G:ENESIS

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The following papers were prepared as inputs into this project and are available on request:

- Environmental impacts of the forestry industry value chain – CSIR Environmentek
- The social impacts of the forestry and pulp and paper industry in South Africa – Morabo Morajele

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1. APPENDIX A: HISTORICAL PHASES IN THE DEVELOPMENT OF PLANTATION FORESTRY IN SA

This section provides a brief overview of the history of forestry development in South Africa.

1876 – 1914: INITIAL STATE-LED AFFORESTATION

The planting in 1876 of a small plantation near Worcester to supply timber for rail purposes (and the commercial success thereof upon selling) marked the beginning of what was to become a significant industry in the South African economy.

By 1895 the Cape Colony imported about 100 000 m^3 of pine wood annually. Fearing dependence on imported wood and import price increases, government realised the importance of establishing its own plantation resources (Van der Zel & Brink, 1980:19). The same was true after the expansion of the colony to include the mine fields further north. Mining, construction and wooden packaging dictated the demand for timber[1].

1914 – 1970: RAPID AFFORESTATION, PROTECTIONISM, PULP & PAPER, AND THE RISE OF THE PRIVATE SECTOR

The outbreak of the **Great War** was the catalyst needed to jump-start the (at that time state-dominated) plantation forestry industry. The resultant world-wide shortage of timber highlighted South Africa's dependence on imported wood. As a counter measure, government launched several afforestation projects (Immelman et al, 1973) and implemented protective legislation[2].

During the **interwar period** plantation forestry was employed as an instrument of employment creation in reaction to the depression-induced poverty problem (such policies had a decisive racial bias, though). Environmental concerns regarding plantation forestry also date back to the interwar period, with research being done on the effect of forestry on the water supply as early as 1935.

Corresponding to the realisation that plantation forestry and sawmilling can be a profitable industry given high post-war levels of demand, the **post-war period** was characterised by rising **private sector involvement** in the industry. Adding to the

1 Another interesting area in which forestry was employed (which later proved to be catastrophic from an environmental point of view), was the planting of wattle and port Jackson trees to stabilise sand in order to prevent it from being blown onto railway tracks. These plantations simultaneously served as an important source of firewood (Immelman et al, 1973).

2 For example, a 1966 cabinet decision compelled state enterprises to use only locally produced timber (Van der Zel & Brink, 1980:24).

state's largely pine wood plantations (for sawmilling purposes), large-scale wattle (for its bark) and eucalyptus (largely for pulp) afforestation was undertaken by the private sector and the first private saw mills opened their doors (Van der Zel & Brink, 1980:21). The end of the Second World War also saw a world-wide **boom in the pulp and paper industry** and, facilitated by government intervention, South Africa followed suit. SAPPI (the South African Pulp and Paper Industries) was among the prominent companies to be established in this period.

The following decades were characterised by interventionist, protectionist policies to promote self-sufficiency of South African industries (Immelman et al, 1973; IIED, 2001). The 1956 government commission on socio-economic development also identified plantation forestry as a potential industry for **regional development** and large scale afforestation was accordingly pursued in what was to become the TBVC "homelands" (IIED, 2001:9).

1970-1990: INCREASED GLOBAL FOCUS, MODERATE CONTINUED AFFORESTATION AND THE RISE OF INDEPENDENT CONTRACTORS

According to Van der Zel and Brink (1980:25) 1970 marked the end of the "infancy" stage of plantation forestry in South Africa, and the beginning of a phase of maturity and diversification.

The period saw the first **exports** of wattle chips, which introduced a shift in emphasis from importing to exporting. The wood chip exporting industry would later become a significant part of the sector with important consequences for local pulping facilities' pricing power[3]. Import-substituting government involvement continued to direct **pricing trends**, with the price of softwood timber largely being determined by the state (Louw, 2004a:81), thereby supplying low-cost inputs to saw millers. Government furthermore encouraged exports via import tariffs and the GEIS (General Export Incentive Scheme).

The plantation forestry, pulp and paper industries continued to expand their contribution to overall and manufacturing GDP over this period and South African companies started to acquire overseas assets (Mayers et al, 2001:11). Increased quality requirements induced a switch from softwood to hardwood in most paper mills. All in all, pulpwood significantly increased in importance, and the demand for mining timber dropped (Louw, 2004a:80).

Tax incentives still encouraged **new afforestation**. Geographic and climatic constraints however implied that, for large expansions at least, the scope for afforestation was becoming limited. This combined with pressures for social involvement, led companies to start considering alternative afforestation schemes.

[3] In fact, the origin of the exporting industry may be found in the dissatisfaction of smaller growers with the oligopolistic structure of the market (Louw, 2004:78). This concentrated structure can be regarded as the result of high capital requirements (IIED, 2001:10).

Sappi launched Project Grow in 1983, and Mondi piloted its Khumalanathi small grower scheme. In 1990 Sappi introduced a second outgrower scheme named the Management Associated Programme (MAP). These programmes support plot holders by providing seedlings, advice and interest free loans over the growth period of the trees (Louw, 2004a:79).

A further important characteristic of this period was the emergence, since the middle of the 1980s, of **independent contractors**. Outsourcing of especially harvesting operations became increasingly popular as it allowed companies to be more focused in their activities, and to reduce their exposure to trade unions. At the same time, opportunities were created for (black) entrepreneurs, even though skills and training opportunities were initially often lacking (Louw, 2004a:84).

The period also saw the emergence of a debate on trees' water use, resulting in the introduction of the **Afforestation Permit System** (APS) in 1972 (Louw, 2004a:79; Mayers et al, 2001:10). Globally, however, the fact that South African timber stems solely from man-made plantations counted in South Africa's favour as environmental pressures started to mount.

1990 TO 2004: PRIVATISATION, CERTIFICATION AND THE ERA OF ENVIRONMENTAL LEGISLATION

A number of trends impacted the plantation forestry industry over the past decade or more.

Privatisation of state forests has been underway since June 1992. The process was started with the formation of the state-owned South African Forestry Company Limited (SAFCOL) to manage and sell state forests (Louw, 2004b:66). Some of the state-owned forests have been successfully privatised, but the process recently suffered a setback with the rejection of a large privatisation transaction due to competition concerns.

Via the small grower schemes piloted earlier, as well as the still growing prevalence of independent contractors and corporate programmes to promote access to housing, potable water, clinics and schools for employees, the industry was able to contribute to the government's post-1994 **Reconstruction and Development Programme** (Louw, 2004b:69).

An important event during this period was the declaration of plantation forestry as the only stream flow reduction activity by the **National Water Act** (No. 34 of 1998). The Act introduced a controversial new form of licensing for both existing plantations and new afforestation. The industry was furthermore impacted by increasing environmental pressures giving rise to the need for **certification** by bodies such as the FSC (Forestry Stewardship Council) and ISO (International Standards Organisation). South Africa can be regarded as the world leader in this regard, with more than 80% of plantation areas having acquired FSC certification. In line with certification and state regulatory requirements, all new afforestation projects are now also subject to an Environmental Impact Assessment.

The difficulty in obtaining planting permits, combined with the unavailability of land, the occurrence of droughts and low domestic growth resulted in net new afforestation showing a downward trend since 1990 and it is generally acknowledged that, with the exception of some areas in the Eastern Cape and KwaZulu-Natal, **the expansion of plantation area has reached a ceiling** (Louw, 2004b:67,72,75).

The industry, with its increasingly global exposure, showed some vulnerability to exchange rate fluctuations since 1990. The focus on pulp and paper expanded and exports of wood chips are still on the rise. The mining timber and sawmilling industries, however, experienced difficulties. HIV/AIDS has also become a factor to be reckoned with, as a high prevalence rate among employees impacts the profitability of the industry.

This historical sketch, then, forms the backdrop against which to consider the current plantation forestry, pulp and paper industries, their role and impact, and the potential for future growth.

2. APPENDIX B: ENVIRONMENTAL IMPACTS OF THE FORESTRY VALUE CHAIN

2.1. INTRODUCTION: METHODOLOGY AND CAVEATS

In order to assess the environmental impacts of the forestry, timber pulp and paper value chain, the impacts thereof on water, air, soil and biodiversity were assessed. A framework was adopted for this task based on a previously applied sustainability structure (Crafford *et al*. 2004). This structure classifies environmental impacts according to the three roles of the environment: as a *source* of raw materials and inputs (e.g. water, energy and fertilizer), as a *sink* for waste and pollutants (e.g. emissions such as sulphur dioxide, effluent and solid waste is received into the different mediums of the environment) and as a *service provider* (e.g. water purification) (Pearce and Turner 1990). Thus we want to measure how the value chain under consideration impacts the three roles of the environment. This is attempted by measuring the *external cost* to society, that is, the environmental impacts experienced by society from the economic activities in the forestry value chain, which are not reflected in a market transaction.

A two-step methodology was used to quantify the environmental impacts in monetary terms. Firstly, the environmental impact associated with a unit of production was quantified (thus: emissions/stream flow reduction/effluent *per unit of production*). This was then multiplied by the total number of units of production. Secondly, per-unit costs were attached to the various types of environmental impacts, after which total costs (highlighting the internalised proportion thereof) were calculated. For the per-unit cost, shadow prices were used. Shadow prices in this case give an indication of the damage cost and/or control costs of an environmental impact, i.e. the costs inferred by an environmental impact on society (where available), or the cost incurred to deal with the environmental impact. Preference was given to published South African specific shadow prices, but where they were unavailable, international estimates were used. In this regard, six points should be noted:

- Firstly, some shadow prices, such as that of stream flow reduction or landfill, look at the price paid by companies for an environmental impact, and when that price was not designed in such a way as to fully internalise the cost to society, the full environmental impact cost may not be captured. Shadow prices are, however, in essence not market prices. Where they do reflect the actual price paid for, say, water, they should be regarded as indicative, rather than as reflecting the full cost to society.
- Secondly, the application of foreign shadow prices, though the only option in a few cases, could be problematic. Applying the “cost” placed on for example

pollution by an industrialised country, where a high premium is nowadays placed on the prevention of further environmental degradation, means that the *developed country preferences* for environmental versus other goods are directly applied to South Africa, without taking the developing country context and the preferences for economic and social development that might be more prominent in a country such as SA[4] than in for example the Netherlands, into account. As shadow prices are directly related to a country's environmental policies, it is problematic to apply such prices to another country. For this reason, sensitivity analyses were also conducted on scenarios of 10% and 20% reductions in foreign shadow prices.

- In converting foreign shadow prices (denoted in Euro) to Rand values, purchasing power parity adjustments are made. The relative PPP index is a currency conversion rate that converts different currencies for different years to a common currency that is reflective or relative to purchasing power of a unit of currency between countries. The exact definition of PPP and which proxy indicators to use, could be rather controversial. The method employed in the current analysis, based on Mohr (1998), is as follows:

$$PPP_t = \frac{PPI_t^{SA}}{PPI_t^{foreign}} \times real\ exchangerate_{Base\ year}$$

where

PPP_t = the relative Purchasing Power Parity index in the year t

PPI_t^{SA} = the Producer Price Index in South Africa in year t with 2003 as the base year

$PPI_t^{foreign}$ = the Producer Price Index in the foreign country in year t with 2003 as the base year

Producer Price Indices (PPI) from OECD (2005) were used for this calculation and the annual R/euro exchange rate for 2003 was obtained from the Oanda exchange rate calculator.

- A further caveat of the present analysis is that *absolute values* are placed on environmental impacts. Therefore it is not necessarily indicated whether such impacts are at a critical level or not. For example, as government realises that the stream flow reduction capacity of plantations have potential externality costs, and hence allocate only specific volumes of water to plantations (after making provision for the needed reserves), it can be argued that the externality is in effect removed by regulation and that the environmental costs lose their critical relevance. Should this argument hold, only water use over and above that allocated to plantations should then be considered to have *external costs*.

[4] It is however difficult to explicitly determine what the South African picture would look like. It may also be that an even higher premium is placed on environmental quality where eco-tourism is a priority.

For the purpose of this analysis, those impacts considered to be of no critical relevance are not quantified. For the rest, the level at which impacts become critical is however not indicated.

- Fifthly, some environmental impacts are quantified in the analysis, but, as no shadow prices could be found for these impacts, they were *not priced* and thus not included in the overall environmental costs of the industry. In each instance, the impact not priced will be pointed out, as well as reasons for not attaching an environmental cost to it. It must however be noted that, as some impacts are not included in the environmental cost, this impacts the validity of the overall results.
- Lastly, it should be noted that the study quantifies the environmental impact of the forestry value chain relative to the natural state of the environment. Though appropriate to get an impression of the absolute value of the value chain's impact, this is not necessarily a realistic basis for policymaking, as *some* economic activity will normally take place on the land, rather than the alternative to forestry being that of conserved natural vegetation.

With these caveats in mind, the following analysis, which is an abbreviated version of the sub-study done for the present analysis by the CSIR-Environmentek[5], should be regarded as an attempt to determine the environmental impact of the value chain by applying scientific best practice to the best available data.

[5] The full report is attached as an additional source document to the report.

2.2. PLANTATION FORESTS

Exotic species grown in plantations in South Africa include *Eucalyptus grandis*, *E. nitens* and various hybrids; *Pinus patula*, *P. elliottii*, *P. taeda; P. radiata*; and *Acacia mearnsii* (wattle) (Theron 2000). Plantations are predominantly found in the KwaZulu-Natal, Mpumalanga and Limpopo provinces, with smaller areas planted in the Eastern Cape and Western Cape provinces. The spatial distribution of exotic plantations is determined by sufficient rainfall and suitable soil types.

There are three types of plantation forestry environmental impacts that will be quantified for the purpose of this analysis: its stream flow reduction properties, its solid waste impact (though it will be shown that this cost is fully internalised) and its carbon sequestration (positive impact). Impacts on biodiversity will be discussed on a qualitative level, whereas it will be shown that soil and fertiliser impacts are not significant enough to be quantified[6].

2.2.1. STREAM FLOW REDUCTION[7]

In South Africa, commercial plantation forestry is designated as a stream flow reducing activity and is regulated on this basis (Chapman, 2005). This is seen as the key negative impact characteristic of plantations. Exotic plantations use more water than indigenous vegetation because their growth rates, and therefore their evapotranspiration, are higher (Scholes *et al*. 1995, Versfeld *et al.* 1994). Stream flow reduction is based on the net increase in water use due to a switch from natural vegetation to plantations.

Plantations tend to have their highest relative impact on stream flow reduction during dry periods or in water-stressed catchments and when plantations enter the riparian zone. It is also feared that plantations may lead to a depletion of groundwater tables, especially within water-stressed catchments. As trees are able to grow deep roots to access water sources, they will make greater use of groundwater during dry conditions in order to survive.

Two studies that calculate the runoff reduction of exotic plantations are Scott *et al*. (1998) and Gush *et al*. (2002). These studies are well known and generally accepted in the scientific arena. The method applied by the latter is employed for the purpose of this analysis, as it is also the model accepted and utilised by DWAF for the calculation of stream flow reduction. It should however be noted that the

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[6] An additional non-quantified impact is that the existence of plantations may also lead to alien invasion in adjacent areas (Scholes et al. 1995, Tewari 2001, Versfeld et al. 1994). The seeds are distributed by wind and birds. They establish easily on land disturbed by fires, floods or human activity. Wattles are especially problematic as they are hard to combat due to their ability to remain dormant and their tendency to be established in riparian zones.

[7] Stream flow reduction refers to the reduction in stream flow relative to the natural vegetation caused by the greater water use (rainfall and groundwater) of plantations.

estimated stream flow reductions are based on generalised catchment conditions and thus cannot be seen as representative of the actual impact in a particular catchment. According to Gush *et al.* (2002), plantation forestry's stream flow reduction impact (measured in m^3/ha) is as shown in Table 1.

Region	Pine	Eucalypt	Wattle
Western and Eastern Cape	434	569	449
KwaZulu-Natal	600	802	581
Mpumalanga and Limpopo	667	895	647
South Africa (weighted)	545	702	535

Table 1: Total stream flow reduction (m^3/ha)

Source: Adapted from Gush et al. (2002)

DWAF water tariffs for stream flow reduction are used as a proxy for the downstream costs of water use. Thus the full environmental cost quantified is internalised through the fact that plantation owners pay these shadow prices as levies. It can, at best, be seen as a conservative estimate on the full value of water (King 2004). The stream flow reduction tariff presents a target that government has set to internalise the cost of stream flow reduction activities on behalf of society and thus represents a lower-bound of the external cost to society and not merely the resource use. At the moment, the charges levied however serve to carry the costs of water resource management, rather than reflecting the *value* of water to society[8].

For the national water tariff, an average is calculated from the regional water tariffs for 2002/03 applied by DWAF in the water management areas containing plantations:

	Domestic/ Industrial	Agriculture (Irrigation)	Forestry
Average water tariff for RSA	1.21c	0.59c	0.5c

Table 2: Average sectoral water unit charges (c/m^3) for 2002/03

Source: calculations based on DWAF (2002)

The unit price placed on plantation forestry's stream flow reduction is thus taken as R0.005 per cubic metre of stream flow reduced. Of the 1 371 626 ha planted to plantations in 2002/2003, 709 194 ha was pine, 541 441ha eucalyptus and 113 264ha wattle (FES, 2004). For the 2002/2003 financial year, total stream flow reduction and total cost associated therewith was thus:

[8]. In the main document, Genesis thus ventures an estimate of the environmental cost of water other than that which the present analysis identifies as the only possible way (given data availability) to attach a cost to forestry's water use.

Species	Area (ha)	m^3/ha stream flow reduction	Total annual stream flow reduction (m^3)	Total cost (R)
Pine	709,194	545	386,274,332	1,928,613
Eucalyptus	541,441	702	379,911,101.7	1,923,912
Wattle	113,264	535	60,633,994.67	302,737
Total	**1,363,899**	**n/a**	**826,819,428.3**	**4,155,261**

Table 3. Total stream flow reduction cost of plantation forestry, 2002/03

Source: Based on CSIR-Environmentek's data calculations.

Table 4 below calculates the environmental costs associated with *regional* stream flow reduction per plantation type. Note that the Rand value of stream flow reduction for South Africa is calculated here by multiplying the total yearly impact for South Africa by the price of stream flow reduction, rather than by summing across the three regions This total is slightly higher than the value presented in Table 3 of R4 155 261. The discrepancies are due to the standard deviation from the national average.

Regions	Pine	Eucalypt	Wattle	Total
Western and Eastern Cape	409 675	51 075	40 828	501 579
KwaZulu-Natal	491 958	1 133 573	269 699	1 895 231
Mpumalanga and Limpopo	1 185 341	1 074 203	58 833	2 318 378
South Africa	**1 929 848**	**1 897 804**	**345 644**	**4 173 296**

Table 4: Regional value of stream flow reduction in plantation forests

Source: CSIR-Environmentek calculations.

2.2.2. CARBON SEQUESTRATION

Plantation forestry's ability to convert atmospheric carbon into vegetation is seen as a positive environmental impact. This decreases the quantity of carbon dioxide in the atmosphere. The total biomass of commercial forest plantations in South Africa is higher than that of the grasslands it usually replaces, which in turn means a higher storage of carbon (the net carbon storage can be calculated as the difference between the carbon densities in the two vegetation types).

Hassan (2002) computed an amount of 3.94m mega grams (MgC) of net accumulation of carbon stocks stored in industrial forest plantations in 1989/1990. This result compares well with an earlier independent estimate of 3.69m MgC for the same year by Christie and Scholes (1995). The net accumulation of carbon stocks stored in industrial forest plantations in 2002/03 is 4.05m MgC (see CSIR source document for the detailed calculations). This translates into 2.95 MgC/ha (that is, 2.95 ton/ha). This number will be used as the net quantity of carbon stored by forest plantations.

A CO_2 price of R17.34 per ton (from Blignaut and Zunckel, 2004) is used for carbon sequestration, adjusted using the producer price index to a 2003 price of R22.02. The total carbon sequestration cost of plantation forestry thus amounts to – R89.26m:

Carbon sequestration benefit quantification	
Impact (MgC/ha)	2.96
Total area (ha)	1 371 626.00
Total impact (t)	4 053 450.73
Price (R/ton)	22.02
Total environmental benefit (R)	**89,264,281**

Table 5. The value of carbon sequestration resulting from plantation forestry, 2003.

Source: Based on CSIR-Environmentek's calculations.

2.2.3. SOLID WASTE/PLANTATION RESIDUES

Approximately 10% of the total timber tonnage produced is not passed on to subsequent sectors and remains behind as residue.

The Department of Minerals and Energy (2004) reported on the feasibility of commercially exploitable biomass resources. The assessments considered the production of biomass energy from bagasse, wood and sawmill waste, and pulp and paper waste in South Africa. As part of the study surveys were conducted on the mass of biomass resources produced per annum. The residue produced from forestry includes wood from tending and thinning young stands, 'waste' resulting from the first commercial thinning cuttings, logging residues from the final cutting areas and low-quality trees with no commercial value. It was found that forestry produces 3.133m tonnes of residual wood of which softwood is 1.825m tonnes and hardwood 1.308m tonnes. These statistics provide a residue of 0.217 tonnes of softwood and 0.121 tonnes of hardwood produced per m^3 of logs sold (DME, 2004).

Plantation residue	Softwood	Hardwood	Reference
Impact (t/m^3)	0.21726	0.12111	DME (2004)

Table 6. The environmental impact of plantation residue.

Source: Department of Minerals and Energy, 2004.

Of this residue approximately 20% comprises non-marketable sticks (usually large sticks with a diameter of less than 7.5cm) that are gathered by the surrounding communities for firewood. Approximately 64% of the residue; predominantly the bark, leaves, needles and smaller branches left behind are low heat burned while the remaining 16% is left on the plantation as groundcover or mulch (Godsmark, 2005, Theron, 2005). Mulch has a positive benefit on the soil and reduces the need for fertiliser as well as facilitating moisture retention and reducing soil erosion at recently felled sites (Godsmark 2005). Thus the residue is *fully internalised* (it is sold for alternative uses, burned, or left in the plantation to degenerate).

Applying a land-fill shadow price of R101.33 per tonne (as will be explained in the pulp and paper section), the following internalised cost results:

Plantation waste	Softwood	Hardwood
Impact (t/m3)	0.217	0.121
Production (m3)	8 402 375	10 803 136
Total impact (t)	1 825 516	1 308 379.8
Total price (R per tonne)	101.33	101.33
Total cost (R)	184,980,100	132,578,530
Total cost (RSA) (Rm)	317.6	

Table 7. Total cost (fully internalised) resulting from plantation forestry solid waste, 2003.

Source: Based on CSIR-Environmentek's calculations.

2.2.4. IMPACTS EXCLUDED FROM THE QUANTIFICATION

Biodiversity

Indigenous biodiversity and habitats are lost as plantations change land use and replace the natural vegetation. The impact of forestry plantations on biodiversity varies depending on the type of vegetation that was replaced, the number of species that were displaced, as well as the spatial distribution and relative abundance of these species. A specific production unit based environmental impact coefficient cannot be obtained for biodiversity, as a single measurement for biodiversity is simply not available. Generally, if a hectare of a plantation displaces a hectare of natural vegetation the actual impact in terms of ecosystem functioning and affected species cannot be quantitatively assumed at a high enough confidence level.

According to national statutory requirements and international guidelines, forest plantations are obligated to leave a minimum amount of the estate unplanted (FSA, 2002). This portion can be conserved or merely left clear, or a permit can be obtained to use it for another land use (De Wit *et al*., 2002). FSA (S.a.) have stated that between 30 to 40% of forest estates are left uncultivated. This estimate is based on the identification of sensitive environmental areas through pre-planting environmental impact assessments and the planting restrictions that protect riparian zones. De Wit *et al*. (2002) document that at least 25% of an estate is not allowed to be afforested. Their estimate is based on the allocation of forestry permits to individual properties in South Africa. These pieces of land may be scattered across the estate on already unproductive areas of land.

Plantations seem to have an advantage over agricultural crops in terms of impact on biodiversity, although, cattle grazing has the least impact on biodiversity (De Haan, Steinfeld and Blackburn 1997). Though no South African specific estimates are available, a South American study showed that forestry plantations are potentially the least damaging in terms of biodiversity (excluding diversified fruit crops) (Pagiola *et al*. 2004). The CSIR estimates the comparative biodiversity impacts of plantations in relation to alternative agricultural land uses to be as follows:

Impact	Maize	Sugarcane	Sub-tropical fruit	Livestock grazing
Habitat loss	↓	↓	↓	↑
Specie loss	↓	↓	↓	↑
Alien invasion	↑	↑	↑	n/a

Table 8: Comparative biodiversity impacts of plantations in relation to alternative agricultural land uses

Source: CSIR-Environmentek's own estimates

Note: ↑ - Impact is higher in plantation forests, or plantations have a negative impact in comparison with alternative agricultural land uses
↓ - impact is lower in plantation forests, or plantations have a positive impact in comparison with alternative agricultural land uses and
n/a – impact is not applicable for the alternative land use type

The lack of adequate biodiversity values will have an impact on the outcomes of the total monetary environmental costs of forest plantations. However, the loss of biodiversity due to the conversion of natural vegetation to plantations is being controlled through the permit system. Plantations have to undergo extensive environmental impact assessments that include an assessment of their impact on biodiversity. Current impacts on biodiversity such as alien invasion are being mitigated through the enforcement of improved plantation management in terms of environmental certification processes (FSC) and the implementation of programmes such as the Working for Water programme.

Impact on Soil

Plantations tend to stabilise soil particles, thus preventing erosion, especially in degraded areas. Bad forest management practices in terms of road locations, road maintenance and timber extraction can however lead to sedimentation (Scholes *et al.* 1995, Versfeld *et al.* 1994). Given an FSC certification rate of at least 80-85% of plantations (Pamsa, 2004a), it is assumed that at most 20%% of plantations have insufficient management practices, which contribute to negative soil impacts. Physical soil impacts mainly occur during harvesting and due to accidental fire damage on the plantation.

Research by Scholes *et al* (1995) and UWC (2001) showed that, under normal circumstances, the erosion rates of plantations (e.g. eucalypts have an erosion rate of 0.1 tonne/ha under a closed canopy) are far below that of other agricultural crops such as maize, wheat, sugar cane (on average these erode 20 tonnes of soil per tonne of crop produced[9]), as well as natural grasslands (between 0.4 and 1.8 tonnes/ha). It is only after wildfires that plantation's erosion rates become significant (5.22 t/ha for eucalyptus and 37 t/ha for pine). Adler (cited in Scholes *et al*. 1995) argued that an acceptable rate of erosion for cultivated lands on sloped land in high rainfall areas is approximately 10 t/ha per annum. This implies that well managed, undisturbed plantation forests would fall within this guideline.

Fertiliser and pesticide use

Plantation forestry may also lead to chemical changes of soil such as the degradation of soil fertility, the depletion of soil nutrients and acidification. The depletion of soil nutrients caused by the removal of the natural vegetation leads to the long-term use of fertilisers. In addition, pesticides are introduced, as monocultures are more prone to attack from pests and disease. The use of fertilisers and pesticides on plantations cause water, soil and air pollution (Dudley, Stolton and Jeanrenaud 1996, Scholes *et al.* 1995, Tewari 2001). However, the environmental impact is not expected to be major. The fertiliser dosages currently applied are fairly small, ranging from 20 to 30 kg per hectare, the composition of the fertilisers is fairly benign (and the chemical constituents are not very mobile in soil and is thus not expected to flow into streams), and the way in which fertiliser is applied leaves little opportunity for leaching into the soil. Thus the environmental impact associated with fertilisers is likely to be far lower than that associated with agriculture, where the use of fertilisers is far more intensive (Du Toit, 2005). In addition, plantation farms are sub-divided into an equal number of compartments based on the rotation period. In optimal rotation, only certain compartments will be planted each year (equal to the number harvested). Thus only a few compartments are fertilised per year.

For these reasons, fertiliser use is excluded from the environmental impact analysis.

2.2.5. CONCLUSION: THE NET ENVIRONMENTAL COST OF PLANTATION FORESTRY AMOUNTED TO –R89.3M IN 2003

Given the impacts and per unit costs discussed, Table 9 provides the total baseline monetary values for the environmental impacts of forestry plantations. The water quality, fertiliser and soil erosion impacts of plantation forestry were excluded as these were considered negligible. However, the exclusion of the value of

[9] Scholes et al. (1995) point out that "since more than 1 ton of crop is generally produced per hectare during a productive season, this implies that soil erosion will generally be worse on agricultural land than on plantations"

biodiversity lost due to the lack of data has resulted in an overestimation of the possible environmental benefit from plantation forestry.

Impact	Pine	Eucalypt	Wattle	Total Hardwood	Total cost (R)	Internalised costs (R)	Net costs (R)
Stream flow reduction	1,928,613	1,896,842	302,737		4,155,261.5	4,155,261.5	0
Plantation residue	192,334,461			137,849,531	317,558,629.6	317,558,629.6	0
Carbon sequestration					89,264,281.3	n/a	-89,264,281.3
Total					**232,449,609.7**		**-89,264,281.3**

Table 9: Baseline results for forestry plantations in Rands

Source: CSIR-Environmentek calculations.

2.3. PULP AND PAPER MILLS

Worldwide, the pulp and paper industry has been considered to contribute substantially in economic and social terms. The industry has however come under environmental pressure to implement cleaner technologies and to minimise its pollution (Dudley, Stolton and Jeanrenaud 1996, IIED 1996). As a result, pulp and paper mills now generally recycle water and often use solid waste to generate energy for the production process.

As different methods are used to pulp wood, there are varying degrees of environmental impacts. The key environmental impacts during the pulping production processes are energy use, water pollution, air pollution and the production of solid waste (a proportion of this is used for energy). Chemical pulping methods produce sulphur dioxide emissions and convert about half of the timber into pulp, thus producing high levels of solid waste. Mechanical methods, on the other hand, have higher conversion efficiency but have a higher energy use than chemical methods. The main pollutants from the papermaking process are chloroform, toluene and pollutants from bleaching (Dudley, Stolton and Jeanrenaud 1996).

2.3.1. ENERGY USE

Energy is generated from electricity (purchased from Eskom off the national grid), fossil fuels and biomass:

Energy source	GJ[10]/tonne of pulp and paper	kWh/ton of pulp and paper
Electricity	3.04	844
Fuels (coal, oil and gas)	15.81	4 392
Fuels (biomass)	9.29	2 581
Total	**28.14**	**7 817**

Table 10: Energy use of the pulp and paper industry in South Africa

Source: Adapted from Mondi (2003), Mondi Kraft (2003) and Sappi (2005)

The energy use per unit of output in the South African pulp and paper industry was estimated by dividing the energy sources by the total paper production and the quantity of exported pulp from all the Mondi (Mondi Kraft 2003, Mondi 2002) and Sappi mills excluding the Usutu mill (Sappi 2005). Annual electricity use in the pulp and paper industry is estimated at 844 kWh per tonne of output produced. Fossil fuel energy use is 4 392 kWh per tonne of output produced, while 2 581 kWh per tonne of output produced is generated from biomass (Table 10).

It is assumed that the use of the fuels, coal, oil and gas give the same emissions as the generation of electricity. For this reason the same price is used for electricity and fuels. The external costs for biomass fuel are assumed to be zero. These coefficients are used to determine the external cost to society due to the use of energy. From Blignaut and King (2002) and Blignaut and Zunckel (2004), the external cost of CO_2 and CH_4 is respectively estimated at R22.02 and R314 per tonne[11].

Blignaut and Zunckel (2004) review three different estimations of the external cost to society of a unit of electricity generated. The core estimates of different studies are very comparable, indicating that the global externality damage as a result of coal-fired power generation ranges between R0.032/kWh and R0.043/kWh, which translate to between 15% and 30% of the retail price of electricity (Blignaut and Zunckel 2004). The lowest value (R0.032/kWh), as estimated by the National Treasury (2003) is used for this study:

[10] Giga-Joule

[11] Blignaut and Zunckel (2004) used 2000 as a base year to derive a CO_2 cost of R17.34 and a CH_4 price of R398.8. The figures applied here were calculated by adjusting the base year to 2003.

	Unit	Central estimate
Spalding-Fecher and Matibe (2003)		
Electricity sales 1999	TWh	172.6
Global damage per unit	R/kWh	0.043
Total coal consumed	Tonne	88 470 000
Global damage per tonne of coal	R/tonne	79.61
Blignaut and King (2002)		
Electricity sales 2000	TWh	177.4
Global damage per unit	R/kWh	0.041
Total coal consumed	Tonne	92 300 000
Global damage per tonne of coal	R/tonne	78.46
National Treasury (2003)		
Electricity sales 2000	TWh	177.4
Global damage per unit	**R/kWh**	**0.032**
Total coal consumed	Tonne	92 300 000
Global damage per tonne of coal	R/tonne	61.04

Table 11: Global damage cost per unit of electricity generated by Eskom

Source: Adapted from Blignaut and Zunckel (2004)

The effect on health from local pollutants due to the combustion of coal, such as sulphur dioxide and particulate matter was estimated to be in the order of R0.01/kWh (Blignaut and Zunckel 2004). When adding the health effects of the local pollutants (R0.01/kWh) to the global damage (R0.032/kWh) caused by global pollutants, the total impact is R0.042/kWh in 2000 (Blignaut and Zunckel 2004). Adjusting this figure so that 2003 is the base year results in a unit price of R0.053/kWh and the resultant environmental cost is as follows:

Pulp and paper energy use	
Coal (kWh/t)	4 392
Electricity (kWh/T)	844
Paper and exported pulp production (t)	3144946
Energy use (kWh)	16 465 761 044
Total price (R/kWh)	0.053
Total energy use cost (Rm)	**859.03**

Table 12. Energy use environmental cost of the pulp and paper industry, 2003.

2.3.2. WATER QUANTITY

The water quantity used in pulp and paper mills refers to the resource use and not external costs to society. The costs incurred from extracting water from bulk water suppliers are a production cost in the mills. Water consumption figures have thus not been treated as external baseline costs.

Mill	Average production (t/day)	Average water intake (m3/day)	Average water intake (m3/t)
Pulp and paper-making	3 185	229 260	72
Paper-making	1 390	37 515	27

Table 13: Average water consumption of the survey of paper mills in South Africa

Source: Calculations based on Steffen et al. (1991)

2.3.3. WATER QUALITY

Steffen *et al.* (1991) conducted a survey to identify the water pollution load of water discharged from various South African mills and processes in 1990 (new technologies may have resulted in lower environmental impact coefficients since then). The results are listed in Table 14:

Mill	Kg COD/t	Kg SS/t	Kg TDS/t	TDS (mg)/l
Integrated pulp and paper-making	40	26	84	1714
Paper-making	7	12	38	3167

Table 14: Average water pollution load of the survey of paper mills in South Africa

Source: Calculations based on Steffen et al. (1991)

Definitions: COD – Chemical oxygen demand; SS – Suspended solids; TDS – Total dissolved salts

Water quality issues are specific to the local context within which they occur. Therefore, the effect of each of these water quality impact coefficients will differ depending on the receiving ecosystem.

Of these, the only shadow price quantified in the present analysis is that of COD as shadow prices for the others were unavailable. As discussed in the introduction, the fact that the SS and TDS impacts are not priced may influence the validity of the results[12]. As costs of water quality per unit of pollution could not be derived from local literature, prices for water quality deterioration had to rely on international estimates, converted into rand values by relative purchasing power parity. From Davidson (2002) (CSIR source document discussion of foreign shadow prices) the Dutch shadow price of COD was converted into a value of R1.43/kg. Applying this shadow price results in an annual “pollution cost” of R157.671m:

[12] In discussing the environmental cost impact on total economic impact in the main document, Genesis thus ventures an estimate for the cost of the industry’s TDS water quality impact.

Water quality impact	Paper mills	Integrated pulp and paper mills
Impact (kg/t) of COD	7	39.5
Production of paper and exported pulp (t)	354 611	2 721 389
Total pollution impact (kg)	2 458 636	107 494 866
Shadow price (R/kg)	1.43	
Total environmental cost (Rm)	**157.671**	

Table 15. The water quality impact of the pulp and paper industry.

2.3.4. SOLID WASTE

Solid waste per unit of output in the pulp and paper industry was estimated by dividing Mondi and Sappi's total annual output of solid waste landfilled by their total annual output of paper and exported pulp. Figures were derived from their sustainable development reports (Mondi 2002, Mondi Kraft 2003, and Sappi 2005). Solid waste per unit of output in the industry estimated at 0.249 tonnes per tonne of output.

The solid waste produced by the pulp and paper industry is partly dumped as landfill waste and partly re-used. For the environmental impact of landfilled solid waste, the levy of waste charged by the municipalities was used from the City of Cape Town and the eThekweni (Durban) municipalities. This value is the cost of managing the landfill site. For the City of Cape Town the levy of landfill waste is R81.25/tonne (including VAT) (Scholt 2005). The eThekweni municipality reported that the levy for landfill waste is R125.40/tonne (Naicker 2005). An average value of R101.33 per tonne (adapted from an actual average of R103 in order to reflect 2003 values) was used as a second best estimate for the externality cost of solid waste.

Solid waste cost: pulp and paper	
Landfill coefficient (t/t)	0.249
Production of paper and exported pulp (t)	3 076 000
Total landfilled waste (t)	767 304
Cost of landfill (R/t)	101.33
Total solid waste environmental cost (Rm)	**77.75**

Table 16. The environmental costs of the pulp and paper industry relating to solid waste disposal, 2003

2.3.5. AIR POLLUTION

To avoid double-counting, emissions of CO_2, CH_4, SO_2 and PM resulting from energy utilisation are included in the external cost of energy use as discussed above. Additional sources of CO_2 and SO_2 related to non-energy production are considered in this section. These sources include emissions from transport, processes and estimated SO_2 emissions as defined by Mondi Kraft (2003). Comparable figures for Sappi and the Mondi Merebank mill were not available. The Mondi Kraft figures thus are a best available estimate for the industry though this generalisation may be problematic due to the varying production processes.

The total emissions of non-energy CO_2 and SO_2 associated with pulp and paper production in 2003 were divided by the company's total output of paper and exported pulp to derive a per unit coefficient. This was calculated at 0.013 tonnes of CO_2 per tonne of paper and exported pulp produced, while SO_2 emissions per unit of output are 0.0049 tonnes per tonne of pulp and paper.

In Eiolca and IPPS data (Hettige *et al*. 1994) (see CSIR source document for a discussion on these references), a number of other air pollutants associated with pulp and paper manufacturing are identified which have not been included in the energy or Mondi Kraft estimates. These pollutants include CO, NO_2, VOC, TSP, GWP, N_2O and CFCs. Coefficients are derived for each of these pollutants and included in Table 17. Note that pulp and paper is the combination of pulp and paper processes where disaggregated data was unavailable.

Air emissions	Units	Pulp	Paper	Pulp and paper	Reference
CO	kg/t			2.37	Adapted from Hettige *et al.* (1994)
SO_2	kg/t			0.0049	Adapted from Mondi Kraft (2003)
CO_2	kg/t			0.013	Adapted from Mondi Kraft (2003)
NO_2	kg/t			1.085	Adapted from Hettige *et al.* (1994)
VOC	kg/t			0.329	Adapted from Hettige *et al.* (1994)
GWP	$MTCO_2E/t$	0.3804	0.6820		Adapted from Eiolca
N_2O	$MTCO_2E/t$	0.0177	0.01		Adapted from Eiolca
CFCs	$MTCO_2E/t$	0.0026			Adapted from Eiolca

Table 17: Environmental impact coefficients within the pulp and paper industry

These impacts, multiplied by the annual production of the pulp and paper industry[13], result in total annual emission figures for the industry of:

- 7 300 tonne CO
- 14 944 tonne SO_2
- 39 993 tonne CO_2
- 3 337 tonne NO_2
- 1 011 tonne VOC

[13] The coefficients in the pulp column were multiplied by exported pulp, in the paper column by total paper and in the pulp and paper column by total paper and exported pulp.

- 1 873 315 tonne GWP
- 36 362 tonne N_2O
- 1 922 tonne CFCs

The costs of CO_2 and CH_4 have already been discussed under the external costs of electricity (R22.02 and R314 per tonne respectively). The price of R22.02/tonne for CO_2 will be used for air pollutants that are expressed in CO_2 equivalents. These air pollutants are GWP, N_2O and CFCs. For the rest, Dutch shadow prices from (Davidson 2002) are applied:

Air emissions	Units	Price	Reference
CO	R/tonne	418	NL, Davidson (2002)
NO_x	R/tonne	14 485	NL, Davidson (2002)
SO_2	R/tonne	28 969	NL, Davidson (2002)
CO_2	R/tonne	22.02	SA, Blignaut (2004)
NO_2	R/tonne	434	NL, Davidson (2002)
VOC	R/tonne	6 447	NL, Davidson (2002)
GWP	R/tonne (CO_2 eq)	22.02	SA, Blignaut (2004)
N_2O	R/tonne (CO_2 eq)	22.02	SA, Blignaut (2004)
CFCs	R/tonne (CO_2 eq)	22.02	SA, Blignaut (2004)
PM	R/tonne	95 988	EU, Holland (2000)

Table 18. Shadow prices applied to pulp and paper air emissions.

Source: CSIR-Environmentek literature review.

Applying these per unit prices to the total impacts (in tonne) named above, the total environmental cost of the pulp and paper industry relating to air emissions (excluding those due to energy use) amounts to **R486.9m**.

2.3.6. CONCLUSION: THE TOTAL ENVIRONMENTAL COST OF THE PULP AND PAPER INDUSTRY AMOUNTED TO R1.58 BILLION IN 2003

Table 19 provides the total baseline monetary values for the various environmental impacts associated with pulp and paper mills. These results include the impact from pulping recovered paper (i.e. recycling). Water quantity was excluded as there was no clear indicator whether or not water was extracted directly from the environment. In the event that water was extracted in this manner, the environmental cost of this water should be added to the total environmental cost of the pulp and paper industry. Furthermore, the lack of price data regarding all but the COD water quality impacts will probably have a significant impact on the total environmental cost as water quality is considered to be one of the most important impacts from the industry.

Pulp and paper environmental impact	Total impact (Rand)
Energy use	859,029,263
Water quality	157,671,295
Waste	77,751,103
Air emissions	486,927,925
Total	1,581,379,586

Table 19: Baseline results for pulp and paper mills in Rands.

Source: CSIR-Environmentek calculations.

Table 20 provides a breakdown of the external cost of environmental impacts from energy use and landfilled solid waste per province. The values are based on available regional data. The table indicates that pulp and paper mills in KwaZulu-Natal have the highest total environmental costs in terms of energy use and landfilled waste. These higher levels are, however, to be anticipated given that the production statistics in the area are higher than elsewhere. Differences in the efficiency of energy use can be accounted for by the various pulping processes employed at different mills.

Type of mill	Province	Production	Energy costs (Rand)		Landfill waste cost
		(tonnes)	Electricity (national grid)	Fossil fuels	(Rand)
Pulp and paper	Kwazulu Natal	1 250 947	95 436 865	355 150 246	50 790 095
	Mpumalanga	447 394	10 041 480	219 255 311	17 759 049
	Gauteng	194 748	16 042 251	59 858 195	10 635 541
Paper	Kwazulu Natal	19 299	na	na	na
	Mpumalanga	13 159	na	na	na
	Gauteng	307 035	na	na	na
	Western Cape	99 419	1 918 912	6 450 211	269 133
	Total	**2 332 000**	**123 439 509**	**640 713 963**	**79 454 818**

Table 20: Regional value of environmental impacts of pulp and paper mills (Rands)

Source: CSIR-Environmentek research

Adding these energy and landfill costs across provinces amounts to a total environmental cost for South Africa of R556.39m. The large discrepancy with the overall cost data provided in Table 19 can be ascribed to the fact that, due to disaggregated data availability constraints, the regional values only include the energy and waste environmental costs for Sappi and Mondi. Thus other companies' paper mills impacts are excluded, as well as air and water quality impacts for the industry as a whole.

2.4. SOLID WOOD PROCESSING

Solid wood processing includes saw milling, the manufacturing of wood chips, poles and mining timber[14]. The main impacts identified from solid wood processing are related to the energy use from kiln drying, water pollution, air pollution from dust and generated energy, solid waste and the risk of using preservatives (Du Toit and Gibbs 2000, Currie 2000, Wessels, 2004).

DWAF has recently recognised the problems associated with sawdust leaching into water bodies on water quality (Gravelet-Blondin 2005). Unfortunately, the extent of the impact cannot be determined on a national basis. Due to insufficient data available on solid wood processing, international coefficients were thus adopted (see Appendix 2 for discussion on these sources). The energy and water use, GWP, N_2O and CFCs are derived from Eiolca's database. The other air pollutants, CO, NO_2, VOC and TSP, and water quality indicators are from Hettige *et al*. (1994). Similar to the pulp and paper mills, CO_2, CH_4, SO_2, and PM are accounted for through energy use and are thus excluded from the list of air pollutants. The solid waste coefficient was derived from DME (2004). This includes sawdust, bark and chips. A conversion factor of one tonne to 0.94 m^3 was applied:

[14] The environmental impacts of timberboard and the treatment of poles were not included in the analysis. Thus the costs associated with solid wood processing may be underestimating the total impact. It was however found that the environmental impacts of these activities are small relative to the overall impacts.

Impact (m^3)	Units	Solid wood processing	Reference
Energy use			
Energy total	kWh/m^3	255	Adapted from Eiolca
Water quantity			
Intake	m^3/m^3	3.09644	Adapted from Eiolca
Water Recycled/Reused	m^3/m^3	61.80597	Adapted from Eiolca
Water Discharged Untreated	m^3/m^3	2.06429	Adapted from Eiolca
Water Discharged Treated	m^3/m^3	272.54836	Adapted from Eiolca
Water quality			
TSS	kg/ m^3	0.03835	Adapted from Hettige *et al.* (1994)
BOD	kg/ m^3	0.00813	Adapted from Hettige *et al.* (1994)
Other emissions		na	
Waste			
Sawmilling	tonne/tonne	0.5037	Own calculation
Mining timber	tonne/tonne	0.12	
Poles	tonne/tonne	0.31	
Air emissions			
CO	kg/m^3	0.4795	Adapted from Hettige *et al.* (1994)
NO_2	kg/m^3	0.1903	Adapted from Hettige *et al.* (1994)
VOC	kg/m^3	0.2039	Adapted from Hettige *et al.* (1994)
GWP	$MTCO_2E/m^3$	0.0258	Adapted from Eiolca
N_2O	$MTCO_2E/m^3$	0.0006	Adapted from Eiolca
CFCs	$MTCO_2E/m^3$	0.0299	Adapted from Eiolca
TSP	kg/m^3	0.2648	Adapted from Hettige *et al.* (1994)
Other emissions		na	

Table 21: Environmental impact coefficients within the solid wood processing industry

The shadow prices for the various air emissions, for waste disposal, water quality and for energy use, have already been quantified under other sections. Following the same method applied in the above sections (multiplying per unit impact by total production to derive total impacts, and then multiplying that by per unit costs to derive total costs), the following baseline estimates of the environmental impacts in the solid waste industry were obtained.

Impact of solid wood processing	Total cost (Rm)	Internalised cost (Rm)	Net cost (Rm)
Energy total	59.3		59.3
Water quantity	excluded		excluded
Water quality	not available		not available
Waste	318	175.1	142.9
Total air emissions	12.4		12.4
Total environmental cost (Rand)	**389.7**		**214.6**

Table 22: Baseline results for solid wood processing in Rands

The internalised cost of waste is based on the solid waste that is either sold as woodchips or used to generate energy and heat (1.144 m^3 of solid waste). Water quantity is excluded for similar reasons to the pulp and paper industry. Information is needed on the quantity of water extracted directly from the environment. Shadow prices for water quality were lacking and thus this impact was excluded from the analysis above. The influence of water quality may have an effect on the net environmental cost of the solid wood processing industry.

The baseline value of waste is quite significant: relatively high values remain even after accounting for the internalised costs of waste. This is predominantly due to the uncertainty around the disposal of the generated waste. Other significant monetary impacts are the externality cost of electricity, the release of SO_2, CO_2, GWP and CFCs. This is expected due to the impact of generating energy from other fuels.

2.5. TRANSPORT

Logs are transported from the plantations to the various downstream industries via roads within the plantations and by road or rail to off-site mills. The main impacts of road transport are on-site soil compaction and erosion, as well as air pollution. Soil impacts are often influenced by the quality of management practices and cannot be inferred without prior knowledge of the practices within various plantations.

Once again, it can be assumed that at most 20% of the plantations are not well managed (that is, not FSC certified) and would thus cause these impacts to a greater degree than the average well managed plantation. The environmental impacts of the two transportation methods are discussed below. The impact from soil compaction and erosion will not be carried forward due to the lack of data surrounding the actual impact of transportation on soil.

Transport of the logs from commercial plantations can be divided into transportation of pulpwood (pulp, paper and board mills) and of sawlogs (poles, mining timber, match wood and charcoal, etc.). Each product has a different route before it arrives at its processor (see Figure 1). Most of the pulpwood goes from the plantation to a transfer point or depot, from where it is transported to a siding for rail transport to the processing plant or directly to the processing plant. Transfer points can be formal depots, satellite sites and sidings. Some of the pulpwood goes directly from the plantation to the processor by road. All sawlogs go directly from the plantation to the processor by road.

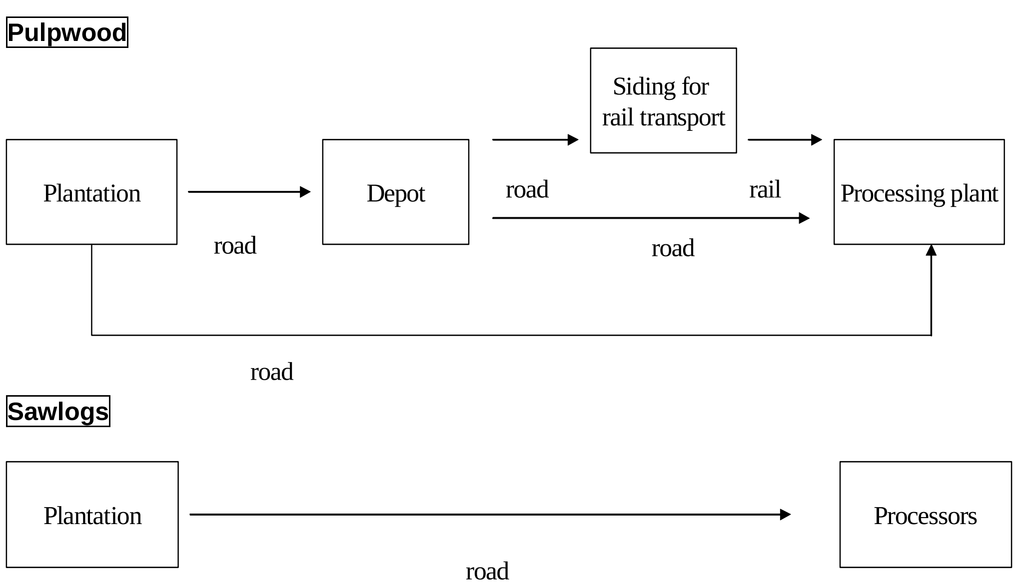

Figure 1: Transport model of pulpwood and sawlogs from plantation to processors

Source: Ackerman (2005) and Morkel (1999)

In Table 23, the total distance travelled is indicated for the different transport routes of pulpwood and sawlogs. To be able to calculate this, the following information is needed; transport distances between the different locations (plantation – depot – processor, and plantation – processor), the method of transportation (road or rail), plantation output and the average load size of the trucks. These numbers are all average numbers obtained from Ackerman (2005).

Type of timber	Route[§]	Distance (km)[†]	Method of transport	Timber output (million t)	Load size per truck (t)	Number of trips (Volume / load size)	Total distance travelled (km) (number of trips * distance * 2)
Pulpwood	PD	10	Road	7.12	12	593 333	11 866 667
	DP	142	Road	7.12	39	182 564	51 848 205
	DSR	12	Road	5.8	12	483 333	11 600 000
	DP	na	Rail	5.8	na	na	na
	PP	142	Road	1.03	25	41 200	11 700 800
Sawlogs	PP	60	Road	4.4	25	176 000	21 120 000

Table 23: Transport method, distances and load per truck for pulpwood and sawlogs

Source: Ackerman (2005) and Morkel (1999)

[§]PP - From plantation to processors; PD - From plantation to depot and DP - From depot to processor; DSR - From depot to siding for rail transport

[†] Distance refers to a one-way trip.

The expected processing plant intake for 2004 was 13.94m tonnes, which will have to be transported, of which 7.12m tonnes move from plantation to transfer area to mill, and 1.03m tonne moves directly from the plantation to the processor. For sawlogs 4.4m tonnes goes directly from the plantation to the processor. Of the 13.94m tonnes 5.8m tonnes is transported by rail (i.e. from plantation to siding to processing plant) (Ackerman 2005).

The road transport takes place with mostly Heavy Commercial Vehicles (Gross Vehicle Mass > 7501 kg) (Ackerman 2005). The total distance travelled on the road can be calculated from Table 23, by aggregating the 'total distance travelled in km' column, which is 108m km per annum.

This study will only consider the emissions from diesel commercial vehicles, as these are mainly used in the forestry value chain. Very little published literature is available on the emissions from transportation in South Africa. One of the few studies found were Stone and Bennet (2001). This study calculated the emissions from diesel commercial vehicles in 1998. Their results are presented in Table 24. Caution against the direct extrapolation of these estimates has to be highlighted for the following main reasons; the vehicle ageing effect on emission levels has not been taken into account in their estimates and the effects of new technology entrants between 1998 and current day is assumed to result in a positive change in emission rates (Stone and Bennet 2001). The estimates presented in this study will be based on 1998 estimates and it is uncertain what effect this will have on the results, as this is dependent on the rate at which commercial vehicles are scrapped and/or replaced.

Impact (m^3): air emissions	Units	Coefficients
CO	g/km	3.82
NO_x	g/km	13.04
SO_2	g/km	1.66
CO_2	g/km	805.00
PM	g/km	0.68

Table 24: Environmental impact coefficients within transportation

Stone and Bennet (2001)

Multiplying these impacts (in g/km) by the 108m km travelled for the value chain's purposes each year, a total impact of 89 127 ton of emissions per annum is obtained. The shadow prices for the various air emissions were discussed under pulp and paper air pollution (Section 2.3). Multiplying the relevant shadow prices by the total impact, results in the following environmental costs ascribable to the transportation employed by the value chain:

Air emissions	Road Transportation cost (Rand)
CO	172 858
NO_x	20 424 665
SO_2	5 200 145
CO_2	1 916 980
HCn	Not available
PM	7 058 208
Total (R)	**34 772 856**

Table 25: Baseline results of the environmental costs of transportation employed by the value chain.

Source: CSIR-Environmentek research.

NO_x and PM contribute the highest environmental cost to the total transport impact. A value for HCn is not included in the table as there is no price available for this pollutant. However, this is also one of the smallest emissions per kilometre travelled.

2.6. RECYCLING

The recycling of recovered paper is used for the production of pulp for tissue paper and other paper products. Pulp from recycled paper is often used in combination with other pulp. The recycling process is similar to other pulping processes, but uses less energy. Furthermore, timber resources are preserved or partially supplemented through this process and solid waste to landfill is reduced. Pollution is produced from the de-inking process as well as the bleaching process of the recycled pulp (Dudley, Stolton and Jeanrenaud 1996). However, from an industrial perspective the environmental impacts of recycling occur at the pulping stage; as recovered paper forms part of the inputs at certain pulp and paper mills.

Alternative disposal methods for used paper include incineration for energy production (hardly practiced in South Africa) and landfilling (IIED 1996). IIED (1996) have compared several studies relating to the life-cycle assessment of recycling, incineration and landfilling. They found varying outcomes regarding the comparison between recycling and landfilling. Generally, recycling is preferred.

It is true that recycling reduces the amount of waste being landfilled. However, it has been shown that the recycling process uses fossil fuels for energy and it also requires transportation to mills, often over longer distances than timber. For the purposes of this study, it is assumed that the environmental impacts from recycling are internalised within the pulp and paper industry, as recovered paper (or recycled pulp) largely forms another input into pulp and paper mills.

2.7. CHARCOAL PRODUCTION

The process of converting wood into charcoal (known as pyrolysis) is responsible for the emission of a number of non-condensable gases, including CH_4, CO, NO_X, SO_2, N_2O, CO_2 and various hydrocarbons (Empowerment for African Sustainable Development 2004). The degree to which charcoal production is practiced however does not justify a quantification of these impacts[15].

[15] In addition, timberboard production was excluded from the analysis, for reasons explained in the CSIR source document. In order to inform the economic impact of the FTPP cluster, Genesis however conducted its own estimate of the environmental cost of timberboard production. These estimates are contained in the main document.

2.8. CONCLUSION

The total estimated baseline cost of environmental side-effects for the entire forestry value chain as defined in this study is approximately R2 228m in 2003 prices. Of the R2 228m, approximately R497m is already internalised throughout the forestry value chain. The net external cost is thus about R1.7 bn, or 14% of the total value added estimated. Table 26 provides a summary of the breakdown for the total environmental cost.

Industry	Total value	Internalised cost	Net external cost	Cost per unit of production
Plantation forests (includes carbon sequestration as a benefit)	232 449 610	321 713 891	- 89 264 281	-4.65 (per m^3) or-65.08 (per ha)
Pulp and paper mills	1 581 379 586	na	1 581 379 586	514.10 (per ton)
Solid wood processing	380 219 216	175 081 364	205 137 852	19.40 (per m^3)
Transport	34 772 856	na	34 772 856	0.32 (per km)
Total	**2 228 821 268**	**496 795 255**	**1 732 026 013**	**na**

Table 26: Summary of the baseline external costs of the forestry value chain (Rands)

Source: CSIR calculations

The baseline value has been lowered through the internalisation of environmental costs through efforts such as the re-use or recycling of waste and by-products and implementing pollution and abatement technologies.

The results of the study are sensitive to the value of the shadow prices used in the study and any changes in these values could have impacts on the final results. The international shadow prices have been transferred using the benefit transfer method. This implies that the preferences of the other countries are assumed to be similar to those in South Africa. A sensitivity analysis using a 10 and 20% reduction in the foreign shadow prices was conducted. The results of this analysis are shown in Table 27. The transportation industry is the most sensitive to changes in the foreign shadow prices (a decline of 9.7% under the 10% scenario and 19.4% under the 20% scenario). The pulp and paper industry showed a decline of 4.8% under the 10% scenario and 9.9% under the 20% scenario. The solid wood processing industry is affected minimally (0.5% and 0.95% under the two scenarios), while plantation forests remained unaffected by changes in the foreign shadow prices.

Industry	Total cost (R)	Internalised cost (R)	Net external cost (R)	Cost per unit of production (R)
10% reduction in foreign shadow prices				
Plantation forests (includes carbon sequestration as a benefit)	232 449 610	321 713 891	- 89 264 281	-4.65 (per m3) or - 65.08 (per ha)
Pulp and paper mills	1 521 217 420	na	1 521 217 420	494.54 (per ton)
Solid wood processing	379 566 899	175 081 364	204 485 535	19.34 (per m3)
Transport	31 487 268	na	31 487 268	0.29 (per km)
Total	**2 164 721 197**	**496 795 255**	**1 667 925 942**	**na**
20% reduction in foreign shadow prices				
Plantation forests (includes carbon sequestration as a benefit)	232 449 610	321 713 891	- 89 264 281	- 4.65 (per m3) or -65.08 (per ha)
Pulp and paper mills	1 461 055 254	na	1 461 055 254	474.99 (per ton)
Solid wood processing	378 914 581	175 081 364	203 833 217	19.28(per m3)
Transport	28 201 681	na	28 201 681	0.26 (per km)
Total	**2 100 621 126**	**496 795 255**	**1 603 825 871**	**na**

Table 27: Summary of sensitivity results on external costs of the forestry value chain (Rands)

The total external cost of approximately R 2 228m represents the best estimate of external environmental impacts associated with the forestry value chain. This value however is likely to be an underestimate of the true environmental cost as a result of various data gaps. These gaps include the lack of information in water quality prices (especially in the pulp and paper industry) and South African environmental impact coefficients especially within the solid wood processing industry[16]. Other important gaps relate to the biodiversity values and water quality in the various industries. For plantation forestry, the lack of prices for biodiversity loss has resulted in an underestimation of the values.

Most of the values related to water use through either stream flow reduction or water intake have been internalised by the various companies[17]. In an expansion scenario, the cost factors and/or shadow prices should be multiplied with the full environmental impact before mitigation or internalisation responses are taken into account. The choice is then for sector planners/decision makers to make provision to internalise these costs, or to take the position that some side-effects on society are acceptable.

[16] Genesis attempted to bridge this gap by applying reasonable and conservative assumptions and generalisations to available data. These quantifications are contained in the main document.

[17] As explained earlier, Genesis does however estimate the cost associated with the stream flow reduction water use of forestry in the main document. These calculations are explained in more detail in Section 3 of the present volume.

3. APPENDIX C: GENESIS ESTIMATES OF ENVIRONMENTAL IMPACTS NOT QUANTIFIED IN THE CSIR ANALYSIS

3.1. THE COST IMPACT OF STREAM FLOW REDUCTION BY PLANTATION FORESTRY

3.1.1. INTRODUCTION

Under the National Water Act of 1998, water is allocated to users according to availability after making allowance for the ecological and social reserves. In light of this it can be argued that allocated water use (provided that users use the water within their legal allocation) does not result in externality costs, as it is consumed within the limits of the water resource. Water use over and above the allocated volume will result in externality costs.

Although this argument may apply to new afforestation, it does not hold for all existing plantation areas. Such plantations may not have undergone the same scrutiny as applied under the current licensing system and the water used may be excessive relative to what would have been allocated under the current system. The underlying question to consider is whether the water used by existing plantations would have been allocated if they were to apply under the current system? This is, of course, complicated as catchments which are currently in deficit may not have been in deficit at the time at which plantations were established.

If the answer is no, the next step would be to ask to what extent forestry is currently "over-using" water[18]. Though this is a question requiring dedicated research that falls outside the scope of the present analysis, we will nevertheless attempt to outline a framework for considering how to approach the matter. It will be attempted to sketch a "worst case scenario" regarding the *opportunity cost* of plantation forestry's water use[19].

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[18] The analysis conducted by the CSIR for the present study measures the environmental impact associated with plantation forestry's stream flow reducing properties in terms of the water resource management charges that the industry pays. On this basis, the full "environmental cost" is internalised via the charges paid. This method is justified on the basis that DWAF's intentions are to develop the system to the point where water tariffs are representative of the environmental impact of water use/the total value of the water used. Until such time, the CSIR-Environmentek claims that their estimates should be seen as a lower bound estimate. The result thus gained is however not satisfactory in informing the debate about the water use of plantation forestry (and the appropriate regulation thereof).

[19] We want to measure the value of water in terms of the possible costs of water use to the rest of society, namely (i) the opportunity costs arising when downstream activities are prevented/reduced due to the fact that inappropriate water use may reduce the availability of water to them, and (ii) the externality cost to society when water reduction impacts the environment, e.g. by contributing to the drying up of estuaries. Due to data constraints, the focus however falls on giving an indication of *opportunity costs*.

In order to attach a quantifiable value to the water use by plantations, two estimates were required:

- The *extent of 'excessive' water use* (i.e. the volume of water that would be considered to be excessive under the current licensing system as well as that used by, for example, wattle jungles).
- The *cost of such water use*. The approach followed in this analysis was to evaluate the cost of 'excessive' water use relative to the cost of remedying the impact. The most likely remedy on which costs estimates were available were the cost to construct dams and transfer schemes to improve water management and increase the water balance that can be allocated.

3.1.2. ESTIMATING THE EXTENT OF EXCESSIVE WATER USE

In line with the arguments made above, excessive water use by plantation forestry is defined as the difference between what is currently used and what would have been allocated under the current licensing system. In addition, water use is only considered for stressed catchments as open catchments imply that no environmental trade-off has to be made to allow the current water use. Based on the National Water Resources Strategy (2004) four water management areas (WMAs) that contain plantation forestry were in deficit in 2000. These were: Luvuvhu and Letaba (36m m^3/annum deficit); Inkomati (260m m^3/a deficit); Mvoti to Umzimkulu (240m m^3/a deficit); and Gouritz (64m m^3/a deficit)[20]. The total deficit for these WMAs amounts to 600m m^3/annum.

For each WMA, the Internal Strategic Perspective (ISP) of 2004 specifies the following water users that together comprise the *total local water requirement* of a WMA: irrigation, urban, rural, mining, bulk industrial, power generation and afforestation. In total forestry is responsible for 11.3% of all water required in these WMAs. If the approach followed in compulsory licensing is applied (i.e. allocating the deficit in proportion to relative water use), plantation forestry's contribution to the deficit is estimated at **67.7m m^3** (11.3% of 600m m^3/annum).

In this analysis, a more conservative approach was followed by considering 'excessive' water use by forestry to equal the total plantation water use in deficit catchments up to a maximum of the total deficit (as it is the estimated water deficit that results in costs to the environment and other water users). The implication is that the total deficit is ascribed to plantation forestry, which is clearly not the case. From the table below, the deficit exceeds the plantation forestry requirement for the Inkomati, Mvoti to Umzimkulu and Gourits water management areas and for these areas the actual forestry water requirement were used (128m^3/annum, 65m^3/annum and 15m^3/annum respectively). For the Luvuvhu and Letaba catchment, the plantation forestry requirement exceeded the deficit and the deficit

[20] These values take transfers between water management areas into account.

value was used (36m m^3/annum). Based on this methodology, the total excessive water use ascribed to plantation forestry was 254m^3/annum (42.3% of the total deficit) in 2000[21].

Deficit water management areas containing plantations	Afforestation water requirement for 2000 (million m3/a)	Deficit in WMA in 2000 (million m3/a)
Luvuvhu and Letaba	43	36
Inkomati	138	260
Mvoti to Umzimkulu	65	240
Gourits	15	64
Total	**261**	**600**

Table 28. Afforestation's local water requirements versus the deficit of plantation containing water management areas, 2000.

Source: NWRS, 2004. Appendix D.

As the water requirements in the NWRS are quoted as water use over and above that of the natural vegetation in a specific area, this figure thus represents the highest potential contribution of plantation forestry to the deficit.

3.1.3. ESTIMATING THE COST OF EXCESSIVE WATER USE

Despite the extensive literature on the costing or valuation of water from an environmental perspective (e.g. willingness to pay, remedy costs, etc) the costing of water remains complicated and contested. Estimates of the environmental value of water utilise varying techniques and are fundamentally site-specific, specified relative to the scarcity of water for a particular area and the preferences of a specific population. Such values are usually derived on the basis of local surveys about preferences and willingness to pay. The use of proxy variables (such as the average transport cost of making a trip to e.g. a wetland) is also common.

In the absence of conclusive findings on the *national* value of water, or opportunity cost of water use in South Africa[22], the approach followed in this analysis was to consider the marginal cost of ensuring that a catchment will not go into deficit. The

[21] It is problematic to make a generalisation of this nature, as the water usage and deficit-inducing characteristics of forestry varies within each specific WMA. It would be most appropriate to consider the water balance of individual quaternary catchments. In the absence of comprehensive data for the purpose of the present analysis, the generalised value will however be applied, but with a note of caution to the reader.

[22] The following studies were reviewed: King in Blignaut and De Wit, 2004; Tewari, 2003; Conradie, 2002; Conningarth Economists, 2002; Greengrowth Strategies, 2003; Van Vuuren et al, 2004; Creemers and Pott, 2002; Olbrich and Hassan, 1999. All these studies are case-study specific, and thus point to the dangers of generalisation to a national level. It can be argued that the value of a resource such as water should be regarded as the economic or marginal value generated from that resource (that is, its productivity) and that different activities can thus lead to different water values. Under a tradable water rights system, the market will then determine the appropriate value of the water by allocating it to its optimal use This corresponds to the methods followed by Tewari (2003), Conradie (2002), Olbrich and Hassan (1999) and Conningarth Economists (2002) . In practice, this does however not always apply. This method of estimation is applied in Section 3.1.4.

most likely remedy on which cost estimates were available is the cost to construct dams and transfer schemes to improve water management and increase the water balance that can be allocated (i.e. restore the reserve). Though this is a “security of supply into the future” cost, it can be taken as a proxy for the environmental cost or cost to society of the water inappropriately used by forestry in that it is the cost incurred in “remedying” or “preventing” a deficit. As there are no adequate measures of externality costs available, our argument is that, by building dams or transfer schemes, the externality cost to the environment of the scarcity of water is removed, as well as the scarcity-related opportunity cost to other users. *Thus marginal cost is used as a proxy for external and opportunity costs.* The available costs to achieve this did not include the environmental costs of such schemes but this would have to be offset against the environmental damage remedied due to the removal of the deficit.

According to DWAF Water Services in KZN (Ward, 2005) the highest marginal cost value that has been estimated for water in KZN is about R1/m^3. This represents the marginal cost of transferring water into the Umgeni system so that all water needs will be met. In the absence of values for all the catchments in question, the conservative approach followed here is to apply this value across the deficit catchments[23].

Applying this value to the above estimated excessive water use by plantations results in an estimated cost of **R254m** (compared to R68m if afforestation’s share in the deficit was allocated based on its relative water use)[24].

In addition, it can be argued that plantation forestry results in additional water losses due to the spread of invasive tree species beyond the commercial plantations. The costs associated with this impact can be estimated by considering the remedy cost incurred through the Working for Water programme. In 2003 the annual budget amounted to 307.7m. Information on the exact proportion that can be ascribed to plantation forestry is not available[25]. In order to rather err on the side of being overly conservative, this analysis assumes that the total Working for Water annual cost (R307.7m) is incurred to clear wattle or other jungles resulting from plantations. In total, the impact of stream flow reduction due to plantation forestry is thus increased to an estimated “worst case scenario” **R562m** per annum.

[23] The logic behind this approach was, as generalisation is inevitable, to identify an opportunity cost value that is so high as to never be a realistic market price (because, if this had been the market price of water, it would have forced many users out of the system, and the market price would drop again)

[24] Alternative ways of gauging the opportunity cost of this water use, namely incremental administrative charges and economic value added foregone if the water used by forestry precludes agricultural activity, are discussed in Section 3.1.4.

[25] Studies considered include Hosking in Blignaut and De Wit (2004), Hosking and Du Preez (2004) and Marais et al (2004). According to Marais (2005) the total cost of the programme should by no means be ascribed to forestry, as some species are not used by commercial forestry, past government interventions (for e.g. dune stabilisation) may have introduced alien species and neglect by individual land owners may have led to invasion.

3.1.4. ALTERNATIVE WAYS OF GAUGING THE OPPORTUNITY COST ASSOCIATED WITH "DEFICIT-INDUCING" PLANTATION WATER USE

Suppose a particular catchment goes into deficit. In order to maintain the environmental reserve, the water use of the water users in a catchment will need to be reduced. Thus we assume that the value of the environmental reserve to society can be gauged by looking at the costs to the other water users to "remedy" this deficit. Now assume that, although luxury water use (such as water for gardening and other domestic purposes) may be taken away from households in the case of a drought, it will never be the case that the *basic water needs of households* (i.e. the social reserve of 25 litre per person per day) will be touched. Also, assume that industrial users have a high assurance of supply. Thus the other users, namely forestry and agriculture, can be assumed to bear the brunt of the necessary reductions in water use. As we are hypothesising that the deficit is partly due to forestry, let us for the moment assume that the full impact is carried by other agricultural activities through the fact that there will now be less water available to them. This will either cause them to obtain water from alternative sources, or will force such activities to cease. Thus we assume that the full environmental cost of forestry's inappropriate water use can be approximated by looking at the hypothetical cost incurred by agriculture due to a reduction in stream flow.

How can that cost be approximated? Apart from the marginal cost proxy discussed in Section 3.1.3, two alternative measures will be considered:

INCREMENTAL ADMINISTRATIVE COSTS

The hypothesis here is that one can look at the cost hypothetically incurred by a farmer to source water out of a tap (i.e. the cost of domestic water provision), versus the cost of irrigation.

According to DWAF (2002), the average price of domestic water supply was 1.21 c/m^3 in 2003, whereas the average price of irrigation water for 2003 was 0.59 c/m^3. Thus the national average per unit cost of forestry's inappropriate water use is R0.0062 per m^3 of water use.

Applying this value to plantation forestry's estimated "deficit-inducing" water use of 254m m^3 renders a cost of **R1.6m**. As can be deducted from the low value this method produces, we are once again looking at *administrative cost* or the value of providing *water services* by applying this logic. This is supported by the fact that the NWA makes it explicit that nobody owns water *per se*, and that tariffs levied will thus per definition always be service provision related. Though handy in pointing out the fact that the opportunity cost value we employ in Method 1 is "conservative enough" in that it is much higher than the "administrative/water service" opportunity cost, we will thus not use this estimate to base conclusions on the value of the water used by forestry on.

ECONOMIC VALUE ADDED FOREGONE

Agricultural GDP for 2003 (excluding forestry and fishing) was R36 294m in 2003[26]. According to the NWRS, irrigation agriculture uses about 60% (7723m m^3) of South Africa's total annual water requirement of 12 871m m^3. According to these figures, R4.7 of value is thus added by agriculture for every $1m^3$ of water consumed. As the water use however only measures that of irrigation agriculture, we can expect this value to overestimate the value added per water use of agriculture. Applying this overestimated value amounts to the 254m m^3 "excessive" water use estimated in Section 3.1.3, results in an estimate of economic value foregone (if "inappropriate" forestry water use precludes agricultural activity) of about R1194m. Even under this scenario, the net value added by the plantation forestry industry remains positive at approximately R1727m.

3.2. IMPACT ON WATER QUALITY

Aspects of water quality impacts not quantified are not significant: The report quantifies the key water quality impacts, with the exception of total suspended solids (TSS) and total dissolved salts or solids (TDS) produced by pulp and paper plants, which were not quantified as shadow prices were not available. However, a part of the *TSS* cost is covered by the price of Chemical Oxygen Demand (COD) and should thus have a limited impact on the net environmental cost of the industry. The remaining impacts are not expected to have a major impact on the overall results.

With regards to the impact of *TDS* a study conducted for the Water Research Council (Urban-Econ, 2000; also see Herold le Roux, 2004) found that salinity concentrations below 1200 mg/l does not have a significant environmental impact. However, increases in salinity does impact on downstream industries and result in economic costs in the form of costs incurred to reduce salinity before use in industrial processes or reduced yields on crops. As the study was based on the impact in a specific water management area, the available data did not allow the estimation of impacts for the water management areas relevant to this study (i.e. those with pulp and paper mills). However, it does provide some indication of the potential impact.

The Urban Econ (2000) study found that a 100mg/l increase in the TDS concentration in the Middle Vaal water management area (the area covered in the study) resulted in direct and indirect costs at a national level of approximately R220m (restated in 2003 terms). Using TDS output data available for pulp and paper mills and water data for the catchments where pulp and paper mills are located, a rough estimate of the impact on concentration levels due to effluent

[26] Calculated by applying the proportional difference between market prices and basic prices for total agriculture, forestry and fishing, to agriculture - for which market prices were not given.

discharge by mills is suggested to be around 22mg/l (i.e. pulp and paper mills increase TDS levels by 21.89mg/l per annum). In proportion, a 22mg/l increase in the Middle Vaal region would, have an estimated impact of R48m. Even if it is taken at the 100mg/l impact level, the total environmental impact of pulp and paper mills will increase to R1.46bn (24% of its contribution to GDP) resulting in a net contribution to GDP of R4.5bn.

4. APPENDIX D: METHODOLOGIES FOR IMPACT AND EXPANSION CALCULATIONS

4.1. METHODOLOGY FOR CALCULATING CONTRIBUTION TO GROSS DOMESTIC PRODUCT

As a basis for calculating the contribution of each component of the value chain to the South African economy, their direct contribution to GDP is calculated. To estimate the direct contribution made by plantation forestry to South Africa's Gross Domestic Product, the concept of value added by the industry has to be measured. The formal definition of GDP is defined by StatsSA (2004c) as:

Value of output at basic prices[27] - intermediate consumption[28]

This translates to calculating the difference between value of output and total value of input costs, and then adding back the components of total cost incurred in remunerating employees and paying taxes. Thus the profit of the industry, the remuneration accruing to people (and thus spent in the economy), and the benefit to the fiscus (tax) are added up to determine the total value added by the sector to the economy. This is the method of calculating value added (VAD) defined by Hassan et al (2002) as:

VAD = value of output – value of inputs[29] + remuneration + tax

If value added tax is included in the value of your outputs and in the input costs, value added is an indicator of an industry's contribution to GDP at market prices. Thus, whereas plantation forestry's share in GDP is stated at basic prices (due to the fact that the data excludes value added tax), pulp and paper's share is stated at market prices. The difference between GDP at basic prices and GDP at market prices is as follows:

GDP at market prices = GDP at basic prices + taxes on products (i.e. VAT) – subsidies[30] on products.

Briefly, some of the short-comings of this definition that is relevant to this study include:

27 Defined as output minus tax, plus subsidies.
28 Defined as goods and services consumed, excluding fixed assets.
29 Including all tax and remuneration paid.
30 Subsidies are not relevant for the value chain under consideration.

- This definition calculates the financial contribution to the economy and does not reflect other aspects of an industry's contribution such as the number of people employed (implying that there are different values to be ascribed to the number of people being employed and the remuneration paid to all employees).
- The calculation of GDP does not reflect the relative importance of the value generated to the specific region in which it was generated. Plantations may contribute a small component to the overall GDP of South Africa, but in some municipal areas, it may be the largest economic activity.
- The definition of GDP does not reflect the relative importance of the value generated based on the availability of alternatives. Where few alternative economic activities are available, plantations, for example, may be valued highly even if it does not contribute a large proportion of GDP.
- The definition of GDP does not reflect externalities generated in the generation of value. One such externality is the impact on the environment.

For these reasons this analysis seeks to take a broader view on the actual contribution of the sector to GDP by taking into account the GDP contribution as well as the context/environment in which it is contributed.

4.2. GDP CALCULATION FOR PLANTATION FORESTRY

Research conducted by FES on the costs structures and operations of a large proportion of forestry plantations (40% in terms of plantation area) provides estimates of total input costs per ton of roundwood produced for different tree species and across different regions (FES, 2004b).

	Available input costs (R/ton)	Region to which applicable
Short rotation eucalyptus	219.23	KwaZulu-Natal average
	182.58	Zululand
	246	Mpumalanga North
	200.06	Mpumalanga South
	200.3	National Average
Long rotation eucalyptus	199.64	Mpumalanga North
	86.95	Cape
	188.15	National Average
Short rotation pine	197.49	KwaZulu-Natal average
	158.88	Zululand
	183.06	Mpumalanga North
	157.96	Mpumalanga South
	173.94	National Average
Long rotation pine	124.65	KwaZulu-Natal average
	112.83	Western and Eastern Cape
	121.29	Mpumalanga North
	94.94	Mpumalanga South
	116.13	National Average
Wattle	284.19	KwaZulu-Natal average
	232.3	Mpumalanga South
	270.62	National Average

Table 29. Rand per ton input cost estimates for plantation forestry by specie and region

Source: FES, 2004b

The national average specie input costs were used to calculate the following production cost figures[31]:

31 For provincial value added calculations, provincial production was multiplied by specific prices where available. Otherwise, national averages were used. This may mean that the provincial value added calculations are somewhat distorted.

Species/management objective	Production 2002/03 (t)	Input cost (R/t - national ave)	Total cost of production (Rm)
Sawlogs	**5,582,397**	n/a	n/a
Soft	5,168,246	116.13	600.188
Hard	414,151	188.15	77.923
Other	**1,188,930**	n/a	n/a
Soft	120,817	173.94	21.015
Wattle	166,412	270.62	45.034
Eucalyptus & other hardwood	901,701	200.3	180.611
Pulpwood	**10,093,162**	n/a	n/a
Soft	3,402,798	173.94	591.883
Wattle	718,460	270.62	194.430
Eucalyptus & other hardwood	5,971,904	200.3	1196.172
Total	16,864,489		2907.256

Table 30. Total cost of production estimates.

Source: Genesis calculations based on standard m^3 to ton conversion factors as provided by FSA and production statistics for 2002/03 contained in FES, 2004. R/ton input costs are from FES (2004b).

If one assumes (as explained in Section 1.3.1 of the main document) that the value of production covered by the FES survey covers only 80% of total production, and then scale production costs up to 100% in the same manner as was applied for value of production, overall input costs for the plantation forestry industry in 2002/03 can be estimated at R3.6 billion. This was then subtracted from the value of production figure of R5.1 billion, after which labour remuneration of R1.2 billion was added (see below for verification of this estimate). The result is a value added figure of R2.66 billion.

4.2.1. VERIFYING ESTIMATES OF LABOUR COST

FSA and NCT (Godsmark, 2004; Jones, 2004) estimate that, as at 2003, 80% of the plantation forestry workforce (including contractors) to be unskilled, 10% to be semi-skilled, and 10% skilled.

Statistics South Africa estimates forestry's annual wage bill to have been R1.2 billion for 2003 (Manamela, 2005). FSA (Godsmark, 2004) also estimates the annual wages accruing to plantation forestry workers to be R1.2 billion. This estimate is based on a rough wage-times -worker calculation assuming wages of R1 200 for unskilled and R5 000 for skilled employees. In this analysis, two additional methods were used in order to evaluate this estimation:

- NCT (Jones, 2004) estimates that in 2003 the national average remuneration rates for plantation forestry workers (once again, this would include contract workers, as they are included in the national plantation forestry workforce estimates[32]) were R105 per day for skilled workers, with R73 per day being paid to semi-skilled and R41 per day to unskilled workers. Given the employment figure of 67 469 for plantation forestry (FSA, 2004) and assuming the skills distribution to be as estimated above by FSA and NCT and an average 22-day working month, a total annual wage bill of **R901m[33]** in 2003 is suggested. This method however does not take into account over-time payments and pension fund, medical aid and other benefits. Furthermore, the 22-workday assumption is restrictive, especially where contractor-workers, who are paid by task, and only for the days on which they actually work.

- An alternative method to estimate labour costs is based on the skills levies (set at 1% of salaries[34] under the Skills Development Levies Act, 9 of 1999) paid by the industry to FIETA. According to FIETA's auditors (Deloitte, 2004) the skills levies paid for the forestry chamber (plantation forestry companies, including contractors) of FIETA amounted to about R 8.7m in 2003. Based on this, the total wage bill (excluding pension fund and medical aid contributions) for the levy-paying companies can be estimated as R871m for the year. However, a study conducted for FIETA by the HSRC (Erasmus, 2004) found that only 76.9% of all 'active forestry companies' are registered levy-payers[35]. If this is extrapolated to all active companies, the total wage bill (excluding pension fund and medical aid contributions) is estimated at **R1.13 billion**. In addition, 'active forestry companies' are defined as those registered with SARS. It can be expected that a proportion of small growers and smaller contractors will not be registered with SARS. It is, however, not clear what the expected coverage is (in terms of the wage bill paid by those companies) **[36]**.

These two methods suggest that FSA's estimate of R1.2 billion is not unrealistic.

4.2.2. THE POSSIBLE IMPACT OF VALUE ADDED TAX ON TOTAL VALUE ADDED

The "value added" of the industry needs to include tax payments. The data however excludes value added tax (VAT) payments on both the production and input cost sides. This means that the value added calculated may be underestimating true value added, because *net VAT payments* are not accounted for. The net VAT payment made by companies to government is: VAT paid on total

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32 It is however to be expected that such workers will form the majority of the unskilled category

33 R708 425 is paid daily to 6 747 skilled employees, R492 524 to the semi-skilled part of the workforce and R2.2m to 53 975 unskilled workers

34 After pension fund and medical aid contributions. Thus we may be underestimating total remuneration if 1% of income excluding benefits is scaled up to 100%.

35 It is assumed that the proportion of companies registered with FIETA (in terms of number of companies) correspond directly with the proportion of total wage bill expected to be paid by these companies. This is unlikely, as it can be expected that the unregistered companies will mostly be smaller (large companies will not take the risk of not registering) and their wage bills may, therefore, be substantially smaller.

36 As industry employment includes contractor-employees, the annual R317m paid to contracted workers is contained within this figure. If, given the caveats named in Footnote 35, we assume that the remaining 23.1% of companies not registered with FIETA only have half the wage bill relative to the registered counterparts; this suggests a total estimated wage bill of R1bn. If it is then assumed that SARS has a 95% coverage (in terms of wage bill), this results in a total estimate of R1.05bn.

value of production, minus VAT paid on inputs. Through government expenditure, it can be argued that that amount of “value” gets added somewhere in the economy.

As VAT is only paid on inputs sourced from outside the firm (that is, not on cost items such as own labour employed and capital depreciation), the proportion of external input cost in total input costs should be known in order to calculate net VAT. As such data is not at our disposal, the following “mental exercise” was conducted:

- Net VAT payments can be a maximum of 14% of total revenue. Net VAT payments can, however, also be *negative* (that is, net VAT receipts are possible, e.g. when a firm runs at a loss over a particular financial year). As we know that plantation forestry outsources a large proportion of its labour, we assume that VAT payments on inputs (that can be claimed back) are large enough that the net VAT rate will always be significantly less than 14%.

We thus sketch two scenarios: that of a net VAT rate of 10%, and that of a net VAT rate of 5%. Under the 10% scenario, R510m should be added to total VAD (to bring it to a total of **R3 176m**) and under the second scenario, R255m gets added to VAD, to result in a total VAD figure of **R2 921m**. We assume the second scenario to be more realistic and it is applied throughout the analysis.

4.3. GDP CALCULATION FOR THE SAWMILLING INDUSTRY

The estimated contribution of sawmills to GDP presented in this section was derived from a number of data sources (the South African Lumber Index, Crickmay and Associates (2004), LHA (2004), Horn (2000), Heyl *et al* (2000)) and numerous discussions with industry experts.

Total value of production was estimated using the production and price data in the South African Lumber Index[37]. Given the fact that mobile mills produce sawn timber of a lower quality than the other mill categories, the sales price for mobile mills was adjusted downwards based on an industry average "wet of saw" price obtained from the South African Lumber mill Index.

In addition, the revenue from the sale of woodchips by large sawmills was also determined. Industry experts provided a price range between R150 and R180 for a ton of softwood chips[38]. The conservative estimate of R150 was used, and in combination with the quantity of woodchips sold the total revenue from the sale of woodchips was determined. The quantity of woodchips sold was calculated with the help of industry experts, who placed the total quantity of woodchips at between 15 and 20% of total timber inputs. The figure was crosschecked against data provided in LHA (2004), and was found to be within a reasonable range.

Category	Volume of production (m^3)	Price per volume (m^3)	Total value (Rm)
Mobile mills	175 000	750	131.25
Small and large mills	2 357 748	1274	3003.77
Total	**2 532 748**		**3135.02**

Table 31. Total value of production for mobile, small and large mills in 2003

Source: Genesis calculations based on the South African Lumber Index and industry interviews

Timber input costs: Similarly to the estimation of production value, the input timber costs was also adjusted to reflect the different prices paid by the different categories of sawmills (based on log class price data from the South African Lumber Mill Index). This was done by determining what log class (or classes) micro mills are most likely to use and then calculating the weighted average. This was done through discussions with industry experts. The weighted average log input costs was used for small and large mills by using the historical log mix and prices for log categories obtained from Crickmay and Associates. Using the weighted average provides a more accurate average than the R177 given in the South

[37] The prices used for these calculations exclude VAT.

[38] Note that the standard industry conversion factors as provided by FSA were used to convert the measurement units from ton to cubic meters and vice versa.

African lumber index since the latter is a simple average; whilst the weighted average log price takes into account the volumes of wood in each price category.

Category	Volume of log intake (m^3)	Price per volume (m^3)	Total value (Rm)
Mobile mills	390 000	97.33	37.96
Small and large mills	4 906 790	170.30	835.63
Total	5 296 790		**873.59**

Table 32. Total value timber input costs for mobile, small and large mills in 2003

Source: Genesis calculations based on the South African Lumber Index and industry interviews

Non-timber input costs were based on two different sources. Note that non-timber input costs includes water and electricity use, treating costs, other fees, and other costs associated with sawn timber production.

- Mobile mills: A study by Heyl et al (2000) provided information on the cost structures of mobile sawmills[39], which were used to estimate the non-timber input cost component for these mills.
- Small and large mills: An industry expert provided Genesis Analytics with data on the average cost structures for the sawmilling industry in South Africa, which was applied to the estimated total revenue in order to derive an estimated non-timber input cost. It is expected that the non-timber costs may be overestimated since the data provided only accounts for large mills and it is believed that small mills have lower cost structures than large mills. Table 33 shows the breakdown of costs to the average large sawmills in South Africa, using a 30km radius from the sawlog plantation to sawmill.

Type of Cost	R/m3
Sawlog cost	*175*
Transport cost	*47*
Roundlog costs	222
Non-timber input costs during production process	470
Total Costs	**692**
Selling Price	*1237*

Table 33: Average large sawmilling industry costs for 2004

Source: Industry expert

Remuneration: Employment data was provided by the South African Lumber Index, per mill category. Unfortunately, employment data per region could not be obtained

[39] Our analysis found some calculation errors, but these were cleared up in discussions with the main author.

(the implications thereof are discussed below). Wage data was obtained using various sources. For large mills, an industry expert estimated the average wage rate per day to be R85 in 2003. It is assumed that this excludes management wage rates; the subsequent figure for remuneration is therefore likely to undercount actual remuneration. Applying this to the employment data for large mills and the estimated number of working days per year[40] yields the estimated wage bill for these mills. For mobile mills, Horn (2000) provided a wage level range, with the wage per day varying between R8 and R35. As it was impossible to determine the proportion of workers paid at the respective wage levels, an average wage level of R20 was applied across the board for micro mills. However, Horn (2000) noted that workers at mobile mills on average only work for 5 months per year. As such, the work year assumption was adjusted to reflect the information provided by Horn. In the case of the small mills, the upper level of the wage range for the micro mills was used. This reflects a very conservative wage rate for small mills.

Category	Number of workers	Estimated daily wage	Estimated days in work year	Estimated total wage bill (Rm)
Micro mills	1 846	20	100	3.69
Small mills	6 030	35	240	50.65
Large mills	12 220	85	240	249.29
Total	**20 096**			**303.63**

Table 34. Total value of remuneration paid for mobile, small and large mills in 2003

Source: Genesis calculations based on the South African Lumber Index, Horn (2000) and industry interviews

Based on the above estimates, an estimate of the contribution of GDP by saw mills can be derived as shown in Table 35.

Component	Mill category			
	Mobile	Small	Large	Total
Total Value of Output-Total value of inputs (Rm)	37.4	258. 5	731.9	1 027.7
Remuneration (Rm)	3.7	50.6	249.3	303.6
Total contribution to GDP (Rm)	**41.1**	**309.1**	**981.2**	**1 331.3**[41]
m^3 used in production	390 000	1 399 446	3 507 344	5 296 790
GDP per m^3 of roundwood input[42]	105.3	220.8	279.8	251.4
Number of workers employed	*1 846*	*6 030*	*12 220*	*20 096*

Table 35: Contribution to GDP by sawmill category for 2003/4

Source: Genesis Analytics Research

[40] This was based on the assumption that workers are employed 20 days per month and 12 months per year.

[41] Note that this includes income received from selling softwood chips to pulp plants. Any additional revenue streams were not added in the calculations.

[42] It has to be noted that the difference in GDP derived per cubic metre of wood input can not directly be interpreted as less productive use of wood in the smaller mills as the value of the wood used by them are also lower.

Regional value of production: Regional production statistics were obtained from the South African Lumber Index[43] for the various mill categories. Since the log input data can only be obtained on a national level, an additional calculation was required to find the log input data per mill category and per region. In order to obtain the log inputs per region, the recovery rate per mill category on a national level was calculated using the data provided in the South African Lumber Mill Index. The recovery rate was then used to determine the log intake per mill category per region (see Table 36). The key assumption here would be that the recovery rates per mill category will be similar between different regions.

Component	Mill category			
	Micro	Small	Large	Total
Estimated national average recovery rate[44]	44.87%	48.04%	48.05%	47.81%
Outputs per mill category per region (m^3)[45]				
KZN	30 435	174 570	389 893	594 898
Eastern Cape, Southern Cape and Border	91 304	128 741	171 685	391 730
Mpumalanga, Limpopo and North West	34 239	313 676	835 859	1 183 774
Western Cape and Northern Cape	19 022	55 306	287 751	362 079
Implied timber inputs per category per region (m^3)				
KZN	67 827	363 385	811 475	1 244 254
Eastern Cape, Southern Cape and Border	203 477	267 987	357 324	819 320
Mpumalanga, Limpopo and North West	76 304	652 948	1 739 655	2 475 913
Western Cape and Northern Cape	42 392	115 125	598 890	757 303

Table 36: Estimating regional timber inputs 2003

Source: Genesis Analytics Research

Regional non-timber inputs: Further, the assumptions regarding non-timber inputs were assumed to hold for the various regions, and applied in the same manner as discussed for the calculations of the national GDP figure.

Regional employment: Since employment figures per region could not be obtained, remuneration could not be estimated directly, even though average wage levels per mill category can be found. As a rough estimation, it is assumed that the number of employees per value of output will not differ across the provinces. In other words, it is assumed that the production processes across regions are similar and that the labour propensity of firms will remain unchanged. If this is the case, this ratio can be used to estimate the number of employees per region and per category and the average wage levels can be applied to this to estimate the total value of remuneration for each province and category combination.

[43] The South African Lumber Index does not subdivide the regions on a provincial level only. It combines provinces to form a larger region. The format was retained in order to avoid additional complications.

[44] Calculated from South African Lumber Mill Index data and assumed to be similar across regions

[45] South African lumber Mill Index and Crickmay and Associates (2004a).

Regional contribution to GDP: Using the regional values of production, input costs and remuneration data estimated above, the contribution to GDP by region and mill category can be estimated as shown in Table 37. Note that these values include revenue from woodchip sales to pulp plants. The assumption was made that all the large mills in all the regions produce the same proportion of woodchips per timber inputs used in order to use the national data (of 15% of total inputs of large mills) provided by an industry expert. Further, it was also assumed that the same price is obtained by all sawmills regardless of region.

	Category			
Region	**Micro**	**Small**	**Large**	**Total**
Mpumalanga, Limpopo & North West	8.04	144.22	486.66	638.92
KwaZulu-Natal	7.14	80.26	227.01	314.41
W. Cape & N. Cape	4.46	25.43	167.54	197.43
E. Cape, S. Cape and Border	21.43	59.19	99.96	180.58
Total	**41.07**	**309.10**	**981.17**	**1331.34**

Table 37: Estimation of regional contribution to GDP in R/m for sawmills by mill category (2003/4)

Source: Genesis Analytics calculations based on industry data and interviews

4.4. GDP CALCULATION FOR THE PULP AND PAPER INDUSTRY

A special survey of the pulp and paper industry was conducted by Pamsa (2005) for the present study in order to gain the information needed for calculating the GDP of the industry.

Though information was requested in order for Genesis to gauge the cost structures of each major product grade (that is: chemical pulp, printing and writing papers, newsprint, corrugated papers, tissue), the data gathered was not reliable enough to make analysis at this level possible.

That information that was deemed reliable by Pamsa was:

- Operating surplus
- Total people costs
- PAYE payments
- Net VAT payments/receipts
- Other tax paid

Using this data, the value added for the pulp and paper industry as a whole was calculated on the basis of profit-plus-remuneration-and tax, rather than the total value of production minus total value of input costs, excluding tax and labour costs applied for the plantation forestry segment. Value added (or GDP) of the pulp and paper industry was thus calculated as:

> Operating surplus + total people costs + PAYE payments + net VAT payments/receipts + tax

Technically, these two methods should, however, produce the same results.

4.5. GDP CALCULATIONS FOR THE TIMBER BOARD INDUSTRY

The data available for the Timber board sector does not allow the calculation of contribution to GDP by each product category separately (chipboard, hardboard, insulation board and MDF).

However the annual report for one of the firms was available and this was used as the basis of estimates for the industry. Given the absence of other industry information, the assumption was made that other timber board plants have similar cost structures and that similar levels of value addition would take place in other firms. Note that this would lead to a possible overestimation if the average firm in the industry's value added proportion is less than the firm whose cost structure was used in our analysis. However, the error margin is believed to be minimal since industry information seems to indicate that the levels of quality amongst most of the firms in the industry are similar (Competition Tribunal, 2004).

FES (2004a) data for 2002/2003 provided the total value of sales for the whole timber board industry. Applying the cost structure proportions derived from the analysis of the available data resulted in the contribution to GDP figures presented in Table 38. Note that the employment data used was that of DWAF (2004a). This differs from other estimates such as Crickmay and Associates (2004b), who places employment in the timber board industry at 5 400. The average wage applied was based on the firm for which the financial statement was available. However, the wage was benchmarked against information from an industry expert, who provided Genesis Analytics with a slightly higher average wage (R6 220 p.m. vs. R6 500 p.m.). Note that the lower wage was applied in the analysis.

Estimated contribution to GDP	Rm
Total value of sales - total value of inputs	384.05
Estimated employee remuneration	447.78
Total contribution to GDP[46]	**848.2**
Number of employees	*6 000*

Table 38: Contribution to GDP by the timber board industry for 2002/2003

Source: Genesis Analytics Research

4.5.1. NOTE ON THE TIMBER BOARD ENVIRONMENTAL CALCULATIONS

Due to data limitations, the CSIR did not attempt to calculate the environmental impact of the timber board industry. Industry players were reluctant to contribute the necessary information; consequently not enough information was available to

[46] Taxes to government of R16.3m are included in this figure.

determine an exact estimate of the environmental impacts and subsequent costs in the timber board production process. Genesis Analytics, in an attempt to calculate the environmental costs of the industry, employed the three impacts as found by the CSIR for solid wood processing, with adjustments being made as far as possible. Table 39 presents a full summary of the results. It is recognised that the timber board industry employs binding agents in the production process; however, since no impact coefficients and no shadow prices were found by the CSIR, these impacts were omitted.

Impact	Timberboard inputs and ouputs (m^3)	Impact per m3		Shadow price R per unit	Net impact (Rand)
Energy use total	**471,154**	**268**	**kWh**	**0.053**	**6,741,870.36**
Waste: total	**700,000**	**0.100**	**t**	**101.33**	**7,093,121.62**
Air emissions					**1,787,464.46**
CO	**630,000**	0.480	kg	418.46	126,422.44
NO2	**630,000**	0.190	kg	433.96	52,033.10
VOC	**630,000**	0.204	kg	6,447.41	828,187.69
GWP	**630,000**	0.026	T CO2E	22.0	358,556.18
N2O	**630,000**	0.001	T CO2E	22.0	8,032.75
CFCs	**630,000**	0.030	T CO2E	22.0	414,232.30
TSP	**630,000**	0.265	kg	not available	not calculated
				Total impact	**15,622,456.43**

Table 39: Full summary of environmental impacts of the timber board industry

Source: CSIR Environmentek and Genesis Analytics Research

Energy use impact: In order to calculate the energy use impact, the study by Arlinghaus and Berger (2002) was used to provide an indication of energy use impacts. However, in order to use these coefficients, the timber inputs had to be converted to tonnes. Since Arlinghaus and Berger make use of woodchips as inputs, woodchip metric conversion ratios were applied to convert the cubic meter inputs into tonnes. The energy use impacts as defined by the aforementioned authors were added together and were also combined with the energy requirements for chipping logs into woodchips[47].

Waste impact: The timber board industry has a high recovery rate of between 90 and 95% (some foreign firms have a 100% use rate; wood not used as inputs is used as fuel) and generate very little waste. The 90% recovery rate was applied to determine the impact of waste by the industry.

47 It was assumed that chipping of virgin fibre would occur at the timber board plants.

Air emissions impact: EBRD (2003) provided a summary of potential air emissions by a timber board plant. These were cross-checked with the emissions identified by the CSIR and were found to be similar; although some emissions noted by the CSIR were not included by EBRD (2003). However, all the emissions identified by the CSIR were included in the analysis, and this may represent a slight overestimation if timber board plants do not emit all the gasses identified by the CSIR.

Other impacts: Other environmental impacts by timber board production were also identified by EBRD (2003). Waste water discharges were mentioned; but this can occur in a closed loop, with limited amounts of waste water being generated. It is not certain whether this is the case in South Africa. Transport costs, noise abatement and chemical use and storage are other impacts. Of these, transport costs were determined by the CSIR, but the others were not quantified due to a lack of data.

4.6. GDP CALCULATION FOR WOOD CHIP EXPORT INDUSTRY

The data for the calculation of the contribution of woodchip export to GDP was obtained from industry sources, which includes Mondi's Sustainable development report (Mondi Kraft, 2003), DWAF (2004a), NCT News and Views (various editions), Flynn (2004) and several industry experts. Data with regard to total employment, timber input quantities, timber input prices[48], woodchip sales prices and total sales revenue was obtained from Pamsa (2004c). The South African woodchip prices for 2003 were obtained from Flynn (2004) in dollar terms. The prices were converted to South African rand using the average R/$ exchange rate level for 2003. Using this price, the total sales revenue amounted to R2.3 billion. Pamsa (2004c) reflect total sales revenue of R2 billion, which implies a different sales price than Flynn (2004). Industry players were unwilling to provide an exact woodchip price and the calculations shown below were, therefore, done using both the implied Pamsa (2004c) price and the price provided by Flynn (2004).

Data on non-timber inputs and wages was difficult to obtain; however, an industry expert provided Genesis Analytics with estimates on non-timber inputs (as a proportion of total sales revenue) and wages. These estimates were applied in the analysis.

Woodchip VAD	Based on Pamsa prices
Total sales revenue (Rm)	2 000
Less: Total input costs (Rm)	1 045
Plus: Remuneration (Rm)	36
Total GDP (Rm)	**991**
Number of direct employees	*500*

Table 40: Contribution to GDP by wood chip exports in 2003 (excludes NCT Durban Woodchips)

Source: Genesis Analytics Research

[48] This price was calculated using FSA's Forestry and Forestry Products Industry Facts 2003. Flynn (2004) also provided a sales price.

4.7. CALCULATION METHODOLOGY: EASTERN CAPE DEVELOPMENT

In order to assess the possible impact that new afforestation and the DWAF plantations would have in the EC, several assumptions and new processes were developed that would enable these calculations to be made. The methodologies employed are discussed in this section.

4.7.1. NEW AFFORESTATION

The data employed for this calculation was obtained from DWAF, FES, interviews with several industry experts and the application of knowledge gained during the course of this study.

Several assumptions were made and are listed below:

- New afforestation will occur by using short rotation hardwoods
- Areas close to the KZN border will sell their timber in KZN rather than in the EC due to a smaller distance and the available market
- 17 500ha of the 35 000ha identified in the Umzimkulu and Umzimbuvu area will be processed in KZN due to the point listed above
- The 17 500ha that is processed in KZN would produce pulp wood for the Mondi and Sappi pulp mills
- Site specie selection would not preclude hardwoods from being planted[49]
- That 17 500ha of the 35 000ha and most of the remaining 25 000ha would be within reach of Mthatha so that processing would occur in the EC
- That the 10 000ha of wattle jungle that has been identified as sustainable by Crickmay and Associates (2004b) would be fully utilised and that similar beneficiation processes would take place.

The caveats pertaining to the assumptions made for the present exercise are discussed in Section 4.8.

The employment impact at a plantation level was determined by assuming one job to be created for every 4ha planted. This is double[50] the ratio provided by industry experts (Ngubane, 2005). To this the average employment estimate of FSA (2000), namely that 1 job gets created by small growers for every 8ha planted (in the form of family members or other helpers employed on the plantation) is added. The fibre

[49] This point is only relevant for the 15 000ha of new afforestation that DWAF (2004f) indicated would be available for pine plantations.

[50] This strong assumption was made in order to be as conservative as possible about the employment impact. As a result, the number of jobs potentially created by new afforestation may be underestimated.

output generated by the plantations was calculated by employing the current output/area ratio for the EC.

Of the fibre that would be processed in the EC, it was assumed that 80% of all fibre will be processed in a woodchip plant within the EC, 10% in timber board plants and 10% in pole manufacturing plants. The measurement units were converted to m^3 where applicable in order to complete calculations. The proportions above were applied to estimate the timber intake of each processing plant, and the subsequent analysis was based on the VAD analysis concluded earlier for each sector that were assumed to process the additional fibre in the EC. Table 1 shows the results obtained.

Description	Result
Employment created	26 250
Total fibre output (tonnes)	242 561
Fibre output processed in EC (tonnes)	181 921
Fibre output processed in KZN (tonnes)	60 640
GDP contribution (Rm)	**127.8**

Table 41: VAD impact of new afforestation in the EC at plantation level

Source: Genesis Analytics

In order to calculate the pulp output that would potentially be produced in the KZN, the current pulp output/fibre input ratio was determined. This ratio was then applied to the estimated fibre volume that would be produced on the estimated 17 500ha designated for processing in KZN. In other words, the annual fibre yield from 17 500ha in the EC was used to generate the potential pulp output.

Similarly, the employment figures were generated by applying input/employment ratios for each of the sectors that were assumed to be possible processing options. The wage data employed in the VAD calculations for each specific sector was then applied to establish remuneration. Note that output data was determined by using industry average yield rates. In order to estimate the impact of new afforestation on GDP, the additional output of each sector due to new afforestation was divided by current output. This new output/current output ratio was then applied to the current VAD calculation to determine the VAD impact that would accrue for each processor. The implicit assumptions made are therefore that labour propensities will remain unchanged, and that manufacturing processes will remain the same.

Processor	Employment created	Total inputs (tonnes)	GDP contribution (Rm)
Chip plants	11	145 537	60.64
Timber Board Plants	130	18 192	18.37
Poles	121	18 192	1.78
Pulp and paper plants[51]	49	60640	47.1
Total	**311**	**242561**	**127.9**

Table 42: Summary of VAD according to processor

Source: Genesis Analytics

4.7.2. DWAF PLANTATIONS

The DWAF plantation analysis was based on the information obtained from DWAF (potential MAI was obtained from FES, 2004b) in Table 43.

Type	Size (ha)	MAI (m^3/ha/a)	Potential MAI (m^3/ha/a)
Pine	16 665	14	15
Eucalyptus	3 000	10	21
Unplanted	7 650	N/A	N/A

Table 43: Specie, acreage and MAI

Source: Genesis Analytics Research based on DWAF and FES data

This data was then applied to determine the production for each specie planted, both for current production using the MAI's currently achieved by DWAF (referred to as estimated production at current yields) plantations as well as the potential MAI's (referred to as estimated production at potential yields). The results are presented in Table 44 and Table 45 below.

Specie	Estimated production at current yields (m^3)	Estimate production at potential yields (m^3)
Pine	233 310	249 975
If unplanted area is used for Pine	107 100	114 750
Total	**340 410**	**364 725**

Table 44: Estimations of current and potential pine production

Source: Genesis Analytics

[51] This refers to the beneficiation, likely employment generation (assuming a constant output to employment ratio) and value added impact *in KwaZulu-Natal,* due to the fibre sourced to the province's mills from the additional plantation area in the Eastern Cape.

Specie	Estimated production at current yields (m^3)	Estimate production at potential yields (m^3)
Eucalyptus	30,000	63,000
If unplanted area is used for Eucalyptus	76,500	160,650
Total	**106,500**	**223,650**

Table 45: Estimations of current and potential eucalyptus production

Source: Genesis Analytics

A further assumption made was that the fibre produced from the DWAF plantations would be processed by sawmills[52], and that the current allocation of timber inputs to mill category in the EC would remain the same. In other words, if micro mills used 20% of the current timber inputs in the EC, they would receive 20% of the timber production from DWAF plantations.

In order to calculate the VAD, a ratio of sawmill output expected from afforesting the unplanted DWAF plantations to current sawmill output was applied to the current VAD of the sawmilling industry. All of these calculations were replicated using the net fibre produced due to improved efficiency at DWAF plantations (the planting of unplanted areas, and the improvement of yield). The results are presented in Table 46.

	Sawmill category			
	Micro	Small	Large	Total
Quantity Log Inputs (m^3)	84,540	111,343	148,461	340,410
Quantity Outputs - Sawn timber (m^3)	37,935	53,489	713,31	162,755
Additional Employment	400	480	517	1,397
Additional Annual Remuneration (Rm)	0.80	4.03	10.55	15.38

Table 46: Summary of the beneficiation impact of the net fibre addition from DWAF plantations

Source: Genesis Analytics

[52] Note that the production from the 3,000ha of Eucalyptus was not included in the calculations pertaining to manufacturing VAD, since it was unclear whether these areas are on a long rotation or a short rotation. Consequently, the impact of additional beneficiation from DWAF plantations is under-estimated.

4.8. CALCULATION METHODOLOGY: KWAZULU-NATAL DEVELOPMENT

The results of the impact analysis conducted for the scenario that 40 000ha of plantation area will be added to current KZN plantations, are as follows:

1. 529,493 tonnes per annum of additional harvested pulpwood
2. 216,096 tonnes per annum of additional paper and exported pulp production, which is 10.7% of current total paper and exported pulp production
3. R72.6m additional value added in plantation forestry
4. R411m additional value added in processing
5. 15,429 additional employment opportunities (includes an additional 10,000 small-growers, 5,000 informal plantation workers and 429 mill employees)

Before the calculations followed to derive these results are discussed, a qualification to the results is called for. In calculating the value added figures, it is assumed that current cost structures will be applicable for the production stemming from the additional afforestation. This may be a problematic assumption, as it is likely that resources will be needed to establish new plantations, as well as to expand current pulp and paper milling capacity to accommodate the additional timber intake. The additional value added should thus be regarded as a likely scenario over the longer term, rather than an immediate result. Likewise, in calculating additional employment in pulp and paper mills, it is assumed that the propensity to employ will remain constant. Realistically, however, it should be expected that, in the event of a pulp mill expansion, the number of additional people employed may not be directly proportional to the additional output volume.

Each of the results will now be discussed in turn:

1. 529,493 tonnes per annum of additional harvested pulpwood

It was assumed that plantation output will grow proportionally to plantation area growth. Current pulpwood output in KZN amounts to 6.04m tonnes per annum, which are produced from a total pulpwood area of 456394 hectares. This means that 13.2 tonnes of pulpwood gets produced, annually, for every 1 ha planted. Multiplying this ratio by the additional 40 000ha renders 529,493 additional tonnes of production per annum. It should however be noted that this additional production will only accrue over the longer term, as plantation area will be phased in and will only be harvested after an appropriate rotation period.

2. 216,096 tonnes per annum of additional paper and exported pulp are produced. This represents 10.7% of current total paper and exported pulp production

Extra pulpwood use in processing activities can be gauged by looking at paper and exported pulp production (as this represents all final product outputs of pulpwood processing). If the national ratio (0.41 in 2003) of paper and exported pulp production to pulpwood intake (calculated from Pamsa, 2004b) is applied to the additional pulpwood that will be available (i.e. 529,493 tonnes), the resultant additional paper and exported pulp production in KZN mills is calculated to be 216,096 tonnes per annum.

Current KZN total paper and pulp production data was not available. It was thus calculated by assuming that KZN pulp and paper mills' share in total pulp and paper production *capacity* can be set equal to its share in total *production.* The province's pulp and paper production capacity was calculated from additional mill data as contained in Section 8. It represented 66% of total pulp and paper production capacities. 66% of total paper and exported pulp production for 2003 amounted to about 2m tonnes. Dividing the estimated additional paper and exported pulp production of 216.096 tonnes by 2m tonnes, it tells us that the additional production will account for 10.7% of current paper and exported pulp production in KZN.

3. R72.6m additional value added in plantation forestry

The plantation forestry value added is calculated by assuming that the ratio between additional plantation forestry value added and total current plantation value added is equal to the ratio of new pulpwood production to current total KZN pulpwood production, namely 7.4%. 7.4% of current total plantation value added in KZN (estimated in Section 11 of the main document to be R992m), amounts to about R73m.

4. R411m additional value added in processing

Following the same logic as for point (3) above, it was assumed that the ratio between additional pulp and paper value added and total current KZN pulp and paper value added is equal to the ratio of new paper and exported pulp production to current total KZN paper and exported pulp, shown in point (2) above to be 10.7%. This proportion of total KZN pulp and paper value added (calculated in Section 2.3 of the main document to be R3.85 billion for 2003) amounts to R411m.

5. 15,429 additional employment opportunities (includes an additional 10,000 small-growers, 5,000 informal plantation workers and 429 mill employees)

The national average size of small-grower woodlots is currently about 2 hectares per person (Ngubane, 2005). Conservatively doubling[53] the area per grower ratio would mean that the 40,000 hectare expansion will result in 10,000 additional small-growers. FSA (2000) estimates that one additional informal job opportunity is created for every 8 hectares planted by small-growers. This adds another 5,000 employees. Thus, 15,000 people will potentially derive a livelihood from the plantation expansion. It must be noted that small-growing often does not represent a person's sole income, but is rather a supplement to other incomes. These income opportunities will also only be created as plantation area is phased in and plantations reach maturity.

In KZN the current provincial pulp and paper mill employment amounts to 4,025 people (Genesis research of individual mills). Assuming that the current final processing output to employment ratio (i.e. propensity to employ) will stay the same, the additional 216,096 tonnes per annum of production will result in 429 additional employment opportunities in KZN pulp and paper mills.

[53] This strong assumption was made in order to be as conservative as possible about the employment impact. As a result, the number of jobs potentially created by new afforestation may be underestimated.

5. APPENDIX E: YIELD ON SA PLANTATIONS

Soft and hardwood deliver distinctive yields for the various rotation lengths. Plantation yield is measured in *mean annual increment* (MAI). This measure, expressed in units of cubic metre per hectare per annum, provides an indication of the growth of a plantation stock for any given year and, multiplied by total plantation area, indicates the sustainable volume that can be harvested annually. For *short rotation softwood* (pulpwood pine), the MAI varies between $14m^3$/ha/a and $18m^3$/ha/a depending on the region, with a weighted average of $15.9m^3$/ha/a. For *short rotation hardwood*, the MAI varies between $15m^3$/ha/a and $26m^3$/ha/a, resulting in a weighted national average of $21.3m^3$/ha/a. For wattle, the corresponding figures are $10m^3$/ha/a to $12m^3$/ha/a, and a weighted average of $12m^3$/ha/a (LHA, 2004).

	Pine	Eucalyptus	Wattle & other
Variation in MAI	14 to 18	15 to 26	10 to 12
National weighted average MAI	**15.9**	**21.3**	**12**

Table 47. Short rotation yield (MAI measured in m3/ha/a)

Source: LHA, 2004.

For *long rotation softwood* (pine sawlogs), the MAI varies between 9 and $15.5m^3$/ha/a. The corresponding weighted average is $13.6m^3$/ha/a. Hardwood once again has a decidedly higher yield: for *long rotation eucalyptus* the regional MAI varies between 12 and 17, with a national weighted average of $16.5m^3$/ha/a (LHA, 2004).

	Pine	Eucalyptus
Variation in MAI	9 to 15.5	12 to 17
National weighted average MAI	**13.6**	**16.5**

Table 48. Long rotation yield (MAI measured in m3/ha/a)

Source: LHA, 2004.

Overall, South African yields are high compared to that of especially European and North American countries. For example, whereas pulpwood pine can be harvested after about 14 years in South Africa, it takes 50 to 100 years in the Northern Hemisphere (Pamsa, 2004a). Compared to countries such as Brazil and China, South African yields are however average.

As discussed in Section 2.5.4 of the market analysis document, it seems likely that the yield of short rotation eucalyptus (with a national weighted average MAI of $21m^3$/ha/annum) can realistically increase by 5% to 10% to between 22 and 23 m^3/ha/annum, whereas that of short rotation pine (which has a current national weighted average of 16 m^3/ha/a can increase to between 17 and $17.5m^3$/ha/a. For long rotation pine, the MAI may improve from 13.6 to somewhere in the region between 14.4 and $15m^3$/ha/annum.

Assuming a best-case scenario of 10% yield increase, this would translate into the following production increases (on the basis of the 19.2m m^3 of timber produced in 2002/03):

	Current average MAI (m3/ha/a)	10% increase in average MAI	Area (ha)	Hypothesised production increase (million m3/a)
Pine (weighted average)	14.6	1.46	**709194**	**1.03**
Short rotation	15.9	1.59	299212	0.48
Long rotation	13.6	1.36	409982	0.56
Eucalyptus (weighted average)	21.1	2.11	**541441**	**1.14**
Short rotation	21.3	2.13	520354	1.11
Long rotation	16.5	1.65	21087	0.03
Total				**2.18**

Table 49. Increase in total pine and eucalypt production if yields were to increase by 10%.

Source: Genesis's own calculations based on average current yields provided by LHA, 2004 and yield increase potential estimated by Howard, 2005.

6. APPENDIX F: FSC CERTIFICATION

The Forest Stewardship Council (FSC) was founded in 1993 as an independent, non-profit, NGO to provide standard setting, accreditation services and trademark assurance in the forestry arena. Based in Bonn, Germany, it is the only established international system of forest management certification. As a prerequisite for certification, it sets environmental, social and economic forest management standards based on 10 principles and criteria of responsible forest. Having obtained *forest management certification*, a forest operation must also acquire *chain of custody* certification in order to sell its products as FSC certified (FSC, 2004). Such products bear the FSC logo and thus provide consumers with assurance of responsible forestry practices in delivering the product that they are buying (Frost et al, 2001).

Over the past decade, 42m hectares of forests were certified in more than 60 countries. The principles governing forest management certification are specified in terms of[54]:

1. Compliance with laws and FSC Principles
2. Tenure and use rights and responsibilities
3. Indigenous peoples' rights
4. Community relations and worker's rights
5. Benefits from the forest
6. Environmental impact
7. Management plan
8. Monitoring and assessment
9. Maintenance of high conservation value forests
10. Plantations

Whereas the first nine principles apply to forests in general, principle ten governs plantation forestry specifically.

6.1. CERTIFICATION IN SOUTH AFRICA

South Africa is ranked seventh when the world total of FSC certified forests (natural and plantation) is concerned. For *plantation forests* South Africa is ranked first, as it has a larger area of certified plantations than any other country. Apart from the forest management certificates, some 30 FSC chain of custody certificates were held by South African companies in 2001 (Frost et al, 2001).

FSC certification in SA was prompted by consumer demand for certified products from a prominent UK buyer of DIY timber from SA. It has however evolved to be a vehicle for companies to demonstrate their environmental commitment, to improve

[54] For a detailed discussion of these principles and the requirements they stipulate, see FSC (2004b).

their internal systems and efficiency, to deal with supply chain pressures and respond to environmental and social criticism. All in all, companies moved towards certification in anticipation of the fact that it would become an industry standard. For Safcol, the motive has been to increase attractiveness for private sector investors in preparation for privatization.

In South Africa, certification takes place in three steps, all conducted by the Qualifor Programme of SGS (the internationally accredited certifier *Societe Generale de Surveillance*[55]): a *pre-assessment*, to determine whether the plantation is ready for auditing, an *independent audit* of forest management quality in terms of specified environmental, social and economic standards, which is carried out every five years and results in a certificate or, otherwise, CARs (corrective action requirements) to be implemented before certification can be achieved. Furthermore, there is also a *surveillance audit* every six months to confirm the maintenance of certification (Frost et al, 2001).

There have been some concerns that social criteria are not adequately enforced in the certification process, even though certification has served to provide a framework for *identifying* social issues and stakeholder opinions. Small growers to date also feel little benefit from certification, but regard it as something that distracts them from more pressing livelihood needs (Frost et al, 2001).

A recent development very relevant to South Africa is FSC's introduction of *SLIMF (small or low intensity managed forests) certification*. It aims to streamline the certification process for SLIMFs by stipulating special certification procedures for forests classified as "not managed intensively" (not applicable to South Africa, as all commercial plantations are, per definition, managed intensively) or as "small" (currently defined as all plantations less than 100ha in size, but FSC plans to increase the threshold to 600ha). Even though environmentalists regard this as a relaxation of criteria that can gravely impact the environment and does not necessarily target small growers in SA (medium growers may also fall within the <100ha bracket and even larger plantations will classify as under 600ha in size), FSC (through its certifiers in South Africa, SGS Qualifor) remains firm in its conviction that its environmental and social principles and requirements for compliance are not compromised, but that the certification process is merely being simplified to make it more cost-effective for SLIMF applicants (Owen, 2004; Marais, 2004).

[55] FSC's independence is guaranteed by the fact that it does not perform certification itself, but contracts it out to accredited independent certifiers, such as SGS (FSC, 2004).

7. APPENDIX G: SALIENT FEATURES OF THE GLOBAL PULP AND PAPER INDUSTRY

The following salient features of the global pulp and paper industry place the South African industry in context.

- **The industry is undergoing a process of consolidation**, with the 10 largest pulp producers representing 36% of the global pulping capacity. The corresponding figure for the paper and board industry is 29% (Jaakko Poyry, 2003). According to PWC's Global Forestry and Paper Industry Survey (2004), eight of the top 20 companies in the pulp and paper industry in 2003 were American, with Finnish, Swedish and Japanese companies also featuring strongly. South Africa is one of only four countries to have two companies among the top 20. The top 30 paper and pulp producing countries are:

Paper & Board		Pulp	
1. USA	16. Spain	1. USA	16. Spain
2. China	17. Austria	2. Canada	17. Austria
3. Japan	18. Taiwan	3. China	18. South Africa
4. Canada	19. Mexico	4. Finland	19. New Zealand
5. Germany	20. Netherlands	5. Sweden	20. Australia
6. Finland	21. Thailand	6. Japan	21. Poland
7. Sweden	22. Australia	7. Brazil	22. Thailand
8. Korea	23. Poland	8. Russia	23. Argentina
9. France	24. South Africa	9. Indonesia	24. Czech Republic
10. Italy	25. Norway	10. India	25. Italy
11. Brazil	26. Switzerland	11. Chile	26. Korea
12. Indonesia	27. Belgium	12. France	27. UK
13. Russia	28. Turkey	13. Norway	28. Belgium
14. UK	29. Portugal	14. Germany	29. Slovak Republic
15. India	30. Argentina	15. Portugal	30. Taiwan

Table 50. Country rankings in pulp and paper & board production, 2003

Source: Pamsa, 2004.

The regional share in pulp and paper production is as follows:

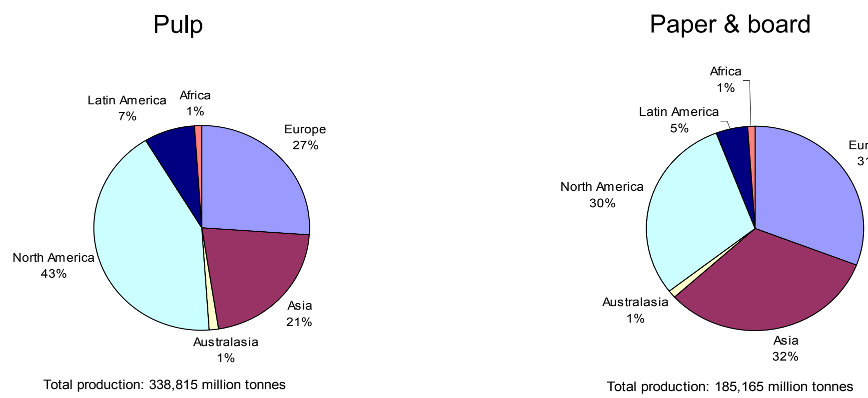

Figure 2. Regional shares in global pulp and paper & board production, 2003
Source: Pamsa, 2004

- **The pulp and paper industry is relatively export-orientated, with trade accounting for one third of world paper and board consumption.** For newsprint and mechanical printing and writing papers, the share is as high as 50%. *Main export countries* are: Canada, Finland and the USA, with Brazil also a noteworthy exporter (Brazil's share has grown recently). The *main importers* are the USA, the UK and China. Latin America and the Middle East are the largest importing *regions* (Jaakko Poyry, 2003). The industry is thus increasingly characterized by globalization.
- **With regard to employment, the global trend has been towards outsourcing and automatisation**.
- **The global industry recognizes the need for sustainability** (both in its own operations and in the sourcing of its inputs) and the minimization of its environmental impact (such as waste and emissions) (Jaakko Poyry, 2003). South Africa is thus not alone in trying to reduce the environmental impact of the industry.
- **China is likely to be a significant driver of global demand into the future**. China is regarded as the global growth engine in timber demand. Its need for natural resources such as oil, minerals and timber to fuel its booming economy has increased dramatically over the past decade (SAF, 2004). China's paper demand is expected to grow from 30m tonnes per annum to 55m tonnes per annum between 2000 and 2010. In 1980 it was as little as 6m tonnes, and increased to about 13m tonnes in 1990 (Neilson & Flynn, 2004)..

  The establishment of high-yield, fast-growing plantations (in order to support the domestic processing industry) is one of the Chinese State Forestry Administration's national priorities. China has about 47m hectares of plantations – about 25% of the world's plantations – and new planting is taking place at a rapid rate. In 1998, government imposed a ban on natural forest logging. This makes plantation development all the more urgent. In 1999 (the fifth national forest inventory), 74% of China's forest plantations were under collective (household) management and the state controlled 26% (Xu & Hyde, 2003). Foreign timber, pulp and paper companies, such as Finnish company Stora Enso, are also concluding agreements to establish plantations and invest in beneficiation plants. At least one Japanese paper manufacturer has initiated plans to establish plantations in China (Global Wood, 2004) . MAIs vary between 20 and 30 m3/ha/annum and pulpwood prices between $28.6/t and $36.5/t at mill gate (Cossalter, 2004).

China's forests have however not been able to keep up with industrial growth, and the country has become the world's second largest timber importer, with forest products being China's largest import commodity group (Xu & Hyde, 2003). Rapid expansion in processing facilities means that Chinese demand for wood will continue to outstrip supply, regardless of plantation growth. Pulp imports increased by between 26% and 30% per annum between 1997 and 2003 (versus a world-wide average growth of 1.6% over the same period) and represented almost 13% of world pulp imports in 2003 (Hawkins Wright in Cossalter, 2004; Paperloop, 2004b). Between 1999 and 2003, China imported 21.2m tonnes of pulp (more than nine times South Africa's annual production).

Demand is likely to continue to grow. Projections are that, over at least the medium-term, China will continue to experience a wood chip/pulp deficit and that, depending on the pulping capacity, the region will need to import between 6.4m and 8.9m m3 of pulpwood annually between 2005 and 2010, with demand continuing to outstrip domestic supply beyond that (Cossalter, 2004).

Caution needs to be taken, though, as the booming Chinese demand is an incentive for timber and pulp companies worldwide to expand production. The pulp industry is notorious for its herd behaviour and boom and bust cycle (Paperloop, 2004b. The extent of the demand from China however makes this threat less pronounced and, while China is the growth engine, the rest of Asia also represents a large market. An FAO study conducted in 1996 ("FAO, 2003b) predicted that, by 2010, consumption of industrial roundwood in Asia will outstrip production by almost 250m m3 per year.

The implication for South Africa is that, even if woodchip demand from Japan were to dry up, there would still be new markets to explore. This means that it remains unlikely, at current export prices, that a major new pulp mill will be built in South Africa, as there will be no incentive to switch wood chip exports (currently between 3 and 5m tonnes per year) to domestic pulping. Given constrained domestic fibre availability and competition with low-cost countries, such as Brazil, it is, however, not likely that South Africa will tap into the pulp export market provided by China.

8. APPENDIX H: PULP AND PAPER MILLS SUMMARY TABLES

Company	Type of Mill	Name	Location	Inputs	Capacity (t/a)	Total capacity (t/a) 2003	Number of people employed	Output
Mondi	Mechanical	Merebank	Durban	Softwood	286,000	992,000	1,200	Mechanical pulp (thermal mechanical and groundwood)
	Kraft	Richards Bay	Richards Bay	Mostly eucalyptus & pine; waste fibre (small proportion)	575000 (planned expansion to 720 000)		632 (down from 707 in 2001)	Kraft pulp (hardwood and softwood) and Baycel: a premier grade bleached market pulp (made from 100% eucalyptus hardwood fibre) (used by tissue and fine paper manufacturers)
		Felixton	Richards Bay	Bagasse (80 000t/a), recovered waste wood fibre from Richards Bay mill (8 000t/a) & waste paper (50 000t/a)	70,000		244	Unbleached bagasse pulp
		Piet Retief	Piet Retief	Eucalyptus logs, pine chips, purchased pulp (7%) and waste fibre (30%)	60,000		264	Chemical pulp (hardwood and softwood NSSC - neutral sulphite semi-chemical)
Sappi	Dissolving pulp	Saiccor	50km south of Durban	Hardwood timber (predominantly eucalyptus)	600,000	1,610,000	1,000	Dissolving pulp (chemical cellulose) for export to Europe, the Americas and Asia. Many applications, e.g. in textiles, food, chemicals and plastics
	Soda	Stanger	Stanger	Bagasse	60,000[56]		609	Bleached bagasse pulp for own consumption
	Kraft	Tugela	Mandini	Pine and Eucalyptus timber (2 different digesters for the different types of timber)	350,000		1,198	Unbleached softwood kraft (230 000 t/a) and hardwood semi-chemical pulp (120 000t/a) for own consumption. Salt cake and tall oil as by-products
		Ngodwana	Nelspruit	Mostly softwood	510,000		1,350	Unbleached kraft pulp for own consumption & bleached chemical pulp for own consumption and market pulp (410 000 t/a); mechanical pulp for own consumption (100 000 t/a)
	Soda	Enstra	Springs	Eucalyptus timber for hardwood pulping (300 000t/a)	90,000		935	Bleached hardwood pulp
Outside SA:		Usutu	Swaziland	Softwood	230,000		1,700	Chemical pulp (and kraft and test liners, MG Kraft, unbleached board, sacks and wrappings
NCT/SodraCell	Planned, project not launched yet.	Pulp United	Richards Bay		300,000			Eucalyptus-based bleached, chemical, thermal, mechanical

Table 51. Pulp production details

Source: These summary tables were drawn up using information obtained from the companies' websites, from personal communications with industry role players, and from telephone calls made to various mills.

56 The pulp output of Sappi Stanger was temporarily reduced, since February 2005, to about 22 000 ton per annum (about 60 tonnes per day) due to environmental concerns of persistent organic pollutants (POPs) resulting from its chlorine bleaching process. Stanger was Sappi's last mill, internationally, to employ a chlorine-based bleaching process. The bleaching plant has however now been shut down. Sappi hopes to implement the necessary technology to start chlorine-free bleached pulp production in 6 months to a year's time. In the mean time, pulp is bought from other South African mills or imported. No retrenchments took place as a result of the bleaching plant shutdown.

Company	Name	Location	Inputs	Capacity (t/a)	Total capacity (t/a)	Number of people employed	Output	Products
Mondi	Merebank	Durban	Mechanical and chemical pulp (Richards Bay)	566,000	1,181,000	n/a	SC magazine paper and uncoated wood-free (fine) paper	Newsprint and telephone directory paper; SC mechanical paper; uncoated fine paper (e.g. Mondi Rotatrim) and other grades
	Richards Bay	Richards Bay	Chemical pulp	260,000		n/a	Corrugated papers	Baywhite: whitetop and kraft linerboard (produced primarily for the corrugated packaging market)
	Felixton		Chemical pulp and recycled material	100,000		n/a	Fluting medium	Bayflute, Mondiflute
	Piet Retief	Piet Retief	Chemical pulp	130,000		n/a	Unbleached linerboard	Boksliner (used as an inner and/or outer layer in the production of corrugated cartons) and Mondiliner (beverages, biscuits and snacks, automotive components, household and cosmetic goods)
	Springs	Springs	Chemical pulp (10%) and recycled material (90%)	125,000		470	Carton board	Packaging products, Industrial products
Sappi	Stanger	Stanger	Chemical pulp (bagasse and softwood kraft from Ngodwana), fillers (calcium carbonate and clay)	110,000	1,145,000	n/a	Coated wood-free graphic paper (80 000 t/a); tissue (30 000t/a)	Converted into paper for office and other uses, as well as tissue-based products
	Tugela	Mandini	Chemical pulp	390,000		n/a	Kraft linerboard and corrugating medium (300 000t/a); other kraft packaging papers (90 000t/a)	Converted into packaging products
	Ngodwana	Nelspruit	Chemical and mechanical pulp	380,000		n/a	Newsprint (140 000 t/a), kraft&white top linerboard (240 000 t/a)	Converted into newspaper and magazine paper to be used by the printing industry, as well as fine paper for office and other uses
	Enstra	Springs	Chemical bleached softwood pulp (34 000t/a); bleached hardwood pulp produced in own pulp mill	170,000		n/a	Uncoated printing and writing paper	3 types of graphic and business papers: acid free, woodfree and elemental chlorine free
	Cape Kraft	Cape Town	Recycled material	60,000		150	Waste-based linerboard and corrugating materials	Testliner, fluting and ceilingboard
	Adamas	Port Elizabeth	Hard & softwood fibres bought from pulp mills; waste paper	35,000		265	Uncoated industrial and packaging papers	Uncoated industrial and packaging papers
Nampak	Belville	Belville	Pulp from Mondi and Sappi, Recycled material, Imports	25,000	108,000	400	Crepe tissue	Various tissue-based products
	Kliprivier	Gauteng		23,000			Crepe tissue	Various tissue-based products
	Riverview	KZN		10,000			Crepe tissue	Various tissue-based products
	Rosslyn	Gauteng	Recycled material	50,000			Corrugated papers	Fluting and testliners
Kimberly-Clark	Enstra	Springs	Recycled material and purchased virgin fibre pulp	52,000	52,000	450	Crepe tissue	Various tissue-based products
New Era	Gayatri	Germiston	Recycled material	45,000	45,000	580	Corrugated papers	Testliner
Other	Other		Mostly recycled material	109,000	109,000		Tissue and corrugated papers	Tissue-based and packaging products

Table 52. Paper production summary

Source: Genesis synthesis of information obtained from company websites, Pamsa, industry representatives, and telephone conversations with individual mills.

9. APPENDIX I: REGULATORY FRAMEWORK FOR PLANTATION FORESTRY[57]

9.1. INTRODUCTION

This section provides a brief overview of the regulatory framework within which plantation forestry operates and how this impacts on the market.

The commercial plantation industry is affected by legislation through: 1) the principles of sustainable management set by the state, 2) the requirements for permission for new afforestation it faces and 3) the charges it pays for water use. The state departments responsible for the various impacts are:

- the **Forestry Directorate of the Department of Water Affairs and Forestry** through the principles, criteria, indicators and standards it sets for sustainable forest management through its National Forest Act, 84 of 1998, and the provisions for fire prevention as set out in its National Veld and Forest Fire Act, 101 of 1998.

- the **Water Affairs Directorate of the Department of Water Affairs and Forestry** through the water allocation and the classification of commercial forestry as a stream flow reduction activity, and the resultant licensing requirement placed on forestry by the National Water Act, 36 of 1998

- the **Department of Environmental Affairs and Tourism** through the biodiversity-permission required for new afforestation under the National Environmental Management Act, 107 of 1998 and its sibling the National Environmental Management: Biodiversity Act, 10 of 2004; as well as provisions under the National Environmental Management: Protected Areas Act, 57 of 2003. Environmental Impact Assessment-permission is also required under the Environment Conservation Act, 73 of 1989, but is to be included under National Environmental Management Act, according to regulations of 2004 (RSA, 2004d).

- The **Department of Agriculture** through the permission required for the “breaking of new soil” and the “planting of weeds/invader species” in the case of new afforestation under the Conservation of Agricultural Resources Act, 43 of 1983.

[57] The following section draws on a regulatory overview done for the study by Mike Howard.

Permission for new afforestation is thus required in the form of an integrated SFRA license issued by DWAF: Water Affairs, subject to permission from the other two departments. In the assessment and advisory process, local and provincial government spheres are also involved and the private sector is given an opportunity for representation. This implies that efficient inter-departmental coordination is called for. There can, in different circumstances, be various other requirements, such as heritage impact assessments under the National Heritage Resources Act.

At a local level, commercial forestry will be affected by the **Municipal Property Rates Act, 6 of 2004**, that will come into effect by the middle of 2005 and will require forestry companies to pay, for the first time, municipal property rates on plantations.

9.2. THE PRINCIPLES GOVERNING COMMERCIAL PLANTATIONS IN SOUTH AFRICA

The national structure of the Department of Water Affairs and Forestry's forestry directorate focuses on the development of policy and regulations while so-called "cluster" (regional) structures focus on operational management of DWAF plantations and natural forest areas together with providing various forestry related support services.

NATIONAL FOREST ACT, ACT 84 OF 1998

The NFA is aimed at promoting and protecting natural forests, woodlands and plantation forests. It also aims to correct the perceived unfair distribution of benefits that occurred in the past. The Act promotes sustainable forest management through the application of a list of principles[58] and asks for a set of criteria, indicators and standard (CI&S) to be implemented. The draft set of CI&S have been developed and are in the process of being refined through a practical testing phase. Sustainable forest management is considered to encompass the economic, social and biophysical elements of the environment and the CI&S comprehensively consider all these aspects. The CI&S will effectively operationalise the principles and policies that have been developed under the NFA.

The Forest Act furthermore strongly focuses on policy development and the establishment of the National Forests Advisory Committee[59] (NFAC) to advise the Minister of Water Affairs and Forestry. Measures to protect forests and certain

[58] Chapter 2
[59] Chapter 5

species of trees[60] and provision for the regulation of access to forests[61] are also contained in the Act.

Relevance to commercial forestry. The CI&S will most probably not impact commercial forestry much, as most of the criteria and standards are already adhered to by private sector role players according to their FSC certification. Apart from stating the principles of sustainable management by which the industry should abide, the Forest Act does not have much direct implications for commercial forestry[62]. One area of importance, however, is the provision that is made for state forests to be leased out to individuals, communities or institutions. Provision is also made for communities to enter into an agreement with the Minister to jointly manage state forests with DWAF officials. It is thus in terms of this act that the privatisation of Safcol is taking place.

Intra-government coordination. Many of the Forest Act's principles have common elements with those in the National Water Act and National Environmental Management Act. These overlaps are quite logical as all these laws are, among other, concerned with the conservation of the biophysical environment.

NATIONAL VELD AND FOREST FIRE ACT, ACT 101 OF 1998

The Veld and Forest Fire Act aims to make provision for measures to prevent and control wildfires through the formation of fire protection agencies,[63] the development of a national fire danger rating index[64] and the regulation and promotion of fire breaks.

Relevance to commercial forestry. The Act is of considerable importance to forestry operations as wildfire is a major risk and cause of injury and extensive damage to property and plantations. A number of fire protection associations have been set up.

9.3. WATER USE CHARGES AND THE PREREQUISITES FOR NEW AFFORESTATION

THE NATIONAL WATER ACT, ACT 36 OF 1998

The licensing requirements of the National Water Act. The purpose of the NWA is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in an equitable and sustainable manner for the

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60 Chapter 3

61 Chapter 4

62 The regulation of new afforestation (which previously resorted under the now repealed Forest Act, 122 of 1984) has been taken over by the National Water Act, to govern forestry in its capacity as a stream flow reduction activity.

63 Chapter 2

64 Chapter 3

benefit of all people. Under the Act, any water use that is not sourced from municipalities (water service providers) is to be registered. Below a certain threshold, a general authorisation is granted for certain activities, and no license is required. All non-municipal water users that do not qualify for the general authorisation however need to be granted water use licenses on the basis of water allocated to them according to the availability of water as represented by the *water balance*, that is, the balance of available water after adequate quantities to sustain society ("the social reserve") and the environment ("the ecological reserve") have been set aside. According to the availability of water, catchments are then classified as "open" (i.e. excess water is available to be allocated) or "closed"/"stressed".

Under the National Water Resources Strategy (of which the first draft was published in 2004), as provided for under the NWA[65], provision is made for the establishment of *catchment management agencies* (CMAs) to manage water resources in an integrated manner at a regional level. These agencies will be responsible for ensuring that there is consonance between water-related plans and programmes, and the plans and programmes of all other role players in the catchments. The CMAs will establish co-operative relationships with a wide range of stakeholders, including other water management institutions, water service institutions, provincial and local government authorities, communities, water users ranging from large industries to individual irrigators, and other interested persons. Funding for the management and operation of the CMAs is to be derived from charges made upon water-users in the catchment.

The NWRS furthermore sets out the order of priority that will be followed in respect of the *construction of dams or other infrastructural development*. For example, the Embiane dam on the Black Umfolozi River, scheduled for completion in 2009, may offer some opportunity for forestry expansion in this catchment and similarly the raising of the wall of the Tzaneen Dam, scheduled for completion in 2007, may have a similar result in that area. Although investigated, it is unlikely that the Thukela-Mhlathuze Transfer scheme will be constructed within the next 25 years. This development could transfer a maximum of an additional 54m cubic metres a year from the Thukela River into the Mhlathuze water management area for possible mining and industrial developments at Richards Bay and surrounding areas and a corresponding relaxation on the restrictions placed on forestry expansion in this catchment.

The SFRA licensing process. The licence is issued by DWAF's Chief Director: Water Use & Conservation where the area of afforestation is greater than 10 hectares and by the Regional Director where the area is less than or equal to 10 hectares, although all licences are reported to the Chief Director. The licences are however only issued once the issuing authority has received the advice of the

[65] Chapter 2, Part 1

provincial SFRA Licence Assessment Advisory Committee (LAAC)[66], the advisory body appointed by the Minister of Water Affairs & Forestry.

Relevance to commercial forestry. Forestry is a dry-land activity often established in upper water catchment areas. Thus it is a large water user that takes water directly from rainfall and run-off before it enters the stream channel. This is very different from irrigated agriculture where the water is pumped from a river or reservoir and can be mechanically regulated. In the case of forestry, the only ways of regulating water use are to control the species, location and area planted. It is for this reason that the National Water Act declares commercial plantation forestry as a stream flow reduction activity (SFRA)[67] (forestry is the only activity to have been declared so to date). This implies that commercial forestry and new afforestation is subject to distinct regulations and licensing requirements in terms of water use, and is required to pay levies for water use[68] that other dry-land agricultural activities need not pay. No General Authorizations have been promulgated for forestry to date.

Water use charges have been in place since 2002. The charges differ from catchment to catchment but range from about R0.30/ha to R0.87/ha for the 2004/5 year. An SFRA license is granted for a period of 40 years, subject to 5-yearly reviews.

NATIONAL ENVIRONMENTAL MANAGEMENT ACT, ACT 107 OF 1998 (NEMA)

Environmental permission requirements. The principles for the conservation of the environment as contained in the National Environmental Management Act, 107 of 1998, as amended in Act 8 of 2004, are also relevant to the commercial forestry industry. It is the umbrella act that is to become the framework and lays down the principles for all new environmental legislation. It has already yielded two subsidiary acts, namely the NEM: Biodiversity Act, 10 of 2004 and the NEM: Protected Areas Act, 57 of 2003.

One of the acts that NEMA is to replace is the *Environmental Conservation Act, 73 of 1989*. Section 21 requires that certain activities, of which forestry is one, may not be carried out without the permission of the Minister for Environmental Affairs & Tourism issued in terms of the ‘Environmental Impact Assessment regulations’. Depending on the nature and scale of the proposed activity’s environmental impact envisaged by the environmental authorities this permission will only be issued after either a scoping report has been submitted or a full EIA has been completed. Application can be made for an exception to the environmental scoping process. This requirement will soon be transferred to the NEMA under new EIA regulations

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[66] Section 99 - 101

[67] **Section 36**

[68] Sections 56 -60

that are currently undergoing a public consultation process. Under the NEM: Biodiversity Act, 10 of 2004, permission is also needed in terms of the loss of biodiversity associated with afforestation.

The NEM: Protected Areas Act, 57 of 2003 is likely to impact new afforestation where it is proposed within the buffer zones of protected areas, as new afforestation will then need to adhere to the norms, criteria and standards to be developed under the Act.

CONSERVATION OF AGRICULTURAL RESOURCES ACT, 43 OF 1983 (CARA)

Agricultural resources permission requirements. Under the regulations of the Conservation of Agricultural Resources Act (CARA), the permission of the Minister of Agriculture is required for certain activities. These include:

- the cultivation of any ‘category 2 plants’. Category 2 contains all the species commonly used in commercial forestry in South Africa such as pine, eucalyptus and wattle
- the ‘cultivation of virgin soil’

The regulations exempt an applicant from obtaining the agricultural permission for cultivation of weeds/invaders where the applicant already has a SFRA licence, but this does not forego the need to obtain permission for the ‘cultivation of virgin soil’. In terms of the definitions provided at the beginning of the Act ‘cultivation’ is defined as a ‘mechanical disturbance of the topsoil’ and even the manual preparation of planting pits is considered to be ‘cultivation’. It is possible for an applicant to make a written application for exemption from the requirement.

OTHER LEGISLATION AFFECTING THE INDUSTRY

There are a number of laws and policies that potentially affect forestry and forestry operations. These include the Basic Conditions of Employment Act (75 of 1997), the National Heritage Resources Act (25 of 1999), and the World Heritage Convention Act (49 of 1999). Of most direct relevance to commercial forestry, however, is the newly promulgated Municipal Property Rates Act, (6 of 2004) which will come into effect by July 2005. Payment of rates is to be phased in over a three year period.

MUNICIPAL PROPERTY RATES ACT, 6 OF 2004

The Act lays out the procedures that municipalities are to follow in developing levy rates on all properties within their jurisdiction. The level of the rates is set independently by each municipality according to a set of criteria provided in the Act. Provision is made for a two stage appeals process, whereby the appellant can appeal the value placed on the land, but not the level of the rates that are to be paid.

Relevance to commercial forestry. Up until now, land zoned for agriculture (and forestry) has not been subject to municipal rates. Once the act comes into effect, rates will however be levied on all properties based on the value of the land and buildings. The payment of rates as well as the administration associated with these requirements may thus serve to increase the cost of production for forestry.

10. APPENDIX J: REGULATORY FRAMEWORK FOR PULP AND PAPER

This section provides a brief overview of the regulatory framework within which the pulp and paper industry operates and how this impacts on the market.

The pulp and paper industry is subject to a myriad of legislation spanning six government departments. Each department has distinct processes to develop and implement legislation, governed by distinct authorities. The aim of this regulatory overview is to provide clarity on the legislation, authorities and processes pertaining to the pulp and paper industry. It is important to keep in mind that all of the legislation should be regarded within the overall framework of cooperative governance through principle-led legislation that government has applied over the past decade. In this regulatory scheme, acts lay down the fundamental principles to be adhered to and then make provision for regulations to be gazetted. These regulations serve to endorse the principles stated in the relevant act and to ensure that the necessary processes are in place for the implementation thereof (Herbst, 2004).

10.1. REGULATORY OVERVIEW

The legislation that is of most importance to the pulp and paper industry resides in two government departments: the Department of Environmental Affairs and Tourism (DEAT) and the Department of Water Affairs and Forestry (DWAF). Within DEAT, the main vehicle for regulating the environmental impact of industries (and thus also the pulp and paper industry, as a major source of air and water pollution) is the National Environmental Management Act (NEMA), 107 of 1998. The aim is for NEMA to become the overarching or “parent” act of environmental legislation in South Africa. Within DWAF, the act most relevant to the pulp and paper industry is the National Water Act, 36 of 1998, and its associated systems, licensing requirements and regulations governing the allocation and quality of South Africa’s water resources.

Furthermore, the industry is regulated by the various general employment-related acts of the Department of Labour, as well as acts by the Department of Trade and Industry (the Trade Metrology Act, 77 of 1973), the Department of Land Affairs (the Development Facilitation Act, 67 of 1995) and the Department of Health (Hazardous Substances Act, 15 of 1973)[69].

[69] This list is not necessarily exhaustive.

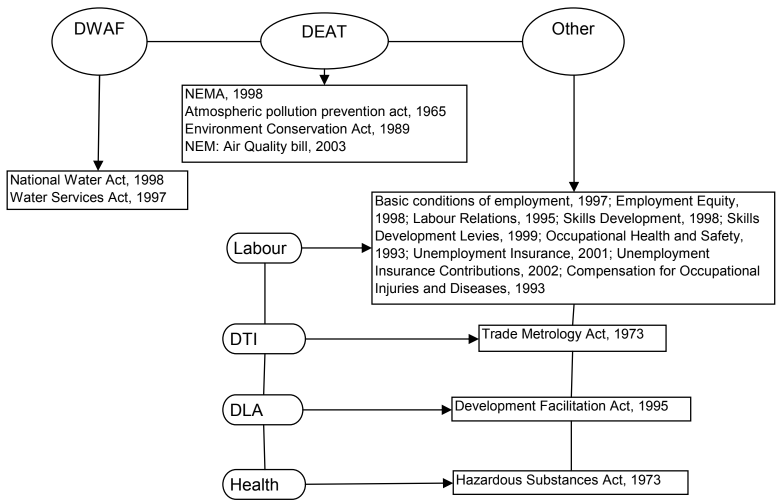

Figure 3. Schematic representation: legislation relevant to the pulp and paper industry.
Source: Genesis research of the various acts.

For the purpose of this analysis, an overview of the legislation most relevant to the pulp and paper industry will be given, namely the National Environmental Management Act, 107 of 1998, the soon to be enacted National Environmental Management: Air Quality Bill, 2004, as well as the National Water Act, 36 of 1998. For a summary overview of the rest of the applicable legislation as set out in Figure 3, the reader is referred to Table 53 at the end of this section.

DEAT: NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 107 OF 1998

The NEMA is a principle-driven act that integrates all other environmental legislation. It is aimed at cooperative environmental management and provides for the necessary institutions/procedures to achieve this. The Act sets out a number of *core principles* for environmental management: *inter alia,* it seeks to protect citizens' rights to a healthy environment (one of its fundamental purposes is that development must be socially, environmentally and economically sustainable) and wants to provide a framework for the promotion of certainty in decision-making (Preamble and Chapter 1).

In Chapter 2, the Act proceeds to establish the institutions necessary to achieve the fundamental environmental management principles set out in Chapter 1: a National Environmental Advisory Forum (Part 1) and a Committee for Environmental Co-ordination (Part 2). Chapter 3 sets out the procedures for co-operative governance. Amongst others, it requires each government department that exercise functions that might affect the environment, as well as each provincial government, to prepare an environmental implementation plan and for government departments involved in environmental management to prepare an environmental management plan (Section 11(1)). A specific Chapter (chapter 5) is devoted to the promotion of integrated environmental management. Section 23(1) states that the Act wishes to "promote the application of appropriate environmental management tools in order to ensure the integrated environmental management of activities".

The NEMA has been amended twice: Amendment Act 56 of 2002 allows for the appointment of environmental management inspectors with powers in terms of the right to enter and search premises, etc, and Amendment Act 8 of 2004 makes allowance for Environmental Impact Assessments to be conducted under the NEMA.

Relevance to pulp and paper industry

The NEMA has become the blanket environmental act for the industry. Of specific relevance is the obligation it places on industry to conduct Environmental Impact Assessments.

Environmental Impact Assessment Regulations (under Section 24 of the NEMA, 107 of 1998, as amended in 2004). The need to conduct an EIA was previously provided for under the Environment Conservation Act (ECA), 73 of 1989. The ECA is however being phased out and replaced by NEMA-related legislation. The EIA regulations are currently undergoing a public consultation process and, once implemented (in 2005), the ECA (1989) will be withdrawn. Chapter 1(i) of the NEMA states that: "The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment". It is upon this principle that the incorporation of Environmental Impact Assessment Regulations into the NEMA are built.

The EIA process. As pulp and paper manufacturing falls within the specified list of industries requiring EIAs, a company wishing to build/expand a mill will approach the provincial department dealing with environmental affairs, who will then give the company instructions to develop a scoping report. Such a report needs to be compiled by independent consultants, and needs to identify issues regarding the potential impact of the operation in terms of, for example, air pollution, increased solid waste disposal or increased water use. Safety and health issues can also come into play. In short, everything that can possibly have an environmental or a social impact needs to be taken into account (theoretically the economic impact of the planned operation should also play a role, but in practice little attention is given to it, as it is assumed that companies will only pursue the venture if it is economically viable) (Scotcher, 2004; Terblanche, 2004, Herbst, 2004; Hunt, 2004).

If the scoping report has identified some environmental or social impacts that need to be addressed, the company must make a proposition for the mitigation of these issues (called an EIA Report Plan), followed by an actual EIA Report. For each of these steps there is a specific public participation process to be followed and periods for public comment are provided. The report is then submitted to the authorities, who reach a *record of decision* that will either authorise the construction/expansion of the plant, or accept it with conditions, or reject it. Any parties that are unhappy with the ruling (be it the applicant if the ruling is negative, or an environmental lobby group if the verdict is positive) then have a 30 day period in which to appeal. It is evident that this process takes rather long, and it is important that companies should make investment decisions with the criteria of an EIA in mind, as this will ultimately determine whether the investment will take place.

Mills that were built prior to the enactment of this legislation are not required to conduct an EIA retrospectively.

DEAT: NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY BILL, B62B OF 2003

Along with its sister-acts (the NEM: Protected Areas Act, 57 of 2003 and NEM: Biodiversity Act, 10 of 2004) the Air Quality Bill, once enacted, will fall under the ambit of the NEMA, and will replace the Atmospheric Pollution Prevention Act, 45 of 1965. The bill aims to prevent pollution and environmental degradation and to ensure ecologically sustainable development, coupled with the promotion of justifiable economic and social development (Section 2(a)) and states that its interpretation and application must be guided by the NEMA principles (Section 5(2)).

It instructs the Minister to, within two years of the enactment of the bill, establish a national framework for achieving the objects of the Act and stipulates that national norms and standards should be developed to promote public participation and the *prevention* of air pollution and air quality degradation, while promoting efficient air quality management and monitoring (Section 7(1) and (2), Chapter 2). Provision is also made for provincial (Section 10(b)) as well as local standards (Section 11(b)).

In Chapter 3, the bill furthermore stipulates that a National Air Quality Advisory Committee should be established, and that air quality officers should be appointed to ensure compliance according to the air quality management measures subsequently set out in Sections 18 through 35. Of particular relevance to the pulp and paper industry is Section 21(1): "The Minister must, or the MEC may, by notice in the Gazette, publish a list of activities which result in atmospheric emissions and which the Minister or MEC reasonably believes have or may have s significant detrimental effect on the environment, including health, social conditions, economic conditions, ecological conditions or cultural heritage…" If an industry is listed (as the pulp and paper industry will be), "no person may without a provisional atmospheric emission or an atmospheric emission conduct an activity listed on the national list … or listed on the list applicable in a province…" (Section 22). Chapter 5 (Sections 36 through 49) provides for, amongst others, the licensing of listed activities, the procedure to be followed, factors to be taken into account by the licensing authorities (metropolitan and district authorities) and the issuing of atmospheric emission licences. Chapter 7 makes provision for penalties in the case of non-compliance.

Whilst a national Act, implementation of the Act rests with local authorities, and the provincial government is also bestowed with the authority to list emission activities that are detrimental to the environment.

Relevance to the pulp and paper industry

It is clear that the NEM: Air Quality Bill once enacted, will be of particular relevance to the pulp and paper industry. As under its predecessor, the Atmospheric Pollution Prevention Act, the industry's air emissions will be regulated and monitored. Instead of the certificates of registration that were previously required, the industry will now be subject to air emission licensing.

DWAF: NATIONAL WATER ACT, 36 OF 1998

As stated in its preamble, the Act seeks to achieve the sustainable use of water (and the sustainability of water resources), as well as the protection of water quality, for the benefit of all users. It is recognised that the distribution of water resources is often skewed and that this should be rectified. National Government confirms its overall responsibility for and authority over (in short, its trusteeship of) the nation's water resources and their use (Section 3). In recognising the basic human needs of current and future generations, sustainability and equity are identified as the central guiding principles, with each person granted entitlement to "reasonable" water use as set out in Section 4.

Though clearly stating its aims and principles, the NWA is fundamentally an implementation-driven act. Chapter 2 sets out water management strategies to be followed at both a national and catchment level. Chapter 3 lays down measures to ensure the comprehensive protection of all water resources, and for the prevention of water resource pollution. These measures are to be developed "progressively within the contexts of the national water resource strategy and the catchment management strategies". The Minister is instructed to prescribe a system for classifying water resources (Section 12) and to then use this system to determine the class and quality objectives of significant water resources in order to establish water quality related goals (Chapter 3, Part 2).

An important concept contained in the NWA, is that of the *water reserve*. Part 3 of Chapter 3 establishes the reserve to comprise a basic human needs reserve, as well as an ecological reserve – that is, the quantity and quality of water required to sustain society and the environment. This reserve is used to determine the water balance (water available to be allocated), on the basis of which water use licences can be granted for all water not sourced from municipalities. The criteria used for the granting of such licences are: water availability, the impact (via water quality) on downstream users, and possible mitigatory measures. National standards for water use and quality are set according to international benchmarks, but with consideration of specific national and local circumstances (Herbst, 2004).

Sections 19 and 20 of the NWA authorise the Minister to make regulations regarding water use and quality. General principles for water use and "permissible water use" are laid out in Part 1 of Chapter 4 (a general authorisation for water use without a licence is granted under Section 22 for water uses that are deemed permissible under Schedule 1). The quantity of water for which a responsible authority may issue a general authorisation in its water management area is to be determined by the Minister, subject to the national water resource strategy (Section 23). Section 26 furthermore grants the Minister the right to make regulations regarding *inter alia* the monitoring, registering or limiting of the extent of water use. Section 27 lays down some considerations for the issue of general authorisations.

The rest of the Act contains detailed stipulations regarding, amongst others, existing lawful water uses (Section 32), controlled activities (Section 37) and procedures for applications (Section 41). Chapter 5 determines that the Minister may, with the concurrence of the Ministry of Finance, establish a pricing strategy for water use charges (Section 56).

Apart from the general powers and duties of the Minister, the Act also provides for the establishment of *catchment management agencies* by the Minister to *inter alia* investigate and advise on water resources, as well as coordinate the related activities of other water management institutions within its water management area. Water use associations are also to be established (Section 91, Chapter 8), with their functions set out in a "model constitution" for such associations (Schedule 5).

Authorised persons (appointed by the Minister) are granted rights of entry and inspection on private property (Section 124, Chapter 13). The Minister is further required (Chapter 14) to establish national monitoring systems and national information systems on water resources.

Relevance to the pulp and paper industry

As a listed activity, the NWA requires a stand-alone pulp/paper mill to have an integrated licence for water abstraction, storage, and discharge[70]. The rationale for the latter rests on Section 21(g) of the NWA, as pulp and paper mills can be regarded as "disposing of waste in a manner which may detrimentally impact on a water resource". DWAF aims to implement (within the next three years) a *waste discharge charge* consisting of a basic monitoring charge, as well as a mitigating

[70] If a mill does not source its water from a river, it pays municipal charges for its water use, as regulated under the Water Services Act, 108 of 1997. It will also pay the municipality to remove its effluent to be sanitised. The worse the quality of the effluent, the higher the charges will be – which also serves as an incentive for mills to reduce their environmental impact.

charge and an effluent-quality related charge. Such a quality-based charge will serve as an incentive for companies to reduce effluent discharges by as much as possible. As effluent is the pulp and paper industry's most important environmental impact, standards are likely to become stricter into the future. Waste discharge charges have not been implemented yet, as they are still under revision by the Waste Discharge Charge Steering Committee (on which industry is also represented). The aim is to set charges that will not be high enough to make a company bankrupt, but will nevertheless be harsh enough to change waste disposal behaviour. Abstraction charges are already in place, as determined by DWAF's pricing strategy (Herbst, 2004; Scotcher, 2004).

10.2. KEY FINDINGS ON THE IMPACT OF LEGISLATION

Industry feels that their voice is not heard in the legislation process. It is difficult to pin down a single representative industry stance on environmental legislation. Generally, the impression is that industry accepts environmental legislation as a necessary part of doing business and welcomes "realistic" legislation that is "transparent and consistent". The impression gained from the industry is however that this is not always the case: although industry is invited to air their views during public consultation processes, industry often feels that it does not have any influence on policy outcomes.

Legislation impacts companies' policies, procedures and finances, and places technological requirements on them. *Policies and procedures* often have to be adapted to adhere to new legislation. Regulation also has a *financial impact*, as funds are required to monitor whether legislation is complied with, and to pay licensing fees and charges where applicable. Quality and other regulations furthermore place *technological requirements* on firms, as the achievement of some standards requires technological improvements or new processes to be implemented. This, in turn, adds to the financial impact. Of particular relevance are water regulations and the planned waste discharge charge – industry argues that the requisite technology required for compliance is not available, or can only be implemented at cost levels that will substantially impact profitability.

Legislation has resulted in a reduced environmental impact. Private sector and government however agree that the tightening of environmental and water legislation (in tandem with technological improvements and consumer demand pressures) have contributed to a considerable reduction in the environmental impact of industries over the past few decades.

Additional industry concerns with the legislation include:

- *Inconsistent enforcement*. Industry is concerned with the fact that many informal, small players (especially tissue paper converters) operate "below the radar screen". Thus larger, law-abiding companies feel "over-legislated" to compensate for the fact that small players get away with non-compliance (with regard to environmental, labour and tax legislation). Costs associated with compliance can also influence companies' competitiveness vis-à-vis informal market players. Consistent enforcement of labour and environmental legislation is thus a notable industry concern[71].

- *Development trade-off***.** There is also some concern that government may be sacrificing development and that care should be taken that environmental standards in South Africa do not mirror those of developed countries to such an extent that development and employment creation needs specific to the developing country context are neglected. Government's view in this regard is that, even though it is sensitive to development needs, there is a certain threshold beyond which it is not willing to compromise the environment.
- *Operational issues*. As is generally the case where a bureaucracy is concerned, industry feels that there are some inefficiencies in the way that the regulatory system operates and legislation is implemented. For example, industry feels that they sometimes do not have enough time to make comments on draft legislation.
- *EIA processes*. Where the EIA regulations are concerned, industry does, once again, not oppose the legislation. They however feel that government should improve its processes to deal with it, for example, where the processing of reports is concerned. It thus seems as if the perceived problem does not lie with the philosophy behind the process, but rather with the capacity of government to coordinate itself and see the process through.
- *Government coordination*. During discussions with industry role players it was emphasised that the relationship between industry and government to a great extent depends on *who* is dealt with in government. As government has many layers and faces, the industry feels that whether a specific person regards government as a watchdog, or as an institution with which they can cooperate, would depend on whether they deal with somebody from the national, provincial or regional offices. Lack of proper coordination between various levels of government is also perceived to be a problem. Industry wants to be able to approach "government" as a whole and have their issues addressed, but realise that this might be an unrealistic expectation.

[71] An area of particular interest is the effects of the Trade Metrology Act (1973). The tissue industry (through PAMSA and the Tissue Manufacturers' Association of SA) lobbies strongly with government to reconsider this act, as the inability of the SABS to effectively police the compliance with it is a source of great concern within the formal part of the industry. It is felt that informal players do not adhere to the sheet-requirements set for toilet tissue and that, combined with the fact that labour conditions and wage levels are not monitored; this gives them an unfair competitive advantage. In the end, it is argued, it is the consumer that is "cheated" by being sold an inferior product (Dosani, 2004, Weisz, 2004, Davison, 2004).

Department	Legislation	Amendments	Purpose & brief description	Relevance to pulp and paper
Dept of Environmental Affairs and Tourism	Atmospheric Pollution Prevention Act, no. 45 of 1965	Act no. 17 of 1973; Act no. 21 of 1981; Act no. 15 of 1985; subjected to the Environmental Laws Rationalisation Act, no. 51 of 1997	It controls air emissions of all scheduled processes in the name of cleaner air, public welfare and a conserved, healthy environment. *It is to be phased out and replaced by the National Environmental Management: Air Quality Act.*	As many processes involved in the pulp and paper industry, such as sulphide processes, are scheduled under the Act, the industry is subject to authorisation in the form of certificates of registration to operate such processes.
	Environment Conservation Act, no. 73 of 1989	Act no. 79 of 1992; Act 52 of 1994; Amendment Bill B45D, 2003.	To protect the environment and control its utilization. It grants authorities the right to declare protected natural environments, curb pollution by the prohibition of littering and control the operation of waste management sites. The minister also obtains the right to declare certain activities as damaging to the environment and control them accordingly. *This act is being phased out and replaced by the National Environmental Management Act, 107 of 1998*.	By legislating the establishment, operation and closure of a solid waste disposal site. Such actions are subject to independent audits, licensing and conditions. Licenses are issued by the minister of DEAT, but only with the consent of the DWAF minister, due to concerns about solid waste leaking into ground water.
	National Environmental Management Act, no. 107 of 1998	Act no. 56 of 2002; Act no. 8 of 2004.	An overarching, principle-driven act that integrates and guides all other environmental legislation. New legislation incorporated under the NEMA is the NEM: Protected Areas Act, no. 57 of 2003, the NEM: Biodiversity Act, no. 10 of 2004, and the to-be-enacted NEM: Air Quality Bill, 2004.	The general environmental regulatory framework for the pulp and paper industry stems from this Act.
	National Environmental Management: Air Quality Bill, B62B of 3002	n/a	Once approved by parliament, the Air Quality Act will aim to prevent pollution and environmental degradation and to ensure ecologically sustainable development. It will furthermore provide national norms and standards to regulate the monitoring, management and control of air quality by all spheres of government.	The licensing requirements for air emission activities that it sets out are directly applicable to the pulp and paper industry.

Department	Legislation	Amendments	Purpose & brief description	Relevance to pulp and paper
Dept of Environmental Affairs and Tourism	Environmental Impact Assessment Regulations	New regulations for streamlined processes, 2004.	The regulations list activities that may not be erected or expanded without environmental authorisation, and stipulate that such authorisation should be based on a detailed environmental impact assessment as carried out by an independent consultant. EIA regulations are provided for in the ECA (1989) but a consultative process is currently underway to incorporate it under Section 24(5) of the NEMA, 1998.	Pulp and paper manufacturing is one of the activities requiring authorisation. The process involves a scoping report and an EIA report plan, and culminates in an EIA report on the environmental, social, health and safety impacts of the proposed operation, as well as mitigatory suggestions.
	White Paper on Integrated Pollution and Waste Management, 2000	n/a	It is currently the driver of the development of national policies, legislation and guidelines with regard to recycling and waste recovery. It introduces a shift in emphasis to *prevention* of waste and pollution and calls for holistic and integrated planning in consultation with all stakeholders. It sets out the vision, principles and strategic goals that government will use for integrated waste and pollution management in SA.	Applicable to the pulp and paper industry as a large generator of waste and air/water pollution, as well as a large recycler.
Dept of Water Affairs and Forestry	National Water Act, no. 36 of 1998	Act no. 45 of 1999	To achieve the sustainable use of water for the benefit of all users and to ensure the protection of water quality and the sustainability of water resources. Government confirms its trusteeship of the natural water resources and proposes regulations regarding the management and protection of water and the allocation of water use rights.	The NWA requires a stand-alone pulp/paper mill to acquire licenses for water abstraction, storage and discharge. Effluent is also subject to certain water quality guidelines.
	Water Services Act, 108 of 1997		It *inter alia* recognises the basic human right of access to water, and provides for service provision in that regard. It also regulates water services charges.	Applicable to plants within the pulp and paper industry that source their water from water services providers (municipalities), rather than from a river.
Dept of Labour	Basic Conditions of Employment Act, no. 75 of 1997	2002	In order to ensure fairness to employees, it regulates employment conditions i.t.o. working hours, employment contracts, overtime, termination, etc.	Applicable to all employees working more than 24 hours a month, earning less than R115 572 p/a, and not in senior management positions.

Department	Legislation	Amendments	Purpose & brief description	Relevance to pulp and paper
Dept of Labour	Employment Equity Act, no. 55 of 1998	n/a	To encourage equal opportunity and fair treatment for all workers and to implement affirmative action measures to rectify past injustices. It prohibits unfair discrimination and instructs employers to, in consultation with employees, implement affirmative action measures, prepare and implement an employment equity plan, and take measures to reduce disproportionate income differentials. All of this is monitored by labour inspectors authorised under the Act.	Affirmative action: applicable to all companies employing more than 50 employees; prevention of unfair discrimination: applicable to all companies
	Labour Relations Act, no. 66 of 1995	1996; 1998; 2000; 2002	To advance economic development, social justice, labour peace and the democratisation of the workplace, it *inter alia* regulates the right to strike and the recourse to lock-out, the right to collective bargaining and the organisational rights of trade unions. It aims to promote employee participation in decision-making through the establishment of workplace forums and to provide simple procedures for the resolution of labour disputes. It also establishes the Labour Court and Labour Appeal Court as superior courts.	Applicable to the pulp and paper industry in terms of the rights to collective organisation and workplace decision-making participation that it grants employees.
	Skills Development Act, no. 97 of 1998	2003	To develop and improve the skills of the South African workforce. It encourages the development of skills programmes and provides the incentive for it in the form of skills programme grants and subsidies.	Applicable to the pulp and paper industry.
	Skills Development Levies Act, no. 9 of 1999	n/a	Stipulates that employers must pay 1% of their workers' pay as a skills development levy. 80% of the funds is sourced to the respective SETAs (Sectoral Education and Training Authorities), and 20% gets allocated to the Skills Development Fund. Any company who develops a skills programme can then apply for a subsidy from the Department of Labour, or a grant from the SETA.	Applicable to all pulp and paper companies with an annual wage bill exceeding R250 000. Categorised as the pulp and paper chamber of the Forestry Industries Education and Training Authority (FIETA).

Department	Legislation	Amendments	Purpose & brief description	Relevance to pulp and paper
Dept of Labour	Occupational Health and Safety Act, no. 85 of 1993	n/a	To ensure the health and safety of al workers in the workplace, as well as all people connected with the manufacturing plant. Employers must ensure that proper health and safety standards, as set out by the Act, prevail.	Applicable to all pulp and paper companies.
	Unemployment Insurance Act, no. 63 of 2001	n/a	It establishes the Unemployment Insurance Fund and provides for the payment of unemployment insurance to assist retrenched employees, as well as for illness, maternity, adoption or dependents' benefits.	Applicable to all employees working more than 24 hours a month.
	Unemployment Insurance Contributions Act, no.4 of 2002	n/a	To allow for the imposition and collection of unemployment insurance duties for the benefit of the Unemployment Insurance Fund (UIF). It stipulates that employers and employees should each on a monthly basis contribute 1% of the employee's income towards the UIF.	Applicable to all employees working more than 24 hours a month. Exemption is granted where employees receive remuneration under a learnership agreement registered in terms of the Skills Development Act no. 97 of 1998.
	Compensation for Occupational Injuries and Diseases Act no. 130 of 1993	n/a	To provide for compensation for disablement caused by occupational injuries or diseases sustained or contracted by employees in the course of their employment, or for death resulting from such injuries or diseases.	Applies to the pulp and paper industry, should employees be injured while on duty.
Dept of Trade and Industry	Trade Metrology Act, no. 77 of 1973	Act 34, 1975; Act 15, 1990; Act 17, 1993; Act 42, 1994; Act 58 of 1996, Trade Metrology Amendment Bill, 2002	To provide an effective and efficient system of measurements, in order to reduce disputes and transaction costs. It levels the playing field for commercial transactions, is a method of stock and fraud control, and provides a measurement for collection of government excise and taxes.	Applicable to the tissue component of the industry in the sheet requirements it sets for toilet tissue: 500 for single-ply, 350 for double-ply.
Dept of Land Affairs	Development Facilitation Act, no. 67 of 1995	n/a	This Act *inter alia* lays down general principles governing land development. It also facilitates the formulation and implementation of land development objectives to measure the performance of local government bodies.	It applies to the pulp and paper industry in terms of the regulations it lays down for the proper zoning of land for industrial purposes.

Table 53. Summary overview of legislation pertaining to the pulp and paper industry

11. APPENDIX K: CALCULATION OF WATER RESOURCE MANAGEMENT CHARGES

Table 54 gives an example of how the WRM charge is calculated for a WMA.

volumes in m^3	Total	Dom/Ind	Agri	Forest	Non-bill
WARMS Registered Vol.	**729,848,000**	50,728,000	677,950,000	970,000	200,000
Volume available[72]	**382,000,000**	*26,550,865*	*354,836,761*	*507,695*	*104,679*

WRM Activity	MTEF Budget	Recov	Trans adj	Input cost	Dom/Ind	Agri	Forest[73]
CMA Establishment[74]	6,297,000	-	-	-	*0.000*	*0.000*	*0.000*
Planning and implementing catchment management strategy	1,668,000	300,000	-	300,000	*0.041*	*0.041*	*0.041*
Dam Safety Regulations	155,000	155,000	-	155,000	*0.021*	*0.021*	
	Rands				*c/m³(cents/cubic meter)*		

Table 54 Example of the calculation of the WRM charge for a WMA

Source: DWAF (2005a) and Genesis calculations

Once the preliminary Reserve has been determined for a catchment, the total volume available for 'economic' users (i.e. 382m m^3 in Table 54) is calculated. Concurrently, the users in each category (domestic, industrial, agricultural and forestry) need to register the amount used, as the distribution of activity costs will be done proportionally to the average registered, licensed or estimated annual water use of sectors benefiting from the activity. In Table 54, this is indicated under each user category as the WARMS registered volume. The total, including the non-billable amount for this line is calculated (i.e. 730m m^3). The greater of the WARMS amount and volume available is used to calculate unit costs for each sector.

Looking at the lower half of Table 54, a number of the WRM activities are shown as an example. Once the: (i) MTEF budget is calculated, (ii) an estimate made of the amount that is feasibly recoverable through WRM charges and (iii) the transfer adjustment to another catchment factored in, then a final input cost is calculated. Using this input cost, the unit charge necessary to recover this input cost is calculated using the total WARMS registered volume (i.e. 300,000/729,848,000 * 100 = 0.041c/m^3). This process is repeated for each WRM activity and summed

[72] The proportion available for each sector is calculated according to the proportion each sector has registered for of the total WARMS registered volume.

[73] There is no charge in the dam safety regulations as forestry is exempt from this charge. The forestry sector receives no benefit as a result of this activity.

[74] No charge is applied for setting up the CMA.

together until a final charge for each sector is calculated. The water sales accounts of registered water users will be determined by multiplying the relevant sectoral unit charge by the registered annual volume of water used by that user.

Table 55 shows a summary of the sectoral WRM charges for the different catchments through-out the country.

Water Management Area	**Sectoral Unit Cost in c/m^3**		
	Domestic/Industrial	Agricultural: irrigation & watering livestock	Forestry
Limpopo	1.23	0.89	0.83
Luvuvhu and Letaba	1.6	1.07	0.98
Crocodile and Marico	0.85	0.7	0.68
Olifants	0.89	0.75	0.7
Inkomati	0.85	0.63	0.57
Usutu to Mhlathuze	0.42	0.42	0.41
Thukela	0.34	0.34	0.33
Upper Vaal	1.3	0.79	0.79
Middle Vaal	0.98	0.8	n/a
Lower Vaal	0.69	0.56	n/a
Mvoti to Umzimkulu	0.91	0.87	0.84
Mzimvubu to Keiskama	0.97	0.67	0.56
Upper Orange	0.38	0.38	n/a
Lower Orange	0.62	0.47	n/a
Fish to Tsitsikamma	1.45	0.61	0.38
Gouritz	2.11	0.72	0.56
Olifants/Doorn	1.16	0.7	0.64
Breede	2.64	0.64	0.41
Berg	3.25	0.76	0.61
Average	**1.19**	**0.67**	**0.61**

Table 55 Summary of sectoral WRM charges per WMA for 2004/05

Source: DWAF (2005a)

12. APPENDIX L: VOLUMETRIC DETERMINATION OF WATER USE

In this section the method of determining water use for raw water user categories is discussed.

WATER SERVICES AUTHORITIES AND INDUSTRIAL USE

According to discussions with DWAF, this is easy to estimate via a system of metering.

IRRIGATION

Three methods are used by DWAF to determine the volumetric extent of average annual water use of individual irrigators (DWAF, 2001).

- *Irrigation requirement*: Average annual crop water requirement[75] less average annual effective rainfall[76].
- *In-field irrigation losses*: Built in losses that must be added to the irrigation requirement, to establish total quantity of water used.
- *Irrigation management*: If there is no method instituted to manage the irrigation system optimally, then an additional quantity of water use will be added.

SFRA (PLANTATIONS)

Historically, the CSIR (Smith-Scott) curves were used to determine the volume of water used by plantations over and above the natural vegetation. However, the accuracy of these curves was contested due to the climatic representativeness of the experiments on which they were based. The experiments were conducted in catchments, all with mean annual precipitation (MAP) greater than 1100 mm, whereas 63% of plantations are based in areas with MAP less than 900mm.

As a result, based on an agreement between the forestry industry and DWAF, there has been a move to use the SFR (Gush) tables[77] and more recently the adapted (Tylcoat) SFR tables[78]. In most catchments, these curves – by taking into account the different species, areas planted, location and resulting moisture availability in quaternary catchments – suggest lower water use by plantation

[75] Minimum quantity of water necessary for optimal plant growth for the specific crop at the specific location. A complex and region specific process, involving satellite imaging, has been developed to estimate crop water requirements. The satellite imaging is, apparently, quite accurate and can be contested by farmers if they have better information.

[76] The rainfall that effectively replaces irrigation.

[77] Presenting mean annual SFR per ha afforestation in each quaternary catchment, over and above the volume of water used by natural vegetation.

[78] A modified version of Gush in order to smooth water charges for the forestry sector.

forestry than the CSIR curves. This obviously appeals to the forestry industry from a registration and pricing point of view.

According to DWAF (2002), in the allocation process “the best available research findings regarding low flows and MAP reduction per tree type should still be taken into account”. If there is not better local research available, then the adapted SFR tables will be used.