Wood from Illegal Harvesting in EU Markets: Estimations and Open Issues

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Abstract

For estimation of worldwide imports and use of wood – unprocessed industrial roundwood (raw wood excluding fuelwood) and products on the basis of wood, including paper – from illegal harvesting, while considering the trade via third party countries a method based on input-output-analysis is used. The results are largely dependent on the quality of the input data used, above all on the presumed share of illegally harvested wood. For the year 2009, we calculated an illegal global harvesting of industrial roundwood of 103 to 284 million m³; depending on the presumed low and high country-specific shares of illegal harvests. That represents between 7 and 17 % of the global harvest. Estimates on imports of illegally harvested wood into the EU strongly depend on whether the countries of the EU are considered individually, hence internal trade of the member countries of the EU has to be taken into account, or whether the European Union is considered as one region and hence internal trade within the European countries is not taken into account. In 2009, imports of wood from illegal harvesting into the countries of the EU accounted for a volume of 15 to 34 million m³. That is 3 to 6 % of all wood imports and 2 to 4 % of the domestic use of wood in the countries of the EU. About one half of the imports are traded directly, the other half is imported via third countries. Considering the EU as one region without internal trade leads to a significantly lower import of illegally harvested wood of 8 to 18 million m³. On the other hand it results in a higher share of 6 to 13 % of total imports into the EU due to the exclusion of the intensive internal trade.

Keywords: *Illegal harvesting, global trade, wood products, import and use, input-output-analysis*

Zusammenfassung

Holz aus illegalem Einschlag auf dem EU-Markt: Abschätzungen und offene Fragen

Um die Einfuhren sowie den Verbrauch von Holz – Rohholz (ohne Brennholz) und Holz- und Papierprodukte auf Basis Holz – aus illegalem Einschlag unter Berücksichtigung des Handels über Drittländer abzuschätzen, wurde eine Methode, die aus der Input-Output-Analyse entwickelt wurde, angewendet. Die unterstellten Illegalitätsanteile bestimmen dabei ganz wesentlich die Ergebnisse. Für das Jahr 2009 errechnet sich ein illegaler Holzeinschlag von weltweit 103 bis 284 Mio. m³ Rohholz (ohne Brennholz). Dies entspricht 7 bis 17 % des globalen Einschlags, jeweils abhängig von den länderspezifischen Annahmen über hohe und niedrige Schätzrahmen für illegalen Einschlag. Die Abschätzungen für die Einfuhren von Holz aus illegalem Einschlag hängen davon ab, ob die Länder der EU einzeln und somit inklusive Intrahandel innerhalb der EU betrachtet werden oder ob die EU als eine Region behandelt und somit der Intrahandel zwischen den Mitgliedsländern nicht betrachtet wird. Im Jahr 2009 berechneten sich die Importe von Holz aus illegalem Einschlag in die Länder der EU auf 15 bis 34 Mio. m³ (r), das sind 3 bis 6 % der Holzeinfuhren insgesamt und 2 bis 4 % des Holzverbrauchs in der EU. Etwa die Hälfte dieses Holzes stammt aus direktem Handel mit den betroffenen Ursprungsländern, der übrige Teil wird über Drittländer eingeführt. Betrachtet man die EU als eine Region ohne Intrahandel, so reduzieren sich die Importe auf 8 bis 18 Mio. m³ (r). Aufgrund des intensiven Intrahandels resultiert mit 6 bis 13 % ein höherer Anteil an Holz aus illegalem Einschlag an den Gesamtimporten in die EU.

Schlüsselworte: *Illegaler Einschlag, Globaler Handel, Holzprodukte, Einfuhr und Verbrauch, Input-Output-Analyse*

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Background and Aim of the Study

Illegal harvesting of wood is considered to be an important cause of worldwide deforestation and forest degradation. It has an adverse impact on biological diversity and exacerbates global climate change. From a social and economic perspective, illegal harvesting of wood leads among other things to a reduction of tax income, to lower wood prices, and undermines national legislation and promotes corruption. Conversely, this increases the economic pressure on legal forestry following sustainability criteria, and reduces as a consequence the willingness to manage forests in this manner (see i.e., Lawson and MacFaul, 2010; Li et al., 2008; WWF, 2008 a).

To combat illegal harvesting and trade in wood and wood products of illegal origin the European Union (EU) enacted the FLEGT (Forest Law Enforcement, Governance and Trade) Action Plan in 2003. In the framework of this action plan, the EU, for example, signs voluntary partnership agreements (VPA) with specific producer countries in order to guarantee that only legally harvested wood is imported from these countries (EC, 2012a). A further element of the FLEGT Action Plan is the EU Timber Regulation (EUTR) which went into force in December 2010 and prohibits the trading of illegal harvested wood and wood products in the EU (EC, 2012b). As of March 2013, market participants in the EU are obligated to apply precautionary regulations in the initial import and supply to domestic markets.

In this context, questions about the level of the illegal harvesting worldwide and the use of illegally harvested wood in the EU need to be answered. While a series of studies quantify the percentage of illegal harvesting, albeit to some extent with strongly varying results, there is a lack of studies on the trade and import of wood and wood products from illegal harvesting which adequately take the complex trade structures of wood and products made from wood into consideration.

This paper presents estimations on production, imports and the domestic use of wood from illegal harvesting. This includes, on the one hand, bilateral trade, and on the other hand, also trade of illegally harvested wood via third party countries. Due to the high uncertainty about real illegally harvested volumes and the lack of information on the respective trade, the study does not claim to represent the real situation. Nevertheless it demonstrates how the situation could be, assuming the underlying input data is valid. The study is focused only on the illegal harvesting of materially used wood and its trade, including manufactured products. Hence, this includes wood and wood products as well as pulp and paper products. Fuelwood is not considered, since no information is available on the illegal harvesting of wood for energy purposes. However, it can be assumed that the international trade of fuelwood is negligible.

For the purpose of this analysis, the most recent information regarding the shares of illegally harvested wood is required. The paper starts with a survey on available illegal harvest figures, accompanied by a discussion on problems of definition, open issues regarding the methodology and fur-

ther uncertainties. Subsequently, the applied methodology is presented which will provide the basis for the calculation of production, import and use of illegally harvested wood for the 27 EU member states. The discussion of the results and an outlook conclude the study.

State of Knowledge

For more than a decade illegal harvesting has been a current issue in international forest policy. Accordingly many studies have been conducted dedicated to this topic. An analysis of these studies, however, reveals that only a few of them offer figures on illegal harvesting in a comprehensive way, meaning that the applied method and the achieved results can be understood and reviewed. Examples among them are Palmer (2001) for Indonesia, Ottitsch et al. (2005a) for Russia or Hansen and Treue (2008) for Ghana. The majority of studies refer to secondary studies which themselves often cite third sources. In many cases the original sources of the data are not retraceable. A survey on findings for tropical countries can be found in a study by Dieter and Küpker (2006, Tab. 11).

Several global surveys also exist based on individual country estimations. Nilsson (2006) states for example that the share of illegal harvests could account for 20 to 40 % of the worldwide production of industrial wood. Seneca Creek Associates and Wood Resources International (2004) compiled a rather global collection of estimations on country-specific shares of illegal harvesting. This study was rather broadly distributed and noted. However, the authors also have to conclude "By definition, tracking and measuring illegal logging and/or illegal trade in forest products is more art than science. Estimates are largely based on speculation and anecdotal information." (Seneca Creek Associates and Wood Resources International, 2004, p. 9). Nonetheless the study builds the basis for the most recent and comprehensive survey on estimated shares of illegally harvested timber by Li et al. (2008). As the basic information on the shares varies widely in a lot of countries, high and low values are indicated. In those cases for which more current data is available, for example Miller et al. (2006) or Contreras-Hermosilla et al. (2007), Li et al. (2008) supplement the original data from Seneca Creek Associates and Wood Resources International (2004). Lawson and MacFaul (2010) later published estimations on the developments in the production of illegally harvested wood since 2002 for the world on average as well as for selected countries.

With regard to the goal of the present study, and in contrast to the variety of estimates on illegal harvesting in individual countries, only few studies provide methods or results on the trade and use of illegally harvested wood. Li et al. (2008) apply their data set on illegality shares and calculate effects on price, production, and trade volume when modelling the progressive elimination of illegally logged wood from the worlds markets. But they do not model trade in illegally harvested timber between individual countries. Two studies conducted on behalf of WWF (2008a, b) do so, but they do not account for trade via third party countries; even though in WWF (2008a) indirect trade via EU member states

is calculated. Accounting for trade via third party countries is the explicit intention of Dieter (2009) who presents a method to analyse trade in illegally harvested timber. Beyond estimations of the imports, the method also allows the use of illegally harvested wood to be estimated.

Crucial Aspects of Estimates on Illegally Harvested Wood

In particular two framework conditions must be mentioned which affect the volume of illegally harvested wood in all of the three dimensions (i) production, (ii) trade, and (iii) use: the definition of illegality and the reference of the illegality shares.

Still there is no international agreement on what exactly illegal harvesting is. A rather narrow definition is applied by Seneca Creek Associates and Wood Resources International (2004, p. 4): "Directly related to illegal logging:

- harvesting without authority in designated national parks or forests reserves;
- harvesting without authorization or in excess of concession permit limits;
- failing to report harvesting activity to avoid royalty payments or taxes; and
- violating international trading rules or agreements, such as export bans or CITES"

In contrast to this rather narrow understanding, environmental agencies often define illegality more broadly. Accordingly wood is considered illegal if national laws are violated at any point in the course of the harvest, the transport or the processing of wood. As a consequence, the share of illegal wood is, of course, higher due to broader definitions. The broader definitions do not allow conclusions to be drawn on the legality of the initial wood harvesting. This is however the subject of the various international efforts (for example FLEGT) to conserve forests with controlled wood use.

Basically there are different approaches appropriate for estimating the shares of illegally harvested wood: inter alia wood balancing, expert survey or extrapolation from single cases. Most studies however do not sufficiently convey the applied methods (for a survey on the example of tropical countries see again Dieter and Küpker (2006, Tab. 11)). Using the results of the existing studies leads to a specific problem: the reference problem. Should the respective illegality shares be referred to the harvesting volume with or without illegally harvested wood? Should it be assumed that the illegally harvested volume is already accounted for in the overall harvesting figures (gross approach)? Or should the volume be added to the reported (legal) harvesting volumes (net approach)? Figure 1 shows schematically how these different approaches affect the resulting volume of illegally harvested wood. One reported share of illegal harvest can lead to fairly strong variations in the estimated volumes of illegal harvest; from 16.7 to 25 units in the given schematic example.

Own Approach and Data Basis

The strongly developed and complex international trade with wood and wood products leads to imports of wood from illegal harvesting via third party countries in significant quantities. In order to be able to estimate bilateral trade as well as trade via third countries, the method developed by Dieter (2009) is applied. For the sake of comprehensibility it is presented in the following very briefly.

The method is based on total wood balances of all countries of the world: by definition total supply equals total use in every individual country. Likewise total exports equal total imports on the global scale. Total supply and total demand are arranged according to an input-output-table but with changed axes. Figure 3 (cited from Dieter, 2009, p. 602) shows the resulting table structure.

In the next step the methodology of input-output-analysis can be applied to this table structure. Due to the changed axes the coefficients must also be calculated differently. Output-coefficients are calculated and used instead of input-coefficients. Conventional matrix algebra leads to inverse trade coefficients. These allow the change in total supply of each country resulting from a change in domestic supply of one individual country to be identified. Interpreting illegally harvested wood as the change in domestic supply, one gets the import of illegally harvested wood from the focus country to all other countries by means of the respective inverse trade coefficients. Hence, they fully take into account the trade via third party countries (for a deeper explanation of the method see Dieter, 2009).

It should be mentioned that this interpretation is only valid under one quite restrictive assumption: the method assumes equal portions of illegally harvested wood for export and domestic use. This means the calculated volume of illegally harvested wood is implicitly distributed among export and domestic use according to their respective shares in terms of volume. This proportionality assumption applies for the countries in which wood is harvested as well as for all other countries in which wood is processed and traded. This assumption is worthy of discussion with regard to the situation in some specific countries, as is done in the discussion later on. But general acceptance of this approach renders a conclusive retracing of the total illegal wood harvesting from the country of origin via international trade, processing, and further through to the use in the target countries possible. However, it must be mentioned that this is only possible for the overall aggregate of all wood and wood products per country, and not for single commodity flows.

To apply this method, primarily information on three different areas is required: on the bilateral trade of wood and wood products, on domestic supply and on country-specific shares of illegally harvested wood. The trade database of the United Nations (UN Comtrade) is used as the data basis for the international trade with wood. It contains bilateral trade data on the nomenclature of the harmonized system (HS). To enable the calculations in the model, the differing units of the trade quantities of the different commodities of wood were converted into the comparable unit of cubic meters of

raw wood equivalents (m^3 (r)).[1] Information on domestic supply is comprised of the wood harvest (excluding fuelwood) and the availability of recycling paper and wood residues. This data was taken from the FAO Forestry Statistics Database (FAO ForesSTAT). The calculations for this paper were carried out for the year 2009. That is the most current year for which all required data are available, although both production and trade at this point in time were affected by the global economic crisis. The UN Comtrade database comprises bilateral trade data of exports and imports in monetary and physical values. As most countries report bilateral trade data, the database had to be reduced by the double counted flows. Moreover, a comparison of imports and of exports showed differing data. For the reduction of the database, we preferred information on imported data as we assume that import data is recorded more exactly by the countries due to the relevance for national taxation (Dieter 2009). The according export data was used if import data was missing. All remaining trade data was checked regarding extreme values. If extreme values occurred, data was replaced with the respective export flow, based on the respective ratios of unit values of comparable flows or according to comparable data bases as provided by Eurostat and FAO. In fourteen countries calculation of domestic use resulted in a negative value. In these cases it was assumed that statistics on domestic supply, i.e., on wood harvest, supply of recovered paper and wood residues are less exact than trade statistics. For these countries per capita consumption of the neighbouring countries was assumed as replacement. The resulting quantity was added to the domestic supply.

We decided on the data provided by Li et al. (2008) as the source of country-specific shares of illegally harvested wood. With this decision, the decision for a rather narrow definition of illegality is also made. The percentages for saw-logs and pulpwood are combined for this study to a joint value for industrial roundwood. For this purpose the illegal percentage is weighted on the basis of the production quantities of saw-logs and pulpwood in the year 2009. Like Li et al. (2008) we also tried to consider the most currently available information in this study. In this regard a study by Lawson and MacFaul (2010), who subsume a drop of 22 % in the global production of illegally harvested wood since the year 2002, has to be mentioned. Although the study decidedly presents the developments of five countries (Brazil, Cameroon, Ghana, Indonesia and Malaysia), regional limitations (only the Amazon region is considered and not Brazil overall), different, not comparable statistics, and differing base years prevent a direct linkage to the values provided by Li et al. (2008). For this reason the worldwide reduction for all countries on average reported by Lawson and MacFaul (2010) is applied to every individual country in our study with respect to the recent developments in the fight against illegal wood harvesting.

Estimations of illegally harvested wood regularly take place on the basis of wood balancing. Data gaps can be disclosed by a balancing of officially reported supply and use of wood, which, as in the above-mentioned studies, are supposed to be closed by illegal harvests. Hence, for the parameterizing of the model in this paper it is assumed that the figures for harvests reported in the official statistics do not include illegal wood harvesting and that the basis of illegal harvests is the overall volume of harvests. This corresponds with the net approach with legally and illegally harvested wood as a basis in Figure 1. Accordingly the volumes of illegally harvested wood are calculated for each country as shown by Equation 1:

$$V_i = V_o * s_i / (1 - s_i) \qquad (1)$$

with

V_i	volume of illegally harvested wood
V_o	officially reported volume of harvested wood
s_i	share of illegally harvested wood
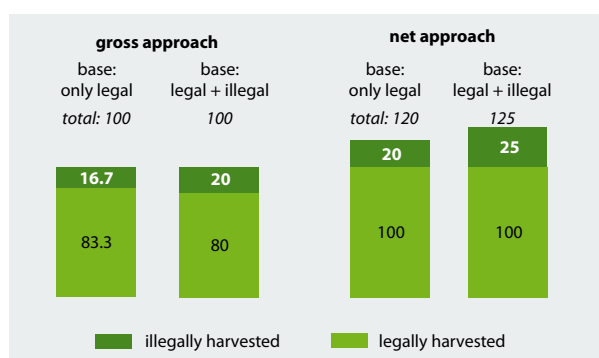
Figure 1

Effects of different references on the estimated volumes of illegally harvested wood; given on an example of 20 % illegal harvesting share and an official harvesting figure of 100

Results

An overview of the different shares of illegally harvested wood for the most strongly affected countries on the continents named can be seen in Figure 2. Both high and low estimates are presented. The great ranges between these two estimates for many countries illustrate the uncertainties to which the illegal shares are tied. This should be taken into account when interpreting the results later on.

In the following the results are presented separately for harvesting, trade (imports) and domestic use for the different regional levels world, EU countries and total EU (which describes the EU as one region, ignoring the internal trade in the European Union).

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1   Raw wood equivalents is a unit which express – in consideration of production losses – how many units of roundwood are required for the production of one unit of the focused semi-finished or finished wood product.

Figure 2
Calculated shares of illegally harvested wood for the most strongly affected countries on the named continents (range between high and low estimate indicated)

Figure 3
Country specific wood balances arranged according to an input-output-table but with changed axes (cited from Dieter, 2009, p. 602

Harvesting

For the year 2009, FAO ForesSTAT reports a global production of industrial roundwood of 1,414 million m^3. On this basis calculations of illegal harvest result in a total of 103 million m^3 (low estimate), respectively 284 million m^3 (high estimate). Thus 7 to 17 % of the harvest of industrial roundwood (except fuelwood) originates from illegal harvesting. Among European countries only a few are suspected of illegal harvesting. For the EU, the production sums up to 5 million m^3 (low estimate), respectively 10 million m^3 (high estimate). The share of illegally harvested wood in the EU ranges between 2 and 3 %, which is fairly lower than on the global scale.

Trade

In the year 2009, 1,543 million m^3 (r) were traded globally. International trade with wood (industrial roundwood and products based on wood) is hence on the same level as the wood harvesting (except fuelwood). However, the share of illegally harvested wood of the total harvest is higher than it is in trade (Table 1). The reason for this is the patterns of use and trade of countries with illegal wood harvests. Their volume of domestic consumption exceeds their volume of exports. The countries of the EU imported 605 million m^3 (r) in 2009. Between 3 and 6 % of this quantity could be assumed to originate from illegal sources. This framework holds for most of the 27 countries of the EU. Merely the calculations for the Baltic countries and Finland result in a much higher import level of illegally harvested wood of up to 14 %. This can be probably associated with the close trade relations with Russia and the higher share of illegal harvests in Russia.

A total of 462 million m^3 or 76 % of the wood and wood products of the EU countries are imported from other EU countries (internal trade). If the internal trade were to be excluded, also the volume of wood originating from illegal harvesting would decrease. This is due to the proportionality assumption, which rules that a country's import of wood from illegal harvesting is distributed proportionally to both domestic use and exports. Accounting for internal trade thus increases the sum of imports of illegally harvested wood as compared to its exclusion. Despite the lower volumes, the shares of the imports of wood from illegal harvesting in the EU are however much higher. The shares range from 6 to 13 %. This is because internal trade predominates in the countries of the EU. With its exclusion only external trade remains in which the wood from illegal harvesting comprises a much higher percentage.

Domestic Use

It may be considered as an advantage of the method applied here that the sum of globally harvested wood finds its counterpart in the sum of wood used globally. Thus also the final destination of illegally harvested wood can be demonstrated. The share of illegally harvested wood from domestic use is lower on a global perspective (4 to 11 %) than the respective share from harvesting (7 to 17 %). This is due to the fact that the total supply is based on harvests as well as recycling of wood and paper, the total use is accordingly higher and the share of illegally harvested wood is accordingly lower. The domestic use of wood in the EU originates with 9 (low estimate) to 20 (high estimate)

million m^3 (r) at 2 to 4 % from illegal sources (Table 1). This framework also holds for many of the individual EU countries. However, outliers with significant higher shares definitely exist. To estimate the relevance of trade via third party countries, the presented results can be compared with the bilateral trade of wood from illegal harvesting (Figure 4). For this purpose, illegally harvested wood is divided into domestic use and export based on the use-structures in each individual country. Thus a direct relationship can be estimated between the country regarded and particular partner countries. Here too, the export of all products based on wood is considered since illegally harvested wood can also be processed in each

Table 1

Imports and domestic use of wood (industrial roundwood and products based on wood) 2009, total and illegally harvested [1,000 m^3 (r)]

| EU27-Country	Imports				Domestic use					
	Total imports	… of which illegal			low estimate	… of which illegal		high estimate	… of which illegal	
		low estimate		high estimate						
Austria	31,672	735	(2 %)	1,304	(4 %)	11,399	160	(1 %)	11,399	284	(2 %)
Belgium	47,281	1,051	(2 %)	2,701	(6 %)	25,047	482	(2 %)	25,047	1,238	(5 %)
Bulgaria	2,782	102	(4 %)	170	(6 %)	3,515	193	(5 %)	3,910	514	(13 %)
Cyprus	1,066	38	(4 %)	74	(7 %)	819	27	(3 %)	819	52	(6 %)
Czech Republic	15,239	390	(3 %)	716	(5 %)	13,853	566	(4 %)	13,853	703	(5 %)
Denmark	13,499	296	(2 %)	645	(5 %)	10,297	178	(2 %)	10,297	388	(4 %)
Estonia	2,411	158	(7 %)	267	(11 %)	2,792	137	(5 %)	4,214	837	(20 %)
Finland	14,481	1,004	(7 %)	1,957	(14 %)	6,825	90	(1 %)	6,825	175	(3 %)
France	67,015	1,579	(2 %)	3,605	(5 %)	73,267	940	(1 %)	73,267	2,146	(3 %)
Germany	103,585	2,414	(2 %)	5,229	(5 %)	72,752	917	(1 %)	72,752	1,987	(3 %)
Greece	7,097	257	(4 %)	534	(8 %)	6,711	200	(3 %)	6,711	417	(6 %)
Hungary	7,602	201	(3 %)	325	(4 %)	5,103	137	(3 %)	5,103	193	(4 %)
Ireland	6,725	156	(2 %)	361	(5 %)	6,445	95	(1 %)	6,445	219	(3 %)
Italy	57,471	1,324	(2 %)	3,091	(5 %)	38,184	680	(2 %)	38,184	1,588	(4 %)
Latvia	1,531	74	(5 %)	133	(9 %)	2,311	150	(7 %)	3,254	435	(13 %)
Lithuania	3,162	148	(5 %)	275	(9 %)	4,266	191	(4 %)	4,266	256	(6 %)
Luxembourg	3,361	54	(2 %)	121	(4 %)	2,686	27	(1 %)	2,686	61	(2 %)
Malta	323	9	(3 %)	19	(6 %)	263	7	(3 %)	263	15	(6 %)
Netherlands	32,890	723	(2 %)	1,618	(5 %)	2,189	39	(2 %)	2,189	87	(4 %)
Poland	24,283	668	(3 %)	1,253	(5 %)	42,702	1,375	(3 %)	43,749	2,389	(5 %)
Portugal	7,569	231	(3 %)	442	(6 %)	5,643	61	(1 %)	5,643	117	(2 %)
Romania	5,531	187	(3 %)	339	(6 %)	10,494	504	(5 %)	10,531	611	(6 %)
Slovak Republic	7,869	249	(3 %)	397	(5 %)	6,775	268	(4 %)	7,019	420	(6 %)
Slovenia	6,136	178	(3 %)	301	(5 %)	2,552	89	(3 %)	2,577	131	(5 %)
Spain	49,855	1,093	(2 %)	2,774	(6 %)	53,388	739	(1 %)	53,388	1,875	(4 %)
Sweden	22,413	655	(3 %)	1,418	(6 %)	14,061	96	(1 %)	14.061	209	(1 %)
United Kingdom	62,341	1.432	(2 %)	3,595	(6 %)	66,389	1,004	(2 %)	66.389	2,521	(4 %)
Total EU27	605,192	15.403	(3 %)	33,664	(6 %)	490,728	9,353	(2 %)	494.841	19,869	(4 %)
Total rest of the World	937,687	36.641	(4 %)	82,109	(9 %)	1,816,357	93,483	(5 %)	1.993.680	264,404	(13 %)
Total World	1,542,880	52.044	(3 %)	115,772	(8 %)	2,307,085	102,837	(4 %)	2.488.521	284,273	(11 %)
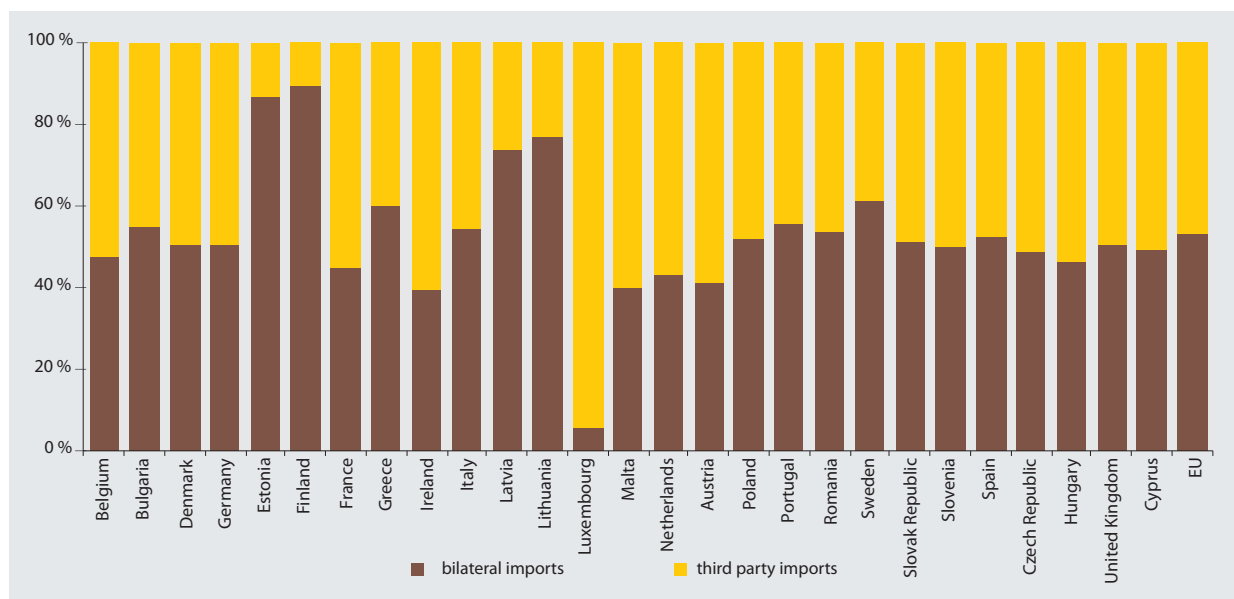
Figure 4

Shares of bilateral imports and imports via third party countries from overall imports of wood (industrial roundwood and products based on wood) from illegal harvesting 2009; mean values from low and high estimates

country of origin. For most EU countries the imports via third party countries and the bilateral import are at the same level. That means that about 50 % of the wood from illegal harvesting is imported directly from the affected countries into the EU, another 50 % is traded via third party countries. At this point again it is necessary to remember that also the bilateral trade includes the trade with all commodities based of wood, which naturally includes roundwood, wood products as well as pulp and paper products, and is not simply the export of industrial roundwood.

Discussion and Outlook

The study presented here shows sound results. Nevertheless, they only apply as long as the input data and methodical restrictions are valid. Under this prerequisite, the results show that illegal wood harvesting continues to be conducted on a large scale from 7 to 17 % of the total harvest, despite a worldwide drop of 22 % reported by Lawson and MacFaul (2010). The percentage is thus much lower than the comparable values of earlier estimates, which assessed the share of illegally harvested wood up to 40 % of the total harvest (see for example Nilsson, 2006). Nonetheless, a large amount of illegally harvested wood also arrives via international trade in the EU countries.

The proportionality assumption of the method used is a relatively general approach to reality and thus only to be considered as a simplification. Examples for strongly deviating relations can also be found in the literature. Thus, for example for the Amazon region in Brazil, high amounts of illegally harvested wood are reported (Lawson and MacFaul, 2010). But a significant component of the Brazilian exports, pulp, is produced mainly from wood plantations. The illegal share of the Bra-

zilian exports is thus probably lower than those from Brazilian roundwood production. Also from a regional perspective, the proportionality assumption can be weakened in reality. The western part of Russia, for example, is attributed lower illegal shares than the eastern part (Ottitsch et al., 2005b; WWF, 2008a). Since in the EU wood is mainly derived from western Russia, for example via Finland, the use of overall illegal shares for all of Russia leads to an overestimation in the case of the EU. As long as such examples are individual cases, the presented results are sufficient to capture the order of magnitude of the trade with illegally harvested wood. With the enactment and enforcement of national regulations to embargo wood from illegal harvesting, it will no longer be possible to keep the proportionality assumption. The maintenance of this proportionality assumption for the import into countries with according regulations would assume a lack of legal enforcement, for which there is no indication at present.

No directly comparable studies are available to validate the results presented here. The closest are two studies of the WWF (2008a, b) on the topic of "Illegal wood harvesting and Germany" and "Illegal wood for the European market." In these studies, the import of illegal wood to Germany in particular and the EU is estimated as well. In order to calculate these amounts, the studies transfer the country-specific illegal shares of wood harvest to the individual exports. In comparison to the method applied in this study – transfer of the export share on the illegal harvest – all exports were assumed to comprise the illegal share of the exporting country, even if raw materials or semi finished products, for example, roundwood for the manufacturing of sawnwood, result from legal harvests in other countries. Conversely, it can also occur that the exports of a country that imports illegal harvested wood are legalized due to their own illegal share of zero. Thus the trade with illegally harvested wood cannot be quantified

adequately with the methods chosen by the WWF. For Germany the indirect imports via other EU member states were also estimated by the WWF (2008a). The illegal shares thus calculated are above the results presented here. This could not be expected since the results presented here include the total imports from third party countries. For the EU in 2006, they were 16 to 19 % and for Germany 7 to 9 %. An explanation can be found in a close analysis of both WWF studies. The shares of illegal wood harvesting for most countries which serve as the basis for the studies are much higher than those in this study. In addition the WWF studies do not consider relevant items in internal EU-trade, which also leads to a higher import share from illegal harvesting.

If the solution to the problem of illegally harvested wood is to be seen by the consumers, measures to prevent imports of illegal origins are required. Regulations as enacted in form of bilateral Voluntary Partnership Agreements (VPAs) within the framework of the EU Timber Regulation (EUTR) are a first step in this direction. Due to the significance of the imports from third party countries, the import of illegally harvested wood cannot be completely prevented by bilateral partnership agreements. It is consistent to block this kind of entry route as well, as intended, e.g., by due diligence regulations. Whether these legal instruments are efficient, and whether their benefit is higher than their costs, cannot be determined with the presented statistics.

It could be expected that the drop of illegal harvesting found by Lawson and MacFaul (2010) in recent years will continue due to the FLEGT Action Plan and the EU Timber Trade Regulation. However, to what extent illegally harvested wood will be redirected into other markets cannot yet be quantified. The introduced measures are supposed to lead to wood from sustainable forestry becoming more competitive (UNECE, 2011).

A major uncertainty of this paper and other comparable studies is the data which serve as the basis of illegal shares. In different national studies the estimates vary widely, often lack an exact definition, or are not verifiable by means of the sources given. The methods to estimate the illegal share are often not discussed. Relatively widely used is the approach that illegal shares are derived from the gaps in the wood balance of a country, meaning, concretely, from a missing volume of supply in order to cover the use. This interpretation is, however, only one of several possibilities. The missing volume of supply can just as well be attributed to statistical shortcomings. Statistically non-reported harvest is not necessarily illegal. In Germany, for example, several studies indicate that the supply of roundwood is not fully reported by the official statistics but does actually exist (Dieter and Englert, 2005; Mantau, 2004; Oehmichen et al., 2010; Weimar, 2011). However information on illegal activity in this context does not exist. Similar interpretations of gaps in their wood balance can be claimed by other countries. This interpretation must be considered in the discussion on individual country results for illegally harvested wood.

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