OIL PALM, SOYBEANS & CRITICAL HABITAT LOSS

A Review
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Coverpicture :
Soya bean (Glycine soja) plantation Paraná, Brazil

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Introduction

Increasing global demand for oil palm and soybean by-products has stimulated dramatic area growth in the last decade. Globally, oil palm area increased by 43% from approximately 6 million ha in 1990 to 10.7 million ha in 2002; while the area planted to soybeans increased by 26% from 57 million in 1990 to 77.1 million ha in 2002. Most of this growth has occurred in just a few countries, primarily Indonesia and Malaysia (for oil palm) and in Argentina, USA and Brazil (for soybeans). While the growth of both sectors has conferred important economic benefits for all of these countries, concerns have been raised about the impact of area expansion on critical habitats (primarily the tropical forests of Indonesia, Malaysia, Brazil, Argentina and Paraguay, the Cerrado savanna region in Brazil and the Chaco ecoregion in Argentina). Concerns are being heightened by the fact that further growth in all of these areas is predicted. This is especially the case for Indonesia, where oil palm area is expected to increase by at least 43% over the next two decades; and for Brazil where soybean area could potentially increase three-fold over the next 50 years, rising from 18.0 million ha in 2002 to 54.0 million ha in 2052.

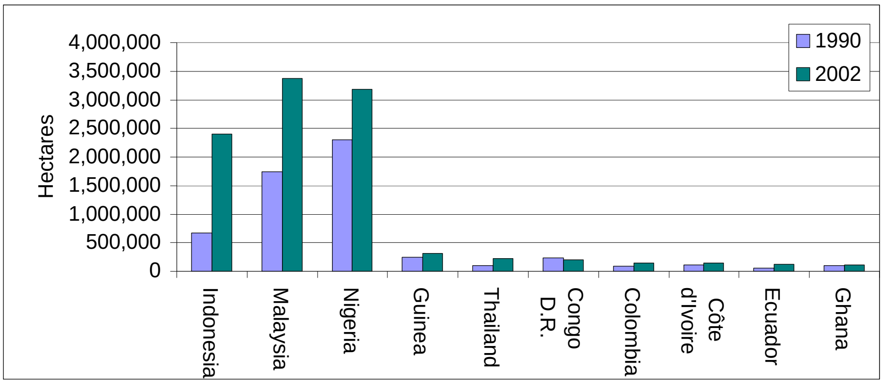
This paper draws upon existing data to explore the relationship (both direct & indirect) between palm oil and soybean expansion and critical habitat loss in Brazil and Indonesia. The relationship is explored through a number of statements, which indicate both the direct and indirect links between oil palm and soybean expansion and critical habitat loss. However, before venturing into these statements, a brief introduction to oil palm and soybeans is first provided along with a brief explanation as to why oil palm and soybean expansion has been identified as a threat to critical habitats in a number of countries.

What is oil palm, what is it used for, where is it planted & produced, where is it consumed?

Oil palm (*Elaeis guineensis Jacq.*) is native to West Africa, where local populations have traditionally used it to make foodstuffs, medicines, woven material and wine. The palm is now planted in large-scale plantations throughout the tropics because it is used in a number of commercial products including cooking oil, soap, cosmetics and margarine. Crude Palm Oil (CPO) is the primary product derived from the red fruits of the oil palm, while Palm Kernel Oil (PKO), derived from the fruit's nut is considered to be a secondary product. Palm Kernel Meal (PKM) is primarily used for animal feed (Cheng Hai 2002).

In the last 12 years, oil palm plantations have primarily expanded in the top two palm oil producing countries of Malaysia and Indonesia. In 2002, Malaysia produced 50% of world palm oil production, while Indonesia produced 30% of global production. While oil palm area is considerable in Nigeria (3.1 million ha), production is only obtained from 362,000 ha (Oil World 2002) (Figure 1).

Figure 1: Oil palm area growth in top ten countries (1990-2002)



Source: FAO 2003.

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Global demand for palm oil has been increasing dramatically. In 2002, palm oil was the second most consumed edible oil in the world after soy oil. Most of this palm oil was being consumed in Asia, primarily by India (14%), Indonesia (11%), China (9%), Malaysia (6%) and Pakistan (6%). Together, the EU-15 countries also consumed 12% of world production (Oil World 2002).

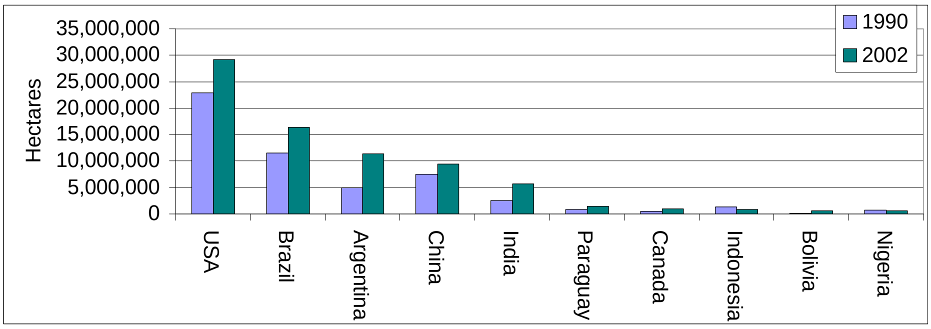
What is soy, what is it used for, where is it planted & produced, where is it consumed?

Soybean (*Glycine max* L.) is a leguminous crop, which produces a number of important products. Soybeans originally came from mainland China where it became a major crop in the Yellow River valley during the Zhou (11-256 B.C) and Qin (221-206 B.C) dynasties. It was traditionally used for fresh, fermented and dried food products and for medicinal purposes (Tengnäs & Nilsson 2003).

Today, soybeans are used for a variety of commercial food products including soy sauce, cooking oil, miso, soy milk, soy curd and bean sprouts. It is also the basis of tempeh and tofu—protein products, which are particularly popular in Asia (Tengnäs & Nilsson 2003). All of these products are becoming increasingly popular in western food markets as soybeans provide an important low-calorie protein source for vegetarians. Soybeans also produce soymeal—the most important oilmeal in the world. Soymeal is primarily used as an ingredient in concentrated feed for livestock (primarily single stomached animals such as chickens and pigs) (Tengnäs & Nilsson 2003).

Soybean is cultivated in a number of countries, however it is dominant in the United States, Brazil, Argentina, China and India. During the last 12 years, soybean expansion has been exceptionally rapid in the countries of Argentina, USA, Brazil and India (Figure 2). Demand for soybeans is mainly driven by demand for soymeal from the animal feed industry.

Figure 2: Soybean area growth in top 10 countries (1990-2002)



Source: FAO 2003.

In 2002, soymeal was the most important oilmeal in the world as it commanded a global market share of 59% (Oil World 2002). The main consumers of soymeal were the United States (24%), the European Union (24%) and China (6%) (Oil World 2002).

Although soy oil, which is used by the food, detergents, cosmetics and chemical industries, is only a by-product of soymeal production, soy oil now ranks as the most important edible oil in the world with a global market share of 23%. However, soy oil is slowly losing its market share to palm oil. As of 2001, the main consumers of soy oil were the United States (27%), China (13%), and Brazil (11%) (Oil World 2002).

Why is WWF concerned about oil palm and soybean expansion?

Over the last decade, deforestation[2] has occurred at an alarming annual rate of 14.6 million ha per annum (FAO 2001). WWF is concerned about deforestation worldwide, however it is particularly concerned about tropical deforestation. This is primarily because tropical forests are rich in biodiversity (FAO 2001).

[2] The FAO (2001) defines deforestation as the conversion of forest to another land use.

Tropical deforestation arises from multiple causes, including large-scale commercial logging, cattle ranching, shifting cultivation, mining, agricultural expansion, land-use policies, urban development and population growth (Angelsen & Kaimowitz 1999). In some areas, soybean and oil palm expansion are among these causes. This is because these two edible oil crops have expanded rapidly in a number of bio-diverse countries known to be experiencing high tropical deforestation rates over the last few decades.

For instance, FAO (2003) statistics suggest that oil palm expansion can be linked to the loss of approximately 700,000 ha[3] of tropical forest in Malaysia (primarily within the province of Sabah). Anecdotal evidence and satellite imagery also suggests that soybean plantations have replaced semi-deciduous dry forest cover in Bolivia (Kaimowitz & Smith 2001; USGS 2003). In Paraguay, soybean plantations have increased rapidly in a global 200 ecoregion known as the Atlantic forests (USDA 2001), while soybean plantations have been increasingly encroaching upon the Chaco ecoregion and the Yungas 'cloudforest' in Argentina (Schnepf *et al.* 2001; Greenpeace 2002).

WWF believes that oil palm and soybean expansion does not only pose a threat to high conservation value forests[4], but also to freshwater ecosystems, the livelihoods of forest dependent peoples, biodiversity and the habitats of endangered species. WWF is particularly concerned about the threat that oil palm and soybean expansion posits to tropical forests and other critical habitats (i.e. bio-diverse savanna) in Indonesia and Malaysia (for oil palm) and Brazil, Argentina, Paraguay & Bolivia (for soybeans) because:

- Oil palm/soybeans are dominant agricultural crops in these countries;
- Soybean/oil palm expansion has been rapid in these countries;
- Soybean/oil palm expansion is expected to continue in these countries;
- Tropical forests rich in biodiversity are rapidly declining in these countries;
- Soybean/oil palm expansion has been directly linked to tropical deforestation in these countries;
- Tropical deforestation and biodiversity loss linked to soybean and oil palm expansion in these countries is occurring in focal ecoregions[5] or Global 200 ecoregions[6];
- Focal species[7] are present in areas being cleared for activities related to oil palm/soybean expansion in these countries.

WWF is also concerned with oil palm and soybean expansion in other parts of the world including certain parts of Africa, Papua New Guinea, Colombia and Ecuador. These governments have expressed interest in facilitating large-scale commercial oil palm developments in the near future. Expansion in some of these countries has already been linked to critical habitat loss (WRM 2001) and future expansion is expected to accelerate tropical deforestation.

In relation to soybeans, WWF is concerned that the great majority of future soybean expansion is expected to occur in bio-diverse Latin America countries such as Brazil and Argentina. WWF is less

[3] The Malaysian government has claimed that most of Malaysia's oil palm plantations have replaced rubber, coconut and cocoa plantations rather than natural forests. If this is a given, FAO statistics suggest that oil palm would have replaced at least 700,000 ha of over land. This is because, during the period 1990-2002, oil palm area increased by 1.6 million ha. However, the area under rubber, cocoa and coconuts only declined by 431,000 ha, 249,500 and 160,700 respectively. Over the same time period, oil palm expansion was most extensive in Sabah where it increased from 276,171 ha to more than 1 million ha. It seems likely that the majority of oil palm planted in Sabah during the last decade has been planted on forest land.

[4] High conservation value forests are defined in the Forest Stewardship Council's Principle 9, as forests that need special protection for their biological value (e.g. they may contain rare or threatened species or ecosystems); their environmental value (e.g. they serve as critical watersheds) or their social value (e.g. they are the prime source of subsistence materials, medicines and food for local communities).

[5] Ecoregions are large areas of relatively uniform climate that harbour a characteristic set of species.

[6] The Global 200 is a science-based global ranking of the Earth's most biologically outstanding terrestrial, freshwater and marine habitats. It provides a critical blueprint for biodiversity conservation at a global scale.

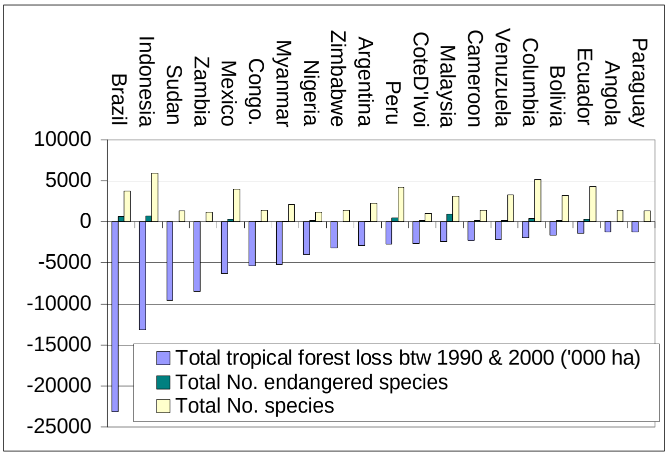
[7] Flagship species are generally wide-ranging or area-sensitive species that because of certain life-history traits—such as specialized diets or breeding requirements—depend on large areas to maintain viable populations. Flagship species often make the best proxies for establishing minimum areas to protect other species resident in the area. Maintaining viable populations of these focal species serves as an important proxy for maintaining ecologically healthy conditions in the ecosystem as a whole.

concerned about soybean expansion in countries such as the United States and India as expansion there is not expected to have an adverse impact upon critical habitats. However, WWF does expect producers, traders and crushers in the latter countries to adhere to internationally agreed and globally applicable social and environmental standards for more sustainable soy production. WWF also expects actors in market countries to support responsible production practices through procurement policies and screening of investments.

This paper places special emphasis on the relationship between soybean and oil palm expansion and critical habitat loss in the two major producing countries of Indonesia and Brazil. This is primarily because oil palm and soybean plantations have rapidly expanded in to a number of critical habitats in these two countries and future expansion is expected to continue in these habitats over the next few decades.

Emphasis has also been placed on Brazil and Indonesia because these two countries are considered to have the greatest tropical deforestation rates in the world (Figure 3). Between 1990 and 2000, Brazil and Indonesia lost approximately 23 and 13 million ha of forest respectively (FAO 2001). In recent years, the rate of tropical deforestation has increased in both of these countries. Recent data from Brazil's National Institute for Space Research revealed deforestation in the Amazon increased by more than 27% in 2002, from an annual average of 1.8 million ha to a record 2.5 million ha (McCarthy 2003); while it is estimated deforestation has increased by 15% from average of 1.7 million ha per year to 2 million ha per year in Indonesia (Matthews 2002).

Figure 3: Tropical forest loss and species in top 20 countries



Source: FAO 2003

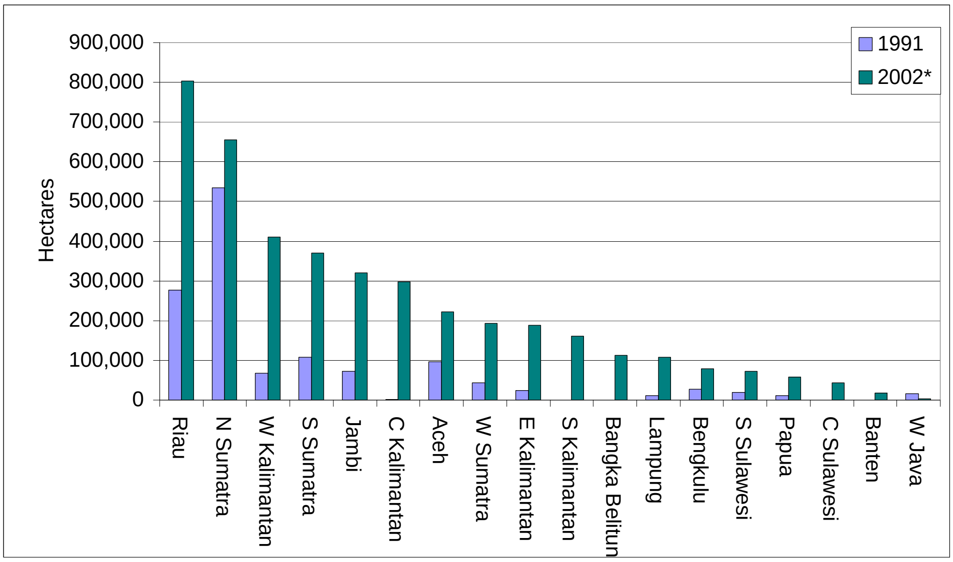
Tropical forest loss in Brazil and Indonesia is a matter of global concern because the forests within these countries are among the most bio-diverse in the world (Figure 3). While deforestation has undoubtedly resulted from a number of causes in these two countries, the direct and indirect contributions of oil palm and soybean expansion to deforestation are significant.

Statement 1: Oil palm and soybean plantations constitute a threat to critical habitats because expansion has been concentrated in a number of areas known to have high conservation values.

High prices and increasing demand for palm oil and soybean derivatives have spurred dramatic oil palm and soybean area growth. In the last decade, the annually harvested global area of oil palm increased by 43% from approximately 6 million ha in 1990 to 10.7 million ha in 2002 (FAO 2003); while the annually harvested global area of soybean increased by 26% from 57 million ha in 1990 to million 77.1 million ha in 2002 (FAO 2003). Most oil palm growth has occurred in Indonesia, followed by Malaysia (Figure 1); while most soybean growth has occurred in Argentina, the USA and Brazil (Figure 2) (Oil World 2002). Expansion in Indonesia and Brazil is of particular concern because these two countries harbour extensive biodiversity resources and expansion has occurred in critical habitats.

The relationship between oil palm expansion and tropical deforestation in Indonesia

Figure 4: Oil palm area growth in Indonesia (1991-2002*)



Source: DJBPP 2002.

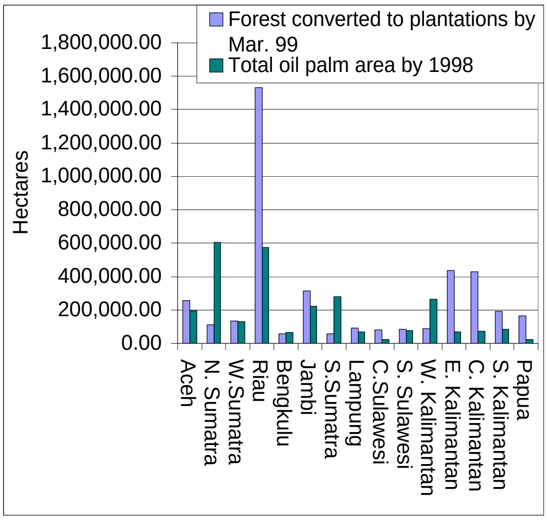
In Indonesia, the oil palm sub-sector has experienced remarkable growth since the late 1960s. The area of oil palm plantations has increased from 106,000 ha in 1967 to approximately 4.1 million ha in 2002[8], implying an average annual growth rate of 114,000 ha. Most of this growth has occurred over the last decade, primarily within the five provinces of Riau (526,680), West Kalimantan (342,032), Central Kalimantan (296,932), South Sumatra (262,873) & Jambi (238,283) (Figure 6).

While this prolific growth has generated employment and important economic benefits, it has become a source of concern because much of this oil palm expansion has occurred at the expense of Indonesia's tropical forest cover. According to the Indonesian Ministry of Forestry, close to 70% of the oil palm plantations located in Indonesia had been planted on forest land[9] by 1999 (Figure 7). This constitutes close to 2.2 million ha of forest land. Overall, the total forest land area converted to oil palm is likely to be much higher because data from the Ministry of Forestry does not take into account forest area converted to oil palm plantations prior to the 1960's. In North Sumatra, for instance, most of the oil palm plantations were established by colonial enterprises originating from the Netherlands, Britain and Belgium (Stoler 1995; Geertz 1963). Most, if not all, of these earlier estates resulted in large tracts of forest land being cleared with fire and manual labour (Brand 1978; Stoler 1995). Moreover, oil palm plantations established in the vicinity of forests may cause further forest conversion, which is difficult to detect. This is because large-scale oil palm plantations often displace local people who may migrate to forested areas to obtain land and forest products. Drainage regimes imposed to support large-scale oil palm plantations may also lower water-tables and impact neighbouring forests.

As of 2000, 70% of forest land converted to oil palm plantations in Indonesia lay within the six Sumatran provinces of: Riau (658,139 ha), Jambi (259,115 ha), Aceh (219,382), West Sumatra (134,885 ha), Central Kalimantan (120,413ha) and South Kalimantan (103,557 ha) (*Badan Planologi* 1999). While most of this forest land had been designated for conversion, more than 18% had not. This forest land had been targeted for timber production or protection. Map data and anecdotal evidence strongly suggests oil palm plantations have been developed within a number of national park buffer zones (including Tanjung Puting National Park, Bukit Tiga Puluh National Park (Figure 8), Gunung Leuser National Park and Danau Sentarum National Park) and other forest areas of high conservation value (Potter & Lee 1998; Casson 2000).

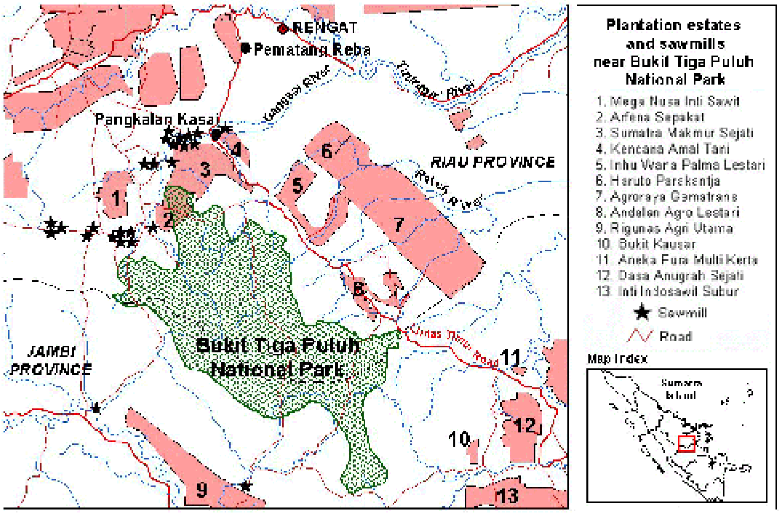
[8] These figures, released by the Indonesian Directorate General of Estate Crop Production, include immature oil palm area plus smallholder oil palm area. The total area is therefore larger than the FAO estimate for total area planted to oil palm in 2002.
[9] Forest land may consist of primary forest, secondary forest, degraded or fragmented forest, or even Imperata (alang-alang) grasslands.

Figure 7: Oil palm planted on forest land in Indonesia



Source: Badan Planologi 1999.

Figure 8: Plantation estates and sawmills near Bukit Tiga Puluh National Park, Riau



Source: Map data from Ministry of Forestry, DFID & CIFOR.

Forests within these national parks and the six provinces in which palm oil expansion has been greatest, contain high levels of biodiversity as they lie within two focal ecoregions identified for their global biodiversity significance—the Sumatra islands lowland and montane forests & the Borneo lowland and montane forests. The lowland forests of Sumatra and Kalimantan are of particular significance as they are considered to be among the most species rich on Earth (Whitten *et al.* 2000; Barber & Schweithelm 2001).

The relationship between soybean expansion and critical habitat loss in Brazil

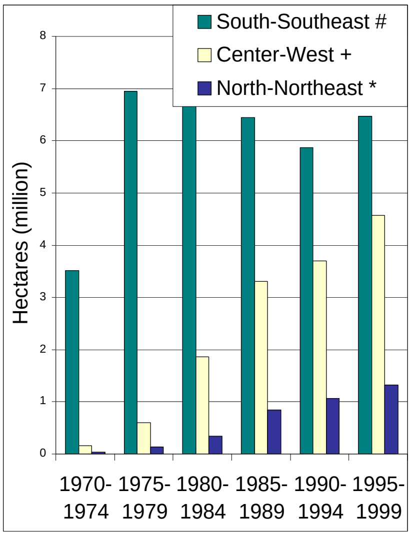
In Brazil, soybean plantations have also rapidly expanded into critical habitats such as the Cerrado ecoregion. According to the FAO (2003), soybean area has increased eight-fold in Brazil, jumping from 1.3 million ha in 1970 to 16.3 million ha in 2002 (FAO 2003). Although, statistics from the Brazilian government state that Brazil's soybean area has already reached 18.4 million ha (IBGE & CONAB 2003). Until the 1980's, soybean plantations were primarily concentrated in the South-Southeast region of Brazil (Paraná, Rio Grande do Sul & Santa Catarina), however expansion has rapidly increased in the Centre-West states of Mato Grosso do Sul, Mato Grosso and Goiás since the 1980s. To a lesser extent, expansion has also been occurring in the North-Northeast Amazonian region where the dominant vegetation is tropical rain forest (Figure 9).

As of 2002, 83% of Brazil's soybean plantations were established in the five states of Mato Grosso (25%), Rio Grande do Sul (19%), Paraná (19%), Goiás (12%) and Matto Grosso do Sul (8%). Rio Grande do Sul and Paraná are located in the South-Southeast region, while Mato Grosso, Goiás and Mato Grosso do Sul are located in the Centre-West region. In the last 5 years, soybean plantations have also increasingly been planted in the Northern Amazonian states of Rondônia, Para and Roraima. Area planted in these three states has increased from 3,000 ha in 1996/7 to 56,000 ha in 2002/3. (IBGE & CONAB 2003).

The relationship between soybean expansion and tropical forest loss is not known in the South-Southeast region, however it is thought to be significant. This is because virtually all of the land in the state of Paraná was originally tropical forest, with a high prevalence of *Araucaria* trees (Kaimowitz & Smith 2001). Currently, there is widespread concern about the expansion of soybeans into the Centre-West states of Mato Grosso, Goiás, Mato Grosso do Sul and Tocantins, where soybean expansion has rapidly increased more than eight-fold from 598,000 ha in 1975 to 5.2 million ha in 2000 (Figure 10). This dramatic expansion was largely accomplished through the wholesale clearing and conversion of virgin savanna land within a critical habitat known as the Cerrado ecoregion (Schnepf *et al.* 2001). The

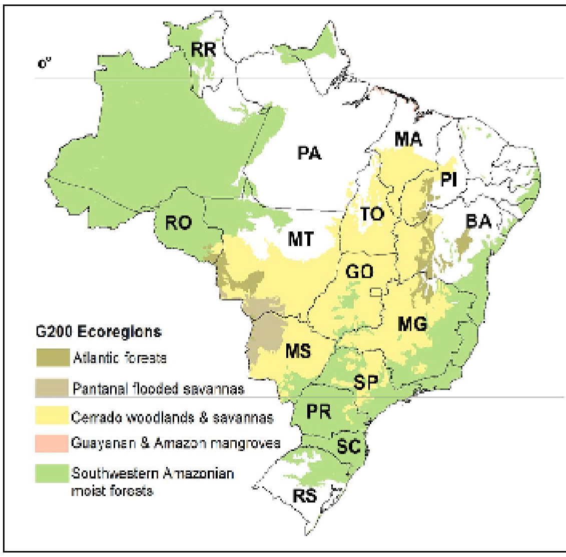
Cerrado ecoregion dominates 1.5 to 2 million km^2 in Brazil's Centre-West states of Mato Grosso, Mato Grosso do Sul, Goias and Tocantins and in parts of Bahia, Maranháo, Minas Gerais and Piaui.

Figure 9: Regional soybean growth in Brazil (1970-99)[10]



Source: Schnepf *et al*. 2001.

Figure 10: Soybean area and Global 200 ecoregions, Brazil



STATE	Soybean Area (Ha) 2002/03	% 2002/03
MT = Mato Grosso	4,521,000	25%
RS = Rio Grande do Sul	3,596,000	19%
PA = Paraná	3,572,000	19%
GO = Goiás	2,221,000	12%
MS = Mato Grosso do Sul	1,409,000	8%
MG = Minas Gerais	862,000	5%
BA = Bahia	850,000	5%
SP = Sao Páulo	605,000	3%
MA = Maranháo	275,000	1%
SC = Santa Catarina	258,000	1%
TO = Tocantins	145,000	1%
PI = Piaui	117,000	1%
RO = Rondônia	36,000	0%
PA = Pará	12,000	0%
RR = Roraima	8,000	0%

Map data from WWF. Statistics from IBGE & CONAB 2003.

The Cerrado ecoregion is the most extensive woodland/savanna region in South America (CI 2002). Within this region there is a mosaic of different vegetation types, including tree and scrub savanna, grassland with scattered trees, and occasional patches of a dry, closed canopy forest called the Cerradão. Gallery forests can also be found along rivers and streams. The region is of enormous ecological and biological significance as it contains around 10,000 plant species, many of which (4,400) are endemic to central Brazil. The Cerrado is also home to a number of 'focal species' such as the maned wolf, the giant armadillo and the giant anteater (ELC 2002). Unfortunately, the Cerrado is one of the least-protected ecosystems in Brazil as only 1.5% lies within federal reserves. It is estimated that only 35% of the Cerrado remains in a relatively natural state (Kaimowitz & Smith 2001).

Statement 2: Oil palm and soybean plantations constitute a threat to critical habitats because global demand prospects for both of these crops are high and future expansion is expected to be concentrated in areas known to have high conservation values.

According to *Oil World* (2002b), palm oil will become the leading edible oil in about 2012. Palm oil producers are expected to increase their share in the vegetable oil market because: 1) oil palm trees produce a much higher yield per hectare than any other seed oil; and 2) palm oil can usually be produced more cheaply than other vegetable oils (Oil World 1999). Global palm oil production is expected to double and reach 48.6 million tonnes by 2020 (Oil World 2020). Indonesia and Malaysia are expected to be the leading producers of palm oil by 2020. Most of the demand for palm oil is expected to come from India, Indonesia and China, where it will be primarily consumed as cooking oil (Oil World 2002b).

While soy oil is expected to lose part of its market share to palm oil in the next few decades, production is expected to increase by 37% from approximately 23 million tonnes to 41 million tonnes by 2020 (Oil World 2002b). Global soymeal production is also expected to increase 20% from around 133 million tonnes to 176 million tonnes (Oil World 2002). Together, Brazil and Argentina are expected to surpass the USA and become the leading soybean producers by 2010 (Oil World 2002b). Most of the demand

[10] # South-Southeast region = Rio Grande do Sul, Santa Catarina, Parana, Sao Paulo, Minas Gerais; + Center-West region = Mato Grosso, Mato Grosso do Sul, Goias, Brasilia, * North-Northeast region = Rondonia, Tocantins, Maranhao, Piaui, Bahai, and others.

for soybean products is expected to come from China and the EU-15 countries, where soymeal will primarily be used for livestock production (USDA 2003a; Oil World 2002).

Increasing demand for palm oil and soybean derivatives will undoubtedly correspond with area expansion. Most of the area growth in the oil palm sub-sector is projected to occur in Indonesia and Malaysia (primarily in Sabah and Sarawak), while most of the area growth in the soybean sub-sector is expected to occur in Brazil, Argentina, India and the USA respectively (Oil World 2002b). Oil palm area growth is expected to be most extensive in Indonesia, where it is predicted to increase by at least 43% by 2020; while soybean area growth is expected to be most extensive in Brazil, where it is predicted to increase by at least 17% (Oil World 2002b).

<u>The relationship between future oil palm expansion and critical habitat loss in Indonesia</u>

After Indonesia's economy recovers from economic crisis, oil palm expansion is expected to continue, primarily within the three provinces of Riau, Jambi and South Sumatra. While the Indonesian government is expected to offer incentives to companies wishing to establish oil palm plantations in Eastern Indonesia (primarily Kalimantan and Irian Jaya), oil palm investors will prefer to establish estates in Sumatra because the island has the best climate and soil conditions in the country for cultivating oil palm. Sumatra also has the necessary infrastructure in place for palm oil processing (palm oil fruits need to be processed within 48hrs) (Casson 2000).

Future expansion of oil palm in Sumatra poses a significant threat to remaining forest resources on the island. This is because the Central Government has already decided to allow the release of 843,052 ha of forest land to plantations in the near future, despite the existence of considerable conversion forest deficits and degraded areas in much of Sumatra. Around 70% of this forest land will be converted to oil palm. Most of this forest land lies within the provinces of Riau (417,503 ha) and Lampung (74,779 ha) (Casson 2000).

Applications for the release of another 4.4 million ha of forest land to plantation companies are still being considered by the Central government. However, some district governments, tired of waiting for central government approval, have already allocated some of this forest land to plantation companies under the auspices of Indonesia's new decentralisation laws. The release of large areas of forest land in Sumatra will almost certainly result in the extinction of Sumatra's remaining lowland forests unless there are immediate policy interventions. The World Bank has already predicted that Sumatra's lowland forests will become extinct by 2005 (Holmes 2002).

Oil palm investors are more likely to establish large-scale oil palm plantations in Kalimantan and West Papua as land resources become limited in Sumatra. Expansion of oil palm on to forest land in these two provinces will largely depend on the Indonesian government's ability to establish suitable infrastructure. Applications for the establishment of plantations on another 3.2 million ha of forest land in Kalimantan and Irian Jaya had already been accepted by the Ministry of Forestry by 1999 (Badan Planologi 1999).

<u>The relationship between future soybean expansion and critical habitat loss in Brazil</u>

According to the United States Department of Agriculture (USDA), Brazil's soybean area could potentially increase three-fold over the next 50 years, rising from 18.0 million ha in 2002 to 54.0 million ha in 2052 (USDA 2003). However, should circumstances arise that enable the Brazilian's to significantly reduce production costs or increase productivity, the rate of soybean expansion will likely be stimulated and its ultimate extent increased by 50-100 million ha to reach 68-118 million ha (USDA 2003b).

Soybean expansion is expected to be exceptionally rapid if key legal, technical and financial developments occur. Specifically, this will require eventual legalization of genetically bio-engineered crops[11], widespread adoption of newly available high yield crop varieties and intensified investment in the development of transportation infrastructure. Each of these factors would enable large-scale producers to reduce their oilseed production costs by 20-50%, increase profit margins, increase yields, and expand crop acreage (USDA 2003b).

Most soybean expansion is expected to occur in the Cerrado region followed by the Amazon basin. Brazil's Agricultural Research Corporation (EMBRAPA) estimate 65 million ha of 'undeveloped' virgin Cerrado is capable of supporting mechanized oil seed production (Schnepf *et al*. 2001). The USDA also considers the Cerrado savanna in the Centre-West to be "the world's greatest remaining tract of accessible but relatively underdeveloped farmland" (Schnepf *et al.* 2001). In the past, poor soil fertility limited both the extent and the range of agricultural development in the Cerrado, however soil management techniques developed by EMBRAPA have been developed to elevate these soils to being among the world's most productive. New soybean varieties[12] are also expected to increase yields and further soy expansion in the area (USDA 2003b).

Improved varieties of soybean are also expected to allow further expansion into the Amazon basin, where high rainfall levels previously deterred expansion plans[13]. This is because Brazilian crop researchers have recently succeeded in breeding high-yield[14] soybean varieties for every climate regime in the country, including tropical varieties for the equatorial lowlands (USDA 2003b). USDA has noted that tropical soybeans are already being cultivated near the major port of Santarem on the Amazon River in the state of Para. In the remote northern state of Roraima—where tropical rainforest is the dominant vegetation—three soybean crops can now be grown in a year (USDA 2003b). Nevertheless, concerns about the sustainability of soybean expansion in the Amazon region are prevalent. This is because the best soils in the Amazon region tend to be found on steep slopes not suitable for mechanized agriculture. High rainfall levels have also caused several soybean crop failures in the region and rendered the use of machinery non-viable (Schneider *et al.* 2000; Fearnside 2001).

Statement 3: Oil palm and soybean plantations constitute a threat to critical habitats because government policies tend to support expansion in areas considered to have high conservation value.

Government policies in countries such as Indonesia and Brazil have greatly facilitated the growth of oil palm and soybean expansion into critical habitats over the last few decades, despite the existence of considerable areas of degraded land in both of these countries. Similar policies are expected to further oil palm and soybean area growth in these countries, primarily because both governments financially benefit from the expansion of these two crops.

Government policies that support oil palm expansion in to critical habitats in Indonesia

In Indonesia, oil palm expansion has conferred important economic benefits for the Indonesian government and some elements of Indonesian society primarily because it has: 1) provided employment for Indonesia's growing population; and 2) become an increasingly important source of foreign exchange. Prior to the 1997 economic crisis, for instance, oil palm exports were able to bring in earnings of approximately US$ 1.4 billion. This was 31% of Indonesia's agricultural exports in 1997, and 3.5% of Indonesia's total non-oil and gas exports (Arifin & Susila 1998:25).

In light of the potential benefits oil palm can offer, the Indonesian government, often with World Bank assistance, has facilitated the growth of the sector by: 1) making direct investments into state run

[11] Up until now, the Brazilian government has resisted the trend that has seen the US and other producers (including Argentina & Paraguay) to shift to genetically modified soybean crops over the last decade.
[12] In 2003, EMBRAPA released a new soybean variety (BRS-Raimunda) for commercial distribution that yields an average of 5.0 tons per ha under normal Cerrado field conditions. Existing varieties were only able to yield 2.4-3.3 tonnes per ha (USDA 2003b).
[13] Soybeans have not previously been suited to areas with high rainfall because the crop required a dry season due to its vulnerability to pest and disease attack while in the vegetative stage (Schneider et al. 2000).
[14] Under optimal conditions, Brazil's tropical soybean can produce yields of 4.7 to 5.4 metric tonnes per ha (Schnepf et al. 2001).

companies called *Perseroaan Terbatas Perkebunan* (PTPs); 2) encouraging greater private estate sector involvement in smallholder development under the PIR-Trans programme (1985-1994) and the Prime Cooperative Credit for Members (KKPA) scheme (1995-1998); and 3) encouraging greater private sector involvement in the oil palm sub-sector by granting access to credit at concessionary rates for estate development, new crop planting and crushing facilities. It has also allocated large tracts of forest land (totalling 8.5 million ha by 1999) to investors, despite the existence of approximately 12.5 million ha of degraded land (Casson 2000). Applications for the conversion of another 8 million ha of forest land had also been accepted before a temporary moratorium on further forest conversion was established in 2000 (Badan Planologi 1999).

While economic crises caused the Indonesian oil palm sub-sector to contract temporarily, the Indonesian government remains hopeful that oil palm can bring in much needed revenue and boost the economy. It is therefore providing a number of incentives to the industry in order to facilitate further growth. These incentives include: debt-restructuring opportunities, regulatory changes that facilitate further development, and access to large tracts of forest land. For instance, the Habibie government offered extensive forest areas to companies wishing to establish plantations in West Papua (Direktorat Jenderal Perkebunan 1999). Twenty-eight companies were granted permission to open large-scale oil palm plantations in the province shortly afterwards (*Jakarta Post*, 9 Nov 1999:1). Investors were also lured to East Kalimantan when the Indonesian government announced plans to establish one million ha of oil palm in the province (*Indonesian Observer,* 27 Oct 1998: 6). Most of these plantations were to be established on forest land.

The government's recent decentralisation policy also has the potential to boost oil palm expansion. In accordance with this policy, district governments have allocated forest land and permits to oil palm investors without gaining central government approval—a process that previously took up to 5-10 years. 'Speeding up the permit process' will inevitably lead to further oil palm expansion at the expense of Indonesia's forest cover, particularly on the island of Sumatra (Casson 2001a; 2001b).

Government policies that support soybean expansion in to critical habitats in Brazil

In Brazil, the soybean industry is considered to be of critical importance to the national economy because it is a dominant agricultural crop. Agriculture plays a significant role in Brazil because it represents 14% of GDP and 33.5% of the value of exports. It also provides jobs for 13% of the labour force (Schnepf *et al.* 2001). The Brazilian government has taken a special interest in the expansion of soybean plantations since the 1960s because soybeans were identified as a viable export crop that could bring in valuable foreign exchange (Schnepf *et al.* 2001). When land became scarce in the south, the government facilitated the growth of the soybean sub-sector by providing subsidized credit and agricultural loans to farmers, creating an Agricultural Research Corporation (EMBRAPA) tasked with producing new soybean varieties suitable for the Cerrado region and the Amazon, and providing necessary transport infrastructure (Kaimowitz & Smith 2001; Schnepf *et al.* 2001). Much of Brazil's soybean expansion has replaced natural bio-diverse vegetation, despite the existence of approximately 10 million ha of degraded pasture or deforested land (USDA 2003b).

In the 1970's, for instance, the Brazilian government gave $577 million in agricultural loans to farmers through the Programme for the Development of the Cerrado (POLOCENTRO) (Kaimowitz & Smith 2001). It also distributed nearly $28 billion in official credit to soybean producers, primarily large-scale soybean producers in the Centre-West region between 1970 and 1990 (Schnepf *et al.* 2001). The publicly funded Brazilian Agricultural Research Corporation founded in 1973, also worked to produce new soybean varieties adapted to the Cerrado, with the explicit goal of advancing the agricultural frontier in to this region. The research allowed farmers in the Centre-West region to increase yields by 43%. More recently, EMBRAPA researchers have successfully bred high-yielding soybean varieties suitable for tropical soils in order to advance soybean expansion in to the North-Northeast Amazonian region (Schnepf *et al.* 2001; USDA 2003b).

Improved transportation infrastructure has facilitated further soybean expansion, particularly within the Cerrado region, because it has lowered transportation costs by approximately 40% (USDA 2003b). Fearnside (2001) argues that much of the transport infrastructure established in the Amazonian region, under the auspices of the Brazil in Action (*Brasil em Ação*) programme (1996-1999) was developed in order to aid soybean expansion. The Brazilian government is presently planning to sharply expand the existing network of paved highways and infrastructure within the Amazon basin. Under the auspices of its *Avança Brasil* (Advance Brazil) program, the government intends to invest $US40 billion in highways, railroads, gas lines, power lines, hydroelectric reservoirs and river channel projects that will criss-cross large expanses of the basin, greatly increasingly accessibility to remote frontier areas. This program is expected to facilitate the expansion of new tropical soybean varieties into the North-eastern Amazon area (USDA 2003b). It is also expected to further deforest and fragment the remaining forests in the Amazon basin (Laurance *et al.* 2001). Economists have determined that a 20% reduction in transportation costs for all agricultural products from the Amazon increases deforestation by 33% (Cattaneo 2001).

Statement 4: Oil palm and soybean expansion constitutes a threat to critical habitats because large scale fires have been linked to the land clearing practices of plantation companies.

In both Indonesia and Brazil, oil palm and soybean expansion has inadvertently posited a significant threat to critical habitats because fire is invariably used to clear former vegetation. In 1997-1998, a number of uncontrolled fires caused significant and irrevocable damage to a number of critical habitats. Unlike many temperate and boreal forests, which are adapted to fire and depend on it for regeneration, tropical moist forests, which are characterized by high levels of humidity and moisture, are unable to fully recover (Nepstad *et al*. 1999:505). Fire in the moist tropical forests of Indonesia and Brazil has also been proven to have a severe impact on wildlife, particularly birds, reptiles and amphibians (Barber & Schweithelm 2000:16; Nepstad *et al.* 1999).

<u>Oil palm expansion and forest fires in Indonesia</u>

In Indonesia, oil palm expansion has been singled out as a major cause of the devastating 1997-1998 forest fires, which affected approximately 11.7 million ha of land. More than half of this land was montane, lowland or peat forest (Tacconi 2003). The fires were undoubtedly aggravated by years of exploitative logging in the Suharto era and an El Niño effect in the Pacific Ocean. However, satellite imagery has proven that the great majority of these fires were triggered and exacerbated by oil palm plantation companies using uncontrolled burning to clear land (CRISP 2002). In light of this evidence, the Ministry of Forestry announced that 133 oil palm companies were suspected of intentionally and systematically using fire to clear land in Sumatra and Kalimantan in mid 1997 (Wakker 1998b).

Despite substantiated evidence that these companies were partly responsible for these fires, few oil palm companies have been prosecuted. In May 2001, the former Minister for Environment, Sonny Keraf, stated that five plantation companies had been sued for their alleged roles in the forest fires on the islands of Kalimantan and Sumatra. However, only one lawsuit has been processed according to the law (*Jakarta Post*, 9 May 2001). The Indonesian Forum for the Environment (WALHI) has recently sued seven regents and 20 companies over the forest fires in Riau because the Indonesian government has not demonstrated an intent to prosecute those found to be responsible for the fires (*Jakarta Post*, 13 June 2003).

These oil palm companies, aware of the fact that they are unlikely to be prosecuted, are likely to continue to use fire to clear land because no legal mechanism yet exists for effective prosecution in Indonesia. Economic analysis of land clearing practices has also demonstrated that Indonesian oil palm plantation companies are likely to continue to use fire for land clearing because zero-burning practices increase land-clearing costs by US$50 to US$150 per ha (Guyon & Simorangkir 2002). It is also speculated that oil palm companies intentionally light fires in order to degrade forest land and speed up permit allocation processes (Casson 2000; Barber & Schweithelm 2000). Satellite imagery indicates oil palm companies have contributed to further damaging fires since 1998 (CRISP 2002). Most of these fires occurred in Riau and Central Kalimantan where expansion has been particularly rapid over the last few years. Oil palm companies will continue to pose a threat to Indonesia's forest cover, both inside and outside concession areas, unless they employ Best Management Practices (BMP) and adopt zero-burning techniques to clear forest land in the future.

Soybean expansion and forest fires in Brazil

In Brazil, soybean expansion has also been identified as a contributing cause of the 1998 forest fires, which affected 14%, or 3.3 million ha of land within the northern Amazonia state of Roraima. Approximately 1.2 million ha of this land consisted of open and dense rain forest (IFFN 2003).

According to the United Nations Humanitarian Affairs Office (1998), the fires were caused by multiple factors—one being soybean expansion in the nearby savanna area. The 'El Nino' phenomenon caused a serious drought in the northern and north-eastern parts of Brazil. Land clearing practices then triggered the fires and increased the severity of the problem. The fires started in savanna areas and were ignited by the *"queimadas"* (burning fields for pasture and agricultural crops such as maize, yucca and soy). These fires are believed to have blazed out of control after temperatures soared and a strong wind of up to 100km per hour went through the area. The increasing prevalence of fire-dependent agriculture in the Amazonian region is expected to result in further forest fires, which will posit a significant threat to the Amazon's tropical forests (Nepstad *et al.* 1999).

Statement 5: Oil palm and soybean expansion constitutes a threat to critical habitats because both crops are primarily established as monocultures, which significantly reduce biodiversity.

In countries such as Indonesia and Brazil, oil palm and soybean plantations are primarily established as monoculture plantations for commercial production. While monoculture plantations offer considerable economic benefits, primarily through economies of scale, the cost to biodiversity in critical habitats is great. This is because all natural vegetation is cleared to make way for these plantations; and pesticides and herbicides kill off the last vestiges of biodiversity able to co-exist with the plantations. Once this has occurred, there is little hope of restoring the habitat.

Biodiversity loss in Indonesia

In Indonesia, oil palm plantations are usually established as monocultures in extensive plantations ranging in size from 4,000 ha to 10,000 ha. The establishment of these plantations usually results in the total clearing of former vegetation, which in the case of Indonesia, is predominantly tropical lowland rainforest.

According to research recently conducted by CIFOR scientists, oil palm plantations result in a significant reduction in biodiversity where plantations replace natural forest, agroforests such as 'jungle' rubber. Under oil palm management, forest clearing was found to result in the loss of 80% of plant species. It was also found to result in an increase in exotic 'weed' species and the loss of key faunal groups. When complete removal of stocks of native species of plants and animals is combined with the intensive use of pesticides and weedicides on large estates, there is little opportunity for biodiversity rehabilitation (pers comm. A.N. Gillison, June 2003).

The widespread and ongoing conversion of forest to oil palm in Indonesia has already resulted in a substantial loss of biodiversity. In provinces such as Riau and Jambi, where oil palm expansion has been exceptionally rapid, biodiversity loss is a matter of global concern. In Tesso Nilo, Riau, this is supported by evidence of the highest concentrations of terrestrial plant biodiversity recorded so far in any country (Gillison 2001). Similar levels of biodiversity have been recorded in the lowland forests of Jambi and Central Sumatra (pers comm. A. Gillison, June 2003). The lowland forests of Riau and Jambi also harbour a number of endangered species, including the Sumatran elephant and the Sumatran tiger. These two focal species are already significantly threatened by the expansion of oil palm plantations because their habitats have already been targeted for expansion. While the tiger can move into remaining forest areas in the interim, the elephant is more conspicuous. This is because the elephant tends to feed on the oil-rich palm nuts. The species is consequently considered to pose a threat to the viability of oil palm plantations in the area and elephants are often killed when they destroy these plantations.

Biodiversity loss in Brazil

In Brazil, large monoculture soybean plantations[15] have had a significant impact on biodiversity, particularly if these plantations replace Cerrado or tropical rain forest. Monoculture soybean plantations are thought to have a larger impact on biodiversity and the general environment than oil palm plantations and cattle ranching because soybeans are an annual crop. Compared to perennial crops, annual cropping inefficiently utilizes water and nutrients resulting in degradation of soil and water quality. Biodiversity loss is greatest in large-scale estates where native vegetation is cleared using machinery and enormous quantities of pesticides and herbicides are used (Tengnäs & Nilsson 2003). It is worth noting that the use of pesticides and herbicides do not only have an impact on biodiversity in areas actually planted with soybeans. Evidence suggests that wide-spread pesticide use has been having an impact on biodiversity on the down-stream Pantanal wetland area. This area is one of the world's largest most important wetlands and refuge to hundreds of bird species, including kites, hawks, macaws and toucans; as well as jaguars, alligators, river otters, iguanas, anacondas, anteaters, monkeys and capybaras—the world's largest rodents (UNESCO 2001).

Concerns have also been raised about the impact of genetically-modified (GM) soybean varieties on biodiversity[16]. This is because genetically modified plants may transfer genetic material and associated traits to wild species. This process may alter ecosystem processes and thereby pose a threat to natural plant species (La Vina 2003). The impact of GM soybean species is of special concern in countries rich in biodiversity, such as Brazil and Bolivia. The Brazilian government banned the use of GM soybean varieties in Brazil in 1999, however at least 10% of Brazilian soybean area is already thought to genetically modified. This is primarily because seeds have been fraudulently imported from Argentina where GM soybean varieties are planted on a wide scale (EU 2002).

Statement 6: Oil palm and soybeans constitute a threat to critical habitats because expansion is often associated with other activities known to result in critical habitat loss.

In Brazil and Indonesia, soybean and oil palm expansion has been associated with logging (Indonesia & Brazil), charcoal production (Brazil) and pasture development (Brazil)—three critical causes of tropical deforestation and critical habitat loss in these two countries. All these activities indirectly increase the impact of soybeans and oil palm expansion on critical habitats.

The relationship between oil palm expansion and logging in Indonesia

In Indonesia, oil palm is primarily established on forest land, despite the existence of vast areas (approximately 12. 5 million ha) of degraded land in the same provinces in which oil palm is being established. This is not coincidental. Oil palm companies will often offset plantation establishment costs with profits obtained from timber extraction. In some cases, companies will also gain access to valuable tropical hardwood species under the pretext of establishing oil palm plantations. This has been the case particularly in Kalimantan and Irian Jaya, where the total area of oil palm plantations had only reached 517,328 ha by 2000, despite the fact that companies had applied for permits to establish oil palm on more than 3.8 million ha of forest land (Badan Planologi 1999). Large areas of production forest have also been allocated to oil palm companies in Central Kalimantan, East Kalimantan and Irian

[15] Properties in Brazil's Centre-West tend to be over 1000 ha.

[16] During the six-year period 1996-2001, the global area under GM crops increased more than thirty-fold, from 1.7 million ha in 1996 to 52.6 million ha in 2001. The seven principal GM crops growing in 1998 were (in descending order of area) soybean, maize, cotton, canola (rapeseed), potato, squash, and papaya (ITDG 2002).

Jaya, despite the fact that conversion forest is still available in these three provinces. This effectively allows companies to clear-cut production forests.

While some of these companies may not have been able to establish oil palm plantations because of financial, infrastructure or labour constraints, others have been quite clearly interested in clearing timber rather than establishing oil palm. This is primarily because permits for the conversion of forest land to oil palm allow companies to clear-cut timber in an unsustainable manner. These companies do not have to be concerned about sustainable forest management because the land has been allocated for full-scale conversion. At a time when long-term investments in areas such as Kalimantan and West Papua Irian Jaya is risky[17], companies would rather walk away with the profits obtained through forest clearing rather than invest in tenuous oil palm plantations that will not yield profits for another eight years.

<u>The relationship between soybean expansion, charcoal production and pasture development in Brazil</u>

In Brazil, soybean expansion has been linked to cattle ranch expansion and charcoal production. In the Cerrado region, for instance, soybean expansion has provided access to Cerrado trees, particularly those found nearby rivers in gallery forests (RBGE 2002). These trees are used by the Brazilian steel industry for charcoal production[18]. It is estimated 80% of the charcoal used in the Brazilian steel industry is derived from native Cerrado trees. The removal of Cerrado trees for the Brazilian steel industry is thought to be resulting in the loss of 200,000 ha of gallery forests per year (ELC 2002). Soybean farmers primarily clear gallery forests for charcoal producers because profits extracted from the clearing of Cerrado tree vegetation on soybean farms can be used to further soybean expansion. The removal of gallery forests has raised concern because these forests play an important ecological role in the area. The forests provide corridors linking the Amazon and the coastal rainforests with the Cerrado on the central plateau; and provide a critical habitat for bird fauna and a number of endemic species (Tengnäs & Nilsson 2003).

Soybean expansion can also be linked to the expansion of pasture development for cattle ranching—one of the main causes of tropical deforestation in Brazilian Amazon (Schneider *et al.* 2000). Satellite imagery has shown how large-scale soy expansion in the southern state of Parana, has inadvertently resulted in the expansion of the agricultural frontier into the Amazon rainforest (Skole *et al*. 1994). This is because government policies, coupled with improved soybean technologies favoured the expansion of large-scale mechanised soybean farms in Parana. This trend forced small-scale farmers to migrate[19] into the Amazon area, where they cleared forest for agriculture or cattle ranching (Schneider *et al.* 1992; Skole *et al*. 1994; Fearnside 2001; Kaimowitz & Smith 2001). These farmers were able to fund the development of new pastures in the Amazon with the profits obtained from the sale of pastures to soybean farmers in the south, and through tropical timber clearing in the Amazon. Concerns have been raised about deforestation in the Amazon because the region contains 40% of the world's remaining tropical rainforest that plays a vital role in regional hydrology, climate and terrestrial carbon storage (Laurence *et al.* 2001).

According to USDA (2003b), cattle farmers have also sought to increase their net acreage in recent years in order to achieve economies of scale and to cash in on strong soybean returns following a substantial multi-year devaluation in the Brazilian currency. Access to new areas in the Amazon has been made possible through the development of new roads. Funds for new pasture development are primarily obtained through forest clearing. In the long term, it is believed that pasture developed in the Amazon will ultimately provide an extensive resource for soy expansion. In fact, the USDA (2003b) estimates that 70-90 million ha of Brazil's existing pasture acreage can be converted to soybean plantations in the future. History shows that the transfer of land to soybeans from pasture will

[17] Ethnic unrest and general dissatisfaction with the status quo has been particularly high in recent years in Kalimantan and Irian Jaya.

[18] Brazil produces approximately 10 million m^3 of charcoal every year.

[19] Laurance et al. (2001) estimated that migration of non-indigenous populations into the Brazilian Amazon increased tenfold from about 2 million people in the 1960s to 20 million people in 2000.

effectively push cattle farmers further into the Amazon frontier where they will clear forest to open up new pastures.

Conclusions

This paper demonstrates oil palm and soybean expansion exerts significant direct and indirect impacts on a number of critical habitats within the bio-diverse countries of Indonesia and Brazil. The most direct impact has arisen through the conversion of natural vegetation to oil palm or soybean plantations. This resulted in the loss of approximately 2 million ha of tropical forest land in Indonesia by 1999; and the loss of vast areas of Cerrado vegetation in the Centre-West region of Brazil. The tropical forests of Indonesia and the Cerrado vegetation of Brazil are considered critical habitats because both habitat types contain high levels of biodiversity and are home to a number of 'focal species' including the orang-utan, Sumatran tiger, Sumatran elephant in Indonesia, and in Brazil, the maned wolf, giant armadillo and giant anteater.

In both countries, government policies have facilitated soybean and oil palm expansion in to critical habitats, such as Sumatra's lowland tropical forests and the Cerrado ecoregion, rather than exploit the vast areas of degraded land. Similar government policies are projected to stimulate further growth within these native forest and savanna habitats in the near future. Further soybean expansion is also expected to have a direct and increasing impact on the Amazonian region as new high-yielding tropical soybean varieties have been specifically created for expansion in this region.

Large-scale oil palm and soybean plantations have a significant impact on biodiversity in bio-diverse countries such as Indonesia and Brazil because plantations are primarily large-scale, commercial monocultures. While monoculture plantations offer considerable economic benefits, development results predominantly in the total clearing of natural vegetation. In plantations, pesticides and herbicides largely eliminate remaining vestiges of indigenous biodiversity and significantly diminish the chances of habitat restoration.

The total impact of oil palm and soybean expansion on critical habitats in countries such as Indonesia and Brazil is difficult to determine. It is expected nonetheless to be far greater than the direct impact caused by the conversion of natural vegetation to oil palm or soybean plantations. This is because oil palm and soybean expansion has been linked to a number of other activities known to cause critical habitat loss. In Indonesia and Brazil, oil palm and soybean companies have been linked to devastating forest fires in 1997-98, which destroyed more than 11.7 million ha of forest and other vegetation in Indonesia, and 3.3 million ha of forest and other vegetation within the northern Amazonian state of Roraima. Oil palm expansion has also inadvertently resulted in further unsustainable logging in Indonesia because forest conversion permits allow clear-cutting of tropical hardwoods in production forest land. In Brazil, soybean expansion has been linked to charcoal production and cattle ranch expansion—one of the main causes of deforestation in the Amazon region. While the area of tropical forest lost through these indirect means is difficult to determine, it is thought to be significant as forests within both countries are diminishing exponentially. It seems clear that the fate of critical habitats within these two countries, and others such as Malaysia, Paraguay, Bolivia and Argentina, will depend largely on the willingness of governments and companies to immediately implement best management practices and sound land-use policies.

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