Identifying the marginal supply of wood pulp

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Jürgen Reinhard[1], Bo Weidema[2] & Jannick Schmidt[2]

[1] EMPA, Technology and Society Lab, Überlandstrasse 126, Dübendorf, Switzerland

[2] 2.-0 LCA consultants, Fibigerstræde 13, 9220 Aalborg East, Denmark

Content

Glossary

Elemental chlorine free (ECF)	A pulp production technique that uses chlorine dioxide for the bleaching of wood pulp. It does not use elemental chlorine gas during the bleaching process and prevents the formation of dioxin, a carcinogen.
Total chlorine free (TCF)	A technique that uses no chlorine compounds for the bleaching of wood pulp for paper production. This prevents the formation of dioxin, a highly carcinogenic pollutant
BHKP	Bleached hardwood kraft pulp (all grades, including BEKP, birch pulp, SMHW, NMHW)
BSKP	Bleached softwood kraft pulp (all grades).
NMHW	Northern mixed hardwood kraft pulp.
SMHW	All mixed hardwood kraft pulp produced in the US
NBSK	Northern bleached softwood kraft pulp, the industries benchmark grade of softwood kraft pulp. (NBSK is produced mainly in Canada and the Nordic countries. Some is also produced in the USA, Germany and Russia.)
BEKP	Bleached eucalyptus kraft pulp, the industries benchmark grade of hardwood kraft pulp. (BEKP is produced mainly in Latin America and Iberia. Some is also produced in Scandinavia and Asia)
Roundwood	Wood in the rough. Wood in its natural state as felled or otherwise harvested, with or without bark, round, split, roughly squared or other forms (e.g. roots, stumps, burls, etc.). It may also be impregnated (e.g. telegraph poles) or roughly shaped or pointed. It comprises all wood obtained from removals, i.e. the quantities removed from forests and from trees outside the forest, including wood recovered from natural, felling and logging losses during the period - calendar year or forest year. Commodities included are sawlogs and veneer logs, pulpwood, other industrial roundwood (including pitprops) and fuelwood. The statistics include recorded volumes, as well as estimated unrecorded volumes as indicated in the notes. Statistics for trade include, as well as roundwood from removals, the estimated roundwood equivalent of chips and particles, wood residues and charcoal.
Sawlogs and Veneer logs	Logs whether or not roughly squared, to be sawn (or chipped) lengthwise for the manufacture of sawnwood or railway sleepers (ties). Shingle bolts and stave bolts are included. Logs for production of veneer, mainly by peeling or slicing. Match billets are included, as are special growth (burls, roots, etc.)
Industrial Roundwood	The commodities included are sawlogs or veneer logs, pulpwood, other industrial roundwood and, in the case of trade, also chips and particles and wood residues.
Fuel Wood	Wood in the rough (from trunks, and branches of trees) to be used as fuel for purposes such as cooking, heating or power production.
Primary Forest (also known as “natural”, “old growth”, or “virgin”.	Undisturbed forests. The highest wood fiber yields come from mature trees in primary forest. This method of harvesting – though a one-time option – is still widespread, notably in parts of Amazonia, Canada and Siberia.
Secondary-growth forest	These are natural forests that have been cut but have regrown (sometimes several times), or have been partially replanted, and are now managed more or less intensively for wood production and other purposes.
Plantation-forest	Have considerable human intervention in their establishment (though no clear line divides a “plantation” from an intensively managed “secondary forest”.

Mechanical wood pulp	Wood pulp obtained by grinding or milling:coniferous or non-coniferous rounds,quarters,billets,etc into fibres or through refining coniferous or non-coniferous chips. Also called groundwood pulp and refiner pulp. It may be bleached or unbleached. It excludes exploded and defibrated pulp, and includes chemi-mechanical and thermo-mechanical pulp.
Chemical wood pulp	Sulphate (kraft) and soda and sulphite wood pulp except dissolving grades, bleached, semi-bleached and unbleached.
Semi-chemical wood pulp	Wood pulp, chemi-mechanical and semi-chemical Wood pulp obtained by subjecting coniferous or non-coniferous wood to a series of mechanical and chemical treatments, none of which alone is sufficient to make the fibres separate readily. According to the order and importance of the treatment, such pulp is variously named: semi-chemical, chemi-groundwood, chemi-mechanical, etc. It may be bleached or unbleached.
Dissolving wood pulp	Wood pulp, dissolving grades chemical pulp (sulphate, soda or sulphite) from coniferous or non-coniferous wood, or special quality, with a very high alpha-cellulose content (usually 90% and over), readily adaptable for uses other than paper making. These pulps are always bleached. They are used principally as a source of cellulose in the manufacture of products such as synthetic fibres, cellulosic plastic materials, lacquers, explosives.
Integrated mill	Integrated mills consist of a pulp mill and a paper mill on the same site.
Unbleached sulphite pulp	Wood pulp, sulphite, except dissolving grades. Wood pulp obtained by mechanically reducing coniferous or non-coniferous wood to small pieces which are subsequently cooked in a pressure vessel in the presence of a bi-sulphite cooking liquor. Bi-sulphites such as ammonium, calcium, magnesium and sodium are commonly used. The class includes semi-bleached and unbleached pulps.
Bleached sulphite pulp	Wood pulp, sulphite, except dissolving grades. Wood pulp obtained by mechanically reducing coniferous or non-coniferous wood to small pieces which are subsequently cooked in a pressure vessel in the presence of a bi-sulphite cooking liquor. Bi-sulphites such as ammonium, calcium, magnesium and sodium are commonly used. The class includes bleached pulp.
Unbleached sulphate pulp	Wood pulp, sulphate (kraft) and soda, except dissolving grades. Wood pulp obtained by mechanically reducing coniferous or non-coniferous wood to small pieces which are subsequently cooked in a pressure vessel in the presence of sodium hydroxide cooking liquor (soda pulp) or a mixture of sodium hydroxide and sodium sulphite cooking liquor (sulphate pulp).The class includes semi-bleached and unbleached pulps.
Bleached sulphate pulp	Wood pulp, sulphate (kraft) and soda, except dissolving grades. Wood pulp obtained by mechanically reducing coniferous or non-coniferous wood to small pieces which are subsequently cooked in a pressure vessel in the presence of sodium hydroxide cooking liquor (soda pulp) or a mixture of sodium hydroxide and sodium sulphite cooking liquor (sulphate pulp). The class includes bleached pulp.
CIF	Cost, Insurance and Freight.

Introduction

Context and objective

This report aims to summarize the steps, arguments and market data that are needed to identify the long term marginal supplier affected by a long-term[1] change in demand for Bleached Hardwood Kraft Pulp (BHKP) and Bleached Softwood Kraft Pulp (BSKP).

The procedure and standard assumptions

Put very briefly, if the general trend in the market is expanding or stable, a long-term change in demand is assumed **to affect the supplier that has the best options for expanding** or renewing the production capacity. This most competitive supplier is often the one with the lowest production costs.

If the market is sharply shrinking, so that production capacity is being reduced, a change in demand is assumed to affect the least competitive supplier.

In some situations, suppliers are constrained in their ability to react to a change in demand, e.g. because of lack of available raw materials or because of production quota. In these situations, an additional assumption is needed, namely that constrained suppliers are not affected by changes in demand. This implies that the demand has to be satisfied by another un-constrained supplier.

The above assumptions are based on simple market economics.

In order to identify the most or least competitive, un-constrained supplier, it is thus necessary to have information about:

- The market in question, i.e. the products, their properties, the geographical and temporal delimitation of the market and the trend in the market.
- Market constraints. In general, we assume that suppliers are not constrained unless there is evidence to the contrary. This implies that the burden of proof lies on those who claim that a process is constrained.
- Competitiveness of different suppliers (typically represented by their production costs).

The procedure to identify the affected supplier has been described in more detail in Weidema [1].

[1] By long-term changes, we mean changes that affect the installed production capacity, as opposed to short-term changes that affect only the current capacity utilisation.

Global wood flows related to the pulp wood industry

Pulp, which is primarily used in the manufacture of paper and paperboards, is a product that can be mechanically or chemically manufactured from a wide variety of plant material such as wood, straw bamboo, flax, hemp and cotton. In general, wood currently account for 90% of the fiber used for pulp production. The production of wood pulp relies primarily on industrial roundwood [2].

General trend in industrial round wood production

In 2007, global production of industrial roundwood – which includes all wood that is not used as fuel – was about 1.7 billion cubic meters (m^3), or 47 percent of the wood that is harvested globally. Industrial roundwood production grew approx. 60 percent between 1961 and 2007, largely because of rising incomes (Figure 1) [3].

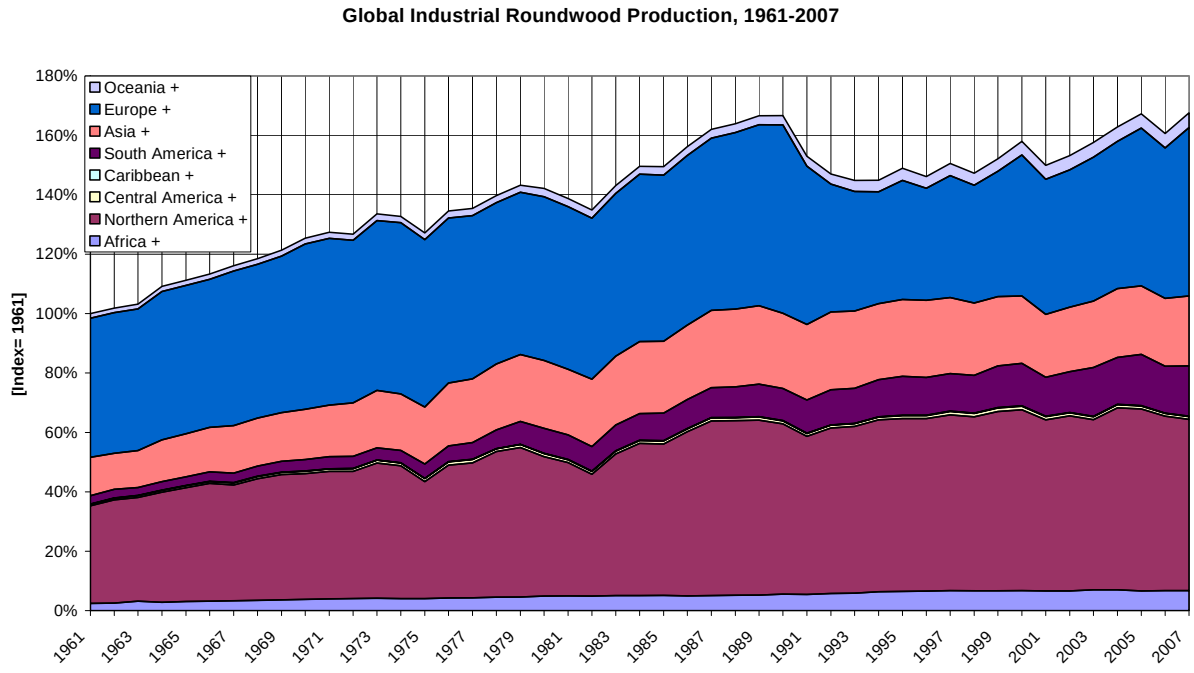


Figure 1: Global Industrial Roundwood Production, 1961-2007 (source: FAO [4])

According to Earth Trends [3], most industrial roundwood production and consumption occurs in the high-income countries, although consumption is leveling as markets for some products like lumber for construction become saturated. The development of more efficient technologies for producing paper products is also helping to slacken demand, although increased demand for paper and some hardwood products partially offsets the declines. Meanwhile, the rapidly growing economies of Asia and Latin America are where demand for construction timber, processed wood products, and paper and paperboard is rising fastest.

Output of global wood pulp industry

The total production of wood pulp has increased by approx 9 percent between 1997 and 2007 (Figure 2). Most of the increase in production is caused by chemical wood pulp and semi-chemical wood pulp (7 and 2 percent from 1997-2007, respectively), whereas the production of mechanical and dissolving wood pulp is stagnating on a global scale.

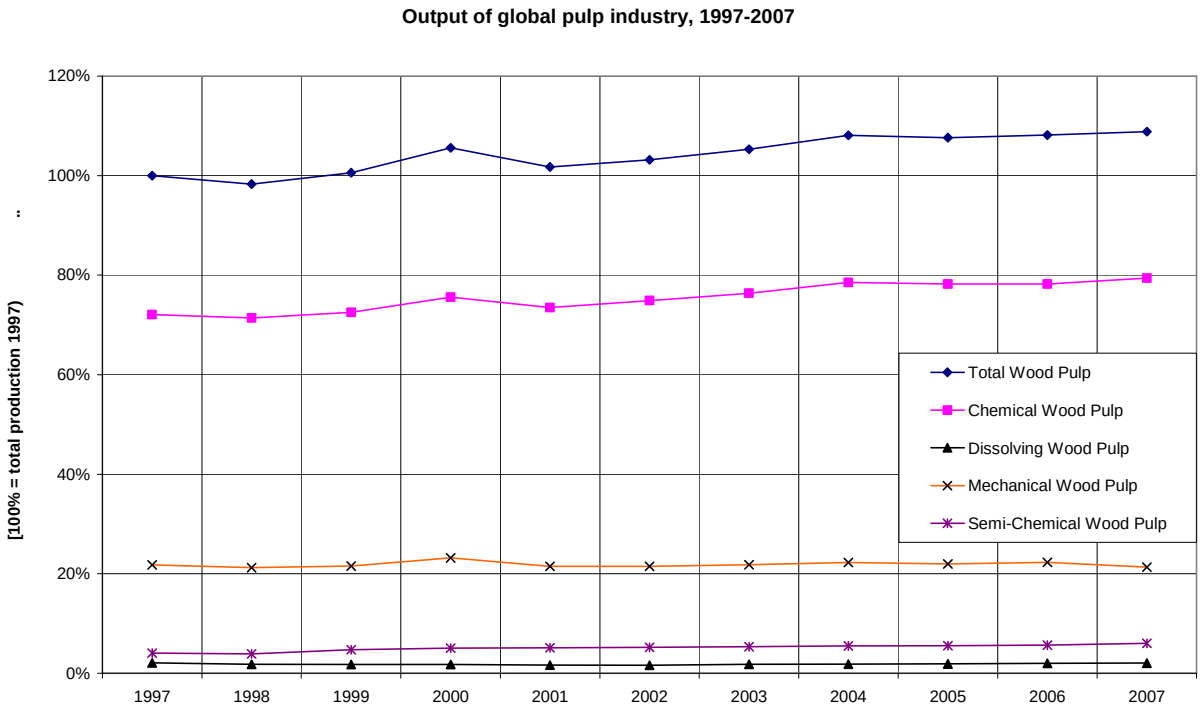


Figure 2: Production of wood pulp per pulp type, 1997-2007 (source: FAO [4])

According to Wood Resource International [5], the top 10 wood based pulp producing countries in 2004 are the USA, Canada, Finland, Sweden, Japan, Brazil, Russia, Indonesia, China and Chile. This sequence appears still evident (Figure 3).

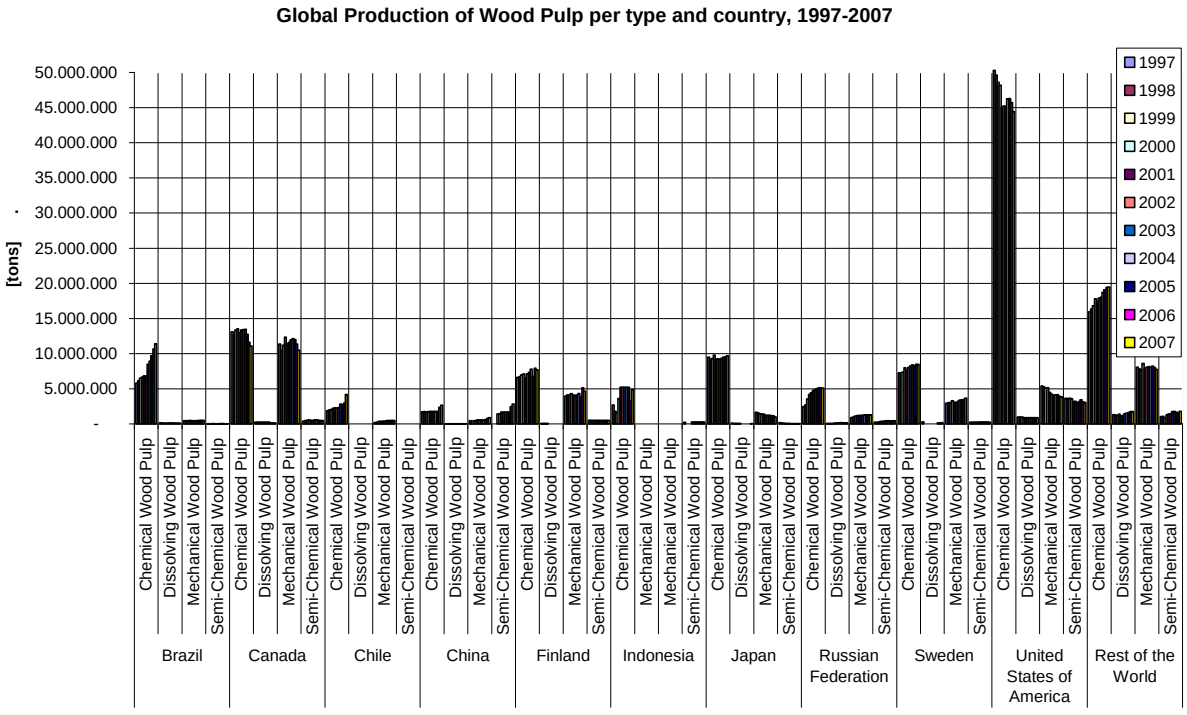


Figure 3: Global production of wood pulp per type and country, 1997-2007. The top 10 pulp wood producing countries cover approx. 84% of the total world production (source: FAO [4]).

The production of all wood pulp types has a negative trend in the USA and Canada and is stagnating in Japan. The overall increase in the production of chemical wood pulp results

mainly from the increased production of wood pulp in Brazil, Chile, Indonesia and the Russian Federation. Within 10 years, those countries have approx. doubled their production and export of chemical wood pulp.

The increase in the production of chemical pulp for the mentioned countries results primarily from the increased production of bleached sulphate (kraft) pulp (Figure 4).

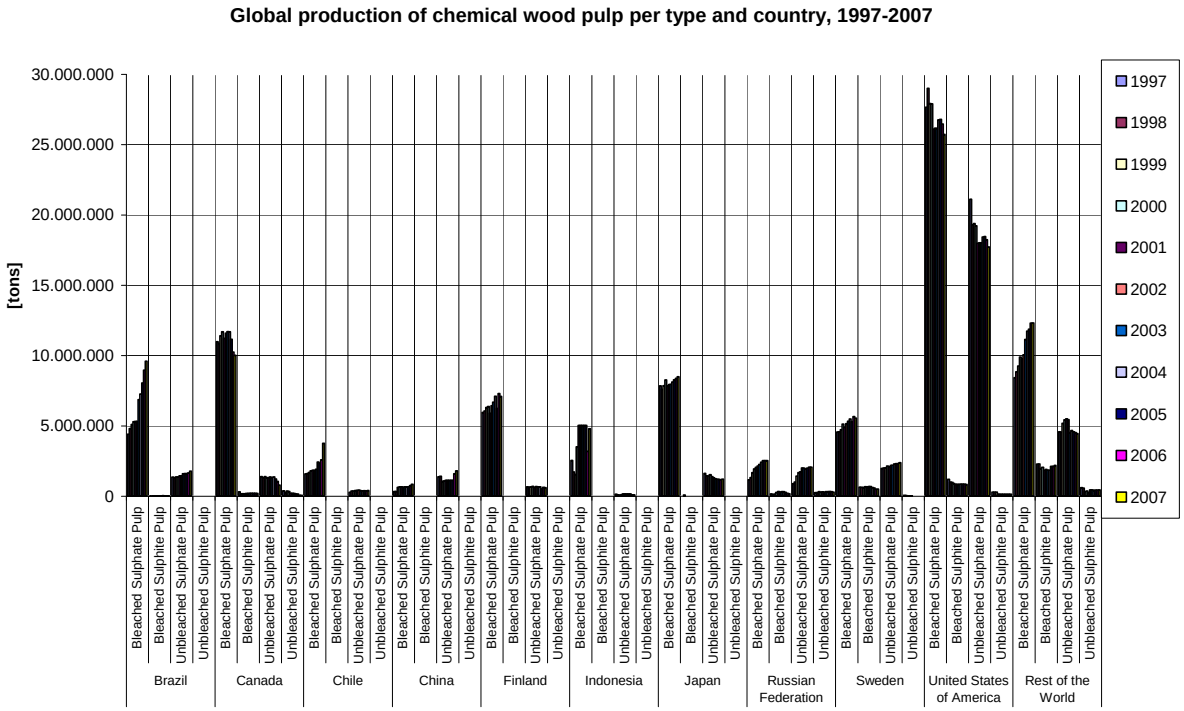


Figure 4: Global production of chemical wood pulp per type and country, 1997-2007. The top 10 pulp wood producing countries cover approx. 85% of the total world production (source: FAO [4]).

In sum, it is the production of kraft pulp which is increasing in particular in the southern hemisphere.

Input to global pulp industry

Figure 5 shows the global wood flows related to the pulp wood industry in 2007. The production of wood pulp relies primarily on industrial roundwood (64.5%), but also wood chips (35.5%). According to Wood Resource International [5], the logs are either from fast-growing plantations such as in Latin America and Oceania or from thinnings and tree tops in the slower-growing regions of North America and the Nordic countries. Wood chips are most commonly consumed in the US, Canada, Sweden and Finland as these countries have large saw-milling sectors.

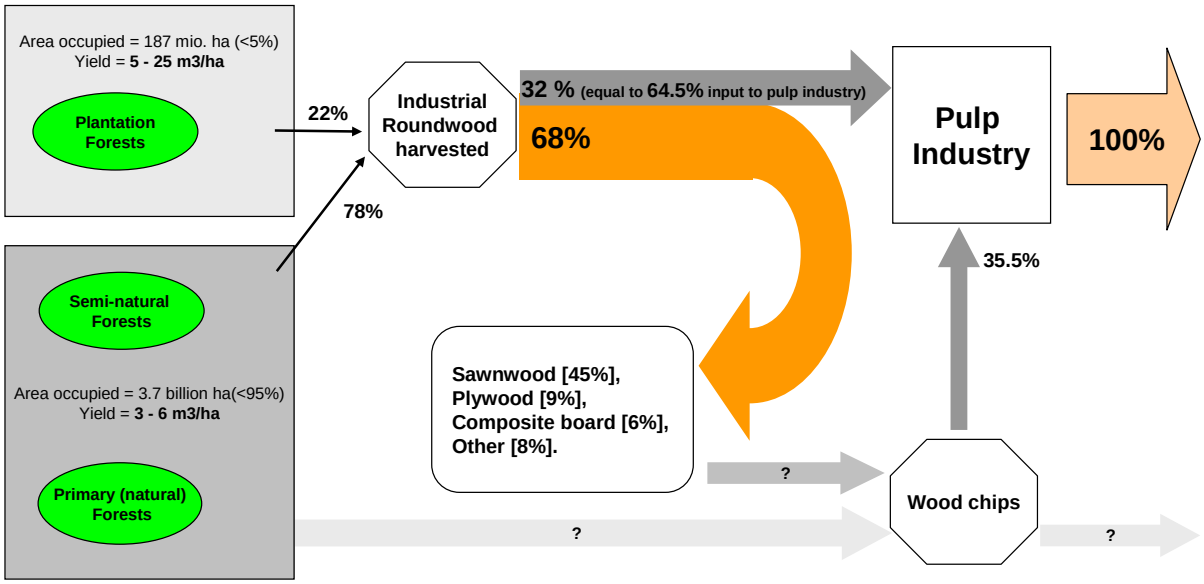


Figure 5: Pulp industry and its wood source (source: own depiction).

Logs and sawn wood for construction comprised the largest use of industrial roundwood usage (about 68%), whereas pulp for paper and paperboard accounts for 32%. Pulpwood removals have increased faster than that of sawlogs the past ten years resulting in a higher share of pulpwood harvests today than in the mid-1990's [5].

According to Earth Trends [3], primary and secondary forests produce about 78 percent of the worlds industrial round wood supply. There are no reliable breakdowns at the global level, of the share of total industrial round wood that each of the two types of forest supply. However, secondary-growth forests have replaced virtually all the original forests. They account for about 80 percent of forested land in Europe, 90 percent in Australia, 85 percent in the United States, 60 percent in New Zealand and 50 percent in Canada [3].

Plantation forests provide about 22 percent of the world's industrial round wood supply although the area occupied by them is just around 5% [6]. In general, the yield of plantations is higher (5-25 m^3 per ha) than the yield of secondary forest (1-6 m^3 per ha). In Oceania, 80 percent of the industrial round wood comes from plantations but also Africa, South America and Asia harvest above-average proportions of industrial round wood from plantations (35, 27 and 23 percent of their total production, respectively) [3].

In semi-managed forests, the impact on nature is relatively larger per produced unit than in plantation forestry, see Figure 6. The main reason for this is that even a low amount of forestry activity implies the removal of sources of dead wood, which is the main habitat influencing overall forest biodiversity. Ample options exist to expand biomass production, without increasing impact on nature, or even while reducing impact, particularly if the production in plantation forests is increased, as foreseen by Brown [6]. By intensifying management and choice of species, yields of biomass per hectare can be increased by at least a factor 2 from the current average of 3 m^3.

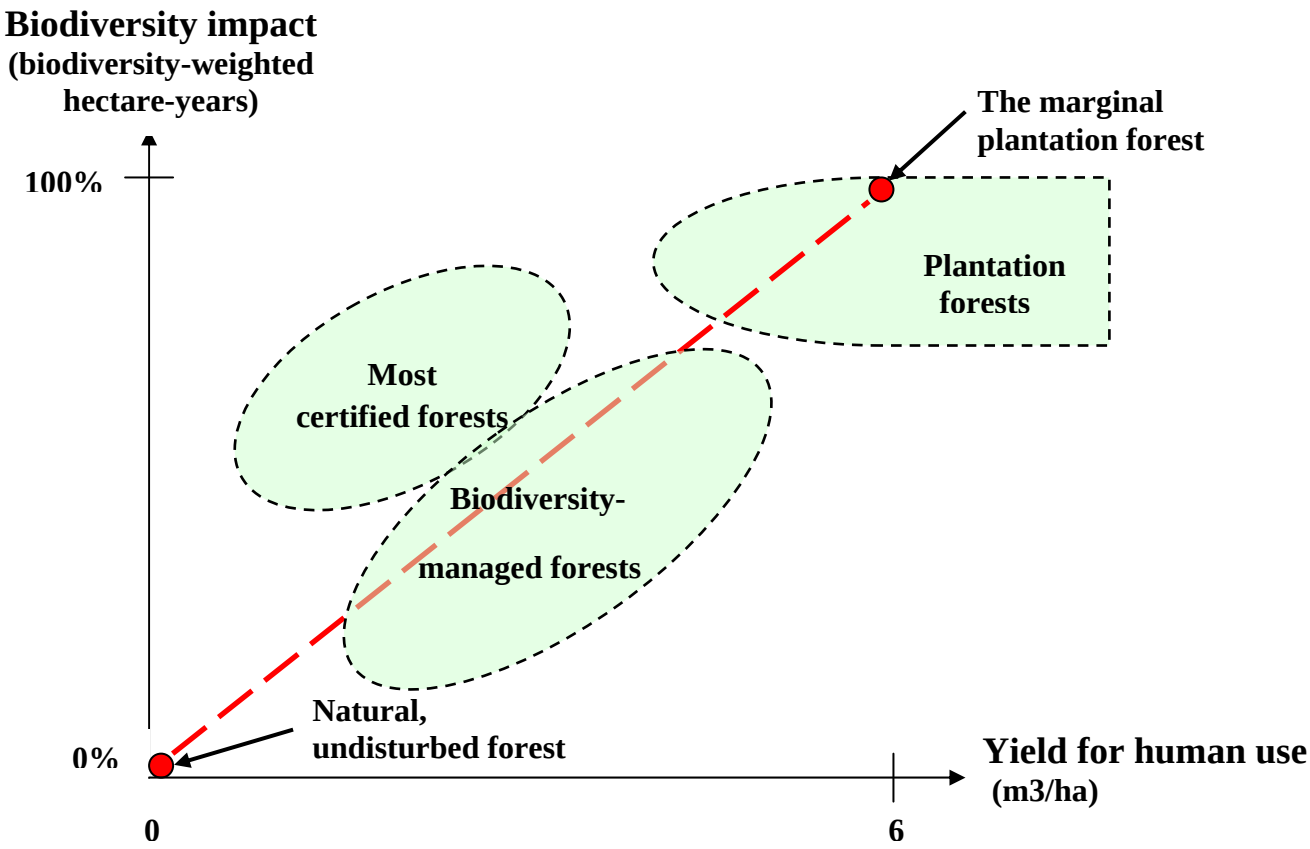


Figure 6: The place of different forest management systems ( ) relative to the iso-biodiversity line ( ), its determining extremes ( ).

The market in question

Product & product properties

The typical board produced from BHKP and BSKP is a multiply board, with long fiber (softwood) in the outer layers and a less dense centre layers (hardwood or softwood). The long fibres provide strength and that two thin but strong layers outside a less dense middle layer provide an I-beam effect that gives more stiffness for less material than a solid/single ply board.

Market trend

As mentioned prior, the production of wood pulp is increasing on a global scale. Thus, we would expect the affected suppliers to be the most competitive. The same conclusion is reached if looking at the forecasts of Hawkins Wright [7] which predict an significant increase for the demand for BHKP and a moderate increase for BSKP.

Market constraints

Market constraints induced by co-production

In the US, Canada, Sweden and Finland wood chips from saw mills and tree tops are the main source for wood pulp production [5]. In Oceania and Latin America an increasing amount of pulp wood comes from fast-growing plantations.

Wood chips are a co-product of the large saw milling sectors. Since the demand for pulp wood exceeds that which can be sourced from wood chips, the price of wood chips is determined by the cost of the direct supply of pulp wood that it can displace, and an increased demand for pulp will thus not be able to affect the revenue and therefore the output from the saw mills. Thus, the demand for timber and logs constrains the availability of wood chips for wood pulp production.

In sum, the top four producing countries of wood pulp appear, in part, to rely on a constrained raw material source, while the fast-growing plantations such as in Latin America and Oceania are not constrained.

Market constraints induced by quality requirements

Timber is used in the construction and furniture industries, which place different quality requirements on the wood. The pulp and paper industry has much less constraints on what sorts of wood that can be used. In terms of species and wood quality, the physical requirements to pulp wood are much similar to the requirements to wood for fuel and board.

Thus, a change in demand for timber may affect very specific forests that can fulfill the specific quality requirements, while a change in demand for wood for pulp, fuel or board can be met by practically any forest with excess capacity. This is also reflected in the price difference between the different wood qualities.

We would thus expect that any constraints in timber supply would be overcome by increasing stand age for the specific wood qualities in question or by plantation forestry, while wood supply for pulp, fuel or board can only be constrained in countries where the production of such products is mainly using dependent co-products.

Market constraints induced by the market in question

Because of the relatively low value of wood, the transport costs are relatively high. This explains why 93% of the World's roundwood production was processed domestically for export or domestic use in 2004 (FAO 2007, p 90). This implies that a large share of trade is in processed products, i.e. pulp and paper, see Figure 7.

Since the quality of the product is largely homogeneous, the main reasons for trade are lack of local raw materials or differences in production costs. If local raw material supply is constrained, wood or its products, such as pulp and paper, can be transported from elsewhere, only restricted by the transport costs.

To identify the affected suppliers of a specific local change in demand, we thus need to know whether the local suppliers are constrained by local raw material availability and how competitive they are compared to alternative suppliers in the neighbourhood.

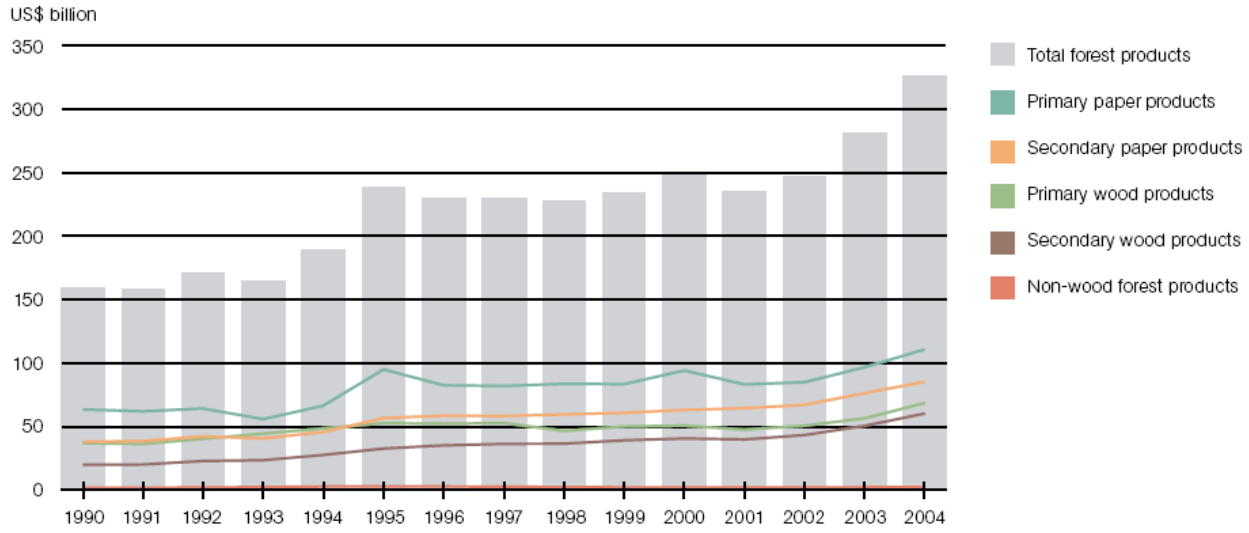


Figure 7: Global exports of forest products 1990 to 2004. Directly obtained from (FAO 2007, p 91).

In general, even at a local scale, biomass production is seldom limited by capacity. Biomass production could easily be increased by using high-yielding species and intensive management [6]. The main reason this does not happen is that cheaper sources of biomass are available from semi-managed forests, either locally or within distances that does not imply prohibitive transport costs.

There are of course exceptions to this general situation, particularly in areas where biomass production is limited by natural conditions such as water shortage. However, even in these extreme situations, it can be argued that the affected supplier is fundamentally the one that is most competitive given the local circumstances, which in this case will always be a foreign supplier.

Brown [6] note that the output from natural, managed forests is constrained by increased regulation and that increasingly the additional output is coming from plantation forestry in countries where trees grows the fastest, i.e. with high forest productivity.

Market constraints induced by natural limits

Obviously, there is an upper limit to how much biomass can be produced on the Earth, and even before this limit is reached, the concern for preservation of natural habitats place a limit

to how much biomass we want to expropriate from nature. The question is therefore whether the current wood removals can be expanded without increasing pressure on nature.

The FAO estimates that current plantations area in the Southern Hemisphere has a potential annual growth of 1.1 billion m^3 [5]. Also, assuming average annual growth rates of 10 cubic meters per hectare, the world's current demand for industrial roundwood could be met from plantations on 1.5 million km^2 of land, equivalent to just over 4 percent of global forest area [5]. Thus, constraints placed by natural limits appear unlikely.

Obviously, it is possible to imagine a situation where demand for wood increases dramatically and therefore exceeds the global sustainable supply. One such situation is if political decisions are made to promote biomass as an alternative to fossil fuels. However, it is unlikely that such politics will be sustained in the long term, since the cost of harvesting a larger part of the forest biomass exceeds the long-term costs of many alternative fuel sources, such as direct solar energy.

In the rest of this discussion paper, we will therefore limit ourselves to investigate the current situation where the global supply of wood is not constrained by natural limits. The following analysis can therefore not be applied in a study of the impacts of biofuel policies.

Competitiveness of suppliers

The competitiveness of a specific supplier depends mainly on the production costs per unit, which are a combination mainly of wood fiber costs, labour costs, interest rates and taxes. These local costs then have to be weighted against the transport costs. Since these costs vary from location to location, it is necessary to perform specific calculations for each specific location of a demand change. As long as transport costs are not a major part of the total price, the expansion of production is likely to happen in plantation forests in countries with high forest productivity and low costs, such as Chile, Brazil and South Africa.

Production costs

Historically, BHKP has been cheaper to produce than BSKP (Figure 8). The difference in production costs range from US$ 89 per ton to US$ 130 over the last 8 years [2].

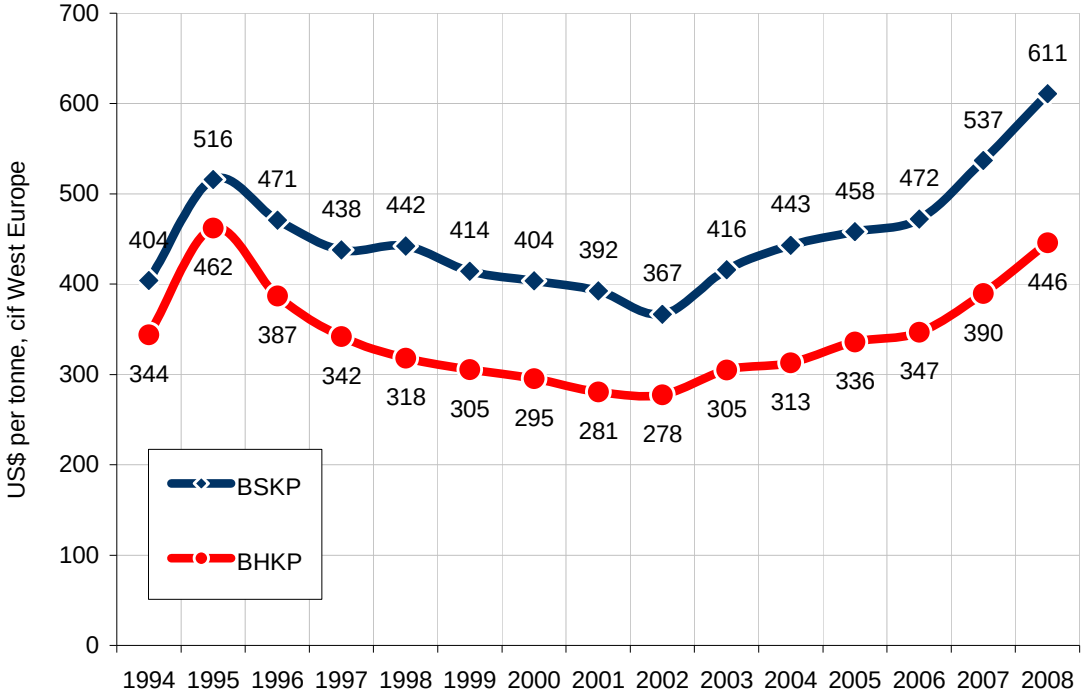


Figure 8: Production costs of BHKP and BSKP (source: Hawkins Wright [7]).

With reference to Hawkins Wright, Yong [2] provide data for the cost composition of BHKP (Table 1). Brazil and Indonesia appear to supply BHKP at the lowest costs, mainly due to the significant lower labour, maintenance, milling and wood costs. In general, hardwood fiber costs account for between 33 (Brazil) and 60 percent (Finland) of the production and delivery costs.

Table 1: Cost composition of BHKP in 2004, in US$/ton, CIF Europe (source: Yong [2])

IN US$/per t	Brazil	Indonesia	US South	Portugal	Canada East	Finland	Spain	Global average	Average
Wood	71	102	128	188	158	243	219	132	155
Chemicals	28	17	37	59	30	38	41	33	35
Energy	10	14	23	6	24	2	11	14	13
Variable Costs	109	133	188	253	212	283	271	179	203,5
Labour	8	13	40	49	50	41	49	30	35
Maintenance	12	13	31	22	23	16	19	18	19
Other Mill costs	24	25	50	37	35	19	36	31	32
Fixed Costs	44	51	121	108	108	76	104	79	87
FOB Mill	**153**	**184**	**309**	**361**	**320**	**359**	**375**	**258**	**294**
Ocean Freight	44	37	53	18	73	38	26	43	42
Marketing and Sales	17	12	10	5	7	8	15	12	11
CIF	**214**	**233**	**372**	**384**	**400**	**405**	**416**	**313**	**346**

Transport costs account for between 5 (Indonesia) and 21 percent (Portugal) of the overall production and delivery costs. Thus, transport costs can not be seen as prohibitive for the global supply of BHKP. In order to confirm this, we calculated costs for different transport distances using worst case assumption (Figure 9).

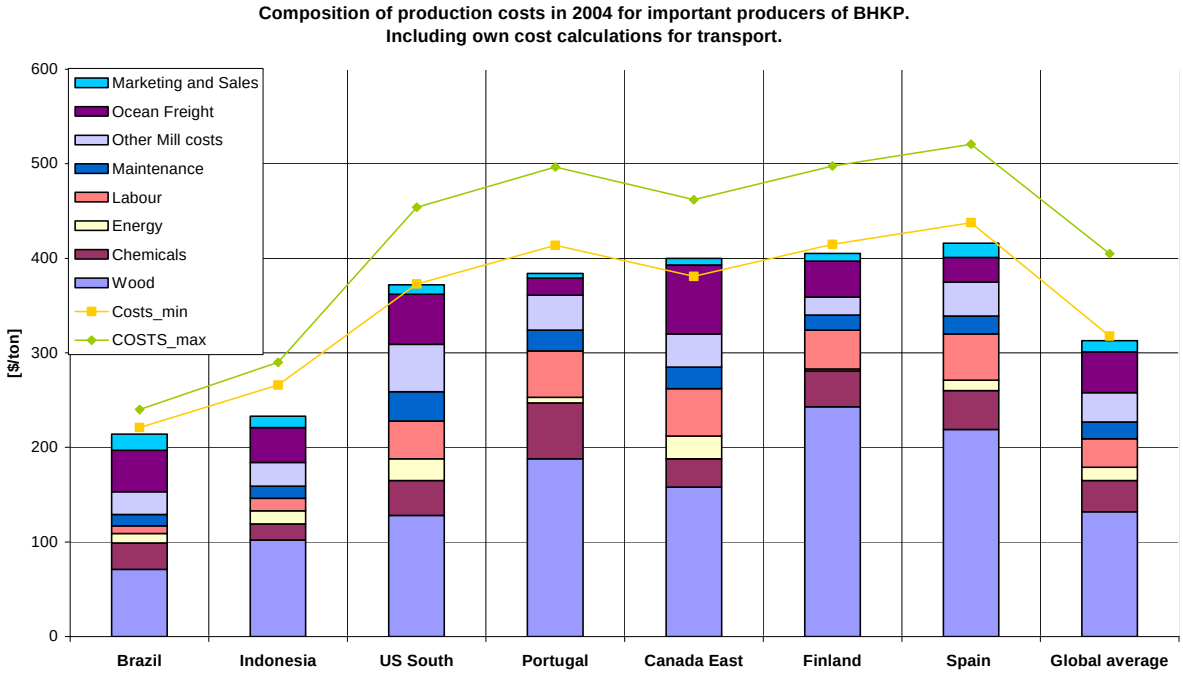


Figure 9: Composition of production costs in 2004 for important producers of BHKP (source: adapted from Yong [2]).

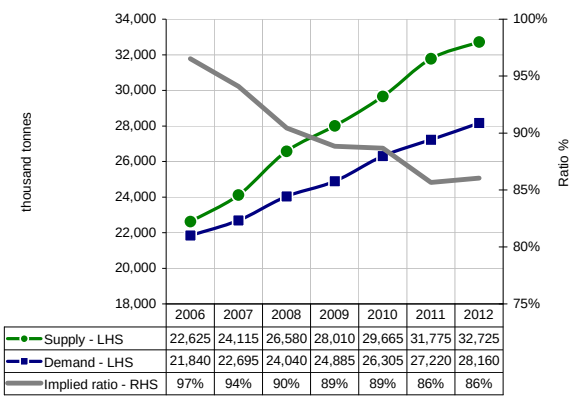
It appears that the production and delivery costs of BHKP increase when adding our transport costs. However, the general patterns don't change, i.e. Brazil and Indonesia still provide BHKP to a significant lower price than all other countries.

According to Pineault [8], Chile remains the lowest cost producer of BSKP. In its latest cost survey, Hawkins Wright estimates Chile with an average cash cost of 370 US$/ton, CIF Europe, compared with the global average production and delivery costs of 443 US$/ton, CIF. Chile's competitive advantage lies in mill efficiency and low labor costs that are currently about a quarter to a third lower than in North America [8].

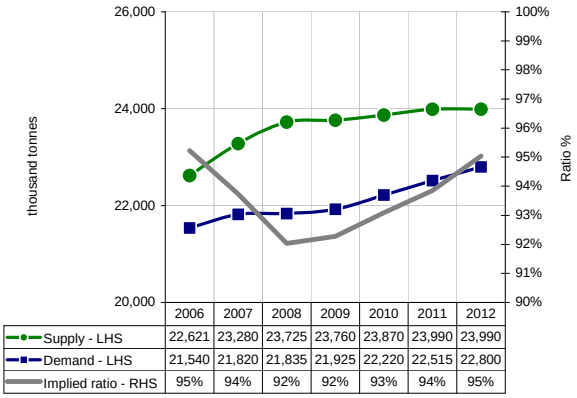
General market trends and prospects

In general pulp prices are on a long-term downward trend. This is primarily a result of larger, more efficient and technically advanced mills being built, thereby lowering costs. At the same time, with most of the investments being in low cost regions such as Latin America and Southeast Asia, on fast-growing, high yield plantations such as eucalyptus and/or acacia, costs of production are also falling [2].

Hawkins Wright [7] prospects that until 2012 the supply of BHKP will increase by approx. 30 percent, while the supply of BSKP is predicted to increase by approx. 5 percent (Figure 10).



	2006	2007	2008	2009	2010	2011	2012
Supply - LHS	22,625	24,115	26,580	28,010	29,665	31,775	32,725
Demand - LHS	21,840	22,695	24,040	24,885	26,305	27,220	28,160
Implied ratio - RHS	97%	94%	90%	89%	89%	86%	86%



	2006	2007	2008	2009	2010	2011	2012
Supply - LHS	22,621	23,280	23,725	23,760	23,870	23,990	23,990
Demand - LHS	21,540	21,820	21,835	21,925	22,220	22,515	22,800
Implied ratio - RHS	95%	94%	92%	92%	93%	94%	95%

Figure 10: Expected development of supply and demand of BHKP (left) and BSKP (right) (source: Hawkins and Wright [7])

Of the estimated 10 million tons of market pulp capacity added over the next few years, approx. 20% will be in the form of BSKP, with the rest mainly BHKP. There are two main reasons why most of the projected supply is expected to come from BHKP – supply and cost. As regards supply, global hardwood stock is estimated at over 254 billion m^3, more than double that of global softwood stock (126 billion m^3). The worldwide stock is mostly concentrated in North America and Russia, whilst hardwood is mostly available in Latin America, Africa and Southeast Asia.

Given that supply is expected to exceed demand over the next few years, the bulk of new capacity will most likely come from low cost regions such like Latin America and the Asia-Pacific.

Conclusion

The presented evidence points to plantation forests in Brazil and Indonesia representing the long term marginal supplier of BHKP, while plantation forests in Chile can be seen as the long term marginal supplier of BSKP.

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