Certification schemes (RTRS and ProTerra) in Brazilian soy

Use of pesticides and cropping systems

Daniel Meyer and Christel Cederberg

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SIK – the Swedish Institute for Food and Biotechnology, Box 5401, SE-402 29 Göteborg, Sweden

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SUMMARY

This report focuses on the development of soybean production, use of pesticides, cropping systems and the rise of certification schemes, RTRS and ProTerra, in Brazil. Soy production is expected to increase and intensify, with China as the major purchaser of Brazilian soy. However, domestic consumption will also increase significantly, for animal feed and biodiesel production.

Despite this development, the contemporary soy model in Brazil is no longer only searching to maximize productivity and economical gain, but is gradually starting to optimize across a far more complex landscape. The issue that Brazilian soy producers face nowadays is how to keep up with the growing domestic and international demand and at the same time address environmental and social concerns. While land use expansion and forest conversion for soy has decreased significantly in the Amazon biome, it has intensified in the Cerrado biome, which holds 5% of the world biodiversity. In order to address environmental impacts, Brazilian producers need to be encouraged to integrate economic and ecological goals into their practices and develop new conservation cropping systems.

Frameworks and tools to protect, manage and monitor vital ecosystems and critical biodiversity areas should be implemented and regional land use dynamics studies should be undertaken. Similarly, pesticide management programs will be needed in Brazil. Despite having a highly efficient and well-adapted cropping system, Brazil is already considered the number one world user of pesticides with soybean crop dominating its consumption. This report shows that soy producers are vulnerable to increasing weed resistance, pests and fungal diseases, as well as market pressures and programs from major pesticide manufactures.

Both certification schemes, RTRS and ProTerra, presented in this report, have possibilities to address and support most of the challenges in order to set up legitimate rules and norms for intensive cropping systems. ProTerra is stricter in terms of environmental and social concerns and excludes GE technology in soy. RTRS have a more integrated approach towards different stakeholders in the value chain. Due to this, RTRS has become less rigorous than ProTerra, but more adaptive and consensual. It is not possible to state that the two certification schemes are transforming cropping systems or changing soy production in Brazil at the moment, as they have just initiated actions and still only have minor market shares in Brazil. Further initiatives and research is therefore needed to continue develop and implement these certification schemes in Brazil.
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INTRODUCTION

Soy is today the most important protein feed crop globally. According to FAOstat, world production and harvested area has increased from almost 27 million ton (Mton) and 24 million hectare (Mha) in 1961 to approximately 253 Mton and 107 Mha in 2012. Despite strong increase in yields over the last 50 years, this has not been enough to satisfy a growing demand for soybeans, and thus planted area has increased significantly.

Brazil is the second largest producer of soy after the United States. Today, soy occupies large swaths of central-western and southern parts of the country and is expanding further, with the forecast to soon become the top world producer and exporter. The intense growth of soy in Brazil together with the globalization of agribusiness increases the pressure on environmental and social systems. Important effects of this development are deforestation, biodiversity loss, water contamination and eutrophication, disruption of land ownership structures, as well as increasing dependency of pesticides and related health impacts, as well as increased dependency of genetically engineered (GE) glyphosate-tolerant soybean cultivars (so-called Roundup Ready (RR) soybeans) (Fearnside 2005; Brown et al., 2007; Cederberg et al., 2009; Green and Owen 2010; Meyer and Cederberg 2010).

To meet ecological and social concerns, actors in the soy value chain are now changing conducts and practices. The goal is no longer simply to maximize productivity, but to optimize it across a far more complex landscape of production, rural development, logistics and environmental and social justice outcomes. Rising interest in developing and taking part in voluntary certification schemes (CS) has therefore become more apparent. CS are used to trace the origin of products, monitor and mitigate negative environmental and social impacts through its activities on the environment, consumers, employees, communities and stakeholders etc and to encourage change.

The aim of this report is to look closer on this new development. It focuses on major environmental impacts, the use of pesticides, cropping systems and the rise of certification schemes, RTRS and ProTerra, by combining data from literature and statistical databases with findings from field visits and interviews with soy producers in Brazil during 2011/2012. The work has been funded by Jordbruksverket, Lantmännen, LRF, Svensk Fågel, Axfood and SIK.
BACKGROUND

Production and land use

Brazil is today the second largest producer of soybeans in the world following United States. Production has tripled during the last two decades, with a total production for 2011/2012 growing season reaching 66.4 Mton, up from around 19.9 Mton in 1990 (CONAB, 2013; IBGE, 2013). Cropland designated to soybeans has also increased and more than doubled during the period to 24.2 Mha for 2012, up from 11.6 Mha in 1990 (ibid.), see Figure 1.

Figure 1 Production and area development for soybeans in Brazil (1990-2012). A prolonged drought in southern Brazil led to a decreased total production during 2011 season. Source: IBGE 2013; CONAB 2013

Major soy producing regions

Two regions have dominated soybean production during the last decades in Brazil: the Center-West and the Southern region. In the Center-West soy production mainly take place on large estates (between > 300 - 50 000 hectares), with high specialization in a few crops (mostly soy and corn), intensive mechanization and use of technology, pesticides and fertilizers. In the Southern region the properties are smaller (mostly between 50 - 200 ha). Mechanization, use of technology and inputs are intensive, but do not reach the same levels as in the Center-West region. Crop production is more diversified and mostly managed by individual farmers who sell their harvests through cooperatives (Bertrand et al., 2005; Bindraban et al., 2009).

Five states dominate soy production today in Brazil, corresponding to 52.2 Mton and close to 80% of of total production: Mato Grosso 21.9 Mton (33%), Paraná 10.9 Mton (16%), Goiás 8.3 Mton (12.5%), Rio Grande do Sul 6.5 Mton (9.8%) and Mato Grosso do Sul 4.6 Mton (7%) (CONAB 2013). Consequently, land use for soy production is also most concentrated in these states, totalling 20.1 Mha (83%) of Brazil total soybean area: Mato Grosso 7 Mha (28.5 %), Paraná 4.5 Mha (18.3%), Rio Grande do Sul 4.2 Mha (17.0%), Goiás 2.6 Mha (10.5%) and Mato Grosso do Sul 1.8 Mha (7.3 %) (ibid.), see Figure 2 and 3.
Photo 1 Example of agricultural landscape in Center-west part of Brazil (photo: D Meyer)

Figure 2 Most important soy producing states in terms of quantity in Brazil (1992-2012). Droughts in southern Brazil reduced the volume of soy production in the states of Paraná and Rio Grande do Sul during 2004/2005 and 2011/12 crop seasons. Source: CONAB (2013)
Domestic consumption and trade

Total domestic consumption of soy (grain, meal and oil together) in Brazil shows a stable trend since 2006. Today, about 36.9 Mton (67%) of total soy produced in Brazil is sold as grain, soy meal stands for 12.7 Mton (23%) and oil for 5.4 Mton (1%), see Figure 4.

Brazil is a major world player in biofuel production. At present, around 78% of the total input for Brazilian biodiesel comes from soy and the contribution is expected to rise to 90% in the near future (Wilkinson and Herrera, 2010).
Exports

According to the MAPA (2013), the value of soybean exports from Brazil in 2012 reached US$ 26.1 billion, an increase of around 8.2% in relation to 2011 when it reached US$ 24.1 billion and representing 26% of the total Brazilian agribusiness exports. In total, 49.9 Mton of soy (grain, meal and oil) was exported from Brazil in 2012, with grain standing for 32.9 Mton, meal 14.3 Mton, oil 1.8 Mton and other soy products 0.9 Mton (Ibid.).

Today, China is the major importer of Brazilian soy. In 2002, major EU countries (Germany, Denmark, Spain, France, Italy and Netherlands) were still the principal importers, standing together for nearly 14.3 Mton (47%). In 2012, the EU’s share from Brazil had decreased to 11.3 Mton (23%) and China increased to 23.5 Mton (48%), up from 4.4 Mton (14 %) in 2002 (CONAB 2013).

Grain
Since 2002, Brazil total export of soy grain has doubled, up from 16 to 32.9 Mton, underpinned by very intense growing demand from China, which reached almost 23 Mton (69%) in 2012. Major EU countries merely stood for 4 Mton (12%) and other countries for 5 Mton (15%) of total grain exports from Brazil, together showing a falling trend since 2005, see Figure 5.

Meal
Since 2002, Brazil exports of soy meal have stayed more or less at the same level of around 12-14 Mton, with the major EU countries as dominating destinies, see Figure 6.

Figure 5 Dominating countries for Brazilian soy grain exports (2002-2012). Source: CONAB (2013)
**Figure 6** Dominating countries for Brazilian soymeal exports (2002-2012). Source: CONAB (2013)

*Oil*

Since 2002, Brazil export soy oil has decreased from 1.9 to 1.8 Mton. China is nowadays the major importer of soy oil from Brazil, see Figure 7.

**Figure 7** Most important soy oil exports in tons by countries (2002-2012). Source: CONAB (2013)

**Future production and land use scenarios**

Future production and land use scenarios indicates a growing development for the Brazilian soybean industry. If domestic biodiesel production and the Brazil-China soybean trade continue to ascent, Brazil will need to intensify its soybean production significantly and expand its land use. According to prognosis by the MAPA (2012), in 2021/2022 soybean production will reach close to 89 Mton. This projection is 22.6 Mton higher then produced during 2011/2012 crop season. Moreover, projected land use of soybean will have to increase to 29 Mha in 2021/2022, representing an increase of 4.4 Mha compared to the todays planted area, see Figure 8. For future domestic use and export, see Figures 9-10.
Figure 8 Future production and land use scenarios for soy in Brazil (2012-2022). Source: MAPA (2012)

Figure 9 Estimation of future domestic use of soybean in Brazil (2012-2022). Source: MAPA (2012)
**Figure 10** Estimation of future soybean exports from Brazil (2012-2022) Source: MAPA (2012)

**MAPITOBA**

Intensification and expansion of Brazilian soy production is expected in a region that has been entitled MAPITOBA, from abbreviations of the four states: Maranhão (MA), Piauí (PI), Tocantins (TO) and Bahia (BA).

**Photo 2** Landscape in western Bahia (photo: D Meyer)

MAPITOBA is located in the north-central Cerrado biome (see map 1). During 2011 MAPITOBA reached 11% share of the national production of soy grains, harvesting 7.4
According to market estimates, by 2021, MAPITOBA should reach 20 Mton of soy (Rabobank 2013).

Map 1 The Brazilian biomes in relation to current and future soy production areas in Brazil. The Cerrado biome covers even some of the eastern and western parts of Brazil

Environmental and social impacts

Biodiversity loss and deforestation

Agriculture is a major cause for loss of global biodiversity and deforestation due to conversion of natural habitats, such as forests and wetlands, into farmland (Green et al., 2005). While concern has focused on the impact of soya expansion into the Brazilian Amazon biome, new soy plantations in earlier rain forest land have been relatively small during the last decade. A voluntary Soy Moratorium (SM) in the Amazon on the sourcing of soya products from recently deforested areas, introduced in 2006, is held to have been effective in halting the expansion of the crop into the Brazilian Amazon. In five years of monitoring activities it has recently been found that 18410 hectares in the states of Mato Grosso, Pará and Rondônia had been cleared and planted with soybeans in the Amazon. The results represent 0.41% of all deforestation in the Amazon, or 0.53% considering the three states analysed (WWF 2012). Nevertheless, critical voices have called into question the effectiveness of the SM in reducing deforestation, and suggest that impacts are likely to be generated through indirect land use change (ILUC) as for example through the displacement of cattle from former pasture areas (Arima et al., 2011), or through the intensification of land use occupation in other biomes.

The Cerrado biome

The Cerrado biome (see map 1) is the second largest biome in Brazil after the Amazon, with an area of approximately 2 million km², which corresponds to about 22% of the Brazilian territory (IBGE 2013). The Cerrado biome is one of the biodiversity richest
savannah biomes in the world, estimated to contain some 5% of the entire Earth’s biodiversity (MMA 2010). Cerrado includes many different forest and vegetation types with both dense forest areas to nearly treeless grassland areas with only few or no shrubs and wetland areas (see photo 3) (Oliveira and Marquis 2002).

According to a survey and satellite image study by the Satellite Monitoring of Deforestation in Brazilian Biomes Project - a technical cooperation project between the Ministry of Environment (MMA), the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), and the United Nations Program for Development (UNDP), the total deforested area until 2002 was 890,636 km², and between 2002 and 2008, this amount was increased by 85,074 km², equivalent to the average annual value of 14,179 km². Thus, by 2008, some 47% of the original and natural vegetation of the Cerrado biome had been lost (MMA 2010). The study also showed that municipalities with the highest recent rates of deforestation also have strikingly high levels of new soya plantations. Furthermore, the Brazilian government’s own research undertaken under the United Nations Framework Convention on Climate Change (UNFCCC) suggest that the recent loss of Cerrado land may have accounted for more carbon dioxide emissions than from deforestation of the Brazilian Amazon as land-use change in the Cerrado is estimated to cause more than 275 Mton of carbon dioxide (CO₂) emissions per year from 2002-2008 (MCT 2010).

Photo 3 Example of cerrado vegetation in the western part of Mato Grosso (photo: D Meyer)

Social impacts

Lima et al., (2011) have done extensive research on the social impacts of soy cultivation in Brazil. According to the authors, there are both positive and negative effects.
Positive effects are that the soybean chain provides jobs in production and transportation of seeds, fertilizers and pesticides, machinery repair, drivers, etc., which is reflected in increased economical welfare as well as in the high Human Development Index (HDI) values in major Brazilian soy municipalities. Furthermore, in 2003, a National Biodiesel Production Program (PNPB) was initiated with a focus on the soy sector, aiming to reduce diesel imports, reduce diesel prices, and promote the inclusion of small soy farmers into the business. Negative effects are, despite increased economic welfare and state aid, that social exclusion of small family farms, illegal occupation and conflicts over land with indigenous people and unfair employment contracts have been commonplace in the Brazilian soy sector. Large-scale plantations have a record of buying out smallholders, who in turn clear cheaper, and untouched land, a movement, which clearly leads to indirect deforestation. Moreover, according to Bickel and Dros (2003), 723 cases of slavery were registered in farms in the state of Mato Grosso in 2002. Indigenous people have also been affected by soy production. Expansion of agricultural and grazing land threatens 650,000 Brazilian Indians in over 200 tribes. In Maranhão, in the northern Cerrado biome, where soy cultivation has expanded rapidly, the number of conflicts rose by 424% over a few years, culminating in 89 land conflicts in 2005 (WWF 2012b). Many cases have also been reported on the negative effects of pesticides on human health; due to large and improper use in soy production (Pignati 2007, Palma 2011).

**PESTICIDES IN SOYBEANS**

Pesticides are substances or mixture of substances intended for preventing, destroying, repelling, or mitigating insects, weeds, foliar diseases, etc.), including herbicide, insecticide, fungicide (EPA 2009). Pesticides are considered crucial ingredients to maintaining the highly intensive Brazilian agriculture model, with many national and international manufactures operating in the country. Statistics on Brazilian pesticide use are mostly reported as sold pesticides in commercial products or volumes active ingredients (a.i.). The a.i. is the chemical compound(s) in the pesticide product that is responsible for killing or otherwise controlling the target insects, weeds, foliar diseases etc. This chapter describes the development of pesticide usage in Brazil with focus on soybean production.

**Development of pesticide use**

Intensive pesticide usage in Brazilian soybean production started during 1960s and 1970s as a result of the Green Revolution and the gradual replacement of small-scale farms into medium and larger farms. Until 1970s, Brazilian farmers mostly use tillage techniques when planting soy, but when no-tillage systems emerged, farmers became highly dependent of herbicides. Until the registration of glyphosate in the early 1980s, producers using no-tillage for soybean had only the herbicides Paraquat and 2,4-D to use for the pre-planting weed control. Glyphosate products were too expensive for producers in early years. The use of herbicides for desiccation at and/or after harvest was also very limited in Brazil until the 1990s, with the major active ingredients used being Bentazon and Atrazin (Landers, 2005).

Since 1970s, Brazilian soybean production has had several fungal and foliar disease epidemics, resulting in heavy yield losses. The frogeye leaf spot caused by Cercospora sojina and plant pathogenic fungus Rhizoctonia solani were the first diseases that really impacted national soy production in the 1970s (FundaçãoMT, 2011). Benzimidazoles fungicides and demethylation inhibitors (DMI) were therefore introduced, and during
the 1980s, strobilurins fungicides become the more popular ones, with Azoxystrobin and Pyraclostrobin + Epoxiconazol and different kinds of mixtures soon used on much of the soybean area (Almeida et al., 2007).

Seed treatment was not a common practice in Brazil during the early days. Soy producers only applied seed treatment more generally after 1990s. Some of the more common used fungicides for seed treatment have been Tetramethylthiuram, Thiamendazole, Carbendazim Thiamendazonel, and Thiophanate-methyl (Henning et al., 2010).

In 1998, the total use of pesticide products in Brazil was around 300000 tons, as active ingredient (a.i) around 130000 tons. The overall average consumption of pesticides as a.i. on the cultivated area increased from 0.8 kg/ha in 1970 to 7.0 kg/ha in 1998, with soy standing for 3.2 kg/ha (EMBRAPA 1998).

Today, Brazilian agriculture is considered the number one world user of pesticides with soybean crop dominating its consumption. According to data from SINDAG (2012), in 2011, the total quantity of pesticides sold in Brazil significantly increased from the previous year. In terms of commercial products, 826,683 tons (+4.9% compared to 2010) was sold (see Figure 11).

These numbers indicate a very strong increase in pesticide usage in Brazilian agriculture when compared with the annual consumption in 1998 (300 thousand tons). Furthermore, pesticide use per unit of cultivated area must therefore be much larger today, with for example Meyer and Cederberg (2010) estimating the average pesticide usage of a.i. for soybean in Brazil at 4.2 kg/ha for 2008.

Brazilian sales of pesticides amounted to a total of US$ 8.5 billion in 2011 versus US$ 7.3 billion in 2010, an increase of +16.2%. In turn, when transformed into Brazilian real (R$) currency value, it is estimated that the pesticide industry sales, in 2011, increased +11.1% over 2010, due to the appreciation of the Brazilian real (R$) currency value (IEA 2012).

1 In 2006 and 2007, the world used approximately 5.2 billion pounds of pesticides, with herbicides constituting the biggest part of the world pesticide use at 40%, followed by insecticides (17%) and fungicides (10%) (EPA 2012)
Soybean is the main consuming crop of pesticides in Brazil, representing 43.5% of total sales of commercial products in 2011 (IEA 2012). Herbicides have the largest value of sales of pesticides. In 2010, it accounted for 33.2% of total revenue, or US$ 2.4 billion, while herbicides in the amount of commercial product, accounted for 415 171 t (52.5%). Sales of herbicides were geared mainly for soybeans (34.6% of the total amount of herbicides). In 2011, fungicides showed the greatest increase in sale quantity of commercial product (compared to 2010), with +27.2%, now reaching 166 336 t (20%), (up from around 56 000 t in 2006). The soybean sector has the highest increase of fungicides, +35% between 2010 and 2011, employed mainly to combat Asian rust (IEA 2012).

The state of Mato Grosso is the largest consumer in Brazil of pesticides. In 2011 the state consumed 171 777 t of commercial product (20.7% of total use) and 72 266 t of active ingredients (21% of total use), followed by São Paulo (15.3% and 16.6%), Paraná (12.5% and 12.2%), Rio Grande do Sul (9.2 % and 9%) and Goiás (10.2% and 10.2%) (SINDAG 2012). The prediction for the crop protection industry in Brazil is that in 2013 pesticide sales and use will continue to increase, particularly, pesticides destined to the Brazilian soybean sector.

**Figure 12** Market shares of the top 10 pesticide manufacturing companies in the Brazilian agrochemical market in 2009

A majority of the pesticide manufacturers in Brazil are represented by the National Association of the Agricultural Defense Products (SINDAG). Currently, it has 44 member companies, such as government agencies, international and national companies, and associations. Among other important entities stands the National Association of Crop Protection (ANDEF), composed by the following companies; Arysta LifeScience, Basf, Bayer CropScience, Chemtura, Dow AgroSciences, DuPont, FMC do Brasil, Iharabras, Isagro, ISK Biosciences, Monsanto, Nisso Brasileira, Sipcam Isagro Brasil, Sumitomo Chemical e Syngenta, many of them with own factories in the country. Around 6000 re-sellers and 1500 agricultural cooperatives perform the distribution of pesticides in Brazil, with Syngenta, Milenia and Monsanto having the highest participation rate (see Figure 12) (Anvisa 2011).
In 2011, 1458 commercial pesticide products (366 a.i.) were registered in Brazil, where the most important were supported by the 489 herbicides, 378 insecticides, 386 fungicides and 144 acaricides. In 2010, of all pesticides products registered in Brazil 44% were classified as extremely or highly toxic and 56% are moderately or slightly toxic. In 2011, the toxicity relationship has lowered to 39% and 61% (Menten et al., 2010; Agrofit 2011; MAPA 2011).

**Pesticide management in Brazil**

*Weeds*

Weeds are a major problem in soy production resulting in significant losses if not managed and controlled properly. In early days, when non-GE soy was generally used, Brazilian producers still followed the pattern of pre-emergence application, applying a range of different herbicide products and active ingredients (a.i.) such as Sencor (metribuzin), Select (cletodin), Herbiflan (trifluralin), followed by post-emergence herbicides selective to the crop such as Basagran 600 (bentazone), Flex (fomesafen), Pivot (imazetapry), Cobra (lactofen), Podium (fenoxaprope-p-ethyl), Classic (clorimuron), and Smart (clorimuron-ethyl) etc. Thus, weed management before GE soy was complicated because of the dependence on many products and it could be difficult to achieve good effects due to resistance problems for some products. As a result, the cultivation of genetically engineered (GE) soybean cultivars in Brazil increased rapidly, thus, changing weed management operation in Brazil. According to practical experiences, GE soybean have simplified weed management and cultivation and also reduced pesticide costs for producers. However, the use of herbicides in Brazil increased significantly between 2004 and 2010, by 60% from around 250 000 tons to 415 000 thousand tons of commercial products (IEA 2005; SINDAG 2012). According to Meyer and Cederberg (2010), between 2003 and 2008, average herbicide use in soybeans has increased from around 2.8 kg to 4.2 kg a.i. per hectare soybean (50% increase), thus, in 2008, approximately 1.5 kg herbicides was used to produce 1 ton soybeans.

The massive adoption of GE soybean cultivars in Brazil has led to excessive reliance of RoundUp Ready (glyphosate) for weed control. Anvisa, the National Health Surveillance Agency in Brazil, has collected data on glyphosate sales in Brazil revealing a dramatic increase in only the last years. Comparing total sales numbers in 2009 (299 965 ton a.i.) with total herbicide sales number in 2009 according to SINDAG (335 816 ton a.i.) indicates that more than 89% of herbicide sales in Brazil were glyphosate based in 2009.
Genetically engineered (GE) glyphosate-tolerant soybeans today dominate the world soybean production and the strong dependence on one herbicide has led to problems with glyphosate-resistant weeds. This development is mostly accentuated in the US but also a growing problem in South America. During field visits in Brazil in 2011/2012 we could identify, with the help of producers, the following weeds with some degree of glyphosate-resistance: Italian ryegrass (*Lolium multiflorum*), Wild Poinsettia (*Euphorbia heterophylla*), Hairy Fleabane/Horseweed (*Conyza bonariensis/Conyza Canadensis*) and Sourgrass (*Digitaria insularis*).

Another common used herbicide to control weeds in Brazil is Paraquat, which is prohibited in the EU due to its toxicity since 2007. It is an herbicide with a different
mode of action than glyphosate and used before the soy crop or for desiccation at harvest. During our field visits, it was suggested to be used as a complement to glyphosate when there is a problem with glyphosate-resistant weeds in soybean production. Statistic of paraquat-based herbicides seems to locate major usage in the southern Brazil.

**Insects**

Soybean crops in Brazil are subject to the attack from a range of insects in all growth phases. Soon after the germination, in the beginning of the vegetative stage, insects such as the stem borer gall maker (*Sternechus subsignatus*), the lesser corn stalk borer (*Elasmopalpus lignosellus*), the white grub complex (*Scarabaeoidea*) and the burrower brown bug (*Scaptocoris castanea* and *Atarsocoris brachiareae*) can cause damage to soybean. The velvet bean caterpillar (*Anticarsia gemmatalis*), the soybean looper (*Pseudoplusia includens*) and several other leaf-feeder insects attack the plants, mainly during the vegetative and blooming stage of crop development. The stink bugs (*Nezara viridula*, *Piezodorus guildinii* and *Euschistus heros*), among other species, cause damage to soybean from the pod set to the end of the pod filling. Soybean crop can also be attacked by other species of insects, considered sporadic, whose population increase is determined by climatic alterations, or other factors as the specific production systems of each region (EMBRAPA 2000; FundaçãoMT 2011).

The use of insecticides in Brazil has increased significantly between 2004 and 2010, by 65% from around 97 thousand tons to 148 thousand tons in commercial products (IEA 2005; SINDAG 2012).

During field visits in 2011/12 we identified with the help of farmers the following insects attacking soybeans in Brazil: velvetbean caterpillar (*Anticarsia gemmatalis*), *lagarta das maçãs* (*Heliothis virescens*), soybean looper (*Pseudoplusia includens*), many different kinds of bugs such as the green stinkbug (*Nezara viridula*), the brown stinkbug (*Euschistus heros*) or the stinkbug (*Edessa meditabunda*) and the soybean stalk weevil (*Sternechus subsignatus*).
Photo 5 Common insects in soybeans, stinkbug and lagarta (photo: D Meyer)

Major Brazilian agriculture research institute such as the Brazilian Agricultural Research Corporation (EMBRAPA) and FundaçãoMT recommends Integrated Pest Management (IPM) as a feasible solution to pests in the country. Field scouting, the correct identification of pests and their natural enemies, as well as the knowledge of the stage of the plant development and their threshold levels are important components of IPM. The results of our field visits indicate that few producers follow all the IPMs recommendations. Only one RTRS farm visited applied IPM.

Several different insecticides products are instead used to control insects in Brazil, but these vary according to insect species and regions. Some of the most common products and active ingredients (a.i.) identified during our fieldwork: Engeo Pleno (lambdaciphalotrina+thiamethoxam), Connect (imidacloprid + betacyfluthrine), Certero (triflumuron), Belt (flubendiamide), Talstar (bifentrin). Also products containing the active ingredients Endosulfan and Methamidophos were used but only on special occasions and most farmers knew about their effects on health and environment and that their legal and commercial validity is to expire in Brazil.

Fungal and foliar diseases

In 2001 the plant pathogenic fungi *Phakopsora pachyrhizi* was discovered in Brazil triggering the first Asian soybean rust epidemic in the country. The Asian soybean rust has since then been a constant problem for soy production, especially during the summer due to favourable conditions in warm and humid period.

According to FundaçãoMT (2011), yield losses due to Asian soybean rust reached 100% in several cases around Brazil between 2001-2010. Especially the Central – West regions soy fields were damaged where the climate is more favourable for the
development of the disease and where the extensive properties pose additional difficulties for control. The most intensive period of the Asian soybean rust in Brazil 2003 – 2007, with the 2005/06 season being the most expensive for soy producers in terms of pesticide cost, see figure 14 below.

![Figure 14](image)

**Figure 14** Annual impact of Asian soybean rust on production of grain, costs for pesticide use and grain loss (2002-2010). Source: Fundação MT (2011)

Yield data from CONAB (2010) show that during years with the most severe attacks of Asian soybean rust (2003-2007), average national yield was significantly, see Figure 15.

![Figure 15](image)

**Figure 15** Soybean year/area/production and yield in Brazil (2002-2010). Source: Conab (2010) & Fundação MT (2011)

A sanitary vacuum period in 2006 was implemented as an important measure against the Asian soybean rust. The sanitary vacuum period runs from July 15 to September 15 and during this period, soybean planting is not allowed. The sanitary vacuum was mainly created as the irrigated corn (safrinha) made fungus surviving the Brazilian winter, making the producers initiate fungicide use as early in September 18 and 30 days after seeding. Several fungicides are today used to control fungal and foliar diseases in Brazil. Some of the major products identified during the field visits were Opera (pyraclostrobin + epoxiconazol), Priori Xtra (azoxystrobin + cyproconazol),
Comet (pyraclostrobin), Aproach Prima (picoxystrobi) and Sphere Max (trifloxystrobin + cyproconazol).

Table 1 gives an overview with examples of some common pesticides used in Brazilian soy, divided for GM and non-GM production. In reality, there are large variations in pesticide use between individual producers, regions and between years due to occurrence of pest and diseases.

**Table 1** Pesticide management and common pesticides in Brazilian soybeans

<table>
<thead>
<tr>
<th>INPUT</th>
<th>STAGE TIME</th>
<th>PRE-PLANTING (DESiCATION)</th>
<th>VEGETATIVE STAGE</th>
<th>REPRODUCTIVE STAGE</th>
<th>HARVEST/POST PLANTING (DESiCATION)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SEP</td>
<td>OCT</td>
<td>NOV</td>
<td>DEC</td>
</tr>
<tr>
<td><strong>MAJOR HERBICIDES (A.I) USED</strong></td>
<td></td>
<td>gm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GM</td>
<td>2,4 D, 2,4 D + Glyphosate, Paraquat, Diuron + Paraquat</td>
<td>Glyphosate</td>
<td>Bentazone, fomesafen, imazetapyr, lactofen, fenoxaprop-p-ethyl, clorimuron, clorimuron-ethyl</td>
<td>Paraquat, Diuron + Paraquat, Diquat</td>
<td></td>
</tr>
<tr>
<td>NON-GM</td>
<td>Metribuzin, cletozin, trifluralin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MAJOR INSECTICIDES (A.I) USED</strong></td>
<td></td>
<td>gm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GM</td>
<td>Endulsulfan*, methamidophos**, thiamethoxam+ciproconazol, lambdaclortaltrina+thiamethoxam, imidacloprid + betacyfluthrine, triflumuron, flube</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NON-GM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MAJOR FUNGICIDES (A.I) USED</strong></td>
<td></td>
<td>gm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GM</td>
<td>Pyraclostrobin + epoxiconazol, azoxystrobin + cyproconazol, pyraclostrobin, picoxystrobi, trifloxystrobin + cyproconazol</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NON-GM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Sales of endosulfan will be prohibited from 2013. **Sales of methamidophos were forbidden in 2012.
CROPPING SYSTEMS

History

In the 1960s, driven by the Green Revolution and the introduction of new crop technologies (fertilizers, pesticides, seeds selection, machinery etc.), as well as different government subsidies and increased international demand, soy was established as an economically important crop in southern Brazil. In just one decade the production multiplied by five, with 98% of this volume being produced in the three southern states of Rio Grande do Sul, Paraná and Santa Catarina, where wheat was grown during winter and soybeans during summer (EMBRAPA 2004).

As a consequence, the production system for soy changed radically in Brazil. Among the most significant transformations was the gradual replacement of small-scale farms adapted to an intercropping system into commercially involved medium- and larger farms (10-50 ha). These farms, located in the southern Brazil based their soybean cultivation with the continuous succession of wheat or a second-season production of corn known as the safrinha (i.e. double-cropping, taking two harvests per years). This system became dependent on intensive soil management. Soil preparation included ploughing, with chiselling or heavy disking, reaching an appropriate soil depth of around 20-25 cm, followed by harrowing before sowing. In total, machineries and vehicles could pass over and stir the soil more than 15 times during a year (EMBRAPA 2010). Due to the side effects of these methods, mainly physical degradation (e.g. soil deterioration, erosion, water loss), and favourable conditions for development of pest and diseases (ibid.), no-tillage practices were introduced into the Brazilian soy production system.

Tillage vs. No-tillage

According to the general knowledge in early days, tillage techniques would allow the seeds to have a better contact with the soil particles constituents, which could favour their germination and hinder weeds (Melo-Junior et al., 2011). Brazilian farmers and researchers, however, soon discovered that the intense usage of tillage was causing destabilization of soil aggregates and reduced nutrient levels in the soil, and as a consequence, led to increasing erosion and losses of water and nutrients. No-tillage techniques therefore started to emerge in Brazil in the 1970s as a cost-effective and more soil-friendly solution. No-tillage means that the soil is always covered with plants or vegetal residues, not using ploughing. The coverage that was left from the previous harvest protects the soil from rain, surface outrun and hydrological and eolic erosion. The only preparation of the soil relates to the seeding, fertilization and application of pesticides (Vila Boas and Garcia 2011).
Genetically engineered (GE) soybean

The first GE soybean seeds officially appeared in Brazil between 1996 and 1997, when the National Technical Biosafety Commission (CTNBio) together with EMBRAPA initiated experiments and field studies with glyphosate tolerant soy varieties. However, national authorities initially did not approve the GE soybeans, but despite its illegal status, the GE soybean continued to rise in popularity by producers. To solve the effects of the increased use of GE soy cultivations in Brazil, the Federal Government, published the Provisional Measure 113/03, authorizing the sale of planted Roundup-Ready (RR) soybeans in the southern state of Rio Grande do Sul, both for domestic and foreign markets, as well as for human and animal consumption, in March 2003. The Provisional Measure was only valid for the 2003/2004 harvest and the continued sale and multiplication of RR seeds was still prohibited. In March 2005, eight years after the introduction of the first GE herbicide-tolerant soy seeds in Brazil, the Biosafety Act 11.105/05 paved the way to the clearing of planting and commercialization of GE soy varieties in Brazil (Schioschet and de Nilson, 2008).

Nowadays, about 20 Mha (85%) are cultivated with GE soybean cultivars (Céleres 2011) in Brazil, up from 5 Mha (20%) in 2004, with Rio Grande do Sul in the south having 99% of its land area planted with GE soybean cultivars, see Figure 16.
Crop rotations and crop distributions

Soybean is the dominating crop in the Center-West region and is increasingly followed by a second crop of maize, known as the safrinha, which is defined as maize grown extemporaneously, from January to April, planted directly after soybeans. Maize can also be grown as the primary crop, then sown in the spring (September/October). In 2011, total cropland area in the Center-West was around 18.4 Mha. Soy and corn represents 95% of the land use area, with soy standing for 10.8 Mha (59%) and corn for 3.9 Mha (36%) (IBGE 2013). According to the field visit, during the rest of the crop year, producers incorporate other crops such as cotton, sugar cane, rice, pearl millet, turnip, wild radish and sorghum, and in some cases even brachiaria for pasture on the fields. Table 2 gives an overview of crop rotations and distributions in the Center-West region.

Figure 16 Share of GE soybean and per cent planted area in major soy producing states in Brazil (2011). Source: Célares (2011)
Table 2 Annual crop rotation options for soy producers in the Center-West Brazil

<table>
<thead>
<tr>
<th>Major crops</th>
<th>Soy planting</th>
<th>Soy harvest</th>
<th>Corn planting</th>
<th>“Safrinha”</th>
<th>Corn harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other crops occasionally integrated with soy</td>
<td>Cotton planting</td>
<td>Cotton harvest</td>
<td>Sugar cane planting</td>
<td>Sugar cane harvest</td>
<td>Sugar cane harvest</td>
</tr>
</tbody>
</table>

In the Southern region, crop rotation involves a more diversified system than in the Center-West. In 2011, the total cropland area in the southern region was around 19.2 Mha. During the summer season the soybean share was 9 Mha (47%), while corn was planted on 4.1 Mha (21%) (IBGE 2013). Wheat, rice and beans were also important crops, together standing for 4.2 Mha (21%). Other crops such as oat, pear millet, turnip etc., are also incorporated during the year. Table 3 gives an overview of crop rotation options in the Southern region.
**Photo 7** Soybean, sown after secondary maize (“safrinha”) (photo: C Cederberg)

**Table 3** Annual crop rotation options for soy producers in Southern Brazil

<table>
<thead>
<tr>
<th>Major crops</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soy planting</td>
<td>Soy harvest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn planting</td>
<td>“Safrinha”</td>
<td>Corn harvest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat harvest</td>
<td>Wheat planting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bean planting</td>
<td>Bean harvest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oat harvest</td>
<td>Oat planting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other crops occasionally integrated with soy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice planting</td>
</tr>
<tr>
<td>Pearl millet plantation</td>
</tr>
<tr>
<td>Turnip planting/desiccation</td>
</tr>
<tr>
<td>Barley harvest</td>
</tr>
<tr>
<td>Sorghum planting</td>
</tr>
<tr>
<td>Brachiaria/Pasture</td>
</tr>
</tbody>
</table>

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CERTIFICATION SCHEMES

The use of certification schemes (CS) standards in soy production, such as RTRS and ProTerra has emerged in recent years to become important for the development of Brazilian soy. CSs are voluntary agreed standards that provide a framework to meet requirements of sustainable production. In this chapter we describe the constituents of both RTRS and the ProTerra schemes in Brazil and compare these to better understand their similarities and differences.

RTRS

The Round Table for Responsible Soy (RTRS) is an international initiative promoted by a range of different global stakeholders as a solution to reconciling opposing viewpoints on economic, environmental and social impacts of soy production (Mier and Terán 2011). RTRS was initiated in 2004 in London and formally formed as an association in Switzerland in 2006 (ibid.).

RTRS distinguishes between Participating and Observing Members and is open to actors of the soy value chain and civil society who may apply to become a Participating Member in one of these three constituencies: Producers; Industry, Trade & Finance and Civil Society. Examples of major participating members are Unilever, Rabobank, Lantmännen, Grupo Andre Maggi, WWF, and The Nature Conservancy (TNC).

The General Assembly (GA) is the highest decision-making body of RTRS. Decisions are made through the vote of Participating Members that are equally represented in the three constituencies. Each constituency has a voting power of one third of the total votes. The GA delegates operational activities and most decision making to the Executive Board (EB), which is elected by the GA and composed of the same three constituencies. Each constituency shall have the right to five seats in the EB.

RTRS Standard for Responsible Soy Production Version 1.0 and 2.0

RTRS has created a global standard for certification of soya production. The RTRS Standard for Responsible Soy Production Version 1.0 was approved 10th of June of 2010 at the annual GA meeting in Brazil after field tests in different countries. In September 2013 version 2.0 of the standard was approved and launched\(^2\).

The RTRS Standard for Responsible Soy Production follows a set of principles and criteria (P&C), which should influence and govern the production of responsible soy crop.

Five principles are applied in the RTRS Standard 2.0 (RTRS, 2013):

- Legal Compliance and Good Business Practice
- Responsible Labour Conditions
- Responsible Community Relations
- Environmental Responsibility
- Good Agricultural Practices

\(^2\) Review in the use of chemicals not included in Rotterdam and Stockholm Conventions, especially Endosulfan, Paraquat and Carbofuran
The principals are followed up by 28 core criteria and 101 detailed indicators that need to be implemented in a certain period, through a process of continuous improvement, by the soy producers.

The RTRS Standard for Responsible Soy Production can be applied to all kinds of soybeans, conventionally grown, GE grown and also organic. Some critical voices have questioned why RTRS accepts GE soy. According to RTRS (2013), a large proportion of GE crops are already being used (around 80% of global soy production is GE). To exclude GM soy from RTRS certification would be to exclude a very large proportion from improvement practices and miss the opportunity to shift the mass of soy production from ‘business as usual’ to a higher standard and on to the path of continuous improvement (ibid).

The P&C in the RTRS Standard for Responsible Soy Production are reviewed not less than once every five years and not more than once every three years unless exceptions are identified or unless the EB or its GA determines otherwise (ibid). RTRS also have a Chain of Custody Standard, version 2.1. The standard make it possible to certify the whole supply chain and presents Module E, with the EU RED mass balance requirements, whereas the rest of the document remains the same. This new module is aligned with EU RED requirements for mass balance EU RED certifications.

Certifying and trading soy

In June 2011 the first shipment to Europe (to the Dutch food and feed industry) of RTRS certified soy from South America was completed (RTRS 2013). In June 2013, over 1.5 Mtons of soy had been certified with RTRS around the world. At producer level, the RTRS certification is valid for 5 years.

RTRS have a web-based trade platform that allows both open and anonymous buying/selling of RTRS certificates as direct transfers between parties, where transferred volumes have to be informed to the system. 1 ton certified RTRS soy is equal to 1 credit. The price of the credit varies according to purchaser/customer negotiation.

RTRS and GMP+

In 2013 RTRS and GMP+ International (a food safety certification scheme) signed an agreement of cooperation, which they say will make certified responsible soy more accessible to a series of markets. The main goal is to provide GMP+ participants the possibility for certification for both Feed Safety Assurance and Feed Responsibility Assurance within a single certification scheme (RTRS 2013).

Many different soy companies, industries and producers, as well as interest from the finance and trade sector and the civil society from Brazil are taking part of RTRS as participating or observing members and Brazil is today the country with most RTRS certified soy at farm level. Table 4 shows Brazilian producers (in terms of area and quantity) that have been certified according to the RTRS standards.
### Table 4 RTRS certified soy by company/producer in Brazil (by June 2013)

<table>
<thead>
<tr>
<th>NAME</th>
<th>STATE</th>
<th>HECTARES</th>
<th>TOTAL (HA)</th>
<th>TONS</th>
<th>TOTAL (T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alfredo Guerra (APDC)</td>
<td>Bahía</td>
<td>1,987.0</td>
<td>140,574.7</td>
<td>6,200</td>
<td>251,748.0</td>
</tr>
<tr>
<td>Grupo André Maggi</td>
<td>Mato Grosso</td>
<td>65,874.0</td>
<td>218,021</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucas Johaness Maria Aernouldts (APDC)</td>
<td>Minas Gerais</td>
<td>300.0</td>
<td>1,080</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLC Agricola</td>
<td>Mato Grosso do Sul/Goias</td>
<td>8,526.7</td>
<td>26,447</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>232,388.7</td>
<td>773,779.0</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fazenda Canaã</td>
<td>Mato Grosso</td>
<td>7,300.0</td>
<td>22,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLC Agricola</td>
<td>Mato Grosso do Sul/Goias</td>
<td>8,526.7</td>
<td>30,762</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grupo André Maggi</td>
<td>Mato Grosso</td>
<td>65,874.0</td>
<td>222,410</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grupo Produtores A Maggi</td>
<td>Mato Grosso</td>
<td>95,400.0</td>
<td>320,543</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siegfried EPP (APDC)</td>
<td>Bahía</td>
<td>8,710.0</td>
<td>33,503</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucas Johaness Maria Aernouldts (APDC)</td>
<td>Minas Gerais</td>
<td>300.0</td>
<td>1,170</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vanguarda Agro</td>
<td>Mato Grosso</td>
<td>46,278.0</td>
<td>143,391</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>432,511.4</td>
<td>1,191,778</td>
<td></td>
</tr>
</tbody>
</table>

### ProTerra

The ProTerra is a certification standard scheme in which companies implement a systematic program of continuous improvement based on ethics, social responsibility and environmental sustainability, as well as product traceability and continuous improvement (Cert ID 2011). ProTerra was developed by Cert-ID and Genetic ID (Europe), from a proposal from Coop Switzerland and the World Wide Fund for Nature (WWF), between the years of 2004 – 2005, mainly as an extension to the guidelines provided in The Basel Criteria for Responsible Soy (2003-2004) (ibid.). ProTerra does not allow GE soy and does not use a governance approach in the same way as the RTRS system. Instead, ProTerra uses a Quality Management System Approach, which lies in parallel to EN/45011/ISO 65, gathering input from foremost members of the food and agricultural industry and public interest organizations (ibid).

ProTerra is applicable to all agricultural products and their derivatives worldwide. It also applies to transport, storage, and handling of agricultural products and to the processing of products into food, feed, and fibre components and manufacturing of foods, animal feeds, natural fibers, fuel and other non-foods for public consumption. ProTerra certified soy can only be a non-GE soybean. All ingredients in the supply chain need to be inspected, audited, sampled and tested before a Non-GE certification may be granted. According to Argos and Cert-ID (2011), the requirements are divided in two groups: Core Criteria that shall be met at certification and maintained throughout the certification period (one year) and Complementary Criteria. Complementary Criteria must be met according to an implementation plan agreed between applicant and certification entity. The criteria requirements are deployed from 18 principles as follows (ProTerra Standard v2.9, 2011):
- Responsible personnel policies, labour practices
- Responsible hiring, compensation and benefits practices
- Protection of worker safety and health
- Freedom for workers to organize and form associations
- Effective communication with workers and community and grievance correction
- Responsible impact on community
- Legal and ethical land use
- Effective environmental management
- Effective management of biodiversity, non-crop vegetation, and environmental services
- Genetically Modified Organisms (GMO) not used
- Waste and pollution managed effectively
- Water managed conservatively
- Greenhouse gasses and energy managed effectively
- Good agricultural practices adopted
- Traceable and segregated chain of custody
- Continuous improvement undertaken
- Correct labeling and logo use

**Certified soy**

The first soybean volume certified as Non-GMO with the ProTerra certification was completed in 2000. In April 2006, the first shipment of certified ProTerra soya from Brazil to Europe was completed. In 2011, 5 Mton of soy had been certified with ProTerra world over. At producer level, the ProTerra certification is valid for 2 years.

**ProTerra in Brazil**

In 2011, approximately 3500 soybean producers (all sizes) and 4.2 Mton of soybean were certified with ProTerra by Cert-ID in Brazil. Most of the ProTerra certified companies and producers in Brazil are found in the supply chain of fourteen producer companies within the Brazilian Association for the Producers of Non-GM Grains (ABRANGE), which include Grupo Andre Maggi, Caramuru, Incopa, Vanguarda and Brejeiro, Integrada, Cvale, Corol, Copacol, Cocari, Coagel, Capal, Agropar and Agrária (ABRANGE 2011). There is however no exact information on which producers and farms are ProTerra certified. For a better overview over the development over time see Figure 17.
Similarities and differences between RTRS and ProTerra

Both RTRS and ProTerra have similar scopes, aiming to contribute to sustainable and responsible soy production practices. However, there are some structural differences as RTRS is a result of a continual governance process, which include consensus building approaches, where many different stakeholders constantly act, exchange ideas and opinions through institutional bodies and different working groups. On the other hand, the Basel Criteria principals prepared the ProTerra certification scheme, and was thereafter set into practice by a private company – Cert-ID. Furthermore, ProTerra opens up for the possibility of certifying all agricultural products and their derivatives at every point in the food supply chain, while RTRS only focus on soy production and the soy supply chain (through their chain of custody standard). Another major difference is that ProTerra does not accept GM technology while RTRS can be applied to all kinds of soybeans, including conventionally grown, GM and as well as organic. The ProTerra certification accepts a maximum GM contamination limit of 0.1% and the RTRS to a maximum of 0.9%.

RTRS and ProTerra are generally equivalent on legal compliance, labour conditions and gender, child labour, community relations, waste and pollution management and good agricultural practice. There are however some differences regarding the subject of land use rights. RTRS allows disruption of traditional land use as long as compensation, subjected to traditional owners free, prior, informed and documented consent is given, while ProTerra forbids all traditional land use disruption.

There are also some differences regarding environmental responsibility. RTRS has a cut-off date by May 2009 for clearing of native forest, but has also developed a mapping project for Brazil that aims to reduce the negative impact of soy expansion over crucial areas for the conservation of biodiversity. ProTerra’s general cut-off date is 1994 but accepts land that has been cleared up to 2004, if compensatory environmental measures have been taken. ProTerra have not developed a similar mapping project as RTRS.

RTRS and ProTerra are equivalent regarding pesticide use, both standards prohibit the use of agrochemicals listed in the Stockholm and Rotterdam Conventions. However,
ProTerra also bans pesticide listed on the WHO class 1a & b and Pesticide Action Network’s “Dirty Dozen” list. Under RTRS, the use of Paraquat and Carbofuran will be eliminated by June 2017. ProTerra list of prohibited chemicals includes endosulfan, carbofuran and methamidophos while the use of paraquat is allowed. Both standards allow Diquat (WHO grade 2), which is commonly used with paraquat. In 2012, RTRS created a pesticide-working group with different stakeholders and researches to discuss the role and use of very toxic pesticides by its members.

RTRS and ProTerra are equivalent regarding greenhouse gas criteria’s and both trying to reduce emissions and increase carbon sequestration. However, RTRS focuses on fossil fuel use, monitoring, and allows increases in fossil fuel use. In contrast, ProTerra requires reductions over time in energy use and especially reduction of all forms of non-renewable energy, not just fossil fuels.

Regarding compliance, RTRS requires for the first audit a compliance of 62% of its indicators, classified as “immediate compliance indicators” and additionally 1 indicator of the total short-term compliance indicators or mid-term compliance indicators. After one year from the date of the initial certification assessment (first annual surveillance assessment) the producer shall meet in addition all the short term compliance indicators. This represents approximately a compliance with the 86% of the RTRS standard. After 3 years from the date of the initial certification assessment: the producer shall comply with 100% of the indicators (immediate + mid-term + short term compliance indicators).

ProTerra requires for the first audit a compliance rate of 80% of its 145 indicators. This means that all (48) core indicators and 70% (68) of the other indicators must have been met. The rest of the indicators must be met during the second year.

Finally, there are also some differences regarding transparency and traceability. RTRS have requirements on public reports and public announcement and that all information regarding certified producers is available on RTRS web site. Public summary report and audit public announcement are not required by ProTerra and it’s very difficult to find information about ProTerra certificated farms.

Similarities and differences between the two standards are summarized in the Appendix 1-3.
DISCUSSION

The Cerrado biome holds around 5% of world biodiversity, but half of its native vegetation has already been cleared. It is very likely that the soy sector in Brazil will continue to open up new agricultural areas in the Cerrado biome to satisfy increasing soy and protein demands, especially from China. This anticipated expansion will happen in the region of MAPITOBA, ideally in areas already cleared for cattle breeding and there transforming degraded pastures into cropland. If so, indirect land use effects will need to be monitored. However, as a result of the latest modification of the Brazilian Forest Code in 2012, law restrictions on forest clearance are now becoming more flexible in Brazil. Certification schemes, such as RTRS and ProTerra, are therefore important for regulating deforestation, loss of forest and native vegetation. In ProTerra, cut-off date has been set to 2004 and is RTRS the cut-off date is May 2009. RTRS has a mapping tool to assess and protect critical biodiversity and highly valuable areas (both social and environmental) as well as identify areas suitable for soy expansion in the Cerrado biome. These certification schemes are also of importance when measuring social impacts, as both prohibits unfair labour conditions, child labour and give emphasis on respectable community relations and good agricultural practice.

Soy production in Brazil is often classified as an unsustainable monoculture system, relying on a very small number of genetic variants, cultivars and planted over large areas for a large number of consecutive years. However, this report shows a more complex picture. Many Brazilian soybean producers have abandoned monoculture systems and use no-tillage and different cropping rotation techniques. These approaches are now leading to diversification of activities on properties with a minimum disturbance of the topsoil layer, but with the disadvantages that weed problems and use of herbicides are increasing.

Most soy producers in Brazil are positive to GE soybean technology. About 20 Mha (85% of total land area for soy) are today cultivated with GE soybean in Brazil. The few ones who have chosen to continue with Non-GM soy do it due to government subventions or market bonuses. Nevertheless, there are no signs that GE soybean cropping have resulted in a general reduction of pesticide use. Instead, this report shows that the Brazilian agriculture is considered the number one world user of pesticides. Over 800 thousand tons of commercial product and 350 thousand tons of active ingredient was used in 2011, with soybean crop dominating its consumption and with an excessive reliance of glyphosate for weed control.

The field visits gave information on other common herbicides used: Zapp (potassium glyphosate), 2-4D (2,4-Dichlorophenoxyacetic acid) and Classic (clorimuron), Gramoxone 200 (Paraquat), Gramoxil (Diuron + Paraquat) but only applied under special circumstances. Common insecticides used are Engeo Pleno (thiamethoxam), Connect (imidacloprid + betacyfluthrine), Certero (triflumuron), Belt (flubendiamide) and Talstar (bifenthrin). Some of the visited farms, mainly middle/smaller sized farmers, where still using insecticides with the active ingredients endosulfan and methamidophos (prohibited in EU), but only on special occasions and most farmers had knowledge about their effects on health and environment. Common fungicides used are Opera (pyraclostrobin + epoxiconazol), Priori Xtra (azoxystrobin + cyproconazol), Comet (pyraclostrobin), Aproach Prima (picoxystrobi) and Sphere Max (trifloxystrobin + cyproconazol). Pesticide use in farms cultivating Non-GM soy differs only in their usage of herbicides, applying products such Flex (fomesafen), Pivot (imazetapyr), Classic (clorimuron), Cobra (lactofen), Select (clethodim), Basagran 600 (bentazone),

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Podium (fenoxapropo-p-ethyl) and Smart (clorimuron-ethyl). Herbicide management in Non-GM soy production is more labour intensive and difficult, as a wide range of products are needed and used, and weed resistance is a problem also here.

Brazilian soy has a high dependence and use of pesticides. A major question is thus: how can an intensive cropping system such as the Brazilian soy system develop to be less dependent of pesticides in future? Obviously, it is not enough with measures only at the field level but rather a whole system approach focusing on many different levels. For example, economic and ecological goals should be integrated in the intensive farming systems and for this to happen, compensation mechanisms by purchasing countries and customers for environmental services probably must be developed. More research is obviously needed, e.g. on relationship between Integrated Crop/Pest Management and Cover Crop Research (CCR). For example the adoption of a living mulch system have been adopted by some farms in Brazil in order to reduce weed infestation and increase weed flora diversity by reducing weed species selection pressure. The system is based on the use of living mulch intercropped in corn or soybean, the living mulch being a forage crop that is used for cattle feed or as soil cover after desiccation by an herbicide. Also methods and systems need to be developed for measuring and monitoring environmental changes at farm and landscape levels, for example pesticide index and global indicators for rural and environmental sustainability. Improving knowledge transfer is important as there is still a large gap between government, research and farmers, which is mostly filled in by major pesticide companies and manufactures. Brazil should intensify the transference and interaction of knowledge between research institutes and producers, and implement multi-stakeholder groups, working groups, consensus building approaches so that manufactures and the “market-advice” are not the first advisor to the producers.

The certification schemes analysed in this report are slowly increasing in significance in Brazil. There are similarities and differences between them and motives for prioritising one before the other seem to be a question of subjective choices.

ProTerra is stricter in terms of environmental and social concerns and excludes GE varieties. RTRS has a more integrated approach with the aim to build consensus between different global stakeholders. Consequently, RTRS has become less rigorous than ProTerra, but more adaptive and with higher probability to create legitimacy. Thus, a major advantage of RTRS is that it can reach all stakeholders that are involved directly or indirectly in the soy value chain and they have access to working groups, training courses, annual events, trade platforms and new sales channels. The advantage of the ProTerra certification is that its certificate seems to be preferred by many environmental organizations and the most demanding non-GM markets and their consumers.

The question that needs to be answered is: what is the effectiveness of these different schemes, in encouraging the spread of positive environmental and social attributes in Brazilian soy- and food production?

There is a measurable gap between what is specified in both certification schemas and what is possible to apply at local level in Brazil. During our farm visits, producers complained about rigorous standards not adapted to the true producer and national realities (mainly the national bureaucracy requirements to comply with the standards). Multi-stakeholder and flexible approaches may therefore be a best practice for finding legitimate solutions among opposing viewpoints, especially when the stakes are high. The Soy Moratorium has been a successful experience in Brazil, in which the private
sector and environmental groups have worked together with the aim to reduce deforestation in the Amazon biome. Experiences and results from the Soy Moratorium initiative could indicate that the RTRS multi-stakeholder approach is the right way to go in order to enhance production and sustainability. Through its governance approach and adaptability, consensus building philosophy and many working groups, RTRS may have better possibilities than ProTerra to set up effective rules and norms and apply new solutions for intensive cropping systems despite the fact of being less strict than ProTerra. Nevertheless, both are still minor in Brazil in terms of quantity, only having 1 % (RTRS) and 7.5 % (ProTerra) of the total soy market share. How these schemes actually can help to change soy production into positive environmental and social attributes in food production is therefore a question that needs further research as they grow in importance.
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ABBREVIATIONS

A.I - Active Ingredient
ANDEF - The National Association of Crop Protection
ANVISA - The National Health Surveillance Agency
APDC – The Association of No-Tillage in the Cerrado
CCR - Cover Crop Research
CTNBio - The National Technical Biosafety Commission
CONAB - The National Supply Company
CO₂ - Carbon Dioxide
CS - Certification Scheme
EMBRAPA - The Brazilian Agricultural Research Corporation
EPA - Environmental Protection Agency
FAO - Food and Agriculture Organization of the United Nations
GE - Genetically Engineered
GMO - Genetically Modified Organism
HDI - Human Development Index
IBGE - The Brazilian Institute of Geography and Statistics
IBAMA - The Brazilian Institute of Environment and Renewable Natural Resources
IEA – Institute of Agricultural Economics
ILUC - Indirect Land Use Change
IPM - Integrated Pest Management
MAPA - Ministry of Agriculture, Livestock and Supply, Brazil
MAPITOBA – Maranhão (MA), Piauí (PI), Tocantins (TO), Bahia (BA)
MCT - Ministry of Science and Technology, Brazil
Mha - Million hectare
MMA - Ministry of Environment, Brazil
Mton - Million ton
Non-GMO - Non-Genetically Modified Organism
P & C - Principles and Criteria
PNPB - National Biodiesel Production Program (PNPB)
RR - Roundup Ready
RTRS - The Round Table for Responsible Soy
SINDAG - The National Association for Agricultural Defence Products
SM - Soy Moratorium
TNC - The Nature Conservancy
UNFCCC - United Nations Framework Convention on Climate Change
UNDP - United Nations Development Program
WWF - World Wide Fund for Nature
APPENDIX 1 - KEY SIMILARITIES AND DIFFERENCES BETWEEN RTRS AND PROTERRA

<table>
<thead>
<tr>
<th></th>
<th>RTRS</th>
<th>ProTerra</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aim</strong></td>
<td>Contribute to sustainable and responsible soy production practices</td>
<td>Quality Management System Approach and certification</td>
</tr>
<tr>
<td><strong>Method</strong></td>
<td>Governance, consensus building and certification</td>
<td>All agricultural products and their derivatives at every point in the food supply chain</td>
</tr>
<tr>
<td><strong>Scope</strong></td>
<td>Soybean production and supply chain</td>
<td></td>
</tr>
<tr>
<td><strong>GM vs. Non-GM</strong></td>
<td>Both GMO and Non-GM (including organic)</td>
<td>Non-GM</td>
</tr>
<tr>
<td><strong>Legal compliance</strong></td>
<td>RTRS and ProTerra are generally equivalent</td>
<td></td>
</tr>
<tr>
<td><strong>Labor conditions</strong></td>
<td>RTRS and ProTerra are generally equivalent</td>
<td></td>
</tr>
<tr>
<td><strong>Community relations</strong></td>
<td>RTRS and ProTerra are generally equivalent</td>
<td></td>
</tr>
<tr>
<td><strong>Land use rights</strong></td>
<td>RTRS allows disruption of traditional land use as long as compensation, subjected to their free, prior, informed and documented consent is given, while ProTerra forbids all traditional land use disruption. RTRS allows certification even though there may be unresolved land disputes. ProTerra requires land disputes to be resolved before certification can be awarded.</td>
<td></td>
</tr>
<tr>
<td><strong>Environmental responsibility</strong></td>
<td>RTRS has a cutoff of 2009 for clearing of native forest, while ProTerra's general cutoff is 1994 but accepts land that has been cleared up to 2004, if compensatory environmental measures have been taken.</td>
<td></td>
</tr>
<tr>
<td><strong>Biodiversity</strong></td>
<td>ProTerra forbids land conversion in the Amazon biome and RTRS has developed maps to guide soy expansion and identify biodiversity hotspots and High Conservation Value Areas (HCVAs)</td>
<td>ProTerra requires that the certified operation maintain and maximize biodiversity in and around the operation. RTRS considers biodiversity at the regional level with the help of its maps</td>
</tr>
<tr>
<td><strong>Waste and pollution management</strong></td>
<td>RTRS and ProTerra are generally equivalent</td>
<td></td>
</tr>
<tr>
<td><strong>Agrochemicals</strong></td>
<td>Agrochemicals listed in the Stockholm and Rotterdam Conventions are not used and pesticides listed on the WHO class 1 a &amp; b, Pesticide Action Network's &quot;Dirty Dozen&quot;</td>
<td>Agrochemicals listed in the Stockholm and Rotterdam Conventions are not used</td>
</tr>
<tr>
<td><strong>Good agricultural practice</strong></td>
<td>RTRS and ProTerra are generally equivalent</td>
<td></td>
</tr>
<tr>
<td><strong>Segregation</strong></td>
<td>RTRS and ProTerra are generally equivalent, however RTRS also allows massbalance (company can produce and/or trade both non-responsible soy and responsible soy)</td>
<td></td>
</tr>
<tr>
<td><strong>Labeling and logo use</strong></td>
<td>ProTerra has requirements linked to labelling of all retail and non-retail packaging allowing for traceability back through all links in the chain of custody</td>
<td>RTRS has a chain-of-custody certification program, however, RTRS is not a consumer-facing certification program, but focus on production</td>
</tr>
<tr>
<td><strong>Greenhouse gases</strong></td>
<td>RTRS and ProTerra are generally equivalent, with both trying to reduce emissions and increase carbon sequestration. However, RTRS focuses on fossil fuel use, requiring monitoring, and allows increases in fossil fuel use with justification. In contrast, ProTerra requires reductions over time in energy use and especially reduction of all forms of non-renewable energy, not just fossil fuels</td>
<td></td>
</tr>
<tr>
<td><strong>Continuous improvement</strong></td>
<td>RTRS have requirements on public reports and public announcement and that all information regarding certified producers is available on RTRS web site. Public summary report and audit public announcement are not required by ProTerra and it’s very difficult to find information about ProTerra certificated farms.</td>
<td></td>
</tr>
</tbody>
</table>

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### APPENDIX 2 - OVERVIEW OF RTRS CRITERIA REGARDING AGROCHEMICAL USE AND TOXICITY

<table>
<thead>
<tr>
<th>RTRS</th>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.4</td>
<td>Negative environmental and health impacts of phytosanitary products are reduced by implementation of systematic, recognized Integrated Crop Management (ICM) techniques</td>
</tr>
<tr>
<td>5.4.1</td>
<td>A plan for ICM is documented and implemented which addresses the use of prevention, and biological and other non-chemical or selective chemical controls</td>
</tr>
<tr>
<td>5.4.2</td>
<td>There is an implemented plan that contains targets for reduction of potentially harmful phytosanitary products over time</td>
</tr>
<tr>
<td>5.4.3</td>
<td>Use of phytosanitary products follows legal requirements and professional recommendations (or, if professional recommendations are not available, manufacturer’s recommendations) and includes rotation of active ingredients to prevent resistance</td>
</tr>
<tr>
<td>5.5</td>
<td>All application of agrochemical is documented and all handling, storage, collection and disposal of chemical waste and empty containers, is monitored to ensure compliance with good practice</td>
</tr>
<tr>
<td>5.5.1</td>
<td>a) products purchased and applied, quantity and dates;</td>
</tr>
<tr>
<td>5.5.1</td>
<td>b) identification of the area where the application was made;</td>
</tr>
<tr>
<td>5.5.1</td>
<td>c) names of the persons that carried out the preparation of the products and field application;</td>
</tr>
<tr>
<td>5.5.1</td>
<td>d) identification of the application equipment used;</td>
</tr>
<tr>
<td>5.5.1</td>
<td>e) weather conditions during application.</td>
</tr>
<tr>
<td>5.5.2</td>
<td>Containers are properly stored, washed and disposed of; waste and residual agrochemicals are disposed in an environmentally appropriate way</td>
</tr>
<tr>
<td>5.5.3</td>
<td>Transportation and storage of agrochemicals is safe and all applicable health, environmental and safety precautions are implemented</td>
</tr>
<tr>
<td>5.5.4</td>
<td>The necessary precautions are taken to avoid people entering into recently sprayed areas</td>
</tr>
<tr>
<td>5.5.5</td>
<td>Fertilizers are used in accordance with professional recommendations (provided by manufacturers where other professional recommendations are not available)</td>
</tr>
<tr>
<td>5.6</td>
<td>Agrochemicals listed in the Stockholm and Rotterdam Conventions are not used</td>
</tr>
<tr>
<td>5.7</td>
<td>The use of biological control agents is documented, monitored and controlled in accordance with national laws and internationally accepted scientific protocols</td>
</tr>
<tr>
<td>5.7.1</td>
<td>There is information about requirements for use of biological control agents</td>
</tr>
<tr>
<td>5.7.2</td>
<td>Records are kept of all use of biological control agents that demonstrate compliance with national laws</td>
</tr>
<tr>
<td>5.9</td>
<td>Appropriate measures are implemented to prevent the drift of agrochemicals to neighboring areas</td>
</tr>
<tr>
<td>5.9.1</td>
<td>There are documented procedures in place that specify good agricultural practices, including minimization of drift, in applying agrochemicals and these procedures are being implemented</td>
</tr>
<tr>
<td>5.9.2</td>
<td>Records of weather conditions (wind speed and direction, temperature and relative humidity) during spraying operations are maintained</td>
</tr>
<tr>
<td>5.9.3</td>
<td>Aerial application of pesticides is carried out in such a way that it does not have an impact on populated areas. All aerial application is preceded by advance notification to residents within 500m of the planned application</td>
</tr>
<tr>
<td>5.9.4</td>
<td>There is no aerial application of pesticides in WHO Class Ia, Ib and II within 500m of populated areas or water bodies</td>
</tr>
<tr>
<td>5.9.5</td>
<td>There is no application of pesticides within 30m of any populated areas or water bodies</td>
</tr>
</tbody>
</table>
### APPENDIX 3 - OVERVIEW OF PROTERRAs CRITERIA REGARDING AGROCHEMICAL USE AND TOXICITY

**ProTerra**

<table>
<thead>
<tr>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>12.5</strong> Growers shall avoid or reduce the use of toxic or polluting materials whenever possible, and shall select agrochemical inputs having the least possible toxicity and environmental impact for the required application</td>
</tr>
<tr>
<td><strong>12.5.1</strong> Pesticides listed on the WHO class 1 a &amp; b, Pesticide Action Network’s “Dirty Dozen” list, and FAO/UNEP’s Prior Informed Consent Procedure, on the Rotterdam Convention and on the Stockholm Convention, may not be used. Hazardous substances listed on the Rotterdam Convention are not to be used in agricultural or industrial operations</td>
</tr>
<tr>
<td><strong>12.5.2</strong> In cases where chemicals included on the lists cited in 12.5.1 can be used legally in the country where agricultural production is conducted, certified organizations shall implement a program of progressive reduction of use over time, which will be agreed with the certification body and tracked on a yearly basis. In such cases, products exported to countries where said pesticides are not allowed by law shall be tested before export to assure that residue levels are negligible or are, at least, compliant with residue limits set in the country of import</td>
</tr>
<tr>
<td><strong>12.5.3</strong> The use of pesticides for pests, diseases, and non-crop plants shall be minimized through integrated pest management (IPM), and use of ecologically sound biological controls for the target pest or disease where applicable</td>
</tr>
<tr>
<td><strong>12.5.4</strong> Certified organizations shall use non-chemical weed control methods whenever possible, such as mechanical methods and management of crop rotations, crop succession and intercrop</td>
</tr>
<tr>
<td><strong>12.5.5</strong> Certified organizations shall only use pesticides on crops and for target species for which they are legally allowed, at the prescribed dosage, during the required timeframe and/or crop conditions, as defined in local laws and regulations and by manufacturers’ recommendations or by documented best practice</td>
</tr>
<tr>
<td><strong>12.6</strong> Agrochemicals shall be applied using methods that minimize harm to human health, wild life, plant biodiversity, and water and air quality</td>
</tr>
<tr>
<td><strong>12.6.1</strong> Certified organizations shall not engage in pesticide spraying over bodies of water, or over preserved, protected or residential areas</td>
</tr>
<tr>
<td><strong>12.6.2</strong> Pesticides shall not be sprayed within 100 meters of human populated areas, and shall not be sprayed within 50 meters of bodies of water</td>
</tr>
<tr>
<td><strong>12.6.3</strong> Recently sprayed areas shall be marked appropriately to warn people not to enter into such areas</td>
</tr>
<tr>
<td><strong>12.6.4</strong> Aerial spraying shall be conducted only under weather conditions that minimize drift to adjacent areas</td>
</tr>
<tr>
<td><strong>12.6.5</strong> Residents within 1 km shall be informed at least one day in advance before aerial spraying is done</td>
</tr>
<tr>
<td><strong>12.6.6</strong> Aerial spraying shall not be carried out with WHO Class II pesticides</td>
</tr>
<tr>
<td><strong>12.6.7</strong> Certified organizations shall adhere to quarantine periods, avoiding harvest until applied pesticide hazard for consumers is reduced to acceptable levels</td>
</tr>
<tr>
<td><strong>12.6.8</strong> Pesticides shall be handled, stored, transported, and disposed of according to manufacturers’ instructions, legal requirements, or according to procedures documented to be superior</td>
</tr>
<tr>
<td><strong>12.6.9</strong> Certified organizations shall maintain, for a period of at least 5 years, records of all pesticides, other agrochemicals and other inputs purchased, used, and disposed of, including bio-control agents. Records of pests, diseases, weather conditions during spraying, and weeds shall also be recorded</td>
</tr>
<tr>
<td><strong>12.7</strong> Best practices are followed in fertilizer use, based on expert opinion or at least the manufacturer’s recommendations</td>
</tr>
<tr>
<td><strong>12.8</strong> Level III organizations shall test agricultural produce on receipt for chemical residues (e.g., pesticides) and harmful contaminants (e.g., mycotoxins), and maintain testing records</td>
</tr>
</tbody>
</table>
Head Office:
SIK, Box 5401, SE-402 29 Göteborg, Sweden.
Telephone: +46 (0)10 516 66 00, fax: +46 (0)31 83 37 82.

Regional Offices:
SIK, Ideon, SE-223 70 Lund, Sweden.
Telephone: +46 (0)10 516 66 00.
SIK, Forslunda 1, SE-905 91 Umeå, Sweden.
Telephone: +46 (0)10 516 66 00.
SIK, c/o Almi, Box 1224, SE-581 12 Linköping, Sweden.
Telephone: +46 (0)10 516 66 00.

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