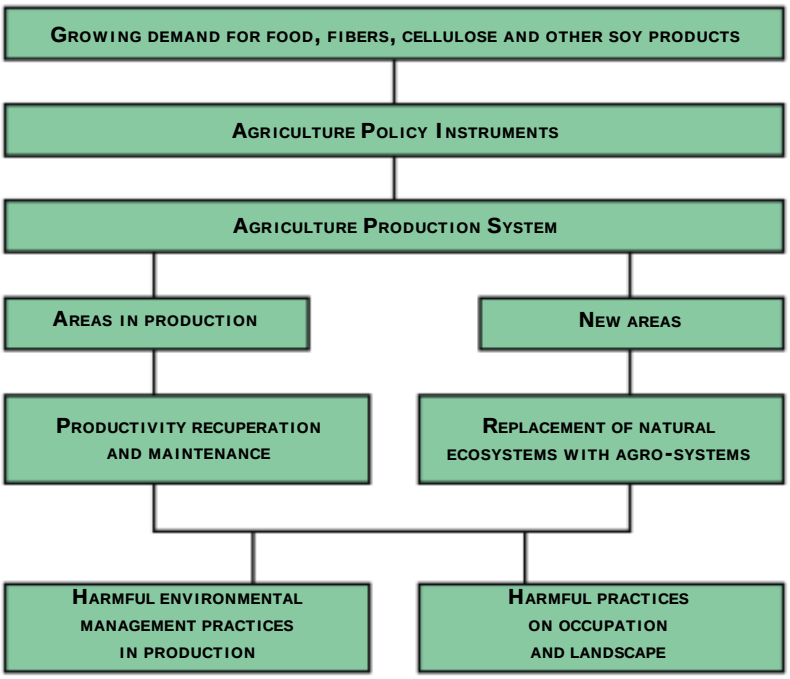
Recognition of the fact that products within the soy complex are heavily taxed has led to initiatives that could reduce the tax burden at the federal level, but concrete solutions have not yet been developed. Discussions on the effects of such policies on economic, social and environmental sustainability of the sector are still just beginning.

4. ENVIRONMENTAL SUSTAINABILITY OF SOY PRODUCTION IN BRAZIL

This section examines factors that impact the sustainability of soy production in Brazil. It begins by discussing unique characteristics of soy production in the Cerrado, followed by consideration of the key environmental impacts of production in both the traditional areas under cultivation and in the agricultural frontier zones. The effects on the expansion process of investments in transportation infrastructure and land occupation in environmentally sensitive regions, special emphasis given to the Amazon, are also examined. Finally, this section considers the impact of soy production on social sustainability.

Figure 4.1 illustrates two key ways in which agricultural expansion can impact the environment: areas already under production and areas into frontier zones. The first relates to the expansion into areas that have already undergone forest conversion, or may already be incorporated to agriculture production or cattle rearing or may even be abandoned and degraded. In such areas impacts are mainly a result of intensive practices adopted for the recuperation and maintenance of production, which is usually done by means of agro-chemicals and intensive technologies. The second way is a result of agriculture expansion into frontier deforestation zones, which typically involves the removal of native vegetation and its substitution by monocultures and the impacts of related infrastructure. On these, the impacts on biodiversity, water and soil are dramatic and take place in a very short time.

FIGURE 4.1 SOY EXPANSION AND ASSOCIATED ENVIRONMENTAL IMPACTS



Before analysing these two processes in more detail, it is important to consider specific environmental impacts associated with growth in soy production in the Cerrado region. There are two key reasons for this initial focus. First, recent expansion of soy production has been most pronounced in Cerrado. Second, the Cerrado's ecosystems are generally misunderstood by the public, which has led to complacency throughout Brazil with respect to the potential threats of rapid deforestation of the region for agricultural development.

4.1 THE NATURE OF SOY EXPANSION INTO THE CERRADO

The Cerrado occupies an area of around 2.1 million km^2 or approximately one quarter of Brazil's national territory. It spans 11 states and the Federal District (Pereira *et al*. 1997). In 1980, the population density in Brazil's Centre-West region, which includes a sizeable part of the Cerrado, was 4.0 inhabitants/km^2 relatively low in relation to the overall Brazilian figure of 17.3 inhabitants/km^2. In 1991 the population density in the region had increased to 5.9 inhabitants/km^2 and it reached 7.2 inhabitants/km^2 in 2000.

In 1980, around 32 percent of the population in the Centre-West region lived in rural areas. In the years that followed, the percentage of rural population in relation to the region's total population dropped markedly and stood at only 13 percent in 2000. In other words, 87 percent of the population in the Centre-West region today lives in urban centres. This accelerated urbanization is due to the fact that the Centre-West region includes Brasília, the capital of Brazil, and a number of large state capitals. It is also due to the nature of agricultural activities

carried out in the Cerrado, specializing in grain production and animal rearing, which are not labour intensive.

Conversion of lands for grazing use is the main form of land use in the Cerrado. These lands are home to around 44 percent of national livestock and are specialized in meat production and, on a smaller scale, milk production. Over the past 40 years there has been dramatic growth in this activity represented by a 400 percent increase in livestock herds. This growth was accompanied by intensive development and the replacement of natural vegetation with cultivated grazing lands. It is estimated that at present there are 45 million ha of cultivated grazing lands in the Cerrado, 80 percent of which are in various stages of degradation. The second form of land use predominant in the Cerrado is for grain cultivation, covering around 10 million ha. For the past 20 years, soy has been the driving force in grain production and in the expansion of cultivated areas in the Cerrado.

4.1.1 PHYSICAL ENVIRONMENT, VEGETATION AND DIVERSITY IN THE CERRADO

Soy needs adequate water supplies to produce high yields. In Brazil, one of the main causes of variations in soy yields between years is lack of water. Drops in average soil yield in Brazil for the 1977-78, 1978-79 and 1985-86 harvests were all caused by water shortages. In addition, soy develops best in conditions where temperatures vary between 20°C and 30°C, with 30°C being the ideal temperature for its development.

Dry winters and rainy summers characterize the climate in the Cerrado (A.W. Köppen's classification). Average annual precipitation is 1,500mm, varying between 750mm at the low end, to maximums of 2,000mm. Rainfall occurs mainly between October and March. Contrasting topographical relief and an extensive latitude distribution result in wide variations in the temperature, although average temperatures during the coldest months rarely fall below 18˚C.

The land in the Cerrado biome consists of a variety of soils, most of which are fit for soy cultivation. The most common type of soil is the latosoils, which are highly intemperate soils and make up approximately 46 percent of the Cerrado biome. The predominant relief forms in the latosoils are residues of plain surfaces known as *chapadas* (flat and gently undulating topography). Over 95 percent of the Cerrado latosoils are poor in nutrients and acids. Inadequate management of latosoils associated with deforestation can lead to erosion-induced deep grooves in the earth.

A second important soil type in the Cerrado is the quartzose sand, which are deep soils with a sandy texture. These make up 15 percent of the biome in flat or gently undulating relief and are also characterized by low levels of nutrients. A third type of soil is the podzolic soils, a heterogeneous class of soil, which accounts for around 15 percent of the Cerrado, concentrated

particularly on the lower part of the slopes. These soils can also be associated with fringe forests in the region.

The Cerrado is home to various types of vegetation including forests, savannas (trees and shrubs scattered over a grassy covering without forming a continuous canopy) and meadows (predominance of herbaceous forms and some shrubs but no trees) (Ribeiro and Walter 1998). The Cerrado is also home to an exceptionally high level of biodiversity including an estimated 60,000 species of plants, animals and fungi (Dias 1994). The heterogeneity of resources and habitats in the Cerrado protects communities of animals with a diversity of species and an abundance of individual forms. However, increased fragmentation in the Cerrado in recent years has affected fauna conservation, especially of mammal species spread over a wide area (Alho 1994). Habitat fragmentation, brought about by breaks in the fringe forests also threatens bird and mammal life. Around 67 percent of bird species in the Cerrado are found both in the *Matas de Galeria* (Gallery Forests) or *Matas Secas* (Dry Bushes) (WWF 2000).

The *Matas de Galeria* play a critical role in terms of forest resources in the Cerrado. Although the *Matas de Galeria* correspond to only 5 percent of the total Cerrado area in Central Brazil, they shelter 80 percent of mammal species, 50 percent of endemic species and 24 percent of all threatened species in the Cerrado. The maintenance of high levels of mammal diversity in these forests is linked to the structural complexity of the habitat, the intact nature of the forests and the quality of the river water. The reduction in mammal populations due to changes and fragmentation in habitats is likely to result in the degradation of vegetation in the medium and long terms.

4.1.2 BIODIVERSITY CONSERVATION IN THE CERRADO

The uncontrolled opening-up of land in the Cerrado has resulted in irreparable harm in terms of biodiversity destruction and loss of resilience in ecosystems. According a recent UNESCO study, just over 57 percent of the original vegetation covering in the Federal District was lost between 1954 and 1998. Accelerated agricultural and urbanization were the main causes of this environmental degradation. The same study showed that the fringe forests in the Federal District were reduced from 109,414 ha in 1954 to 57,770 in 1998 (a 47 percent reduction) in spite of being protected by the Forest Code.

The expansion of the area under soy cultivation in Brazil includes the gradual dominance of soy in the Cerrado. If production in the states of Minas Gerais and Bahia are added to the Centre-West regions of the Cerrado, total cultivated area in the Cerrado has increased by almost 5.3 million ha. Expansion into a substantial part of this area has necessitated the removal of natural vegetation cover, with associated negative impacts on biodiversity.

Forest surveys recently conducted in the Cerrado region, including the states of Mato Grosso do Sul and Tocantins and in the Cerrado areas in the Amazon found 950 woody species (trees and shrubs), the majority of which were extremely rare. Further, the diversity of small plants (herbaceous types, semi-shrubs and small shrubs) found was much richer than the diversity of larger trees and shrubs. Indeed, the number of species found is so high that detailed flora lists are only available for some locations.

The creation of an adequate protection system for the region is urgent. The Cerrado currently contains only 1.5 percent of federal reserves and is one of Brazil's least protected ecosystems. Even less protected are the transition areas between the Amazon forest and the Cerrado, where the greatest number of endemic species of vegetation are located (Fearnside & Ferraz 1995).

The inadequate distribution of conservation units in the Cerrado biome is being highlighted since the 1990s, when special attention was suggested for the biome area in transition with the Amazon forest (Dias 1994). The three regions with least coverage are the Centre-South (Goiás) with 0.9 percent, the Northeast (Bahia. Piauí and Ceará) with 1.9 percent, and the Southwest (Mato Grosso do Sul) with 2.2 percent. This poor geographic representation reflects the lack of consideration for the enormous regional heterogeneity in the Cerrado biome. The importance of preserving samples of ecosystems in both the centre areas of the biome nucleus as well as in transition belts with other biomes is critical.

4.1.3. CERRADO CONVERSION INTO AGRICULTURE AND RANCHING AND CLIMATIC IMPACTS

Scientific assessments show the interactions between climate and the conversion of tropical savannas to grazing lands (Hoffman & Jackson 2000). The net result of the conversion of the Cerrado areas meant replacement of a range of woody and grassy species by systems dominated by grassy lands (grazing areas) or by other herbaceous plants (crops). Studies by these authors show that a change in forest coverage from 50 percent to zero results in a significant drop in precipitation in savannah regions. In addition to decreasing precipitation throughout the rainy season, the dry season will be prolonged due to the drop in precipitation at the start and at the end of the rainy season.

Moreover, changes in savannah vegetation as a result of human activities are occurring at the same time as adjacent areas are being deforested, adding to the climatic effect of this change (Hoffman & Jackson 2000). Changes in climate brought about by deforestation contribute to conditions that discourage the natural regeneration of forests by 500km to 1,000km in the south Amazonian region (Nobre *et al*. 1991). If left alone, these areas will grow back as savannas.

4.2 ENVIRONMETAL IMPACTS IN ESTABLISHED AGRICULTURAL REGIONS IN THE CERRADO

4.2.1 WATER AND SOIL MANAGEMENT

- **Water resources and agricultural management in the Cerrado**

Information available on water resources is scarce and focuses on small parcels of land in the Cerrado. Schneider (1996) shows that the plain areas in the Mineiro Triangle on sediment lands containing high levels of clay near to drainage systems favour the occurrence of large hydromorphic fields at the watersheds and along small rivers in wide and shallow valleys. These relatively wet fields are responsible for storing water during the rainy season and for feeding the drainage network during the dry season. After these areas are drained, and once they are dry, they are incorporated into the areas under grain cultivation. Comparisons of maps illustrating soil use in 1964 and 1994 shows that out of a total of 29,000 ha of wet fields existing in 1964 approximately 6.2 thousand ha have completely dried up and are being used for soy cultivation.

Special attention should be paid to the conservation of water resources. It is at the top of plains, unprotected by fringe forests, that important watershed responsible for the water supply in cities in the Centre-West, Northeast and South regions of the country are located. That is why the Cerrado is known as *berço das águas* (cradle of waters).

Although irrigation has expanded in recent years, in terms of total production, it is not common in the Centre-West region of Brazil. Where irrigation does exist in the Cerrado, it allows the production of grains and seeds, especially soy, rice, corn, cotton, coffee and other crops such as beans, peas, watermelon and tomatoes, in dry autumn and winter months. Simple measures such as seed treatment and crop rotation can reduce or avoid worsening of problems associated with plant diseases that can be encouraged by irrigation water. In addition, varied pathogenic microorganisms may accumulate in the soil thus infecting subsequent crops, unless rotation is one of the techniques employed.

- **Soil management and erosion**

Great damage to the soil brought about by management in conventional soy cultivation in the Cerrado led to the introduction of no-till cultivation systems in the mid 1980s. This technique had been used in Paraná and Santa Catarina, where it has proven to be very effective in controlling erosion.

At present, various forms of no-tillage cultivation are employed in the Cerrado. No-tillage is the technique employed in around 70 percent of the cultivated area, compared with 30 percent under conventional systems. A fundamental aspect for evaluating environmental impacts

associated with soy cultivation is data collection on management related to no-tillage cultivation and regional distribution.

Erosion is the greatest concern regarding soy crop implementation in the Cerrado. The most used Cerrado soils for crop cultivation have a flat to gently undulating relief. In the plains, sloping rarely exceeds three percent, while on the lower slopes and up to near the watercourses sloping is on average five percent. In natural conditions, latosoils are considered to be resistant to erosion due to their high permeability, great depth, high levels of aggregation and vegetal covering. However, the removal of natural vegetation followed by intensive annual cultivation significantly alters their resistance.

Soil erosion typically occurs in two phases. The first occurs when the surface soil is broken up as a result of the impact of forces such as rain. The second is the transportation of separated soil particles, due to flooding, from their point of origin to a point in the slope where deposition occurs when sediment loads exceeds its capacity to be carried by floods (Foster 1982). Deposition is a selective process. Thicker particles are deposited first, causing the loss of finer particles, which are important for moisture and nutrient retention (Frere *et al.* 1980).

Substituting conventional systems of cultivation with no-tillage techniques substantially reduces soil loss from erosion. No-tillage cultivation allows crop residue to build up on the surface. This layer of organic matter acts as a mulch to prevent erosion, maintain moisture, and bind with any chemical inputs so as to improve their productivity. No-tillage techniques reduce soil erosion as well as the transportation of pesticides, herbicides, and fertilizers by water, ensuring fewer inputs run-off into freshwater resources.

- **Nutrient levels**

The use of conventional soil management systems can contribute to losses of nutrients and organic materials in water resulting in financial costs and environmental damage. The eutrophication of water sources is the result of nutrient accumulation deposited during flooding, and to the decomposition of biomass that occurs naturally at the bottom of reservoirs (Hernani *et al.* 1999). In order to preserve the quality of watercourses, it is necessary to combine management systems, such as direct cultivation, with other conservation practices, such as terracing. No-tillage cultivation has encouraged greater average concentrations of phosphorus in sediment in the systems studied. Moreover, it has also resulted in greater concentrations of calcium in solution and has higher rates of phosphorous enrichment compared to systems used for preparation for wheat-soy cultivation. On balance, no-tillage cultivation has been found to be the most effective system for controlling erosion and preventing substantial losses in levels of nutrients and organic materials.

- **Soil Compacting**.

Soil compacting is caused by the action and pressure of tools used in soil preparation, especially when this activity is carried out in wet soil conditions and when there is intense traffic from agricultural machinery. Continuous soy production using inadequate management practices has led to decreasing yields and increasing production costs, particularly in the traditional areas of soy cultivation. In particular, intensive use of the disk harrow causes the soil to breakdown and encourages compacting in soils when production is continuous. Compacting prevents the roots from penetrating deep into the soil resulting in superficial rooting. Therefore, plants are typically less able to absorb water and nutrients efficiently are more vulnerable to short periods of drought (Spain *et al*. 1996). No-tillage cultivation requires less machinery than traditional methods and therefore results in less compacting.

- **Trace gas and CO_2 emissions**

Nitrogen circulation in terrestrial ecosystems is affected by numerous factors including geology, climate, land use history, and management practices. In recent decades, changes in land use have occurred rapidly in the Amazon and the Cerrado (Davidson *et al*. 2001). The magnitude of this change is significant and can affect regional and global balances in nitrous oxide (N_2O) and nitric oxide (NO) from soils.

In the Cerrado, information related to soy's impact on trace gas emissions is limited. There is some evidence that the conversion of natural systems for agricultural use can significantly increase emissions of N_2O. N_2O emissions increased during the first 100 days of soy cultivation, reaching 0.5 ng N cm^2 hr, presumably as a result of the increasing N fixation caused by cultivation (Nobre 1994). In another study looking at soy cultivated in rotation with corn during the rainy season, emission of N_2O varied between 0.8 to 2.5 ng N cm^2 hr-1 (Saminêz 1999). These increases are modest compared to other cases associated with crop conversion in the tropics. This is probably due to the relatively dry climate in the Cerrado, which does not favour high N_2O emissions. However, irrigation during the dry season can significantly increase N_2O emissions.

Areas in the Cerrado where shrub-tree vegetation predominates normally have large amounts of biomass in underground systems (Oliveira 1999). The replacement of native vegetation with annual species with less capacity for releasing carbon in deeper soil layers can reduce the system's carbon storage capacity, and increase levels of CO_2 released from the soil into the atmosphere. This occurs as a result of decomposition in the root systems and from traditional techniques including harrowing, which breaks down the soil structure and exposes organic material, usually protected inside the structure against microorganisms attacks (Resck *et al*. 1991). This can lead to a significant loss of organic material, crucial for maintaining physical,

chemical and biological soil conditions. The replacement of conventional cultivation techniques with no-tillage systems reduces this problem.

4.2.2 PEST PREVENTION AND CONTROL

The national legislation on plant protection defines the term "pest" to include insects and other arthropods, invasive weeds and diseases that attack any agro-forest cultivation. In order to control pests that affect soy cultivation, the use of "integrated pest management" (IPM) techniques are recommended. This technology was developed and widely disseminated in the main production regions in the country and includes regular plantation inspections to verify economic damage caused by specific pest infestation in specific lands. Pesticides are used when economic damage exceeds the cost of the intervention. There is no prophylactic or routine spraying of crops. However, according to the UN Food and Agriculture Organization (FAO) the combination of GM technology and IPM techniques actually produce higher yields at lower costs than either do separately. In Brazil, soy was the first crop to receive attention from inspectors, in the 1970s, and it is now considered one of the most advanced countries in terms of the application of IPM techniques. Nevertheless, the indiscriminate use of chemical pesticides remains widespread, resulting in continuous damage to population's health and environmental impacts.

- **Weed control**

Grain cultivation requires that attention be paid to controlling invasive weeds since they can cause significant losses in production, hamper the harvesting operations, and damage the quality of the soy[6]. Typical methods used alone, or in combination, to control weeds include cultural, mechanical, chemical, and biological techniques.

"Cultural" techniques refers to practices that provide the soy crop with a greater capacity to compete with the weeds. "Mechanical" techniques include the use of tools to reduce populations of the invasive weeds. Weeding can be manual (simple and effective but requiring substantial labour) or mechanical through instruments such as the plough, harrow, hoe and cultivator. The advantage of chemical control is that it involves little labour and products can be applied quickly. The prior identification of the plants to be controlled is the most important factor for choosing an appropriate chemical product and achieving success. However, in some cases weeds are resistant to certain herbicides (for example, *Brachiara plantaginea, Bidens pilosa,* and *Euphorbia heterophylla),* when they are applied to soy cultivation.

[6] In the Cerrado an increasing infestation of fedegoso (Senna obtusifolia), carrapicho beiço-de-boi (Desmodium tortuosum), cheirosa (Hyptis suaveolens), capim custódio (Pennisetum), balãozinho (Cadiospermun halicacabum), and others have been observed.

- **Soy diseases and control measures**.

Among the main factors limiting high yields in the soy sector are diseases, many of which are difficult to control. Approximately 40 diseases caused by fungi, bacteria, nematodes and viruses have already been identified in Brazil. This number continues to increase as soy production expands into new areas and as a consequence of monoculture and the transportation of infected grains. At the same time, traditional diseases have reached epidemic proportions in the Cerrado regions. The majority of pathogens are transmitted through seeds. Therefore seed treatment is essential for preventing or reducing losses caused by disease.

- **Pesticides and no-tillage cultivation**.

Pesticides are widely used in soy cultivation (Vieira *et al*. 2001). Among them, there is a broad spectrum of chemical products used to control insects and other arthropods, diseases and invasive weeds that affect plants and animals. Demand for pesticides has been increasing in recent years. In 1989 pesticide consumption in Brazil reached 151.8 thousand tons and Brazil was the fifth largest consumer market in the world (Campanhola *et al*. 1998). Pesticide use and marketing in Brazil are governed by Law no. 7.802, 11-01-1989, and regulated by Decree 98.816, 11-01-1990, which classifies pesticides in terms of their use and their toxicological impacts vis-à-vis humans and other living organisms in the environment (Compêndio 1996).

No-tillage cultivation is widespread due to its effectiveness in erosion control and soil cultivation. However, for the success of this practice, the adoption of a good weed control system is necessary. The chemical method is most widely applied in conjunction with no-tillage techniques.

A number of problems associated with pesticides are related to the technology used in their application. Lack of adjustment of sprayers, altered funnels and errors in dosage application are frequently cited as responsible for poor results. Climatic conditions are also directly linked to pesticide application. Some herbicides leave residues in the soil and can persist over long periods of time. The use of such herbicides requires extreme care, particularly when soy is planted in rotation with corn.

- **Transgenic soy**

Transgenic engineering has succeeded in producing soy varieties resistant to glyphossate herbicide, produced in Brazil through a joint venture between Monsanto and the Brazilian company FT Sementes. The Monsoy was launched in 1996 in order to encourage soy production and soil management, using only one herbicide, the glyphossate (Round-up commercial product) produced by Monsanto.

In Brazil, the National Biosafety Technical Commission (Comissão Técnica Nacional de Biossegurança - CTNBio), under the Ministry of Science and Technology, is responsible for regulating research, transportation and marketing of transgenic organisms and their derivatives. CTNBio approved the authorization of marketing of transgenic soy varieties resistant to the herbicide Round Up. In June 1999, the Ministry of Agriculture required compulsory registration for the production and marketing of seeds for the five transgenic soy cultivars in Brazil. However, consumer defence organizations have obtained temporary injunctions suspending authorization granted for the commercial cultivation of transgenic soy varieties. Nevertheless, despite restrictions on transgenic soy cultivation crops are planted in secret in Brazil.

Transgenic plant technology is considered by some to be advantageous for producers, allowing for a reduction in production costs, improved management (such as control of weeds and pests) and increases in yields, while providing consumers with less agro-chemicals products. However, issues such as production increases and decreasing use of pesticides as well as agri-business control over genetic engineering remain controversial (Fearnside 2001). This is due first to uncertainties regarding the potential risks from the liberation and consequent presence of genetically modified organisms into nature and second, to damage related to the use of the glyphossate herbicide (Cox 1999).

In 1997, EMBRAPA signed a technical cooperation contract with Monsanto, obtaining legal support for research involving effectiveness of the gene that gives the plant resistance to Round Up/glyphossate, and the genetic development of soy resistant to glyphossate herbicide. In the context of this contract, EMBRAPA concluded that the Monsanto technologies are technically effective. Furthermore, based on the results of its studies, EMBRAPA decided to develop transgenic soy cultivars resistant to glyphossate herbicides. These will be protected exclusively by EMBRAPA (www.embrapa.br).

CTNBio also stipulated that scientific monitoring be carried out for five years in order to certify the absence of environmental risk in commercial cultivation. The main restrictions to transgenic plants and their derivatives include allegations that they have not been tested sufficiently to detect possible effects on human health and the environment. In addition, transgenic technology is considered to have the potential to create negative economic impacts by encouraging the formation of monopolies in the seed production and distribution markets.

Brazil exports 70 percent of the soy that it produces and given sentiments against GM food (mainly in European countries) it is possible that some countries could prohibit the import of GM products. This is a strong argument in favour of banning GM soy in Brazil. Currently the EU is Brazil's most important export market for soy while its main competitors, the United States and Argentina, already use transgenic soy.

Box 2 Pesticide use and environmental contamination risks : A case study in municipalities in the Upper Taquari Basin, in the State of Mato Grosso do Sul

Vieira *et al.* (2001) assessed the evolution of cultivated areas in municipalities in the Upper Taquari Basin (Bacia do Alto Taquari - BAT) in Mato Grosso do Sul and part of Mato Grosso. They estimated the volume of pesticides used according to chemical class and group, separated according to year (1988 to 1996), crop, and municipality. Since the 1970s, the removal of native vegetation, mainly in the Cerrado and the BAT for agricultural development became more intense. The *latosoils* situated in the Chapadões Plains with topography appropriate for agricultural mechanization were planted mainly with soy, corn, rice, wheat and bean crops. Pesticide use became cause for concern due to the risk of it contaminating the Pantanal. Data revealed that the São Gabriel do Oeste municipality was the one which held the largest area under cultivation and that soy was the crop which showed the highest indication of pesticide use. Out of the total volume of pesticides (herbicides + insecticides + fungicides) measured at 1,369,957 litres and 157,120 kilos in the BAT municipalities from 1988 to 1996, São Gabriel do Oeste had the greatest proportion. Herbicides were the most commonly used in the BAT during the period studied, followed at a distance by insecticides and fungicides. Soy cultivation used the highest levels of herbicides

4.1 EXPORT CORRIDORS AND THE EXPANSION OF SOY CULTIVATION

Given appropriate conditions, altered areas of forests in the Cerrado and natural landscapes in the Legal Amazon are poised to experience significant growth in soy and other grain cultivation for export. An important limiting factor to such expansion is the lack of infrastructure, although, the government is already investing in trans-regional transportation programs aiming at reducing that restriction.

The Amazonian region includes two export corridors: the Centre-North export corridor around the Carajás railroad, linking the Itaquí port to the extreme north of the Araguaia-Tocantins waterway, and the North-West export corridor, which covers the multi-modal complex formed by the Cuiabá - Porto Velho highway and the Rio Madeira port in Porto Velho and the Itacoatiara port on the Amazon River. Transportation structures for bulk soy are being established in order to support expanded production.

Investments are also being made in the Santarém export corridor, made up of the Cuiabá - Santarém highway, the Tapajós waterway, and the Santarém port on the Amazon River. Once completed, this complex together with the route to the Caribbean through the BR-174 highway (Manaus - Caracas), will facilitate transportation of soy production from Brazil's Centre-West

and North regions. The region's physical infrastructure was recently reinforced by the construction of transmission lines bringing hydroelectric energy from Tucuruí and Venezuela.

There are two visions regarding these events. The first is pessimistic, contemplating a significant advance into the Amazon and the increased destruction of the tropical rain forests (Fearnside 2001). The second perspective, put forward by EMBRAPA, is moderately optimistic and suggests that it is to the advantage of producers to occupy areas in the Cerrado that are already deforested and are now accessible due to improvements in transportation (EMBRAPA 2000).

Attention should not only be paid to effects related to deforestation. Even in zones that have already been opened up, soy production brings intensive machine and material use, with potential negative effects on soil and water. These impacts are not specific to the Amazon, although intensive rain patterns in this region can aggravate these problems.

At an EMBRAPA seminar to assess the potential for, and problems with, grain crops in the Amazon, it was acknowledged that this region is subject to great environmental risk, similar to what occurs in traditional agricultural production areas (EMBRAPA 2000). In light of this, it is necessary to carefully analyze all initiatives in order to avoid repetition of past errors. Moreover, when grain production is undertaken on previously used land, such as degraded grazing lands, risks associated with intensive fertilizer and other pesticides emerge.

- **Impacts of expanded transportation infrastructure**

The role of the transportation network in soy expansion is illustrated by what happened in South Maranhão. Until the early 1990s soy production was insignificant in this area. With the implementation of the Northern export corridor, which allowed for product transportation through the Itaquí port in the north, and the partnership between EMBRAPA, the Vale do Rio Doce Company and other institutions, soy expansion increased and it became a key economic activity in south Maranhão. By 2000, the South Maranhense geographical meso-region recorded a cultivated area of 176.4 thousand ha. Moreover, the initial development of soy in adjoining areas, particularly in Tocantins and Piauí States, was also observed.

The challenge lies in associating infrastructure development with effective large-scale conservation strategies in forested areas so as to lessen inevitable impacts associated to means of transportation. For example, the BR 163 highway, linking Cuiabá to Santarém, part of the Santarém export corridor, which crosses areas of the Amazon forest, was opened in 1974. However, its 1,000km were never paved, which slowed the process of lumber exploitation and conversion of forests into grazing lands. Only five percent of the forests were cleared (50 km on each side of the highway) in contrast with the 26 percent to 58 percent deforested along the paved highways 20 to 30 years.

Today there is pressure, particularly from producers in north Mato Grosso, to complete the paving of the highway. This would represent a savings of US$ 70 million per year in the transportation of soy and other agricultural products. Paving would also reduce costs of transporting lumber destined for international and domestic markets, thus possibly encouraging industrial expansion in that sector. The impacts would not necessarily be negative. Successful experiences in environmental monitoring and control strategies can contribute to positive impacts on environment sustainability.

However, there appears to be a strong correlation between opening and paving highways and deforestation. While highway paving can bring benefits to the region, these projects must be developed through appropriate planning and monitoring of the development process along the highways. Three quarters of deforestation between 1978 and 1998 occurred along a 100 km strip spanning the region's paved highways in the Amazon. Deforestation along a 50 km strip on each side of 3 highways in the region, shows that between 29 percent and 58 percent of the forests had been cleared by 1991 (Table 4.1).

TABLE 4.1 DEFORESTATION ALONG PAVED HIGHWAYS IN THE AMAZON

PAVED HIGHWAY	LENGTH (KM)	FRONTIER AGE (YEARS)	DEFORESTED AREA[1] KM²	%
BR-010 (BELÉM-BRASÍLIA)	1514	~35	47.000	58,0
PA-150 (ABAETETUBA-SANTANA DO ARAGUAIA)	991	~20	32.000	37,2
BR-364 (CUIABÁ-PORTO VELHO)	1454	~25	31.000	28,7

[1] DEFORESTED AREA REFERS TO THE 50 KM STRIP ON EACH SIDE OF THE HIGHWAY. SOURCE: NEPSTAD ET AL. 2001.

In addition, intensification on existing cultivated lands leads to greater local incorporation of income and employment generation than does expansion of the frontier. Intensification of economic activities in an old frontier area through agricultural or forest production systems increases the profitability of agricultural, livestock and lumber activities by 26 times. Intensification of land use means increasing productivity gains (obtaining greater production in a smaller area) thereby reducing the need for deforestation.

4.4 SOCIAL IMPACTS OF SOY PRODUCTION

The expansion of soy production in the Centre-South and in the Cerrado relied on thousands of rural entrepreneurs who now make up one of the most successful groups of Brazilian rural business people. As in the case of environmental impacts, the social effects associated with soy expansion are both positive and negative.

Positive impacts associated with soy-agribusiness are driven largely by increased growth in the chain of custody and exports, thus increasing income and employment. Furthermore, soy production consumes substantial amounts of materials and services and provides important

inputs into the crushing and processing industries. These in turn generate material for important production sectors both in terms of domestic market supply as well as in meeting external demand. Negative effects are usually associated with social movements (migration) resulting from the sector's expansion. These effects include, *inter alia*, destabilizing impacts on traditional communities, reduced employment, and possible negative impacts on the distribution of income.

An assessment of both positive and negative social effects requires distinguishing between the different regions where soy is grown, as well as the acknowledgment of differences between traditional lands in the southern states and places where soy replaced other crops or grazing lands in the Cerrado's central area. Moreover, in the regions where soy was planted in rotation with other crops there are also differences. Social impacts of soy expansion in the southern states were different from those that occurred in areas in the Cerrado that were already occupied. However, in both cases, soy cultivation resulted in the dislocation of the labour force, reduced jobs, and contributed to urban migration.

In the southern states, the most dramatic impacts occurred in Paraná. Until the mid 1960s this state was the main Brazilian coffee producer. However, a combination of successive "super harvests" and frost spells led to subsidy policies that led to reduced area under coffee cultivation. There were large coffee estates in Paraná but small and medium-scale ones predominated. Settling in parts of North Paraná, where coffee became established, was carried out through sales of reduced size lots. Coffee cultivation was replaced with livestock production and soy cultivation, both of which use significantly less labour. This resulted in a reduction in agricultural employment opportunities in agricultural areas, followed by a marked rural exodus. It also led to the buying up of small and medium-sized properties to form larger establishments and take advantage of economies of scale.

Population data in Paraná reflect the impacts of such changes. Between 1950 and 1960, when coffee production was strong, the total population increased extraordinarily, from 2.1 million to 4.3 million inhabitants. A similar process occurred with the rural population, which increased by almost 2 times, from 1.6 million to approximately 3 million, comprising around 70 percent of the total population in 1960. However, during the 1960s when coffee was replaced by livestock and soy production, a process of modernization began. As a result, although the total population of the state continued to grow (the population totalled 7.7 million in 1980) there was considerable reduction in rural production, which dropped from 4.5 million in 1970 to less than 3.2 million in 1980. Rapid urbanization has negative impacts on cities and contributes to the further migration of producers and workers to the agricultural frontier in the Centre-West.

What occurred in the southern states was not only intensification of concentration in land ownership, but also a marked dislocation in the labour force brought about by reduced labour needs associated with "modern agricultural practices", an accelerated rural exodus, and a loss

of space by small farmers. For example, during the 1960s and 1970s almost 30 million people left the fields, heading for the cities and agricultural frontier regions, mainly in the Amazon. This abated somewhat in the 1980s (Mueller and Martine 1997). It led to an increase in property invasions through actions similar to those of the "Landless Movement" in the most agriculturally developed states in Brazil's Centre-South.

In most southern states, the main social impacts of soy expansion were associated with the modernization process in Brazilian agriculture. Based on the adaptation of "Green Revolution" technologies it was successful in increasing production and productivity. However, the advantages of technological change favoured commercial agriculture, especially in soy production, due mainly to land ownership issues that were not addressed prior to the industrialization process. This tendency to favour large-scale agriculture was marked by incentive and support policies for modernization. Subsidized credit, minimum price, technological development and official incentive policies adopted at that time as a fundamental part of the modernization strategy were directed towards commercial agriculture. Large agricultural establishments that took advantage of mechanization and production processes requiring little labour therefore adapted the technologies developed.

In the Cerrado's centre area where soy replaced other activities, the evolution was similar. However, negative social impacts were less marked because it was a relatively undeveloped agricultural area with a lower population density. Nevertheless, soy expansion also produced unemployment and a rural exodus, in addition to effects regarding land ownership concentration. Attempts were made to accommodate the excess labour supply in official rural settlements (the Cerrado registers few private settlement experiences). If well implemented, settlements offer advantages to economically inactive populations once small-scale agriculture takes up more labour than large-scale commercial agriculture. Yet, rural settlements in the Cerrado have shown high out-migration rates. Families sold their lots, encouraging new concentration of land, and occupying land in new areas. Migration away from settlements is due in part to the settlement model used in Brazil, which involves the granting of land, a maintenance salary, and some type of credit along the lines of the Programa Nacional da Agricultura Familiar (PRONAF, the National Family Agriculture Program) that applies varied rural development measures (but its main characteristic is the line of credit). However, lack of technical assistance, association and marketing support, education and training make these settlements unsustainable in the long term. This phenomenon has also been observed in the settlement projects in the Amazon, but social problems are most acute in the densely populated regions in the Cerrado.

In the frontier zones of the Cerrado soy production has occupied lands with topographical features well adapted to large-scale use of mechanized agriculture. Extensive areas in the plains region were put under production. These areas were generally barely populated and had a low economic density. Given that these lands were cheap and that the buyers (the majority

of whom are commercial producers from the south of Brazil and São Paulo) had accumulated resources from previous activities, extensive agricultural establishments were developed, which led to a concentration in land ownership.

In addition, soy-culture is an activity that generates high and concentrated production and income even when it causes reduced impacts in terms of labour absorption. There are some opportunities for qualified workers (managers, tractor drivers, mechanics, agronomists and agricultural specialists) offering reasonable salaries. However, there are almost no jobs for less-skilled labour, which indicates that soy production in new areas will not necessarily result in prosperity for the social sectors linked to traditional agriculture in these regions.

In addition to the agricultural production, ramifications of the entire soy complex should be considered. It is evident that upstream and downstream activities in the soy complex generate income and employment, as analyzed in Section 1. However, the concentration of the crushing and processing industries, as well as of enterprises, which use soy sub-products, in regions outside the Cerrado indicate that the effects on employment from the various components of the soy complex are modest and geographically limited.

5. SUSTAINABILITY RECOMMENDATIONS FOR THE SOY SECTOR IN BRAZIL

Further to the issues raised by the expansion of soy in Brazil, this study proposes specific policy measures that can be pursued by the government of Brazil, producers, and civil society to ensure that opportunities for growth presented by increasing demand for, and trade in, soy and soy products are pursued in a way that respects environmental integrity and social responsibility and ultimately contributes to sustainable development. Given that the soy sector is likely to continue to expand, the question is how to ensure that there is adequate management of environmental and social impacts. The case-study emphasises three types of policies:

- **Policies at the International Level:** Trade and Subsidy-related Policies The first set of policy recommendations includes actions that can be taken at the international level through the various negotiating fora in which Brazil participates. Proposed recommendations focus on changing the terms of trade for soy and products in the soy complex to encourage Brazil to develop increased value-added in its exports, particularly with respect to the EU, Mercosur and the FTAA.

- **Domestic Policies related to the Soy Sector:** The second set of policy recommendations includes domestic policies that can be implemented in Brazil to pursue various goals, ranging from promoting more sustainable land use at the national level to encouraging best practices at the farm level. These policies, which include *inter alia*, zoning, tax policies, and research

and development, rely on a combination of economic incentives and command and control measures for their implementation.

- **Cross-cutting Policies:** The third set of policy recommendations includes cross cutting policies that are relevant for different producing sectors, including soy. Awareness raising and education, governance and compliance with existing legislation are highlighted.

The analysis in this study suggests that the soy sector is likely to continue to expand in Brazil, especially in Cerrado areas of the mid-west and southern Amazon. It is critical to ensure that there is an adequate management of environmental and social impacts associated with this expansion. The case study identifies several policy options, which can help reduce any negative impacts associated with increased soy production and enhance its environmental, social, and economic sustainability. These policies are summarised below.

5.1 POLICIES AT THE INTERNATIONAL LEVEL: TRADE AND SUBSIDY-RELATED POLICIES

The first set of policy recommendations includes actions that can be taken at the international level through the various negotiating fora in which Brazil participates. Proposed recommendations focus on changing the terms of trade for soy and products in the soy complex to encourage Brazil to develop increased value-added in its exports, particularly with respect to the EU, Mercosur and the FTAA.

In addition to implementing measures at the domestic level to help manage any increases in soy production brought about by improved or changing terms of trade, there are measures that can be pursued at the international level, including through positions adopted in international trade negotiations.

Brazil's main objective in international trade negotiations is to obtain greater market access for its exports, and particularly agricultural products. If new markets are opened and prices continue to be stable, increased exports of soy have the potential to generate large economic gains and surpluses in the current account balance, which would benefit the Brazilian economy. This international dimension is key for this sector given high levels of exports and the role of trade policies in encouraging growth.

- ***Tariff escalation practiced by countries that import Brazilian soy should be removed***.

The existence of differential tariffs on processed soy products (tariff escalation) may create pressure for the continued expansion of soy production. The reduction of tariff escalation, if accompanied by implementation of domestic policies to improve environmental and social performance, could have beneficial impacts and improve overall profitability and sustainability

of the sector. Removing tariff escalation would improve global profitability and sustainability in the agricultural sector. Positive gains for sustainability would be brought about by the generation of greater value-added soy products in Brazil, encouraging employment growth and increased investments in agro-processing activities.

- ***Production-related subsidies in industrialized countries should be removed.***

The existence of production-related subsidies, such as those applied in industrialised countries, encourages competition for market share by employing environmentally damaging 'cost-cutting' measures, including expanding the area of agricultural land under production. However, there might be a trade-off between employment and the environment. Should soy subsidies in competing countries and trade barriers be removed immediately, there could be a strong impetus towards further expansion of soy into new areas, resulting in dramatic conversion of natural habitats. Domestic policies will need to be put in place to ensure that any increasing production is managed sustainably.

- ***Growth in the production of soy for export should be managed sustainably.***

Any reduction of subsidies in other producer countries and phase-out of market barriers in consumer countries should be balanced by a demonstrated commitment by Brazil to reduce the environmental and social impacts from current production, as well as the expansion of soy as a result of policy changes elsewhere. The government of Brazil should adopt and enforce policies to govern the expansion of soy cultivation. Without these parallel efforts, export-led strategies for expanding soy production are likely to cause irreversible environmental damage in ecologically sensitive areas, such as the Cerrado and the transition area between the Cerrado and the Amazon.

- ***Sustainability assessments of trade should be conducted.***

Sustainability assessments (SA) of trade, including for key sectors such as soy in Brazil, should be undertaken in the context of regional trade negotiations. The ongoing negotiations between the EU and Mercosur, and the FTAA negotiations, provide a unique opportunity to place SA on the agenda of regional trade negotiations. In July 2002, SA was discussed at a ministerial meeting between EU and Brazilian trade negotiators. Further discussions on SA should lead to tangible policy outcomes. SA should also be considered in the context of the FTAA negotiations.

- ***Genetically modified (GM) soy should not be planted in Brazil.***

The rights of consumers to know whether the soy they consume is GM-free, such as through labelling and certification, should be encouraged. Preference for GM-free soy in important export markets (such as the EU and China) is an opportunity for Brazilian soy.

5.2 DOMESTIC POLICIES RELATED TO THE SOY SECTOR

The second set of policy recommendations includes domestic policies that can be implemented in Brazil to pursue various goals, ranging from promoting more sustainable land use at the national level to encouraging best practices at the farm level. These policies should be taken in conjunction with any policies that might be pursued at the international level. Domestic policies rely on a combination of economic incentives and command and control measures for their implementation.

- Zoning and land-use planning
- Tax related policies
- Best management environmental practices in agriculture
- Legal Reserves and Protected Areas
- Water management
- Employment
- Rural settlement and socio-development
- Research and development

5.2.1 LAND USE PLANNING POLICIES AND PRACTICES, AND ZONING

Conversion of natural habitats into agricultural landscapes is one of the main problems associated with increased soy production and cultivation. Deforestation, water pollution and indirect impacts due to infrastructure investment and development (construction of roads, railways and waterways to transport soy) can be significant. Avoiding any negative impacts involves, among other measures, improved planning. Advanced zoning and land use planning policies should be applied to the soy sector. Several proposals have been presented by universities, public bodies and non-governmental organizations. Such policies would help identify areas for production and areas for priority environmental conservation, urban expansion and other uses. Extensive consultations with social groups that are directly affected are required.

- *Effective implementation and enforcement of Ecological and Economic Zoning should be pursued by all states.*

With large parts of its territory relatively intact, Brazil is in a unique position to guide its future development and land use in a way that accommodates priorities related to both conservation and development. Ecological and Economic Zoning at the state level in Brazil is now widely recognized as a key land-use planning tool and has become an important component of public policy, particularly in the Amazon region. The zoning process defines areas that must be earmarked for conservation of biodiversity, and those that can be used for crop cultivation, livestock rearing development, and other human uses.

Few states in the Brazilian Amazon and Cerrado biomes have completed their Ecological and Economic Zoning, with the notable exception of the State of Acre. Even where this process has been started, biodiversity conservation is not receiving the attention that it deserves. Typically the areas that are set aside for conservation are marginal lands that are unsuitable for agriculture and ranching. These areas have not been selected based on the application of any fundamental criteria for conservation of biodiversity. Policies must be put in place to ensure that the expansion of soy cultivation and agribusiness does not take place at the expense of ecologically valuable habitats. Participation and involvement of civil society in these processes is very important for their success.

Zoning should include consideration of the following elements that should form the basis of criteria for the effective implementation of Ecological and Economic Zoning:

- Areas should be earmarked for agricultural activities when land is best suited given the nature of the soil, and priority areas for crop cultivation, agro-forestry, forestry, and habitat restoration.
- Areas should be identified that are economically and ecologically unsuitable for agriculture or livestock development based on such criteria as development density and environmental degradation.
- Areas should be identified that are those most suitable for ranching, ranging from extensive to intensive practices.
- Areas should be identified for conservation based on the systematic application of biological criteria, taking into consideration the importance of 'ecological corridors'.

Where soy expansion must occur, land already deforested and abandoned should be given priority, taking into consideration Economic and Ecological Zoning. In the Amazon alone, more than 160,000 km^2 of degraded and abandoned land exists. Where suitable, this land should be used to accommodate agrarian reform settlements, expansion of cash crops, and ranching.

Effective implementation and enforcement of Ecological and Economic Zoning should be pursued by all Brazilian states, and particularly those located in the Amazon and Cerrado biomes. In states such as Mato Grosso, Rondônia, Tocantins, Maranhão, Piauí, Bahia and Goiás, where soybean expansion is occurring most rapidly, the implementation and enforcement of effective zoning and land use should be a priority.

- *Large-scale infrastructure development should be subject to comprehensive environmental and social impact assessments.*

Investment in transportation infrastructure (particularly roads) has led to the occupation and the opening-up of new land, pushing the soy frontier north into the Cerrado. In addition, large-

scale improvements to waterways for the transportation of soy and other products threaten to alter freshwater habitats and impact negatively on biodiversity.

The Brazilian government has committed itself to conduct broad environmental impact assessments when developing infrastructure projects. Such reviews will include an analysis of the cumulative impacts of transportation infrastructure at a landscape or ecoregion level. While this is a step in the right direction, it is too early to assess the success such assessments will have in preventing and mitigating any negative environmental impacts of infrastructure development related to soy expansion, or how that expansion might affect other sectors, such as energy, for example.

Comprehensive environmental and social assessments of large infrastructure projects should be systematically carried out. These should include, but not be limited to, consideration of measures to avoid primary and secondary environmental impacts associated with the conversion of habitats with a high ecological value. Important social elements should also be addressed in these evaluation processes.

Large-scale infrastructure development projects should be integrated with ecological and economic zoning. This would reinforce coherence and synergy between decisions affecting land-use planning at state and federal levels.

5.2.2 TAX-RELATED POLICIES

Fiscal policy directed towards the soy sector in Brazil has had a strong influence on its development and patterns of specialization. At present, there is a clear bias in favour of production and export of soybeans, at the expense of crushing and value-added processing activities. Existing preferential tax treatment of soybeans for export should be removed or balanced with less onerous taxation of soy processing activities.

- ***The emphasis in the tax burden should be shifted to encourage the increased processing of soy.***

From an environmental perspective, removing taxes such as the ICMS, PIS, COFINS and FUNRURAL, would lead to an expansion of planted area, estimated at almost 4.3 million hectares. While tax elimination is not by itself environmentally harmful, it is likely that increased production following tax rebates would result in expansion of the agricultural frontier given current deficiencies associated with land-use planning.

The emphasis in the tax burden could be shifted to encourage the increased processing of soy and enhanced value-added. This would help alleviate pressure on the agricultural frontier by

shifting more activity in the sector into value-added products. However, such changes should be implemented in conjunction with appropriate land-use policies and effective enforcement of existing legislation.

- ***Soy-producing states that have not done so should adopt the "green" ICMS.***

The "ecological" or "green" ICMS provides that a greater share of municipalities' ICMS revenue be dedicated to environmental conservation through the creation of protected areas. As of December 2002, 11 of the 27 states in Brazil had put such a mechanism in place. Soy-producing states, particularly those located in the Cerrado and Amazon biomes, should make it a priority to adopt the "green" ICMS.

5.2.3 BEST MANAGEMENT PRACTICES (BMPS) AT THE FARM LEVEL

- ***The Brazilian government should adopt a range of incentives and command and control policies to encourage or compel the adoption of BMPs, which reduce or avoid environmental impacts (particularly those on soil and water) and increase the efficient use of inputs.***

At the farm level the adoption of environmental management practices in the agricultural sector could improve the overall environmental conditions associated with soy production. Among such technologies developed in Brazil there is a set of principles that guide a production management system, known as Best Management Practices (BMPs), being implemented and adopted by public and private institutions with success in conserving resources and promoting sustainable production. The majority of the producers in the Cerrado do not employ the full range of BMPs that have been adopted by more progressive producers for some time now in many regions of the country.

- ***Incentives should be put in place to encourage the widespread adoption of no-tillage techniques and discourage the use of conventional cultivation systems.***

No-tillage cultivation techniques can prevent erosion and other damage to the soil and are less harmful to the environment than conventional methods of tillage. No-tillage techniques have been adopted in most grain-producing regions in the South and Southeast of Brazil and are being disseminated in the Cerrado. The use of no-tillage techniques should be extended to the remaining 30 to 40 percent of areas under soy cultivation in the Cerrado, where they have not yet been adopted.

A well-targeted system employing direct payments and tax incentives could help ease the transition from conventional systems to no-tillage technology, as well as encourage companies

to develop, improve, and disseminate the necessary machinery. Promoting the use of such technologies could be accomplished in part by conditions attached to agricultural lending. To this end, credit portfolios of financing agencies should provide for technical assistance geared towards such techniques and practices.

- ***The promotion of combined cattle rearing and crop cultivation should be encouraged.***

An effort should be made to develop and implement programs to encourage the production of cattle and high yield crops in rotation in the Cerrado and other soy-producing regions. A program combining cattle rearing and crop cultivation activities could promote economic development and capitalise on the large areas of degraded pasture in the Centre-West region of Brazil. Such programs would respond to requirements for domestic supply and at the same time reduce pressure to convert natural habitats. Success in such a program could help Brazil meet its international commitments under *Agenda 21* by contributing to poverty alleviation associated with extensive cattle rearing practices in the Cerrado. In some cases, especially for small farmers, financial support may be needed to cover start-up investments.

5.2.4 LEGAL RESERVES AND PROTECTED AREAS

The Brazilian Forest Code requires that all private properties must protect the vegetation cover on mountain slopes, in riparian forests, and in watersheds – so called Areas of Permanent Protection (APPs). It also requires landowners to set aside portions of their property under “legal reserves”. In the Cerrado, 20 percent of the property must be set aside, while in the transition Cerrado/Amazon forests that rate is 50 percent and in the Amazon forests, 80 percent. Clear-cutting is forbidden in “legal reserves”. The development and enforcement of APPs is urgently needed to promote sustainability. The following policies would contribute to this effort:

- ***The identification, creation and demarcation of new protected areas should be vigorously pursued.***

The identification, creation and demarcation of new protected areas, particularly in highly ecological valuable habitats, is an urgent priority that should be pursued by the Brazilian government. This includes habitats situated in the regions of the Cerrado and the Amazon, which are most vulnerable to conversion into agriculture and ranching. Specific habitats, such as *chapada* woodlands and shrub lands that are very rich in biodiversity should be identified and given high priority for protection.

- ***Landowners should be encouraged to comply with set-aside requirements to create “legal reserves”.***

Programs should be established to encourage landowners to comply with requirements to set aside land as "legal reserves". There are a number of promising initiatives underway. For example, in the state of Mato Grosso there is a program that allows landowners, who had no pristine natural habitats on their property when the legislation came into force, to "acquire" from the state government an equivalent area in sites earmarked as state protected areas. This is a variation on tradable rights whereby the government sells sufficient land to producers to meet their set-aside requirements in the vicinity of parks and reserves so that these areas become "private extensions" of parks and reserves. Another option would be to reforest the corresponding area on their existing property (with a lapse of 20 years as in the state of Mato Grosso do Sul). Elsewhere, the idea of creating cooperatives of landowners to buy areas to be set aside for protection is being developed.

- ***Development of APPs should be encouraged through the application of the "Green Protocol".***

The idea for a "Green Protocol" should be reviewed and considered for adoption. Such a protocol would condition public and private bank loans on environmental performance criteria. The requirement that loans be granted only after the legal reserves and APPs have been set aside must be enforced.

- ***Enforcement of APPs should be enhanced.***

Innovative techniques for monitoring compliance with legislation requiring "legal reserves" should be adopted in all states and efforts to ensure effective enforcement of the law should be prioritised. In Mato Grosso, for example, a pioneer system of satellite monitoring of compliance with the requirement to set aside legal reserves has been put in place. Such a system should be adopted by other states. Some public prosecutors (*promotorias*) have played an important role in enforcement. However, for the most part, efforts have been isolated and need to be improved significantly to become meaningful.

5.2.5 WATER MANAGEMENT

Water management and conservation is a key environmental concern with respect to expanded soy production, particularly in the Cerrado. Existing policies in this area, such as the creation of Hydrographical Basin Commissions and implementation of the new Water Legislation, should be supported and encouraged. In order to promote the sustainable use of water in the region, policies should be put in place immediately to prevent damage to watersheds and waterways.

- ***Institutions for water governance should be strengthened.***

An effort should be made to foster the creation and support the effective functioning of institutions for water governance. The views and experience of relevant national entities and organisations (such as the Consortia of Water Users) should be considered, particularly in areas where water is scarce and where there is a high concentration of irrigated agriculture.

- ***Integrated pest management techniques should be adapted to soy and other crops.***

Integrated pest management techniques should be widely disseminated through a mix of incentives in conjunction with effective enforcement of the new Water Legislation, to prevent water pollution by agrochemicals. This should occur in conjunction with strengthening initiatives such as the Reduction of Agrochemicals National Program.

- ***Policies to restore watersheds should be developed.***

Special attention should be directed to developing policies that promote the restoration of watersheds, riparian forests and wetlands, which form natural corridors linking hydrographical basins. In relation to management of hydrographical micro basins, policies should aim at appropriate development of these ecological units, including soil conservation practices, recovery of degraded areas, reforestation at riverheads, restoration of riparian forests, management of grazing lands and the implementation of agro-forestry systems.

5.2.6 EMPLOYMENT

Social problems associated with the expansion of soy production include concentration of land and the creation of dispossessed and landless rural workers. Successful negotiations to liberalize trade in various fora should permit increased export of processed soy products, which is likely to result in increased number of new jobs in the soy processing industry. Increased employment would have a positive social impact, although, the beneficiaries of these new jobs would not necessarily be the same groups that suffered negative social impacts from expanded soy production in the countryside. In conjunction with policies that might improve employment opportunities, measures need to be taken in the short term to ensure that soy cultivation will not expand into critical ecosystems.

- ***Programs designed to foster the development of the soy-related agro-industry as well as investment in the soy crushing and oil industry should be developed and implemented***.

5.2.7 SETTLEMENTS AND SOCIAL DEVELOPMENT

Rural workers and the landless poor have been displaced by expanded soy production. Agrarian reform settlements have been created to relieve some of that pressure but the overall result is relatively insignificant. For the most part, the economic viability of settlements is weak and a number of the settlers end up selling their plots, which contributes to the concentration of land ownership and increases pressure on new areas elsewhere.

Policies should focus on the root causes of this problem. Soy cultivation is not viable for small producers. Experience indicates that the best solution for this target group is to encourage organization around cooperatives of rural settlers and/or small producers whereby they join to rent additional land and form partnerships with a view to saving scarce capital and increasing production. Such arrangements improve access to means of production and to markets. At the individual level, cooperatives prevent small producers from tying up scarce capital in land and machinery, or becoming indebted as a result of their purchasing.

- ***The federal government should develop and implement a plan to improve settlement models pursued in agrarian reform, taking into account sustainability***.

Settlements should be located on land that has already been converted for agricultural use. A number of settlements have been established in forested areas that are critical for conservation. This has led to deforestation and habitat conversion not only in the Cerrado and Amazon, but also in the highly endangered Atlantic Forests. A plan, which outlines support for settlements, could be adopted and disseminated by the National Institute for Agrarian Reform (INCRA). In addition, settlement schemes should take into account educational needs and alternatives available to farmers to reduce the rate of urban migration.

Policies must reflect the fact that natural resource management and environmental conservation and preservation are collective societal responsibilities. Documents governing the settlements and cooperatives should include strict clauses for compliance with rules and practices for natural resource management and environmental conservation.

5.2.8 RESEARCH AND DEVELOPMENT

Research has been critical for the development and expansion of soy agriculture in Brazil. It has been fundamental, for instance, in adapting soy cultivation to Brazilian tropical and subtropical climates and soils.

- ***Research and extension programs should be pursued that aim to reduce resource use and environmental and social impacts of soy cultivation, not just improving production.***

Research can help prevent and resolve soy-related environmental problems. Priority attention should be given to agricultural producers and their associations' research centres, and non-governmental organisations (NGOs). Policies should be the result of collective action involving research centres, institutions and foundations, federal and state government authorities, NGOs, rural producer associations and cooperatives, private companies, as well as urban communities, particularly those in the Cerrado.

Priority areas for further research and development include:

- The *trade offs* between more intensive use of areas already occupied (reducing pressure for new clearing) and the use of machines and materials (allowing for intensification of already cultivated soils and posing risks such as increasing contamination of water).
- The viability of grain production in areas previously used for grazing.
- The development and dissemination of improved biological control practices such as integrated pest management, to lower the risk of increased intensity of pests and diseases and harmful agricultural run-off.
- Understanding and developing responses to potential challenges facing expansion in cultivated area brought about by prospective reductions in trade barriers and increasing domestic consumption.
- Identifying methods to meet the growing need for intensive herbicide use to control invasive weeds.
- Developing and encouraging the use of modern techniques for soy production, including less environmentally harmful techniques.
- Examining opportunities associated with developing a system of soy certification.
- Designing different scenarios in terms of the future development of soy in Brazil and its potential environmental and social impacts.

5.3 CROSS-CUTTING POLICIES

The third set of policy recommendations includes cross cutting-policies that are relevant for many sectors, including soy. These include:

- Awareness raising and education
- Governance

5.3.1 AWARENESS RAISING AND EDUCATION

A first step towards pursuing sustainability in all sectors, including the soy sector, is through increasing awareness and education. This involves disseminating information about potential

positive and negative economic, social and environmental impacts and engaging key stakeholders in the development and implementation of solutions. Developing a sense of "co-responsibility" is fundamental to fostering change. Both international and national experiences demonstrate that solutions of this type are more cost effective than the exclusive use of command and control instruments.

- ***Awareness raising should occur through messages to key actors conveying practices that promote sustainable cultivation and processing of soy and its by-products.***

Key target audiences for these messages are soy producers, banks and investors, trading companies, the soy processing industry, consumers in both producer and consumer countries, and government policy-makers responsible for environmental conservation, land-use planning, agrarian reform, soy production, trade and education. Win-win opportunities should be promoted, together with arguments and perspectives that consider environmental and social impacts and lead to increased cost-effectiveness in the soy sector and stronger international and domestic negotiating positions.

- ***Awareness raising should occur through education programs that encourage society to value biological diversity in its multiple aspects.***

This includes the dissemination of information on the ecological, genetic, social, economic, scientific, educational, cultural, recreational, aesthetic, and intrinsic values of biodiversity.

In order to develop an increased awareness of key sustainability issues related to the soy sector, awareness-raising efforts should include the following elements:

- Working with leadership groups and key target audiences.
- Fostering networks of local, national and international NGOs.
- Supporting and empowering local communities.
- Including sustainability as a core theme in new initiatives on environmental education, and incorporating it into school programs.
- Undertaking continuing education and training programs for workers in rural areas.
- Developing programs to support compliance with existing standards and regulations, including encouraging private companies to demonstrate social and environmental responsibility.

5.3.2 GOVERNANCE

There are clear divisions in responsibility between the various institutions that are part of the public administration in Brazil. However, the identification, planning, and implementation of sustainability solutions require a systemic, multi-disciplinary, inter-institutional focus. The

ministries of Agriculture, Rural Development and Agrarian Reform, Science and Technology, Education, Environment, Foreign Affairs, Planning, Energy and Transport will need to work together with a view to establishing goals and achieving common targets to help resolve environmental and social problems at the national level. At present, as a result of a process of decentralisation that began in 1988 whereby increasing power and financial resources were divested by the federal government to state and local governments, policy formulation and implementation is not well-integrated.

- ***Prior to any further expansion of agriculture in the Cerrado or the Amazon regions, an integrated, long-term vision and action plan for conservation and development in the soy sector should be established that includes policies to promote sustainability, taking into account the different roles and responsibilities of the federal, state and local governments as well as the communities affected.***

This is part of an overall imperative to define and establish effective governance structures for policies related to sustainability. Articulation of such as strategic vision and the development of the institutional structures to support it, should be guided by principles that reflect the decentralized administration, respect the "Federal Pact", empower grassroots and civil society groups, are cost effective, and encourage accountability.

- ***A coordinating structure should be developed to manage activities related to sustainability in the soy sector in a participatory way.***

Such a structure goes beyond inter-departmental planning. A coordinating structure would manage agreed activities; identify, convene and mobilize stakeholders; delegate roles and responsibilities; ensure cooperation between the state and federal levels, as well as with the private sector and other representatives of civil society; and identify indicators, and monitor progress towards measurable goals.

- ***Efforts should be made to improve Brazil's institutional capacity for the effective implementation and enforcement of legislation related to sustainability.***

Brazilian legislation includes ample provisions that, if implemented effectively, should encourage environmental protection and promote sustainability. The application of command and control measures alone, however, is unlikely to be sufficient given the lack of institutional capacity for effective enforcement. Some interesting alternative methods are being developed that could render monitoring and enforcement less costly and more effective. These include, for example, the use of satellite technology for monitoring the enforcement of legal reserves in Mato Grosso. The development of institutional capacity to effectively implement, enforce and monitor legislation related to sustainability should include concrete initiatives to involve civil society in a broad,

participatory manner. Policies with recognised negative environmental and social impacts should be identified and avoided.

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Sustainability Assessment of Export-led Growth in Soy Production in Brazil

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I. INTRODUCTION

This is the summary of the report "Sustainability Assessment of Export-led Growth in Soy Production in Brazil", which was undertaken by WWF Brazil as part of a three-year project on Sustainability Assessment of trade led in partnership by WWF International and WWF US. As part of the Sustainability Assessment (SA) Project, WWF initiated a case study to examine the impacts of liberalisation on soy agriculture in Brazil.

The case study highlights the major factors associated with growth in the sector, which include the development of increasing export markets for Brazilian soy grain in Europe and elsewhere, which are leading to unprecedented intensification and expansion of production. The study assesses from a sustainability perspective, the methods of expansion, including production practices and conversion of land for agriculture, with a particular focus on the vulnerable ecosystems in the Centre-West region of Brazil: the Cerrado, the Pantanal and the Amazon.

This case study was considered timely for a number of reasons:

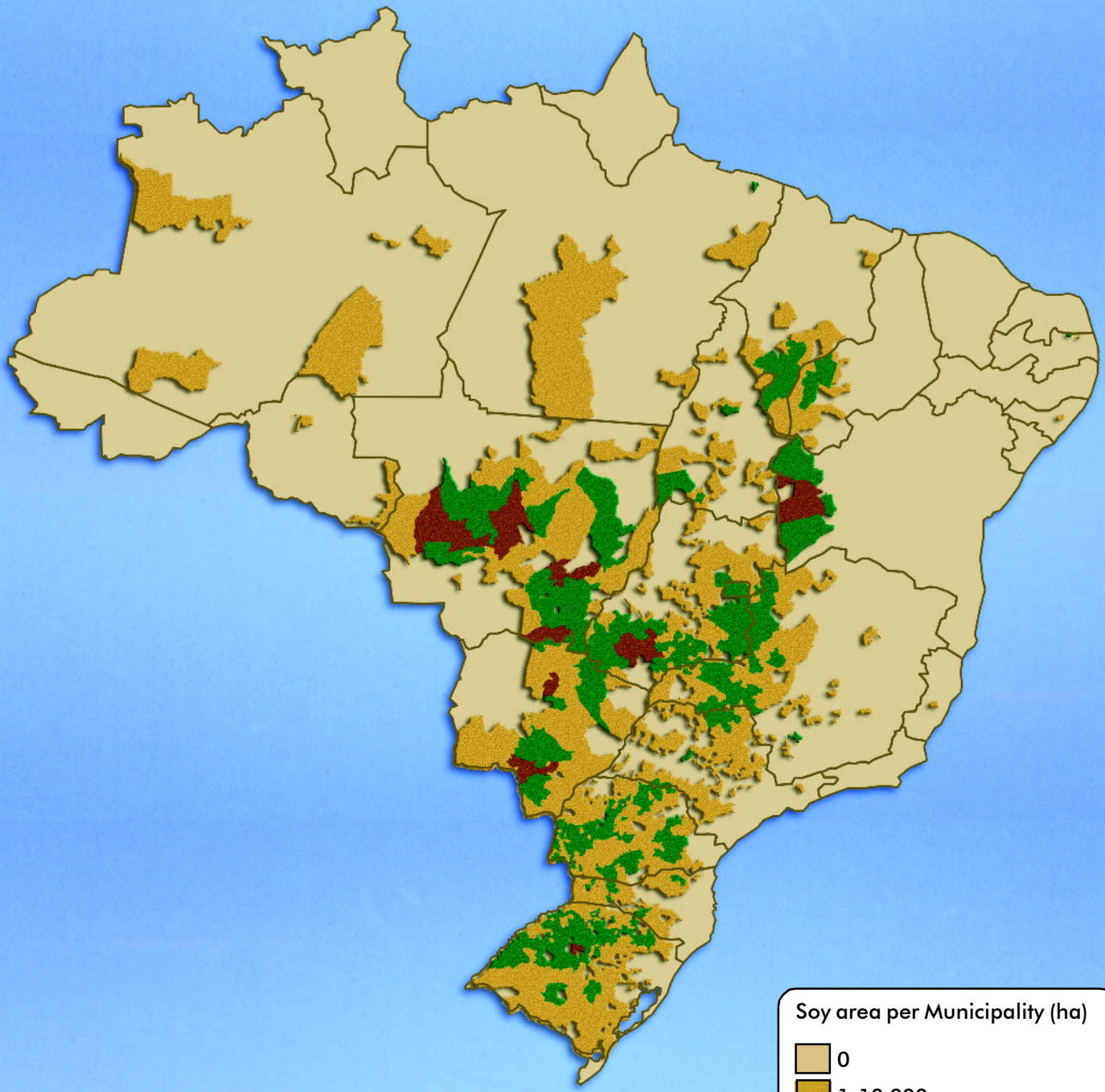
- Agriculture, and soy in particular, is a critical export sector for Brazil, and stands to be impacted by current World Trade Organisations (WTO) negotiations around the Agreement on Agriculture.

- Brazil, as a leading country in MERCOSUR, is engaged at present in negotiations with the EU. The EU is the most important export market for Brazilian soy and much of the Brazilian production is exported directly in its unprocessed form to the EU.

- Negotiations in support of a Free Trade Area of the Americas (FTAA) will conclude in the coming years with potential impacts on Brazilian agriculture, and in particular trade in soy vis-a-vis relations with Brazil's most important competitor for soy grain exports, the United States.

The study examines in detail the current state of domestic oversight, production and trade of soy and soy products in Brazil. It concludes that the soy sector in Brazil is at a critical stage in its development. In the context of increasing efforts to liberalise agricultural trade in a number of fora, it is vital that decisions taken by the Brazilian government, both at home and in an international context, place the soy sector on a solid path to sustainability. The study identifies a number of trade-related and non-trade related policies that could contribute to achieving this goal.

DISTRIBUTION OF SOY PRODUCTION IN THE BRAZILIAN MUNICIPALITIES, 2000



Soy area per Municipality (ha)

- 0
- 1-10.000
- 10.001-100.000
- 100.001-360.000

Brasília, October 2000
Source: INCRA/SIDRA

II. SOY IN BRAZIL

Rates of growth in the soy sector in Brazil have outpaced growth of any major crop, anywhere in the country, this century. Soy is a core component of the Brazilian economy, representing six per cent of the gross domestic product (GDP) and employing close to five and a half million people. It is also a major export crop. Brazil stands second only to the United States in exports of soy grain and second to Argentina in exports of soy meal.

Expansion in soy is being driven by a number of factors; some domestic and some associated with international trade and behaviour in major export markets. The consumption of soy and its derivative products in Brazil has been growing steadily throughout the 1990s, but the vast majority of production is exported in the form of soy grain or, to a lesser extent, as "first level" processed by-products (meal and oil). Production is likely to increase to meet this demand, fuelled in part by an increase in demand for animal protein such as chicken, pork and beef, much of which is fed a staple diet that includes high concentrations of soy meal. In addition, demand from European markets has risen as a result of protein substitution from meat and bone towards soy and other proteins. This is due in part to bans on the use of meat and bone meal in animal food in the European Union (EU) as a result of recent outbreaks of *Bovine Spongiform Encephalopathy* (BSE/"mad cow" disease). Following its accession to the World Trade Organisation (WTO) China is poised to become a major importer of Brazilian soy, which could put further pressure on the sector and encourage unsustainable production practices.

Increased demand, particularly in export markets, has been met by increasing production of soy and increasing exports of soy grain. A number of policies in Brazil and in its major trading partners favour this specialization in grain. First, Brazil's processing industry is not as competitive as the industries of its main rival Argentina, which benefits from a favourable tax climate for processors and where the industry employs state-of-the art technology. Second, grain destined for the processing industry is subject to taxes that reduce profit margins in the soy-crushing industry in Brazil. These taxes are not imposed on grain and therefore encourage production of grain, which is exported. Third, tariff escalation policies on processed soy products in importing countries favour the export from Brazil of grain, rather than meal and oil. These factors have combined to put downward pressure on investment in the processing industry in Brazil, which in turn, further reduces competitiveness of processed soy products.

III. THE CENTRE-WEST REGION

The rapid growth in soy production took place initially in the southern states in Brazil. Since the 1990s, this production has expanded and over half the soy is now produced in the region of the Cerrado in the Centre-West region of Brazil, which is well suited for soy cultivation with a favourable geography and climate. However, much of the Cerrado is also ecologically sensitive and home to an exceptionally high level of biodiversity and will be impacted by both the rate and the means of expansion.

The expansion of soy cultivation is characterized by increasingly large production units designed to take advantage of economies of scale. These large farms are typically established by buying smaller parcels of land from small landowners. However, it also involves expansion onto significant areas of new land, which must be cleared and prepared for soy production. Side effects of this process include deforestation, the destruction of species and habitats, removal of natural vegetation and the loss of ecosystem functions and services. Not only does the natural vegetation protect and sustain biodiversity, it also plays a role in regulating climate and hydrological cycles. Studies on tropical forests have shown that large-scale deforestation can lead to a drop in precipitation and a rise in temperature. Among the most worrisome impacts are on the "gallery" forests in the Cerrado, which are home to half of Brazil's endemic species and a quarter of its threatened species. Expansion into such ecologically complex ecosystems could have impacts that are irreversible.

The concentration of land ownership into large production units also has important social impacts. It encourages small landowners to sell their land and thus effectively lose their livelihoods. The production of soy is not labour intensive and many of these farmers are forced to migrate to large urban centres, contributing to problems in cities associated with urbanization. Other farmers engage in speculative purchases of land further west into the Cerrado or north into the Amazon, which they clear and re-sell.

Production has not only come about as a result of expansion of the area in production. There have also been significant increases in yields in Brazil, brought about by quicker and more efficient diffusion of technology including seeds, agrochemicals and other cultivation materials (such as lime and fertilizer). Increasing yields relieve pressure on land, but they also have negative employment effects. In addition, production practices, including conventional tillage techniques and the use of machinery, cause erosion and degrade the nutrient quality in the soil. Pesticides are commonly used to control weeds and pests. This can have impacts on the environment through contamination of the land and water, and can also impact human health if methods for application are not carefully controlled.

Policies directed towards improving the transportation infrastructure in the Centre-West region of Brazil also drive the expansion of production. Major infrastructure projects are being undertaken to develop new export corridors to improve transport of grain between production areas in the Centre-West part of the country, the processing facilities (located close to large urban centres) and ports. However, as transportation infrastructure develops, there is a danger that expansion will be encouraged even further north into areas of the Amazon that have, until now, not been economically viable for exploitation. Coupled with an expectation that domestic demand for soy products will continue to grow, it is critical that policies to enhance infrastructure to service the large plantations in the Cerrado

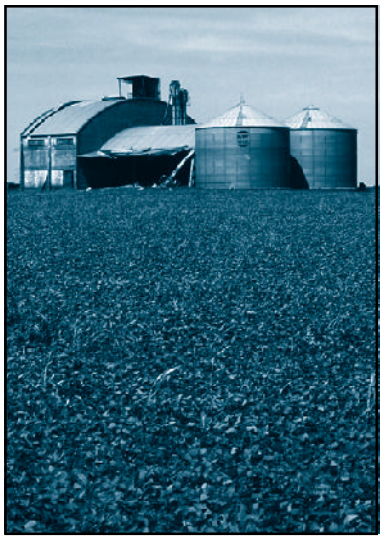
be accompanied by policies that will temper the effects of this infrastructure in encouraging growth into new, and particularly vulnerable, regions. Policies should be put in place to prevent unfettered expansion into sensitive areas and protect key ecosystems in the Cerrado, the Pantanal and the Amazon and encourage any additional production to occur on the already degraded tracts of land, by means of technologies that assure the continued productivity of the natural resources.

IV. TRADE IN SOY AND SOY PRODUCTS

The Brazilian government is engaged in a number of international negotiations on trade liberalization that will impact the soy sector. Typically, government negotiators seek to gain market access and eliminate discriminatory practices such as domestic support and tariff escalation in competitor countries (such as the United States). If these policies are achieved, they will increase the competitiveness of Brazilian soy and might encourage the export of larger quantities of processed production. This could have positive effects for sustainability by adding value to the product and increasing employment in urban areas. By increasing overall earnings in the sector, a shift from unprocessed to processed soy products could help to stem the pressure to increase total soy production, thus relieving pressure to convert lands in the vulnerable areas of the Cerrado, Pantanal and the Amazon. There might also be opportunities associated with continued refusal to adopt the widespread use of genetically modified organisms (GMOs). The "GMO-free" status of Brazilian soy could give Brazil a competitive advantage in some markets (such as the EU), as the soy industries and its major competitors, Argentina and the United States, are now inextricably linked to GMOs.

At the same time, increased liberalisation in the soy sector is likely to encourage existing trends in production, with potential negative environmental and social effects. While opportunities offered by trade negotiations to eliminate these policies that are barriers to greater sustainability in the soy sector should be seized, the Brazilian government also needs to develop and enforce policies to manage the expansion of soy production and promote more sustainable cultivation practices in parallel with efforts to promote exports. This will require, *inter alia*, strong and effective environmental and social policies.

V. SUMMARY OF POLICY RECOMMENDATIONS



Further to the issues raised by the expansion of soy, in Brazil and elsewhere, this study proposes specific policy measures that can be pursued by the government of Brazil, producers, and civil society to ensure that opportunities for growth presented by increasing demand for, and trade in, soy and soy products are pursued in a way that respects environmental integrity and social responsibility and ultimately contributes to sustainable development. Given that the soy sector is likely to continue to expand, the question is how to ensure that there is adequate management of environmental and social impacts. The case-study emphasises three types of policies:

- POLICIES AT THE INTERNATIONAL LEVEL: TRADE AND SUBSIDY-RELATED POLICIES: The first set of policy recommendations includes actions that can be taken at the international level through the various negotiating fora in which Brazil participates. Proposed recommendations focus on changing the terms of trade for soy and products in the soy complex to encourage Brazil to develop increased value-added in its exports, particularly with respect to the EU, Mercosur and the FTAA.

- DOMESTIC POLICIES RELATED TO THE SOY SECTOR: The second set of policy recommendations includes domestic policies that can be implemented in Brazil to pursue various goals, ranging from promoting more sustainable land use at the national level to encouraging best practices at the farm level. These policies, which include *inter alia*, zoning, tax policies, and research and development, rely on a combination of economic incentives and command and control measures for their implementation.

- CROSS-CUTTING POLICIES: The third set of policy recommendations includes cross cutting policies that are relevant for different producing sectors, including soy. Awareness raising and education, governance and compliance with existing legislation are highlighted.

The analysis in this study suggests that the soy sector is likely to continue to expand in Brazil, especially in Cerrado areas of the mid-west and southern Amazon. It is critical to ensure that there is an adequate management of environmental and social impacts associated with this expansion. The case study identifies several policy options, which can help reduce any negative impacts associated with increased soy production and enhance its environmental, social, and economic sustainability. These policies are summarised below.

1. POLICIES AT THE INTERNATIONAL LEVEL: TRADE AND SUBSIDY-RELATED POLICIES

The first set of policy recommendations includes actions that can be taken at the international level through the various negotiating fora in which Brazil participates. Proposed recommendations focus on changing the terms of trade for soy and products in the soy complex to encourage Brazil to develop increased value-added in its exports, particularly with respect to the EU, Mercosur and the FTAA.

In addition to implementing measures at the domestic level to help manage any increases in soy production brought about by improved or changing terms of trade, there are measures that can be pursued at the international level, including through positions adopted in international trade negotiations.

Brazil's main objective in international trade negotiations is to obtain greater market access for its exports, and particularly agricultural products. If new markets are opened and prices continue to be stable, increased exports of soy have the potential to generate large economic gains and surpluses in the current account balance, which would benefit the Brazilian economy. This international dimension is key for this sector given high levels of exports and the role of trade policies in encouraging growth.

- **Tariff escalation practiced by countries that import Brazilian soy should be removed**.

The existence of differential tariffs on processed soy products (tariff escalation) may create pressure for the continued expansion of soy production. The reduction of tariff escalation, if accompanied by implementation of domestic policies to improve environmental and social performance, could have beneficial impacts and improve overall profitability and sustainability of the sector. Removing tariff escalation would improve global profitability and sustainability in the agricultural sector. Positive gains for sustainability would be brought about by the generation of greater value-added soy products in Brazil, encouraging employment growth and increased investments in agro-processing activities.

- **Production-related subsidies in industrialized countries should be removed**.

The existence of production-related subsidies, such as those applied in industrialised countries, encourages competition for market share by employing environmentally damaging 'cost-cutting' measures, including expanding the area of agricultural land under production. However, there might be a trade-off between employment and the environment. Should soy subsidies in competing countries and trade barriers be removed immediately, there could be a strong impetus towards further expansion of soy into new areas, resulting in dramatic conversion of natural habitats. Domestic policies will need to be put in place to ensure that any increasing production is managed sustainably.

- **Growth in the production of soy for export should be managed sustainably.**

Any reduction of subsidies in other producer countries and phase-out of market barriers in consumer countries should be balanced by a demonstrated commitment by Brazil to reduce the environmental and social impacts from current production, as well as the expansion of soy as a result of policy changes elsewhere. The government of Brazil should adopt and enforce policies to govern the expansion of soy cultivation. Without these parallel efforts, export-led strategies for expanding soy production are likely to cause irreversible environmental damage in ecologically sensitive areas, such as the Cerrado and the transition area between the Cerrado and the Amazon.

- **Sustainability assessments of trade should be conducted.**

Sustainability assessments (SA) of trade, including for key sectors such as soy in Brazil, should be undertaken in the context of regional trade negotiations. The ongoing negotiations between the EU and Mercosur, and the FTAA negotiations, provide a unique opportunity to place SA on the agenda of regional trade negotiations. In July 2002, SA was discussed at a ministerial meeting between EU and Brazilian trade negotiators. Further discussions on SA should lead to tangible policy outcomes. SA should also be considered in the context of the FTAA negotiations.

- **Genetically modified (GM) soy should not be planted in Brazil**.

The rights of consumers to know whether the soy they consume is GM-free, such as through labelling and certification, should be encouraged. Preference for GM-free soy in important export markets (such as the EU and China) is an opportunity for Brazilian soy.

2. DOMESTIC POLICIES RELATED TO THE SOY SECTOR

The second set of policy recommendations includes domestic policies that can be implemented in Brazil to pursue various goals, ranging from promoting more sustainable land use at the national level to encouraging best practices at the farm level. These policies should be taken in conjunction with any policies that might be pursued at the international level. Domestic policies rely on a combination of economic incentives and command and control measures for their implementation.

(a) Land Use Planning Policies and Practices, and Zoning

Conversion of natural habitats into agricultural landscapes is one of the main problems associated with increased soy production and cultivation. Deforestation, water pollution and indirect impacts due to infrastructure investment and development (construction of roads, railways and waterways to transport soy) can be significant. Avoiding any negative impacts involves, among other measures, improved planning. Advanced zoning and land use planning policies should be applied to the soy sector. Several proposals have been presented by universities, public bodies and non-governmental organizations. Such policies would help identify areas for production and areas for priority environmental conservation, urban expansion and other uses. Extensive consultations with social groups that are directly affected are required.

- **Effective implementation and enforcement of Ecological and Economic Zoning should be pursued by all states.**

With large parts of its territory relatively intact, Brazil is in a unique position to guide its future development and land use in a way that accommodates priorities related to both conservation and development. Ecological and Economic Zoning at the state level in Brazil is now widely recognized as a key land-use planning tool and has become an important component of public policy, particularly in the Amazon region. The zoning process defines areas that must be earmarked for conservation of biodiversity, and those that can be used for crop cultivation, livestock rearing development, and other human uses.

Few states in the Brazilian Amazon and Cerrado biomes have completed their Ecological and Economic Zoning, with the notable exception of the State of Acre. Even where this process has been started, biodiversity conservation is not receiving the attention that it deserves. Typically the areas that are set aside for conservation are marginal lands that are unsuitable for agriculture and ranching. These areas have not been selected based on the application of any fundamental criteria for conservation of biodiversity. Policies must be put in place to ensure that the expansion of soy cultivation and agribusiness does not take place at the expense of ecologically valuable habitats. Participation and involvement of civil society in these processes is very important for their success.

Zoning should include consideration of the following elements that should form the basis of criteria for the effective implementation of Ecological and Economic Zoning:

- Areas should be earmarked for agricultural activities when land is best suited given the nature of the soil, and priority areas for crop cultivation, agro-forestry, forestry, and habitat restoration.

- Areas should be identified that are economically and ecologically unsuitable for agriculture or livestock development based on such criteria as development density and environmental degradation.

- Areas should be identified that are those most suitable for ranching, ranging from extensive to intensive practices.

- Areas should be identified for conservation based on the systematic application of biological criteria, taking into consideration the importance of 'ecological corridors'.

Where soy expansion must occur, land already deforested and abandoned should be given priority, taking into consideration Economic and Ecological Zoning. In the Amazon alone, more than 160,000 km^2 of degraded and abandoned land exists. Where suitable, this land should be used to accommodate agrarian reform settlements, expansion of cash crops, and ranching.

Effective implementation and enforcement of Ecological and Economic Zoning should be pursued by all Brazilian states, and particularly those located in the Amazon and Cerrado biomes. In states such as Mato Grosso, Rondônia, Tocantins, Maranhão, Piauí, Bahia and Goiás, where soybean expansion is occurring most rapidly, the implementation and enforcement of effective zoning and land use should be a priority.

- **Large-scale infrastructure development should be subject to comprehensive environmental and social impact assessments.**

Investment in transportation infrastructure (particularly roads) has led to the occupation and the opening-up of new land, pushing the soy frontier north into the Cerrado. In addition, large-scale improvements to waterways for transportation of soy and other products threaten to alter freshwater habitats and impact negatively on biodiversity.

The Brazilian government has committed itself to conduct broad environmental impact assessments when developing infrastructure projects. Such reviews will include an analysis of the cumulative impacts of transportation infrastructure at a landscape or ecoregion level. While this is a step in the right direction, it is too early to assess the success such assessments will have in preventing and mitigating any negative environmental impacts of infrastructure development related to soy expansion, or how that expansion might affect other sectors, such as energy, for example.

Comprehensive environmental and social assessments of large infrastructure projects should be systematically carried out. These should include, but not be limited to, consideration of measures to avoid primary and secondary environmental impacts associated with the conversion of habitats with a high ecological value. Important social elements should also be addressed in these evaluation processes.

Large-scale infrastructure development projects should be integrated with ecological and economic zoning. This would reinforce coherence and synergy between decisions affecting land-use planning at state and federal levels.

(b) Tax-related Policies

Fiscal policy directed towards the soy sector in Brazil has had a strong influence on its development and patterns of specialization. At present, there is a clear bias in favour of production and export of soybeans, at the expense of crushing and value-added processing activities. Existing preferential tax treatment of soybeans for export should be removed or balanced with less onerous taxation applied to soy processing activities.

- **The emphasis in the tax burden should be shifted to encourage the increased processing of soy.**

From an environmental perspective, removing taxes such as the ICMS, PIS, COFINS and FUNRURAL, would lead to an expansion of planted area (estimated at almost 4.3 million hectares). While tax elimination is not by itself environmentally harmful, it is likely that increased production following tax rebates would result in expansion of the agricultural frontier given current deficiencies associated with land-use planning.

The emphasis in the tax burden could be shifted to encourage the increased processing of soy and enhanced value-added. This would help alleviate pressure on the agricultural frontier by shifting more of the activity in the sector into value-added products. However, such changes should be implemented in conjunction with appropriate land-use policies and effective enforcement of existing legislation.

- **Soy-producing states that have not done so should adopt the "green" ICMS.**

The "ecological" or "green" ICMS provides that a greater share of municipalities' ICMS revenue be dedicated to environmental conservation through the creation of protected areas. As of December 2002, 11 of the 27 states in Brazil had put such a mechanism in place. Soy-producing states, particularly those located in the Cerrado and Amazon biomes, should make it a priority to adopt the "green" ICMS.

(c) Best Management Practices (BMPs) at the farm level

At the farm level the adoption of environmental management practices in the agricultural sector could improve the overall environmental conditions associated with soy production. Among such technologies developed in Brazil there is a set of principles that guide a production management system, known as Best Management Practices (BMPs), being implemented and adopted by public and private institutions with success in conserving resources and promoting sustainable production. The majority of the producers in the Cerrado do not employ the full range of BMPs that have been adopted by more progressive producers for some time now in many regions of the country. *The Brazilian government should adopt a range of incentives and command and control policies to encourage or compel the adoption of BMPs, which reduce or avoid environmental impacts (particularly those on soil and water) and increase the efficient use of inputs.*

- **Incentives should be put in place to encourage the widespread adoption of no-tillage techniques and discourage the use of conventional cultivation systems.**

No-tillage cultivation techniques can prevent erosion and other damage to the soil and are less harmful to the environment than conventional methods of tillage. No-tillage techniques have been

adopted in most grain-producing regions in the South and Southeast of Brazil and are being disseminated in the Cerrado. The use of no-tillage techniques should be extended to the remaining 30 to 40 percent of areas under soy cultivation in the Cerrado, where they have not yet been adopted.

A well-targeted system employing direct payments and tax incentives could help ease the transition from conventional systems to no-tillage technology, as well as encourage companies to develop, improve, and disseminate the necessary machinery. Promoting the use of such technologies could be accomplished in part by conditions attached to agricultural lending. To this end, credit portfolios of financing agencies should provide for technical assistance geared towards such techniques and practices.

- **The promotion of combined cattle rearing and crop cultivation should be encouraged.**

An effort should be made to develop and implement programs to encourage the production of cattle and high yield crops in rotation in the Cerrado and other soy-producing regions. A program combining cattle rearing and crop cultivation activities could promote economic development and capitalise on the large areas of degraded pasture in the Centre-West region of Brazil. Such programs would respond to requirements for domestic supply and at the same time reduce pressure to convert natural habitats. Success in such a program could help Brazil meet its international commitments under *Agenda 21* by contributing to poverty alleviation associated with extensive cattle rearing practices in the Cerrado. In some cases, especially for small farmers, financial support may be needed to cover start-up investments.

(d) Legal Reserves and Protected Areas

The Brazilian Forest Code requires that all private properties must protect the vegetation cover on mountain slopes, in riparian forests, and in watersheds – so called Areas of Permanent Protection (APPs). It also requires landowners to set aside portions of their property under "legal reserves". In the Cerrado, 20 percent of the property must be set aside, while in the transition Cerrado/Amazon forests that rate is 50 percent and in the Amazon forests, 80 percent. Clear-cutting is forbidden in "legal reserves". The development and enforcement of APPs is urgently needed to promote sustainability. The following policies could contribute to this effort:

- **The identification, creation and demarcation of new protected areas should be vigorously pursued.**

The identification, creation and demarcation of new protected areas, particularly in highly ecological valuable habitats, is an urgent priority that should be pursued by the Brazilian government. This includes habitats situated in the regions of the Cerrado and the Amazon, which are most vulnerable to conversion into agriculture and ranching. Specific habitats, such as *chapada* woodlands and shrub lands that are very rich in biodiversity, should be identified and given high priority for protection.

- **Landowners should be encouraged to comply with set-aside requirements to create "legal reserves".**

Programs should be established to encourage landowners to comply with requirements to set aside land as "legal reserves". There are a number of promising initiatives underway. For example, in the state of Mato Grosso there is a program that allows landowners, who had no pristine natural

habitats on their property when the legislation came into force, to "acquire" from the state government an equivalent area in sites earmarked as state protected areas. This is a variation on tradable rights whereby the government sells sufficient land to producers to meet their set-aside requirements in the vicinity of parks and reserves so that these areas become "private extensions" of parks and reserves. Another option would be reforesting the corresponding area on their existing property (with a lapse of 20 years as in the state of Mato Grosso do Sul). Elsewhere, the idea of creating cooperatives of landowners to buy areas to be set aside for protection is being developed.

- **Development of APPs should be encouraged through the application of the "Green Protocol".**

The idea for a "Green Protocol" should be reviewed and considered for adoption. Such a protocol would condition public and private bank loans on environmental performance criteria. The requirement that loans be granted only after the legal reserves and APPs have been set aside must be enforced.

- **Enforcement of APPs should be enhanced.**

Innovative techniques for monitoring compliance with legislation requiring "legal reserves" should be adopted in all states and efforts to ensure effective enforcement of the law should be prioritised. In Mato Grosso, for example, a pioneer system of satellite monitoring of compliance with the requirement to set aside legal reserves has been put in place. Such a system should be adopted by other states. Some public prosecutors (*promotorias*) have played an important role in enforcement. However, for the most part, efforts have been isolated and need to be improved significantly to become meaningful.

(e) Water Management

Water management and conservation is a key environmental concern with respect to expanded soy production, particularly in the Cerrado. Existing policies in this area, such as the creation of Hydrographical Basin Commissions and implementation of the new Water Legislation, should be supported and encouraged. In order to promote the sustainable use of water in the region, policies should be put in place immediately to prevent damage to watersheds and waterways.

- **Institutions for water governance should be strengthened.**

An effort should be made to foster the creation and support the effective functioning of institutions for water governance. The views and experience of relevant national entities and organisations (such as the Consortia of Water Users) should be considered, particularly in areas where water is scarce and where there is a high concentration of irrigated agriculture.

- **Integrated pest management techniques should be adapted to soy and other crops.**

Integrated pest management techniques should be widely disseminated through a mix of incentives in conjunction with effective enforcement of the new Water Legislation, to prevent water pollution by agrochemicals. This should occur in conjunction with strengthening initiatives such as the Reduction of Agrochemicals National Program.

- **Policies to restore watersheds should be developed.**

Special attention should be directed to developing policies that promote the restoration of watersheds, riparian forests and wetlands, which form natural corridors linking hydrographical basins. In relation to management of hydrographical micro basins, policies should aim at appropriate development of these ecological units, including soil conservation practices, recovery of degraded areas, reforestation at riverheads, restoration of riparian forests, management of grazing lands and the implementation of agro-forestry systems.

(f) Employment

Social problems associated with the expansion of soy production include concentration of land and the creation of dispossessed and landless rural workers. Successful negotiations to liberalize trade in various fora should permit increased export of processed soy products, which is likely to result in increased number of new jobs in the soy processing industry. Increased employment would have a positive social impact, although, the beneficiaries of these new jobs would not necessarily be the same groups that suffered negative social impacts from expanded soy production in the countryside. In conjunction with policies that might improve employment opportunities, measures need to be taken in the short term to ensure that soy cultivation will not expand into critical ecosystems.

- **Programs designed to foster the development of the soy-related agro-industry as well as investment in the soy crushing and oil industry should be developed and implemented.**

(g) Settlements and Social Development

Rural workers and the landless poor have been displaced by expanded soy production. Agrarian reform settlements have been created to relieve some of that pressure but the overall result is relatively insignificant. For the most part, the economic viability of settlements is weak and a number of the settlers end up selling their plots, which contributes to the concentration of land ownership and increases pressure on new areas elsewhere.

Policies should focus on the root causes of this problem. Soy cultivation is not viable for small producers. Experience indicates that the best solution for this target group is to encourage organization around cooperatives of rural settlers and/or small producers whereby they join to rent additional land and form partnerships with a view to saving scarce capital and increasing production. Such arrangements improve access to means of production and to markets. At the individual level, cooperatives prevent small producers from tying up scarce capital in land and machinery, or becoming indebted as a result of their purchasing.

- **The federal government should develop and implement a plan to improve settlement models pursued in agrarian reform, taking into account sustainability**.

Settlements should be located on land that has already been converted for agricultural use. A number of settlements have been established in forested areas that are critical for conservation. This has led to deforestation and habitat conversion not only in the Cerrado and Amazon, but also in the highly endangered Atlantic Forests. A plan, which outlines support for settlements, could be adopted and disseminated by the National Institute for Agrarian Reform (INCRA). In addition, settlement

schemes should take into account educational needs and alternatives available to farmers to reduce the rate of urban migration.

Policies must reflect the fact that natural resource management and environmental conservation and preservation are collective societal responsibilities. *Documents governing the settlements and cooperatives should include strict clauses for compliance with rules and practices for natural resource management and environmental conservation*.

(h) Research and Development

Research has been critical for the development and expansion of soy agriculture in Brazil. It has been fundamental, for instance, in adapting soy cultivation to Brazilian tropical and subtropical climates and soils.

- **Research and extension programs should be pursued that aim at reducing resource use and environmental and social impacts of soy cultivation, not just improving production.**

Research can help prevent and resolve soy-related environmental problems. Priority attention should be given to agricultural producers and their associations' research centres, and non-governmental organisations (NGOs). Policies should be the result of collective action involving research centres, institutions and foundations, federal and state government authorities, NGOs, rural producer associations and cooperatives, private companies, as well as urban communities, particularly those in the Cerrado.

Priority areas for further research and development include:

- The *trade offs* between more intensive use of areas already occupied (reducing pressure for new clearing) and the use of machines and materials (allowing for intensification of already cultivated soils and posing risks such as increasing contamination of water).

- The viability of grain production in areas previously used for grazing.

- The development and dissemination of improved biological control practices such as integrated pest management, to lower the risk of increased intensity of pests and diseases and harmful agricultural run-off.

- Understanding and developing responses to potential challenges facing expansion in cultivated area brought about by prospective reductions in trade barriers and increasing domestic consumption.

- Identifying methods to meet the growing need for intensive herbicide use to control invasive weeds.

- Developing and encouraging the use of modern techniques for soy production, including less environmentally harmful techniques.

- Examining opportunities associated with developing a system of soy certification.

- Designing different scenarios in terms of the future development of soy in Brazil and its potential environmental and social impacts.

3. Cross-Cutting Policies

The third set of policy recommendations includes cross cutting policies that are relevant for different producing sectors, including soy.

(a) Awareness Raising and Education

A first step towards pursuing sustainability in all sectors, including in the soy sector, is through increasing awareness and education. This involves disseminating information about potential positive and negative economic, social and environmental impacts and engaging key stakeholders in the development and implementation of solutions. Developing a sense of "co-responsibility" is fundamental to fostering change. Both international and national experiences demonstrate that solutions of this type are more cost effective than the exclusive use of command and control instruments.

- **Awareness raising should occur through messages to key actors conveying practices that promote sustainable cultivation and processing of soy and its by-products.**

Key target audiences for these messages are soy producers, banks and investors, trading companies, the soy processing industry, consumers in both producer and consumer countries, and government policy-makers responsible for environmental conservation, land-use planning, agrarian reform, soy production, trade and education. Win-win opportunities should be promoted, together with arguments and perspectives that factor in environment and social costs and lead to increased cost-effectiveness in the soy sector and stronger international and domestic negotiating positions.

- **Awareness raising should occur through education programs that encourage society to value biological diversity in its multiple aspects.**

This includes the dissemination of information on the ecological, genetic, social, economic, scientific, educational, cultural, recreational, aesthetic, and intrinsic values of biodiversity.

In order to develop an increased awareness of key sustainability issues related to the soy sector, awareness-raising efforts should include the following elements:

- Working with leadership groups and key target audiences.
- Fostering networks of local, national and international NGOs.
- Supporting and empowering local communities.
- Including sustainability as a core theme in new initiatives on environmental education, and incorporating it into school programs.
- Undertaking continuing education and training programs for workers in rural areas.

- Developing programs to support compliance with existing standards and regulations, including encouraging private companies to demonstrate social and environmental responsibility.

(b) Governance

There are clear divisions in responsibility between the various institutions that are part of the public administration in Brazil. However, the identification, planning, and implementation of sustainability solutions require a systemic, multi-disciplinary, inter-institutional focus. The ministries of Agriculture, Rural Development and Agrarian Reform, Science and Technology, Education, Environment, Foreign Affairs, Planning, Energy and Transport will need to work together with a view to establishing goals and achieving common targets to help resolve environmental and social problems at the national level. At present, as a result of a process of decentralisation that began in 1988 whereby increasing powers and financial resources were divested by the federal government to state and local governments, policy formulation and implementation is not well-integrated.

- **Prior to any further expansion of agriculture in the Cerrado or the Amazon regions, an integrated, long-term vision and action plan for conservation and development in the soy sector should be established that includes policies to promote sustainability, taking account the different roles and responsibilities of the federal, state and local governments as well as the communities affected.**

This is part of an overall imperative to define and establish effective governance structures for policies related to sustainability. Articulation of such as strategic vision and the development of the institutional structures to support it, should be guided by principles that reflect the decentralized administration, respect the "Federal Pact", empower grassroots and civil society groups, are cost effective and encourage accountability.

- **A coordinating structure should be developed to manage activities related to sustainability in the soy sector in a participatory way.**

Such a structure goes beyond inter-departmental planning. A coordinating structure would manage agreed activities; identify, convene and mobilize stakeholders; delegate roles and responsibilities; ensure cooperation between the state and federal levels, as well as with the private sector and other representatives of civil society; and identify indicators, and monitor progress towards measurable goals.

- **Efforts should be made to improve Brazil's institutional capacity for the effective implementation and enforcement of legislation related to sustainability.**

Brazilian legislation includes ample provisions that, if implemented effectively, should encourage environmental protection and promote sustainability. The application of command and control measures alone, however, is unlikely to be sufficient given the lack of institutional capacity for effective enforcement. Some interesting alternative methods are being developed that could render monitoring and enforcement less costly and more effective. These include, for example, the use of satellite technology for monitoring the enforcement of legal reserves in Mato Grosso. The development of institutional capacity to effectively implement, enforce and monitor legislation related to sustainability should include concrete initiatives to involve civil society in a broad, participatory manner. Policies with recognised negative environmental and social impacts should be identified and avoided.

CD content:

- **Full Sustainability Assessment of Export-led Growth in Soy Production in Brazil**