

Tobacco and Forests

The Role of the Tobacco Industry Regarding Deforestation, Afforestation and Reforestation

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1. Introduction

Tobacco is grown in over 125 countries, on over 4 million hectares of land, whereby the major producer is China (FAO 2009b). It is grown on a wide variety of soils and climates.

Growing tobacco contributes to some extent to deforestation, whereby the main issue is the wood required for the curing process and not the land used for cultivation. Against this background, the International Tobacco Growers' Association (ITGA) seeks to assess and estimate the effects of the tobacco industry on deforestation and their efforts towards reforestation. In addition, these aspects shall be related to other industries (e.g. soybean, palm oil, cotton, coffee) and activities (e.g. use for fuel wood, logging, grazing) that cause deforestation.

The present report addresses these issues and discusses the impact of the tobacco industry on deforestation. The first part gives an overview on global deforestation as well as on the major causes and drivers of deforestation. The second part addresses the role of the tobacco industry towards deforestation and describes the share of deforestation due to cultivation and due to the tobacco curing process. In the following chapter, tree-planting activities, wood-efficient curing and other initiatives undertaken by the tobacco industry to address deforestation are described by means of selected examples. Based on selected countries the impact of the tobacco industry on forests is analysed in detail and related to the impact of the production of other crops and different drivers of deforestation.

2. Global Deforestation

2.1. Deforestation Facts

According to the Forest Resources Assessment 2005 of the FAO, about 13 million hectares of the world's forests are lost each year due to deforestation. South America suffered the largest net loss of forests from 2000 to 2005 – 4.3 million hectares per year – followed by Africa, which lost 4.0 million hectares annually (FAO 2006a).

The ten countries with the largest net forest loss per year between 2000 and 2005 are Brazil (-3.1 Mio. ha/year), Indonesia (-1.87 Mio. ha/year), Sudan (-0.59 Mio. ha/year), Myanmar (-0.47 Mio. ha/year), Zambia (-0.45 Mio. ha/year), Tanzania (-0.41 Mio. ha/year), Nigeria (-0.41 Mio. ha/year), Democratic Republic of the Congo (-0.32 Mio. ha/year), Zimbabwe (-0.31 Mio. ha/year) and Venezuela (-0.29 Mio. ha/year). 37 countries and territories lost 1 percent or more of their forest area each year between 2000 and 2005, while 20 countries gained more than 1 percent per year due to natural expansion of forests and afforestation (FAO 2006a).

Figure 1 gives an overview of the world's forested landscape today and in the past. Green areas are the landscapes of today's forests. Intact (large undisturbed) forests appear in dark green, and managed or fragmented forests in lighter shades of green. Brown areas represent estimates of historical forest cover. These are areas where forests have been replaced by developed land and croplands (dark brown) or pastures and grasslands (light brown). Red areas show recent (2000 to 2005) tropical deforestation (WRI 2009).

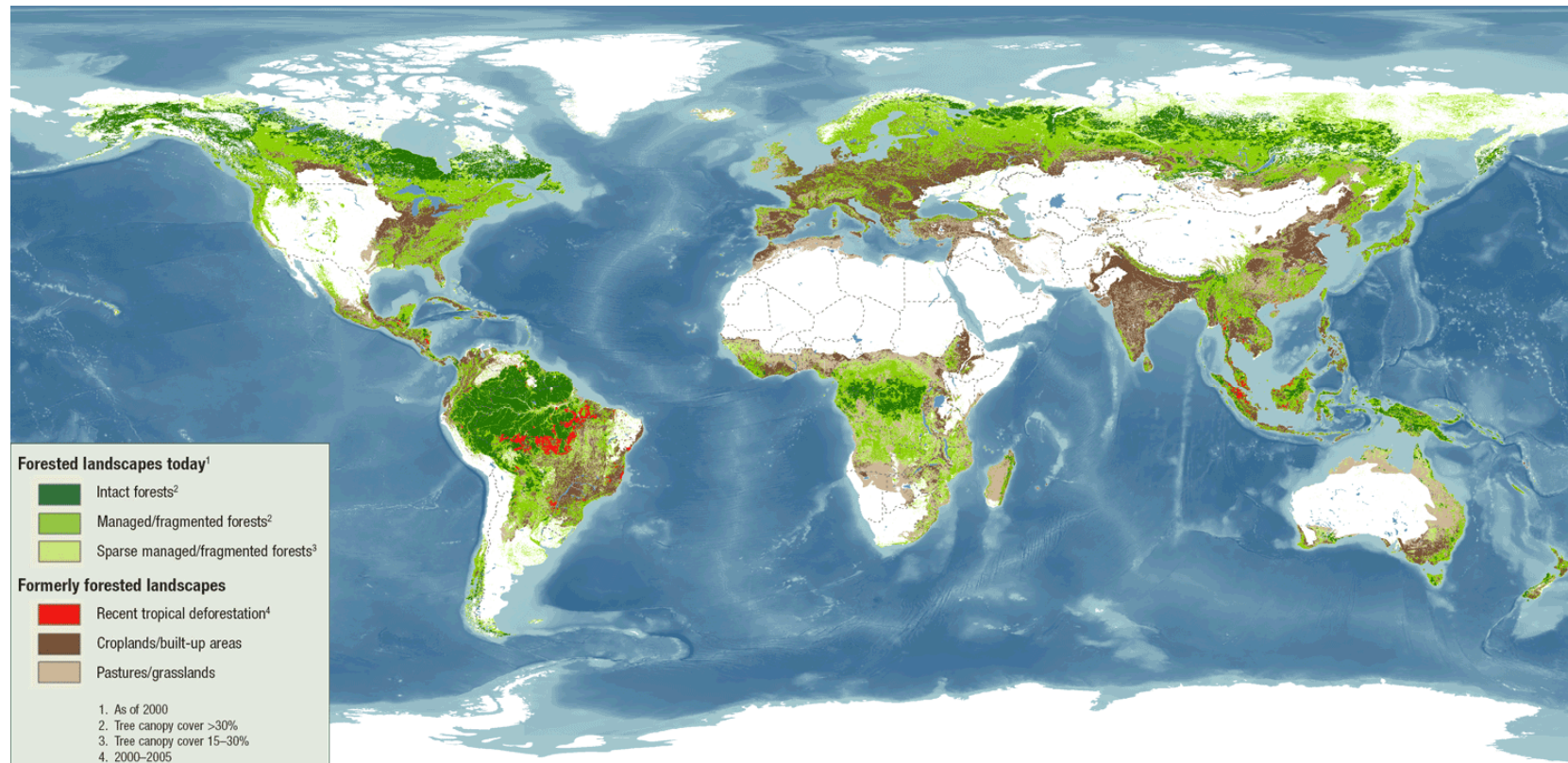


Figure 1 State of the world's forests today and in the past (WRI 2009).

2.2. Major Causes of Deforestation

2.2.1. Overview

The most important causes of deforestation include logging, the conversion of forested lands into land for agriculture and cattle-raising, urbanisation, mining and oil exploitation, acid rain and fire. There has been a tendency in the literature of highlighting small-scale migratory farmers or poverty as the major cause of forest loss (FAO 2009a). However, since wealthier households such as ranchers and plantation owners also deforest, higher income does not necessarily lead to lower rates of deforestation. In the Brazilian Amazon, poor households are responsible for less than one-fifth of deforestation. 39 percent of deforestation occurs in increments that are larger than 200 hectares. Since subsistence farmers are generally unable to clear more than 20 hectares per year, these large increments are most likely attributable to relatively wealthy interests (Chomitz 2007).

The main forest cover changes in the tropics are due to the direct conversion of forests to permanent agricultural land (see Figure 2). Differentiated by region either the conversion to small-scale agricultural land (main factor in Africa) or to large-scale agricultural land are predominant (FAO 2009a).

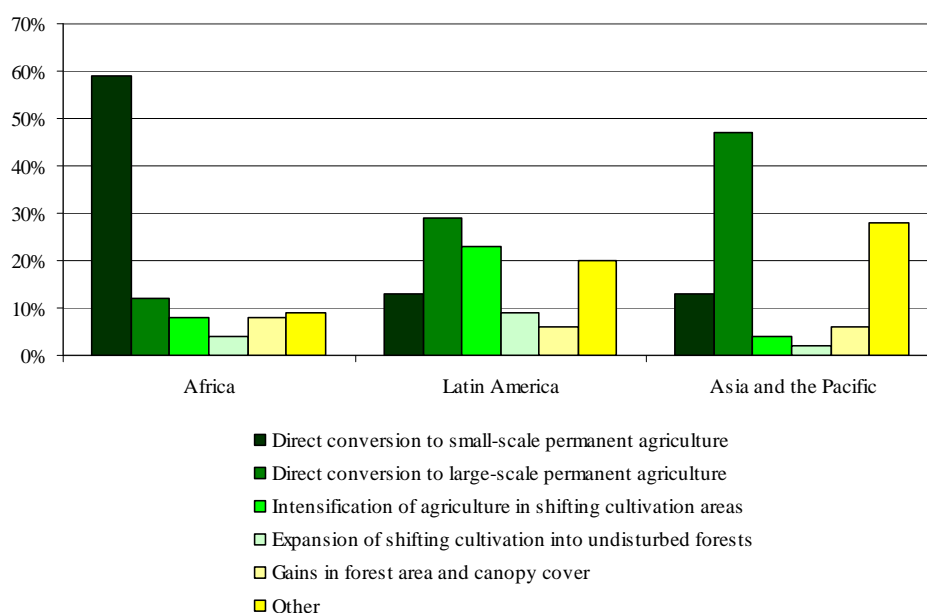


Figure 2 Main forest cover changes in the tropics (Africa, Latin America and Asia) (FAO 2009a).

As discussed by Chomitz (2007), deforestation is a result of individual decisions of millions of large and small actors, and is driven largely, if not exclusively, by economic motivations. Deforestation can be, and often is, individually economically desirable, making way for profitable agriculture and other land uses and can, of course, be environmentally catastrophic in terms of losses of biodiversity. Deforestation may be legal or may be initiated and executed illegally by a range of interests ranging from corporate agricultural interests to ranchers and poor slash-and-burn farmers desperately seeking a livelihood.

While the more direct causes – agricultural expansion, infrastructure extension and wood extraction – are rather well established, indirect drivers of deforestation form of a complex web of interlinked and place-specific factors.

Angelsen & Kaimowitz (1999) synthesize the results of more than 140 economic models analyzing the causes of tropical deforestation. The main source of deforestation is clearing by households or companies for agriculture or timber. The question is: what factors make farmers and loggers decide to clear forests? These underlying causes of deforestation are more complex and it is harder to establish clear links between underlying causes and deforestation. They conclude that more roads, higher agricultural prices, lower wages, and a shortage of off-farm employment generally lead to more deforestation. How technical change, agricultural input prices, household income levels, and tenure security affect deforestation is according to the study unknown. The role of macroeconomic factors, such as population growth, poverty reduction, national income, economic growth, and foreign debt is ambiguous (Angelsen & Kaimowitz 1999).

A study by Helmut Geist and Eric Lambin (2002) examined and compared the factors causing deforestation based on 152 case studies in Africa, Asia and Latin America. The authors based their analysis on a distinction between the proximate causes of deforestation – human activities on the ground and local level – and the larger underlying causes or driving forces that explain these activities. This approach recognises that people in the front line of deforestation are strongly influenced by macroeconomic and social factors operating at regional, national or global level over which they have little control. Figure 3 shows the four broad clusters of proximate causes (agricultural expansion, wood extractions, infrastructure development and others) which are linked to five clusters of underlying causes (demographic, economic, technological, policy and institutional, and cultural factors). The study states that no universal link between cause and effect exists.

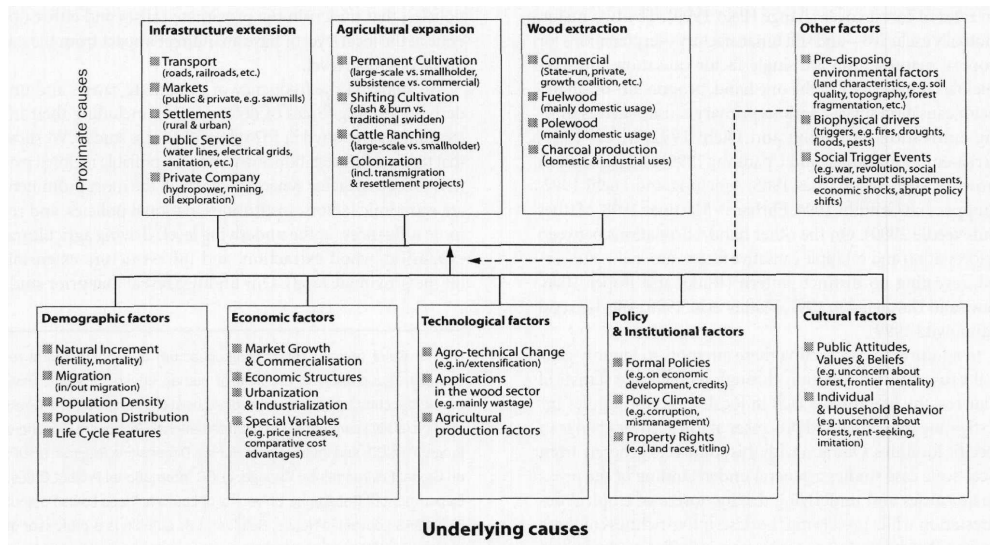


Figure 3 Proximate and underlying causes of forest decline (Geist & Lambin 2002)

Agricultural expansion is the leading land-use change associated with nearly all deforestation cases analysed in the study (96%). Among the detailed categories of proximate causes for all regions, the extension of overland transport infrastructure, followed by commercial wood extraction, permanent cultivation, cattle ranching, are the leading proximate causes of deforestation. Contrary to widely held views, case study evidence suggests that shifting cultivation is not the primary cause of deforestation (Geist & Lambin 2002).

At the underlying level, deforestation is also best explained by multiple factors and drivers. Economic factors are prominent underlying forces (81% of the analysed studies). Commercialisation and the growth of mainly timber markets as well as market failures are frequently reported to drive deforestation. Institutional factors also drive many cases of deforestation (78% of the analysed studies). These factors mainly include formal pro-deforestation measures such as policies on land use and economic development related to colonisation, transportation, or subsidies for land-based activities. Among demographic factors (61% of the analysed studies), only in-migration of colonising settlers into sparsely populated forest areas shows a notable influence on deforestation. Contrary to a common misconception, population increase due to high fertility rates is not a primary driver of deforestation at a local scale, as it intervenes in 8% of the cases only and is always combined with other factors (Geist & Lambin 2002).

Schaeffer & Rodrigues (2005) agree with the conclusions of Geist & Lambin that the underlying causes of deforestation are complex and involve an interaction of

underlying government policies (economic and environmental), as well as institutional (fragility), agritechnological and socio-economic factors (i.e., population, income, food demands).

2.2.2. Description of Different Deforestation Drivers

In the following, the factors influencing deforestation are described in more detail for the three regions Africa, Latin America, and Asia and the Pacific according to the FAO report "State of the World's Forests 2009 (FAO 2009a).

Africa

Although Africa holds only 16 percent of the global forest area, from 2000 to 2005 it lost about 4 million hectares of forests annually, close to one-third of the area deforested globally. Most forest loss is taking place in countries with a relatively large forest area. To date, conversion to small-scale permanent agriculture has been the main contributor to forest loss (see Figure 2), but investment in large-scale agriculture could become a major driver of deforestation in the future. Forest loss is likely to continue at current rates. The growing demand for food and energy and rising prices will exacerbate the situation, especially as increased investments in infrastructure open up new areas. Climate change will also have an impact; increasing frequency of droughts, declining water supplies and floods strain coping mechanisms at the local and national levels and undermine efforts to manage forests sustainably.

Latin America

In countries with relatively high forest cover and in the early stages of industrialisation, forests are highly vulnerable. Between 1990 and 2005, the region lost almost 64 million hectares, or 7 percent, of its forest area. The region accounted for more than one-third of annual global forest area loss from 2000 to 2005. All South American countries registered a net forest loss between 2000 and 2005 except Chile and Uruguay, which had positive trends because of large-scale industrial plantation programmes. With the increasing global demand for food, fuel and fibre, those forest-rich countries in South America that remain dependent on natural resources will continue to lose forests to large-scale industrial agriculture and cattle ranching as long as these are competitive. New planted forests for industrial uses, especially in Argentina, Uruguay and potentially Colombia, may partially offset the loss of natural forests, although not in

ecological terms. In most Central American countries, net forest loss declined from 2000 to 2005 in comparison with the previous decade, with Costa Rica achieving a net increase in forest area. However, in percentage terms, Central America has had still one of the highest rates of forest loss of any subregion in the world, exceeding 1 percent per year from 2000 to 2005. This rate is expected to decline as small-scale agriculture becomes uneconomic, with abandonment of marginal farmlands, increasing opportunities for alternative sources of income and growing urbanisation. Therefore, several countries in the subregion are likely to witness stabilisation and recovery in their forest area.

Asia and the Pacific

Asia and the Pacific had 734 million hectares of forest in 2005, about 3 million hectares more than in 2000. However, this increase was largely a result of the high afforestation rate in China, masking significant loss of natural forests in a number of countries; in the region as a whole (excluding China), 3.7 million hectares were lost annually between 2000 and 2005. Considering the two dominant development paths – rapid economic growth through industrialisation and agriculture remaining the mainstay of livelihoods – forest loss is likely to continue in most countries in the next two decades at more or less the current rates. Some countries have reversed their trends of forest loss, but the countries with the largest deforestation rate are unlikely to be able to do so. Expansion of large-scale commercial crops will remain to be the most important driver of deforestation in the region (see Figure 2), especially as oil-palm cultivation expands to meet the growing demand for biodiesel and foodgrain prices rise. In addition, in the more populous countries, especially those in South Asia, forest degradation will be a major problem stemming from unsustainable collection of wood and non-wood forest products and from grazing.

2.2.3. Some Drivers in Detail

Pasture Expansion

Expansion of livestock production is a key factor in deforestation, especially in Latin America where the greatest amount of deforestation is occurring – 70 percent of previous forested land in the Amazon is occupied by pastures, while feedcrops cover a large part of the remainder (FAO 2006c). In Southern America, forest area has been reduced by almost 40 percent over the past 40 years. Over the same period, pasture areas and the cattle population increased rapidly (FAO 2006b). Figure 4 puts the trend of the forest area in perspective with the pasture area and the cattle population.

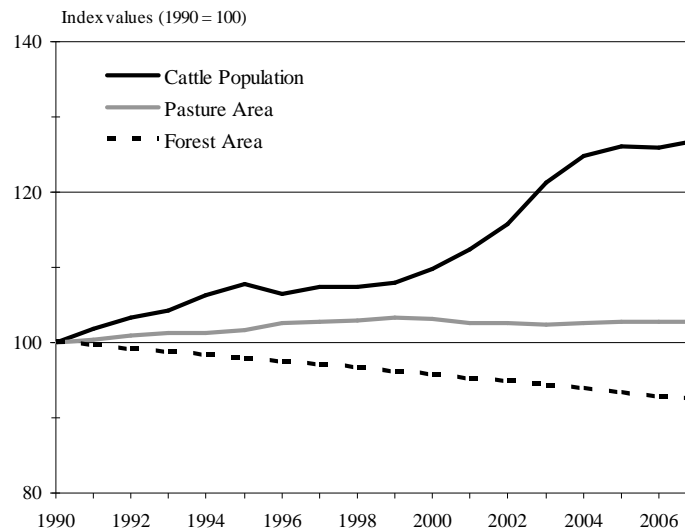


Figure 4 Forest area, pasture area and cattle population in Southern America, 1990 – 2007 (based on data from FAO 2009b).

Livestock production is projected to be the main land use replacing forest in the neotropics after clearing. Indeed, Wassenaar and colleagues estimate that the expansion of pasture into forest is greater than that of cropland (Wassenaar et al., 2006). For South America Figure 5 indicates deforestation hotspots and areas with a more diffuse deforestation pattern.

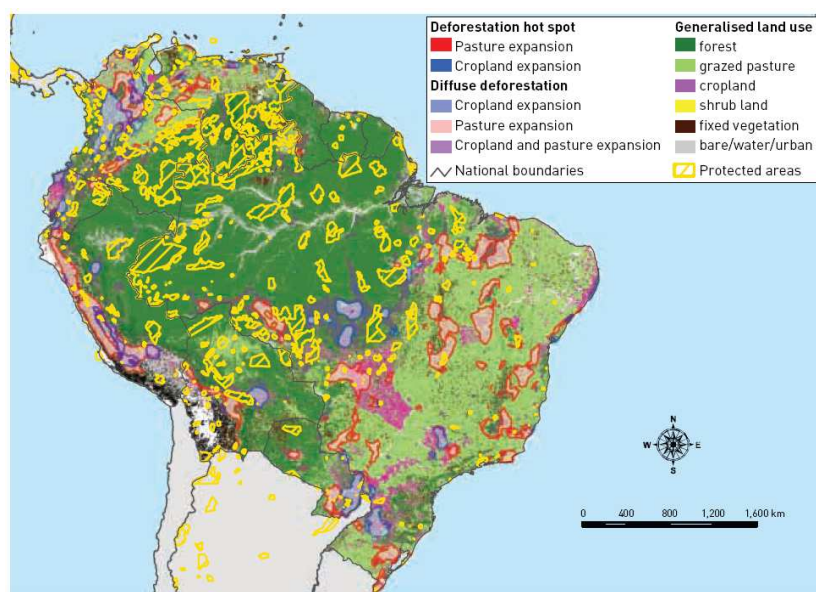


Figure 5 Projected expansion of cropland and pasture into neotropical forest from 2000 to 2010 (Wassenaar et al. 2006).

Illegal Logging

Table 1 provides estimates of illegal logging as a percentage of total wood harvest in 17 countries. Illegal logging in these countries is believed to range from 10 to 15 percent of total harvest in northwest Russia to up to 80 percent of total harvest in Bolivia and Peru and 90 percent in Cambodia (The World Bank 2006).

Table 1 Indicative estimates of illegal logging in percent of the total timber production in selected countries (The World Bank 2006).

Country	Percent of total timber production
Bolivia	80
Brazil	20–47
Cambodia	90
Cameroon	50
Colombia	42
Ecuador	70
Gabon	70
Ghana	60
Indonesia	70–80
Malaysia	Up to 35
Myanmar	50
Papua New Guinea	70
Peru	80
Russia	10–15 (northwest), 50 (far east)
Thailand	40
Vietnam	20–40

Woodfuel Consumption

Africa and Asia together use about three quarter of the woodfuel produced in the world.

Africa: About a third of the global woodfuel is produced and consumed in Africa. As household incomes and investment in appropriate alternatives remain low, wood is likely to remain an important energy source in Africa in the coming decades (FAO 2008). Forecasts suggested a 34 percent increase in woodfuel consumption from 2000 to 2020 (Figure 6). However, the rise in fuel prices in the past years suggests that this increase is likely to be even greater. The share of woodfuel in the total energy supply is likely to decline, but the absolute number of people dependent on wood energy is predicted to grow. Although woodfuel supply and demand are balanced at the aggregate level, there are areas of acute deficit, resulting in unsustainable removals, particularly around urban centres (FAO 2009a).

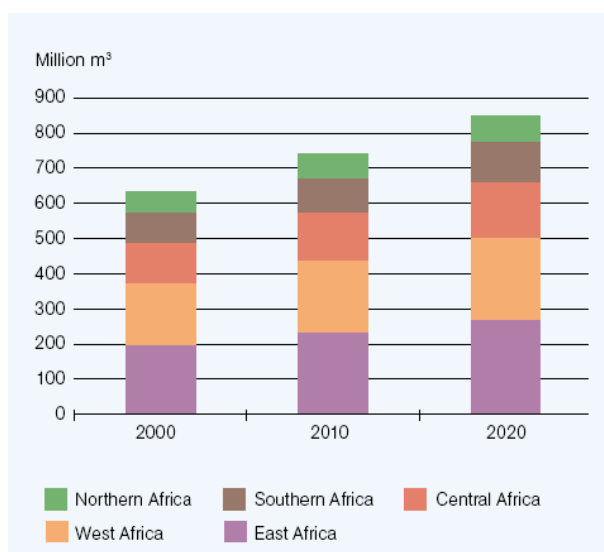


Figure 6 Woodfuel consumption. Predictions for Africa (FAO 2009a).

Asia: Almost three-quarters of the wood produced in Asia and the Pacific is burned as fuel. In South and Southeast Asia, woodfuel's share in total wood production is 93 and 72 percent, respectively. In contrast, woodfuel accounts for less than 1 percent of the wood produced in Japan (FAO 2009a).

Woodfuel consumption in the region declined between 1980 and 2006 from about 894 million to 794 million cubic metres. South Asia was the only subregion that registered an increase. As incomes and urbanization increase, woodfuel will be

substituted with electricity, kerosene and gas. For example, South Asian woodfuel consumption is expected to grow and then start to decline from around 2015. However, rising fossil fuel prices could lead to a different scenario, and the predicted fuel switching may not take place. In some cases, there could even be a shift back to woodfuel, with consequences of increased collection and forest degradation (FAO 2009a).

Agricultural Expansion

According to Geist and Lambin (2002) agricultural expansion is the leading land-use change associated with nearly all deforestation cases (96%) in the 152 case-studies they examined.

The relative importance of small- and large-scale agriculturalists is debated. A lot of Brazilian and Indonesian deforestation is undertaken by large commercial interests, and most African and mainland Southeast Asian deforestation is thought to be carried out by smallholders (see also Figure 2). The FAO (2001) estimated that expansion of shifting cultivation into undisturbed forest represented only about 5 percent of all pan-tropical changes in land use. Intensification of agriculture in shifting cultivation areas represented more than 20 percent of tropical land use change in Asia and less than 10 percent in Africa. Direct conversion of forest area to small-scale permanent agriculture accounted for 60 percent of land use change in Africa, but only a small portion elsewhere. Direct conversion of forest to large-scale permanent agriculture represented about 45 percent of tropical land use change in Latin America and about 30 percent in Asia.

Figure 7 shows forest degradation rates by suitability for rainfed annual cropping, according to the Global Agro-Ecological Zones assessment by the FAO and the International Institute For Applied System Analysis (IIASA). In Africa and Latin America degradation rates are higher on better soils, as a simple economic model would predict. But a lot of forest degradation is occurring on lands considered marginal for annual agriculture. In Asia there is no clear relationship between agroclimatic conditions and degradation rates. It is possible that in these areas, forest degradation is driven by logging or by conversion to perennials rather than annual cropping. In all three continents this analysis suggests that a substantial amount of deforestation and degradation occurs in areas with little agricultural value (Chomitz 2007).

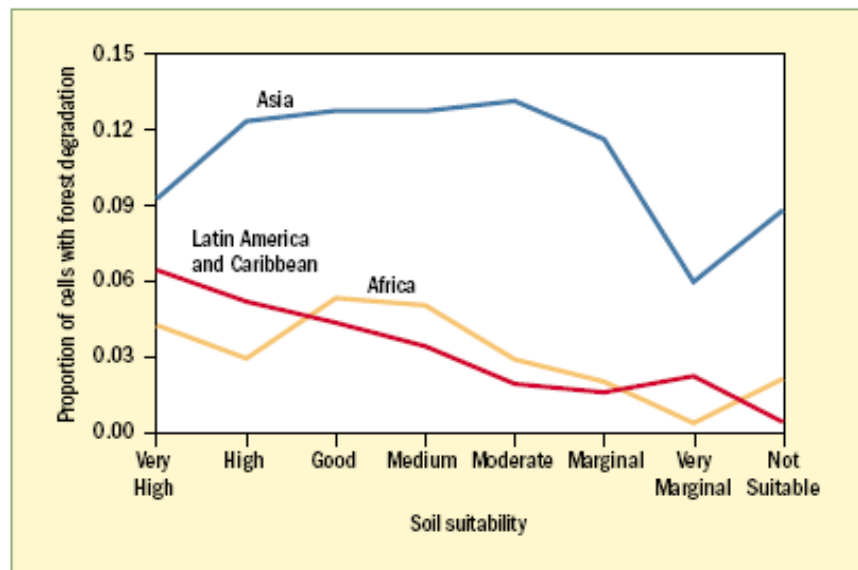


Figure 7 Forest degradation rates by the suitability for rain-fed annual cropping (Chomitz 2007).

3. Tobacco Growing Countries

3.1. Overview

Figure 8 shows the major tobacco growing countries according to their production in tons for the year 2007. The highest production quantity has China followed by Brazil, India and the USA.

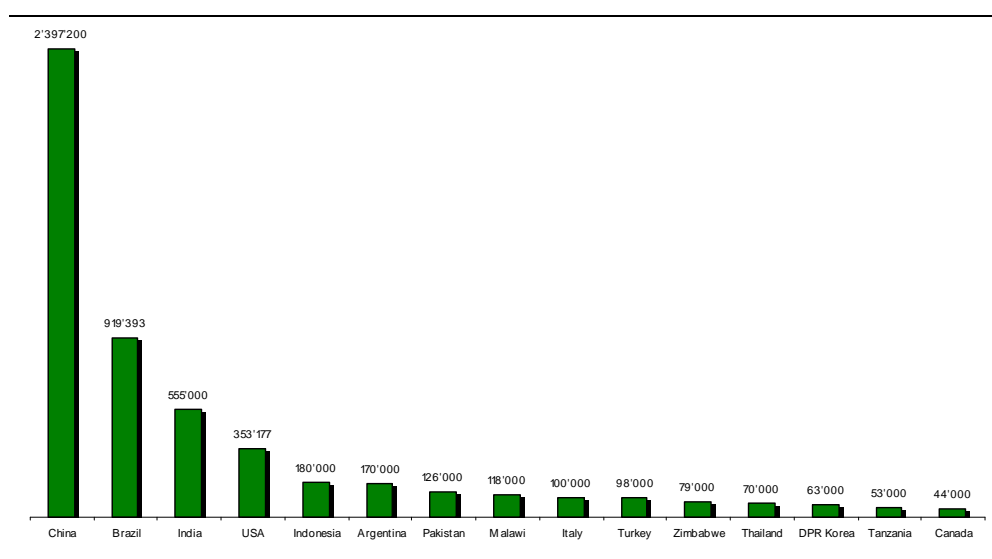


Figure 8 Tobacco Production in tons for the major tobacco growing countries for the year 2007 (based on data from FAO 2009b).

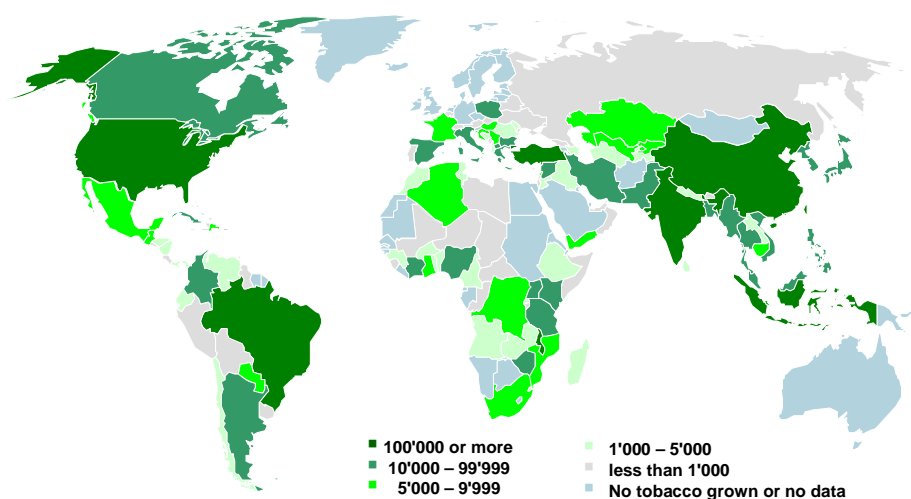


Figure 9 Land devoted to grow tobacco, area in hectares for the year 2007 (based on data from FAO 2009b).

Figure 9 shows the land area devoted to the production of tobacco worldwide. The countries with the largest agricultural areas devoted to grow tobacco are China, Brazil, India, Indonesia, Malawi, Turkey and the USA with more than 100'000 hectares.

Table 2 puts in perspective the area where tobacco is harvested and the total agricultural area for the countries where this ratio is higher than 0.5%. In addition, it shows the annual forest change in 1'000 hectares and percent for the years 2000 to 2007. Malawi has the largest share on agricultural area devoted to grow tobacco followed by the Republic of Macedonia, Lebanon, Zimbabwe, DPR Korea and Jordan. All other countries grow tobacco on less than 1% of their agricultural area. Of the countries with the largest share on agricultural area devoted to grow tobacco only Malawi (118'000 tonnes¹), Zimbabwe (79'000 tonnes), DPR Korea (63'000 tonnes) and China (2.4 million tonnes) are major tobacco producers by means of production per year.

Table 2 Harvested Tobacco Area compared to the total agricultural area for countries where this ratio is higher than 0.5% in the year 2007 and Annual Forest Change in these countries between 2000 and 2007 (based on data from FAO 2009b).

Country	Harvested Tobacco Area /	Annual Forest	
	Agricultural Area *	Change 2000-2007	
	%	1'000 ha	%
Malawi	4.97	-33.0	-0.9
Republic of Macedonia	3.68	0.0	0.0
Lebanon	3.14	1.1	0.8
Zimbabwe	1.55	-313.0	-1.6
Democratic People's Republic of Korea	1.50	-126.8	-1.9
Jordan	1.31	0.0	0.0
China	0.92	4057.8	2.3
Bulgaria	0.91	50.0	1.5
Republic of Korea	0.84	-7.0	-0.1
Brazil	0.69	-3103.0	-0.6
Cuba	0.69	55.6	2.3
Dominican Republic	0.68	0.0	0.0
Turkey	0.59	24.6	0.2
Saint Vincent and Grenadines	0.58	0.1	0.8
Indonesia	0.57	-1871.4	-1.9

* According to the definition of the FAO the total agricultural area is defined as land where permanent crops are cultivated plus arable land (land under temporary agricultural crops, temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is not included in this category.). Permanent meadows and pastures are not included in the numbers mentioned above.

¹ Production data for the year 2007 (FAO 2009b).

Only with these data it is not possible to make a general statement on the link between the part of the agricultural area where tobacco is grown and the annual forest change. Therefore, a closer look on deforestation due to the cultivation of tobacco is necessary.

3.2. Deforestation due to the Tobacco Industry

There are two possible contributions of the tobacco industry to deforestation: clearing of forested land for the production of tobacco and deforestation due to the use of wood for curing of tobacco. In the following, we address these two issues.

3.2.1. Deforestation due to Cultivation

There is no data available, which would show the impact of the tobacco production and other crops on deforestation directly. Therefore, we analyse data from the FAO and put it into perspective to the main tobacco producing countries and the change of the forest area, the change of the agricultural area, the change of the area where the different crops are cultivated ("Area Harvested") and the change of the ratio "Area Harvested / Total Agricultural Area" (see Table 5). The data analysis shows, that whenever the change of the forest area in a country over a certain period (1990-2000 or 2000-2007) was negative, the agricultural area increased. For example the forest area in Indonesia decreased between 1990 and 2000 of about 16%, whereas the agricultural area increased of 5% in the same period. This fact gives first evidence that agricultural expansion has an impact on deforestation. In addition, the data show the relative impact of the tobacco production on the deforestation due to agricultural expansion. For example the area where tobacco was cultivated in Indonesia between 1990 and 2000 decreased by 29% and the share of tobacco on the total agricultural area by about 32%. During the same time the area where palm oil fruits were cultivated almost doubled. In this case it can be concluded, that the production of palm oil fruits may have been a main driver on deforestation in Indonesia between 1990 and 2000 and the tobacco production certainly had no significant impact on deforestation due to agricultural expansion.

In summary, Table 3 gives an overview of the main and secondary drivers of deforestation due to agricultural expansion for countries with a negative forest area change. The selection is based on Table 4 and Table 5: Considered as main drivers are those crops, where the change in the area harvested and the change in the ratio area harvested to agricultural area are highest.

Table 3 Main and secondary agricultural drivers of deforestation in selected countries with negative forest change.

Country	1990 - 2000		2000 - 2007	
	Main Drivers	Secondary Drivers	Main Drivers	Secondary Drivers
Brazil	Oil palm fruit, Soybeans	<i>Tobacco</i>	Wheat, Soybeans, <i>Tobacco</i>	Cotton, Oil palm fruit, maize
Indonesia	Oil palm fruit	Rize, Maize, Cotton	Oil palm fruit	<i>Tobacco</i>
Argentina	Maize, Soybeans	Rize, <i>Tobacco</i> , Wheat	Soybeans	<i>Tobacco</i>
Pakistan	Soybeans	<i>Tobacco</i>		<i>Tobacco</i> , Rize, Cotton
Malawi	Rice	<i>Tobacco</i>	<i>Tobacco</i>	Rize, Maize
Zimbabwe	Cotton, <i>Tobacco</i>	Rice, Maize, Soybeans		Soybeans, Cotton, Maize
Tanzania	Maize, <i>Tobacco</i>	Rice, Wheat	Wheat, Rice	Cotton

Table 4 Share of the harvested area in total agricultural area for different crops and main tobacco producing countries (in % for the years 1990 and 2007) (based on data from FAO 2009b).

Country	Ratio 'Area Harvested' / 'Agricultural Area'													
	Tobacco		Rice		Maize		Soybeans		Wheat		Cotton		Oil palm fruit	
	1990	2007	1990	2007	1990	2007	1990	2007	1990	2007	1990	2007	1990	2007
China	1.2%	0.9%	25.5%	19.3%	16.3%	18.4%	5.8%	5.8%	23.4%	15.0%	4.3%	3.6%		
Brazil	0.5%	0.7%	6.9%	4.4%	19.8%	20.8%	20.0%	31.0%	4.7%	2.7%	3.3%	1.7%	0.1%	0.1%
India	0.2%	0.2%	25.2%	26.0%	3.5%	4.6%	1.5%	5.0%	13.9%	16.5%	4.4%	5.5%		
USA	0.2%	0.1%	0.6%	0.6%	14.4%	20.2%	12.2%	17.7%	14.9%	11.9%	2.5%	2.5%		
Indonesia	0.7%	0.6%	32.8%	32.4%	9.9%	9.2%	4.2%	1.5%			0.1%	0.1%	2.1%	12.2%
Argentina	0.2%	0.3%	0.4%	0.5%	5.7%	8.5%	18.1%	48.1%	21.2%	16.4%	2.0%	0.9%		
Pakistan	0.2%	0.3%	10.1%	11.7%					37.5%	38.1%	12.7%	14.6%		
Malawi	4.2%	5.0%	1.2%	1.7%	56.5%	54.1%			0.1%	0.1%	2.0%	1.6%		
Italy	0.7%	0.4%	1.8%	2.4%	6.4%	11.1%	4.4%	1.4%	23.2%	21.0%				
Turkey	1.2%	0.6%	0.2%	0.3%	1.9%	2.2%	0.3%	0.0%	34.1%	34.6%	2.3%	3.0%		
Zimbabwe	2.0%	1.5%			38.1%	43.2%	1.8%	2.1%	1.9%	0.8%	7.6%	11.9%		
Thailand	0.3%	0.2%	42.7%	54.7%	7.5%	5.0%	2.0%	0.7%			0.3%	0.0%	0.5%	2.3%
Korea, DPR	1.6%	1.5%	24.3%	19.2%	27.6%	16.5%	13.8%	10.0%	3.6%	3.1%	0.6%	0.6%		
Tanzania	0.2%	0.4%	3.8%	6.5%	16.3%	29.4%	0.1%	0.0%	0.5%	0.9%	3.9%	2.5%		
Canada	0.1%	0.0%			2.0%	2.6%	0.9%	2.2%	27.2%	16.6%				

Table 5

Change of the forest area and the agricultural production area in total and for different crops, and share of the production area in the total agricultural area, for main tobacco producing countries (changes are given in % between the years 1990 to 2000, and the years 2000 to 2007) (based on data from FAO 2009b).

1990-2000																
Country	Change 'Forest Area'	Change 'Agricultural Area'	Change 'Area Harvested (CAH)' and Change 'Ratio Area Harvested/Agricultural Area (RAH)'													
			Tobacco		Rice		Maize		Soybeans		Wheat		Cotton		Oil palm fruit	
			CAH	RAH	CAH	RAH	CAH	RAH	CAH	RAH	CAH	RAH	CAH	RAH	CAH	RAH
China	13%	10%	-10%	-18%	-10%	-18%	7%	-2%	23%	12%	-13%	-21%	-28%	-34%	5%	-5%
Brazil	-5%	14%	13%	0%	-7%	-18%	2%	-10%	19%	5%	-60%	-65%	-58%	-63%	36%	20%
India	6%	1%	5%	3%	5%	3%	12%	10%	150%	147%	17%	15%	15%	14%		
USA	1%	-5%	-36%	-32%	8%	14%	8%	14%	28%	35%	-23%	-19%	11%	17%		
Indonesia	-16%	5%	-29%	-32%	12%	7%	11%	5%	-38%	-41%			8%	3%	199%	185%
Argentina	-4%	5%	36%	29%	62%	54%	98%	88%	74%	65%	11%	6%	-39%	-42%		
Pakistan	-16%	5%	38%	32%	12%	7%			435%	410%	8%	3%	10%	5%		
Malawi	-8%	21%	19%	-2%	50%	24%	7%	-12%			8%	-11%	-17%	-31%		
Italy	13%	-6%	-56%	-53%	3%	9%	39%	47%	-52%	-49%	-16%	-11%	-100%	-100%		
Turkey	4%	-5%	-26%	-22%	25%	31%	8%	13%	-80%	-79%	0%	5%	2%	7%		
Zimbabwe	-14%	11%	51%	36%	25%	12%	24%	11%	16%	4%	-17%	-26%	62%	46%		
Thailand	-7%	-8%	-31%	-26%	13%	22%	-21%	-15%	-47%	-43%	60%	73%	-64%	-61%	117%	135%
Korea, DPR	-17%	13%	10%	-3%	-11%	-21%	-27%	-36%	-9%	-20%	-34%	-42%	19%	5%		
Tanzania	-10%	0%	114%	114%	34%	34%	127%	127%	2%	2%	33%	33%	-45%	-45%	7%	7%
Canada	0%	1%	-19%	-19%			7%	7%	119%	118%	-23%	-23%				

2000-2007																
Country	Change 'Forest Area'	Change 'Agricultural Area'	Change 'Area Harvested (CAH)' and Change 'Ratio Area Harvested/Agricultural Area (RAH)'													
			Tobacco		Rice		Maize		Soybeans		Wheat		Cotton		Oil palm fruit	
			CAH	RAH	CAH	RAH	CAH	RAH	CAH	RAH	CAH	RAH	CAH	RAH	CAH	RAH
China	16%	6%	-3%	-8%	-3%	-8%	22%	15%	-4%	-10%	-14%	-19%	34%	27%	7%	1%
Brazil	-4%	2%	49%	46%	-21%	-22%	19%	17%	51%	48%	71%	67%	38%	36%	27%	24%
India	0%	-1%	-12%	-11%	-2%	0%	18%	19%	33%	35%	2%	3%	8%	10%		
USA	0%	-3%	-25%	-23%	-10%	-7%	19%	23%	4%	7%	-4%	-1%	-20%	-17%		
Indonesia	-13%	12%	28%	14%	3%	-8%	-1%	-12%	-30%	-38%			-5%	-14%	127%	104%
Argentina	-3%	16%	54%	33%	-13%	-25%	-8%	-21%	86%	61%	-15%	-27%	-8%	-21%		
Pakistan	-14%	2%	10%	8%	9%	8%			-98%	-98%	0%	-1%	11%	10%		
Malawi	-6%	9%	31%	20%	21%	11%	18%	8%			-12%	-19%	21%	12%		
Italy	8%	-14%	-10%	5%	6%	23%	2%	18%	-48%	-39%	-12%	2%				
Turkey	2%	-6%	-38%	-34%	47%	56%	-1%	5%	-20%	-15%	-9%	-3%	12%	19%		
Zimbabwe	-11%	0%	-43%	-43%	0%	0%	2%	2%	10%	10%	-40%	-40%	8%	8%		
Thailand	-3%	0%	-8%	-7%	5%	5%	-22%	-22%	-35%	-35%	-17%	-16%	-69%	-69%	109%	110%
Korea, DPR	-13%	7%	2%	-5%	7%	0%	0%	-7%	-3%	-10%	58%	47%	0%	-7%		
Tanzania	-8%	2%	-18%	-20%	29%	26%	-19%	-21%	-11%	-12%	33%	30%	17%	15%	0%	-2%
Canada	0%	0%	-31%	-31%			23%	23%	10%	10%	-20%	-20%				

3.2.2. Deforestation due to Tobacco Curing

There are primarily four different techniques to cure tobacco: Air-cured, fire-cured, flue-cured and sun-cured tobacco. For all techniques the cut plants or pulled leaves are transferred to tobacco barns, where they are cured. The curing methods vary with the type of tobacco grown.

- *Flue-cured* tobacco was originally strung onto tobacco sticks, which were hung from tier-poles in curing barns. These barns have flues which run from externally fed fire boxes, heat-curing the tobacco without exposing it to smoke, slowly raising the temperature over the course of the curing. The process generally takes about a week. This method produces cigarette tobacco that is medium to high in sugar and has low to high levels of nicotine.
- *Fire-cured* tobacco is hung in large barns where fires of hardwoods and/or hardwood byproducts are kept on continuous or intermittent low smoulder and takes between three days and ten weeks, depending on the process and the tobacco. Fire curing produces a tobacco low in sugar and medium to high in nicotine. Pipe tobacco, chewing tobacco, and snuff, as well as a limited amount of cigar and cigarette tobacco, are fire cured.
- *Air-cured* tobacco is hung in well-ventilated barns and allowed to dry over a period of four to eight weeks. Air-cured tobacco is low in sugar, which can give the tobacco smoke a light, sweet flavour, and low to high in nicotine. Some cigar and burley tobaccos are air cured.
- *Sun-cured* tobacco dries in the sun. This method is used in Turkey, Greece and other Mediterranean countries to produce oriental tobacco. Sun-cured tobacco is high in sugar and low in nicotine and is used primarily in cigarettes.

Fire- and flue-cured tobacco mainly uses wood as fuel to provide the energy needed for the curing process. In 2008, about 70% of the total global tobacco production – equal to 4'175'400 tonnes farm sales weight, the weight as purchased from the farmers – was Flue-Cured Virginia (FCV) tobacco. Fire-cured tobacco represents less than 1% of the world production, with 54'400 tonnes. The largest producers of FCV are China (2'300'000 tonnes), Brazil (608'000 tonnes), India (279'300 tonnes), U.S. (218'600 tonnes), E.U. (128'000 tonnes) and Argentina (84'800 tonnes) (ITGA 2009). In Africa, major producers of FCV are Tanzania (51'233 tonnes), Zimbabwe (48'843 tonnes), Malawi (23'767 tonnes), Uganda (16'000 tonnes), Kenya (16'000 tonnes) and Zambia (14'069 tonnes).

Estimation of Tobacco's Share on Deforestation due to the Curing Process

In the following the approach of Geist (1999) calculating the share of curing tobacco to deforestation is described and updated with new data and estimations. Geist applied in his study the following six steps:

(1) Total annual world tobacco production

Table 6 shows the annual world tobacco production in metric tons green weight for the years 1990, 2005, 2007 and 2008 and the share of the different types of tobacco. Flue-cured tobacco is with about 70% of the total annual production the major kind of tobacco produced worldwide. Since 1990 the total annual tobacco production decreased by about 20%.

Table 6 Annual World Tobacco Production in metric tons green weight for the total production and different types of tobacco (FAO 2009b (for 1990) and ITGA 2009).

Annual World Tobacco Production									
Year	Total	Flue-Cured	Burley	Oriental	Light Air-Cured	Dark Air-Cured	Dark-Fired	Sun-Cured	Others
1990	7706'900	4921'600	870'100	786'400			60'100		1227'700*
2000	5955'154	3723'958	798'187	533'197	38'583	173'178	67'147	274'704	346'200
2005	5928'882	4037'278	771'277	352'457	31'197	144'681	37'220	190'143	364'629
2007	5498'702	3874'528	615'663	234'769	32'375	142'460	40'057	189'900	368'950
2008	6030'446	4175'400	733'834	266'422	9'715	132'447	54'403	232'175	426'050

In % of total annual production									
1990		63.9%	11.3%	10.2%			0.8%		15.9%
2000		62.8%	13.5%	9.0%	0.7%	2.9%	1.1%	4.6%	5.8%
2005		68.1%	13.0%	5.9%	2.4%	0.6%	3.2%	6.2%	0.0%
2007		70.5%	11.2%	4.3%	0.6%	2.6%	0.7%	3.5%	6.7%
2008		69.2%	12.2%	4.4%	0.2%	2.2%	0.9%	3.9%	7.1%

* Data for 1990 includes air-cured, sun-cured and others

(2) Annual tobacco production using wood

Flue-cured and dark fire-cured tobacco are the two types of tobacco which use wood for the curing process². Other common energy sources used for the curing process are coal, oil and gas. Table 7 shows the share of wood in percentage of flue-cured tobacco for different regions and Table 8 for individual countries. The differences between the regions are considerable: while the use of wood is of minor importance in Europe and North America, it is widely used in South America, Africa and – to a lesser degree – in Asia.

² Other curing processes, e.g. curing burley tobacco use wood only for poles. As this factor is from inferior importance it is neglected in this study.

Table 7 Share of wood-based flue-curing of tobacco (Geist 2000).

Region	Fuelwood for curing as % of flue-cured tobacco
Europe	< 1%
North & Central America	2%
South America	95%
Africa	44%
Asia	10%
World	19%

Table 8 Share of wood-based flue curing of tobacco for selected countries (Geist 2000 and update for Argentina from Universal Leaf Tabacos SA 2009)

Number of growing countries	Fuelwood as % of flue tobacco cured						
	100%	90%	67%	50%	36%	30%	5%
Africa	18 ^a					1 ^b	
America		16 ^c					1 ^d
Asia & Oceania	2 ^c	7 ^f			9 ^g	2 ^h	
World (N=56)	27	16	1	9	2	1	

^a Angola, Benin, Congo, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Morocco, Mauritius, Mozambique, Nigeria, Reunion, Sierra Leone, Tanzania, Uganda and Zambia

^b Zimbabwe ^c Brazil, Honduras ^d Argentina*

^e Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Jamaica, Mexico, Nicaragua, Peru, Trinidad & Tobago, Uruguay and Venezuela

^f Pakistan, India, Myanmar, Cambodia, Laos, Malaysia and Philippines

^g Cyprus, Iran, Jordan, North Korea, South Korea, Syria, Thailand, Vietnam and Yemen

^h Bangladesh, Sri Lanka

* A recent report from Universal Leaf Tabacos SA (2009) indicates that in Argentina 95% of the flue-cured tobacco is dried using gas as a fuel. The remaining 5% is cured with wood, purchased from wood dealers. Geist indicated this value to be 67%.

Applying the world mean from Table 7 (19%) the annual global tobacco production using wood for the curing process can be calculated (Table 9). Comparing to 1990 the tobacco production using wood decreased from almost 1 million tonnes to about 850'000 tonnes in 2008.

Table 9 Annual global tobacco production using wood for the curing process (ITGA 2009).

Year	Annual global tobacco production using wood	
	[tonnes]	[% of total tobacco production]
1990	995'204	12.9%
2005	804'303	13.6%
2007	776'217	14.1%
2008	847'729	14.1%

(3) Annual solid wood required for tobacco

The amount of wood used for curing varies substantially according to the barns used and the techniques applied. The range of estimations for the amount of wood used is between 3 kg wood/kg tobacco for an energy-efficient barn up to 30 kg wood/kg tobacco for inefficient traditional barns (see Table 10).

Table 10 Amount of wood used per kilogram tobacco cured.

Techniques	Source	kg wood / kg tobacco cured
Traditional small-scale farmer	ProBEC Malawi 2006	10 to 30
Global mean	Geist 1999	8.6
Median of 14 countries	ITGA 1997	5.5
Rocket Barn small-scale farmer	ProBEC Malawi 2006	3 to 3.5

(4) Additional annual (deficit) wood required for curing tobacco

Using the degree of self-sufficiency in wood obtained from private woodlots, the share and amount of solid wood originating from open and common land and natural forests can be estimated.

The percentage of tobacco farmers who are self-sufficient in wood can be converted to the equivalent deficit wood needed. Table 11 shows the percentage of tobacco farmers who have woodlots for the wood needed for the curing process for different countries based on data from Geist (2000). The global mean is 42%, with big differences between the countries. The data collected by Geist refer to data collected between 1990 and 2000, while reports of tobacco companies show that tree planting activities to increase self-sufficiency have increased in the last years (see also chapter 4.1.).

Table 11 Percentage of flue-curing tobacco farmers who are self-sufficient in wood supply for the curing process, based on Geist (2000) and increase due to tree-planting activities by the tobacco industry.

Country	Percentage of flue-curing tobacco farmers who are self-sufficient in wood for the curing process	Increase due to tree-planting and other activities by the tobacco industry
Argentina	10%	N/A ¹
Brazil	82%	Yes ²
Honduras	10%	N/A
Congo	100%	N/A
Kenya	100%	N/A
Malawi	20%	Yes ³
Nigeria	30%	N/A
Sierra Leone	25%	N/A
Tanzania	7%	Yes ⁴
Uganda	80%	N/A
Zambia	10%	Yes ⁵
Zimbabwe	70%	N/A
Sri Lanka	75%	N/A
Pakistan	10%	N/A
Global Mean	42%	N/A

¹ N/A = No data available

² This value may have increased due to the following reasons: Governmental laws prohibit the cutting of trees for tobacco curing and there have been reforestation activities documented by Universal Leaf Tabacos Ltda., which handles about 20% of the domestic tobacco production (see also chapter 4.1.).

³ There have been considerable tree planting efforts by the Limbe Leaf Tobacco Company, which produces about 50% of the domestic tobacco (see also chapter 4.1.). This may have led to an increase of the grade of self-sufficiency.

⁴ Due to a programme of reforestation and land regeneration by the Association of Tanzania Tobacco Traders (A.T.T.T.) the grade of self-sufficiency substantially increased since 2002 (see also chapter 4.1. and chapter 5.4.).

⁵ There have been tree planting efforts by the Zambia Leaf Tobacco Company Limited, which produces about 50% of the domestic tobacco (see also chapter 4.1.). This may have led to an increase of the grade of self-sufficiency.

(5) Sustained-yield area of woody biomass needed to provide the wood required for curing tobacco

Using mean annual increment (MAI) values, the equivalent area of woody biomass needed and assumed to be harvested on a sustained-yield basis can be calculated. With this approach, the sustainable managed forest area necessary for the curing process of tobacco can be estimated.

The mean annual increment is the average annual increase in volume of individual trees or stands up to a specified point in time. The MAI changes with different growth phases in a tree's life, being highest in the middle years and then slowly decreasing with age. The point at which the MAI peaks is commonly used to identify the biological maturity of the stand and its readiness for harvesting. It is often used to indicate the yield, since it represents the long-term sustainable quantity of wood which can be harvested.

MAI for different plantation forests:

- Temperature plantations = 2 – 12 m³/ha (mean: 7 m³/ha)
- Tropical plantations = 6 – 24 m³/ha (mean: 15 m³/ha)

(6) Equivalent area of natural woody biomass deforested

Using growing stock (GS) values as specified for a medium woody biomass potential (forest, woodlands, vegetational mosaics), the wooded area needed and removed (deforested), can be calculated considering the grade of self-sufficiency of the tobacco farmers.

The growing stock of woody biomass is the commercially harvestable part of the tree, which gives the (solid) volume of wood standing on a given area. The growing stock of a medium woody biomass potential, which represents the most common natural environments where tobacco is grown, is applied: 27 tonnes per hectare.

Estimation of Tobacco's Share on Deforestation

Based on the described steps above, the share of the tobacco curing process on deforestation can be estimated. Table 12 shows this share for different assumptions of wood requirement for the curing process (3, 5.5, 8.6 and 30 kg wood/kg tobacco) for the year 2009. Values are calculated for a share of wood-based flue-curing of 19%, a grade of self-sufficiency of 42% (global mean value),

a mean annual increment of 15 m³/ha and a growing stock of 27 t/ha. Based on these values, the share of the curing process on deforestation is between 0.7% and 7.5%, whereas the extreme values on both sides may be not realistic scenarios on the global scale. It can be assumed that the estimated tobacco's share on deforestation due to the curing process is between 1 and 2%.

Table 12 Estimation of the global share on deforestation of the tobacco curing process for the year 2008 (based on data from FAO (2009b), ITGA (2009) and Geist (1999)).

kg wood / kg tobacco	30.0	8.6	5.5	3.0
(1) Total Production 2008 [tonnes]	6'030'446	6'030'446	6'030'446	6'030'446
(2) Production using wood [tonnes]	847'729	847'729	847'729	847'729
(3) Solid wood required [t]	25'431'870	7'254'017	4'662'510	2'543'187
(4) Annual (deficit) wood required [t]	14'750'485	4'207'330	2'704'256	1'475'048
(5) Sustained yield area [ha]	1'092'628	311'654	200'315	109'263
(6) Equivalent area of natural biomass [ha]	546'314	155'827	100'158	54'631
Tobacco's share on deforestation [%]	7.5%	2.1%	1.4%	0.7%

Values applied:

- Share of wood-based flue-curing = 19%
- Grade of self-sufficiency = 0.42
- GS = 27 t/ha
- MAI = 15m³/ha
- Estimated total global area deforested in 2008 = 7'326'314 ha/year

If the grade of self-sufficiency in wood required for the curing process can be augmented, the share on deforestation will decrease (see Table 13). For example the share on deforestation can be decreased from 1.4% (grade of self-sufficiency of 42%) to 0.5% for a consumption of 5.5 kg/kg tobacco based on a grade of self-sufficiency of 80%.

Table 13 Tobacco's share on deforestation for different grades of self-sufficiency.

Grade of self-sufficiency	Tobacco's share on deforestation [%]			
	30.0	8.6	5.5	3.0
0%	12.9%	3.7%	2.4%	1.3%
10%	11.6%	3.3%	2.1%	1.2%
20%	10.3%	2.9%	1.9%	1.0%
30%	9.0%	2.6%	1.6%	0.9%
40%	7.7%	2.2%	1.4%	0.8%
50%	6.4%	1.8%	1.2%	0.6%
60%	5.1%	1.5%	0.9%	0.5%
70%	3.9%	1.1%	0.7%	0.4%
80%	2.6%	0.7%	0.5%	0.3%
90%	1.3%	0.4%	0.2%	0.1%
100%	0.0%	0.0%	0.0%	0.0%

Values applied:

- Share of wood-based flue-curing = 19%
- GS = 27 t/ha
- MAI = 15m³/ha
- Estimated total global area deforested in 2008 = 7'326'314 ha/year

Uncertainties and Assumptions

The described calculations above are subject to some uncertainties and assumptions:

- **Annual tobacco production using wood:** Unfortunately there is no current data available for the share of wood-based flue-curing of tobacco aggregated to the continent or world level. The data listed in Table 7 are derived from the early 90s.

Some considerations: As China is the largest FCV producer in Asia and still cures most of his tobacco with coal, the percentage of wood-based flue-curing may still be the same. In contrary, the percentage of wood-based flue-curing in Africa may have increased, mainly because many of the commercial FCV farmers in Zimbabwe are out of business now. Most of these farmers used coal for the curing process. With an increase in small-holder FCV production, the percentage of wood-use may have increased. The percentage of wood-based flue-curing in the South American region is likely to have remained constant, because in Brazil as one of the largest FCV producer mainly wood is used for the curing process.

- **Annual solid wood required for tobacco:** There is a controversy about the issue how much wood is required per kg of cured tobacco. The values range from 3 to 30 kg wood/kg tobacco. To our knowledge, no global estimation

based on current country specific data or systematic evaluations of how many energy-efficient curing barns are in use worldwide exist. However, reports from tobacco companies seem to indicate that fuel-efficiency increased for selected countries in the recent years.

- **Self-sufficiency of tobacco farmers:** The data cited above refer to a compilation of data made in the years 1990 to 1997. There are initiatives of the tobacco industry which aim to increase the grade of self-sufficiency, which significantly decrease the impact on natural forests due to the curing of tobacco. In addition governmental agreements such as in Brazil forbid the use of wood from natural forests to cure tobacco. As already mentioned in Table 11 there is data available concerning tree-planting activities by the tobacco industry in Brazil, Malawi, Tanzania and Zambia. These activities are described in some more detail in chapter 4.

3.2.3. Comparison to other Crops

Table 14 shows the area where different crops are harvested in percentage of the total area where crops are harvested for Africa, South America, Asia and the world. The compiled data show, that the share of tobacco (up to 0.51% in South America) is small compared to other crops. Besides the major food crops wheat, maize, rice and soybeans, also crops like cotton, sugar cane, oil palm fruit and natural rubber have a substantially higher share on the total harvested area than tobacco. Implicitly, this can be interpreted in the way that the share on deforestation due to agricultural expansion is smaller for tobacco than for other crops.

Table 14 Comparison of the Area where different crops are harvested in percentage of the total area harvested for the world, Africa, South America and Asia (FAO 2009b).

	World	Africa	South America	Asia
Wheat	17.04%	4.52%	7.74%	16.74%
Maize	12.57%	13.35%	17.25%	8.66%
Rice	12.39%	4.33%	4.32%	23.97%
Soybeans	7.18%	0.58%	35.36%	3.35%
Cotton	2.63%	2.11%	1.76%	3.74%
Sugar cane	1.81%	0.79%	7.30%	1.74%
Oil palm fruit	1.10%	2.07%	0.36%	1.51%
Natural rubber	0.68%	0.32%	0.11%	1.32%
Jute	0.11%	0.002%	0.004%	0.23%
Sisal	0.03%	0.05%	0.25%	0.00%
Tobacco	0.29%	0.18%	0.51%	0.40%

4. Activities of the Tobacco Industry

To counteract potential negative effects, the tobacco industry has stepped up efforts to set up woodlots for fire wood, to reforest land, to support sustainable forest management, and to develop more wood-efficient curing technologies. The industry aims to be self-sufficient in terms of wood for the curing process or to use other fuel sources for this process. Unfortunately, it is difficult to find reports on tree-planting and other activities by the tobacco industry. However, written evidences from other industries such as the mining, cattle or cotton industry are difficult to find as well. In the following, examples of activities undertaken by the tobacco industry are described.

4.1. Selected Tree Planting Initiatives

British American Tobacco³

As an example, British American Tobacco has an afforestation programme since 1980 in Bangladesh to compensate for wood burning in tobacco curing. The pressure on land for farming meant that farmers were at first reluctant to allocate land to trees, especially as they might not be able to harvest them for some years.

The company's solution was to plant fast-growing trees on canal banks, roadsides and railway embankments. To date, 710 km of canal banks, 115 km of roadsides, and 52 km of railway embankments have been planted. Through commitment by company managers in the field, farmers' demand for saplings has increased to the point where over 3.5 million trees are planted a year.

British American Tobacco Bangladesh received the Prime Minister's Award for Afforestation in 1993 and 2005 and, as a result of the company's afforestation activities, Bangladesh now has a wood fuel surplus of 80,000 metric tonnes.

³ Paragraph is based on British American Tobacco 2009a.

*Imperial Tobacco*⁴

Imperial Tobacco aims to reduce the impact of its activities on wood consumption in Madagascar. High levels of wood consumption contribute to deforestation and loss of habitat, and it has been Imperial Tobacco's policy to promote a tree planting programme with the agreement of the appropriate authority, the Service des Eaux et Forêts.

Woodlot planting has been introduced to provide materials for the construction of drying and grading barns and fuel for curing barns. The programme, introduced with the agreement of local environmental departments, aimed to be self-sufficient by 2006, yielding as much or more wood than used in the construction and curing process.

In addition, a forestation programme promotes the reintroduction of indigenous plants by cultivating stocks in nurseries, and planting species such as bamboo alongside rivers to protect the environment against soil erosion during the heavy rain and flood season.

*ITC Limited*⁵

The ITC limited has a large Social Forestry⁶ programme in India. For example, during 2008 and 2009, about 2'392 hectares of land are brought under Social Forestry plantations, expanding the cumulative total to 14'360 hectares. The Social Forestry project today covers 454 villages and 16'061 poor households. In addition, the CDM Executive Board of the United Nations Framework Convention on Climate Change has confirmed the registration of a large-scale social forestry CDM project developed by ITC. The project, which has been initiated on private degraded wastelands owned by tribals and the rural poor in India, installed a carbon sink of about 3'000 hectares. The project titled "Reforestation of severely degraded landmass in Khamman district of Andhra Pradesh" is being implemented

⁴ Paragraph is based on Imperial Tobacco 2009.

⁵ Paragraph is based on ITC 2009.

⁶ A Social Forestry Program intends to afforest degraded land in rural areas. A Social Forestry Program can contain farm forestry (encouragement of farmers to plant trees on their own farmland), community forestry (raising of trees on community land), extension forestry (planting trees on the sides of roads, canals, railways and wastelands) and agroforestry (silvicultural practices combined with agricultural crops and live stock farming on the same land).

through several Non Governmental Organisations in close collaboration with local communities.

Zambia Leaf Tobacco Company⁷

Zambia Leaf Tobacco Company (ZLTC) a member of Universal Leaf Africa supports growing tobacco in Zambia. Most small-scale tobacco farmers in Zambia depend on natural woodlands. It is estimated that 1'500 kg tobacco utilizes 4'500 to 7'000 kg of wood. Thus, ZLTC has initiated an awareness programme amongst all its contracted farmers to remedy the problem of deforestation. The objective is to help growers plant sufficient trees to fully meet the FCV curing requirements within 6 years. In a first phase between 2004 and 2005 the tobacco growers reforested a total surface of 1'154 hectares with a total of eight fast-growing multipurpose tree species: *Acacia polyacantha*, *Acacia galpinii*, *Albizia lebbeck*, *Gliricida sepium*, *Khaya nyasica*, *Senna siamea*, *Senna spectabilis* and *Faidherbia albida*.

Limbe Leaf Tobacco Company⁸

Limbe Leaf Tobacco Company (LLTC) implements a tree planting programme in Malawi. Between 2002 and 2008 a total of 12'690 hectares were afforested. About 16 million trees survived. This tree planting programme was carried out in cooperation with the Land Resources Conservation Department of the Ministry of Agriculture and Food Security and with the Agricultural Research and Extension Trust of Malawi. Table 15 gives a summary of the programme between 2002 and 2008 and Table 16 shows the planned programme between 2008 and 2011.

Table 15 Summary of the programme of LLTC in Malawi 2002 – 2008.

Description	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	Total 2002-08
Ha planted with trees	1'260	1'590	3'070	2'845	2'845	1'080	12'690
Trees planted per ha	1'666	1'666	1'666	1'666	1'666	1'666	
Survival rate of trees	64%	75%	73%	76%	81%	65%	
Total trees survived	1'339'640	1'984'334	3'753'770	3'603'770	3'820'121	1'500'000	16'001'635

⁷ Paragraph is based on Zambia Leaf Tobacco Company (2005).

⁸ Paragraph is based on Limbe Leaf Tobacco Company (2009).

Table 16 Outline of the programme of LLTC in Malawi 2008 – 2012.

Description	2008-09	2009-10	2010-11	2011-12	Immediate impact
Ha planted with trees	930	960	1'110	1'050	4'050 ha planted
Expected amount of trees planted per ha	1'666	1'666	1'666	1'666	7'200'000 trees planted

Association of Tanzania Tobacco Traders (A.T.T.T.)⁹

The Association of Tanzania Tobacco Traders (A.T.T.T.) started a programme of tree planting and land regeneration in 2002 to ensure the sustainability of wood production as source of fuel to cure tobacco.

The objectives of the project were to address environmental issues with full village involvement, to train the community members in tree nursery and forest management, to ensure self-sufficiency for the tobacco-growing community in terms of wood and to regenerate natural forest land.

The programme covered an average of 43'351 ha in total and ensured the raising of about 53 million trees in total, with a successful survival rate of 73% since 2002. 1 ton of cured tobacco needs about 181 trees to be cut each year, which leads to about 9.5 million trees that are needed to be cut each year for the annual tobacco production of about 53'000 tonnes in Tanzania. Assuming that a tree needs to grow on average 5-7 years before it can be cut, about 57 million trees (of different ages) are needed to be grown to be self-sufficient. Thus, if the farmers are continuing their replanting and naturally regenerating activities with about 9.5 million trees each year, the grade of self-sufficiency in Tanzania will increase to nearly 100% in future.

Universal Leaf Tabacos Ltda. (ULT)¹⁰

Universal Leaf Tabacos Ltda, which handles about 20% of the domestic tobacco production, has a long history of tree planting activities in Brazil to provide wood for tobacco curing, having started woodlot planting activities at the beginning of

⁹ Paragraph is based on Association of Tanzania Tobacco Traders (2009).

¹⁰ Paragraph is based on Universal Leaf Tabacos Ltda (2009).

the 1980s. In Brazil tobacco is cultivated mainly in the states of Rio Grande do Sul, Santa Catarina and Parana, which represent about 95% of the domestic production of this crop. Farmers under ULT contract have planted an area of nearly 44,000 ha with woodlots for curing, and have to maintain an area of about 46,000 ha of natural forest.

In 2000 a term of agreement of compliant behaviour was signed in the state of Santa Catarina between the government, the tobacco industry and the farmers. The most important points of this document are:

- The tobacco companies should provide finance to farmers that are not self-sufficient in firewood to buy wood from reforestation with exotic species (from *Eucalyptus* species).
- The tobacco companies should launch campaigns to promote reforestation, native forest preservation and to inform the farmers about the risks of not complying with the environmental legislation.
- The tobacco companies should give incentives for and promote reforestation with exotic species to achieve self-sufficiency in firewood. Also the tobacco companies should provide technical assistance to farmers in terms of reforestation.
- The tobacco companies should provide transport of firewood from *Eucalyptus* to farmers that are not self-sufficient in firewood (farmers without land and with limited land available).
- The tobacco companies should add a clause to the annual contract with farmers that they will not buy tobacco cured with firewood from irregular origin (from native species and/or without license).
- The tobacco companies should not have contracts with farmers who were sued by the Environmental Protection Agency.
- The tobacco companies should provide annually an agreement signed by the farmers identifying the origin of the wood that will be used to cure the flue-cured tobacco.

The tobacco companies signed a similar agreement with the Parana State Environmental Protection Agency, IAP, in 2004.

The State of Rio Grande do Sul did not laid down specific conditions, mainly because deforestation in this state is virtually non-existent due to the active control by the environment agency and very high penalties. Also there is good supply of wood (*Eucalyptus* sp. and *Acacia Negra*) from independent afforestation schemes.

4.2. Wood-Efficient and Alternative Curing Initiatives

Malawi - The Rocket Barn

In close cooperation with the tobacco industry in Malawi (Limbe Leaf) the regional Programme for Basic Energy and Conservation (ProBEC) implemented by the German Agency for Technical Co-operation (GTZ) in the Southern African Development Community (SADC) region conducted research into the creation of more efficient tobacco barns in order to assist small-scale tobacco farmers. As a result of ProBEC's interventions, farmers have substantially reduced their wood use.

The invented "Rocket Barn" is an adaptation of a rocket stove technology, applied to small-holder tobacco curing enterprises. These barns represent a range of barns that would be suitable for both small holder and commercial growers. The Rocket Barn was designed with an enclosed horizontal feed system and produces impressive results using air dried hardwood.

Tests (field tests and tests at a testing site) during the curing season 2008 showed the following results (Peter Scott 2008):

- Compared to traditional barns the Rocket Barn 250 stick reduces the wood consumption by 49.5% from 24.9 m³/t tobacco to 12.6 m³/t tobacco. This data is based on 86 constructed Rocket Barns in Malawi (Mponela and Kasungu).
- Firewood is not free in Malawi, and a small holder farmer with 1 hectare of flue cured tobacco spends an average of USD 285 per year buying wood. Thus, fuelwood accounts for almost 23% of the total average production costs of tobacco in Malawi. The benefit due to the use of the Rocket Barn 250 was for the season 2008 USD 1354.
- Tests with 10 different barns at a test site showed that the kg wood to kg dried leaf ratio can be decreased from 7.6:1 for a 250 Stick Traditional Barn to 1.5:1 for the most efficient 720 Stick Rocket Barn.

Alternative fuels in Sri Lanka, Vietnam and Bangladesh

The Ceylon Tobacco Company (CTC), a British American Tobacco (BAT) company in Sri Lanka pioneered a method of curing tobacco leaf that does not involve the use of fossil fuels and woodfuels. Since 1997, all farmers supplying leaf to CTC have only burned rice husks, not wood, in curing leaf.

Rice husks are the 'cover' surrounding the white grains of rice that are eaten; they are removed by milling and are often a waste material. But farmers in Sri Lanka collect the husks during the milling season to use for burning in tobacco curing.

As well as reducing wood use, another benefit of burning rice husks is that the ash formed when they are burned is rich in potash and phosphorous and is used on the soil to reduce acidity and improve fertility. This curing method therefore uses no fossil fuels and produces no waste material, and is fully sustainable and cost-effective if rice husks are readily available.

Ceylon Tobacco Company's method of curing with rice paddy husk in Sri Lanka has been extended to British American Tobacco companies in Vietnam and Bangladesh. In 2002-2004 BAT in Vietnam funded a project with its joint venture partner Vinataba to develop the use of rice husk in Gialai province in central Vietnam, where very large quantities of rice are available. All the farmers involved in the project now use rice husk instead of wood for curing, in a total of 500 curing barns.

In 2003 BAT Bangladesh began a pilot project with 3 paddy husk furnaces in the Chittagong Hills. There are now some 40 paddy husk furnaces. Only 30 per cent of the tobacco produced in Bangladesh is cured using wood; 70 per cent is cured by rice paddy husk, straw and other non-wood alternatives.

In other countries in the Asia-Pacific region, poor road infrastructure and/or the cost of bringing rice husk from the areas where rice is grown can make the method too expensive (British American Tobacco 2009b).

4.3. Other Initiatives

British American Tobacco – Biodiversity Risk Assessment¹¹

The companies of the British American Tobacco Group are required to make risk assessments to identify biodiversity impacts on land within their sphere of influence, such as on any protected or sensitive areas, IUCN Red List species or on the diversity of life and natural systems, and to develop plans to reduce any impacts.

A biodiversity risk assessment tool has been established and trialled in Indonesia with a risk assessment in 2006 by British American Tobacco Indonesia and two NGO partners, Fauna & Flora International and Earthwatch Europe.

No direct impacts of company activities were identified on protected areas, but tobacco agriculture was found to be adversely affected by ongoing forest degradation in some areas. Company activities were not seen to contribute to forest degradation, although a move from kerosene to coal fuel for tobacco curing, which could enable growers to use wood more easily in curing, was identified as a potential risk. British American Tobacco Indonesia is drawing up action plans based on the risk assessment findings. In the future the following actions will be taken by British American Tobacco:

- Putting systems in place to gather information on the two key biodiversity measures – wood for tobacco curing and risk assessments – and to track local biodiversity indicators resulting from risk assessments by the end of 2009;
- Carrying out Biodiversity Risk Assessments in all the markets where BAT grow leaf by the end of 2010;
- Launch of a training programme aimed at leaf managers and launch a learning module for all employees during 2009;
- Develop and trial replicable models of forest regeneration and native forest management by the end of 2010;
- Investigate the use of alternative fuels and how to increase furnace efficiency to help in the aim of farmers using less than 3 per cent of wood fuel from natural forests by 2015.

¹¹ Paragraph based on British American Tobacco 2009c.

5. Case Studies

This chapter seeks to have a closer look on the role the production of tobacco has related to deforestation on the basis of selected case studies and countries respectively. The chosen countries are: Brazil, Malawi, Indonesia, Tanzania, Pakistan, Madagascar and Argentina. These countries have been chosen based on their role in the production of tobacco (total production, area compared to total agricultural area, etc.), data availability, geographical location, the rate of deforestation and the role of other crops in relation to deforestation.

The countries are described according to the following structure:

- Forest Resources and Deforestation
- Tobacco Production
- Tobacco's Share on Deforestation and Comparison to other Crops
- Comparison to other Drivers of Deforestation

The share on deforestation due to the curing process of tobacco is estimated similar to the calculations conducted in chapter 3.2.2. for the global level. The deforestation due to agricultural expansion is based on rough estimations using data from the FAO. The values show the role of the tobacco production relatively to the production of other crops¹².

¹² FAO data only states the "area harvested", which refers to the area from which a crop is gathered. Area harvested, therefore, excludes the area from which, although sown or planted, there was no harvest due to damage, failure, etc. If the crop under consideration is harvested more than once during the year as a consequence of successive cropping, the area is counted as many times as harvested.

This definition implies that forest loss due to agricultural expansion is generally overestimated in the following case studies.

5.1. Brazil

Forest Resources and Deforestation

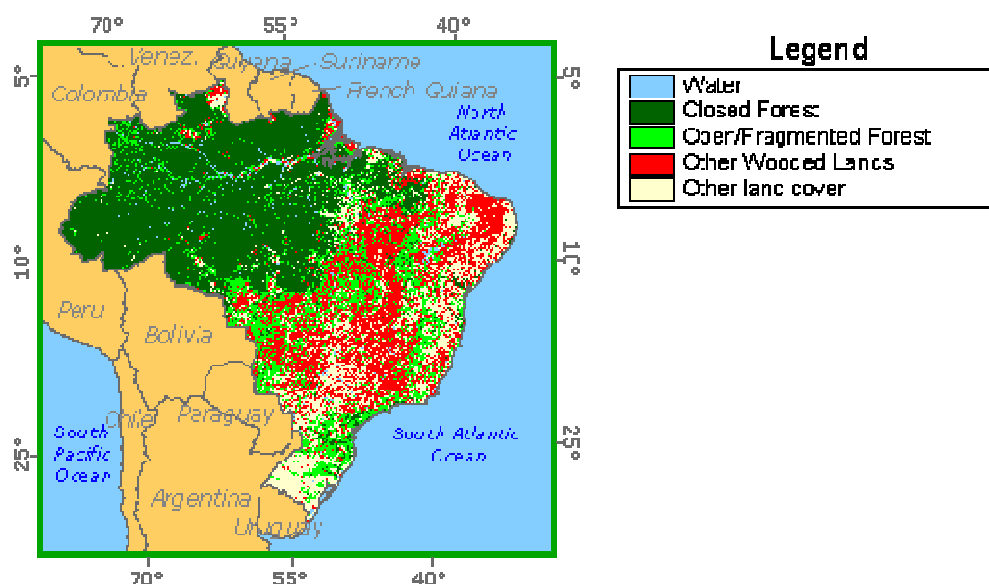


Figure 10 Forest Cover Map of Brazil (FAO 2001).

The humid tropical forests of the Amazon region constitute the largest block of closed forests in any tropical country. The total forest cover in Brazil is about 470 million hectares in the year 2007. Between 2000 and 2007 about 0.6% of the forest area was lost per year, corresponding to about 3 million hectares per year (see Table 20). Between 1990 and 2007 the country lost almost 10% of its total forest cover (FAO 2009b).

Table 17 Forest Area and Annual Change Rate of the Forest Cover in Brazil (FAO 2009b).

1990	Forest Area [1000 ha]		Annual Change Rate	
	2000	2007	1990-2000	2000-2007
520'027	493'213	471'492	-0.5%	-0.6%

Tobacco Production

The production of tobacco in Brazil increased from about 400'000 metric tons in the year 1990 to more than 800'000 metric tons in the year 2004. Since then, the production decreased to about 700'000 metric tons. With this production capacity Brazil is still the third biggest producer of tobacco after China (2.4 million tons) and India (780'000 tons).

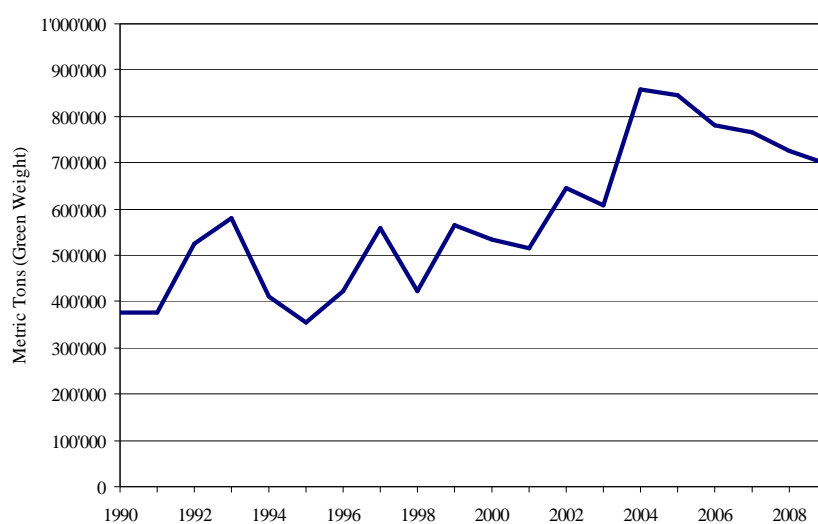


Figure 11 Tobacco production in metric tons (green weight) between 1990 and 2009 in Brazil (ITGA 2009).

Tobacco's Share on Deforestation and Comparison to other Crops

Due to the curing process: Assuming a share of wood-based flue-curing of tobacco of 100% (see Table 8), a grade of self-sufficiency of 82%¹³, a growing stock of 27t/ha, a mean annual increment of 15m³/ha, an estimated forest loss in 2008 of 3'103'000 ha/year and a mean wood usage of 5.5 kg wood / kg tobacco cured, tobacco's estimated share on deforestation in Brazil due to the curing process is 0.7% (Table 21).

Table 18 Estimation of the share on deforestation of the tobacco curing process for the year 2008 for Brazil (based on data from FAO (2009b), ITGA (2009) and Geist (1999)).

kg wood / kg tobacco	30.0	8.6	5.5	3.0
(1) Total Production 2008 [tonnes]	724'195	724'195	724'195	724'195
(2) Production using wood [tonnes]	608'000	608'000	608'000	608'000
(3) Solid wood required [t]	18'240'000	5'202'656	3'344'000	1'824'000
(4) Annual (deficit) wood required [t]	3'283'200	936'478	601'920	328'320
(5) Sustained yield area [ha]	243'200	69'369	44'587	24'320
(6) Equivalent area of natural biomass [ha]	121'600	34'684	22'293	12'160
Tobacco's share on deforestation [%]	3.9%	1.1%	0.7%	0.4%

Values applied:

- Share of wood-based flue-curing = 100%
- Grade of self-sufficiency = 0.82
- GS = 27 t/ha
- MAI = 15m³/ha
- Estimated Total area deforested in 2008 = 3'103'000 ha/year

As stated in chapter 4.1., the grade of self-sufficiency may have increased due to tree-planting activities undertaken by the tobacco industry since 2000 and legal contracts between the Brazilian Government and the tobacco industry. With an increase of about 10%, the share of the tobacco industry on deforestation would decrease to about 0.3%.

Due to agricultural expansion: In total, the agricultural area in Brazil increased between 1990 and 2007 by about 9 million hectares (2000 – 2007: 1.3 million hectares). The crops with the highest estimated share on the increase of the total agricultural area are soybeans (responsible for 57% of the increase), sugar cane (18%), maize (15%), sorghum (3.3%) and tobacco (1.2%). About 30% of this increase of the agricultural area can be attributed to the switch from other cultures.

¹³ According to Geist 2000 the grade of self-sufficiency in Brazil is high compared to other countries. Only few farmers have to rely upon other than own sources of wood.

A substantial part of the rest may be to the expense of forests, at maximum about 6.4 million hectares between 1990 and 2007 (see also Table 19).

Table 19 Area Harvested for different crops (1990 and 2007), estimated share on the increase in agricultural area between 1990 and 2007 and estimated maximum area of forests lost due to agricultural expansion for selected crops in Brazil (based on FAO 2009b).

Crop	Area Harvested 1990 [ha]	Area Harvested 2007 [ha]	Estimated Share on the Increase in Agricultural Area 1990 to 2007 ¹	Estimated Maximum Area of Forest lost due to Agricultural Expansion [ha] ²
Soybeans	11'487'300	20'565'300	56.9%	3'645'238
Maize	11'394'300	13'767'400	14.9%	952'910
Sugar cane	4'272'600	7'080'920	17.6%	1'127'671
Beans	4'680'090	3'788'280	-	-
Rice	3'946'690	2'890'930	-	-
Coffee	2'908'960	2'264'130	-	-
Cassava	1'937'570	1'894'460	-	-
Wheat	2'680'990	1'853'220	-	-
Cotton	1'903'590	1'126'103	-	-
Oranges	912'996	821'244	-	-
Cashew nuts	582'818	731'412	0.9%	59'667
Sorghum	137'758	662'994	3.3%	210'907
Cocoa beans	664'853	628'928	-	-
Cashewapple	551'844	610'000	0.4%	23'352
Bananas	487'883	515'346	0.2%	11'028
Tobacco	274'098	459'481	1.2%	74'440

¹ Crops without value have a decrease in the production area between 1990 and 2007

² Total Forest Area lost between 1990 and 2007 = 48'535'000 hectares

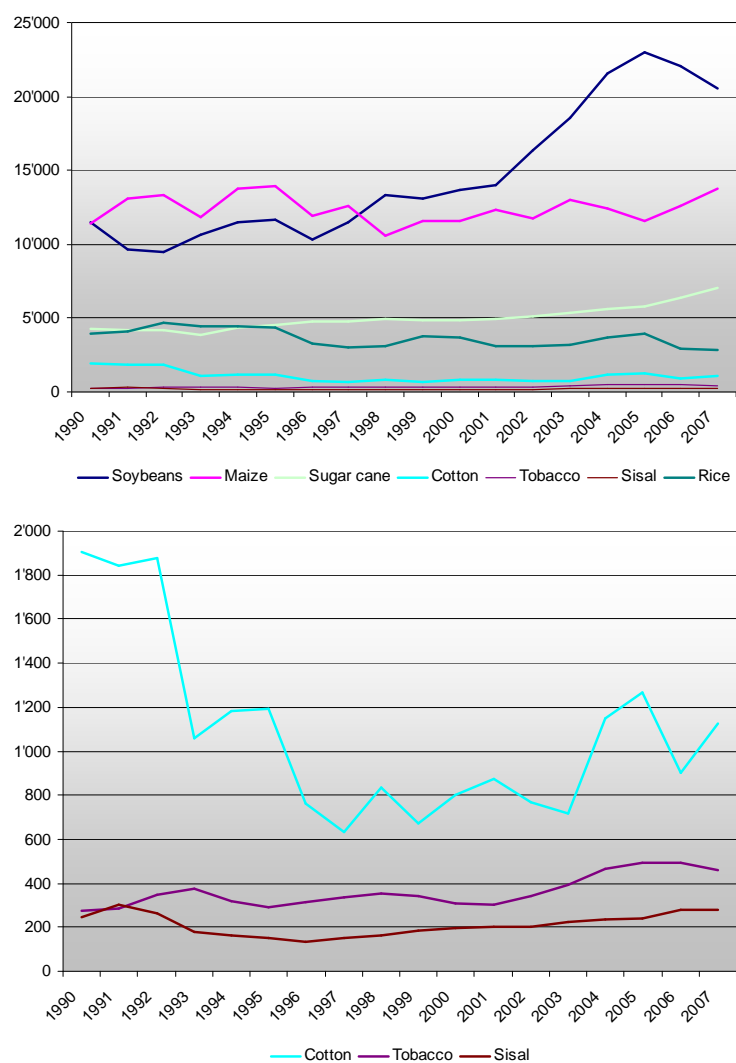


Figure 12 Trend of the production area 1'000 ha for selected crops between 1990 and 2007 in Brazil (FAO 2009b)

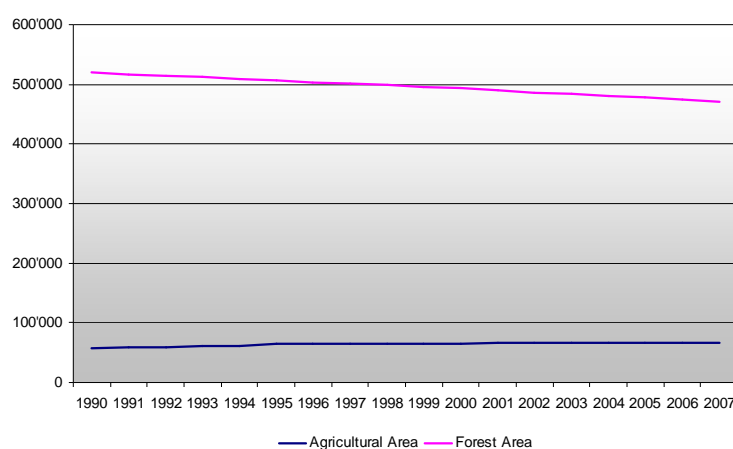


Figure 13 Trend of the agricultural area 1'000 ha and the forest area in Brazil between 1990 and 2007 (FAO 2009b)

Comparison to other Drivers of Deforestation

Cattle Ranching: In Latin America, cattle ranches are expanding rapidly (FAO, 2006c) and, for example, accounted for an estimated 70% of deforestation in Brazil in 2007 (Malhi et al. 2008). While the average size of a cattle ranch in Brazil is 24 000 hectares, some are as large as 560'000 hectares: in the Brazilian Amazon region, ranches cover an area in total of at least 8.4 million hectares (UNEP, FAO, UNFF 2008).

The expansion of these land based industries in Brazil is caused by a complex set of factors including low land prices, devaluation of the Brazilian currency, and improved transportation infrastructure and production systems. Brazil has also been quick to respond to new export opportunities capitalizing, for example, on meat exports at times when outbreaks of diseases like foot-and-mouth disease are present in other regions and markets (Nepstad 2006).

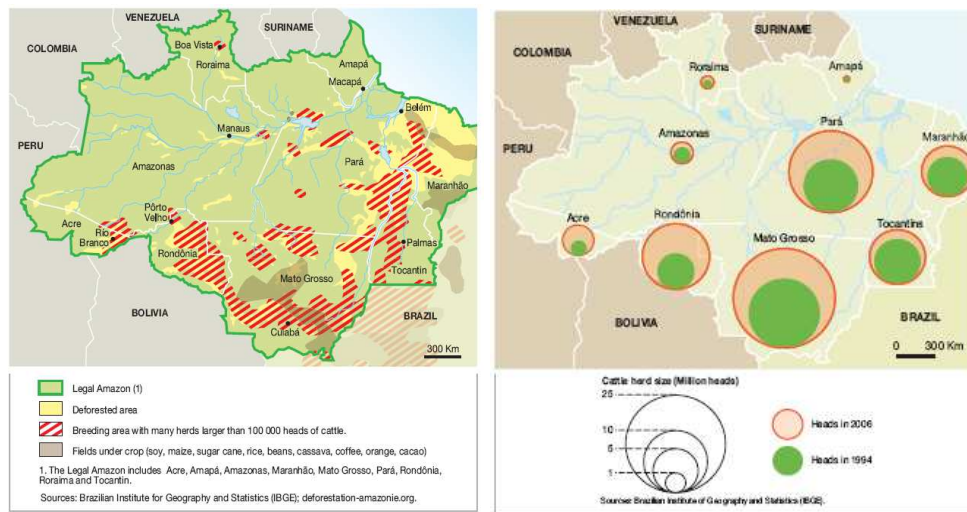


Figure 14 Overview of the Brazilian Amazon, the deforested area, the cattle breeding area and the fields under crop production (left); and the growth of cattle breeding in the Brazilian Amazon between 1994 and 2006 (UNEP, FAO, UNFF 2008).

Logging: The total area of selectively logged forests in the Amazon is unknown, although estimates indicate that this activity may affect 10,000-20,000 km² of forest per year in the Brazilian Amazon (Nepstad et al. 1999; Matricardi et al. 2001; Asner et al. 2005). Some of these forests are converted to agricultural and pasture land soon after timber is harvested, while other areas remain as logged forest. A substantial share of timber harvested in the Brazilian Amazon - estimated at 47 percent in 2001 and 43 percent in 2004 - is thought to be illegal. These figures probably represent an underestimate of illegal logging, since numerous licensed loggers fail to implement forest management plans or harvest illegally in public unclaimed lands. As conventionally practiced, logging causes substantial damage to the forest, especially when associated with wildfires (WRI 2006).

5.2. Malawi

Forest Resources and Deforestation

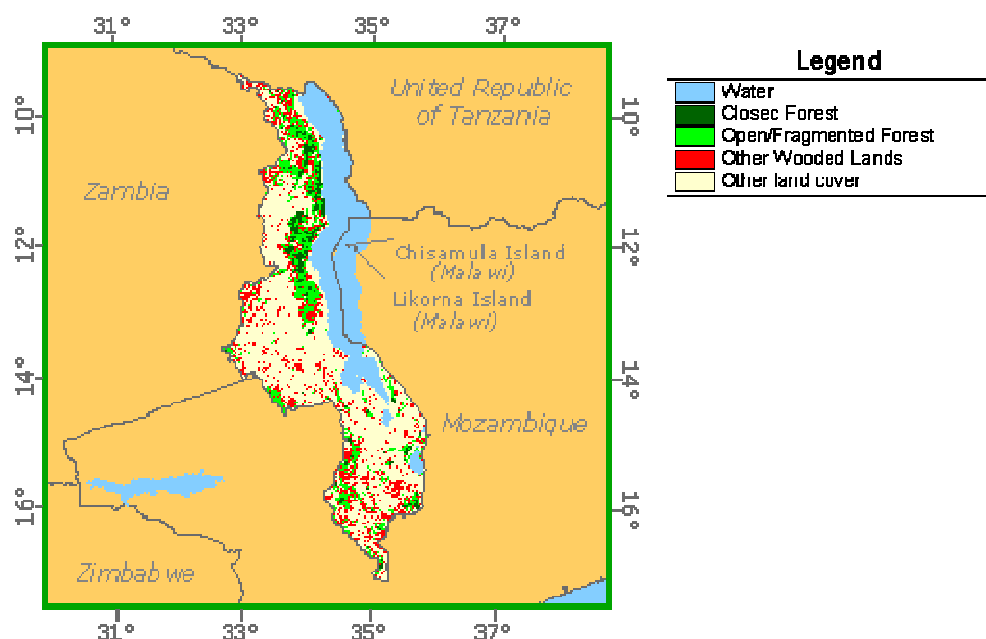


Figure 15 Forest Cover Map of Malawi (FAO 2001).

Various types of fire-climax woodland, depending on altitude and rainfall, constitute the largest part of the natural woody vegetation (see Figure 15). Closed forests occur only in the form of patches of very limited area. They have been grouped into three main types according to their altitude (FAO 2001).

The total forest cover in Malawi is about 3.3 million hectares in the year 2007. Between 2000 and 2007 about 0.9% of the forest area was lost per year, corresponding to about 33'000 hectares per year (see Table 20). Between 1990 and 2007 the country lost 14% of its total forest cover (FAO 2009b). The main causes are fuelwood collection, charcoal production, and subsistence and commercial agriculture.

Table 20 Forest Area and Annual Change Rate of the Forest Cover in Malawi (FAO 2009b).

Forest Area [1000 ha]			Annual Change Rate	
1990	2000	2007	1990-2000	2000-2007
3'896	3'567	3'336	-0.8%	-0.9%

Tobacco Production

In the last 20 years the annual tobacco production increased from about 100'000 tons in the year 1990 to an estimated 266'000 tons in the year 2009 (ITGA 2009) (Figure 16). The share of the agricultural area where tobacco is grown of the total agricultural area is with 4.97% (year 2007) the highest in the world (FAO 2009b).

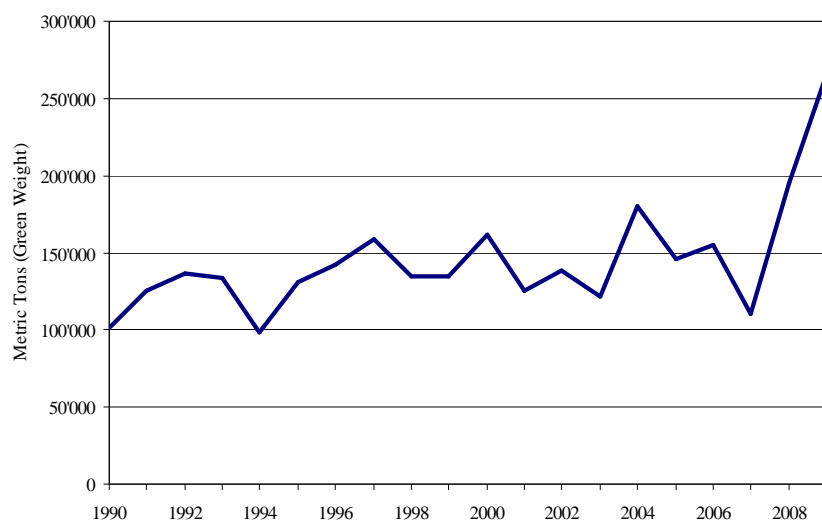


Figure 16 Tobacco production in metric tons (green weight) between 1990 and 2009 in Malawi (ITGA 2009).

Tobacco's Share on Deforestation and Comparison to other Crops

Due to the curing process: Assuming a share of wood-based flue-curing of tobacco of 100% (see Table 8), a grade of self-sufficiency of 20% (see Table 11), a growing stock of 27t/ha, a mean annual increment of 15m³/ha, an estimated forest loss in 2008 of 33'000 ha/year and a mean wood usage of 5.5 kg wood/kg tobacco cured, tobacco's estimated share on deforestation in Malawi due to the curing process is 12.8% (Table 21).

Table 21 Estimation of the share on deforestation of the tobacco curing process for the year 2008 for Malawi (based on data from FAO (2009b), ITGA (2009) and Geist (1999)).

kg wood / kg tobacco	30.0	8.6	5.5	3.0
(1) Total Production 2008 [tonnes]	194'872	194'872	194'872	194'872
(2) Production using wood [tonnes]	25'716	25'716	25'716	25'716
(3) Solid wood required [t]	771'480	220'052	141'438	77'148
(4) Annual (deficit) wood required [t]	617'184	176'041	113'150	61'718
(5) Sustained yield area [ha]	45'717	13'040	8'382	4'572
(6) Equivalent area of natural biomass [ha]	22'859	6'520	4'191	2'286
Tobacco's share on deforestation [%]	69.3%	19.8%	12.7%	6.9%

Values applied:

- Share of wood-based flue-curing = 100%
- Grade of self-sufficiency = 0.20
- GS = 27 t/ha
- MAI = 15m³/ha
- Estimated Total area deforested in 2008 = 33'000 ha/year

As mentioned in chapter 4.1. the Limbe Leaf Tobacco Company implements a tree-planting programme since 2002 and planted about 16 million trees. With the need of about 181 per ton of tobacco cured, about 4.6 million trees are needed each year for the production using wood of 25'716 tons. As Limbe Leaf produces about 50% of the total tobacco production in Malawi about 2.3 million trees are needed each year. To be self-sufficient a total of about 14 million trees are needed, assuming that the trees can be cut every sixth year. Thus, if the yearly needed trees (about 2.3 million) can be replanted each year, the grade of self-sufficiency can be increased to about 100% for the tobacco produced by Limbe Leaf. With the plan of Limbe Leaf to plant between 2008 and 2012 additional 1.8 million trees each year (see chapter 4.1.), this goal can almost be achieved. Assuming a grade of self-sufficiency of nearly 100% for the farmers contracted by the Limbe Leaf Tobacco Company and of 20% for the remaining (value by Geist), *the share of the tobacco industry on deforestation in Malawi can be decreased to 6.3%.*

Due to agricultural expansion: In total, the agricultural area in Malawi increased between 1990 and 2007 by about 0.74 million hectares (2000 – 2007: 0.25 million hectares). The crops with the highest estimated share on the increase of the total agricultural area are groundnuts (responsible for 26% of the increase), potatoes (19.3%), cassava (14%), beans (13.9%) and pigeon peas (6.5%). The area where tobacco is produced increased between 1990 and 2007 by about 18'400 hectares. About 22% of the increase of the agricultural area can be attributed to the switch from other cultures. A substantial part of the rest may be to the expense of forests, at maximum about 0.58 million hectares between 1990 and 2007 (see also Table 22).

Table 22 Area Harvested for different crops (1990 and 2007), estimated share on the increase in agricultural area between 1990 and 2007 and estimated maximum area of forests lost due to agricultural expansion for selected crops in Malawi (based on FAO 2009b).

Crop	Area Harvested 1990 [ha]	Area Harvested 2007 [ha]	Estimated Share on the Increase in Agricultural Area 1990 to 2007 ¹	Estimated Maximum Area of Forest lost due to Agricultural Expansion [ha] ²
Maize	1'343'784	1'215'356	-	-
Beans	150'000	260'306	13.9%	80'274
Groundnuts	48'185	258'111	26.4%	152'770
Potatoes	34'299	188'176	19.3%	111'982
Cassava	61'506	172'539	14.0%	80'803
Pigeon peas	110'000	161'508	6.5%	37'484
Tobacco	100'110	118'551	2.3%	13'420
Chick peas	113'941	88'000	-	-
Cow peas	78'000	79'000	0.1%	728
Sorghum	30'814	74'131	5.4%	31'523
Cotton	48'516	60'673	1.5%	8'847
Rice	29'042	58'091	3.7%	21'140
Millet	19'583	44'878	3.2%	18'408
Plantains	44'800	30'000	-	-
Sugar cane	17'000	23'000	0.8%	4'366

¹ Crops without value have a decrease in the production area between 1990 and 2007

² Total Forest Area lost between 1990 and 2007 = 560'000 hectares

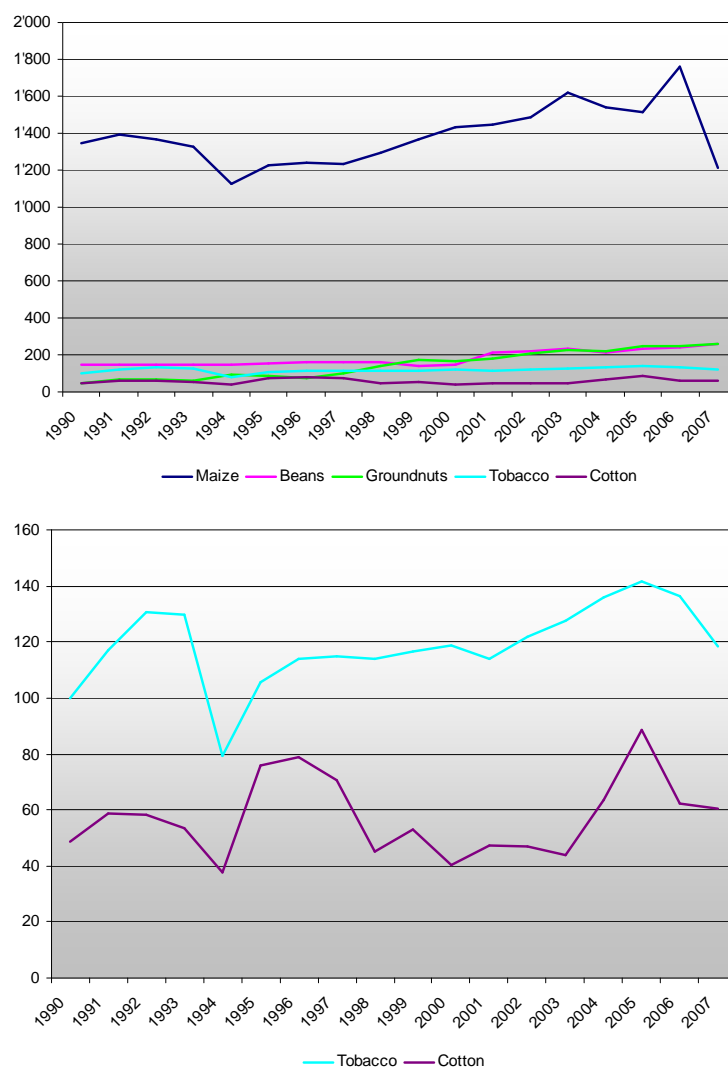


Figure 17 Trend of the production area 1'000 ha for selected crops between 1990 and 2007 in Malawi (FAO 2009b)

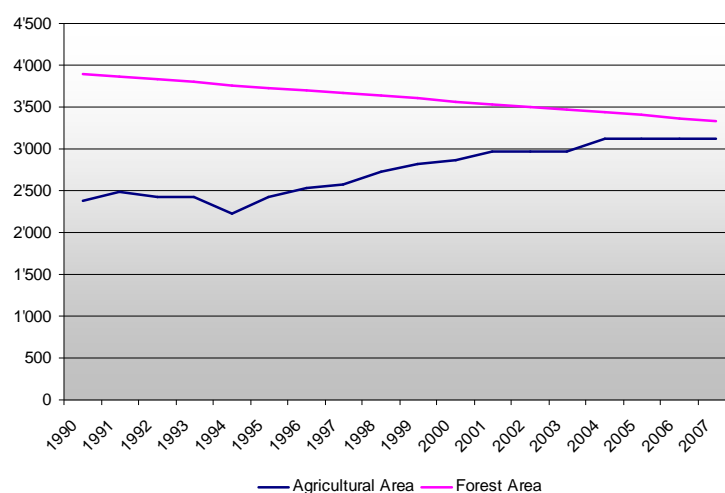


Figure 18 Trend of the agricultural area 1'000 ha and the forest area in Malawi between 1990 and 2007 (FAO 2009b)

Comparison to other Drivers of Deforestation

Charcoal Production: The International Institute for Environment and Development (UK) published a study in 2007 which analysis the charcoal production and its impact on deforestation in Malawi. In total about 230'000 tons of charcoal was used in the urban centres of Malawi which is equivalent to about 1.4 million m³ of wood and corresponds to about 15'000 hectares of forest destroyed for the production¹⁴. Compared to the annual deforestation of Malawi – about 33'000 hectares per year – the production of charcoal has a share of almost 50% of the deforestation in Malawi (IIED 2007).

¹⁴ It has to be considered that the production of charcoal not necessarily destructs the forest in total, as charcoal production is soften selective, based on species and tree size.

The volume of timber per hectare of the forest land in Malawi is considered to be 95m³.

5.3. Indonesia

Forest Resources and Deforestation

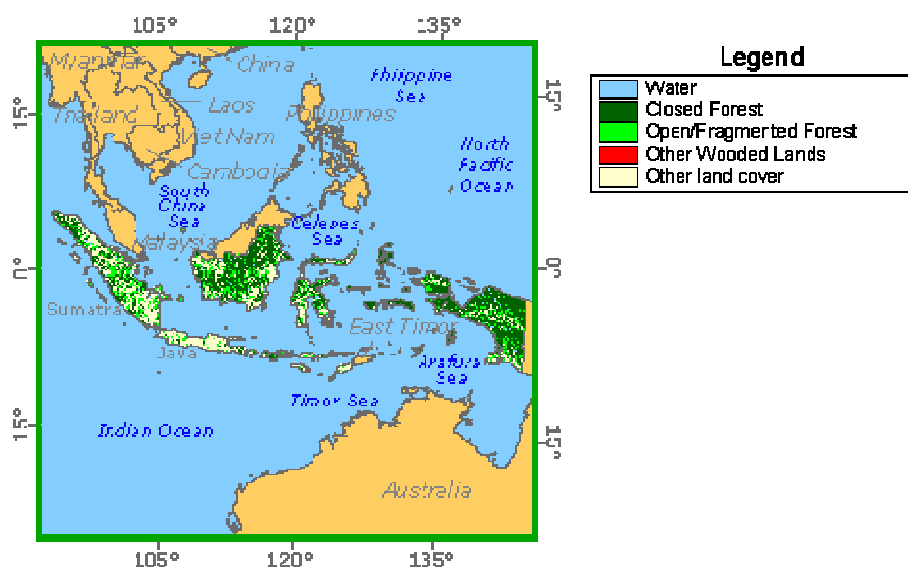


Figure 19 Forest Cover Map of Indonesia (FAO 2001).

For an area that stretches for about 5'000 km along the equator with several recognised geological and phyto-geographical divisions, the flora of Indonesia is relatively uniform, however still exhibiting a biological diversity and richness which is without comparison in South East Asia. The various climax types have stages derived both artificially (by man) and by nature itself. Shifting cultivation, hunting, burning practices and selective tree felling have influenced vegetation in some places to a high degree, for many centuries. There is little difference between pioneer stands resulting from anthropogenic causes and those originating from natural factors such as fire, storm and volcanic eruption (FAO 2001).

The forest in Indonesia covers about 85 million hectares in the year 2007. According to FAO estimates, over 2000-2005 Indonesia had the second largest area of deforestation (after Brazil) with about 1.87 million hectares cleared every year and an annual deforestation rate of 1.91% of forest area per year (FAO 2009b).

Table 23 Forest Area and Annual Change Rate of Forest Cover in Indonesia (FAO 2009b).

Forest Area [1000 ha]			Annual Change Rate	
1990	2000	2007	1990-2000	2000-2007
116'567	97'852	84'752	-1.6%	-1.9%

Tobacco Production

In the late 90s the tobacco production in Indonesia increased from about 60'000 tons to 120'000 tons. In consequence to the widespread East Asian economic crisis During the first years of this century the production dropped to under 80'000 tons per year but increased in the last years again to about 110'000 tons per year.

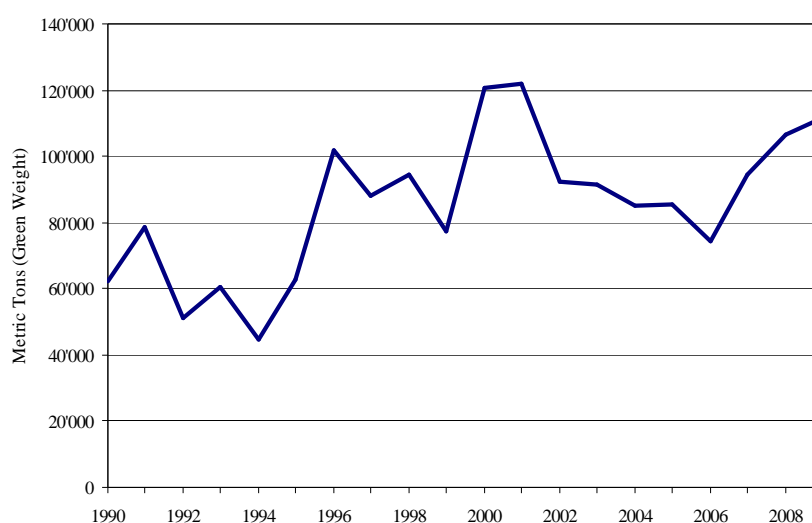


Figure 20 Tobacco production in metric tons (green weight) between 1990 and 2009 in Indonesia (ITGA 2009).

Tobacco's Share on Deforestation and Comparison to other Crops

Due to the curing process: Assuming a share of wood-based flue-curing of tobacco of 90%, a grade of self-sufficiency of 42% (global mean), a growing stock of 27t/ha, a mean annual increment of 15m³/ha and an estimated forest loss in 2008 of 1'871'400 ha/year and a mean wood usage of 5.5 kg wood / kg tobacco cured, tobacco's estimated share on deforestation in Indonesia due to the curing process is 0.3% (Table 24).

Table 24 Estimation of the share on deforestation of the tobacco curing process for the year 2008 for Indonesia (based on data from FAO (2009b), ITGA (2009) and Geist (1999)).

kg wood / kg tobacco	30.0	8.6	5.5	3.0
(1) Total Production 2008 [tonnes]	106'470	106'470	106'470	106'470
(2) Production using wood [tonnes]	45'600	45'600	45'600	45'600
(3) Solid wood required [t]	1'368'000	390'199	250'800	136'800
(4) Annual (deficit) wood required [t]	793'440	226'316	145'464	79'344
(5) Sustained yield area [ha]	58'773	16'764	10'775	5'877
(6) Equivalent area of natural biomass [ha]	29'387	8'382	5'388	2'939
Tobacco's share on deforestation [%]	1.6%	0.4%	0.3%	0.2%

Values applied:

- Share of wood-based flue-curing = 90%
- Grade of self-sufficiency = 0.42
- GS = 27 t/ha
- MAI = 15m³/ha
- Estimated Total area deforested in 2008 = 1'871'400 ha/year

Due to agricultural expansion: In total, the agricultural area in Indonesia increased between 1990 and 2007 by about 5.5 million hectares (2000 – 2007: 3.9 million hectares). The crops with the highest estimated share on the increase of the total agricultural area are oil palm fruit (responsible for 39.5% of the increase), rice (16.8%), natural rubber (9.3%), cocoa beans (7.8%), coconuts (6.5%) and maize (4.8%). The area where tobacco is produced decreased between 1990 and 2007 by about 41'000 hectares. About 16% of the increase of the agricultural area can be attributed to the switch from other cultures. An estimated maximum area of about 4.67 million hectares between 1990 and 2007 may be attributed to the conversion of forest to agricultural area (see also Table 25).

Table 25 Area Harvested for different crops (1990 and 2007), estimated share on the increase in agricultural area between 1990 and 2007 and estimated maximum area of forests lost due to agricultural expansion for selected crops in Indonesia (based on FAO 2009b).

Crop	Area Harvested 1990 [ha]	Area Harvested 2007 [ha]	Estimated Share on the Increase in Agricultural Area 1990 to 2007¹	Estimated Maximum Area of Forest lost due to Agricultural Expansion [ha]²
Rice	10'502'357	12'147'637	16.8%	785'366
Oil palm fruit	673'033	4'540'000	39.5%	1'845'877
Maize	3'158'092	3'630'324	4.8%	225'418
Coconuts	2'261'563	2'900'000	6.5%	304'755
Natural rubber	1'865'606	2'775'546	9.3%	434'355
Cassava	1'311'584	1'201'481	-	-
Coffee	746'759	969'082	2.3%	106'125
Cocoa beans	158'820	923'968	7.8%	365'239
Groundnuts	650'560	660'480	0.1%	4'735
Soybeans	1'334'100	459'116	-	-
Sugar cane	345'000	404'653	0.6%	28'475
Bananas	132'454	337'831	2.1%	98'036
Beans	502'420	310'000	-	-
Cashew nuts	125'000	308'171	1.9%	87'436
Tobacco	235'866	194'517	-	-

¹ Crops without value have a decrease in the production area between 1990 and 2007

² Total Forest Area lost between 1990 and 2007 = 31'814'800 hectares

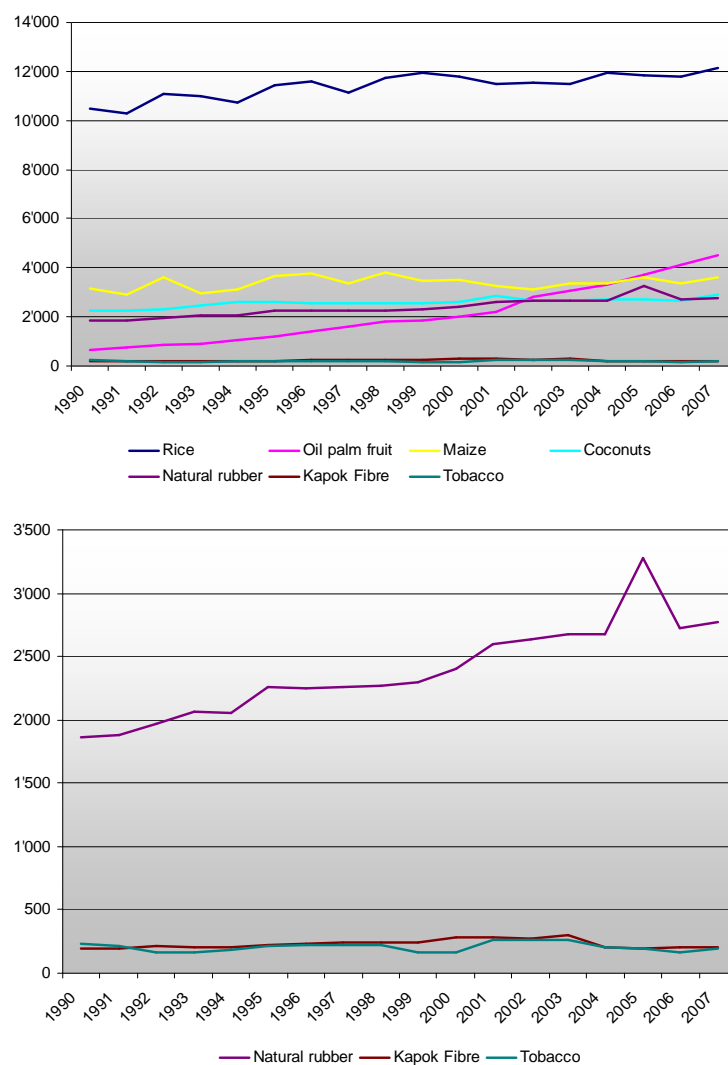


Figure 21 Trend of the production area 1'000 ha for selected crops between 1990 and 2007 in Indonesia (FAO 2009b)

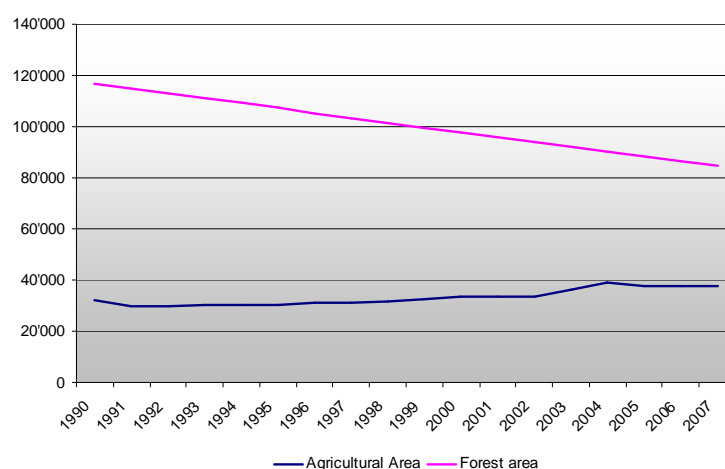


Figure 22 Trend of the agricultural area 1'000 ha and the forest area in Indonesia between 1990 and 2007 (FAO 2009b)

Comparison to other Drivers of Deforestation

Palm Oil: Conversion to agriculture, including the recent expansion in the area devoted to oil palm plantations, continues to be the main cause of forest loss in the Indonesia and the whole Southeast-Asian region. Forests, even in protected areas such as Kalimantan in Indonesia are being logged and have declined by more than 56 per cent between 1985 and 2001 (Curran et al. 2004).

Figures 23 and 24 give an overview of the expansion of palm oil in Indonesia. According to data provided by the FAO the area of palm oil plantations increased between 1990 and 2007 from 673'000 hectares to more than 4.5 million hectares, corresponding to an increase of almost a factor of 7. As already described above, the forest area decreased in the same period by 31 million hectares corresponding to almost 2% per year.

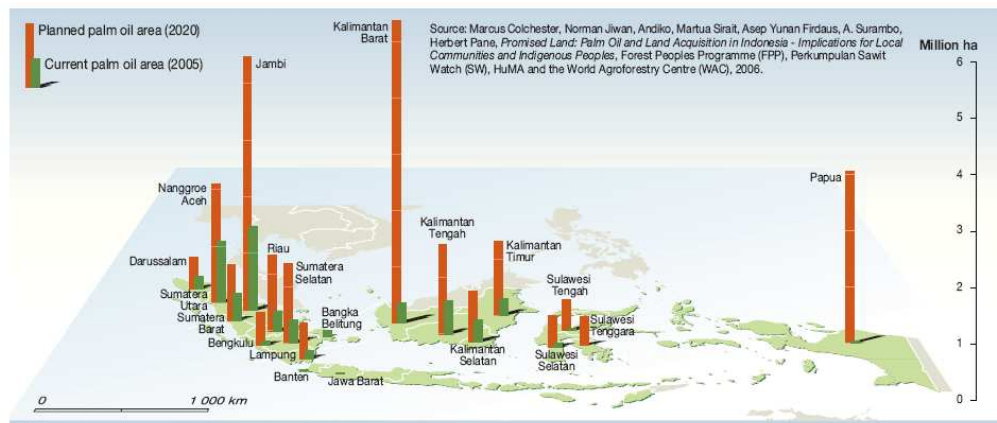


Figure 23 Future expansion of palm oil in Indonesia (Colchester et al. 2006).

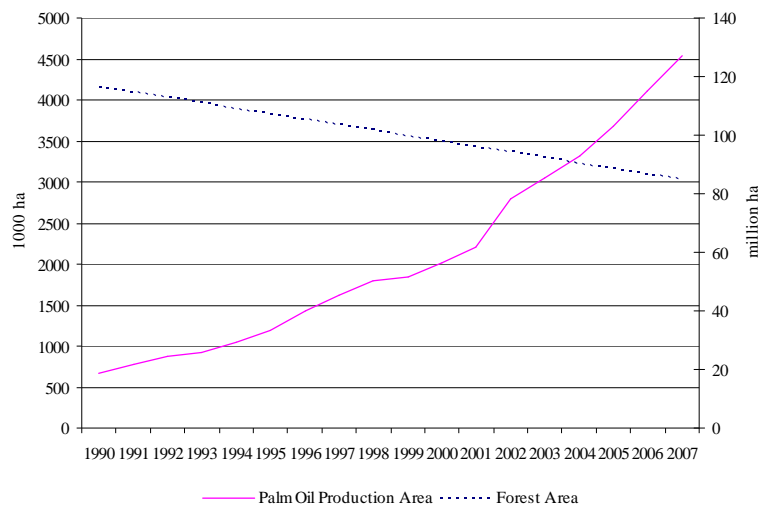


Figure 24 Forest cover vs. palm oil production in Indonesia 1990 – 2007 (FAO 2009b).

Timber Production and Illegal Logging: More than half of Indonesia's forests are allocated for timber production on a selective felling basis. Many logging concessions override traditional patterns of land ownership or use rights. Lack of corporate oversight and accountability means that forestry management is poorly supervised and, over time, many production forests have been overexploited. The government now classifies nearly 30 percent of surveyed logging concessions as being in a "degraded condition." Nearly 9 million hectares of land have been allocated for development as industrial timber plantations, but much of this land was natural forest. Only about 2 million hectares have actually been planted, leaving up to 7 million hectares of cleared and unproductive land (FWI / GFW 2002).

Logging concessions, timber plantations, and forest clearance combined provide less than half the wood needed by Indonesia's wood processing industries. Imports are relatively small, and illegal logging makes up the shortfall. Indonesia today is plagued by organized wood theft on a massive scale: 50-70 percent of wood supplied to the forest products industry each year is cut illegally. The total area of forest lost to illegal logging is not known, but a former senior official of the Ministry of Forestry, Titus Sarijanto, claimed that theft and illegal logging have destroyed an estimated 10 million ha of Indonesian forests (FWI / GFW 2002).

As this brief summary makes clear, deforestation in Indonesia must be seen as a complex phenomenon in which all these factors interact. An overview of some of these interactions is provided in Figure 25.

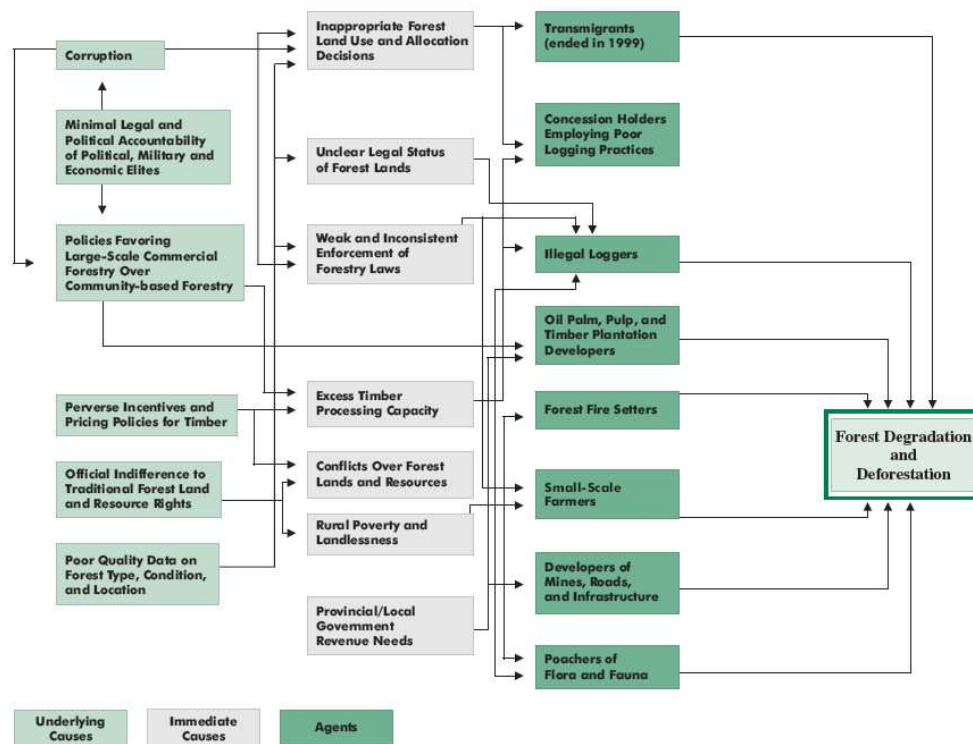


Figure 25 Processes of Forest Degradation and Deforestation in Indonesia (FWI / GFW 2002).

5.4. Tanzania

Forest Resources and Deforestation

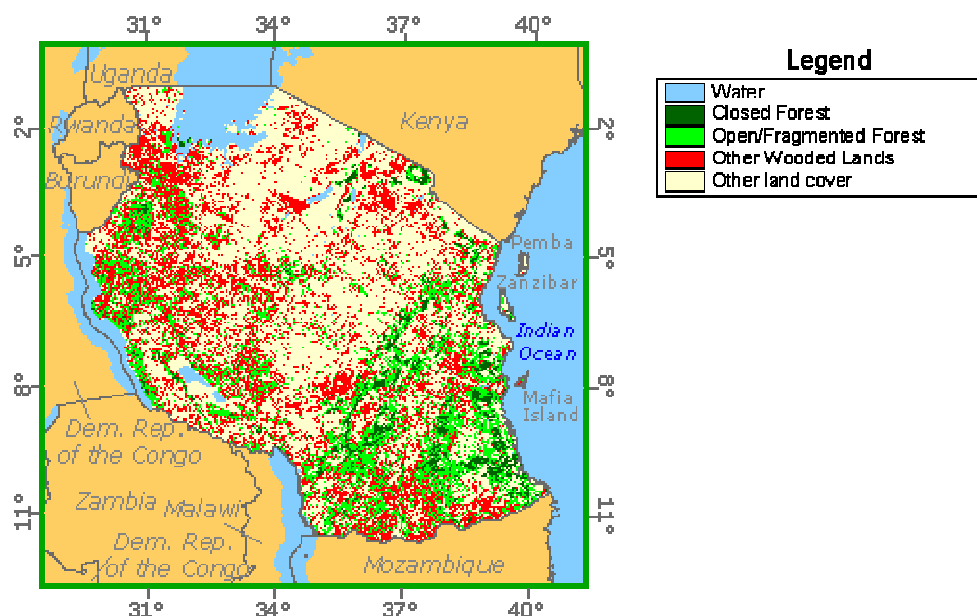


Figure 26 Forest Cover Map of Tanzania (FAO 2001).

A wide range of ecological conditions is responsible for a special pattern of vegetation from tropical forest to alpine moorland, though there is little of either extreme. Closed forests are scarce in Tanzania. The so-called miombo woodlands, with generally small trees, occupy extensive areas. They extend from sea level up to 1'600 m. They occupy the central plateau in the north and the south-east, separated by a "miombo-free" corridor about 500 km long and 60 to 120 km wide.

The forest in Tanzania covers about 34.4 million hectares in the year 2007. According to FAO estimates, over 2000-2007 Tanzania lost 412'200 hectares of forests per year corresponding to an annual deforestation rate of 1.1% of forest area per year (FAO 2009b).

Table 26 Forest Area and Annual Change Rate of Forest Cover in Tanzania (FAO 2009b).

Forest Area [1000 ha]			Annual Change Rate	
1990	2000	2007	1990-2000	2000-2007
41'441	35'257	34'433	-1.0%	-1.1%

Tobacco Production

The production of tobacco in Tanzania increased since 1990 from about 10'000 tons per year to about 60'000 tons in 2009 (Figure 27).

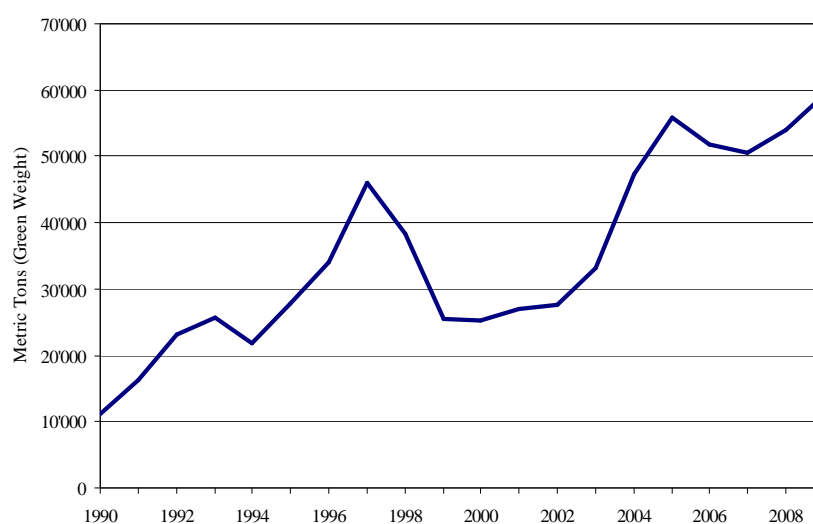


Figure 27 Tobacco production in metric tons (green weight) between 1990 and 2009 in Tanzania (ITGA 2009).

Tobacco's Share on Deforestation and Comparison to other Crops

Due to the curing process: Assuming a share of wood-based flue-curing of tobacco of 100% (see Table 8), a grade of self-sufficiency of only 7% (see Table 11), a growing stock of 27t/ha, a mean annual increment of 15m³/ha and an estimated forest loss in 2008 of 412'200 ha/year and a mean wood usage of 5.5 kg wood/kg tobacco cured, tobacco's estimated share on deforestation in Tanzania due to the curing process is 2.7% (Table 27).

Table 27 Estimation of the share on deforestation of the tobacco curing process for the year 2008 for Tanzania (based on data from FAO (2009b), ITGA (2009) and Geist (1999)).

kg wood / kg tobacco	30.0	8.6	5.5	3.0
(1) Total Production 2008 [tonnes]	53'952	53'952	53'952	53'952
(2) Production using wood [tonnes]	53'652	53'652	53'652	53'652
(3) Solid wood required [t]	1'609'560	459'100	295'086	160'956
(4) Annual (deficit) wood required [t]	1'496'891	426'963	274'430	149'689
(5) Sustained yield area [ha]	110'881	31'627	20'328	11'088
(6) Equivalent area of natural biomass [ha]	55'440	15'813	10'164	5'544
Tobacco's share on deforestation [%]	13.4%	3.8%	2.5%	1.3%

Values applied:

- Share of wood-based flue-curing = 100%
- Grade of self-sufficiency = 0.07
- GS = 27 t/ha
- MAI = 15m³/ha
- Estimated Total area deforested in 2008 = 412'200 ha/year

As seen in chapter 4.1. the reforestation programme of the Association of Tanzania Tobacco Traders (A.T.T.T.) led to an increase of the grade of self-sufficiency to almost 100%, if the farmers continue replacing cut trees in future (about 9.8 million trees are needed to be replaced each year). Thus, *tobacco's share on deforestation will come down to almost 0%*¹⁵.

Due to agricultural expansion: In total, the agricultural area in Tanzania increased between 1990 and 2007 by about 0.2 million hectares. The crops with the highest estimated share on the increase of the total agricultural area are maize (responsible for 33.7% of the increase), sorghum (12.8%), bananas (10.3%), rice (8%), groundnuts (7.5%) and sweet potatoes (4.9%). The share of tobacco is 0.4%. Only about 1% of the increase of the agricultural area can be attributed to the

¹⁵ Besides the prerequisite that about 9.5 million trees have to be replaced each year, this calculation assumes that the trees cut are used for tobacco curing and not for other activities.

switch from other cultures. An estimated maximum area of about 0.19 million hectares between 1990 and 2007 may be attributed to the conversion of forest to agricultural area (see also Table 28).

Table 28 Area Harvested for different crops (1990 and 2007), estimated share on the increase in agricultural area between 1990 and 2007 and estimated maximum area of forests lost due to agricultural expansion for selected crops in Tanzania (based on FAO 2009b).

Crop	Area Harvested 1990 [ha]	Area Harvested 2007 [ha]	Estimated Share on the Increase in Agricultural Area 1990 to 2007 ¹	Estimated Maximum Area of Forest lost due to Agricultural Expansion [ha] ²
Maize	1'631'260	3'000'000	33.7%	66'649
Sorghum	380'000	900'000	12.8%	25'321
Rice	384'500	710'000	8.0%	15'850
Beans	410'000	700'000	7.1%	14'121
Cassava	590'210	675'000	2.1%	4'129
Sweet potatoes	306'540	505'000	4.9%	9'664
Bananas	63'200	480'000	10.3%	20'296
Cotton	389'340	450'000	1.5%	2'954
Groundnuts	110'000	415'000	7.5%	14'852
Coconuts	302'000	310'000	0.2%	390
Plantains	253'000	308'000	1.4%	2'678
Millet	178'000	265'000	2.1%	4'236
Cow peas	145'000	150'000	0.1%	243
Sisal	58'450	50'000	-	-
Tobacco	20'574	36'000	0.4%	751

¹ Crops without value have a decrease in the production area between 1990 and 2007

² Total Forest Area lost between 1990 and 2007 = 7'008'400 hectares

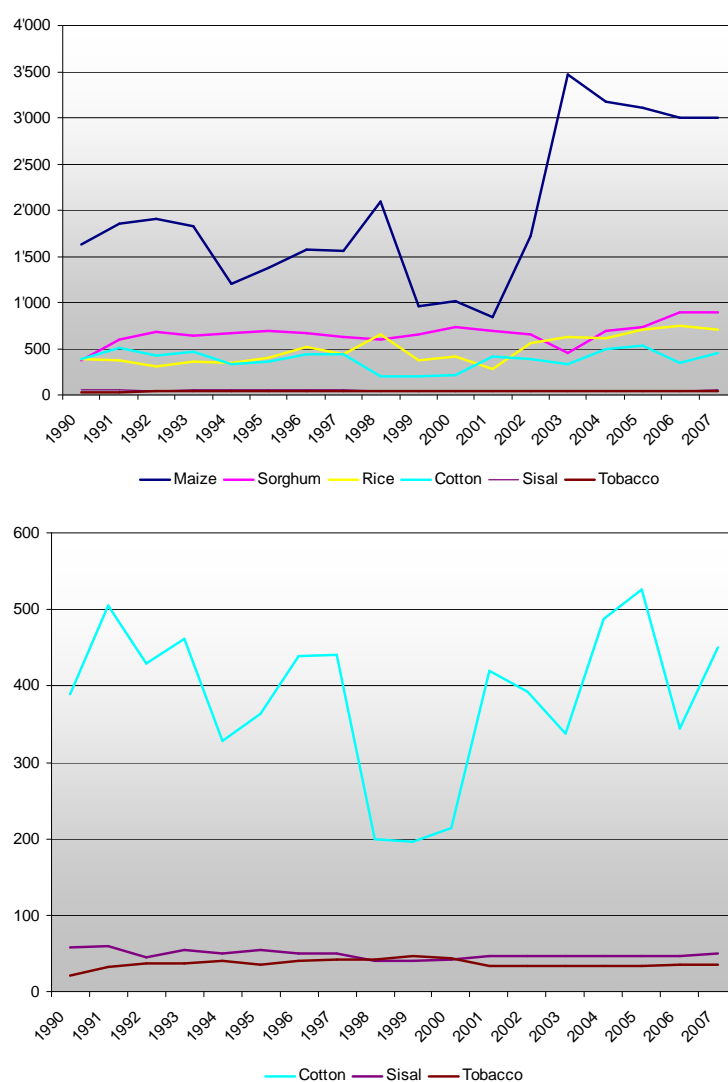


Figure 28 Trend of the production area in '000 ha for selected crops between 1990 and 2007 in Tanzania (FAO 2009b)

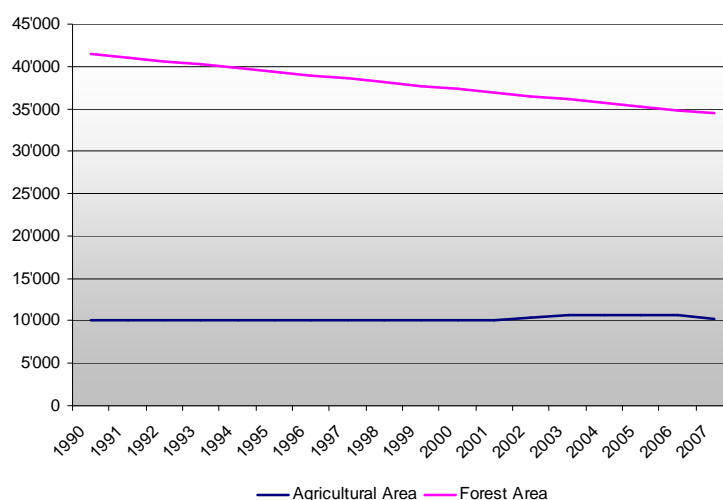


Figure 29 Trend of the agricultural area in '000 ha and the forest area in Tanzania between 1990 and 2007 (FAO 2009b)

Comparison to other Drivers of Deforestation

Woodfuel and charcoal consumption: Wood accounts for 90% of the total energy used in Tanzania. While the supply of fuel wood is dwindling, demand is rapidly increasing. More than 90% of the population depends on wood fuel energy. Charcoal is used widely in urban centres with an estimated consumption of 392'000 tonnes per annum and charcoal burners/producers are licensed to burn charcoal in both public woodlands and productive forest reserves. Firewood is mostly used in rural and peri-urban areas. In 1993, fuel wood consumption was estimated at 45 million cubic meters per annum, with a per capita wood consumption of 2.0 cubic meters of round wood per annum. The rural areas alone consumed about 43.8 million cubic meters of firewood. By the year 2000, fuel wood demand surpassed 60 million cubic meters (UN 2002).

5.5. Pakistan

Forest Resources and Deforestation

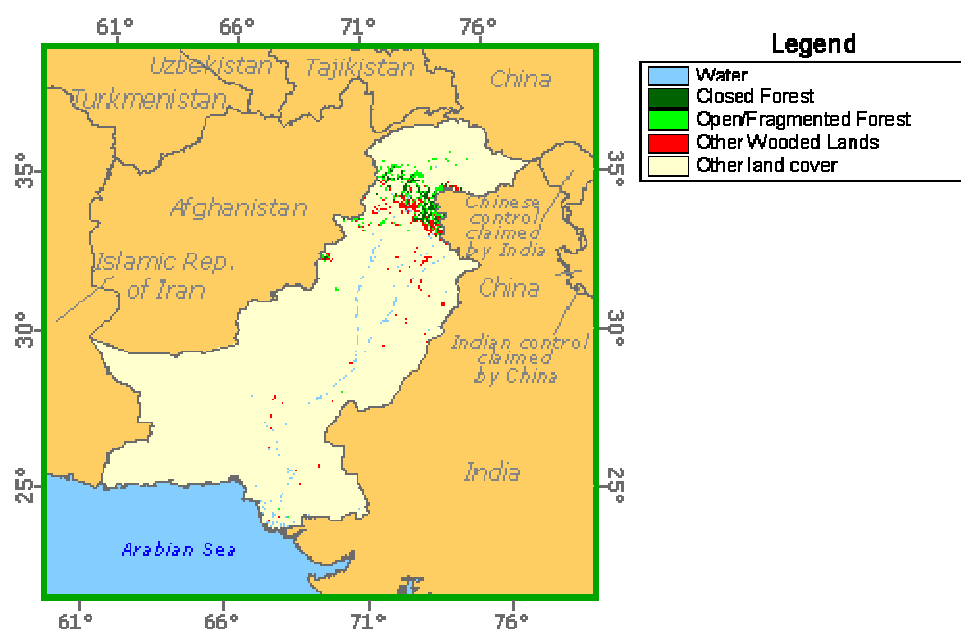


Figure 30 Forest Cover Map of Pakistan (FAO 2001).

The natural vegetation of the country is particularly varied, ranging from tropical thorn forest to temperate and alpine types.

The forest in Pakistan covered about 1.8 million hectares in the year 2007. According to FAO estimates, over 2000-2007 Pakistan lost 428'000 hectares of forests per year corresponding to an annual deforestation rate of 2% of forest area per year (see Table 29) (FAO 2009b).

Table 29 Forest Area and Annual Change Rate of Forest Cover in Pakistan (FAO 2009b).

Forest Area [1000 ha]			Annual Change Rate	
1990	2000	2007	1990-2000	2000-2007
2'527	2'116	1'816	-1.6%	-2.0%

Tobacco Production

With almost 120'000 metric tons per year in 2009, Pakistan is one of the major tobacco growing countries in Asia. In the last 20 years the annual production increased from about 68'000 metric tons per year to about 120'000 metric tons per year.

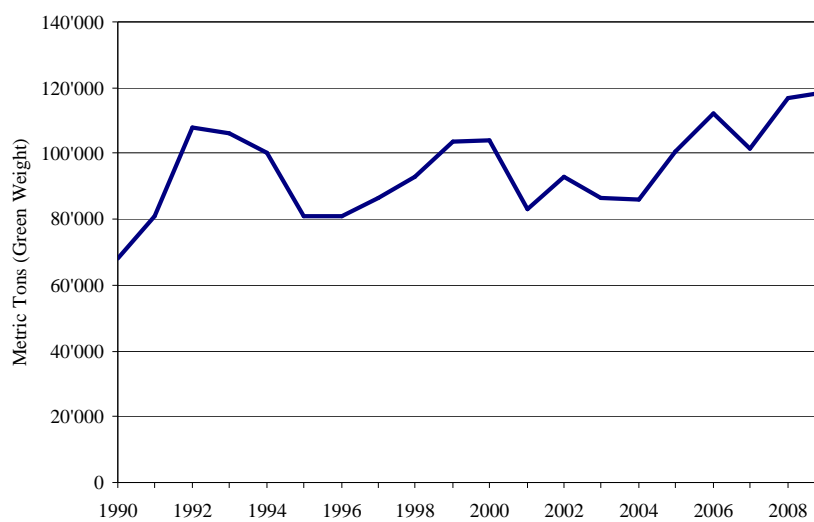


Figure 31 Tobacco production in metric tons (green weight) between 1990 and 2009 in Pakistan (ITGA 2009).

Tobacco's Share on Deforestation and Comparison to other Crops

Due to the curing process: Assuming a share of wood-based flue-curing of tobacco of 90% (see Table 8), a grade of self-sufficiency of 10% (see Table 11), a growing stock of 27t/ha, a mean annual increment of 15m³/ha and an estimated forest loss in 2008 of 42'800 ha/year and a mean wood usage of 5.5 kg wood/kg tobacco cured, tobacco's estimated share on deforestation in Pakistan due to the curing process is 26.6% (Table 30)¹⁶.

Table 30 Estimation of the share on deforestation of the tobacco curing process for the year 2008 for Pakistan (based on data from FAO (2009b), ITGA (2009) and Geist (1999)).

kg wood / kg tobacco	30.0	8.6	5.5	3.0
(1) Total Production 2008 [tonnes]	113'400	113'400	113'400	113'400
(2) Production using wood [tonnes]	62'460	62'460	62'460	62'460
(3) Solid wood required [t]	1'873'800	534'470	343'530	187'380
(4) Annual (deficit) wood required [t]	1'686'420	481'023	309'177	168'642
(5) Sustained yield area [ha]	124'920	35'631	22'902	12'492
(6) Equivalent area of natural biomass [ha]	62'460	17'816	11'451	6'246
Tobacco's share on deforestation [%]	> 100%	41.6%	26.8%	14.6%

Values applied:

- Share of wood-based flue-curing = 90%
- Grade of self-sufficiency = 0.1
- GS = 27 t/ha
- MAI = 15m³/ha
- Estimated Total area deforested in 2008 = 42'800 ha/year

Due to agricultural expansion: In total, the agricultural area in Pakistan increased between 1990 and 2007 by about 1.36 million hectares. The crops with the highest estimated share on the increase of the total agricultural area are wheat (responsible for 24.6% of the increase), rice (13.5%), cotton (13.1%), sunflower seed (10%), maize (6.9%) and sugar cane (5.9%). The area where tobacco is produced increased between 1990 and 2007 by about 10'100 hectares. About 18% of the increase of the agricultural area can be attributed to the switch from other cultures. An estimated maximum area of about 0.58 million hectares¹⁷ between

¹⁶ Applying a value of 30kg wood per kg tobacco cured, would lead to a share on deforestation of more than 100%. This value therefore indicates the limit where all forest in Pakistan would be deforested due to the tobacco curing process under the given circumstances.

¹⁷ Pakistan lost about 0.65 million hectares of land classified by the FAO as "other land" between 1990 and 2007, which may have been converted to agricultural land as well. Therefore an estimated maximum area of about 0.53 million hectares between 1990 and 2007 may be attributed to the conversion of "other land" to agricultural area.

1990 and 2007 may be attributed to the conversion of forest to agricultural area (see also Figure 31).

Table 31 Area Harvested for different crops (1990 and 2007), estimated share on the increase in agricultural area between 1990 and 2007 and estimated maximum area of forests lost due to agricultural expansion for selected crops in Pakistan (based on FAO 2009b).

Crop	Area Harvested 1990 [ha]	Area Harvested 2007 [ha]	Estimated Share on the Increase in Agricultural Area 1990 to 2007 ¹	Estimated Maximum Area of Forest lost due to Agricultural Expansion [ha] ²
Wheat	7'844'500	8'578'000	24.6%	143'096
Cotton	2'662'200	3'054'000	13.1%	76'435
Rice	2'112'700	2'515'000	13.5%	78'483
Chick peas	1'035'400	1'052'000	0.6%	3'238
Maize	845'200	1'052'000	6.9%	40'344
Sugar cane	854'300	1'029'000	5.9%	34'082
Millet	490'500	531'000	1.4%	7'901
Rapeseed	307'100	399'000	3.1%	17'928
Sunflower seed	25'899	323'067	10.0%	57'974
Beans	220'700	282'000	2.1%	11'959
Sorghum	416'500	281'000	-	-
Mangoes	82'692	164'558	2.7%	15'971
Pulses	397'800	164'000	-	-
Onions	58'600	150'000	3.1%	17'831
Tobacco	40'911	51'000	0.3%	1'968

¹ Crops without value have a decrease in the production area between 1990 and 2007

² Total Forest Area lost between 1990 and 2007 = 710'600 hectares

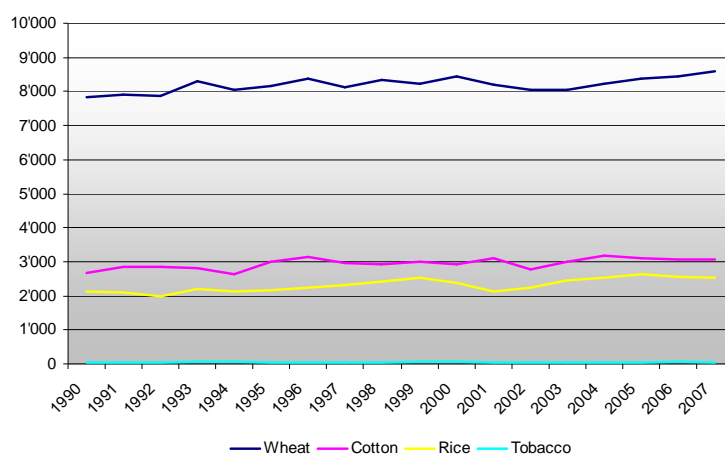


Figure 32 Trend of the production area in 1'000 ha for selected crops between 1990 and 2007 in Pakistan (FAO 2009b)

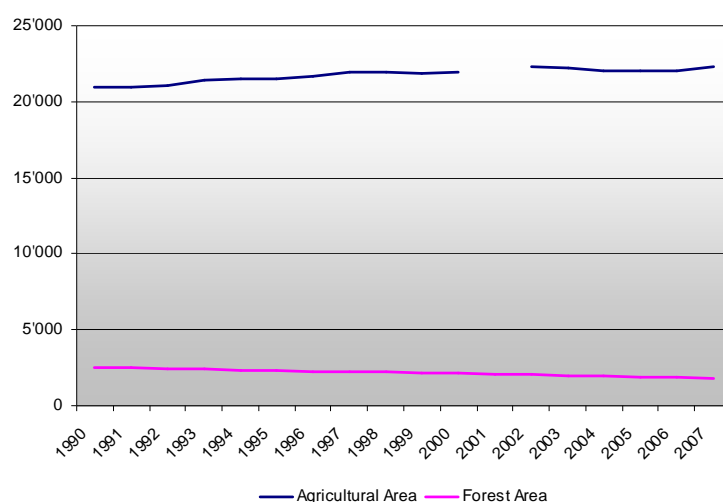


Figure 33 Trend of the agricultural area in 1'000 ha and the forest area in Pakistan between 1990 and 2007 (FAO 2009b)

* Forest Area: No reliable value available for the year 2001

Comparison to other Drivers of Deforestation

Woodfuel Consumption: Woodfuel is very important in Pakistan. Around 90 percent of Pakistan's wood production is used as fuel, and almost 80 percent of households use wood for cooking (FAO 2001). Thus, this factor is an important driver of deforestation in Pakistan.

A report submitted to the XII World Forestry Congress 2003 states that unsustainable removals of fuelwood, suspension of forest management in natural forests, unscientific grazing beyond carrying capacity, lack of adequate and sustained financial inputs for natural regeneration and sustainable development of fragile ecosystems (mountain, riparian, desert, mangrove), floods, fires storms, pests and diseases, developmental pressure i.e. construction of roads, buildings, and water reservoirs disturbing riparian and mangrove ecosystems lead to widespread deforestation in Pakistan (Saeed 2003).

5.6. Madagascar

Forest Resources and Deforestation

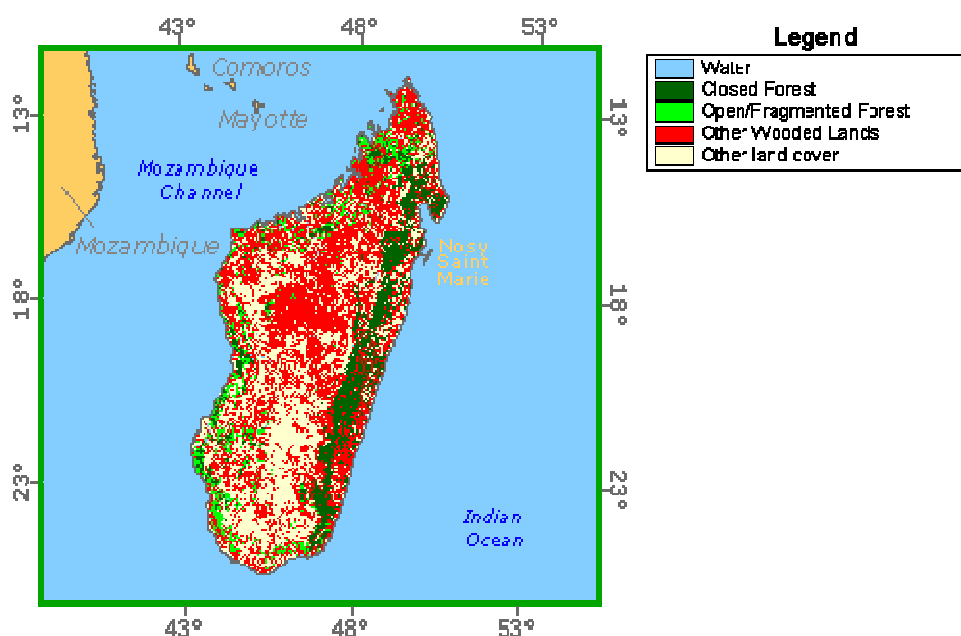


Figure 34 Forest Cover Map of Madagascar (FAO 2001).

Primary forest vegetation has disappeared from most of the country, and real rainforest is now only found in small areas in the east and north-west. Elsewhere, it has been destroyed by fires and clearing and been replaced by a degraded formation, the savoka, a shrub forest rich in ubiquitous species and bamboos. Following further fires and clearing, the savoka is gradually degrading into savannah in the east and centre. Savannah covers vast areas in the centre and west, suited to a long dry season, growing in the west. The south and south-west are mostly covered by bush vegetation in the semi-desert regions (FAO 2001).

The forest area in Madagascar covered about 12.8 million hectares in the year 2007. In the period 2000-2007 about 259'000 hectares of forests were lost corresponding to an annual deforestation rate of 0.3% (see Table 32) (FAO 2009b).

Table 32 Forest Area and Annual Change Rate of Forest Cover in Madagascar (FAO 2009b).

Forest Area [1000 ha]			Annual Change Rate	
1990	2000	2007	1990-2000	2000-2007
13'692	13'023	12'764	-0.5%	-0.3%

Tobacco Production

With a production of under 2'000 metric tons per year in 2009, Madagascar is not a major tobacco growing country. In the last twenty years the production even dropped from about 5'500 tons per year to 1'800 tons per year.

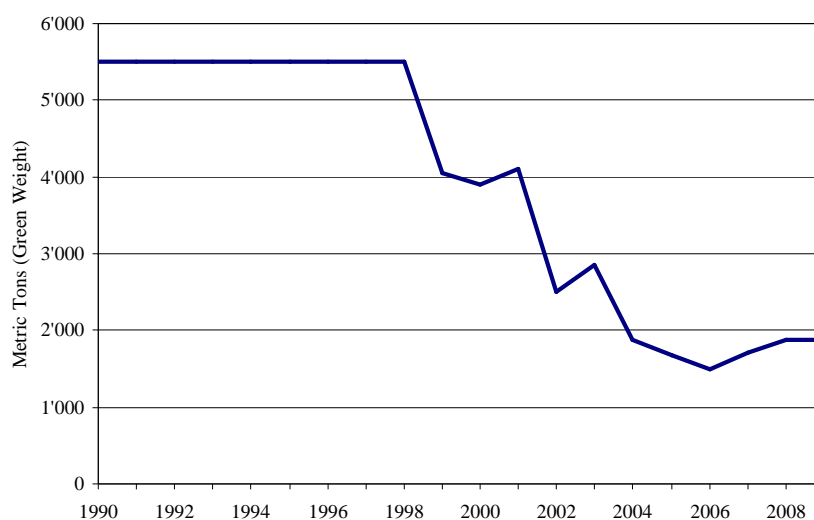


Figure 35 Tobacco production in metric tons (green weight) between 1990 and 2009 in Madagascar (ITGA 2009).

Tobacco's Share on Deforestation and Comparison to other Crops

Due to the curing process: Assuming a share of wood-based flue-curing of tobacco of 100% (see Table 8), a grade of self-sufficiency of 42%, a growing stock of 27t/ha, a mean annual increment of 15m³/ha and an estimated forest loss in 2008 of 37'100 ha/year and a mean wood usage of 5.5 kg wood/kg tobacco cured, tobacco's estimated share on deforestation in Madagascar due to the curing process is 0.3% (Table 33).

Table 33 Estimation of the share on deforestation of the tobacco curing process for the year 2008 for Madagascar (based on data from FAO (2009b), ITGA (2009) and Geist (1999)).

kg wood / kg tobacco	30.0	8.6	5.5	3.0
(1) Total Production 2008 [tonnes]	1'880	1'880	1'880	1'880
(2) Production using wood [tonnes]	900	900	900	900
(3) Solid wood required [t]	27'000	7'701	4'950	2'700
(4) Annual (deficit) wood required [t]	15'660	4'467	2'871	1'566
(5) Sustained yield area [ha]	1'160	331	213	116
(6) Equivalent area of natural biomass [ha]	580	165	106	58
Tobacco's share on deforestation [%]	1.6%	0.4%	0.3%	0.2%

Values applied:

- Share of wood-based flue-curing = 100%
- Grade of self-sufficiency = 0.42
- GS = 27 t/ha
- MAI = 15m³/ha
- Estimated Total area deforested in 2008 = 37'100 ha/year

As seen in chapter 4.1. the tree planting activities undertaken by Imperial Tobacco led to an increase of the grade of self-sufficiency to almost 100% by 2006. Thus, ***tobacco's share on deforestation will come down to almost 0%***, assuming that the cut trees will be replaced.

Due to agricultural expansion: In total, the agricultural area in Madagascar increased between 1990 and 2007 by about 0.23 million hectares. The crops with the highest estimated share on the increase of the total agricultural area are maize (responsible for 33.6% of the increase), rice (26.3%), sweet potatoes (6.6%), vanilla (6.5%) and beans (6%). The area where tobacco is produced decreased between 1990 and 2007 by 1'850 hectares. About 44% of the increase of the agricultural area can be attributed to the switch from other cultures. An estimated

maximum area of about 0.03 million hectares¹⁸ between 1990 and 2007 may be attributed to the conversion of forest to agricultural area (see also Table 34).

Table 34 Area Harvested for different crops (1990 and 2007), estimated share on the increase in agricultural area between 1990 and 2007 and estimated maximum area of forests lost due to agricultural expansion for selected crops in Madagascar (based on FAO 2009b).

Crop	Area Harvested 1990 [ha]	Area Harvested 2007 [ha]	Estimated Share on the Increase in Agricultural Area 1990 to 2007 ¹	Estimated Maximum Area of Forest lost due to Agricultural Expansion [ha] ²
Rice	1'165'000	1'300'000	26.3%	6'852
Maize	157'390	330'000	33.6%	8'761
Cassava	344'600	320'000	-	-
Sweet potatoes	91'000	125'000	6.6%	1'726
Coffee	240'400	115'000	-	-
Beans	53'050	84'000	6.0%	1'571
Sugar cane	64'800	83'000	3.5%	924
Vanilla	30'700	64'000	6.5%	1'690
Groundnuts	33'500	55'000	4.2%	1'091
Bananas	40'000	50'000	1.9%	508
Potatoes	39'000	38'000	-	-
Sisal	27'000	14'500	-	-
Cotton	27'000	13'000	-	-
Tobacco	3'650	1'800	-	-

¹ Crops without value have a decrease in the production area between 1990 and 2007

² Total Forest Area lost between 1990 and 2007 = 928'200 hectares

¹⁸ Madagascar lost about 3.5 million hectares of land classified by the FAO as "other land" between 1990 and 2007, which may have been converted to agricultural land as well. Therefore an estimated maximum area of about 0.1 million hectares between 1990 and 2007 may be attributed to the conversion of "other land" to agricultural area.

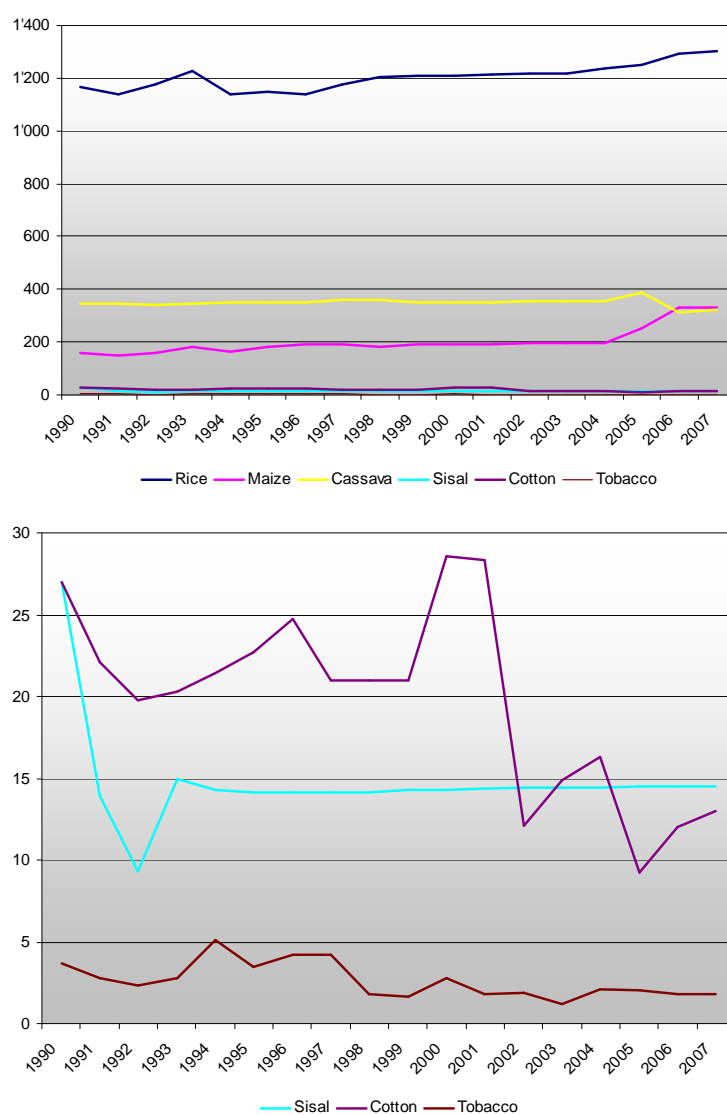


Figure 36 Trend of the production area in '000 ha for selected crops between 1990 and 2007 in Madagascar (FAO 2009b).

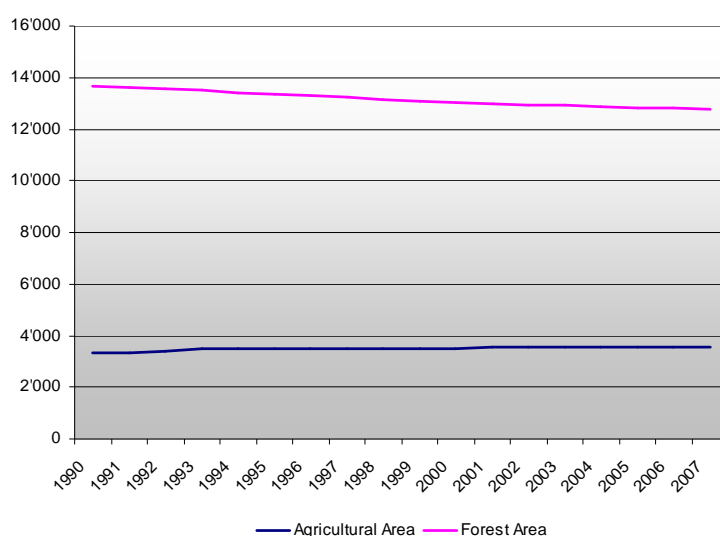


Figure 37 Trend of the agricultural area in '000 ha and the forest area in Madagascar between 1990 and 2007 (FAO 2009b).

Comparison with other Drivers of Deforestation

Rice production: Madagascar's people depend heavily on rice and a few other staple crops. In 1960 average rice productivity was 1.8 tons a hectare—about the same as Indonesia, and much more than the 1 ton a hectare average in Mali. By 2000 productivity had doubled in Mali and more than doubled in Indonesia, but it was almost unchanged in Madagascar. Static productivity – despite a substantial increase in irrigated rice area – reflects in part the implosion of the nation's road network, which fell from 55,000 km in 1960 to 33,000 in 2000. It reflects also a low and declining rate of fertilizer use: only 4 kilograms per hectare, against a Sub-Saharan average of 12 and a developing country average of 96 (WRI 2000).

Meanwhile, population grew from 5.4 million to 15.5 million. The combination of an expanding population and stagnant productivity generated pressures for agricultural expansion through forest conversion. Small farmers expanded slash-and-burn cultivation of rice into forest lands officially belonging to the state. The practice is attractive to farmers because of its low labour and input requirements and relatively attractive yields in the first two years. But yields rapidly decline to less than half a ton per hectare after a year or two. Subsequently, the land is used for even lower productivity uses, such as cattle, or it is abandoned. In drier parts of the country, grazing and fuelwood extraction spur forest degradation (The World Bank 2002).

5.7. Argentina

Forest Resources and Deforestation

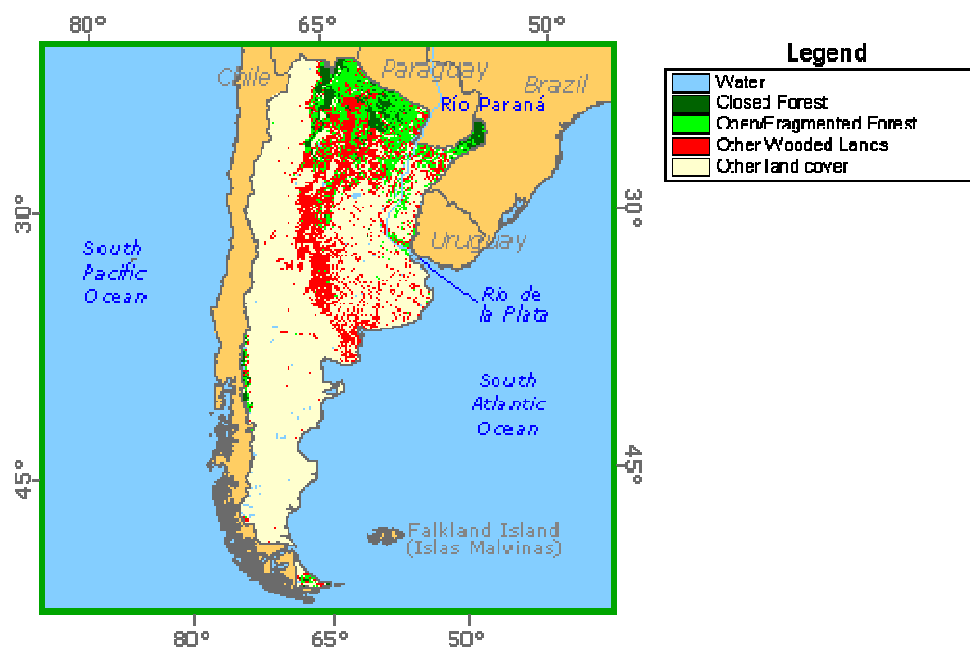


Figure 38 Forest Cover Map of Argentina (FAO 2001).

The forest in Argentina covers about 32.7 million hectares in the year 2007. According to FAO estimates, the annual deforestation rate between 2000 and 2007 was 0.4% corresponding to a loss of 149'800 hectares of forest area per year (FAO 2009b).

Table 35 Forest Area and Annual Change Rate of Forest Cover in Argentina (FAO 2009b).

Forest Area [1000 ha]			Annual Change Rate	
1990	2000	2007	1990-2000	2000-2007
35'262	33'770	32'721	-0.4%	-0.4%

Tobacco Production

The production of tobacco in Argentina almost doubled since 1990 from about 70'000 tons per year to about 135'000 tons in 2009 (Figure 27).

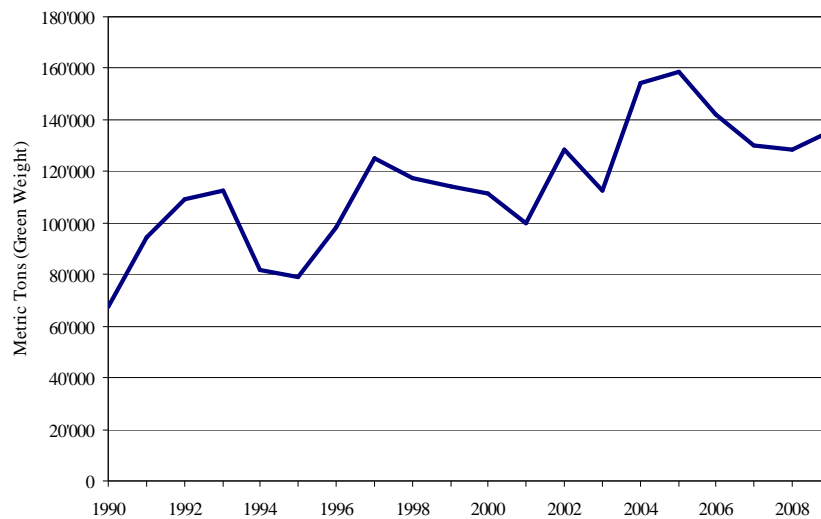


Figure 39 Tobacco production in metric tons (green weight) between 1990 and 2009 in Argentina (ITGA 2009).

Tobacco's Share on Deforestation and Comparison to other Crops

Due to the curing process: Assuming a share of wood-based flue-curing of tobacco of 5%¹⁹ (see Table 8), a grade of self-sufficiency of 10% (see Table 11), a growing stock of 27t/ha, a mean annual increment of 15m³/ha and an estimated forest loss in 2008 of 149'800 ha/year and a mean wood usage of 5.5 kg wood/kg tobacco cured, tobacco's estimated share on deforestation in Argentina due to the curing process is 0.5% (Table 36).

Table 36 Estimation of the share on deforestation of the tobacco curing process for the year 2008 for Argentina (based on data from FAO (2009b), ITGA (2009) and Geist (1999)).

kg wood / kg tobacco	30.0	8.6	5.5	3.0
(1) Total Production 2008 [tonnes]	128'180	128'180	128'180	128'180
(2) Production using wood [tonnes]	4'109	4'109	4'109	4'109
(3) Solid wood required [t]	123'278	35'163	22'601	12'328
(4) Annual (deficit) wood required [t]	110'950	31'647	20'341	11'095
(5) Sustained yield area [ha]	8'219	2'344	1'507	822
(6) Equivalent area of natural biomass [ha]	4'109	1'172	753	411
Tobacco's share on deforestation [%]	2.7%	0.8%	0.5%	0.3%

Values applied:

- Share of wood-based flue-curing = 5%
- Grade of self-sufficiency = 0.10
- GS = 27 t/ha
- MAI = 15m³/ha
- Estimated Total area deforested in 2008 = 149'800 ha/year

Due to agricultural expansion: In total, the agricultural area in Argentina increased between 1990 and 2007 by about 6 million hectares. The crops with the highest estimated share on the increase of the total agricultural area are soybeans (responsible for 84.5% of the increase) and maize (9.8%). The area where tobacco is produced increased between 1990 and 2007 by about 48'000 hectares. About 12% of the increase of the agricultural area can be attributed to the switch from other cultures. An estimated maximum area of about 2.2 million hectares²⁰ between 1990 and 2007 may be attributed to the conversion of forest to agricultural area (see also Table 37).

¹⁹ According to a report from Universal Leaf Tabacos SA (2009), 95% of the flue-cured tobacco is dried using gas as fuel in Argentina. The remaining 5% is cured with wood.

²⁰ Argentina lost about 3.4 million hectares of land classified by the FAO as "other land" between 1990 and 2007, which may have been converted to agricultural land as well. Therefore an estimated maximum area of about 2.9 million hectares between 1990 and 2007 may be attributed to the conversion of "other land" to agricultural area.

Table 37 Area Harvested for different crops (1990 and 2007), estimated share on the increase in agricultural area between 1990 and 2007 and estimated maximum area of forests lost due to agricultural expansion for selected crops in Argentina (based on FAO 2009b).

Crop	Area Harvested 1990 [ha]	Area Harvested 2007 [ha]	Estimated Share on the Increase in Agricultural Area 1990 to 2007 ¹	Estimated Maximum Area of Forest lost due to Agricultural Expansion [ha] ²
Soybeans	4'961'600	15'981'264	84.5%	1'874'804
Wheat	5'817'300	5'831'684	0.1%	2'447
Maize	1'560'330	2'838'072	9.8%	217'386
Sunflower seed	2'688'700	2'351'348	-	-
Sorghum	729'135	594'410	-	-
Barley	148'900	419'180	2.1%	45'983
Cotton	544'900	393'005	-	-
Sugar cane	255'649	290'000	0.3%	5'844
Beans	207'400	251'190	0.3%	7'450
Oats	451'200	224'250	-	-
Grapes	206'014	220'000	0.1%	2'379
Groundnuts	165'900	215'060	0.4%	8'364
Maté	101'842	177'000	0.6%	12'787
Rice	116'620	164'635	0.4%	8'169
Tobacco	43'931	92'000	0.4%	8'178

¹ Crops without value have a decrease in the production area between 1990 and 2007

² Total Forest Area lost between 1990 and 2007 = 2'540'600 hectares

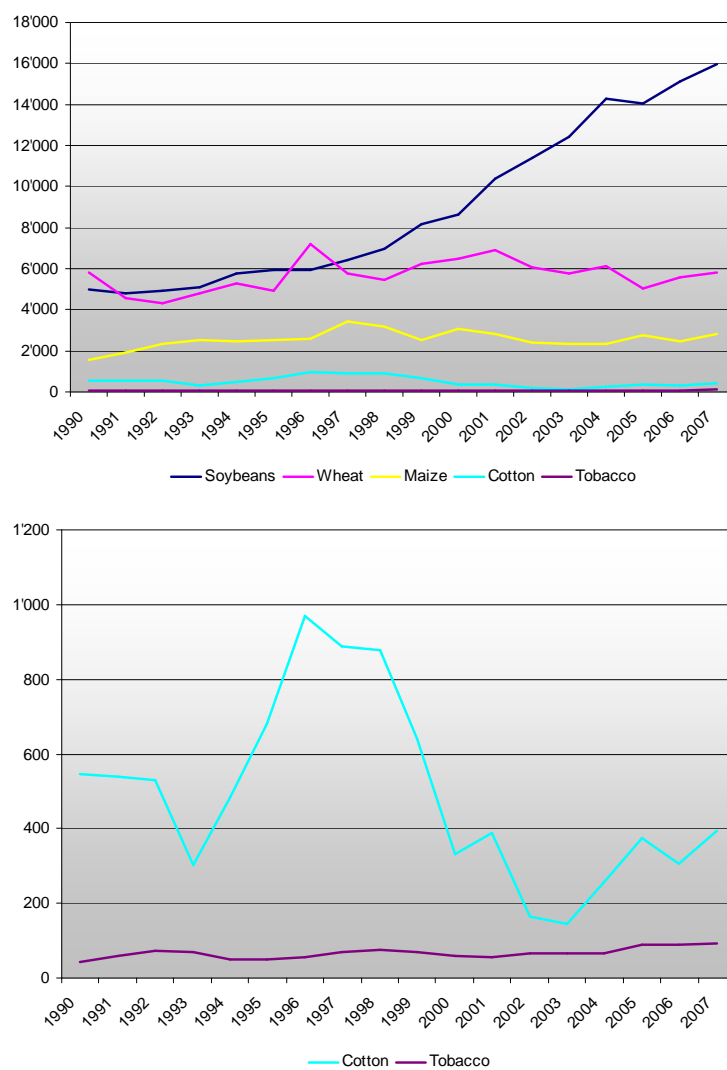


Figure 40 Trend of the production area in '000 ha for selected crops between 1990 and 2007 in Argentina (FAO 2009b).

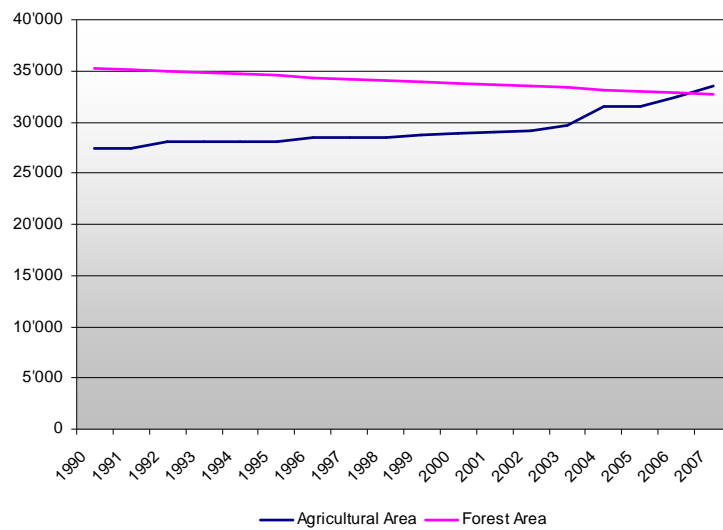


Figure 41 Trend of the agricultural area in 1'000 ha and the forest area in Argentina between 1990 and 2007 (FAO 2009b).

Comparison to other Drivers of Deforestation

Soybean production: A study by Grau et al. (2005) estimated deforestation in Argentina in the Semi-arid Chaco in Argentina, one of the largest forested biomes in South America, where soybean is the most important crop. Between 1972 and 2001, 588'900 ha (ca. 20% of the forests) were deforested. Deforestation has been accelerating, reaching $>28'000 \text{ ha yr}^{-1}$ after 1997. The initial deforestation was associated with black bean cultivation following an increase in rainfall during the 1970s. In the 1980s, high soybean prices stimulated further deforestation. Finally, the introduction of soybean transgenic cultivars in 1997 reduced plantation costs and stimulated a further increase in deforestation. The domestic economy had little association with deforestation. Although deforestation was more intense in the moister (rainfall $>600 \text{ mm yr}^{-1}$) areas, more than 300'000 ha have already been deforested in the drier areas, suggesting that climatic limitations are being overcome by technological and genetic improvement. Furthermore, more than 300'000 ha of forest occur in sectors without major soil and rainfall limitations. If global trends of technology, soybean markets and climate continue, and no active conservation policies are applied, vast areas of the Chaco will be deforested in the coming decades.

5.8. Results from Case Studies

In the following the results from the selected case studies are summarized.

Deforestation due to the Curing of Tobacco

Table 38 summarizes the share on deforestation due to the tobacco curing process for the selected case studies and lists the underlying assumptions based on studies by Geist available on deforestation linked to tobacco. Pakistan and Malawi have the highest share on deforestation. One reason is their low grade of self-sufficiency. Tanzania also has a low grade of self-sufficiency, but as the total area deforested in the country is higher compared to Malawi and Pakistan the share on deforestation of the curing process is lower.

Compared to the estimation of the share on deforestation due to the curing process on a global level – 2.1% (see Table 12 in Chapter 3.2.2.) – Argentina, Brazil, Indonesia and Madagascar have a lower share on deforestation whereas Tanzania, Malawi and Pakistan have a higher share on deforestation.

Table 38 Overview of the share on deforestation due to the curing process for selected countries and underlying assumptions – Scenario based on studies by Geist.

Country	Share on deforestation due to the curing process	Assumptions*			Estimated area deforested for tobacco curing [ha/year]
		Share of wood-based flue-curing	Grade of self-sufficiency	Area deforested for all purposes [ha/year]	
Brazil	1.1%	100%	82%	3'103'000	34'133
Malawi	19.8%	100%	20%	33'000	6'534
Indonesia	0.4%	90%	42%	1'871'400	7'486
Tanzania	3.8%	100%	7%	412'200	15'664
Pakistan	41.6%	90%	10%	42'800	17'805
Madagascar	0.4%	100%	42%	37'100	148
Argentina	0.8%	5%	10%	149'800	1'198

* The following assumptions are valid for all countries:

- kg wood / kg tobacco = 8.6
- GS = 27 t/ha
- MAI = 15m³/ha

In a number of countries the tobacco industry has stepped up activities to increase the grade of self-sufficiency of the farmers and to make the curing process more wood-efficient or non-wood based. Assuming that the tree planting activities of the tobacco industry will continue with the necessary amount of trees to replace the amount of trees needed for the curing process, the grade of self-sufficiency can substantially be increased in those countries. On that condition, the reported

activities will lead to a grade of self-sufficiency of about 100% in Brazil and Tanzania and of about 60% in Malawi. Thus, the share on deforestation due to the curing process will decrease to almost 0% in Brazil and Tanzania and to 6.3% in Malawi (see Table 39).

Table 39 Overview of the share on deforestation due to the curing process for selected countries and underlying assumptions – Scenarios based on tree-planting activities of the tobacco industry.

Country	Share on deforestation due to the curing process	Share of wood-based flue-curing	Assumptions*		Estimated area deforested for tobacco curing [ha/year]
			Grade of self-sufficiency	Area deforested for all purposes [ha/year]	
Brazil	~ 0.0%	100%	~ 100%	3'103'000	~ 0
Malawi	6.3%	100%	~ 60%	33'000	2'079
Indonesia (*)	0.4%	90%	42%	1'871'400	7'486
Tanzania	~ 0.0%	100%	~ 100%	412'200	~ 0
Pakistan (*)	41.6%	90%	10%	42'800	17'805
Madagascar (*)	0.4%	100%	42%	37'100	148
Argentina (*)	0.8%	5%	10%	149'800	1'198

* The following assumptions are valid for all countries:

- kg wood / kg tobacco = 5.5

- GS = 27 t/ha

- MAI = 15m³/ha

(*) No new data available

Deforestation due to Agricultural Expansion

The deforestation due to agricultural expansion is based on rough estimations using data from the FAO. Table 40 summarizes for the selected case studies the crops with the highest share on the increase of the total agricultural area and shows a comparison to tobacco. In all selected countries, tobacco plays a minor role concerning agricultural expansion and therefore a minor role concerning deforestation due to agricultural expansion.

Table 40 Summary of the crops with the highest estimated share on the increase of the total agricultural area in the selected case studies and comparison to tobacco.

Country	Crops with the highest estimated share on the increase of the total agricultural area	Tobacco
Brazil	Soybeans (57%), sugar cane (18%), maize (15%)	1.2%
Malawi	Groundnuts (26%), potatoes (19.3%), cassava (14%), beans (13.9%)	2.3%
Indonesia	Palm oil fruit (39.5%), rice (16.8%), natural rubber (9.3%)	–
Tanzania	Maize (33.7%), sorghum (12.8%), bananas (10.3%)	0.4%
Pakistan	Wheat (24.6%), rice (13.5%), cotton (13.1%), sunflower (10%)	0.3%
Madagascar	Maize (33.6%), rice (26.3%), sweet potatoes (6.6%), vanilla (6.5%)	–
Argentina	Soybeans (84.5%), maize (9.8%)	0.4%

6. Conclusions

About 13 million hectares of the world's forests are lost each year due to deforestation. Some of the main drivers that cause this deforestation are agricultural expansion, illegal logging, pasture expansion and woodfuel consumption. But the underlying causes of deforestation are much more complex and it is harder to establish clear links between underlying causes and deforestation.

This report analyzed the role of the production of tobacco regarding deforestation. The two possible contributions are a) clearing of forested land for the production of tobacco and b) deforestation due to the use of wood for the curing process.

As described in section 3.2.1. and in the selected case studies, tobacco only plays a minor role in the conversion of forests to agricultural land. Other crops, such as soybeans or palm oil have a larger impact.

The estimated mean global share on deforestation due to the curing of tobacco is between 1% and 2% depending on the fuel-efficiency of the curing process; but can increase to substantially higher amounts for selected countries. This share is in particular dependent on the grade of self-sufficiency in wood-supply of the tobacco farmers.

In recent years, the tobacco industry expanded their tree-planting and woodlots programmes. In addition, there are several initiatives put in place in order to make the curing process more energy-efficient. Taking into account these efforts, the grade of self-sufficiency increased in the respective countries and therefore the impact of the tobacco production on forests decreased and will decrease on condition that the started tree-planting activities will continue in future.

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