Dutch trade and biodiversity

Biodiversity and socio-economic impacts of Dutch trade in soya, palm oil and timber

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Preface

Around the globe, biodiversity is in decline and the Netherlands plays a not insignificant role in this process. Besides a decreasing level of biodiversity in the Netherlands itself, the import of products from other countries has an impact on the biodiversity in those countries. To decrease the ecological impact of the Netherlands, the Dutch government is striving for greater sustainability in production, trade and consumption in the Netherlands and abroad. It aims at integrating biodiversity aspects in all economic sectors through cooperation with the private sector and societal organisations. For that purpose the Dutch government is supporting initiatives to achieve sustainable sourcing and processing of agricultural commodities. The Ministry of Economic Affairs, Agriculture and Innovation is actively involved in this process and, two years ago, commissioned LEI and Alterra, both part of Wageningen University and Research Centre, to strengthen its knowledge base and to provide up-to-date information about the position of the Netherlands in the international trade in palm oil, soya and tropical timber, and about the socio-economic and biodiversity impacts of the production of these products in the major production regions for Dutch imports.

Prof Dr R.B.M. Huirne
Managing Director LEI

Summary

S.1 Key findings

The Netherlands is a large importer of soya, palm oil and tropical timber products. The total annual import value in the period 2007-2009 was around USD5.3b. The imports of soya from Brazil, palm oil from Indonesia and Malaysia and timber from Indonesia require in these countries roughly the same area as the total agricultural land area of the Netherlands (see section 5.2).

Consequently, the Netherlands contributes to the loss of biodiversity in these countries. In Indonesia and Malaysia, vast areas of forests are converted into oil palm plantations and the expansion of soya cultivation in Brazil is an important driver for large-scale forest conversion, leading to direct losses of biodiversity at the production sites and fragmentation of the remaining forests (see section 5.4).

The oil palm, soya and timber industry provides employment for millions of people in the exporting countries. The development of large-scale operations, however, has negative effects on the local communities (see section 5.5).

To decrease the ecological and socio-economic impact of the Dutch import, the Netherlands government could promote sustainable intensification of production, expansion of production in degraded areas, and integrated land use planning in the exporting countries (see section 5.6).

Table S.1	Production area needed for the annual Dutch import in the period 2007-2009		
Commodity	**Exporting country**	**Dutch import equivalent**	**Production area x 1,000 ha**
Soya bean and products	Brazil	4.3m tonnes	1,545
Palm oil and products	Indonesia	0.5m tonnes	141
Palm oil and products	Malaysia	1.0m tonnes	246
Wood and products	Indonesia	0.2m m^3 RWE	104
Source: Various statistics plus own calculations, see report.			

S.2 Complementary findings

Trade

In the period 2007-2009, the Netherlands imported annually about 4.3m tonnes of soya products from Brazil. A large part of the imported soya beans is re-exported to neighbouring countries, directly or after processing in the Netherland (see section 2.2).

In the same period the annual Dutch import of crude palm oil was 1.0m tonnes from Malaysia and 0.5m tonnes from Indonesia. A major part of the imported crude palm oil is re-exported after processing, in particular to Germany and Belgium (see section 3.3).

The European Union accounts for 45% of the total global wood imports. About 30 % of the total total EU wood import from Malaysia enters the EU via the Netherlands, for Indonesia it is about 20%. However, the import from these countries account for only 11% of the total Dutch wood import. Two thirds originates from neighbouring EU countries (see section 4.2).

For the annual Dutch soya imports from Brazil in the period 2007-2009 an estimated production area of about 1.5m ha was needed (see sub section 2.4.2). For the palm oil imports from Indonesia and Malaysia the required area was almost 0.4m ha (see sub section 3.5.2) and for the imported timber from Indonesia around 0.1m ha (see sub section 4.4.4) (see section 5.2).

Biodiversity

The conversion of forests into soy fields and oil palm and timber plantations leads to an almost complete loss of the original biodiversity. However, forest remnants in the production regions often still harbour a substantial part of the original forest species. Selectively logged forests also support fewer species than primary forests, yet their species richness is still far above the values reported for agricultural crop or tree plantations (see section 5.4)

Socio-economic impacts

Soya production is an important economic driver for economic development in Brazil, but the highly mechanised production of soya beans leads to a loss of employment and increased poverty in the production regions (see section 2.6).

An estimated 6m people in Indonesia benefit from the palm oil production and related activities (see section 3.7).

The loss of agricultural and forested land, however threatens the local food security and the food supply to the increasing urbanised population (see section 3.7).

The intensive use of agro-chemicals in plantations can seriously affect the health of the local population (see section 2.6 and 3.7).

S.3 Method

The Dutch Ministry of Economic Affairs, Agriculture and Innovation commissioned LEI and Alterra to provide updated information on the impact of the import of palm oil, soya and tropical timber. The following research questions are answered:

- What is the position of the Netherlands in the international trade in palm oil, soya and tropical timber?
- What are the biodiversity and socio-economic in the major production regions for Dutch imports?
- What are the options for mitigating the negative effects of these imports?

The trade flows of soya from Brazil, palm oil from Indonesia and Malaysia and timber from Indonesia have been analysed. To assess the biodiversity and socio-economic impacts of Dutch imports a calculation has been made of the area needed to produce these commodities following different production methods in the exporting countries. The assessment of the biodiversity and socio-economic impacts is based on an extensive literature analysis, supported by previous field experience of the involved researchers (see Chapter 1).

Samenvatting

S.1 Belangrijkste uitkomsten

Nederland is een grote importeur van soja, palmolie en tropische houtproducten. De totale jaarlijkse waarde van de import in de periode 2007-2009 bedroeg ongeveer 5 miljard US dollar. Voor de import van soja uit Brazilië, palmolie uit Indonesië en Maleisië en hout uit Indonesië is in deze landen ruwweg dezelfde landoppervlakte nodig als de totale oppervlakte aan landbouwgrond in Nederland.

Op die manier draagt Nederland bij aan het verlies van biodiversiteit in deze landen. In Indonesië en Maleisië veranderen grote stukken bos in oliepalmplantages en de uitbreiding van de sojacultuur in Brazilië is een belangrijke oorzaak van de grootschalige conversie van bos in landbouwgrond, wat leidt tot een direct verlies van biodiversiteit op de productielocaties en tot een fragmentatie van de overblijvende bossen.

De palmolie-, soja- en houtindustrie biedt werkgelegenheid voor miljoenen mensen in de exportlanden. De ontwikkeling van grootschalige bedrijven heeft echter negatieve gevolgen voor de lokale gemeenschappen.

Door duurzame intensivering van de productie, uitbreiding van de productie in gedegradeerde gebieden en geïntegreerde landinrichting in de exportlanden te stimuleren, kan de Nederlandse overheid de ecologische en socio-economische impact van de Nederlandse import reduceren.

Tabel S1	Benodigd productiegebied voor de jaarlijkse Nederlandse import in de periode 2007-2009		
Product	**Exportland**	**Nederlandse import**	**Productiegebied x 1.000 ha**
Sojabonen en -producten	Brazilië	4,3 miljoen ton	1.545
Palmolie en palmolieproducten	Indonesië	500.000 ton	141
Palmolie en palmolieproducten	Maleisië	1,0 miljoen ton	246
Hout en houtproducten	Indonesië	0,2 miljoen m^3 RWE	104
Bron: diverse statistieken plus eigen berekeningen, zie rapport.			

S.2 Overige uitkomsten

Handel

In de periode 2007-2009 importeerde Nederland jaarlijks ongeveer 4,3 miljoen ton sojaproducten uit Brazilië. Een groot deel van de geïmporteerde sojabonen wordt direct of na verwerking in Nederland geëxporteerd naar buurlanden.

In dezelfde periode was de jaarlijkse Nederlandse import van ruwe palmolie 1,0 miljoen ton uit Maleisië en 500.000 ton uit Indonesië. Een groot deel van de geïmporteerde ruwe palmolie wordt na verwerking weer geëxporteerd, hoofdzakelijk naar Duitsland en België.

De Europese Unie neemt 45% van de totale wereldwijde houtimport voor haar rekening. Ongeveer 30% van de totale houtimport van de EU uit Maleisië komt van de import de EU binnen via Nederland, voor Indonesië is dat zo'n 20%. De import uit deze landen vormt echter slechts 11% van het totale volume aan hout dat door Nederland wordt geïmporteerd. Twee derde is afkomstig van EU-buurlanden.

Voor de jaarlijkse Nederlandse soja-import uit Brazilië in de periode 2007-2009 was naar schatting een productiegebied van zo'n 1,5 miljoen hectare nodig. Voor de import van palmolie uit Indonesië en Maleisië was er bijna 400.000 hectare nodig en voor de import van hout uit Indonesië zo'n 100.000 hectare.

Biodiversiteit

De conversie van bossen in sojavelden en oliepalm- en houtplantages leidt ertoe dat de oorspronkelijke biodiversiteit bijna volledig verloren gaat. De resterende bossen in de productieregio's herbergen vaak een aanzienlijk deel van de oorspronkelijke bossoorten. Selectief gekapte bossen hebben een lagere biodiversiteit dan primaire bossen, maar hun soortenrijkheid ligt desondanks nog ver boven de gerapporteerde waarden voor landbouwgewassen en boomplantages.

Socio-economische impact

De sojaproductie is een belangrijke drijver van economische ontwikkeling in Brazilië, maar de sterk gemechaniseerde productie van sojabonen leidt tot een verlies van werkgelegenheid en meer armoede in de productieregio's.

In Indonesië profiteren er naar schatting zo'n 6 miljoen mensen van de palmolieproductie en gerelateerde activiteiten.

Het verlies van land- en bosbouwgrond vormt een bedreiging voor de lokale voedselveiligheid en voedselvoorziening voor de in toenemende mate verstedelijkte bevolking.

Het intensieve gebruik van agrochemicaliën in plantages kan grote negatieve gevolgen hebben voor de gezondheid van de lokale bevolking.

S.3 Methode

Het ministerie van Economische Zaken, Landbouw en Innovatie heeft LEI en Alterra de opdracht gegeven om actuele informatie te verschaffen over de impact van de import van palmolie, soja en tropisch hout. De volgende onderzoeksvragen zijn behandeld:

- Wat is de positie van Nederland in de internationale handel in palmolie, soja en tropisch hout?
- Wat zijn de gevolgen voor de biodiversiteit en de socio-economische impact in de belangrijkste productieregio's voor de Nederlandse import?
- Welke opties zijn er om de negatieve effecten van deze import tot een minimum te beperken?

Er is een analyse uitgevoerd van de handelsstromen van soja uit Brazilië, palmolie uit Indonesië en Maleisië, en hout uit Indonesië. Om de gevolgen voor de biodiversiteit en de socio-economische impact van de Nederlandse import te bepalen, is er een berekening gemaakt van het benodigde gebied om deze producten te produceren volgens verschillende productiemethodes in de exportlanden. De beoordeling van de gevolgen voor de biodiversiteit en de socio-economische impact is gebaseerd op een uitgebreide literatuuranalyse met ondersteuning van eerdere praktijkervaring van de betrokken onderzoekers.

1 Introduction and methodology

1.1 Introduction and policy background

Around the globe biodiversity is in decline, which ultimately threatens the welfare of us all. Though a small country, the Netherlands plays a not insignificant role in this process. That can be illustrated by the 'global ecological footprint' of the Netherlands, which shows that for the Dutch domestic consumption in 2005 a total land area was needed three times the total surface of the Netherlands (PBL, 2008). Hence the Netherlands is a small country with a big global footprint, amidst most other developed countries. To decrease the ecological impact of the Netherlands, the Dutch government is striving for greater sustainability in production, trade and consumption in the Netherlands and abroad and aims at integrating biodiversity aspects in all economic sectors through cooperation with the private sector and societal organisations. The Dutch government focuses on the following commodities: coffee, cacao, tea, soya, palm oil, fish products and tropical timber.

A key element in the policy of the Ministry of Agriculture, Nature and Food Quality (LNV)[1] is to achieve greater sustainability in international agricultural trade, as is referred to in the following policy documents:

1. *The Choice for Agriculture (LNV, 2005)*
   This policy document outlines a vision for the future of the Dutch agri-business sector based on a balanced concern for the economic, ecological and social aspects of sustainable agricultural development. Product certification is considered an effective instrument to increase the sustainability of the production of products imported in the Netherlands.
2. *Biodiversity Policy Programme (LNV, 2007)*
   One of the five priority policy tracks of this policy programme focuses on sustainable production of all raw materials that are used in the Netherlands and derived from natural resources or nature in the Netherlands or elsewhere in the world, with particular attention to conservation and sustainable use of ecosystem functions and biodiversity. The envisioned points of action are product certification and increasing market shares of certified products in the Netherlands. In January 2009, the Taskforce Biodiversity and Natural

[1] Since October 2010, LNV is part of the new Ministry of Economic Affairs, Agriculture and Innovation.

Resources was instituted by several Dutch ministries, among which the Ministry of LNV. In this Taskforce different societal groups are participating (business, science, civil society organisations and the government. Together these members are looking for the best ways and methods to use biodiversity sustainably.

3. *Agriculture, Rural Economic Development and Food Security (LNV and the Ministry of Development Cooperation,[1] 2008)*
   One of the five priority policy tracks in this policy document focuses on sustainable value chain development. Value chains (products, trade, processing and consumption) should be made more effective and sustainable, with due regards to People (income distribution), Planet (ecological sustainability) and Profit (economic growth). Central to the implementation strategy of this policy is the support to and the facilitation of public-private partnerships such as the Round Table for Responsible Soy (RTRS), the Round Table of Sustainable Palm Oil (RSPO) and the Dutch multi-stakeholder platform Initiative for Sustainable Trade (IDH).[2] Promising results of this strategy are the letter of intent signed by the cocao sector and the Ministry of LNV on sustainable cacao in March 2010 and the establishment of Taskforce Sustainable Palm Oil, in which all major stakeholders in the Dutch palm oil chain are represented. In November 2010 the Taskforce signed a manifesto in which the participating parties announce to strive for all palm oil for the Dutch market to be sustainable in 2015.
4. *Action Plan Sustainable Trade 2011-2015 (LNV and Ministry of Foreign Affairs)*
   In June 2010, the ministries of Foreign Affairs and LNV agreed to the 'Action Plan Sustainable Trade 2011-2015', which includes more than 70 sustainability initiatives of companies and civil society organisations. This agreement underlines the importance that the Dutch government attaches to collaboration with the private sector and civil society for stimulating sustainable agricultural trade.
5. *International policy context*
   In the European and international context, the international objectives of the Convention of Biodiversity (CBD), the Millennium Development Goals (MDGs)

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[1] The Ministry of Development Cooperation is in the new government part of the Ministry of Foreign Affairs.
[2] IDH was instituted in 2008 as a result of the Schokland Agreements (2007). This platform bundles the knowledge and experiences on stimulating sustainable trade of business, social organisations and trade unions for accelerating and up-scaling sustainability within mainstream commodity markets.

and the European Union's policies form the framework for Dutch policy developments. The Dutch government calls for an integrated approach in which the biodiversity, climate and food crises are addressed in coherence. The Netherlands also plays an active role in this field in the UN.

Against this background, the Ministry of LNV asked Wageningen UR to strengthen its knowledge base for promoting sustainable trade, in particular on linkages between agricultural trade and biodiversity. The project, which was implemented by LEI and Alterra, focuses on three commodities: soya, palm oil and tropical timber. This report presents the outcomes of the study.

1.2 Objectives of the study

The study aims at providing quantitative and qualitative information on:
- the position of the Netherlands in the global international trade in soya, palm oil and tropical timber;
- future trade developments in soya, palm oil and tropical timber;
- biodiversity impacts of the production of soya, palm oil and tropical timber in the major production regions for Dutch imports;
- socio-economic aspects of the production of soya, palm oil and tropical timber.

The study builds upon existing knowledge, rather synthesising available knowledge than creating new knowledge. The added value of the study is that the economic importance of the trade in soya, palm oil and tropical timber for the Dutch agri-business is directly linked to the socio-economic and biodiversity impacts of the related production in the major production areas for Dutch imports.

1.3 Selected commodities and focus countries

The study concentrates on trade flows of soya, palm oil and tropical timber.

Palm oil
Palm trees are the world's second largest source of edible oils (after soya bean). Globally, oil palm plantations cover over 15m ha (FAO, 2010a). Indonesia

and Malaysia account for 85% of the global palm oil production. In 2009, they produced about 44m tonnes of palm oil, a tenfold increase since 1980 (FAO, 2010a). The expansion of the oil palm area is in most cases at the expense of natural habitats; palm expansion is blamed for forest destruction, uncontrolled forest fires and losses of environmental good and services (Aratrakorn et al., 2006). The continuing expansion of oil palm plantations has led to a growing international concern about the social and environmental impact.

Soya

Soya is one of the world's major commodities. Soya is very rich in protein and in Europe is used mainly for the production of animal feed. The USA, Brazil and Argentina are the largest producing and exporting countries of soya beans. The global area under cultivation of soya beans increased from around 50m ha in 1980 to almost 100m in 2009, most of the plantations were in South America, where the total area increased in the same period from round 11m to almost 43m ha (FAO, 2010a). Soya bean cultivation is one of the major drivers behind deforestation and the subsequent loss of biodiversity in the sub-continent and is internationally associated with social problems such as land conflicts, displacement of small holder farmers, poor employment conditions, health problems and the loss of local food security and employment.

Tropical timber

Worldwide, the use of wood for construction and furniture is increasing, leading to a fast growing trade in wood and wood products; in the last decade the international trade doubled. Canada is by far the most important wood exporting country, followed by the Russian Federation, both countries mainly exporting softwood. Malaysia, Indonesia and Brazil are the main producers of tropical wood and wood products. Part of the required wood is harvested under sustainable forest management systems, in particular in Europe and Northern America, but a major part of the tropical timber is harvested in primary forests in an unsustainable way causing irreversible damage to the environment. The fast decreasing area of tropical forests causes great concerns about the future of these forests and the ecological and social implications.

Selection of focus countries

In consultation with policy makers of the ministry of LNV the following selection of countries has been made. For palm oil the analysis focuses on Indonesia and Malaysia, being the two major producers of palm oil. Indonesia is in particular interesting, because it is not only the largest exporter of palm oil in the world, but has also the potential for further expansion due to the large availability of forest land. Wood extraction (as part of deforestation) and development of oil palm plantations are often part of a continuous process of deforestation for which it is not always possible to assess which of the two is the driver for forest conversion. Conversion of forest to oil palm plantations is expected to have a strong impact on biodiversity and the socio-economic living conditions in the areas concerned.

For that reason, Indonesia is also selected as the focus country for the analysis on tropical timber.

Another reason for extra attention to Indonesia are the strong collaborative networks of Wageningen UR and the Ministry of LNV in Indonesia, including the Joint Working Group on sustainable development and the Working Group on agriculture, which offers opportunities for putting recommendations into practice.

With respect to soya the analysis focuses on Brazil, based on the notion that for the Netherlands it is by far the largest trade partner for soya, while at a global scale it is the second most important producer and exporter of soya after the USA. Another reason is that Wageningen UR is collaborating within many networks around soya, such as the Round Table on Responsible Soy (RTRS).

1.4 Methodology

The strongest drivers of loss of biodiversity are associated with land-use change from natural ecosystems to agricultural production, infrastructure and urban areas (Alkemade et al., 2009; Pereira et al., 2010). A recent study of land-use changes in tropical regions shows that between 1980 and 2000 55% of agricultural expansion was on previously intact forest areas, while another 28% was on already disturbed forest areas (Gibbs et al., 2010). More intensive land use systems have a stronger effect than more extensive systems. In a scenario study ten Brink et al. (2010) indicated that the option of closing the yield gap, i.e. reduce the difference between current and potential yields, could reduce loss of original biodiversity by 2050 by 20% compared to the baseline scenario. Hence, to assess the impact of Dutch imports of palm oil, soya and wood from the selected countries on biodiversity it is necessary to relate the quantities exported to the Dutch market to the area needed to produce the commodity under different production methods and combine this with the biodiversity impact of the various production systems. This methodology includes the following three steps:

A. Based on trade statistics, the volume of import of the three commodities by the Netherlands from the focus countries is determined.
B. The imported volume combined with factors that determine both the production yields and the biodiversity impacts, such as production system, country, region, biome and/or ecosystem form the basis for an estimation of the area in each region and ecosystem that is being used for the production of the Dutch imports.
C. The impact of the production of the respective commodities on biodiversity in the production regions depends on the original ecosystem and the used production system, i.e. mainly the intensity of production. Combining this information with the area used for Dutch imports in each ecosystem under different production systems determines the total biodiversity impact of the production for the Dutch market.

The methodology is detailed below.

A. *Estimation of Dutch import*

To determine the value and volume of Dutch import for the three selected commodities UN Comtrade statistics and national statistics were analysed. However, there is often a mismatch between the figures of the exporting countries and those of the importing countries. For instance, the export statistics of Malaysia report an export of 2.0m tonnes of crude palm oil to the Netherlands, while the Dutch import data show only 1.6m tonnes of imports from Malaysia. The disparity of the trade data may be explained by the fact that while a commodity is being shipped to the Netherlands, the load is not cleared in the Netherlands, yet only re-loaded for further transport. Another possibility is that the load is being sold while on sea and arrives at a different destination than planned when departing. The volatile market makes it interesting for the exporters to ship to Europe for the 'Rouen-Hamburg range' and decide on the final destination in a late stage. Illegal trade may also influence the trade statistics as well as the time difference between export and import clearance. The latter may cause registering exports in a specific year while imports are recorded in the following year.

In this report, the UN Comtrade figures are taken as starting point for further analysis. It needs to be noted here, that the biodiversity impact in this report is estimated on the basis of the import figures and not adjusted for transit trade or re-export after processing. A substantial part of the imported products to the Netherlands, however, is re-exported to other countries, directly or after processing.

B. *Estimation of related land area and production methods*

To estimate the land area needed for the Dutch imports of the selected commodities, it is necessary to link the imports with the related production regions and production systems. The level of detail for such linkages with regions, biomes and production methods, however, depends on available data. Because trade statistics generally refer to country level, the production for the Dutch market cannot easily be traced to specific areas, biomes and production methods in the producer's country. If more detailed information on the production areas or methods in the selected countries is available, it is assumed in this study that the production for the Dutch market follows the shares of the respective production factors in the country's total production. For instance, if according to local production statistics 40% of the total Malaysian palm oil production is from peat swamps in Sarawak, it assumed that also 40% of the production for the Dutch market is derived from the particular ecosystems in Sarawak.

C. *Assessing biodiversity impacts of production*

For the assessment of biodiversity several indicators can be used. It would be straightforward to include species richness as an indicator. However, especially in more extensive land-uses, like selective logging, often the species richness initially increases, because species that are better adapted to the disturbed conditions may enter the area, while other species with decreasing populations are still present in the area. Focusing only on species richness as biodiversity indicator, thus, will hide part of the consequences of the production activities. In this study the following two indicators are used:

1. *Relative species richness (RSR)*

   This is the species richness of the production systems as percentage of the original ecosystem. To asses this indicator, information on original species richness and species richness in the production system is needed. Total biodiversity in the production system may be relatively high, but can consist of entirely different species than the original system. This difference is not visible in the RSR. In addition, this indicator does not include the abundance of a species.

2. *Relative species richness of original species (SROS)*
   This species richness indicator refers only to species that were already present in the original ecosystem before conversion into the new production purposes. To calculate this SROS, not only information on species numbers in both the natural ecosystem and the respective production system is required, but also information on which of the species observed in this production system were already present in the natural situation. Similar to the SRS, the SROS does not include the abundance of the species.

For each of the three selected commodities in this study a limited number of production categories were identified that enables differentiation between different production (land-use management) methods and production intensities (e.g. clear felling, selective logging, reduced impact logging, plantations and conversion for production of timber). Indicators have been assessed for different production regions, and as far as data are available a distinction has been made between different ecosystems.

1.5 Outline of the report

The report is structured according to the three major commodities, i.e. soya (Chapter 2) palm oil (Chapter 3) and tropical timber (Chapter 4). For each of these commodities, the most important features of the trade flows between the major producing countries and the major importing countries are described. This description provides insights into the position of the Netherlands in the global international trade in these commodities. It further indicates the origin of the Dutch imports and the production area needed in the exporting countries. After that, the biodiversity impacts are described and the effect of production on local income, employment, access to land and human health discussed. Options for mitigating the negative biodiversity and socio-economic impacts are described in a separate paragraph. Each chapter is concluded with a synthesis of the findings.

In Chapter 5 the major findings of this study and options for achieving more sustainable trade are presented.

2 Soya

2.1 Introduction

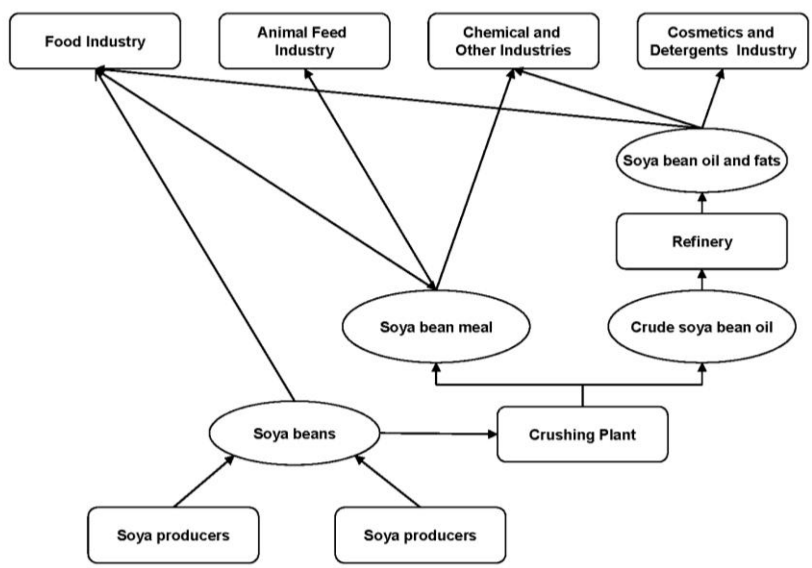
Soya is one of the most important agricultural commodities. It is a source of protein and oil with multiple uses in both human food and animal feed products and with numerous industrial applications. Figure 2.1 gives a schematic overview of the soya supply chain. Part of the soya beans is directly used in the food industry, but the major part is processed in crushing mills to extract the oil. About 18-19% of the soya bean consists of oil, which is further refined for different purposes in the food and non-food industry. Soya oil is also used for biodiesel. The remaining product, soya bean flakes, is further processed into soya bean meal and cake, which is almost entirely used in the animal feed industry.

Around 100m ha of agricultural land in the world is used for soya bean production. Soya beans are grown in sub-tropical and humid climate zones: (the south of) the United States of America, Latin America (mainly Brazil and Argentina) and Asia (mainly China and India). Over recent years, soya bean production has been increasing rapidly, a trend which is likely to continue. The prime driver of soya bean production is the demand for soya products as ingredient for animal feed in the intensive livestock industry. The major part of the soya beans are crushed in the production countries, in China mainly for own use and in the other countries for a large part for export, too.

The soya industry is an important and still growing economic sector in Latin America, but expansion of soya bean production is not by itself a reliable engine for broad-based development that benefits the local rural population in these countries (Pérez et al., 2008). The soya bean production is based on high-input, industrialised monoculture farming, which leads to both employment and wages declining in the production areas despite rising production.

In addition, the fast agricultural expansion has led to lasting ecological damage in some production regions, which has raised global concerns about the environmental impact of further expansion.

Figure 2.1 **Schematic outline of the soya supply chain**



Source: Adapted from Berkum and Bindraban (2008).

The increasing concerns over the impact of the rapid soya expansion on the local environment and local societies have led to the establishment of the Round Table of Responsible Soy (RTRS) in 2006. The RTRS is a global platform to promote the use and growth of responsible production of soya. All major actors in the soya value chain are participating in this global platform, including soya bean producers, industry and civil society actors. As a result of the consultations in the RTRS a standard for sustainable soya has been developed and RTRS certified soya will become available on the global market at the beginning of 2011 (see Text box 2.1 for further information on the RTRS).

The RTRS has the continuous support of the Dutch government and also of the Dutch Task Force Sustainable Soy in which a group of Dutch companies involved in the soya chain participate. In December 2009, the Task Force agreed to ensure that at the end of 2015 the soya that is needed to satisfy the Dutch market should be produced in accordance with the RTRS principles and criteria.

Text box 2.1	Round Table on Responsible Soy (RTRS)

The Round Table of Responsible Soy (RTRS) is an international multi-stakeholder initiative founded in 2006 that promotes the use and growth of responsible production of soy, through the commitment of the main stakeholders of the soy value chain (soy producers, traders, processors, financial institutions and civil society organisations) and through a global standard for responsible production.

The main objectives of the RTRS are to:

- Facilitate a global dialogue on soy that is economically viable, socially equitable and environmentally sound.
- Reach consensus among key stakeholders and players linked to the soy industry.
- Act as Forum to develop and promote a standard of sustainability for the production, processing, trading and use of soy.
- Act as an internationally recognised forum for the monitoring of global soy production in terms of sustainability.
- Mobilise diverse sectors interested in participating in the Round Table process

In the RTRS participate 140 producer organisations, companies and environmental and development NGOs from 21 countries.

The May 2007 General Assembly of RTRS agreed on 11 principles for criteria for measuring the sustainability of soy production. In the 'Principle and Criteria document' of October 2008 these principles are summarised into the following five:

- Principle 1: Legal Compliance and Good Business practice;
- Principle 2: Responsible Labour Conditions;
- Principle 3: Responsible Community Relations;
- Principle 4: Environmental Responsibility;
- Principle 5: Good Agricultural Practice.

In May 2009, the Annual General Assembly approved a Principles and Criteria - field test version and in June 2010 the RTRS standard for sustainable soy production was approved. In 2011 it will be possible to obtain soy in accordance with the RTRS principles and criteria in the international market.

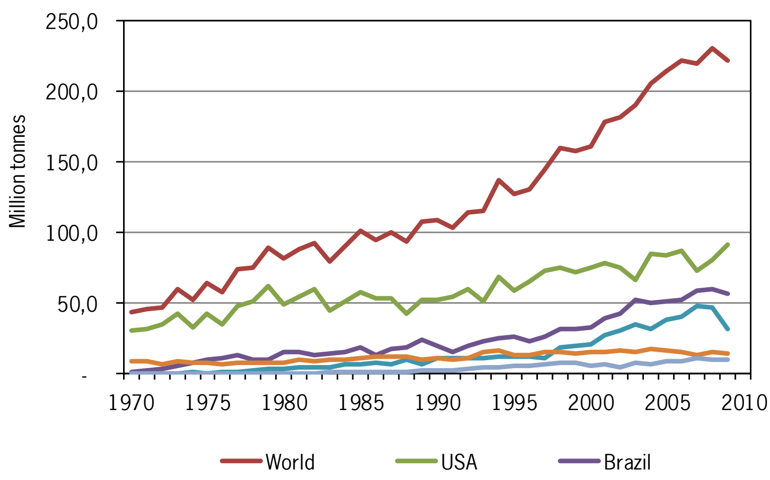
Source: www.responsiblesoy.org

An important initiative in the development of sustainable soya is the Amazon Soy Moratorium. In June 2006, Brazilian soya processors and traders, in consultation with the European soya industry and civil society organisations, among others Greenpeace, announced that for a minimum period of two years they would not trade soya from areas in the Amazon biome that were deforested after 24 July 2006. In the meantime the moratorium has been extended until July 2011. The moratorium that was originally an initiative of the private sector and civil society, has received the support of the Brazilian government.

2.2 Global trade flows and the Dutch trade position

South America accounts for about 43% of the total world area under soya beans of around 100m ha, the USA 32% and China and India each about 10%. The United States of America is the largest producer of soya beans, with 41% of the total world production in 2009, followed by Brazil (26%) and Argentina (14%). China is also in the top five of the soya beans producing countries, yet China is also the world's biggest importer of soya beans.

Figure 2.2 Development of the soya bean production in the USA, Brazil, Argentina, China, India and the World (1970-2009)



Source: FAO (2010a).

The largest producing countries are also dominating world export flows (see Table 2.1). The USA dominates the export of soya beans with about half of the total trade (40.5m tonnes). Brazil is second with 28.6m tonnes. Argentina is by far the major exporter of soya oil and oil cake (4.4 respectively 21.6m tonnes). China is the largest importer, in particular of soya beans for further processing domestically. In 2009, China imported more than half of the total global trade in soya beans (42m out of the 81m tonnes). China is also an important importer of soya oil, in particularly from Argentina (2m tonnes). The Netherlands is one of the major destinations for soya beans and soya oil cake within the EU.

Table 2.1 Major exporters of soya bean products and their markets (2009, million tonnes)

Exporter	Soya beans		Soya oil		Soya oil cake	
	world	**major destinations**	**world**	**major destinations**	**world**	**major destinations**
USA	40.5	China: 22.9 Mexico: 3.3 Japan: 2.5	1.3	Morocco: 0.17 Mexico: 0.17 India: 0.16	7.7	Canada: 1.1 Mexico: 0.9 Philippines: 0.7
Brazil	28.6	China: 15.9 Netherlands: 2.4 Spain: 2.1	1.6	China: 0.54 India: 0.17 Bangladesh: 0.13 Algeria: 0.12	12.2	Netherlands: 2.6 France: 2.4 Germany: 1.2
Argentina	4.3	China: 3.1 Iran: 0.4 Egypt: 0.2	4.4	China: 1.98 India: 0.64	21.6	Netherlands: 2.2 Italy: 2.0 Spain: 2.0
Other countries	7.8		2.3		14.1	
Total	81.2		9.6		55.6	

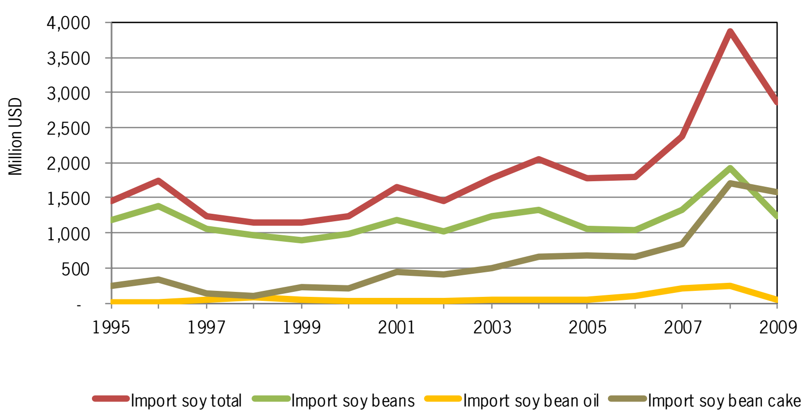
Source: UN Comtrade, LEI.

Dutch imports of soya products

There are substantial differences between the statistics from importing and exporting countries. Brazil and Argentina report quite different volumes of soya products shipped to the Netherlands than what the Dutch import records register. While Brazil reports to export 2.4m tonnes of soya beans to the Netherlands in 2009, the Dutch statistics report no more than 2.0m tonnes. According to the Dutch statistics, oil cake imports were 1.7m tonnes from Argentina and 1.6m tonnes from Brazil, while these volumes were 2.2 and 2.6m respectively according to the export data files of the respective countries. Reasons for this disparity are discussed in section 1.4. In the following sections about the trade of the Netherlands, the Dutch reported figures are taken as starting point for further analysis.

Trends in the Dutch imports of soya products are presented in Figure 2.3. The total import value significantly increased since 2000 and adds up to more than USD4b in 2008, and a sharp decline in the following year, caused by an increased competition in the global food market since 2007 (see *FAO Monthly Price and Policy Update*).

Figure 2.3 **Value of the Dutch import of soya products (1995-2009)**



Source: UN comtrade, LEI

In the last three years, the Netherlands import of soya products accounted for around USD3b per year (see Table 2.2). The Netherlands imports mainly soya beans and oil cake in about the same amount and very little soya oil. The Dutch import of soya beans is mainly from Brazil and in a lesser extent from the USA. Imports of soya beans from Argentina were valued around USD100m in the mid-1990s but are close to zero in recent years. Soya oil cake imports is nearly only from Argentina and Brazil, both exporters taking a share of almost 50% in the Dutch import.

Table 2.2	**Major exporting countries for soya products to the Netherlands (average 2007-2009)**	
Commodity	**Import value**	**Import volume**
	million USD	**1,000 tonnes**
Soya beans	1,497	3,344
Brazil	903	2,253
USA	358	858
Paraguay	98	224
Soya oil	165	165
Brazil	53	62
Germany	45	39
Belgium and Luxembourg	33	33
Soya oil cake	1,374	3,460
Argentina	649	1,684
Brazil	648	1,603
Germany	37	80

Source: UN Comtrade, LEI.

The soya beans are shipped into the Netherlands through Rotterdam and Amsterdam harbours for further processing by the two only processors in the Netherlands, ADM en Cargill. However, not all beans are being processed in the Netherlands: about one third of the imported beans are being exported, mainly to Germany and Belgium. The rest is crushed to extract the oil, which is (after further refinement) partly exported to other EU countries. The other major output of the crushing process, soya meal and oil cake is being used in the feed industry in the Netherlands and in other EU countries as well.

The average import and export figures in Table 2.4 show that the Netherlands had a negative trade balance for soya beans, a balanced trade for soya oil cake and a surplus for soya oil over the period 2007-2009. A major part of the imported soya beans are processed in the Netherlands and re-exported as soya oil and cake to neighbouring countries or used for feed in the domestic livestock sector. Based on the data from the Dutch processing industry, Hoste and Bolhuis 2010) estimate that in total about 2m tonnes of soya bean equivalents are used in the Dutch livestock industry, which is less than import surplus based on the UN Comtrade data used in Table 2.4.

Table 2.3	Major importing countries for soya products from the Netherlands (average 2007-2009)	
Commodity	**Import value**	**Import volume**
	million USD	**1,000 tonnes**
Soya beans	471	1037
Germany	380	869
Belgium and Luxembourg	41	78
Soya oil	551	481
Belgium/Luxembourg	140	125
United Kingdom	135	115
Germany	131	121
Soya oil-cake	1,315	3,459
Germany	634	1,736
Belgium and Luxembourg	179	455

Source: UN Comtrade, LEI.

Table 2.4	Trade balance of the Netherlands in soya products (average 2007/09)					
Commodity	**Value in million USD**			**Volume in 1000 tonnes**		
	import	**export**	**balance**	**import**	**export**	**balance**
Soya beans	1,497	471	-1,026	3,344	1,037	-2,307
Soya oil	165	551	+386	165	481	+316
Soya oil-cake	1,374	1,315	-59	3,460	3,459	-1

Source: UN Comtrade, LEI.

EU trade policy

Imports of soya beans and oil cake are not charged by import tariffs (see Table 2.5). Soya oil, on the other hand, is charged by an import tariff of 4.8% maximum on crude oil and by 7.35% maximum on refined/processed oil. Imports from Brazil and Argentina are subject to only 1.45% and 3.85% import tariff respectively.

Table 2.5	Import tariff structure of soya commodities	
HS-code and Commodity name	**Tariff**	**Countries**
Soya beans	0%	For all countries
Soya oil, crude	0%	For all countries except:
	1.45%	Argentina, Brazil
	4.80%	Norway, Switzerland, USA
Soya oil, other than crude	0%	For all countries except:
	3.85%	Argentina, Brazil, China, Morocco, Thailand
	7.35%	Canada, Norway, Switzerland, USA
Soya oil-cake and other solid residues	0%	For all countries

Source: MacMAP tariff data.

Conditions for EU imports of soya bean and soya products have been set in the GATT Dillon Round in the 1960s when the EU agreed to import oilseeds (among others soya beans) and protein commodities free from tariffs and duties. Yet, as soya beans is one of the major genetically modified organisms, imports are condition to the European legislation on this issue (see www.ec.europa.eu/food/food/biotechnology). According to Directive 90/220/EEC GM seed varieties have to be authorised by the European Food Safety Agency (EFSA) before they are included in the Common Catalogue and marketed in the EU. Currently three GM soya varieties are approved in the EU: one since April 1996 (Monsanto's Roundup Ready) and two in 2008 (Roundup Ready 2 and Liberty Link produced by Bayer Crop Science). The latter two are expected to be produced in the USA in 2009 whereas introduction in Argentina and Brazil is under consideration. These varieties are approved for being used as food and feed ingredients in Europe. GM soya products (soya beans, soya oil and meal) of these varieties are accepted as imports, yet there is no authorisation for GM soya bean cultivation in the EU.

2.3 Future trade developments

Soya bean supply and demand projections by OECD/FAO (2009) and FAPRI (2009) indicate that market developments are strongly influenced by the increasing demand for soya in the feed and energy sector (see also section 3.4.1 for a description of the major drivers of supply and demand). The price increase of soya beans, meal and oil between 2000 and 2007 has stimulated production to growth, especially in the Latin American countries, but as it is expected that the demand will further increase (mainly in China but in the EU as well) both organisations expect that, on average, prices will be at higher levels in the years to come than in the last decade.

Growing demand in China and some other South-east Asian countries is largely due to rapid economic growth resulting in higher food consumption levels and a consumption pattern that includes more meat. To meet its increasing demand for vegetable oil and animal feed China is expected to expand its imports to 56m tonnes in 2018, accounting for around 60% of total world imports of soya beans (see Table 2.6, FAPRI, 2009:220). China has very limited possibilities to expand soybean production as there are many competing claims on suitable agricultural land and other crops turn out to be economically more attractive. Therefore, it is plausible to expect an increasing import dependency. FAPRI (2009) projections indicate an even slightly declining soya bean area harvested in China. The EU is traditionally a deficit region resulting in large import flows of soya beans and meal. FAPRI (2009) does not expect that the EU imports will increase notably, as economic growth is modest, population growth is stagnant, and livestock numbers rather constant over the projection period. Yet, there may be a larger demand for vegetable oil for bio-fuel purposes. This increasing demand stimulates next to domestic (EU) supply of rapeseed, the import of sunflower and palm oil. Soya oil is less suitable for bio-fuels, so FAPRI's projections indicate rather stable EU imports of soya beans and a modest (10-15%) to significant increase in the imports of soya bean meal and oil respectively over the period up to 2018/2019.

Table 2.6	Projections of soya exports and imports (million tonnes)					
	Soya beans		Soya bean meal		Soya oil	
	2008/09	2018/19	2008/09	2018/19	2008/09	2018/19
Net-exporters						
Argentina	11.3	13.3	27.4	36.3	5.6	7.3
Brazil	25.2	42.2	12.2	13.2	2.1	2.4
USA	29.7	31.0	7.5	11.9	0.7	1.9
Paraguay	4.0	8.0	1.1	1.5	0.3	0.3
Net-importers						
China	35.5	56.4	0.4	0.5	2.3	4.1
EU	14.1	13.6	22.5	25.8	0.4	0.9
Total trade a)	71.4	91.7	54.6	72.2	9.8	11.4

a) Excluding intraregional trade.
Source: FAPRI (2009), World Agricultural Outlook (2009: 220-237).

The USA, Brazil and Argentina are the main suppliers of soya beans, meal and oil and dominate on the export side of international trade. A quick expansion of production in the USA in response to increasing demand for soya beans is not plausible: expansion has to come from increasing yields or from crowding out other crops as there is no land in the USA presently unused that may be easily used for agricultural purposes. Other crops such as maize are more attractive than soya beans from an economic point of view; the position of maize has been enhanced in recent years due to the increasing demand for the crop as bio-fuel. The increasing demand for soya bean products in China and other Southeast Asian countries will not lead to much expansion of the area as other crops are either more economically attractive (in combination with agronomic circumstances). FAPRI (2009) therefore concludes that the supply response to continuously increasing demand for soya products has to come from Latin American countries like Brazil, Argentina and Paraguay, by applying new land for agricultural purposes, shifts between crops and more intensive use of agricultural land. According to FAPRI's projections, the soya bean production areas in Latin American countries will expand by 10m ha in the three major production countries, of which 5m in Brazil (See Table 2.7). Their share in the total world production area under soya beans will increase from 42% in 2008/09 towards 46% in 2018/19.

Table 2.7	Projections of soya bean areas in major producing countries (million ha)	
	2008/09	2018/19
Argentina	18.0	20.7
Brazil	21.3	26.9
China	9.3	8.7
EU	0.3	0.3
India	9.6	11.2
Paraguay	2.4	3.6
USA	30.2	31.0
Total world	97.8	110.5

Source: FAPRI (2009), World Agricultural Outlook (2009: 220-237).

2.4 Land area used for Dutch import of soya products from Brazil

In this section an estimate is made of the land area that is needed for the Dutch import of soya products from Brazil. Starting point for the calculations are the above import figures of the Netherlands, which are combined with estimates of yields per hectare for different production regions in Brazil.

2.4.1 Main production areas and yields

In an assessment of grain production in Brazil, CONAB (2009) divided the country in five regions (north, northeast, mid-west, southeast, and south), each covering 2 to 4 states. The northern region includes the states of Roraima, Rondônia, Pará and Tocantins; the north-eastern region includes Maranhão, Piauí and Bahia; the mid-west region includes Mato Grosso, Mato Grosso do Sul, Goiás, Distrito Federal; the south-east region includes Minas Gerais and São Paulo; and the southern region includes Paraná, Santa Catarina and Rio Grande do Sul. By far, the most important soya producing regions are the mid-west and southern regions (Table 2.8)

Table 2.8	Total soya area, productivity and production in five regions in Brazil (averages of 2007-2008)			
Region	**Area**	**Productivity**	**Total production**	**Production**
	million ha	**tonnes/ha**	**million tonnes**	**% of total**
North	0.5	2.86	1.5	2.5
North-east	1.6	2.91	4.6	7.8
Mid-west	9.7	2.98	29.0	49.1
South-east	1.4	2.84	4.0	6.8
South	8.2	2.44	20.0	33.8
Brazil	21.4	2.82	59.1	100.0

Source: CONAB (2009).

The Brazilian Atlantic forest is the region where mechanised soya bean cultivation first rapidly expanded in the 1970's (Fearnside 2001). After Matto Grosso (5.8m ha of soya field in 2008, 6% of the total area of the state) in the Mid-west, the southern states Parana (4.0m ha of soya field in 2008) and Rio Grande do Sul (3.8m ha of soya field in 2008), are the states with the largest area and production of soya bean in Brazil. Parana (20%) and Rio Grande do Sul (13%) are also the leaders in terms of the percentage of the area of the state currently covered by soya fields.

After soya varieties became available that could be cultivated at lower latitudes, soya expansion moved northwards into the Cerrado biome of the central states, where currently about 60% of the Brazilian soya is produced (Bindraban et al., 2009; Fearnside, 2001). The most recent expansion of the soya area occurs mainly in the northern states in the Amazon region on recently deforested land or on grazing lands. At the moment the share of soya production from the Amazon region in the total Brazilian production is still modest, but until before the Amazon Moratorium on soya production this areas was expanding fast (Cerri et al., 2005; Nepstad et al., 2008).

The soya production in the southern states is mainly done by small to medium sized farms; with in the states Rio Grande do Sul and Parana respectively 90% and 92% of the total soya production area on farms smaller than 1,000 ha (Berkum and Bindraban 2008). In contrast, the farms in the mid-west are mainly medium to large sized, with in the states Mato Grosso and Mato Grosso do Sul respectively 78% and 51% of the soya production area on farms larger than 1,000 ha (Berkum and Bindraban 2008). Usually only larger farms (more than 1,000 ha) are able to implement technological improvements to achieve higher yields, which can explain the lower productivity in the southern states as shown in Table 2.7. Where increasing farm sizes is not feasible in the southern states, farmers tend to focus on niche markets like organically produced soya and GM free soya (Berkum and Bindraban, 2008).

2.4.2 Estimated land area needed for Dutch soya imports from Brazil

The following estimate of the land area needed for Dutch soya import from Brazil is based on the annual average figures for the period 2007-2009. The imports mainly consisted of unprocessed soya beans (on average 2.25m tonnes during 2007-2009) and soya bean cake (1.60m tonnes). In addition a small amount of soya oil (0.06m tonnes) is imported. Primary processing of soya beans yields approximately 80% high protein cake (or meal) and 20% oil, where the high protein meal is seen as the main product of soya bean processing, while the oil is a by-product (Elbersen et al., 2008). For the production of the imported 1.6m tonnes of soya bean cake thus 2.0m tonnes of soya beans were needed. In total during 2007-2009 thus annually 4.25m tonnes of soya beans needed to be produced in Brazil for the Dutch market.

To assess the areas of crop land needed to produce these 4.25m tonnes of soya beans it was assumed that the distribution of production across the different regions in Brazil followed the distribution for the total Brazilian soya bean production by region as shown in Table 2.8. Combining the production and the yield data per region (Table 2.9) gives the total area needed in each region for producing the imports of the Netherlands, which is 1.54m ha. In comparison, this area covers roughly one-third of the Dutch land-area and would seize 80% of the cultivated area in the Netherlands in 2009.

It need to be noted here that these calculations are based on the total imports of soya products by the Netherlands, not taking into account that a major part of it is re-exported, mainly to Germany and Belgium as explained above (see Table 2.3). According to Hoste and Bolhuis (2010) around 400,000 ha are needed for feeding the Dutch livestock industry.

Table 2.9	Estimated area needed for the Dutch imports of soya products from Brazil a)					
	North	Northeast	Midwest	Southeast	South	Total
Total soya production (million tonnes)	1.5	4.6	29.0	4.0	20.0	59.1
Percentage by region	2	8	49	7	34	100
Annual Dutch import (million tonnes)	0.10	0.33	2.09	0.29	1.44	4.25
Production per ha by region (tonnes)	2.86	2.91	2.98	2.84	2.44	
Area needed for Dutch import (1,000 ha)	37	114	701	102	590	1,544

a) Based on average annual figures of 2007-2009.

2.5 Biodiversity impacts

2.5.1 Direct effects on biodiversity

The discussion on sustainability of soya production mainly focuses on the expansion of the soya bean area into undisturbed ecosystems. The most important biomes that are affected by soya cultivation are the Brazilian Atlantic forest in the south and south-east, the Cerrado savannah system in the Midwestern states and the Amazon forest in the northern states (CONAB, 2009; Fearnside, 2001). Although there is much concern about deforestation in the Amazon, also the Cerrado savannah ecosystem and Atlantic forests were identified as hotspot areas for their high share of endemic species experiencing an exceptional loss of habitat (Myers et al., 2000). The Cerrado covers 1.7m km^2 in central Brazil, providing habitat to more than 10,000 plant species, of which 44% is endemic and 1,268 vertebrate species, of which 9% is considered to be endemic (Myers et al., 2000). Primary vegetation in the Atlantic forest currently only covers 91,000 km^2, or 7.5 % of its original extent 1.2m km^2 and harbours 20,000 plant species (of which 2.5% endemic) and 1,362 vertebrate species (of which 41% are endemic) (Myers et al., 2000).

In addition, the soya related production is the single most important economic activity justifying the investments in massive infrastructural developments (Laurance et al., 2004). In turn these attract other actors leading to forest encroachment and contributing to forest degradation and further deforestation (e.g. Asner et al., 2006). In this way the expansion of soya bean cultivation becomes one of the most important driving factors in a whole chain of proximate and underlying causes for deforestation of tropical forests (Geist and Lambin, 2001).

The expansion of soya cultivation promotes some large-scale forest conversion directly (Fearnside, 2001; Laurance et al., 2004), but more often it is part of a whole chain of land dynamics. This often starts with (illegal) logging. Although this often is selective logging, in which the forest structure remains more or less intact, it opens up the forest and provides access for other actors. After this initial logging the land is deforested by cattle farmers. On these farms livestock densities are usually very low, while the grassland productivity is subject to degradation (Berkum and Bindraban, 2008). After 3 to 5 years soya production occurs on land that was used for cattle farming before. In those cases, however, the expansion of soya cultivation pushes cattle farmers further into the forest frontier, indirectly adding to the further deforestation (e.g. Laurance et al., 2004). This can be illustrated by the fact that the hotspots for pasture expansion into forests are often adjacent to the large-scale soya production zones (Wassenaar et al., 2007).

Cattle herding is one of the most important direct drivers for deforestation in the Brazilian Amazon. Although in the past economic profitability of cattle was very limited, conversion of forest to pasture occurred at large-scale, mainly because of the fact that land titling depended on active use of the land. The cheapest way to make land productive was to convert it into to pastures.

In the Amazon, the large land owners mainly have cattle ranches based on extensive production systems (Pacheco, 2009). However, the soya bean cultivation is also expanding here (Nepstad et al., 2006), although still in a limited extent, which may be due to the Amazon Soy Moratorium that was agreed on in 2006 and has been extended until July 2011. This moratorium on the purchase of soya from illegally logged rainforests in the Amazon is an agreement between the major public and private stakeholders in the soya sector, including the Brazil government, international soya traders and Greenpeace.

Besides the direct loss of biodiversity caused by forest into soya field conversion, large-scale soya fields strongly fragment the forest and Cerrado landscapes. A study near Manaus in the Brazilian Amazon showed that especially trees surviving in forest edges are strongly affected (Laurance et al., 2004). The tree communities changed dramatically within two decades after fragmentation, resulting in a remarkably fast degradation of the forest given the usually slow and inert responses of trees. Another study in the Brazilian Amazon showed that fragments of 100 ha lose half of the understorey forest birds within 15 years (Ferraz et al., 2003).

Large parts of the Cerrado are dominated by different agricultural activities strongly altering the landscape structure. Analysis of the fragmentation patterns showed that crop dominated Cerrado landscapes are much more fragmented than pasture dominated landscapes (Carvalho et al., 2009), while small-scale forest clearing maintain a more complex landscape than the large-scale clearing for soya cultivation (Ewers and Laurance, 2006). At the same time the crop dominated areas also contain fewer fragments that are able to sustain healthy populations of endangered large mammal species like Jaguar, Giant Anteater and Giant Armadillo (Carvalho et al., 2009; Silva and Diniz, 2008). A study in a highly fragmented area in the Cerrado, however, showed that ten species of carnivore mammals was able to explore the whole study area, including some remaining patches of savannah, Eucalyptus plantation and sugar-cane agriculture (Lyra-Jorge et al., 2008). This area, however, did not include large-scale soya cultivation and still included a complex landscape.

Currently only small fragments of Atlantic forest remain intact (e.g. Metzger, 2009), with more than 80% of the fragments being smaller than 50ha each (Ribeiro et al., 2009). Although this is not only due to soya cultivation, but has also other anthropogenic sources, this strong fragmentation of the forest leads to further loss of biodiversity. Alvarenga et al. (2010) showed for instance that patches of Atlantic forest that were able to host rich epiphytic flora were over 300 ha in size, which is larger than the area of most forest remnants (above, Ribeiro et al., 2009).

2.5.2 Indirect effects on biodiversity

Next to the direct effects of deforestation and conversion of natural habitats into agricultural fields and subsequent fragmentation, also the wide-scale use of fertilisers and other agro-chemicals adds up to the detrimental effect of soya production on biodiversity. The use of genetically modified (GM) seeds that tolerate the Roundup Ready herbicide probably results in more intensive production. The increasing use of Roundup (glyphosate), a strong herbicide, will likely directly affect biodiversity in and around soya fields. The use of large quantities of this herbicide, however, also has become a major source of pollution, contaminating surface water and aquifers.

The ecological consequences of using GM soya versus conventional soya production systems has been given in detail in Bindraban et al. (2009). The use of GM crops in combination with intensive use of herbicide is expected to reduce diversity in field margins and to further reduce numbers of species associated with weeds (Bindraban et al., 2009). This loss in diversity may eventually have a negative effect on the farming system due to the potential reduction of pollinators depending on margins and forest edges. On the other hand Bindraban et al. (2009) noted that increased use of GM may lead to implementation of zero-tillage.

Besides loss of biodiversity also other important ecosystem functions are affected, resulting in loss of services these ecosystems provide. In relation to climate change mitigation especially carbon emissions due to land conversion and lost possibility for sequestration are an important service that is lost through conversion of savannah or forest systems to soya fields. Additionally deforestation leads to increased erosion and increased water run-off into rivers. This in turn will affect water cycling and rain fall in the Amazon that significantly depends on water that is being recycled. Erosion and increased run-off will also affect water quality in the rivers and may lead to changes in the course of streams (more water and dissolved soil particles that settle on the river bed). In turn, the subsequent reduction in precipitation may result in a negative feedback leading to water stress, trees dying and further degradation as a result of further increasing drought and fires. Effects on river streams may result in flooding of large areas and will affect the livelihoods of people that depend on these rivers (drinking water, fishing, tourism, etc.).

2.6 Socio-economic impacts of soya production in Brazil

Soya production is an important driver for economic and rural development in Brazil. In this section the impact of the development of soya production in Brazil on rural communities is discussed in terms of: (a) employment, (b) income, (c) access to land and (d) health. Where relevant, a differentiation will be made in the type of production region (viz. established, expansion and frontier regions) and the size of the farms (small-scale farms i.e. less than 1,000 ha and large-scale farms i.e. larger than 1,000 ha).

Employment

The entire soya industry in Brazil is estimated to provide employment for about 5.4m people in 2000, of which about 0.9m on soya farms (D´Alembert et al., 2003). The employment in the soya producing regions, however, is decreasing due to the continuous up-scaling of soya bean production and the transformation from more labour intensive crops, such as sugar cane and cotton, towards the highly mechanised soya bean production. Soya bean production in the frontier regions is characterised by large-scale producers, with more than 1,000 ha per farm and the farm structure in the established regions is developing in the same direction (Stickler et al., 2005; Patel and Cassel, 2003; Fearnside, 2001; Carvalho et al., 2002). Already in 1996, one per cent of the landholders holding more than 2,000 ha each, controlled 53% of the private land, while, in contrast, 83% of landholders with less than 100 ha each controlled only 11% of all agricultural land (Pacheco, 2009). Small-scale farms employ on average around one worker per 5-7 ha of land, compared to about one worker per 200 ha on large-scale farms. Kessler et al. (2007) estimate the rural employment in the soya producing regions being declined from 740,000 jobs in 1996 to 335,000 in 2004.

The mechanised soya production does not only require less labour, but also other type of labour, both leading to decreasing employment opportunities for the local population. The large-scale farms employ more high skilled workers, such as agronomists and mechanics, than low skilled workers. This leaves out local farmers experienced with traditional agriculture (D´Alembert et al., 2003). They have to rely for their livelihood on seasonal work and subsistence farming or migration to urban centres. As a result soya producing regions are generally characterised by a rural exodus (Patel and Cassel, 2003). On the other hand, new employment opportunities are created in the other links of the soya chain, in the supply, processing and food industries and logistics as well (D´Alembert et al., 2003).

Income

The Brazilian government stimulates soya production as it boosts export earnings and national income (Weinhold et al., in press). The soya industry in Brazil generates around USD32b per year, i.e. 16% of the total Brazilian agribusiness (USD195b) and 6% of the national Gross Domestic Product (GDP) (D´Alembert et al., 2003). A study of Kessler et al. (2007), however, shows that the GDP in soya producing regions is decreasing. The conversion to large-scale farming in combination with low employment has increased income inequality in the respective regions, because the wages paid on soya farms are rather low (Sawyer, 2008). It is expected that further development of large-scale soya bean cultivation will lead to further increasing inequalities especially in the frontier regions. In 2000, the poverty rates in the frontier regions were already twice as high as the national average: 64% of the population lived in poverty, of which 33% in extreme poverty (Kessler et al., 2007).

Access to land

In many studies the expansion of soya production is associated with land conflicts (Kessler et al., 2007; Sojacoalitie, 2006; Van Gelder and Dros, 2006; Berkum and Bindraban 2008). Governmental policies for land distribution in the Amazon lured many people to the region hoping to obtain land ownership (Oliveira, 2008). Customary land rights of local communities are often not or only partially legally recognised. Local people who rely on small-scale crop production and cattle rearing for their livelihoods generally do not have official proof of land ownership or land use rights. Because weak governmental capacities to regulate the registering of land ownership (Berkum and Bindraban, 2008; Oliveira, 2008) public (forested) land is often occupied without obtaining official land titles. Soya companies often acquired land that was already occupied and in use by local farmers or land was obtained without getting registered ownership (Sojacoalitie, 2006).

The expansion of large scale soya bean production either directly (through forest conversion) or indirectly (through opening up forests) contributes to forest degradation and further deforestation. Decreasing availability of non-timber forest products has a direct negative impact on local incomes and food security. In particular indigenous people depend for their livelihood on the availability of wild life, fish, wild fruits, jungle rubber and other non-timber forest products.

Human health

The transition from a small-scale diversified agricultural production system with maize, rice and cassava for the local market towards a large-scale soya production system for export is not only threatening the local food provision (Sojacoalitie, 2006), but also the food security of the increasing urbanised population (Carvalho et al., 2002). In the established and expansion regions food security scores better than the national average, while the situation in frontier region scores worse.

Intensive use of pesticides and fungicides in large sized farms is dangerously polluting land and water (Stickler et al., 2005). Pesticides run-off into the rivers and creeks cause mortality of aquatic organisms and jeopardise the supply of drinking water and fish stock for local communities (ibid.). Many studies report on cases of poisoning (Sojacoalitie, 2006; Steward, 2007; Van Gelder and Dros, 2006; Stickler et al., 2005). Whyte et al. (2004) report that the use of pesticides together with the loss of agricultural food production has led to increased occurrence of child illnesses.

2.7 Options for mitigating biodiversity and socio-economic impacts

The expected increasing world demand for soya products will lead to further expansion of the area used for soya bean cultivation in Latin American countries, in particular in Brazil, Argentina and Paraguay. The estimated area under soya bean in these countries will increase with about 10m ha, of which half in Brazil. This development will certainly lead to further deforestation. The challenge, however, is to mitigate the negative biodiversity impacts by supporting a shift of soya production from large plantations towards small and medium sized farms, preventing unnecessary deforestation of high value forests, connecting and managing forest remnants and improved environment oriented management of the soya bean fields.

Small-scale soya producers can play an important role, particularly in a transition towards more sustainable agricultural systems that benefit both biodiversity conservation and sustainable rural development (Study et al., 2008). Government support is needed to shift soya bean cultivation from large plantations to small and medium-sized farms, integrating them into broader programmes of land reform and crop diversification.

Ever since 1938, the legal reserve legislation in Brazil requires that 20% of the area in a rural property (e.g. used for agricultural practices) should be left as forest or its original vegetation. Later in the 1990, the requirements for the Amazon region were increased to 80% of the area of each rural property (Mueller and Alston, 2007; Pacheco, 2009). Initially, this legal reserve was introduced to secure supply of wood for fuel. When the need for such reserve became superfluous over time, the legislation remained in place but was not actively enforced. Since the 1980's, the objectives of the legal reserve legislation have been changed based on mere environmental considerations. Also the legislation change over time, reflecting the constant tussle between environmental and agricultural interests. For instance in 1997 properties below 100 ha were exempted from the 80% limit (Mueller and Alston 2007). Yet, probably due to slack enforcement not more land is divided into 100 ha plots (Mueller and Alston, 2007). An explicit inclusion of the legal reserve in the Environmental Crimes law, which would make deforestation of the reserve a crime with penal and administrative sanctions, did not pass (Mueller and Alston, 2007).

A modelling study by Teixeira et al. (2009) showed that in the Atlantic rainforest area in south-eastern Brazil increasing deforestation leaded to a heterogeneous landscape with patches of forest mainly remaining near rivers, on steep slopes and far from dirt roads. Of a number of modelled scenarios, including law-enforcement and agricultural intensification, showed that only the law-enforcement scenario will eventually lead to the recovery of interconnected forest area (Teixeira et al., 2009). This indicates that improved enforcement of currently existing legislation, prohibiting agriculture on unsuitable land along river margins and slopes, and the rule to keep at least 20% of land of each agricultural property as forest reserve would effectively conserve forest species in the short term.

For that purpose, the Round Table on Responsible Soy (RTRS) agreed that RTRS Certified producers should strictly abide the legal reserve legislation in Brazil, to keep the original vegetation intact.

According to the Amazon Soy moratorium, soya bean cultivation should not take place on land that has been deforested after 2006. This moratorium has been extended to July 2011. This is not sufficient to prevent further deforestation, because soya bean expansion on former pasture land pushes the original cattle ranchers further into the Amazon forest frontiers, indirectly leading to further deforestation. These potential leakage effects should also be taken into consideration.

Furthermore, since fragmentation of the forest or savannah biomes may have a strong effect on biodiversity, the establishment of the legal reserves and High Conservation Value Areas (HVCAs) should be done in a coordinated way using an integrated land use planning approach. This would need to result in large intact areas of remaining HCVAs and other forest over different properties that are also as much as possible interconnected with corridors. Large soya farms inhibit an effective establishment of reserves and HCVAs, because they easily become isolated in a landscape with large-scale soya fields. Small and medium sized farms in a mosaic agricultural and natural landscape can thus play an important role in the transition towards a more sustainable soya production. Economic sustainability of smaller farms can be achieved by adequate support in increasing the yields per hectare.

Next to deforestation and fragmentation of natural habitats, soya bean production does affect biodiversity through the wide-scale use of fertilisers and other agro-chemicals. Positive results are to be expected from a more environment oriented crop management. In this context the use of genetically modified (GM) seeds that tolerate the Roundup Ready herbicide is controversial. The ecological consequences of using GM soya versus conventional soya production systems has been given in detail in Bindraban et al. (2009). The use of GM crops in combination with intensive use of herbicide is expected to reduce diversity in field margins and to further reduce numbers of species associated with weeds (Bindraban et al. 2009). This loss in diversity may eventually have a negative effect on the farming system due to the potential reduction of pollinators depending on margins and forest edges. On the other hand, Bindraban et al. (2009) noted that increased use of GM may lead to implementation of zero-tillage. The related increase of yields per hectare will also lead to less pressure on conversion of forest into soya bean fields.

2.8 Synthesis

Production and trade

Soya is one of the most important agricultural commodities. Around 100m ha of agricultural land in the world is used for soya bean production. The USA is the largest producer of soya beans, with 41% of the total world production in 2009, followed by Brazil (26%) and Argentina (14%). China is also in the top five of the soya beans producing countries, yet China is also the world's biggest importer of soya beans. The USA dominates the export of soya beans with about half of the total trade (40.5 of 81m tonnes). Brazil is second with 28.6m tonnes. Argentina is by far the major exporter of soya oil and oil cake (4.4 respectively 21.6m tonnes). In 2009, China imported more than half of the total global trade in soya beans and is also an important importer of soya oil, in particularly from Argentina. The EU is also a large importer of soya products. Within the EU, the Netherlands is one of the major destinations for soya beans and soya oil cake. The total import value significantly increased since 2000 and added up to more than USD4b in 2008. Then the import declined substantially, caused by an increased competition in the global food market since 2007. The average annual import value in the period 2007-2009 was USD3m. About one third of the soya beans shipped into the Netherlands is re-exported, mainly to Germany and

Belgium. The rest is processed; the end products are used in the food and feed industry in the Netherlands and other EU countries as well.

It is expected that the production of soya beans will further increase due to the growing demand for vegetable oil and animal feed, in particular in China, which is expected to account for around 60% of total world imports of soya beans in 2018. According to FAPRI's projections the soya bean production areas in Latin American countries will expand with about 10m ha, of which half in Brazil. The share of Latin America in the total world soya bean area will increase to about 46% in 2018.

Biodiversity

The massive growth of soya bean production in Latin America has been realised in till then undisturbed ecosystems such as the Brazilian Atlantic forest in the south and south-east, the Cerrado savannah system in the Midwestern states and the Amazon forest in the northern states. Soya cultivation has a dramatic direct effect on biodiversity. The large-scale mono-culture soya fields lead to a nearly 100% reduction of forest species on the fields themselves. In addition, the soya production is the most important economic activity justifying the investments in massive infrastructural developments in these regions, attracting other activities leading to forest degradation and deforestation. This often starts with (illegal) selective logging, which leaves the forest structure more or less intact, but opens up the forest for other activities, in particular extensive cattle farming. After a few years, the land is then taken over for soya cultivation which pushes cattle farmers further into the forest frontier, indirectly adding to the further deforestation.

The large-scale soya fields strongly fragment the forest and savannah landscapes, leading to a remarkably fast degradation of the remaining forest. Often only small fragments of forest remain intact, leading to further loss of biodiversity, because the disconnected fragments are not able to sustain healthy populations of endangered species, including some of the endangered large mammal species like Jaguar, Giant Anteater and Giant Armadillo.

In addition to these direct effects, the wide-scale use of agro-chemicals adds up to the detrimental effect of soya production. The use of large quantities of fertilisers and herbicides is a major source of pollution, contaminating surface water and aquifers and affecting biodiversity in and around soya fields. The use of GM soya is increasing, due to higher yields and profitability. The ecological consequences of GM soya versus conventional soya production systems are controversial. The use of GM crops in combination with intensive use of herbicide is expected to reduce biodiversity in the field margins, but may also lead to zero-tillage in the fields, with less impact on biodiversity.

Social and economic impacts

Soya production is an important driver for economic and rural development in Brazil. However, from the perspective of the local communities the soya industry is often not so positive. The socio-economic impacts of soya production differ among regions in particular depending on the dominant farm structure. In regions with large-scale soya production, the highly mechanised production of soya beans leads to a drastic loss of employment, because per 100 ha in large-scale production less than one worker is employed instead of around 15-20 workers in small-scale production. In these regions, poverty is increasing, in particular in the frontier regions, where according to some studies almost two thirds of the population lives in poverty. As a result, local inhabitants rely on seasonal work and subsistence farming or migrate to urban centres. On the other hand, new employment opportunities are created in the other links of the soya chain, i.e. in the supplying, processing and food industries and logistics as well.

The expansion of soya production is, according to many studies, linked with land conflicts because of unclear land owner rights and weak capacities of the government to regulate land ownership. As a result, soya companies often acquired land that was already occupied and in use by local farmers or land was obtained without getting registered ownership.

The transition from small-scale diverse agricultural production systems with maize, rice and cassava for the local market towards large-scale soya bean production systems for export does not only involve risks for the local food provision, but also for the food security of the increasing urbanised population in these regions.

Deforestation for soya production does also affect the possibilities for collecting of non-timber forest products which is one of the traditional food sources for the local communities. In addition, the intensive use of agro-chemicals in soya fields is seriously affecting the health of the local population, directly through inhaling and contact and indirectly because of land and water pollution.

Estimate of the land area used for Dutch import of soya products from Brazil

The share of the Netherlands in the soya products from Brazil gives a rough indication on the impact of Dutch soya industry on biodiversity and the socio-economic situation in Brazil. The Netherlands imports mainly unprocessed soya beans and oil cake and a little amount of soya oil. Taking into account the net yield of oil and oil cake per tonne of soya beans, the total Dutch annual imports of soya beans and soya products in 2007-2009 is equivalent to about 4.3m tonnes of soya beans. That is about 7.5% of the total production in Brazil. It is not possible to trace back the Dutch soya imports to the specific production areas, so only a rough estimate can be made of the land area that is needed for the Dutch import of soya products from Brazil. Assuming that all production regions contribute to the export to the Netherlands and taking into account the average soya bean yield per hectare in these regions, the total area that is needed for the Dutch import of soya beans from Brazil is equal to about 1.5m ha of land. In comparison, this area covers roughly one third of the Dutch land-area or almost 80% of the total cultivated area in the Netherlands. This estimate is based on the total gross imports of soya products of the Netherlands, not taking into account that a substantial part of it is re-exported, directly or after processing.

Options for mitigating biodiversity and socio economic impacts

The expected further increasing area used for soya bean cultivation will certainly lead to further deforestation. The challenge, however, will be to mitigate the negative impact on biodiversity by preventing unnecessary deforestation of high value forests, connecting and managing forest remnants and improved environment oriented management of the soya bean fields. The legal reserve legislation in Brazil provides an instrument to prevent large areas of natural habitats in the forests and savannah regions to be converted into agricultural areas. However, improved law-enforcement measures are required to combat an insidious conversion process. In this context, it is promising that the Round Table on Responsible Soy (RTRS) agreed that RTRS Certified producers should strictly abide the legal reserve legislation in Brazil and that the Amazon Soy moratorium does not allow soya bean cultivation on land that has been deforested after 2006. This moratorium gets support from the Brazilian government and has recently been extended to July 2011.

Since fragmentation of forest or savannah biomes may have a strong effect on biodiversity, the establishment of the legal reserves and High Conservation Value Areas (HVCAs) should be carried out in a coordinated way, using integrated land use planning approaches, resulting in interconnected areas of HCVAs and other forests. Small and medium sized farms in a mosaic landscape of agriculture and natural areas could play an important role in the transition towards a more sustainable soya production.

Another option for mitigating the biodiversity impact of soya production is to further increase the yields per ha, so that less land is required for the same production. Adequate support to small-scale farmers is required to achieve higher yields and increase sustainability.

In addition to that, positive results are to be expected from a change from the currently wide-scale use of fertilisers and other agro-chemicals towards more environment oriented crop management systems.

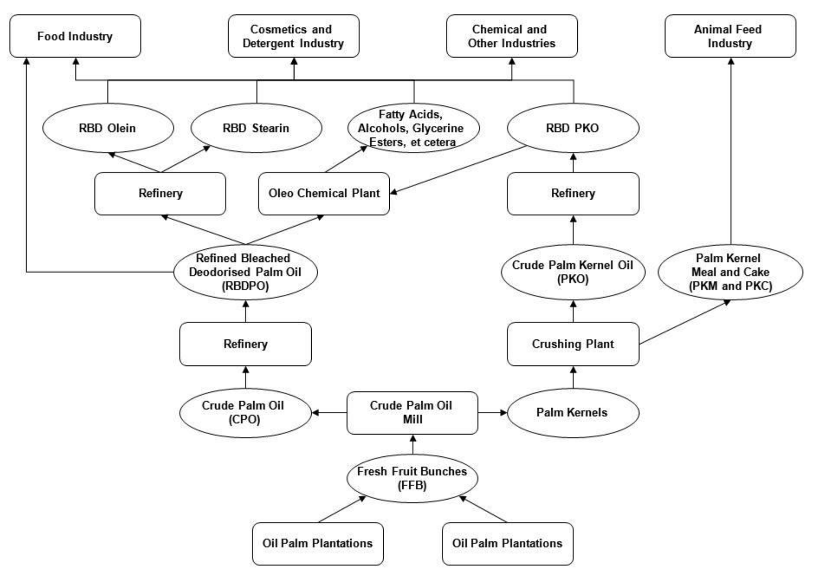
Into what extent the use of genetically modified (GM) seeds will contribute to a decreasing impact of soya production on biodiversity is controversial: there are positive and negative ecological consequences of using GM soya beans.

3 Palm oil

3.1 Introduction

Palm oil has become a major agricultural commodity which is used in a multitude of food and non-food products, such as cooking oil, soaps, detergents, lubricants, cosmetics, oleo-chemicals, animal feed and biodiesel. In general, the raw material passes through various stages of processing before it reaches the consumer. Figure 3.1 gives a schematic overview of the palm oil supply chain. In the chain from producers to consumers various actors are involved and the product provides employment and income for millions of people along the chain.

Figure 3.1 Schematic outline of the palm oil supply chain



Source: Adapted from Van Gelder (2004).

In recent years, the global demand for palm oil products has increased tremendously, resulting in a rapid development of oil palm plantations, in particular in Southeast Asia. Vast forest areas have been converted into oil palm plantations, leading to increasing concerns over its impact on the local environment and local societies. These concerns have led to the establishment of the Roundtable on Sustainable Palm Oil (RSPO) in 2004. To achieve its goal of a growing use of sustainable palm oil, the RSPO has introduced a RSPO Growers Certification and a RSPO Supply Chain Certification. All major global traders and processors are in the process of approval for a supply chain certification and the first consignment of certified sustainable palm oil came on the market in November 2008. As by September 2010, 1.7m tonnes of RSPO certified palm oil was available on the market, of which around 60% was purchased. (see Text box 3.1 for further information)

In 2009, Greenpeace has pursued a campaign for sustainable sourcing of palm oil by multinationals. Unilever, the world's largest buyer of palm oil, responded by blacklisting two major Indonesian members of the RSPO for being engaged in 'unsustainable' practices.

Following a recent audit of investments of the International Finance Corporation (IFC) in the oil palm sector by the Office of the Compliance Advisor/ Ombudsman (CAO), the World bank Group ordered a moratorium on investments in palm oil until a comprehensive sector strategy has been developed.

An important milestone in the development towards sustainable palm oil in the Netherlands is the establishment of a Taskforce Sustainable Palm Oil, which represents all major stakeholders in the Dutch palm oil chain. In November 2010 the participating parties signed a manifesto in which they announce to strive for all palm oil for the Dutch market to be sustainable in 2015.

The following sections provide a description of the developments in production, in particular of Indonesia and Malaysia, the volume of trade in particular to the Netherlands and the related impact on biodiversity and the social economic situation in the production areas. This chapter will end with a synthesis of the major findings.

Text box 3.1	Roundtable on Sustainable Palm Oil (RSPO)

The RSPO is a not-for-profit association that is aiming at promoting the development of sustainable palm oil production. It provides all stakeholders in the palm oil industry a platform for developing and implementing global standards for sustainable palm oil. Currently the RSPO has 363 ordinary and 82 affiliate members and 12 supply chain associates. The members can be divided into seven groups: oil palm growers (85 members), palm oil processors and traders (141 members), consumer goods manufacturers (87 members), retailers (22 members), banks and investors (8 members), environmental or nature conservation organisations (NGOs) (11 members) and social or development organisations (NGOs) (9 members). All major producers, processors, traders and manufacturers are RSPO member *(RSPO website, September 9, 2010).*

To achieve its goal of a growing use of sustainable palm oil, the RSPO has introduced a RSPO Growers Certification and a RSPO Supply Chain Certification. To receive this certification the companies' production process needs to be approved by RSPO approved Certification Bodies. As by September 2010, 17 oil palm growers with 66 mills in total are certified. They cover a production area of about 576,000 ha and produce around 2.9m tonnes of Certified Sustainable Palm Oil (CSPO) and 0.7m tonnes of Certified Sustainable Palm Kernels (CSPK).

Nine growers in Indonesia are certified, with a CSPO production of 0.8mn tonnes and a CSPK production of 0.2m tonnes. RSPO recognises four supply chain certificates:

- 'Identity Preserved': the product contains x % palm oil that can be traced back to a specific RSPO certified grower (mill and plantation);
- 'Segregated': the product contains x % palm oil that can be traced back to a shipment that originates from different RSPO certified growers;
- 'Mass Balance': the product contains palm oil, that according to the transporter or processor contains x% palm oil from RSPO certified growers;
- 'Book and Claim': the product contains palm oil, that according to the attached documents or certificates contains x% palm oil from RSPO certified growers;

To date, 44 companies have a RSPO supply chain certificate. All major global traders and processors are in the process of approval for a supply chain certification, almost all opting for both Segregated and Mass Balance certification. This is also the case for the traders and refineries in the Netherland. Only one company in the UK submitted an application for an Identity Preserved Certificate.

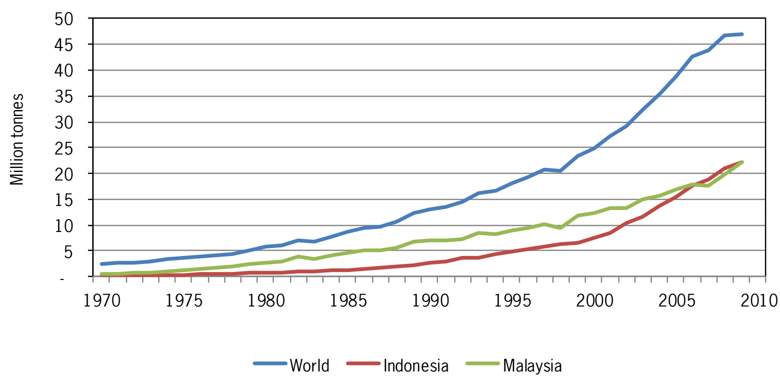
The first consignment of certified sustainable palm oil came on the market in November 2008. As by September 2010, 1.7m tonnes of RSPO certified palm oil was available on the market, of which around 60% was purchased (RSPO website: www.rspo.eu/market/index.html 9/9/2010). The higher price for certified palm oil compared with not-certified palm oil is impeding the purchases.

Source: RSPO website: http://www.rspo.eu

3.2 Total oil palm area and palm oil production

Oil palm is currently the most rapidly expanding crop in Southeast Asia. Globally it covers over 14.7m ha and is one the world's major sources of edible oils, about the same amount as soya oil. Palm oil production increased from around 2m metric tonnes in 1970 to an estimated 47m tonnes in 2009 (FAO, 2010a). Indonesia and Malaysia account for about 85% of the global palm oil production, with each about the same share.

Figure 3.2 **Development of the production of palm oil (inclusive palm kernel oil) in Indonesia, Malaysia and the World (1970-2009)**



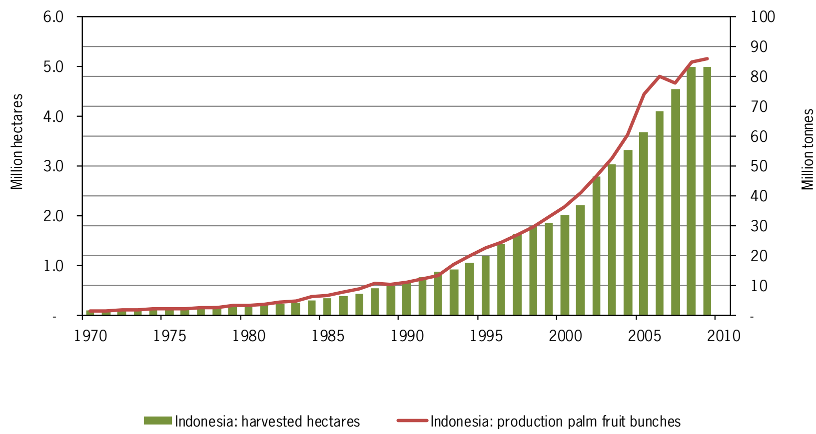
Source: FAO (2010a).

With respect to the total area of oil palm plantations, there is a large discrepancy between FAO figures (FAO 2010a) and figures published by the palm oil industry, possibly due to the exclusion of recently planted areas that are not yet producing (less than 3 years).

3.2.1 Indonesia

The development of oil palm plantations in Indonesia shows a steep growth from the mid-nineties of the last century onwards (see Figure 3.2), from less than 1m ha around 1990 towards more than 7m ha in recent years. According to Shean (2009) the total area in 2009 was 7.3m ha, of which 5.06m ha is mature and producing. The total area is expected to grow to 8.9m ha in 2012 (Santosa, 2008).

Figure 3.3	Oil palm area harvested and production volume of fresh fruit bunches in Indonesia in the period (1970-2009)



Source: FAO (2010a).

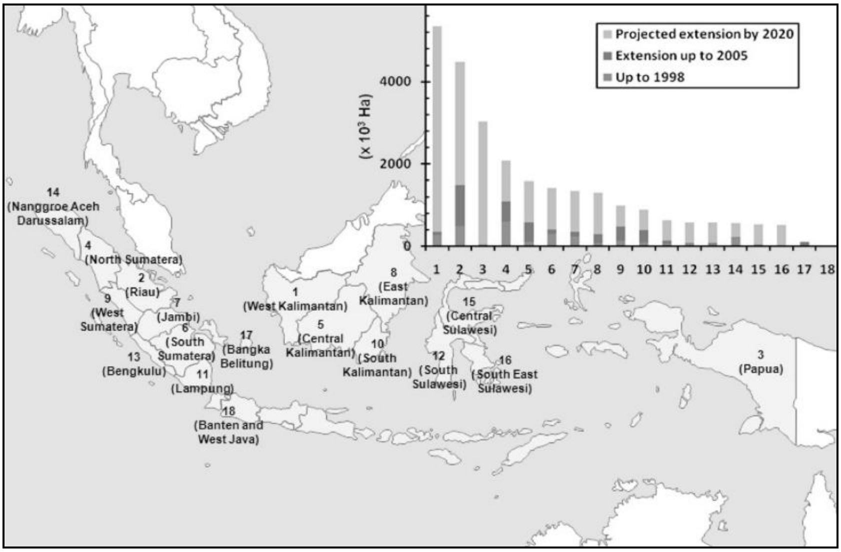
According to FAPRI (2009) projections, Indonesia will maintain its leading position in world palm oil production, increasing its output from around 20m tonnes in 2008/09 to 28m tonnes in 2018/2019. The strong increase in palm oil production in Indonesia is driven by the large global demand for crude palm oil and is facilitated by different levels of the Indonesian Government. An important role in this respect plays the decentralisation of power caused by the fall of Suharto, which has given the lower local level authorities (district) the right to decide on the use of state land. Local government authorities are leasing land to private companies that start large-scale oil palm plantations. In 2007 the total planted area accounted 6.8m ha of which 3.3m ha was controlled by private companies, 2.8m ha by small holders and 0.7m ha by public companies. Smallholders accounted for 35% of the total crude palm oil produced and 41% of the productive area (Sheil et al., 2009; Vermeulen and Goad, 2006). Because of the required machinery and palm oil mill, most small holder plantations occur as nucleus estates in cooperation with larger, company owned plantations (Sheil et al., 2009). These so-called 'supported small-holders' cultivate some 25,000 ha of land in Indonesia, while the so-called 'independent small holders', who do not have outside assistance, cultivate some 650,000 ha of land (Vermeulen and Goad, 2006).

The major part of the Indonesian oil palm plantations is located in lowlands that are relatively easy to access; more than 95 % in Sumatra and Kalimantan, but the palm oil sector is also expanding into other parts of Indonesia such as Papua and Sulawesi (see Table 3.1 and Figure 3.4).

Table 3.1	**Local production areas of palm oil in Indonesia (2005)**	
Province	**Area (million ha)**	**%**
Nangroe Aceh Darusalam	0.22	4.27
North Sumatra	0.68	13.20
West Sumatra	0.2	3.88
Riau	1.4	27.18
The Rest of Sumatra	1.25	24.27
Total Sumatra	3.75	72.80
Java	0.02	0.39
West Kalimantan	0.46	8.93
Central Kalimantan	0.34	6.60
South Kalimantan	0.2	3.88
East Kalimantan	0.2	3.88
Total Kalimantan	1.2	23.29
Sulawesi	0.12	2.33
Irian Jaya (Papua)	0.06	1.17
Total Indonesia	5.15	100
Source: GAPKI and Directorate General of Estate Crops (Bangun (2006), www.gapki.or.id/).		

Forest clearings for plantation development increasingly occur in the hilly inlands of Central Kalimantan, although a recent report by ISRIC concludes that these lands are highly unsuitable for oil palm (Mantel, 2007). Plans to establish 1.8m ha of oil palm plantations along the Sarawak-Kalimantan border, through the heart of Borneo (The Kalimantan Border Oil Palm Mega Project) have failed so far. Based on the proposed extensions for oil palm plantations, West Kalimantan, Riau and Papua will become the largest palm oil producing states by 2020. Currently Papua is still a minor producer.

Figure 3.4	Oil palm concession areas and their proposed extensions by 2020 for Indonesia

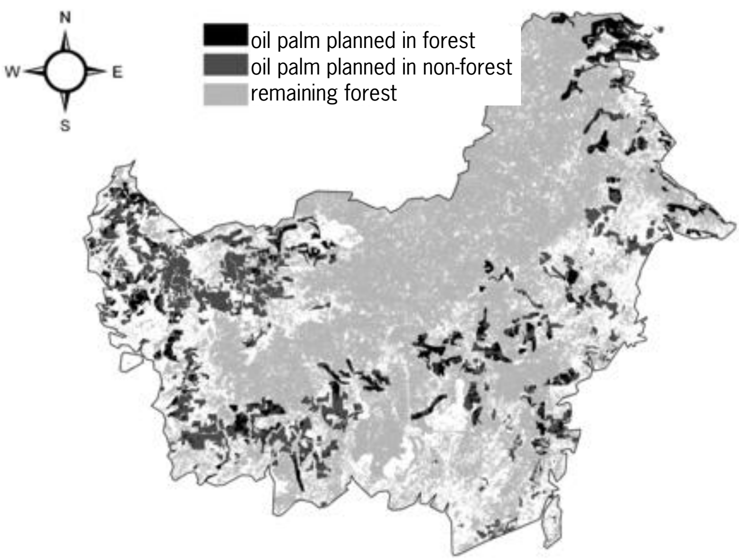


Source: Santosa (2008).

The Indonesian Ministry of Forestry statistics indicates that 70% of the current oil palm estates in Indonesia are located in areas formally belonging to the Indonesia's forest estate between 1982 and 1999 (Sheil et al., 2009). Many of them have been established in forested areas because the timber yields can offset the costs of plantation establishment. Many plantation companies are associated with logging companies to make this possible (see Casson, 2000; Casson, 2007). According to international non-governmental organisations a large part of the approved oil palm concessions in Indonesia has never been planted with oil palms but was merely used for timber extraction. To illustrate this, Casson (2007) described that within the province of West-Kalimantan some 5.3m ha of location permits for oil palm plantations were approved, whereas only 1m ha of land have actually been planted with oil palm. In addition, Riau province (Sumatra) lost 4m ha (64%) of its forests between 1982 and 2007; 29% of this was cleared for industrial oil palm plantations, 24% for industrial pulpwood plantations and 17% was not replaced by any crop cover (Uryu et al., 2008). This process is expected to continue also elsewhere in Indonesia because part of the oil palm concessions to be developed are planned in forest areas (Venter et al., 2009), as it is shown in Figure 3.5, which is an overlay of the planned oil palm plantations in Kalimantan and a 300 meter resolution forest cover map (ESA, 2008).

In conclusion, a large part of the deforestation in Southeast Asia is indirectly related to oil palm development. This indirect land use change is not accounted for in the estimates of impacts of Dutch palm oil import on biodiversity presented in this report.

Figure 3.5 **Location of planned oil palm concessions in forest and deforested areas Kalimantan**



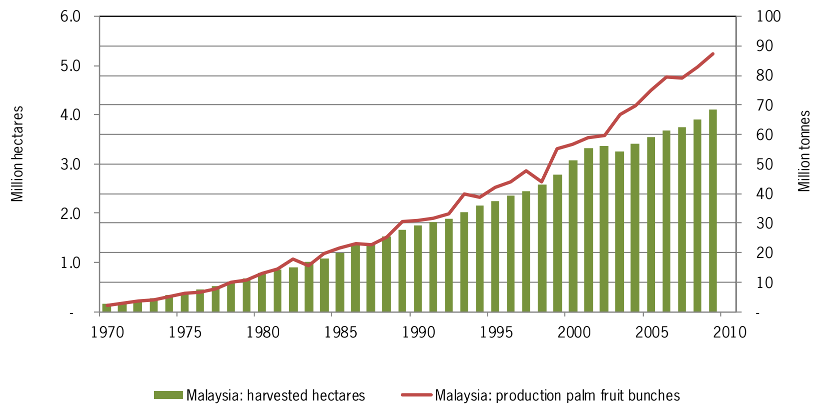
Source: Venter et al. (2009).

The authority for approval of development plans for oil palm plantations over 1,000 ha lies still with the central government (Colchester et al., 2006). According to the Indonesian government, there is still an area of 27m ha of unproductive forest land available for palm oil production (Colchester et al., 2006). It is unclear to what extent this estimate takes into account the large number of people in Indonesia who are depending upon state forest areas for their livelihoods. It is estimated that 60-90m of the in total 220m people in Indonesia are depending on forest resources, hence, the transformation from state owned forest land to oil palm plantations will heavily affect Indonesia's rural communities (see section 2.7).

3.2.2 Malaysia

In Malaysia, the palm oil production started to grow much earlier than in Indonesia. The area of oil palm shows a steady grow from less than 0.5m ha in 1975 towards more than 3.5m ha in 2007 (Figure 3.6).

Figure 3.6 **Oil palm area harvested and production volume of fresh fruit bunches in Malaysia (1970-2009)**



Source: FAO (2010a).

Large-scale production of palm oil in Malaysia started in Peninsular Malaysia, where its plantations covered over 2,36m ha in 2007 (Table 3.2). The area of oil palm plantations is fast growing in the states of Sabah and Sarawak as well. According the MPOB statistics, Sabah had planted about 1.28m ha of oil palm plantations in 2007 and Sarawak 0.66m ha. Recent sources indicate, however, that the total area of oil palm plantations in Sarawak was some 1.39m ha in 2007 (Forest Department Sarawak, *pers. comm.*), which is surprisingly more than twice the figure shown by the official MPOB statistics. Most of the oil palm plantations are located in the coastal lowlands, but oil palm is also being planted in the hilly inlands of Sarawak, close to the Kalimantan border and close to the heart of Borneo Area.

Table 3.2	Distribution of oil palm planted areas by estates in Malaysia (2007, ha)						
State	**Small holders**	**Felda**	**Felcra**	**Risda**	**State agencies**	**Private estates**	**Total**
Johor	151,025	119,740	22,070	5,134	43,921	328,751	670,641
Kedah	15,484	510	1,124	1,252	1,916	54,810	75,096
Kelantan	1,873	38,230	5,314	767	8,878	44,701	99,763
Melaka	6,419	2,848	2,411	1,966	-	35,469	49,113
N. Sembilan	15,229	46,125	7,644	10,523	3,003	88,319	170,843
Pahang	29,213	284,228	31,283	22,112	55,956	218,660	641,452
P. Pinang	7,054	-	511	56	-	5,683	13,304
Perak	72,292	20,252	31,548	19,779	13,717	193,395	350,983
Perlis	61	-	199	-	-	-	260
Selangor	30,685	4,989	4,297	342	1,126	87,876	129,315
Terengganu	5,435	38,500	19,962	19,555	12,732	65,103	161,287
Peninsular Malaysia	**334,770**	**555,422**	**126,363**	**81,486**	**141,249**	**1,122,767**	**2,362,057**
Sabah	106,186	113,874	14,690	-	94,087	949,407	1,278,244
Sarawak	29,199	7,681	22,838	-	78,209	526,685	664,612
Sabah and Sarawak	**135,385**	**121,555**	**37,528**	**-**	**172,296**	**1,476,092**	**1,942,856**
Malaysia	470,155	676,977	163,891	81,486	313,545	2,598,859	4,304,913
Source: www.econ.mpob.gov.my/economy/annual/stat2007							

Large-scale production of palm oil in Malaysia started in Peninsular Malaysia, where its plantations covered over 2,36m ha in 2007 (Table 3.2). The area of oil palm plantations is fast growing in the states of Sabah and Sarawak as well. According the MPOB statistics, Sabah had planted about 1.28m ha of oil palm plantations in 2007 and Sarawak 0.66m ha. Recent sources indicate, however, that the total area of oil palm plantations in Sarawak was some 1.39m ha in 2007 (Forest Department Sarawak, pers. comm.), which is surprisingly more than twice the figure shown by the official MPOB statistics. Most of the oil palm plantations are located in the coastal lowlands but oil palm is also being planted in the hilly inlands of Sarawak, close to the Kalimantan border and close to the heart of Borneo Area.

3.3 Global trade flows and the Dutch trade position

Being the two largest producers of palm oil products of the world, Indonesia and Malaysia also dominate international trade; they are the largest exporters of palm oil and oil cake (see Table 3.3). In 2009, Indonesia was the world's largest exporter of crude palm oil, while Malaysia was the major exporter of processed palm oil. The countries' exports of oil cake are quite balanced. Together they account for 80-90% of the world's exports in these palm oil products.
The Netherlands and India are the two most important importers of crude oil, while China is a key importer of processed or refined palm oil. The Netherlands is also a major importer of oil cake.

Table 3.3 Major exporters of palm oil and their markets, 2009 (in million tonnes)

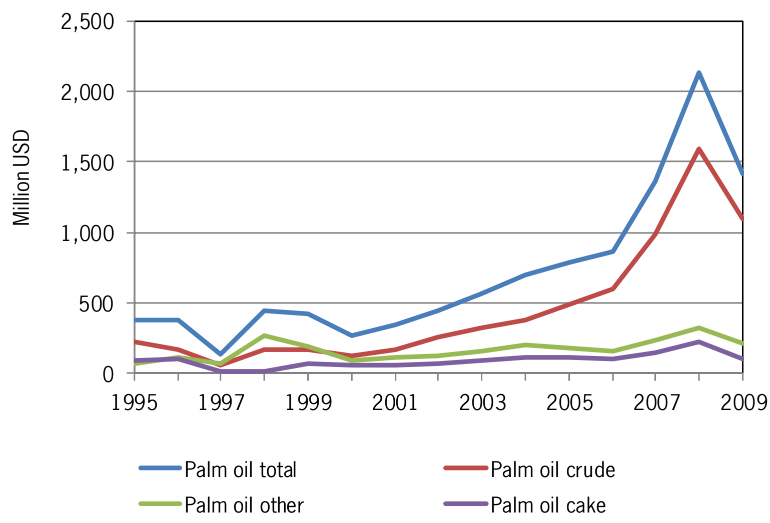
Exporting country	Palm oil, crude		Palm oil, other than crude		Oil cake	
	world	major destination	world	major destination	world	major destination
Indonesia	9.6	India: 4.4 Netherlands: 1.1 Malaysia: 1.1 Italy: 0.6 Singapore: 0.6	7.3	China: 2.3 India: 1.1 Bangladesh: 0.7 Egypt: 0.4 Netherlands: 0.3	2.6	Netherlands: 1.1 New Zealand: 0.5 China: 0.3 Republic of Korea: 0.3
Malaysia	2.6	Netherlands: 1.0 India: 0.6 Pakistan: 0.4 China: 0.2 Finland: 0.2	11.3	China: 3.2 Pakistan: 1.5 USA: 0.6 India: 0.5 Japan: 0.5	2.2	Netherlands: 1.0 Republic of Korea: 0.4 New Zealand: 0.3
Other countries	0.9		2.2		0.6	
Total	**13.1**		**20.8**		**5.4**	

Source: UN Comtrade, LEI.

Table 3.3 is based on UN Comtrade statistics. It need to be noted that there is a mismatch between the Indonesian and Malaysian export figures and the Netherlands' import figures, e.g. Indonesia and Malaysia report an export of 2.0m tonnes crude palm oil to the Netherlands, while the Dutch import data show only 1.6m tonnes of imports from these countries. For oil cake these figures are 2.0 respectively 0.7m tonnes. On the other hand, the import data of some European countries are much higher than the reported export data of the two exporting countries. There is no clear explanation for these disparities in trade data, as has been discussed section 1.4.

In the following sections about the trade of the Netherlands, the Dutch reported figures are taken as starting point for further analysis. Trends in the Dutch imports of palm oil products are presented in Figure 3.7. The total import value significantly increased since 2000 and adds up to almost USD2.1b in 2008, and a sharp decline in the following year, caused by an increased competition in the global food market since 2007. In the period 2007-2009, the annual Dutch import value was about USD1.6b and accounted for 7% of the total global trade in palm oil products. For crude palm oil the share of the Netherlands was 15% and for palm oil cake even 23%.

Figure 3.7 **Value (million USD) of Dutch import of palm oil products (1995-2009)**



Source: UN Comtrade, LEI.

The commercial links of the Dutch palm oil traders and processors are more intensive with Malaysia than with Indonesia, as is shown in Table 3.4: the import volume of crude palm oil and palm oil cake from Malaysia is about twice as much as from Indonesia.

Table 3.4	**Major exporting countries for palm oil products to the Netherlands (average 2007-2009)**	
Commodity	**Import value**	**Import volume**
	million USD	**1,000 tonnes**
Palm oil, crude a)	1,226	1,669
Malaysia	666	1,020
Indonesia	427	521
Papua New Guinea	39	44
Palm oil, other than crude	256	290
Malaysia	102	128
Indonesia	123	136
Oil-cake	158	853
Malaysia	95	521
Indonesia	48	256
Germany	15	74

a) Import volume of crude palm oil is average of 2007/2008, 2009 figures not available.
Source: UN Comtrade, LEI.

The Netherlands is not only a significant importer of palm oil products, in particular crude oil, but also a major exporter, especially of processed palm oil and oil cake (see Table 3.5). The most important export destinations are the neighbouring countries Germany and Belgium.

Table 3.5	Major importing countries for palm oil products from the Netherlands (average 2007-2009)	
Commodity	**Export value**	**Export volume**
	million USD	**1,000 tonnes**
Palm oil, crude	123	151
Finland	43	67
Germany	38	38
Palm oil, other than crude	1,158	1,090
Germany	342	351
Belgium	307	283
France	134	121
Oil-cake a)	65	372
Germany	35	210
Belgium	16	89

a) Export volume of oil cake is average of 2007/2008, 2009 figures not available.
Source: UN Com trade, LEI.

Table 3.6 shows the importance of palm oil processing for the Netherlands: the import value of crude palm oil is about the same as the export value of processed palm oil. The total balance shows a deficit for the Netherlands.

Table 3.6	Trade balance of the Netherlands in palm oil products					
Commodity	**Value in million USD (average 2007/09)**			**Volume in 1,000 tonnes (average 2007/08) a)**		
	import	**export**	**balance**	**import**	**export**	**balance**
Palm oil, crude	1,226	123	-1,103	1,669	174	-1,495
Palm oil, other than crude	256	1,158	+902	351	1,231	+880
Oil-cake	158	65	-93	1,044	372	-672

a) Volumes are averages of 2007/2008, because 2009 figures on volumes were not available for all commodities.
Source: UN Comtrade, LEI.

Import tariffs

In most cases there are no import tariff charges on palm oil and cake when entering the EU. However, imports from Malaysia and Indonesia are subject to a tariff on palm oil, with less than 2% on crude palm oil imports whereas the EU charges a significant 9.5% import tariff on processed palm oil

Table 3.7	Import tariff structure of palm oil commodities	
Commodity	**Tariff**	**Countries**
Palm nuts and kernels	0%	For all countries
Palm oil, crude	0%	For all countries except:
	1.9%	Indonesia, Malaysia, Norway, Philippines, Singapore, USA
Palm oil, other than crude	0%	For all countries except:
	3.2%	Argentine, Brazil, China, Morocco, Russian Federation, Saudi Arabia, Thailand, UAE, Ukraine
	8.93%	Sri Lanka
	9.45%	Indonesia, Republic of Korea, Malaysia, Norway, Philippines, Singapore, Switzerland, USA
Oil-cake and other solid residues	0%	For all countries

Source: MacMAP tariff data.

3.4 Future trade developments

3.4.1 Drivers of supply and demand

This section presents an analysis of the main drivers of the supply and demand developments on the international agricultural market in general and for palm oil and soya bean products in particular. Furthermore, expectations in production and trade for the next 10 to 15 are depicted, based on estimated international supply and demand developments. The projections show where (in which countries) and to what extent palm oil production most probably will expand.

Drivers of demand

Population growth and rising incomes are, together with migration from rural to urban areas and changing consumption habits the most important drivers of developments in the demand of agricultural products. All four factors interact with each other and cannot be regarded separately. For the coming ten years the worldwide population growth is estimated to be no more than 1% annually, although population growth will be much higher in the lower (Africa) and middle income (Latin America, Asia) countries than this average figure (OECD/FAO, 2009). Moreover, more and more people in developing countries are migrating from the poorer rural areas to the growing and richer urban centres, in the prospect of finding better paid work in the cities. As a result of this migration an increasing part of population will not be able to get sufficient food based on subsistence farming and hence more and more people have to earn money to purchase food. Despite the world wide slow-down of economic growth in the most recent years due to the financial and economic crisis of 2008/2009 projections for 2011-2018 indicate a substantial economic growth for all regions in the world, although the expected growth figures are significantly higher in the emerging economies like China, India and Russia and (other) developing countries compared to those for the EU-15, the USA and Japan.

Income growth per capita leads generally to more consumption of 'luxury' goods. This implies a shift in food consumption patterns towards more convenience and processed products, while consumers show greater attention to food safety, environmental and health issues. In volume terms it may not be expected that food consumption will increase much in high-income countries, yet increasing income in developing countries will result into more demand and a shift to products with higher added value. An important implication is the shift in the consumption pattern from cereals to meat products and that implies an increasing demand of coarse grains and protein rich products such as soya beans for animal feed.

In addition to these four 'traditional' drivers a new source of demand for agricultural commodities has emerged, viz. biofuels (primarily of bio-ethanol from maize and sugar cane and biodiesel from rapeseed and lately palm oil). The recently growing demand and production of biofuels has been the result of increasing prices of fossil fuel and the policies in the USA and EU to direct the share of renewable energy in total energy consumption as part of their strategic energy and climate policy. Also other countries (e.g. Argentina and Brazil) promote ethanol and biodiesel production. Although the usage of grain for the production of biofuels is still only a small share of well below 5%, the production of ethanol from grain is mainly promoted or planned to be promoted in the grain exporting countries. This leads to a decrease in the availability of agricultural raw materials for exports and thus on the world market with possible consequences for international prices if production falls short of demand growth.

EU's goals set in its biofuel policy will not be met without a significant increase of imports of oilseeds and vegetable oils (Banse et al., 2008).[1.] As a consequence of biofuels policies and their impact on demand for agricultural commodities, the price structure, i.e. the relation between the prices of individual commodities, will change, which effect supply responses.

Supply and demand projections
According to projections in OECD/FAO (2009) supply response to these demand developments will largely be the results of productivity increases (at least in the most productive areas) while expansion of areas and/or livestock numbers will only contribute little. The outcome of the dynamics in supply and demand is that in the 10 years to come the (real) prices of agricultural commodities will be on average on a significant higher level than they were in the decade prior to the 2007-2008 peaks (and despite the significant price decrease in 2008/09 against 2007/08). The situation varies by commodity with average crop prices being projected to be 10-20% higher, while vegetable oils real prices are expected to be more than 30% higher relative to 1997-2006.

3.4.2 Projections of palm oil exports and imports

According to FAPRI projections, Indonesia and Malaysia will continue to dominate world exports of both palm oil and meal (Table 3.8). The largest importers are China, India and the EU. Population and income growth cause palm oil consumption to expand in China and India, as industrial use for palm oil rises rapidly with the demand for processed food. The EU depends on imports to maintain its palm oil consumption which is expected to increase about 20% over the projected period. Because rapeseed oil, the major vegetable oil in the EU, is primarily used for biodiesel production, the low cost palm oil becomes a preferred substitute for other industrial uses.

[1] EU's biofuel policy is much under debate. Goals set to reach a biofuel target of 10% blending by 2020 are not considered sustainable in terms of industry development as well as in terms of land-use in and outside the EU (see Renewable Fuel Agency, The Gallagher Review of the indirect effects of biofuels production, July 2008). For latest updates of the policy and the specifications of EU's Biofuel Directive, see www.ec.europa.eu/agriculture.

Table 3.8	Projections of palm oil exports and imports (million ton)					
	Palm oil		Palm kernel meal		Palm kernel oil	
	2008/09	2018/19	2008/09	2018/19	2008/09	2018/19
Net-exporters						
Malaysia	13.9	18.2	2.1	2.6	0.5	0.5
Indonesia	14.6	22.3	2.2	3.2	1.5	2.4
Net-importers						
China	5.7	9.1			0.4	0.7
EU	3.8	4.5	2.4	2.8	0.6	0.7
India	4.9	6.7				
Rest of world	14.0	21.2	2.0	3.0	1.1	1.4
Total trade a)	28.4	40.5	4.4	5.8	2.1	2.8

a) Excluding intraregional trade.
Source: FAPRI(2009) World Agricultural Outlook (2009: p. 264).

3.5 Land area used for Dutch import of palm oil

In this section an estimate is made of the land area that is needed for the Dutch import of palm oil and palm oil products from Malaysia and Indonesia. Starting point for the calculations are the Dutch import figures combined with estimates of yields per hectare for different type of producers in Malaysia and Indonesia.

3.5.1 Production methods and yields

The productivity of oil palm plantations, i.e. both the yield of fresh fruit bunches (FFB) per hectare and the FFB quality, depends on various factors such as the site conditions, the management of the plantation, the age of the oil palms (mature palms produce more fruits than young ones) and the variety used. The palms start producing at the age of three and they reach their highest average production at 8-10 years old, after which the yields decline gradually until the end of the rotation, normally about 25 years. In 2007 only 12.6% of the Malaysian plantations had immature palms and consequently a lower production. This explains why in Malaysia the productivity increases relatively faster than the area used for production (Figure 2.6). The age distribution of plantations differs between states, with especially younger palms in the more recently established plantations in Sarawak. Partly because of this age effect the yields in Sarawak are lower compared to other Malaysian states.

The most important measures to increase the plantations yield are soil preparation, application of fertiliser and pest control, either chemically or biologically. The maximum yields reported for oil palm are 48.3 tonnes FFB per hectare per year (Harun 2005). Without soil preparation oil palm yields on peat are generally lower, but proper soil and water management of oil palms on deep peat can result in FFB yields closely mirroring those on good mineral soils (Harun, 2005). Soil compaction reduces soil water evaporation and increases root branching and phosphorus uptake. It also prevents three toppling and slows down the soil subsidence. However, soil compaction is not practiced in all plantations on peat.

Each tonne of fresh fruit bunches yields about 180-200 kg of crude palm oil (CPO), depending on the oil content of the fruit, which depends on a number of factors such as climate, soil type, and water- and nutrient availability.

There is a large difference between the FFB yields from private and government plantations and yields small holders attain. The FFB yields are generally highest in the large scale private and government estates and much lower in small holder production systems. In both Indonesia and Malaysia small holders can be divided in supported small holders and independent small holders (Vermeulen and Goad, 2006). Supported small holders receive technical assistance and high quality seed stock, fertilisers and pesticides from government institutions or the private sector, while independent small holders lack this type of support. Although there are high yielding independent growers, the average yields of independent small holders are much lower compared to supported small holder growers (ibid).

3.5.2 Estimated land area needed for Dutch palm oil imports from Indonesia and Malaysia

This section provides an estimate of the land area needed for the import of palm oil products from Indonesia and Malaysia to the Netherlands. These calculations are based on the import of Crude Palm Oil (CPO). It is assumed that no additional area is needed to produce Palm Kernel Oil (PKO) and oil cake for the Dutch market because PKO and oil cake form only a limited part of the total Dutch palm oil import. In the calculations the differences in CPO yield per ha for private and government estates and small holder production is taken into account (Tables 2.9 and 2.10). The total area used for Dutch CPO import from these countries is assumed equal to the sum of the production areas of these three producer's categories and that the share of each category is the same as their shares in the total national production of Indonesia or Malaysia.

It needs to be noted here that these calculations are based on the total imports of palm oil products by the Netherlands, not taking into account that a large part of it is re-exported, mostly after processing, to other countries, mainly Germany and Belgium.

Indonesia

The yields attained by the private and state-owned oil palm estates in Indonesia are about 21 tonnes FFB and 4.2 tonnes CPO per ha. Despite the differences are becoming smaller, the overall small holders' production is lower. The yields of supported small holders, usually around 19 tonnes FFB and 3.8 tonnes CPO per hectare, are close to those of the large estates. However, within the group of independent small holders, there is a large variation in productivity, mainly depending on the size of the holding. High yielding small holders usually have more than 10 ha oil palm and produce 17 tonnes of FFB and around 3.4 tonnes CPO per ha, while smaller independent producers have on average around 2 ha and produce only 10 tonnes FFB and approximately 2 tonnes CPO per ha (Vermeulen and Goad, 2006), which is about half the yield of the large estates and the supported small holders. The share in the total small holders' oil palm area is about 50% for the supported small holders, 36% for the low yielding independent producers and 14% of the high yielding independent producers (Vermeulen and Goad, 2006). Weighing for these area shares, the average small holder yield in Indonesia is approximately 3.1 tonnes CPO per hectare, which is about a quarter lower than that of the large estates.

In 2007 some 2.81m ha of oil palm plantations in Indonesia were owned by small holders, 3.26m ha by private estates and 0.71m ha by the government. Following the above described method, the Indonesian area needed for the Dutch import of CPO in the period 2007-2009 was on average about 140,000 ha per year (see Table 3.9) which is equivalent to 7% of the total Dutch agricultural land area.

Table 3.9	Estimated area needed for the Dutch imports of crude palm oil (CPO) from Indonesia during 2007-2009 a)			
	Small holders	Government estates	Private estates	Total
Area (million ha)	2.81	0.71	3.26	6.78
CPO yield per ha (tonnes)	3.1	4.2	4.1	3.7
Total CPO production (million tonnes)	8.71	2.98	13.37	25.06
Average Dutch import CPO (million tonnes)	0.18	0.06	0.28	0.52
Area needed for Dutch CPO import (1,000 ha)	58.3	14.7	67.7	140.7

a) CPO yield data are for 2007; Dutch import data refer to the average annual Dutch imports during 2007-2009.

Malaysia

The Malaysian annual production of independent small holders was reported to be between 16 and 17 tonnes FFB per ha (Ismail et al., 2003; Vermeulen and Goad 2006), which gives 3.3 tonnes CPO per ha per year and thus equals that of the Indonesian high yielding independent small holders. The productivity of supported small holders was with 19 tonnes FFB and 3.8 tonnes CPO per hectare also similar to that of the supported small holders in Indonesia (Vermeulen and Goad 2006). The supported small holders have a share of 76% in the total small holders oil palm area and the independent small holders about 24%. Taking into account these shares, the weighted average CPO production for small holders in Malaysia is about 3.7 tonnes CPO per hectare. There are no data available on production differences between government and private companies, so that it is assumed that the yields obtained in these plantations are the same, 4.2 CPO per ha (Shean, 2009; Vermeulen and Goad, 2006). Based on these figures the total area in Malaysia needed for the Dutch annual import of CPO during 2007-2009 is approximately 246,000 ha (Table 3.10), which is roughly equivalent to 13 % of the total Dutch agricultural land area.

Table 3.10	Estimated area needed for the Dutch imports of crude palm oil (CPO) from Malaysia during 2007-2009 a)			
	Small holders	**Government estates**	**Private estates**	**Total**
Area (million ha)	0.47	1.24	2.60	4.30
Production per ha (tonnes)	3.7	4.2	4.2	4.1
Total CPO production (million tonnes)	1.74	5.21	10.92	17.87
Annual Dutch import CPO (million tonnes)	0.10	0.30	0.62	1.02
Area needed for Dutch CPO import (1,000 ha)	26.8	70.8	148.4	246.0

a) CPO yield data are for 2007; Dutch import data refer to the average annual Dutch imports during 2007-2009.

3.6 Biodiversity impacts

3.6.1 Introduction

Land clearing for agriculture is the greatest single cause of deforestation in the world and it is proceeding most rapidly in countries with the highest biodiversity (Balmford and Long, 1994). In Southeast Asia, the majority of the remaining forest area consists of secondary, logged-over forests, and it is especially these forests that are being converted into oil palm plantations (Bhagwat and Willis, 2008). To assess the impact of oil palm plantations on biodiversity, results from field studies across South-East Asia were used. The collected data were inserted into a database and for all these studies the relative species richness (RSR, see section 1.4) was derived. Where possible, data were further subdivided into species that occurred in both the studied ecosystem as well as in the reference ecosystem, and species that occurred in only one of the two ecosystems. Unfortunately, these details lacked for most of the species groups in our review. The data are used here to portray differences in species richness in oil palm plantations relative to primary forest and relative to logged-over forest.

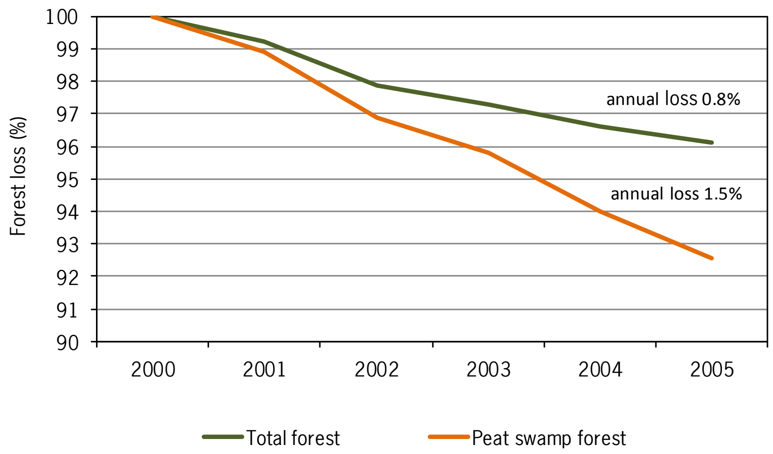
There is an ongoing scientific debate on the effects of small holder versus large-scale palm oil plantations on biodiversity. It is generally expected that small holder production in more extensively managed mosaic landscapes is more beneficial to wildlife and maintenance of local biodiversity than in intensively managed large scale plantations. There are, however, limited data to support this. On the other hand, many small holder plantations have low crop yields, which mean that they need more land to produce a given amount of palm oil compared to intensive plantations. In the following paragraphs the biodiversity impacts of oil palm plantations is described in general terms without differentiating between small-scale and large-scale palm oil plantations. The term 'direct effects' will be used to indicate the effects of land use change, in this case the conversion of forest into oil palm plantations. These effects are described in paragraph 3.6.2. The term 'indirect effects' on biodiversity indicates the effects of plantation establishment and management on biodiversity in indirect ways, such as changed hydrology or water pollution. These effects, which are hard to identify and to measure, are briefly described in paragraph 3.6.3.

3.6.2 Direct effects on biodiversity

A rapidly increasing number of scientific publications indicates that tropical biodiversity is critically affected by the conversion of forest into oil palm plantations (e.g. Danielsen et al., 2009; Fitzherbert et al., 2008; Koh, 2008c). Losses of tropical forest, and in particular lowland forests, represent one of the greatest threats to bird diversity globally (Aratrakorn et al., 2006; Aratrakorn et al., 2006). It is also iconic mammal species such as the Orang-utan that are suffering dramatic declines because of the ongoing expansion of oil palm plantations (Robertson and Van Schaik, 2001).

The deforestation rate in Southeast Asia is among the highest in the world, averaging 1.5% per year. Deforestation occurs throughout the region but is most rapid in the lowlands, in particular in peat areas (Figure 3.8). Development of peat areas, mainly for oil palm plantations is the major driver of the ongoing peat swamp forest conversion in Indonesia and Malaysia (Bhagwat and Willis 2008). In the state of Sarawak alone, more than 0.5m ha of peat land have been planted with oil palm, equalling 38.3% of Sarawak's total peat area (Forest Department Sarawak, pers. comm.). In 1996, about 1m ha of peat swamp forest in Central Kalimantan were cleared and drained in the Mega Rice Project (MRP). Due to such large-scale developments peat swamp forests are one of the most rapidly disappearing ecosystems in the world. Although the peat forest vegetation harbours fewer species compared to some other tropical forest types, such as mixed Dipterocarp forest, there are several endemic animals and plants that fully depend on the peat swamp forest ecosystem.

Figure 3.8	Loss of forest and peat swamp forest in Insular Southeast Asia (2000-2005)



Source: Hooijer (2006).

Where future expansion of oil palm concessions is planned in forest areas, the impact on biodiversity will be especially high (Venter, in press.). Nevertheless, most of the current forest conversion in Malaysia and Indonesia takes place in lowland tropical forests that have been logged over in the past decades. Logging operations have declined the species diversity of these ecosystems, but a number of studies indicate that logged-over forest patches may still harbour the majority of the originally occurring forest species (Koh, 2008a,b; Peh et al., 2006; Struebig et al., 2008; Turner, 1996) (see also section 4.5.1).

The results of local field studies in oil palm plantations should be considered within the background of their species richness being the result of four main characteristics:

a. *The diversity of vegetation within and around the plantation*

Most field studies indicate that oil palm plantations have simple communities of non-forest species of low conservation concern (Danielsen et al., 2009; Turner and Foster, 2009).The observed low species richness in oil palm plantations relative to forest is for a large part related to the homogeneity in vegetation structure, which provides less potential habitat space and food sources. The loss in abundance and biomass of arthropods for example was related to three different structural elements: ferns, canopy and litter.

In general their abundance and biomass declined during conversion to oil palm, but the abundance of ants in the canopy seemed to increase in oil palms, although their biomass declined. It indicates a tendency that bigger species survived. These effects illustrate the complexity species shifts caused by habitat conversion.

b. *The permanence of the various crops within the plantation*
In oil palm plantations the main crop has a rotation cycle of 25 years. This allows long-lived species to grow and reproduce within the plantation. Therefore oil palms and other tree crop plantation such as rubber, harbour many more species than short rotation crops like soya or maize. In addition, the larger physical structure of an oil palm offers more ecological niches compared to smaller crops. In many oil palm plantations cover crops are used for various reasons. These cover crops may be replaced several times within the 25-year oil palm cycle.

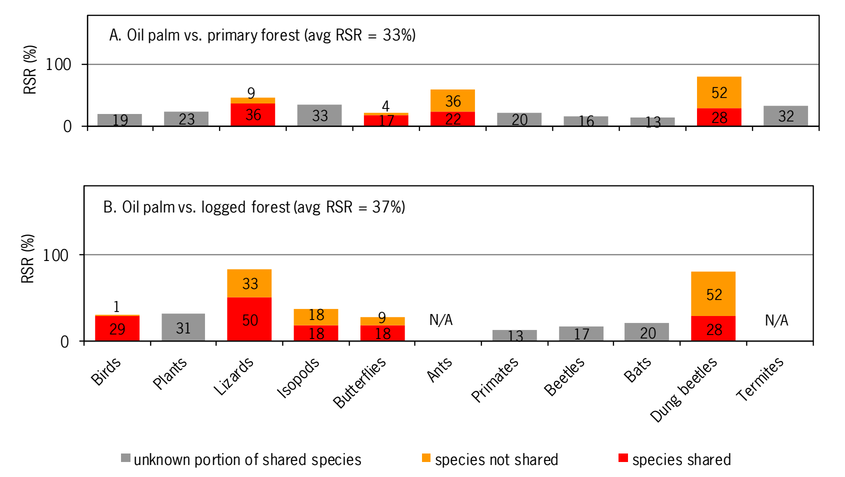
c. *Plantation management*
Species richness in oil palm plantations is strongly influenced by plantation management as well. For example, the use of herbicides and slashing of undergrowth or removing epiphytes from the oil palm stem will decrease the plant species richness (Abdullah, 1995; Bucas and Saliot, 2002). Intensive use of fertilisers and agro chemicals for pest control will have negative effects on the environment, for example due to leaching of chemicals to the water system (see paragraph 2.6.3). However, plantations can also be managed to increase biodiversity without decreasing yields, for example by introducing biological pest control such as barn owls.

d. *The extent of the isolation of the plantation from natural vegetation*
Surrounding forests have significant effects on biodiversity within the oil palm plantation borders because they offer necessary refugee area. They contain many species themselves so the incidence of species visiting the plantation is higher compared to plantations that are not surrounded by forest. Indeed, the percentage cover of old-growth forests surrounding an oil palm estate has been found to significantly increase the number of butterfly species observed within the plantation. Similarly, the percentage of cover of young secondary forests surrounding an estate was found to increase the number of bird species encountered within the plantation (Koh 2008b).

The reviewed scientific literature shows that oil palm plantations are relatively species poor (33% of the number of species found in primary forest) and that the majority of species found in forests (either primary or logged-over) was not present in plantations (Figure 3.9). For example, Chung et al. (2000) found that plant species richness in oil palm plantations was 77.3% lower compared to primary forest and none of these species or families were shared with forest. Although dung beetles were relatively well represented in oil palm plantations, more than half of the species found in oil palm did not occur in forests (Davis and Philips, 2005), which indicates a large shift in dung beetle communities during forest conversion to oil palm. Similarly, for bees it was observed that most species within the family Apidae, which are important forest pollinators, lacked in oil palm plantations (Liow et al., 2001). For birds it seems that no unique species were associated with oil palm plantations. The plantations had about one third of the number of bird species of logged-over forests. All except one bird species in oil palm plantations were also found in logged-over forest. In contrast, lizards seem relatively well represented in oil palm plantations (RSR=83%), sharing 50% of the species with logged-over forest (Glor et al., 2001).

Generally it was found that oil palm plantations are often dominated by a few abundant generalists, non-forest species (including invasive alien species) and pests (Aratrakorn et al., 2006; Danielsen and Heegaard, 1995; Hassall et al., 2006). In Sabah for example, ant fauna in oil palm plantations was dominated by the crazy ant, *Anoplolepsis gracilipes* (Brühl and Eltz, 2009). Beetle communities shifted from predator-dominated in forests to communities with a higher proportion of fungivores and sporophages in oil palm plantations (Chung et al., 2000) and the scarab beetle community in oil palms in Ghana was dominated by invasive savannah species (Davis and Philips, 2005).

Figure 3.9 **Species richness of plants and animals in oil palm plantations relative to primary forests (A) and logged-over forests (B) a)**



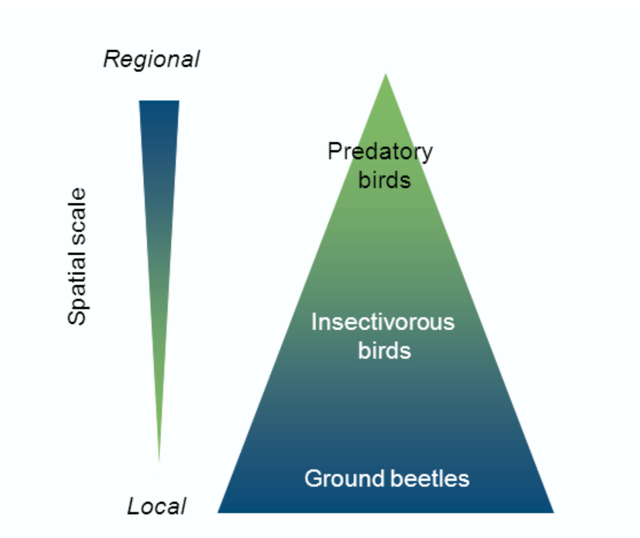
a) RSR=relative species richness; N/A: no information available.

3.6.3 Indirect effects on biodiversity

Most of the studies on biodiversity effects of oil palm plantations are conducted within the plantation area. Therefore, off-site biodiversity effects of large-scale oil palm plantations, such as the influence of drainage and fertiliser and pesticide run-off are as yet poorly understood. These off-site impacts may be particularly high in peat areas that are drained for oil palm. In Central Kalimantan, peat drainage has led to the large-scale drying of peat, in areas far beyond the indicated plantation concessions (Werf et al., 2008; Rieley, 2005). Those areas suffered massive forest loss through drought and subsequent fires. Considering the large-scale conversion of tropical peat lands to oil palm plantations in Malaysia and Indonesia, these effects may seriously threaten the species diversity in remaining forest remnants that form part of the same peat dome. Extensive forest and peat fires ignite every year in Sumatra and Kalimantan, burning down remaining patches of forest and releasing vast amounts of CO_2 into the atmosphere (Hooijer et al., 2006; Page et al., 2002).

Species losses may also occur as a consequence of cascading effects within a food-web. For example the loss of ground beetles may affect insectivorous birds that feed on them, which again may result in lower the abundances of predators of these birds (Chung et al., 2000) (Figure 3.10). This example shows that local changes in species richness at the bottom of the food-web may trigger accumulating losses of species at higher levels within the food-web. In the context of large-scale oil palm development, these accumulating effects may become an important threat to biodiversity conservation in still relatively species rich forest remnants. Such biological impacts may not be easy to assess but it is important to acknowledge that species losses measured on the site may lead to species losses in a wider range around the particular site.

Figure 3.10 **Illustration of indirect effects on biodiversity through trophic interactions**



See text for further explanation.

3.7 Socio-economic impacts of palm oil production in Indonesia

In this section the impact of the development of palm oil production in Indonesia on rural communities is discussed in terms of: (a) employment, (b) income, (c) access to land and (d) health. Where relevant, a differentiation will be made in the type of production region (viz. established, expansion and frontier regions[1]), the social groups involved (original inhabitants and immigrants) and the type of oil palm plantation (small holder production and large-scale private or government estates).

Employment
Oil palm plantations nationwide employ around 2.0m people in Indonesia. Including related industries, around 6m people benefit from the oil palm plantations in Indonesia (Wakker, 2004; Zen et al., 2005). The Indonesian government plans to double the annual production of palm oil over the next ten years, creating new jobs for an estimated 1.3m households and reducing poverty for around 5m people (Bahroeny, 2009). Whether oil palm provide a pathway out of poverty very much depends upon the terms under which small holders engage with oil palm and the dynamics that shape that engagement (McCarthy, 2010). Oil palm plantations are labour intensive and have, therefore, a potential for creating employment for local communities (Bertule and Twiggs, 2009). However, the employment potential is not always realised. Many local communities in the frontier and expansion regions depend for their livelihoods upon shifting agriculture. Companies prefer labourers with experience in sedentary agriculture (WorldBank, 2010). Labour for the oil palm plantations is therefore often 'imported' from Java, where landlessness and poverty drive farmers with experience in the monoculture of rice towards migration to the oil palm regions (McCarthy and Cramb, 2009).

The arrival of plantation workers leads to the development of secondary activities. The construction of infrastructure, houses and health and education services are often initiated in tandem with the establishment of large-scale oil palm plantations (Bertule and Twiggs, 2009). As a result, rural communities have easier access to local markets. However, the large influx of migrants for employment in the oil palm plantations can also cause cultural disruptions that lead to conflicts with and within traditional communities (Sheil et al., 2009; Wakker, 2004; Schrevel, 2008). It has been noted that with the increase of immigrants the culture of community sharing and traditional law systems are getting lost (Colchester et al., 2006).

[1] Following Kessler et al. 2007 Kessler et al. 2007 Kessler et al. (2007) three types of production regions are distinguished: (1) the 'established regions' where palm oil has been produced over a longer period of time and little expansion has taken place, (2) the 'expansion regions' that are characterised by strong expansion of palm oil production and (3) the 'frontier regions' that are characterised by a fast transformation of forests into oil palm plantations.

The labour conditions at the plantations are often described as poor, including payment under minimum wages, poor responses to union requests, unsafe working conditions and forced evictions (Colchester et al., 2006). About half of the plantation workers are day labourers and this percentage has been increasing over the past years. Production targets are high and it is, therefore, not unusual that employees work together with their wife and children to meet these targets. In many cases, workers are not aware of their rights and safety precautions for harvesting and dealing with pesticides are not implemented (Colchester et al., 2006; Sheil et al., 2009).

New employment is not only created by large-scale plantations but also by small holders. The Indonesian government is supporting small holders' palm oil production through various small holder schemes (Vermeulen and Goad, 2006). In Plasma-Nucleus Estate Programmes, small holders transfer part of their land to a company, which transforms the land into a palm plantation. The small holder keeps and manages a part of it. Deals between companies and small holders may differ greatly, but in general a small holder sells ten hectare to a company in turn for 2 ha of palm plantation (Rist et al., 2010). The development of nucleus oil palm plantations supported by individual small holders has been initiated by the Indonesian Government aiming at improving the rural socio-economic situation in the regions concerned (Zen et al., 2005). It is estimated that in 2009 small holders accounted for about 40 per cent of the total national oil palm area (Teoh, 2010).

Income

A study of Kessler et al. (2007) shows that at the regional level there is a rise in GDP in both the expansion and established regions. This study notes, however, an increase of poverty in the frontier regions. Schrevel (2008) observed an increase in poverty for rural communities in the long term. At the farm level, the government's nucleus estates and support to individual small holdings has resulted in a raise in income of more than half a million farmers (Zen et al.). Susila (2004) found that in these estates palm oil production generates over 63% of the farmers' income. The average income for these small holders is seven times higher than the average income of a subsistence farmer (Sheil et al., 2009).

Susila (2004) concluded that there is a positive effect on farmers' income generated by palm oil production which reduces inequality and poverty in the palm oil communities. This conclusion is supported by a recent study of Rist et al. (2010) that documented a strong interest of communities for palm oil plantation as a way to enhance income. However, individual farmer incomes depend upon the amount of debt that a farmer has to pay for the development of the palms on his land, interest rates, time period for repayment of loan, costs for inputs and prices paid for palm fresh fruit bunches. Small holders in nucleus estates often share risks with the company with regard to crop failure (Sheil et al., 2009). They can also be restricted in the choice on how to use the land, for example to apply multi-cropping. Generally, small holders are unaware of the agreements made with the company as they often consent without reading the contract (Rist et al., 2010). The dependence on the company makes small holders economically vulnerable (Bertule and Twiggs, 2009).

Access to land

The development of oil palm plantations requires changes in land use and land use rights, both having direct implications for local communities. Landownership of local communities in Indonesia is generally based on custom and tradition rather than on formal law or contract. Customary landownership is legally recognised, although the procedures to attain an official land title are ambiguous, absent, defective and rarely applied (Sheil et al., 2009). The government frequently allows oil palm plantations on land that is in use of local communities (Colchester et al., 2006; Schrevel, 2008; Wakker, 2004; McCarthy and Cramb, 2009). Competing land claims together with weakly identified and recognised customary land rights held by rural communities have caused severe conflicts and illegal activities. Conflicts arise from unmet promises for development of infrastructure and social facilities by companies, changing land values and unclear tenure rights (Rist et al., 2010). Occasionally companies are blamed for unrightfully occupying land, while the land has been legally sold by community members. This happens without consent or awareness of the entire community.

Illegal activities include the falsification of land permits, occupation of land without permit, no prior consent with communities, compensation not paid or only partly, no recognition of customary laws, use of violence for stopping community resistance, and manipulation of community leaders to sell land (Colchester et al., 2006). All these actions can lead to violent conflicts in which more serious violations of human laws occur. According to the consortium for agrarian reform (KPA) one third of the land conflicts in Indonesia are related to oil palm plantations, in half of which the military was involved. They also noted that between 1998 and 2003 479 people were tortured in 41 conflicts, 12 were killed, 134 shot, 25 abducted and 936 arrested (data by KPA as presented in Colchester et al., 2006).

Human health
Generally, rural communities in Indonesia rely on a diversity of livelihood activities, such as agricultural production of rice, rattan, rubber, tea, cacao and coffee (Wakker, 2004) combined with the gathering of products such as timber, game, medicines, fruits and fish from forests and rivers. The transfer of forests into oil palm plantations indicates a reduction of related environmental goods and services (Rist et al., 2010) and hence a decrease of local food security.

Many peat areas in Indonesia are converted into palm oil plantations (see sub-section 2.6.2). Fires to clear land quickly and to reduce the acidity of peat soils is a common, but an illegal practice among oil palm developers. The smoky haze of these fires causes recurrently respiratory problems and affects the health of people months after the occurrence of the haze (Frankenberg et al., 2005). In 1997 over 20m Indonesians suffered from respiratory problems (WHO, 1998), whilst the costs of health treatments for Indonesians and loss of income from tourism was estimated at USD1.4b (Tacconi, 2003).

Furthermore, the use of mostly very toxic agro-chemicals on plantations combined with low safety precautions form a direct threat to plantation workers' health (Wakker, 2004). The use of agro-chemicals also endangers the quality of the drinking water sources and fish populations on which the communities rely for their livelihood.

3.8 Options for mitigating biodiversity and socio-economic impacts

The global demand for palm oil for food, feed and fuel is expected to increase further as a result of a growing world population, increasing incomes, changing consumption habits and a growing demand for biofuels. This will lead to further expansion of the oil palm plantations and related loss of biodiversity. Recently, Fitzherbert et al. (2008) stated that substantial biodiversity losses will only be averted if future oil palm expansion is managed in such a way that further deforestation is avoided.

A major decision with potential significant effects on biodiversity is the spatial planning of new oil palm plantations. There is general consensus about the potential to focus future area expansion on so-called degraded land, carrying small carbon stocks and low species diversity (Gallagher, 2008; Rötheli, 2008). For example in Indonesia, extensive areas of land have been deforested without further agricultural development. Already in 2003, it was estimated that 12.5m ha of heavily degraded land was available for agricultural development (Casson, 2003). As suggested by several international NGOs and research institutes, the utilisation of these areas for agricultural expansion would minimise the pressure to clear new land (e.g. Sheil et al., 2009; Casson, 2000; Casson, 2007). A field study in Indonesia revealed that grasslands dominated by alang alang *(Imperata cylindrica)* offered the best opportunities for agricultural expansion without significant further losses of biodiversity (Fairhurst and McLaughlin, 2009). Several Indonesian oil palm companies have already experience with alang alang control in new plantations and some field examples show that these idle lands can be made productive with the right measures. However, experience in Indonesia has also shown that many grassland areas are claimed by local people, and the costs of negotiating over land rights may be a significant factor in preventing the use of degraded lands for oil palm plantations (WorldBank, 2010). In addition to that, conversion of forest areas provides initial income from wood production, which is often used to finance plantation establishment, which is not possible in degraded areas.

Remnant forest patches that are still crucial for biodiversity conservation may be identified using integrated land use planning approaches. Several publications have emphasised that remnant forest patches support a great portion of local species richness (Koh, 2008a, b; Peh et al., 2006; Struebig et al., 2008; Turner, 1996). A case study in Sumatra showed that there is considerable potential for enhancing biodiversity, including some Red List species, through the adoption of conservation set-aside policies in palm oil plantations and that there are administrative mechanisms to implement such policies (Bateman, 2009). The involvement of local communities and indigenous peoples in the planning and management of protected areas is an effective way to link conservation and development aims, and is supported by the Convention of Biological Diversity's programme of work on protected areas. Key to the success of this approach is an enabling institutional and legal environment that promotes equitable distribution of costs and benefits and ensures genuine participation of local communities in planning and management.

Oil palm companies could contribute to the conservation of species diversity by preserving large forest fragments in their concession area and connect them with important ecological corridors, such as natural streams within in the plantation and adjacent natural areas outside the plantation. The introduction of integral spatial planning will be instrumental for that purpose.

The introduction of integrated land use planning will be instrumental for that purpose. The RSPO has recently adopted the protection of HVCAs within certified oil palm concessions (see Text box 3.2). For this policy to be effective these areas need to be identified in advance within all areas subject to oil palm expansion, and in due consideration of the needs of local communities, at least when the owners would like to have their produce RSPO certified. Moreover, the establishment of small isolated reserves of HVCAs needs to be prevented. Examples from temperate natural areas have shown that the establishment and protection of ecological corridors may be very successful to facilitate species migration. Corridors can help to mitigate habitat loss by increasing the connectivity between forest fragments and thus increasing the area available to the species. Although there is as yet no evidence that such corridors are successful to protect species in the tropics, the limited available field studies suggest that species richness is significantly higher in areas with close connectivity to natural areas (Bateman, 2009).

Text box 3.2	**High Value Conservation Areas (HCVA)**
The Roundtable on Sustainable Palm Oil proposed to use the concept of High Conservation Value Forests (HCVF) as a tool for optimising land use planning and conservation of biodiversity. The HCVF status can help prioritise different land uses and protect forests that are of high conservation concern for example because they contain high biodiversity values or threatened ecosystems such as a rare class of peat swamp forest. The concept was originally introduced by Forest Stewardship Council (www.fsc-uk.org) for its timber certification scheme but it is now being used for timber purchasing policies, investment safeguard policies and government land use planning processes. A number of HCVF areas in Indonesia and Malaysia have been identified, some of which turned out to be effective and some of which have failed (Ardiansyah, 2006). Both countries developed their own HCVF toolkit, a document in which the criteria and indicators for high conservation value are outlined.	

Another way to reduce the pressure to clear new land is to increase the palm oil yield per hectare. Such enhanced production efficiency may offer a promising way to conserve remaining forests and their biodiversity (Aratrakorn et al., 2006). The scale of the plantation and its management may have a huge influence on how it affects biodiversity. For example, small plantations (less than 10 ha) that form part of a small scale mosaic landscape generally harbour more species compared to larger oil palm estates (larger than 10 ha), especially because they are surrounded by other land uses that offer additional niches.

Shean (2009) estimated that the current average yields of CPO per ha in Indonesia are well below their potential, both for small holders and large scale plantations. It should be possible for small holders to increase the average CPO production from 3.4 towards 5.0 tonnes per ha and for state and private companies from around 4 to 7 tonnes. Such yield increases would further increase total production by over 40% or reduce the area needed by 40%. Given the large share of small holders in the total palm oil production and the large yield differences between independent small holders, supported small holders and large scale estates, improving productivity of independent users could increase the total production in Indonesia by 2m tonnes of CPO per year or reduce the total needed oil palm area by 500,000 ha. This is four times the Dutch gross imports of palm oil from Indonesia.

Key technical measures to improve the productivity in small holder plantation are the use of new high yielding crop varieties and the application of fertiliser. Currently, many of the independent small holders hardly use any fertiliser on their land and the genetic stock growing on their properties is generally inferior to that propagated by private and government estates. According to the USDA (2009), small holder production could increase to at least 5 tonnes CPO per hectare if they would plant high-yielding crop varieties a potential increase of 47% over current levels. To achieve higher yields, these small holders should be supported in making a transition towards higher yielding hybrid varieties, applying fertilisers and overcoming the time lag between planting and the new palms becoming productive.

In Malaysia the total area of small holders in palm oil production is smaller than in Indonesia and also the yield difference between small holders and estates is relatively small. Therefore, the gain from improving small holders' productivity will be smaller in Malaysia. The relative future effect will largely depend on developments in plantation development. If total palm oil production in Indonesia mainly expands based on large scale estates the relative effect of improving small holders productivity will become smaller.

The small holders in palm oil production face many constraints in maximising their potential, which include: (a) uncertainty over land tenure, (b) poor access to loans and credits, (c) lack of technical, policy and market information and (d) high vulnerability to price fluctuations (Vermeulen and Goad, 2006). The Task Force on small holders of the RSPO recognizes the many challenges to ensure that small holders manage and produce crude palm oil in line with the RSPO Principles and Criteria. The theme of the 8th roundtable meeting held in November 2010 in Indonesia was 'RSPO is also for small holders'. Participants raised that certification for small holders goes beyond price premiums and additional support is needed.

In addition to avoided deforestation, also plantation management can significantly affect the suitability of oil palm plantations for certain plant and animal species. Aratrakorn et al. (2006) found that bird species richness in plantations was significantly greater where undergrowth was allowed to regenerate beneath the crop trees, which is largely due to the increased number of insects (Koh, 2008b). Similarly, in a Malaysian oil palm plantation in East Sabah the percentage ground cover of weeds enhanced the species richness of butterflies, and epiphyte prevalence and the presence of leguminous crops enhanced bird species richness.

Specific management efforts to increase biodiversity within oil palm plantations are the application of biological pest controls such as the use of Barn owls to reduce rat abundance, the removal of dead palm stems to avoid the spread of stem rot, the intercropping of cover-crops to increase soil moisture and soil fertility, improved water management and soil preparation, zero-burning and the use of grazing animals such as ruminants to control weeds.

3.9 Synthesis

Oil palm is currently the most rapidly expanding crop in Southeast Asia. Globally it covers over 14.7m ha and is the world's largest source of edible oils together with soya bean (FAO 2010a). The most rapid oil palm expansion has been in Malaysia, Indonesia and Thailand. Indonesia and Malaysia account for 85% of the global palm oil production. It is expected that the palm oil production in both countries will further increase, driven by the large global demand for crude palm oil.

The Netherlands is one of the most important importers of palm oil products. In the period 2007-2009, the Dutch import accounted, on average, for 7% of the total world trade value in palm oil products. For crude palm oil the share of the Netherlands was 15% and for palm oil cake even 23% of the world trade value.

Biodiversity impacts

The production of palm oil has led to a massive clearing of tropical forests and subsequent loss of biodiversity. Due to these large-scale developments, peat swamp forests are one of the most rapidly disappearing ecosystems in the world and with that the habitat for many endangered species, including several

IUCN Red List species. Besides these direct losses, there are also indirect effects of palm oil production on biodiversity, caused by the drainage of peat swamps, peat fires and the use of agro-chemicals. These activities have an impact far outside the oil palm concessions, threatening biodiversity in forest remnants. Although a larger part of the oil palm plantations have been established in lowland tropical forests that have been logged over in the past decades, the impact is yet tremendous. Studies show that most of the species found in oil palm plantations are not found in forests, either primary or logged-over. Plantations are often dominated by a few common species and forest endemics are lost. It is obvious that in case primary tropical forests have been transformed into plantations, the impact on biodiversity is much higher. Many of the species occurring in tropical rainforests have never been described even, and it is likely that most of these will be lost without knowing them.

Socio-economic impacts

Around 6m people in Indonesia benefit from palm oil production, of which around 2m in oil palm plantations. Palm oil production has a positive effect on farmers' income and reduces inequality and poverty, hence leading to a strong interest of communities for palm oil plantation as a way to enhance income. The socio-economic impacts of oil palm plantations, however, differ between the regions and type of plantation. In the so-called nucleus oil palm plantations, for instance, the dependence on the core company makes small holders economically vulnerable. There are also regional differences, depending on the pace of the expansion of oil palm production and the extent to which forests are transformed into oil palm plantations in a specific region. Palm oil production can provide employment opportunities for existing rural communities, but in areas where shifting cultivation agriculture is dominant, labour is often 'imported' from other regions, such as Java and Papua. In that situation, the income of the immigrants rises in contrast to that of the original inhabitants.

Palm oil production provides an attractive income opportunity for small holders, but their position is often weak due to not well identified or recognised customary land rights, the dependence on the nucleus companies and the often limited knowledge of the signed nucleus estate contracts.

The Indonesian government plans to double the annual production of palm oil over the next ten years, creating employment and reducing poverty for around 5m people. However, the trade-off between oil palm expansion and the environment largely depends on where the oil palm is planted. A key challenge for Indonesia is guiding the development of new palm oil plantations into areas where the environmental impact is minimised and where there are either no land claims by local people or where local people have an interest in developing oil palm plantations.

Estimate of the land area used for Dutch import of palm oil from Indonesia and Malaysia

Although there are many studies describing the impact of deforestation on biodiversity, it is difficult to quantify the impact and to link it to the area of plantations needed for the Dutch import of oil palm products. The total production of crude palm oil in Indonesia is estimated on roughly 26.5m tonnes per annum in the period 2007 -2009, of which only 0.5m (2.0 %) destined for the Netherlands. The CPO production of Malaysia is estimated on 17.4m tonnes, of which 1.0m for export to the Netherlands, which is 5.8%. The percentages above can be considered as proxies for the share of the Netherlands in the loss of biodiversity in Indonesia and Malaysia. For a small country as the Netherlands is, these figures are considerable, as it can be illustrated by the fact that the import of palm oil products from these two countries is equivalent to an estimated area of 387,000 ha, which is 20% of the total Dutch agricultural area. It should, however, be noted that a large part of the imported palm oil products is re-exported, after processing, so the net impact of the Netherlands is much smaller.

Options for mitigating biodiversity and socio-economic impacts

The global demand for palm oil for food, feed and fuel is expected to increase further as a result of a growing world population, increasing incomes and changing diets and a growing demand for bio-energy as well. It is, however, not necessary to clear tropical forests in the same pace. Millions of hectares of forest in Indonesia have been transformed into oil palm plantations, but there are also millions of hectares cleared without realising the planned oil palm plantations. These left-over so-called 'degraded forest' areas offer good opportunities for oil palm expansion without significant further loss of biodiversity. Plantations will likely have positive impacts on biodiversity in these areas.

Oil palm companies could contribute to the conservation of species diversity by preserving large forest fragments in their concession area and connect them with important ecological corridors such as natural streams within in the plantation and adjacent natural areas outside the plantation. The RSPO has recently adopted the protection of High Value Conservation Areas (HVCA) within certified oil palm concessions. The introduction of integrated land-use planning could be instrumental for that purpose. The involvement of local communities and indigenous peoples in the planning and management of protected areas is an effective way to link conservation and development goals.

Increasing the palm oil yield per hectare is another option to reduce the pressure to clear new forest land and, hence, offer a promising way to conserve remaining forests and their biodiversity. Given the large share of small holders in palm oil production in Indonesia and the large yield differences between independent small holders, supported small holders and large scale estates, improving productivity of independent producers could increase the total palm oil production by 2m tonnes of CPO per year, hence, reducing the needed area of oil palm in Indonesia by an estimated half a million hectares.

Other, management related measures can also lead to decreasing the environmental impact of the plantations, such as zero-burning policy, biological pest control, improved water management and soil preparation.

4 Tropical timber

4.1 Introduction

The increasing world population in combination with an increasing income, will lead to increasing worldwide demand for wood. About 30% of the world's forests are designated for production of wood and non-wood forest products, while an additional 24% is designated for multiple uses including wood production (FAO, 2010b). Brazil, Malaysia and Indonesia are the major exporters of tropical timber and wood products, while China and the European Union are key importers. Future export of wood from Malaysia and Indonesia to the EU is expected to become affected by a number of key factors, which include amongst others: (a) the declining natural resources in these countries and the implementation of associated Sustainable Forest Management (SFM) policies, limiting the amount that can be produced in these countries, (b) the increasing demand for wood products from China, (c) the increasing log export duties in Russia, further increasing Chinese demand for wood from other regions, in particular South-East Asia, and (d) the stricter timber procurement and certification policies of importing countries in the EU, which may constrain the demand for wood and wood products from Indonesia and Malaysia if the criteria for certification cannot be met (CIFOR, 2008). Another important factor may be the implementation of the Reducing Emissions from Deforestation and Forest Degradation (REDD) mechanism under the Kyoto Protocol.

With the aim of promoting sustainability of wood from tropical regions, the EU launched an action plan to restrict the amount of illegal timber entering the EU through Voluntary Partnership Agreement (VPA) with the exporting countries (see Text box 4.1 about FLEGT). In November 2010 the EU published its new Regulation on Timber which prohibits placing of illegally harvested timber on the market.[1]

[1] European Commission, REGULATION (EU) No 995/2010 of the European Parliament and of the council, Official Journal of the European Union, 12/11/2010 of 20 October 2010, laying down the obligations of operators who place timber and timber products on the market (www.eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:295:0023:01:EN:HTML).

Text box 4.1	EU Forest Law Enforcement, Governance and Trade (FLEGT)

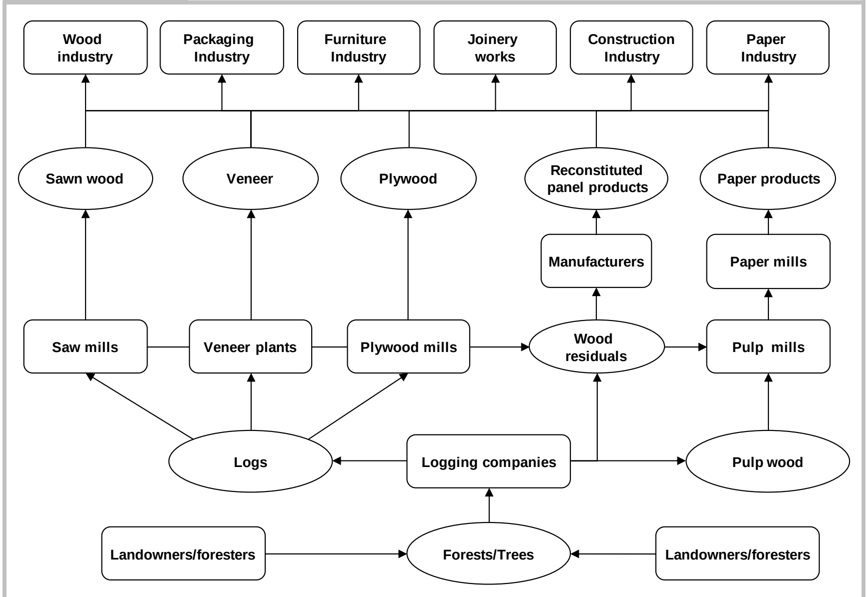
In response to concerns about the negative social and environmental impacts of large scale illegal logging in tropical countries, in 2003 the European Commission (EC) adopted an action plan for Forest Law Enforcement, Governance and Trade (FLEGT). This EU FLEGT initiative (2003) intends to halt the trade in illegal timber, to support sustainable forest management and to implement a transparent and accountable tracking and licensing system. Under the 2005 EU regulation for a FLEGT licensing scheme, timber exporting countries, among which Indonesia and Malaysia, negotiate with the European Union a Voluntary Partnership Agreement (VPA) for imports of timber into the European Community. A key element of the FLEGT regulation is that each shipment of timber must be covered by a license issued by an authority in the country of origin before being released into free circulation in the EU.

The FLEGT action plan further provides for governance reforms and capacity building in the VPA countries. The EU has been negotiating VPA's with Cameroon, Ghana, Congo, Indonesia, Malaysia and Viet Nam, while other countries like Bolivia, Liberia, and Gabon have expressed interest in developing voluntary agreements. The first agreements have been signed with Ghana, Congo and Cameroon.

A number of EU member states are putting into effect stricter timber procurement policies focusing on certification. The governments of these countries have developed sets of criteria for legality and sustainability (e.g. CPET, 2010; TPAC, 2008) against which forest certification schemes are assessed by independent committees, such as the Central Point of Expertise on Timber Procurement (CPET) in the UK, and the Timber Procurement Assessment Committee (TPAC) in the Netherlands. In the Netherlands, from 2010 onwards, all wood and wood based products procured by the national government need to meet these sustainability criteria. In practice, certification of wood products is one of the most important instruments to achieve a sustainable wood chain. Many different certification schemes are currently in use. Besides many different national certification schemes, there are two key global schemes that include national certification standards, viz. the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC) schemes.

The following sections start with a description of the developments in the global trade in wood and wood products and the Dutch trade position. The paper chain as depicted in Figure 3.1 was not included in the analysis. The major part of this chapter is focussed on the trade relations between the Netherlands and Indonesia with respect to tropical timber and the related impact on biodiversity and the social economic situation in the production areas in Indonesia. This chapter will end with a synthesis of major findings.

Figure 4.1 Schematic outline of the wood supply chain



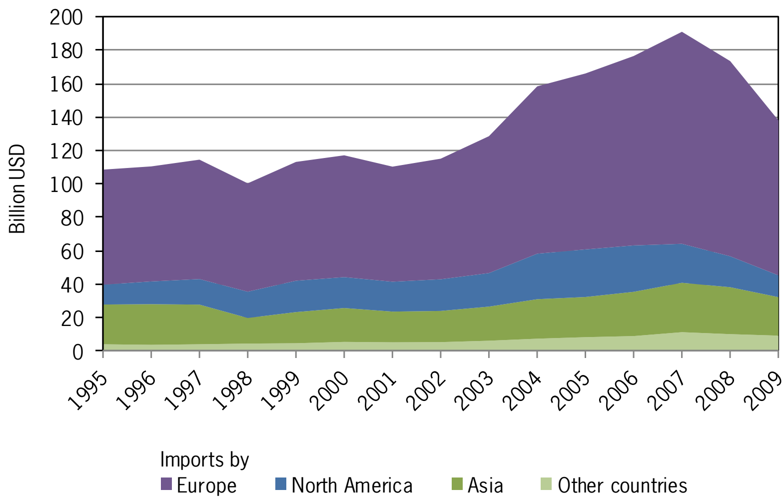
4.2 Global trade in wood and the Dutch trade position

4.2.1 Development of global trade in wood and wood products

In the period 2001 to 2007, the total world trade in wood and wood products grew very fast, almost doubling from USD63b towards USD120b. However, after that, the total trade decreased to the level of 2004, because of a sharp drop in demand in Europe and North America caused by the economic crisis[1] (see Figure 4.2).

[1] The trade figures of UN Comtrade used in this chapter refer to HS code 44 - Wood and articles of wood; wood charcoal; paper and paper products are not included in these figures.

Figure 4.2	World trade in wood and wood products 1995-2009

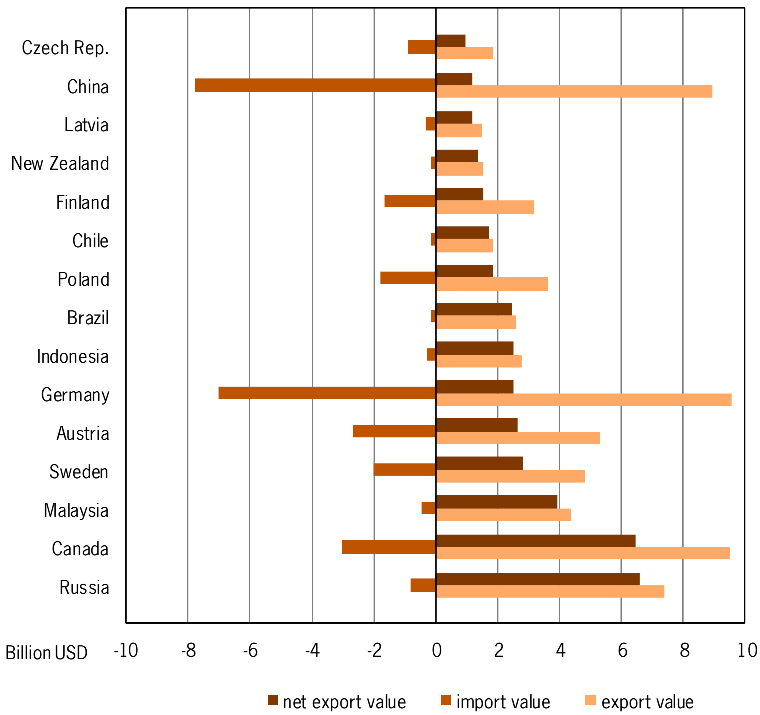


Source: Based on import data in UN Comtrade, LEI.

The three most important exporting countries of wood and wood products are Germany, Canada and China, with respectively 8.9%, 8.9% and 8.3% of the total world trade (See Figure 4.3 and Table 4.1).

Thereinafter follow the Russian Federation and the US, with an export value of 6.9% respectively 5.9% of the total world trade. Malaysia, Indonesia and Brazil are in a group of countries with a world trade share of 2% to 5%. The total export value of a country does also include wood and wood products that have been imported and then processed and re-exported. Figure 4.3 shows the role of China and Germany as the most important import based 'furniture factories' in the world. Russia and Canada are the world most important wood exporting countries, with a net export value of about USD6.5b. Malaysia, Indonesia and Brazil are the most important exporters of tropical wood and wood products with a net export value of USD3.9b, USD2.5b and USD2.5b.

Figure 4.3 **The most important export countries of wood and wood products (average 2007-2009)**



Source: UN Comtrade, LEI.

The European Union is a large player in the world wood trade: the share of the EU-27 in the world import value of wood and wood products is 45.6% (see Table 4.1). The importance of the EU for the top 15 wood exporting countries varies significantly. Most EU-countries, mentioned in table 4.1, export around two thirds to other EU countries, but the EU imports take only 6% of the total export of Canada, being the second largest wood exporter of the world, and one third of the total exports of the Russian Federation and China, the other two top exporters. The EU accounts for 46% of the total wood export of Brazil, 28% of Indonesia and 16% of Malaysia.

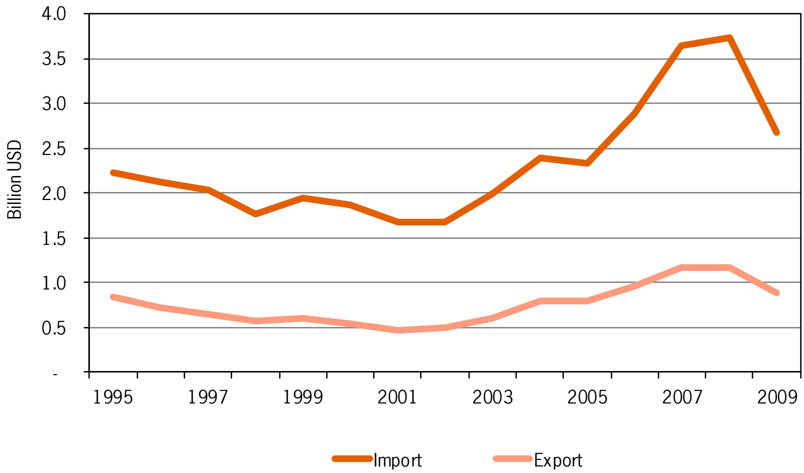
Table 4.1	Share of the EU-27 and the Netherlands in the total export of wood and wood products of the top 15 exporting countries (average 2007-2009)			
	Total export value	Share in total export	Share in total export by country	
			EU-27	Netherlands
	billion USD	%	%	%
World	107.3	100.0	45.6	3.1
Germany	9.5	8.9	70.0	6.1
Canada	9.5	8.9	6.0	1.1
China	8.9	8.3	32.7	2.5
Russian Federation	7.4	6.9	34.7	1.3
USA	6.4	5.9	18.0	0.7
Austria	5.3	4.9	67.6	1.3
Sweden	4.8	4.5	57.7	4.8
Malaysia	4.4	4.1	16.4	4.9
Poland	3.6	3.4	66.3	1.6
Belgium/Luxembourg	3.3	3.1	68.2	14.6
France	3.2	3.0	63.4	5.1
Finland	3.2	3.0	66.1	5.4
Indonesia	2.8	2.6	28.4	6.0
Brazil	2.6	2.4	46.2	4.1
Italy	2.1	1.9	52.3	1.0
Sum of 15 largest exporting countries	77.0	71.8	42.6	3.6
Other countries	30.3	28.2	53.3	2.0

Source: UN Comtrade, LEI.

4.2.2 The Dutch position in the global wood trade

The import of wood and wood products by the Netherlands follows largely the developments in global trade. However, a comparison of Figure 4.2 and Figure 4.4 show that in the period before 2007 the Dutch imports grew faster than global trade. The Netherlands accounted for 3.1% of the average annual world trade in the period 2007-2009 (Table 4.1).

Figure 4.4	Development of the Dutch import and export of wood and wood products



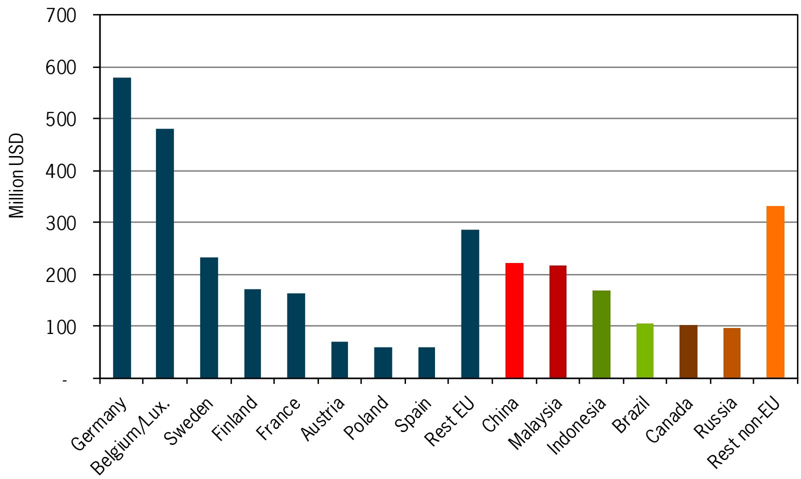
Source: UN Comtrade, LEI.

The major part of the imported wood and wood products of the Netherlands is from the European Union, in particular from the neighbouring countries Germany and Belgium, in total 63% of the average annual import value in the years 2007-2009. Of the remaining 37%, one third is tropical timber imported from Malaysia, Indonesia and Brazil. The rest is mainly imported from China, Russia and Canada (See Figure 4.5).

Dutch import of tropical timber

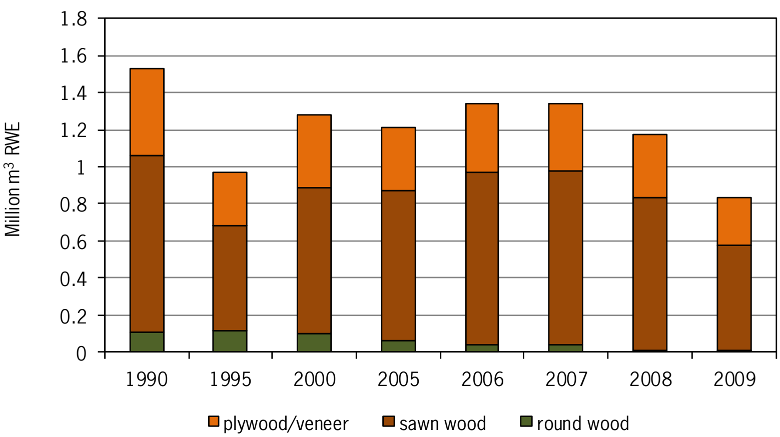
From 2000 onwards the total import of tropical timber by the Netherlands was around 1.3m m^3 RWE (Round Wood Equivalents), but due to the economic crisis the imports decreased with 40% to 0.8m in 2009 (Figure 4.6). The average import volume over the years 2007-2009 was about RWE1.1m with a value of USD0.7b.

Figure 4.5 **The most important countries of origin of Dutch imports of wood and wood products (average 2007-2009)**



Source: UN-Comtrade, LEI.

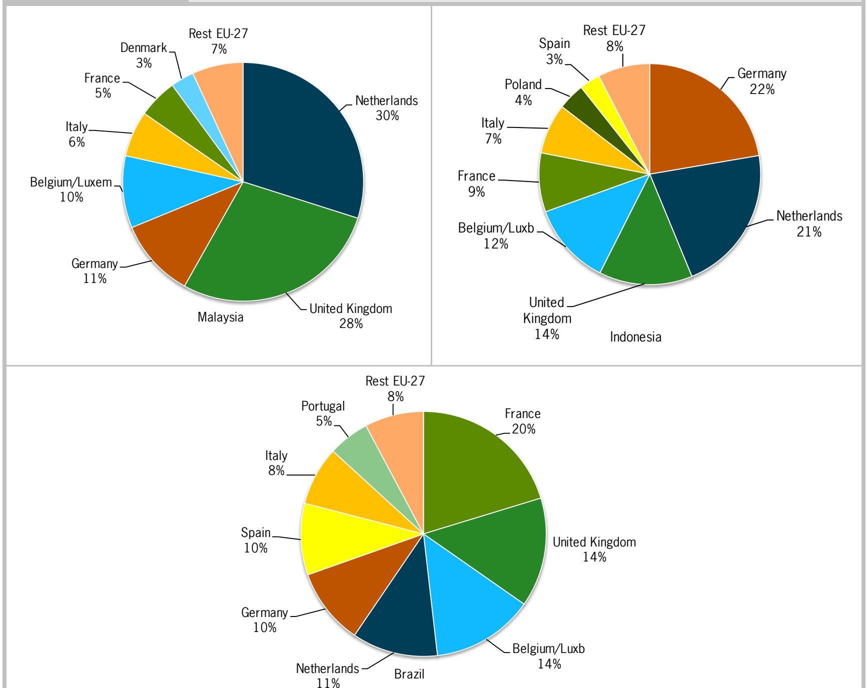
Figure 4.6 **Dutch import of tropical timber by type**



Source: PROBOS (2010).

The major part of the tropical timber is imported from Malaysia, Indonesia and Brazil. The Netherlands is an important entry point for tropical timber to the European Union. Based on the average annual export value over the period 2007-2009, 30% of the total wood export of Malaysia entered the EU via the Netherlands. The second importing EU country is the UK with 28% (see Figure 4.7). For Indonesia, Germany and the Netherlands are the major destinations in the EU, with a share of 22% respectively 21%. For Brazil, the Netherlands is less important (9%). France, the UK and Belgium account for almost half of the Brazilian wood export to the EU.

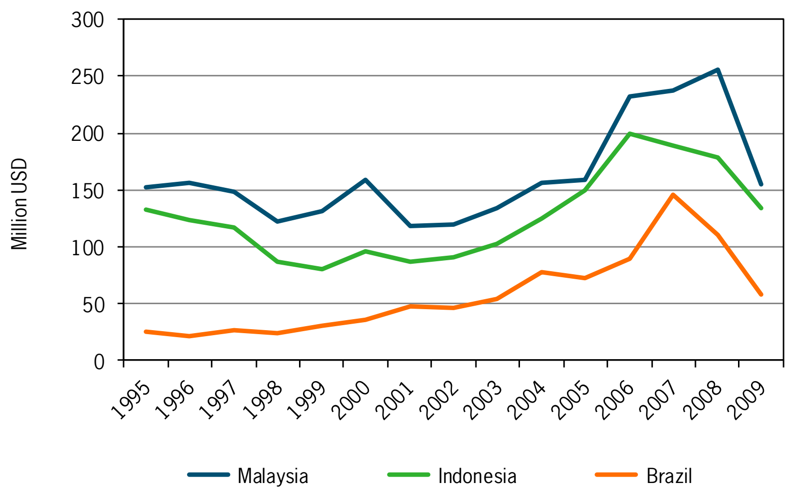
Figure 4.7 Export of wood and wood products from Malaysia, Indonesia and Brazil to the EU-27 in million USD (average 2007-2009)



Source: UN-Comtrade-LEI.

The Dutch imports tropical timber from Indonesia and Malaysia show a steady grow since the year 2000 (Figure 4.8). After a growth from USD150m in 2005 towards USD200m in 2006, the imports from Indonesia started to decline to about USD134m in 2009. The Dutch imports from Malaysia surged from USD158m in 2005 towards 256m USD in 2008, but dropped with around USD100m in the following year. The last year decrease is caused by the global economic crisis, which also severely affected the wood imports from Brazil. The import value from Brazil fell back from almost USD146m in 2007 towards 58m in 2009.

Figure 4.8 **The import of the Netherlands of wood and wood products from Malaysia and Indonesia (1995-2009, in million USD)**



Source: UN-Comtrade, LEI.

4.3 Future trade developments

As shown above, the market of wood and wood products is severely affected by the financial and economic crisis that started in 2008 with the crash in the housing market in the USA. The residential housing starts in the USA fell from over 2.2m units in 2006 till about 0.5m in 2009. The UNECE timber committee expects in its statement on forest products markets 2010, that the bottom of the downward trend has been reached. The demand for wood products is growing again but a full recovery is not expected before the housing markets starts to recover.

The market for tropical timber was less influenced by the crisis, partly because the major part of the tropical timber is traded within the timber producing regions of Asia and South America and these regions are less affected by the economic crisis than Europe and the USA. For example, 60% of the global trade in tropical sawn wood is within the Asian region. However, the declining demand in the USA, Japan and Europe did have a severe impact on the Chinese wood processing industry, which was strongly affected by the contracting consumption in the USA, Europe and Japan. China succeeded in limiting the impact of the financial crisis on its economy by huge financial interventions and, hence, supported its timber and furniture industry, but that did not prevent a downturn in the import of tropical timber. On longer term, however, a recovery of the global economy is expected leading to a growing demand for tropical timber.

Besides the financial and economic developments, the market of wood and wood products will be influenced by the climate change policies and the policies to reduce illegal logging. The policies to decrease the greenhouse gas emissions and to use renewable energy sources will have a positive impact on the demand for forestry products.

The policies to combat illegal logging by the major importing countries, in particular the EU (FLEGT initiative) and the USA (Lacey Act Amendment) are expected to have increasing implications for producers and traders of wood and wood products. The certified forest area is increasing, but it concentrates on Europe and North-America, representing more than 90% of the global certified round wood supply. One of the major challenges for the future is to extend the legal timber certification schemes to the major tropical timber producing countries.

4.4 Land area used for Dutch import of tropical timber from Indonesia

In this section an estimate is made of the land area that is needed for the Dutch import of wood and wood products from Indonesia. Starting point for the calculations are the above import figures combined with estimates of yields per hectare for different production regions and logging systems. For most tropical countries no extensive forest and logging data are available or easy accessible. For that reason the projections in this report are based on data on management types, harvested areas, timber yields, losses, damage and growing stock in separate scientific publications, which generally relate to smaller area or regions within a country. The relative figures in these studies are used for up-scaling to larger areas and to the country level.

4.4.1 Introduction to wood production methods

Forest management and logging systems have a considerable influence on the net wood production per hectare and, hence, on the forest area needed for Dutch timber import. To take into consideration different intensities of wood production, four different management types in industrial round wood production are distinguished: (a) clear felling, (b) conventional selective logging (CL), (c) selective logging with application of reduced impact logging techniques (RIL) and (d) wood production in wood plantations.

In many tropical countries timber is extracted from the forest through selective logging, i.e. in a given forest area only a small number of trees of commercial value is harvested. Under selective logging usually the number of harvested trees is rather low, but the damage to the remaining forest stand may be considerable. Under the name Reduced Impact Logging (RIL), during the last decades a number of (combinations) of measures have been developed with the purpose to minimise the damage to the residual forest, in particular to trees suitable for harvesting in the future. During CL those precautionary measures are not taken. Although RIL is an emerging harvesting system that receives a lot of attention by forest researchers, its implementation beyond pilot and research-scale experiments is modest. Hence, in contrast to CL, data on RIL are mostly based on experimental harvesting under controlled conditions.

Although the difference in harvested volumes per area is generally not large between CL and RIL, the difference in damage to the forest may be considerable (e.g. Sist and Nguyen-The, 2002; Sist et al., 1998). In this study it is assumed that the produced volumes are similar for CL and RIL. Yet, because, in general, the harvesting losses and damage to the residual forest for RIL is half those for CL, the total volume felled under RIL is considerably lower than the total volume felled or damaged under CL. Therefore, higher yields can be sustained by using RIL techniques compared to CL.

In general, Indonesian forests support a relatively high abundance of commercial timber species compared to other tropical forests, like for example in the Amazon. As a consequence, a considerable part of the total timber volume produced in Indonesia comes from clear-felling. However, with decreasing availability of accessible, mature natural forests, commercial tree plantations are becoming ever more important for timber production in Indonesia.

4.4.2 Major timber production areas and methods in Indonesia

Illegal logging is a vast problem in Indonesia and may account for a two to four times bigger volume of timber produced than reported in the official country statistics (Brown, 2002, Contreras-Hermosilla, 2005). Production statistics for Indonesia are usually not incorporating the total domestic production. For example the total timber volume produced in 2001 reported by the Indonesian Department of Forestry was based on the projected log consumption of reporting large sawmills only (Brown, 2002). The definition of a large mill is one with a licensed production capacity of over 6,000 cubic meters per year. There are thought to be about 425 such mills in the country, of which only 217 did report to the Department's Directorate of Timber Processing and Marketing (Brown, 2002). Production statistics therefore vary from 25m m^3 round wood equivalents (RWE) (IDF) to 74m m^3 RWE (Brown, 2002).

More than half of the total timber volume legally produced in Indonesia in 2006 originated from timber plantations and about 46% from natural forest (APHI, 2009). Most of this wood came from Sumatra, where 12.7m m^3 of timber was produced in 2006 (Table 4.2). Riau Province, of which 7.6m m^3 in the major part of the production coming from plantations with fast growing timber species such as *Acacia mangium*. Kalimantan was the second largest production region with a volume of 5.8m m^3 in 2006. Here, most of the wood comes from selective logging and clear felling of native forests. The number of timber plantations in Kalimantan, however, is rising and the role of plantations is likely to increase as natural forest cover is diminishing. On Java, the timber produced is from private native forests and state-owned teak *(Tectona grandis)* plantations. West Papua is also an important producer (1.2m m^3 in 2006), mainly by selective logging and clear-felling but increasingly from commercial timber plantations, which are being established to meet future demand for timber. The Moluku Islands produced some 0.6m m^3 of timber in 2006, mainly from selective logging.

Table 4.2	Log production (1,000 m^3 RWE) in Indonesia in 2006, by region and source of production							
Province	**Natural Forest**				**Forest Plantations**			**Total**
	selective logging	**clear felling**	**private native forests**	**total natural forests**	**teak**	**private**	**total plan-tation**	
Sumatra	205	1,703	14	1,922	0	10,771	10,771	12,693
Java	0	0	968	968	338	0	338	1,306
Nusa Tenggara	0	25	0	25	0	0	0	25
Kalimantan	3,549	1,584	0	5,133	0	664	664	5,796
Sulawesi	122	0	0	122	0	0	0	122
Moluku Islands	522	51	0	573	0	16	16	589
Papua	1,189	71	0	1,261	0	0	0	1,261
Total	5,587	3,434	982	10,003	338	11,451	11,789	21,792

Source: APHI (2009).

The figures reported by the Association of Indonesian Forest Concession Holders (APHI 2009) were used to assess the shares of different forest management types in the production for export to the Netherlands. It was assumed that these shares are proportionate to the production methods in the total Indonesian log production, except for the production from private native forests, which is assumed to be largely used for local consumption. The remaining timber is harvested from timber plantations (56.7%) and natural forests, through selective logging (26.8%) or clear felling (16.5%) (see Table 4.2 and Table 4.4).

4.4.3 Average yields by forest management type

Estimates for timber plantations

In 2005, the most important timber species used in Indonesian forest plantations were teak (*Tectona grandis*, 37%), *Acacia mangium* (26%), *Pinus merkusii* (20%), *Acacia* ssp. (3%), *Agathis* ssp. (3%), and mahogany (*Swietenia macrophylla*, 3%) (see Table 4.3). Teak plantations form the oldest commercial timber plantings in Indonesia, with some of them over 100 years old. Most of these plantations are state-owned. Teak has a long rotation length (at least 40 years) compared to fast growing timber species such as *Acacia* ssp. and *Pinus merkusii*. In 2006 however, only 9% of the teak plantations was mature (FAO, 2006), resulting in a relatively low contribution to total plantation output.

High yielding timber species are those with indicated short minimum rotation cycles in Table 4.3. Their mean annual increment may reach up to 24 m^3 per ha per year *(Acacia mangium)* or even 53 m^3 per ha per year *(Paraserianthes falcataria).* Combining the information for fast and slow growing deciduous and fast growing coniferous plantation species, the average yield per ha of plantation was estimated to be 182m^3 per ha out of 222 m^3 felled volume in 2005. The highest maximum yields have been reported for *Agathis* ssp (250 m^3 per ha) and *Pinus merkusii* (197m^3 per ha), both species with a low wood density. The predominant purpose of the industrial timber plantations is the production of sawlogs (43%) and pulp/fibre (35%) (FAO, 2006).

Like oil palm estates, many of the large-scale timber plantations are being established in areas with lowland rainforest vegetation, and some of them in peat swamps that need to be drained to grow harvestable timber. Some plantations in Riau Province have experienced an excessive soil subsidence of more than 10 cm per year (Wösten, pers. com.). It shows that timber plantations on peat may be a risky investment, especially for species with a long rotation because some areas may subside below sea level on relatively short term (30-50 years).

Table 4.3 **Timber species most frequently used in commercial timber plantations in Indonesia by 2005**

Species planted	Share in plantations	Mean annual increment (m^3 per ha per year)		Rotation (years)	
	%	minimum	maximum	minimum	maximum
Tectona grandis	37	12		40	80
Acacia mangium	26	19	24	6	10
Pinus merkusii	20	2	14	10	50
Acacia spp.	7		19	6	8
Agathis spp.	3	20		25	35
Swietenia macrophylla	3	15		40	50
Paraserianthes falcataria	1	19	53	6	10
Albizia sp.	1		19	6	8
Eucalyptus sp.	1		19	6	8
Other	1		19	6	8

Source: FAO (2006).

The data from the FAO Forest Resources Assessment 2005 (FAO, 2006) and the country report for Indonesia (FAO, 2005) have been used for estimating the total round wood production and the corresponding area natural and planted forests. The low values for production in 2005 in the FRA2005 data are probably an underestimation as a result of deficient reporting since the decentralisation of the forestry system in Indonesia in 1999 (see Brown, 2002). Therefore, the data from FRA2005 have been adjusted based on the relative difference between the 2000 and 2005 production data in FAOstat (FAO, 2008), showing that the production of industrial round wood in 2005 was 97% of that in 2000. In general the production statistics as reported by Indonesia appear to be rather unreliable; illegally harvested volumes appear to be more than double the official statistics (Brown, 2002; Freezailah et al., 2002).

Estimates for selective logging

The estimates of felled volumes per hectare for the different production methods are based on values in scientific literature. However, the values reported in different studies in the same regions often show large variations. These variations are due to combinations of differences in methods of experimental harvesting, variation in harvesting practices by different logging companies and by variations in available figures about commercial volumes of wood in forests. The harvested volumes presented in different studies on selective logging (both RIL and CL, see FAO, 2004) widely vary, from 30 to 250 m^3 per ha. Most reported average harvests are, however, around 40-80 m^3 per ha. Therefore, 60m^3 per ha is used to estimate the area that is selectively harvested for wood production for the Dutch market we therefore used 60 m^3 per ha. The differences in harvested volumes between CL and RIL are usually small, but in forests harvested according conventional practices (CL), losses amount to about 55% of the harvest while these losses are halved using RIL techniques (FAO 2004). Taking into account the harvest losses as indicated in FAO (2004), the estimated volume felled per hectare is 93 m^3 over bark (o.b.) per ha for CL and 76 m^3 o.b. per ha for RIL.

Estimates for clear-felling

According to FAO statistics (FAO, 2004), the total volume of commercial trees per hectare varied between 83 and 125 m^3 under bark (u.b.) per ha. Therefore, in the calculations for this report, the midpoint between these two values, 104 m^3 per ha, has been used as the produced volume per hectare for clear-felling.

4.4.4 Estimated area used for Dutch timber imports from Indonesia

The Netherlands imported in the period 2007-2009 on average around 200,000 m^3 RWE per year from Indonesia, mostly as plywood, sawn wood and pulp. It is assumed that the Dutch import originated from different sources and that the share of the different management and logging systems in the imports are equal to the share of each system in the total timber production of Indonesia as depicted above. For example, 24.6% of the total wood production in Indonesia is estimated to be harvested under CL, so the same percentage of the Dutch import from Indonesia is assumed to originate from CL. The figures used for these calculations are based on the situation in 2006 (see Table 4.2).

According to ITTO (2006), 6% of the natural forest area is under sustainable forest management, presumably at least following basic principles of RIL (see 4.4.2). Because the differences in yield per ha, 60 and 104 m^2 for RIL respectively clear felling, the share of RIL in the total wood production is 2.2%. Therefore RIL was assumed to be practiced for 2.2 % of the wood exported to the Netherlands.

Based on these assumptions, the area of natural forest needed to produce the annual Dutch import in the period 2007-2009 was 1.833ha, of which the majority was produced with CLT (820 ha) and a small amount following RIL standards (73 ha). Some 317 ha of forest were clear-felled and the remaining 623 ha were timber plantations (Table 4.4).

In contrast to the other two commodities, soya and palm oil, wood is not an annual crop that can produce similar yields on the same hectare year after year. To give the forest the possibility to replenish the timber stock, long periods of time are needed between two harvests. Ideally, the time in between two harvests (felling cycle) is sufficiently long for the forest to recover and sustain similar yields over long time periods. The (sustainable) felling cycle depends on tree species, local growing conditions, and logging method. To compare the areas needed for wood imported by the Netherlands with the other commodities, the areas need to be multiplied by the length of a (sustainable) felling cycle to give the area claimed for (sustained) Dutch wood production over longer time periods. To calculate this area needed for sustained yields the following felling cycles were assumed: CL 60 years, RIL 40 years (based on Sist et al., 2003a; Van Gardingen et al., 2003) and clear felling 100 years, which is a rough estimate and not likely to result in completely sustained yields. For plantations, the rotation cycle was estimated at 33 years, based on the average rotation for the various species and the share of the different plantation species (Table 4.3). On this basis, the annual forest area of 1,833 ha needed in Indonesia for wood exports to the Netherlands, leads to a claim on 104,426 ha of forest for a sustained future production.

It need to be noted that these estimates include only timber that was directly imported (and registered) from Indonesia to the Netherlands. Timber that has been imported to the Netherlands through other countries, such as Belgium, Singapore, China and Malaysia is not included. Some sources indicate, however, that this may involve considerable volumes (AidEnvironment, 2009).

Table 4.4 **Share of management type in total production, Dutch import volumes (m^3) and corresponding area (ha) needed to produce these volumes of timber from Indonesia (2007-2009)**

	CL	RIL	Clear felling	Plantation	Total
Share in wood production in Indonesia (%)	24.6	2.2	16.5	56.7	100
Average yield per hectare (m^3 per ha)	60	60	104	182	
Annual Dutch import in 2007/2009 m^3 RWE)	49,200	4,400	33,000	113,400	200,000
Corresponding forest area (ha)	820	73	317	623	1,833
Forest felling cycle (years)	60	40	100	33	
Forest area claim for sustained yields (ha)	49,200	2,933	31,731	20,562	104,426

CL = Conventional Selective Logging; RIL = Reduced Impact Logging.

4.5 Biodiversity impacts

4.5.1 Direct effects on biodiversity

The impact of timber production on biodiversity depends mainly on differences in production methods. As presented above, 57% of the legal timber production in Indonesia comes from plantations, 27% results from selective logging, either CL or RIL and 17% from clear-felling. Several publications have shown that the diversity of species is clearly diminishing along a gradient from near primary forest via logged forest to agro-forestry and annual crop systems (Schulze et al., 2004). Logged forests also support fewer species than primary forests, but their species richness is still far above the values reported for tree or agricultural crop plantations. Species respond differently to selective logging as it may leave behind a highly heterogeneous environment in which some species will thrive and others will decline. Environmental changes following logging in Central Kalimantan for example induced a shift in feeding guilds of bird species; canopy gleaning species and terrestrial insectivores were negatively affected whereas understory birds increased in abundance (Cleary et al., 2007).

Primary and near-primary forests contain the highest biodiversity for most species groups (e.g. Dennis et al., 2008; Fredericksen and Putz, 2003). Nevertheless, secondary forests supported high numbers of understory plants, birds, and butterflies and agro-forestry systems did support relatively high numbers of butterfly species (Schulze et al., 2004). Some studies showed that bees and arthropods were observed more frequently in logged forest compared to primary forest (Figure 4.5). This might be explained by the change in micro-climate that stimulates growth of flowering plants in the forest understory and the increase in course woody debris following logging (Liow et al., 2001; Turner and Foster, 2009).

Additionally, more primate species were found in logged-over and secondary forests. This may suggest either that primates prefer (lightly) logged forest as a habitat type or that primates are forced to extend their range as food sources become scarce due to forest degradation and fragmentation. The higher primate richness observed could however also be the result of a sampling bias, since monkeys are easier to spot in more open forests. Overall, species diversity in selectively logged forests is about 88% of the richness found in primary forest[1] (see Figure 4.5). The variation that was observed in logged forests was, however, very high, probably as a result of high variation in the degree of disturbance, i.e. it includes both heavily and recently logged forest as well as forest that was logged longer ago and at lower intensities. Furthermore, the monitored species groups and methods used were not precisely similar in the studies that were used in this review.

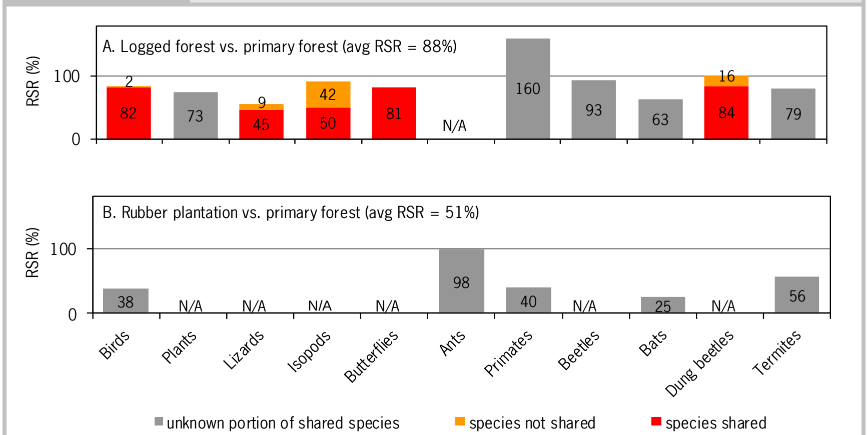
The number of original species (i.e. primary forest species) is still considerably high in selectively logged forests, as opposed to timber plantations. Timber

[1] It is important though to mention that the RSR does not incorporate the abundance of species. When for example more primate species were found in secondary forest compared to primary forest, their populations may have been much smaller. Unfortunately, abundance of species is often not known, although it is an important component of biodiversity.

plantations are dominated by a few common species of low conservation concern, comparable with oil palm plantations. Based on five species groups, the average relative species richness is 51% in rubber plantations versus primary forest. The number of shared species in both systems is still undocumented.

So far, only few studies have examined the effects of RIL on biodiversity. It has been shown that RIL significantly reduced skidding damage compared to conventional logging, but as felling intensity increases the positive effects of RIL become negligible and additional silvicultural rules are needed (Sist et al., 2003b). It is likely that the damage induced by logging operations brings about a shift in species composition, but it is not yet determined whether the overall biodiversity would increase by RIL compared to CL. Species compositions have indeed changed in RIL concessions compared to CL concessions and positive effects were seen for bats (Castro-Arellano et al., 2007), dung beetles (Davis, 2000), mammals, soil macro-fauna, flying insects and trees (Mannan, 2008). These studies suggest that RIL better preserves the primary forest assemblage than CL. Some species groups such as primates, birds, arachnids and ants were even observed more often in RIL forest compared to primary forests.

Figure 4.9 **Species richness of plants and animals in logged forest relative to primary forest (A) and rubber plantation relative to primary forest (B) a)**



a) RSR=relative species richness; N/A: no information available.

Clear-felling systems are often used to replace a forested area for agriculture (i.e. oil palm) or timber plantations. In Indonesia clear-felling is often followed by land preparation in the form of open burning of residual biomass. During clear-felling and burning most species are lost from the site. Depending on the fire intensity some soil biota may survive. Although after burning the site may rapidly be re-colonised, the replacing pioneer communities are generally species poor and natural succession is limited as the land use shifts to agriculture or timber plantation.

4.5.2 Indirect effects on biodiversity

As the direct biodiversity effects of timber production, so the indirect effects of timber production relate to the type of production. Particularly intensive timber plantations are prone to indirect losses of biodiversity, for example through environmental disturbance. For instance, large-scale *Acacia mangium* plantations on peat require sufficient drainage of the peat soil, which leads to the drying out of peat, also in areas surrounding the plantation. Additionally, the use of pesticides is common in commercial timber plantations, potentially leading to pollution with possible hazardous effects when taken up by plants or animals. Indirect effects of selective logging in natural forests may be less pronounced, but have not been assessed in the field. They could relate, for example, to accumulating species loss through substantial logging damage. Clearly, the development of infrastructure for the extraction of timber from forests might affect biodiversity by fragmentation of forests.

4.6 Socio-economic impacts of the timber industry in Indonesia

The development and impacts of the tropical timber industry in Indonesia is intertwined with the development of oil palm plantations. Concessions on land for both products have been decentralised and are granted by the local departments of the Government of Indonesia as described in section 2.1.1 (Engel and Palmer, 2006). Both production systems are driven by a large-scale global demand, translated into big commercial companies that acquire land for wood and palm oil production (Kartodihardjo and Supriono, 2000). For that reason the social and economic impacts of timber production and oil palm development have a lot in common. This section is focussing on timber plantations and their impact on employment, income, access to land and health.

Employment and income

The timber industry is an important economic sector in Indonesia. It contributes around 10% to the national income and provides employment and income to millions of people. Between 2002 and 2006, however, the number of people employed in the Indonesian forestry sector decreased with around 800,000 of the estimated total of 3m, due to a decline in timber production and export (Obidzinski and Chaudhury, 2009). In response to the economic decline of the timber industry and under pressure of global community about the destruction of Indonesia's forest resources, the Indonesian Government initiated a new timber plantation policy, which is aimed at reviving the timber industry by the development of 9m ha of industrial timber plantations by 2016 (Obidzinski and Chaudhury, 2009). Industrial timber plantations, however, offer on average only 1 to 3 jobs per 100 ha of plantation (Charnley, 2006). Wages offered are generally low and working conditions are poor and dangerous (van Bodegom et al., 2008). Loggers and sawmill workers often operate dangerous machinery with no health or safety safeguards (Scotman, 2000). Although industrial timber plantations generate employment, jobs are often taken by (educated) immigrants. Local people are most likely to benefit if the establishment of a plantation is combined with the development of wood processing and manufacturing facilities (Charnley, 2006).

The government promotes the participation of rural people in timber plantation programmes (Rohadi et al., 2010). Small holder timber plantations represents a potential contribution to rural households employment and income. The development, however, remain behind the official targets. In 2004, 1.5m ha of small holders plantations were realised in contrast to the 41.5m ha that are available for that purpose (Rohadi et al., 2010). One of the reasons is the dependence of small holders on large companies for timber transport and market access and hence for their income. Timber plantations contribute only a small part to the household income of small holders. A survey on teak plantations showed that teak contributed up to 12% to the households income; food crops and animal husbandry together contributed 25%, while other off-farm activities such as paid labour, trade and the provision of services provided the remaining part. Farmers grow timber mainly as a safety net and harvest it when cash is urgently needed. Economically, timber plantations are far less profitable for small holders than rubber or oil palm plantations (Rohadi et al., 2010).

Access to land
Forests play a crucial role in local economies. In Indonesia 30m people are estimated to depend on the forest for their livelihoods and for environmental services such as water filtration and flood protection (FWI/GFW, 2002). In general rural people in Indonesia depend for their livelihoods on rice cultivation, vegetable growing, fisheries and harvesting timber and non-timber forest products (NTFPs) such as rattan, honey. The establishment of industrial timber plantations may lead to displacement of local communities and causing conflicts similar to those associated with the establishment of oil palm plantations. It has been reported that people lost their (rice) fields, cemeteries and holy land and species (Noor and Syumanda, 2006).

The loss of agricultural and forested land due to industrial timber plantations potentially decreases the food security in rural communities. Small holder timber plantations, however, are often planted in agro-forestry systems. Usually a farmer will only use around 10% of his land for the production of timber, hence, these plantations will not have a significant impact on local food security (Rohadi et al., 2010).

Noor and Syumanda (2006) conclude that the diverse products provided by natural forests and shifting agriculture provide rural communities with better opportunities to deal with changes in markets and climate than timber plantations.

Health
Industrial timber plantations often use irrigation for their water supply, thereby affecting the water table in the catchment area. Dropping water tables may lead to water shortage in agricultural fields adjacent to timber plantations and ultimately result in yield reductions. Another potential negative effect is water pollution caused by pesticide use, leading to decreasing fish stocks and, hence, decreasing income from fisheries. Loss of biodiversity can also affect local livelihoods in several ways, for example by the loss of species that form part of the diet of local people, or by the increase of pests and diseases (Noor and Syumanda, 2006).

4.7 Options for mitigating biodiversity and socio-economic impacts

In contrast to soya (see section 2.7) and palm oil (see section 3.8), intensification of wood production from selectively logged tropical forests is not recommendable. Modelling studies (e.g. Arets, 2005; Sist et al., 2003a;

Van Gardingen et al., 2003) show that only moderate harvest intensities and sufficiently long felling cycles, i.e. the time in between two harvests, will result in long term sustained yields. Higher harvest intensities will result in forest degradation and lower (quality) yields at the following harvests. Ten Brink et al. (2010) explored the possibility to intensify wood production by establishing more forest plantations. The results indicate that this may reduce the pressure on natural forests in the long term, but will lead to higher levels of biodiversity in the short term. As part of an integrated land-use planning at a landscape scale, forest plantations could be planned strategically, especially on degraded land. As such, forest plantations may well be part of a strategy to alleviate the pressure on natural forests, but they are only one element in a whole package of measures to reduce the deforestation of natural forests and to promote their sustainable use and management (van Bodegom et al., 2008).

The most promising policies with respect to mitigating thebiodiversity impact of wood production are forestry certification schemes, such as the international certificates, PEFC and FSC, and national certificates as MTCS (Malaysian Timber Certification Scheme), CSA (Canadian Standards Association) and SFI (Sustainable Forestry Initiative, USA). Forest certification systems include a variety of 'good management practices' such as Reduced Impact Logging, retention of seed trees, establishment of riparian buffer zones and non-riparian corridors and the identification of High Conservation Value Forests (HCVF). A HCVF refers to a rare forest type or a forest with an exceptionally high number of rare species. Protection of such ecologically important areas within forest management units may be among the best instruments for biodiversity conservation. However, the effectiveness of HCVF in tropical countries has yet to be proven. Biodiversity rich areas do not automatically receive a HCVF status, for instance, because they are not easy to access or because they are being logged before any proper inventory has taken place. In addition, HCVF status does not guarantee protection of the area, especially not in countries with a high rate of illegal logging (Ardiansyah, 2006).

A crucial role in biodiversity conservation might be played by ecological corridors. In temperate zones, ecological corridors have been proven to have positive effects on biodiversity (Haddad et al., 2003). They may initiate important ecological processes such as migration, seed dispersal and pollination by offering suitable habitat for the species underlying these processes. Mammals and birds for example have been observed to migrate through corridors (Pereboom et al., 2008; Tewksbury et al., 2002). A study to howler monkeys in Mexico showed that their abundance increased with the degree of connectivity with other forest fragments (Anzures-Dadda and Manson, 2007). Nasi et al. (2008) suggested that forest fragments may be used to mitigate the negative impact of plantations on biodiversity, especially when connected to remaining natural forest patches (Nasi et al., 2008). Riparian buffer zones are also promising in biodiversity conservation. High insect abundance near streams makes them a crucial feeding habitat for several important species groups such as forest birds (Chan et al., 2008). A successful example of connecting remaining natural forest patches, comes from the Tesso Nilo conservation area on Sumatra. However, such examples are as yet very rare in tropical Southeast Asia.

Within timber plantations, the plantation management could significantly influence their suitability for species conservation. For example, low-input rubber *(Hevea brasiliensis)* agroforests support relatively high species richness compared to rubber plantations. They play an important role in the conservation of forest species in an impoverished landscape that is increasingly dominated by monoculture plantations (Beukema et al., 2007). On the other hand, management of agro-forestry systems that includes the thinning of tree stands can facilitate invasive species such as the Yellow Crazy Ant, *Anoplolepis gracilipes* (Bos et al., 2007). Dominance of pest forming species like those observed in oil palm plantations do also occur in timber plantations. Plantation management and tree selection andmodification is forced to act accordingly.

To ensure that the basic needs of local communities are met in forestry planning, local communities and indigenous peoples should be involved in the identification and management of areas that they require for the provision of ecosystem services and areas critical to their traditional cultural identity. These areas should be included in HCVFs. Timber plantations may also have a positive impact on the livelihoods of local people, because they provide employment and income opportunities, but there is risk of an unfair distribution of plantation costs and benefits (see section 4.6). An option is to establish mixed species and agroforestry plantations with well-defined rights of access and use for the local population. Integrated land-use planning involving all relevant stakeholders is a promising option to find a solution that fits best to them all.

4.8 Synthesis

The by far most important wood producing countries in the world are Canada and the Russian Federation. Malaysia, Indonesia and Brazil are the most important producers of tropical wood and wood products. The European Union is one of the largest importers of wood and wood products, next to China. The import by EU-27 countries counts for 46% of the total world trade. A larger part of the import of EU member states origins from other member states. The share of EU countries in the total trade of wood exporting EU countries is about two thirds. The EU accounts for about one third of the total wood export of China and the Russian Federation, almost half of the export of Brazil, 28% of that of Indonesia and 16% of the wood export of Malaysia. The Netherlands is an important entry point for tropical timber to the European Union. Around 30% of the total timber export of Malaysia entered the EU via the Netherlands. For Indonesia is was 21% and Brazil 9%.

The market of wood and wood products is severely affected by the financial and economic crisis that started in 2008 with the crash in the housing market in the USA. As a result the consumption of wood and wood products started to decline in that year after a long period of growing demand. It looks that the bottom of the downward trend has been reached, but a full recovery is not expected before the housing markets starts to recover. The market for tropical timber was less influenced by the crisis, partly because the major part of the tropical timber is traded within the timber producing regions of Asia and South America and these regions are less affected by the economic crisis than Europe and the USA.

Biodiversity impacts

The impact of wood production on biodiversity is largely dependent on forest management and logging systems. Four different management types can be distinguished: (a) clear-felling, (b) conventional selective logging (CL), (c) selective logging with application of reduced impact logging techniques (RIL) and (d) wood production from wood plantations. It is obvious that the impact on biodiversity is largest when the whole forest area is harvested. Because of the high density of good quality trees, a considerable part of the total timber production in Indonesia comes from clear felled forests. However, in many tropical countries timber is extracted from the forests through selective logging, i.e. in a given forest area only a small number of trees of commercial value is harvested. The number of harvested trees is rather low, but the damage to the remaining forest stand may be considerable. In a RIL system a number of precautionary measures are taken to minimise the damage to the residual forest, and in particular to trees suitable for harvesting in the future. Although on average the difference in harvested volumes between CL and RIL is not large, the harvesting losses and damage to the residual forest for CL is considerable, so that, eventually, more forest need to be felled for the same amount of wood as under RIL.

There is not much information available about the impact of both logging systems, but the available studies suggest that reduced-impact logging better preserves the primary forest assemblage than conventional logging techniques do. In general, the damage to biodiversity in selectively logged forests is limited; studies found an overall species diversity in these forests of about 84% of the richness found in primary forest. The situation changes dramatically, when these forests are converted into timber plantations. In general the biodiversity in timber plantations is comparable to that in oil palm plantations and is dominated by a few common species of low conservation concern. Nevertheless, the management of timber plantations (especially long-rotation trees) is more extensive compared to oil palm plantations, which may eliminate some of the negative biodiversity impacts.

Management of tree plantations could significantly influence its suitability for species conservation. Important aspects are tree density, the undergrowth and the use of agro-chemicals. Forest plantations generally consist of mono-specific blocks interspersed with natural forest remnants, which can provide an important way to mitigate the negative impact of plantations on biodiversity, provided that they are appropriately interconnected and managed. Protecting ecologically important areas and corridors within forest management units and conservation of High Conservation Value Forests may, therefore, be among the best instruments for species conservation.

Well managed forest plantations, however, also can reduce pressure on remaining forest areas for wood production. Global scenarios in which the share of wood produced from plantations is increased show a reduction in impact of forestry on biodiversity (ten Brink et al., 2010). This is because on the long term less primary forest area is needed to meet global wood demand. As a trade-off, however, initial plantation establishment will on the short term, result in additional loss of natural areas and biodiversity.

Socio-economic impacts

The timber industry is an important economic sector in Indonesia. It contributes around 10% to the national income and provides employment and income to millions of people. Since a number of years, however, the industry is in decline. In response to that and under pressure of global community about the destruction of Indonesia's forest resources, the Indonesian Government started a new timber plantation policy, which is aimed at reviving the timber industry by the development of 9m ha of industrial timber plantations by 2016. Industrial timber plantations, however, offer a few jobs per 100 ha of plantation, the wages are generally low and working conditions are poor. New positions on industrial plantations are often filled in by immigrants. Local people are most likely to benefit from plantations if they are combined with wood processing and manufacturing facilities. The Indonesian government is also promoting small holders' plantations, but the development remain behind the official targets, probably because timber plantations are not very profitable. Farmers grow timber mainly as a safety net and harvest it when cash is urgently needed.

The establishment of industrial timber plantations generally leads to the deprival of land and forest resources for rural communities and involves risks of social unrest and conflicts, impoverishment and food insecurity, in particular for indigenous people. Other negative impacts often associated with industrial timber plantations are decreasing water availability for agricultural and domestic uses, water pollution and non-voluntary resettlements.

An estimate of the forest area used for the Dutch import of wood products from Indonesia

To estimate the impact of Dutch import of wood and wood products from Indonesia, figures of Dutch import are combined with estimates of yields losses, damage and growing stock per hectare for different logging systems and production regions in Indonesia. In the period 2007-2009 the Netherlands imported annually about 200,000 m^3 RWE from Indonesia. It is assumed that the Dutch wood import comes from different sources and that the share of the different management and logging systems in the imports are equal to the share of each system in the total timber production of Indonesia. Based on these assumptions, the area of natural forest needed to produce the Dutch import volume was about 1,800 ha, of which 49% was produced by selective logging, 17% by clear felling and 34% on timber plantations.

Wood, however, is not an annual crop that can produce similar yields on the same hectare year after year. Long periods of time are needed between two harvests to replenish the timber stock. The (sustainable) felling cycle depends on tree species, local growing conditions, and logging method. For conventional selective logging the felling cycle is about 60 years, for reduced impact logging 40 years, for clear felling 100 years and for plantations 33 years. On this basis, the annual forest area of 1,800 ha needed in Indonesia for wood exports to the Netherlands, leads to a claim on about 104,400 ha of forests and plantations for a sustained future production.

This estimate includes only timber that was directly imported (and registered) from Indonesia to the Netherlands. Some sources indicate, however, that considerable volumes are imported to the Netherlands through other countries, such as Belgium, Singapore, China and Malaysia.

Options for mitigating biodiversity and socio-economic impacts

The most promising policies with respect to mitigating the impact of wood production on biodiversity are the various forestry certification schemes, such as the international certificates, PEFC and FSC.

Forest certification systems include a variety of 'good management practices' such as Reduced Impact Logging, retention of seed trees, establishment of riparian buffer zones and non-riparian corridors and the identification of High Conservation Value Forests (HCVF). In particular protecting ecologically important areas and corridors within forest management units and conservation of HCVF may be among the best instruments for species conservation. However, the effectiveness of HCVF in tropical countries has yet to be proven. Biodiversity rich areas do not automatically receive a HCVF status and a HCVF status does not guarantee protection of the area, especially not in countries with a high rate of illegal logging.

To ensure that local communities and indigenous people will equally share in benefits (and costs) of the HCVFs and that their needs and concerns will be heard, they should be involved in the planning and management of HCVFs. Integrated land use planning may be one of the options to achieve biodiversity and socio-economic goals in a sustainable way.

5 Key findings and options for sustainable use of biodiversity

5.1 Introduction

In the last decades, the world has witnessed tremendous changes in land use, caused by a rapid growing demand for food, feed and fuel for the increasing world population, together with rising incomes and changing food consumption patterns from cereals to meat products. The growing demand and production of biofuels is a new driver behind land use changes and challenges producing countries to secure people's food security and achieving environmental priorities such as sustainable use of biodiversity. The Dutch government through its Biodiversity Policy Programme (2008-2011) aims at making the Dutch international trade 'sustainable inclusive', a term that refers to public and private policy making that equally takes into account the social, economic and ecological interests associated with international trade. The international trade in products and commodities that require large areas of land and consequently put a high pressure on biodiversity, such as tropical timber, palm oil, soya, coffee, cacao and fish products have the particular interest of the Dutch government.

This study focuses on soya, palm oil and tropical timber. This chapter provides the key findings of this study with respect to the global trade in these commodities and the Dutch trade position (section 5.2), the expected future trade developments (section 5.3), the impact on biodiversity (section 5.4), and the impact on rural communities (section 5.5). In the concluding section (section 5.6) three options for mitigating the biodiversity and socio-economic impacts are presented: (a) sustainable intensification, (b) expansion of production in degraded areas and (c) integrated land use planning.

5.2 Global trade flows and the Dutch trade position

- The world soya bean area rose from about 25m ha fifty years ago to around 100m ha in 2009. South America has about 43% of the total world area under soya beans, the USA 32% and China and India each about 10%. The USA account for 41% of the global soya bean production of over 220m tonnes in

2009, followed by Brazil (26%) and Argentina (14%). In the period 2007-2009, the total Dutch import value of soya bean products was around USD3b per year. Since the year 2000, the Dutch soya import significantly increased and added up to more than USD4b in 2008, with a sharp decline in the following year, caused by an increased competition in the global food market since 2007. The Dutch import of soya beans is mainly from Brazil (67%) and the USA (25%), while soya oil cake is almost totally imported from Argentina and Brazil, each almost 50%. About one third of the total soya import of the Netherlands is exported to its neighbouring countries, in particular Germany and Belgium. The remaining part of the soya bean import is crushed in the Netherlands to extract soya bean oil, which is exported partly to other EU countries. The majority of the processed products (soya bean meal and oil cake) are used as feed in the livestock industry in the Netherlands and other EU countries (see section 2.2).

- The world oil palm area grew from 3m in the sixties of last century to 14m ha in 2009, of which more than 10m ha in Indonesia and Malaysia. These two countries account for 85% of the global palm oil production of 47m tonnes in 2009, each producing around 22m tonnes. The Netherlands is the second largest importer of crude palm oil after India. In the period 2007-2009, the Netherlands imported annually about 1.0m tonnes of crude palm oil from Malaysia and some 0.5m tonnes from Indonesia. The total global Dutch import value significantly increased since 2000 and added up to almost USD2.1b in 2008, with a sharp decline in the following year, caused by an increased competition in the global food market since 2007. In the period 2007-2009, the Dutch import value was USD1.6b per year and accounted for 7% of the total global trade in palm oil products. For crude palm oil the share of the Netherlands was 15% and for palm oil cake even 23%. A significant part of the imported crude palm oil is - after processing into palm oil and oil cake - exported to neighbouring countries, in particular Germany and Belgium. The value of the exported palm oil products is nearly equal to the value of total crude palm oil import (see section 3.2 and 3.3).
- In the period 2001 to 2007, the global trade in wood and wood products almost doubled from USD63b to USD120b. Malaysia, Indonesia and Brazil are the world's major exporters of tropical timber. The production of tropical wood is partly intertwined with the development of soya and oil palm production. A majority of the large oil palm estates in Malaysia and Indonesia is located in former forest areas because timber yields can offset the costs of plantation establishment. Many oil palm companies are, therefore, associat-

ed with logging companies. The expansion of soya production in South America occurs mainly in former forest areas that have been logged in the last decades and then used for extensive cattle farming. The EU is one of the largest importers of wood in the world, with 46% of the total world trade in 2007-2009. The EU accounts for almost half of the wood export of Brazil, 28% of that of Indonesia and 16% of Malaysia. Of the total EU import from Malaysia 30% enters the EU via the Netherlands, for Indonesia it is about 21% and for Brazil 9%. The share of the Netherlands in the global wood trade is about 3.1%. In the period 2007-2009; 63% of the total Dutch import originated from neighbouring EU countries and of the remaining 37%, one third is tropical timber, imported from Malaysia, Indonesia and Brazil. The total import value of tropical timber was about USD0.7b per year (see section 4.2).

- The impact of Dutch imports of palm oil, soya bean and timber products on biodiversity in the production regions can be illustrated by the total area of land needed for the production of these products in the respective countries (Brazil, Malaysia and Indonesia). It is not possible to trace back the Dutch imports to the specific production areas, so only a rough estimate can be made of the land area that is needed for the Dutch imports. This estimate is based on the assumption that the imports of the Netherlands are produced proportionally to the distribution of the total production over the different production regions and production methods in the exporting countries. For the annual Dutch soya imports from Brazil in the period 2007-2009 an estimated production area of about 1.5m ha is needed (see section 2.4). For the annual Dutch palm oil imports from Indonesia and Malaysia this area equals to almost 0.4m ha (see section 3.5). These gross imports require roughly the same area as the total agricultural land area of the Netherlands. It should be noted that a significant part of the Dutch soya and palm oil imports is re-exported to neighbouring countries, mostly after processing. For a sustainable import of timber products from Indonesia a forest and plantation area of about 100,000 ha is required (see section 4.4).

5.3 Future trade developments

- The demand for soya in the feed and energy sector is expected to increase over the coming years, especially in China, due to a continuing economic growth resulting in higher food consumption levels and changing food con-

sumption patterns from cereals to meat products. The EU imports of soya beans are not expected to increase and imports of soya oil and soya bean meal will slightly increase. Soya bean production areas in Latin America are expected to expand by 10m ha, of which 5m ha in Brazil (see section 2.3).
- Indonesia and Malaysia will continue to dominate the world exports of palm oil products. The export of both countries is expected to increase to 50m tonnes in 2018/19. A major growth of palm oil consumption is expected in China and India, as the industrial use for palm oil will continue to rise due to the growing demand for processed food products. The EU import is expected to increase about 20% over the period 2008-2018 (see section 3.4).
- The market for wood and wood products was severely affected by the recent financial and economic crisis, but the expected global economic recovery will lead to a growing demand for tropical wood products. Policies to combat illegal logging by the major importing countries, in particular the EU (FLEGT initiative) and the USA (Lacey Act Amendment) are expected to have important implications for producers and traders of tropical wood products. The certified forest area is increasing, but concentrates in Europe and North-America, representing 97% of the global certified round wood supply (see section 4.3).

5.4 Impacts on biodiversity

- The growth of soya bean production in Latin America has mainly been realised at the cost of until then undisturbed ecosystems in Brazil and Argentina. The expansion of soya bean cultivation promotes sometimes large-scale forest conversion directly, but more often it is part of a whole chain of land use dynamics, in which it indirectly drives deforestation. Deforestation leads to direct losses of biodiversity at the site and it contributes to fragmentation of the forest and Cerrado landscapes. Exact species losses due to soya bean cultivation have not yet been quantified, although it is likely that the loss of rare ecosystems with high levels of endemism such as the Atlantic forest and Cerrado would result in significant reductions of biodiversity (see section 2.5).
- Tropical biodiversity is critically affected by the fast conversion of forest into oil palm plantations, which mainly takes place in the lowlands of Indonesia and Malaysia. Biodiversity impacts are greatest when oil palm expansion is planned in forest areas, but also conversion of secondary forests that have

been harvested for wood will lead to a relatively strong reduction in richness of original species, i.e. the species that would be present in primary forest. There is an ongoing scientific debate on the effects of small holder versus large-scale palm oil plantations on biodiversity. It is generally expected that small holder production in more extensively managed mosaic landscapes is more beneficial to wildlife and maintenance of local biodiversity than intensively managed large scale plantations. However, there are limited data available to support this claim. On the other hand, many of the small-holder plantations have low crop yields, which means that they need more land to produce a given amount of palm oil compared to intensive large-scale plantations. Most of the current forest conversion in Malaysia and Indonesia for large scale palm oil development takes place in lowland tropical forests that have been logged over in the past decades. These logged-over forest patches, however, may still harbour a substantial part of the originally occurring forest species. In contrast, oil palm plantations are relatively species poor. The number of species in these plantations is only 37% of the number of species found in logged-over forest. The majority of species found in forests, either primary or logged-over, is not present in plantations. The clearing of forests for oil palm plantations also entails several indirect effects on biodiversity, for example caused by drainage and the use of agrochemicals. These effects may be potentially large but are hard to quantify (see section 3.6).

- The impact of wood production on biodiversity largely depends on forest management and logging systems. Diversity of several species groups is clearly diminishing along a gradient from near primary forest via logged forest to agro-forestry and annual cropping systems. Selective logging, in which only a selection of trees in a forest is harvested, is the main practice in tropical forests. These selectively logged forests support fewer species than primary forests, yet their species richness is still far above the values reported for agricultural crop or tree plantations. Increasing amounts of timber are being produced in plantation forests, relative to natural forests. Timber plantations are comparable with oil palm plantations in that they are dominated by a few common species of low conservation concern (see section 4.5).

5.5 Impacts on rural communities

- Soya production is an important driver for economic and rural development in Brazil. However, the total employment in the soya industry is estimated on 5-6m people. The employment in soya producing regions is decreasing due to the introduction and expansion of large scale highly mechanised soya farms, which employ only a few workers per 100 ha. This drives farmers to migrate to urban areas and vice versa seasonal workers to migrate to plantation areas. It is expected that further development of large-scale soya bean cultivation will lead to increasing poverty rates. The expansion of soya production is also often associated with land conflicts (see section 2.6).
- Oil palm industry is among the major economic activities in Indonesia and Malaysia. An estimated 6m people in Indonesia benefit from the palm oil production and related activities. The employment potential of large-scale plantations is not always realised and the influx of large numbers of migrants for employment in the oil palm plantations regularly lead to conflicts within existing rural communities. The labour conditions at this type of plantations are often described as poor. Moreover the establishment of large-scale plantations, either owned by private or public companies are often associated with land conflicts, due to weakly identified and recognised customary land rights. In 2007, small holder growers accounted for about 40% of the productive oil palm area and 35% of the crude palm oil production. For small holders palm oil production provides an attractive income opportunity, but their economic position is vulnerable due to uncertainty over land tenure and lack of technical, policy and market information and, hence weak bargaining power (see section 3.7).
- The timber industry is an important economic sector in Indonesia. It contributes around 10% to the national income and provides employment and income to millions of people. Between 2002 and 2006, the number of people employed in the Indonesian forestry sector decreased due to a decline in timber production and export. In order to revive the timber industry the Indonesian Government initiated a new timber plantation policy, which is aimed at the development of millions of hectares of industrial timber plantations. Industrial timber plantations, however, offer on average only a few jobs, the wages offered are generally low and working conditions are poor. Local people are most likely to benefit if plantations are combined with the development of wood processing and manufacturing facilities (see section 4.6).

5.6 Options for mitigating biodiversity and socio-economic impacts

The growing global demand for palm oil, soya and wood products will certainly lead to further large-scale conversion of natural habitats. The following three options are identified to mitigate the biodiversity and socio-economic impacts.

A. Sustainable intensification of production

The strongest drivers of biodiversity loss are associated with land-use changes from natural ecosystems to agricultural production, infrastructure and urban areas (Alkemade et al., 2009; Pereira et al., 2010). A recent study on land-use changes shows that between 1980 and 2000, 55% of agricultural expansion was on previously intact forest areas, while another 28% was on already disturbed forest areas (Gibbs et al., 2010). In a scenario study, ten Brink et al. (2010) indicated that the option of closing the yield gap, i.e. reducing the difference between the current and the potential yields, could reduce the loss of original biodiversity in 2050 with 20% compared to the baseline scenario. This was mainly achieved by reducing agricultural expansion and even agricultural abandonment in some regions. On a global scale, this option would gain 2m km^2 of wilderness area compared to the baseline situation.

In general, more intensive management of agricultural areas, involving artificial fertilisers and pesticides will have a negative impact on biodiversity at the local scale. Yet, because the largest biodiversity losses are associated with forest conversion, it is probably better to intensify production, rather than to further expand the total production area, as illustrated by the scenario study mentioned above. Intensification of production, however, should be applied in a sustainable way and preferably be part of a larger strategy of integrated land-use planning. In that way, areas could be identified where the production could be intensified, of course within the ecological, social and economic context, and areas where the intensification and expansion of production should be limited, e.g. areas with high ecological values or with vulnerable local communities. In these areas, agrochemicals and fertilisers should be used with care, and its application in terms of composition and concentration should be optimised to make sure that degradation of soils and pollution of water is prevented. Imposing constraints on intensification, promoting biological pest control and the use of organic fertilisers could lead to production systems with fewer negative impacts on biodiversity and human health.

The results of ten Brink et al. (2010) show that improved agricultural practices are especially effective for cereals and rice and in Sub-Sahara Africa, the area with currently the widest yield gap. Yet, the trends in palm oil and soya yields (as well as for their substitutes) show also room for improvement and are key to answering the question how much more productive land is needed to meet the fast growing global demand.

For palm oil, the average yields of independent small holders are much lower compared to private and government estates and supported small holder growers. This affects not only the total area needed for oil palm, but also farmer's income. Improving the yield of the low yielding independent growers, who occupy some 650,000 ha of land in Indonesia, may be very effective to reduce the expansion rate of oil palm plantations on the short term. If independent small holders would improve their yields to the level of supported small holders, the total production of oil palm in Indonesia could increase by 2m tonnes of CPO per yea,r or the total area of palm oil plantation be reduced by half a million hectares. Shean (2009) estimated that the average CPO production per ha could even be increased from 3.4 to 5.0 tonnes for small holders and from around 4 to 7 tonnes for state and private companies. Such yield increases would further increase the total production of palm oil by over 40% or reduce the area needed by 40%. Most small holders currently apply no or only little fertiliser, while their genetic stock is inferior to that used on estates. These small holders should be supported to make a transition to higher yielding hybrid varieties, to apply fertilisers and to overcome the time lag until the new palms become productive. A reason that private and government estates are still well below their potential yields appears to be a lack of motivation to manage plantations more intensively. They already achieve large profits at current production levels, so there is little incentive for higher investments in optimal fertiliser application (Shean 2009).

Compared to palm oil, there is apparently less potential for yield increments in soya production, although there are large differences in yields that seem to depend on the level of technology adapted. For instance, some farmers succeed in harvesting twice a year from the same field. Despite the greatest part of the total soya production originates from intensive large-scale plantations, there are still small and medium sized producers. Large-scale farms strongly inhibit an effective establishment of nature reserves and High Value Conservation Areas, because they easily become isolated in a landscape with large soya fields. Small and medium sized farms in a mosaic landscape of agriculture and natural areas can thus play an important role in the development towards a more sustainable soya production. With adequate support small farmers can also increase yields. However, to prevent degradation and further indirect losses of biodiversity, attention needs to be paid to the ecological and socio-economic boundary conditions.

The key elements of an enabling environment for intensification of small holder palm oil and soya production include secure land tenure for individuals and community groups, adequate supportive infrastructure, access to markets, fair credit schemes, new technology and improved seeds.

In contrast to palm oil and soya, intensification of wood production from selectively logged tropical forests is not recommendable. Modelling studies (e.g. Arets, 2005; Sist et al., 2003a; Van Gardingen et al., 2003) show that only at moderate harvest intensities and sufficiently long felling cycles, i.e. the time in between two harvests, will result in long term sustained yields. Higher harvest intensities will result in forest degradation and lower yields at the following harvests. Ten Brink et al. (2010) explored the possibility to intensify wood production by establishing more forest plantations. The results indicate that this may reduce the pressure on natural forests on the long term, but results in higher levels of biodiversity loss on the short term. As part of an integrated land-use planning at a landscape scale, forest plantations could be planned strategically, especially in degraded areas. As such forest plantations may well be part of a strategy to alleviate the pressure on natural forests, but they are only one element in a whole package of measures to reduce the deforestation of natural forests and promote their sustainable use and management (Van Bodegom et al., 2008).

Timber plantations do not automatically have a positive impact on the livelihoods of local people. Plantations seem to favour the interests of a few above the basic needs of the majority of the rural population. One promising option is integrated land-use planning for plantation development involving all relevant stakeholders. Another strategy focuses on mixed species and agroforestry plantations with well-defined rights of access and use for the local population. The most promising policies with respect to mitigating the impact of wood production on biodiversity are forestry certification schemes, such as the international certificates, PEFC and FSC and national certificates as MTCS (Malaysian Timber Certification Scheme), CSA (Canadian Standards Association) and SFI (Sustainable Forestry Initiative, USA).

B. Expansion of production in degraded areas

Yield improvement of palm oil and soya alone is not expected to match the growing world demand over the next thirty years. Area expansion will almost certainly be needed. There is general consensus about the potential to focus future area expansion on so-called degraded land, carrying small carbon stocks and low species diversity (often Imperata grasslands or 'alang alang'). Several Indonesian oil palm companies already have experience with alang alang control in new plantations and some field examples show that these idle lands can be made productive with the right measures. However, experience in Indonesia has also shown that many grassland areas are claimed by local people, and the costs of negotiating over land rights may be a significant factor in preventing the use of degraded lands. In addition, palm oil is a labour intensive crop that requires high investments to establish and manage, and there is a relatively long time lag between establishment of a plantation and the first production, at least three years. Therefore, conversion of forest areas often provides initial income from wood production, which is used to finance plantation establishment. This situation makes the establishment of oil palm plantations on degraded areas less attractive.

C. Integrated land use planning

Integrated land use planning for the development of new agricultural areas and plantation expansion is a key strategy to reduce negative biodiversity and socio-economic impacts and to ensure preservation of regional biodiversity. Such an integrated planning should involve ecological and economic zoning, including protection zones, i.e. vulnerable areas rich in biodiversity and endemic species, and intensification zones, i.e. areas where ecological and social boundary conditions further agricultural expansion and intensification permit. The involvement of local communities and indigenous peoples in the planning and management of protected areas is an effective way to link conservation and development goals, and is supported by the Convention of Biological Diversity's programme of work on protected areas. Key to the success of this approach is an enabling institutional and legal environment that promotes equitable distribution of costs and benefits and ensures genuine participation of local communities in planning and management.

An example is the Ex Mega Rice Project area in Central Kalimantan, Indonesia, where integrated land use planning was applied for a sustainable development of the area. Biophysical and socio-economic baseline studies and land suitability analyses have been used to identify areas for conservation and rehabilitation of forests and peat lands, and areas for agricultural development. In order to ensure that the planning reflects local realities and builds on the knowledge of stakeholders in the area, a multi-stakeholders approach was applied including workshops and consultations, as well as engagement and cooperation with governmental institutions at all levels.

Integrated land use planning is also a promising approach for a successful establishment of High Conservation Value Areas (HVCAs) interconnected with corridors of other intact forest areas over different properties. HCVAs are included in the draft global standard for responsible soya production of the Roundtable on Responsible Soy Association (RTRS). The concept is also included in the standard for sustainable palm oil of the Roundtable on Sustainable Palm Oil (RSPO) and in the FSC timber certification scheme. Key to the establishment of HCVAs, in particular to ensure the equal distribution of costs and benefits of these areas, is the involvement of local communities and indigenous people in the planning and management of HCVAs to ensure their needs and concerns will be heard.

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