# TRENDS AND OPPORTUNITIES IN SOUTH AFRICAN FORESTRY

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*Those who cannot remember the past are condemned to repeat it.*
*- George Santayana*

# TRENDS AND OPPORTUNITIES IN THE FOREST INDUSTRY

## 1. INTRODUCTION

The purpose of this document is to give a brief overview of the development, present trends and opportunities in the forest industry. The early history, when South Africa was dependent on the limited natural forestry resources, is briefly discussed. Government's initiatives, to establish plantation forestry, in an effort to protect the natural resource and to make the country self sufficient in forest products as well as the factors, which influenced it, are described. The development and maturation of forestry into a significant industry and the emergence of the pulp and paper industries and the willingness of private investors to assume a leading role are also covered in this document.

This document should give sufficient information to the reader for long term strategic planning in the further development of the forest industry in South Africa and also in the SADC countries.

The Author of this document holds a Master of Science Degree in Forestry and has more than 30 years experience in the planning, management and research fields of Government owned plantations. His last position at SAFCOL was that of Group Manager for Research and Development for the period 1998 to 2002.

Information contained in this document was properly researched, using mainly published work and personal communications with experts in specific fields. A reference list is included at the back of this document. The information is a general overview and no effort was made to give detail. The document was peer reviewed and agreed to by a forestry specialist and SAFCOL top management respectively.

## 2. EXECUTIVE SUMMARY

South Africa is a dry country and poorly endowed with natural forest resources, with only about 300 000 ha covered in high forest, which is roughly 0,25% of the surface of South Africa. High forests occur mainly on the Southern and Eastern mountain ranges from the Western-Cape to Limpopo.

The early history of forestry in South Africa is comparable to that in other countries. The indigenous forests were exploited indiscriminately without any effort of re-afforestation. As the natural timber resources became depleted, the governmentGovernment embarked on the protection and scientific management of these resources. Very early it was realized that the increment of indigenous trees was very low, necessitating the planting of fast-growing exotic species.

During the First World War this country was severely affected by timber shortages because the importation of timber was temporary cut off. This motivated the Government to promote the establishment of fast growing exotic plantations. The private sector was initially reluctant to venture into such a long-term investment and the Government had to take the initiative in establishing the forestry industry of South Africa. South Africa was extremely successful in establishing exotic plantations and today is self sufficient in respect of most of its forest and timber products.

Initially private investors were only interested in investing in short rotation projects such as the wattle bark and mining timber industries and later the production of pulpwood. As the industry grew, the private sector became increasingly involved in timber processing and growing the longer-term sawtimber product and contributed in building an internationally important industry.

**Plantation Forestry**

Locally there is little scope to increase the plantation area due to climatic, environmental, legal and social factors. Productivity on already planted land can however be increased through:

a. Better site/species matching, tree breeding and improved management.
b. Better utilisation of untapped biomass resources like trees in urban areas, better waste management and alternative products (continuous research required).

**Indigenous forests**

Historically, indigenous trees were regarded to be too slow growing for commercial viability.

However the following opportunities need to be further investigated:

a. Recent provenance trials of yellowwood have shown that much can be done to improve the growth performance through the selection of genetic material for specific sites. This may also be true of other species.
b. Rural people posses a vast knowledge about the nutritional, medicinal and household uses of indigenous trees and they could become important partners in community projects to address the needs of the rural poor.

**Southern Africa**

While South Africa is now self sufficient in forest and timber products, the rest of Southern Africa, bar one or two countries, having an under-developed forestry sector. NEPAD could play an important role to develop this sector in the SADC countries.

# 3. HISTORY OF SOUTH AFRICAN FORESTRY

## 3.1 Indigenous forests

Soon after 1652 the harvesting of indigenous forests was started for the building of houses, ox-wagons, ships and for firewood. It was reported that difficulties were experienced as early as 1690 to supply sufficient volumes of firewood to ships in the Cape and harvesting was extended to the interior of the country. In the 1780s timber was exported through the Plettenberg Bay harbour and in 1818 also from Knysna. By 1852 the first sawmill was built in the Pirie forest near King Williams Town and in 1882 a steam driven mill was built in Gouna for the sawing of 500 000 yellowwood railway sleepers over a five year period. Yellowwood was soon depleted and the forest department took over this mill to saw stinkwood, rooiels and terblaans for state departments [44]. There was no scientific management of the indigenous forests at this stage. This exploitation of the natural forests was extended to the provinces to the north when they were colonized during the middle of the nineteenth century. The discovery of gold first in Mpumalanga (1870) and then the Witwatersrand (1886) accelerated the harvesting from these forests.

In 1880 the first qualified forestry official, M le Comté de Vasselot de Régne, was appointed in South Africa. In 1881 he started with the systematic management of indigenous forests. His objective was to manage the forests in such a way that sustainable yields would be realized. He had good intentions but in practice there were many problems. There were too few qualified foresters to control the harvesting activities, low yields and the selective demand for yellowwood. Le Comté was dismissed in 1891 and the management of the indigenous forests was placed under the Commissioner of Crown Lands. Forest management principles were compromised to generate funds for the state coffers and by 1895 indigenous forests were hopelessly over-exploited [1].

In 1909 the first known working plan was compiled. This plan prescribed the planting of *Acacia melanoxylon*, *Pinus radiata* and *Pinus canariensis* in the open areas of the indigenous forests.

Around 1910, a large percentage of the Cape midlands population was dependent on the indigenous forests for a livelihood. The Government decided to register all the forest workers at that stage and that no new registrations would be allowed. In 1939 the remaining forestry workers were de-registered and employed by the Department of Forestry [1].

## 3.2 Plantation Forestry

The first exotic timber plantation was established at Worcester in 1876 to produce fuelwood for the early steam locomotives [44]. Furthermore, small-scale plantings were extended to the east and the north as sample plots. About 1 000 species were tested over many years. The results of these plots proved valuable for later afforestation programmes. The main three genera, which were used in the early commercial plantings, were *Pinus, Eucalyptus* and *Acacia*. *Acacia mearnsii* was cultivated in the Cape regions for poles, fuel and shelter for stock. By 1880 a number of wattle plantations had been planted in KwaZulu-Natal and bark from these plantations was sold to a local tannery. In 1886 the first consignment of tanning extract material was sent to London, where after the industry developed rapidly and by 1917 there was an estimated 65 000 ha of *Acacia mearnsii* [37].

The Union Forestry Department was founded in 1910 [43]. At this stage the Department of Forestry had established 13 500 ha of plantations and the railway had 5 000 ha. The timber from the railway plantations was used for the building of coaches and wagons and timber was also sold to the mines [35].

During World War One the economic life of the country was disrupted by the timber famine, which arose, when the importation of timber supplies were cut off. Timber prices soared and this experience triggered renewed Government interest to make South Africa self-sufficient in timber resources [1]. At this stage the private sector was not interested in such long-term investments and the Government took the lead in establishing exotic pine plantations for saw timber production. Private investors concentrated on short rotation products like wattle bark, pole production, etc. The depression years of the late 1920s and early 1930s added an additional incentive for afforestation. Unemployed families were housed in “forestry settlements” where they were employed to plant trees.

When timber became available from the thinnings of the early pine plantations, there were no sawmills to process the timber and the private sector was again reluctant to invest large amounts of money in wood processing plants. The Government built the first sawmill in 1915 at Fort Cunnynghame to saw pine timber [44].

South Africa was extremely successful in the establishment of exotic plantations. Dr Ian Craib who, in 1939, published his well known “Thinning, pruning and management studies on the main exotic conifers grown in South Africa” made one of the most important contributions. Many of the South African principles were also implemented in other Southern hemisphere countries like New Zealand, Australia and the South America’s.

Afforestation was accelerated again after the Second World War but the private sector still concentrated on the short rotation products.

The production of sawtimber from State plantations increased progressively and the Government was forced to build the following sawmills [44]: -

* Elandshoek 1935
* George 1937
* Sabie 1940
* Nelspruit 1942
* Timbadola 1946

Others like Weza followed.

In 1960 close to 900 000 ha commercial plantation had been established in South Africa. The breakdown by ownership and species is shown in table 1.

**Table 1: Afforested area in South Africa by species and owner during 1960 [1]**

| Species | Public Ownership | Private Ownership | Total |
|---|---|---|---|
| *Pinus* | 224 000 ha | 150 000 ha | 374 000 ha |
| *Eucalyptus* | 30 000 ha | 130 000 ha | 160 000 ha |
| *Acacia meansii* | 5 000 ha | 356 000 ha | 361 000 ha |
| Other | 1 000 ha | 2 000 ha | 3 000 ha |
| Total | 260 000 ha | 638 000 ha | 898 000 ha |

Table 1 shows that by 1960 there was a well established private forest industry with a planted area more than double that of public ownership. However, 56% of the private area was planted to wattle. A relatively small area 130 000 ha was, at that stage, planted by entrepreneurs to *Eucalyptus*, mainly for the mining industry. This was the peak of the wattle industry. Due to an over-supply of tannin on the local and world markets in the 1960s, wattle became unprofitable and part of the wattle plantations were converted to other products [37].

The period after 1960 marked the maturation of the forestry industry. Private sector became more involved in the longer-term forestry initiatives of sawtimber and processing plants. It is also the period in which the mining timber sector peaks at the cost of the wattle bark industry. In 1970 there was an area of 471 000 ha planted to pine, 289 000 ha to *Eucalyptus* and 191 000 ha to wattle, while other commercial species covered an area of 7 000 ha. Total afforested area equalled 958 000 ha. Farmers and the public became increasingly concerned about the effect of afforestation on the water resources and the environment during this period [1].

## Hydrology

The Department of Forestry established the Jonkershoek hydrological research station in 1935, the Cathedral Peak Hydrological Research station in 1936 and the one at Mokobulaan in 1945 to test the effect of afforestation on streamflow. Sufficient data became available in the 1960s and 1970s to assist in scientific decision making regarding new plantings. Complaints by the public regarding the negative effect of afforestation on the water resources increased in times of drought such as the one in the early sixties. In 1968 the Minister of Forestry, in consultation with the Departments of Water Affairs and Agricultural technical services established a committee to investigate the concerns of the farmers and the public, regarding negative effects of afforestation on water resources. The findings of this committee contributed to the implementation of the afforestation permit system in an effort to minimize the effect of afforestation on water resources (Act 40 of 1972). The Afforestation permit system was a forerunner of the current integrated catchment management system [48].

## Environment

In regions where exotic plantations grow well, the landscape was transformed by large-scale commercial afforestation [2]. Pastoral and arable land was transformed to forestry, which affected biodiversity in the environment, social relationships with local communities and natural habitats.

Forestry companies in South Africa are fully aware of the environmental effects of large-scale forestry. Guidelines for application of conservation practices in forestry were published and are voluntary accepted by the major companies [5].

During the early 1970s the Department of Forestry promoted afforestation/forestry through the "Our green heritage" programme. The public was made aware of the benefits of the forestry industry. A financial aid system was also introduced in 1972 to promote afforestation, when loans of R80/ha at an interest rate of 5% were granted to individuals and companies who wanted to afforest 10 to 500 ha. This scheme did not operate for long [32].

## Forestry in former "homelands"

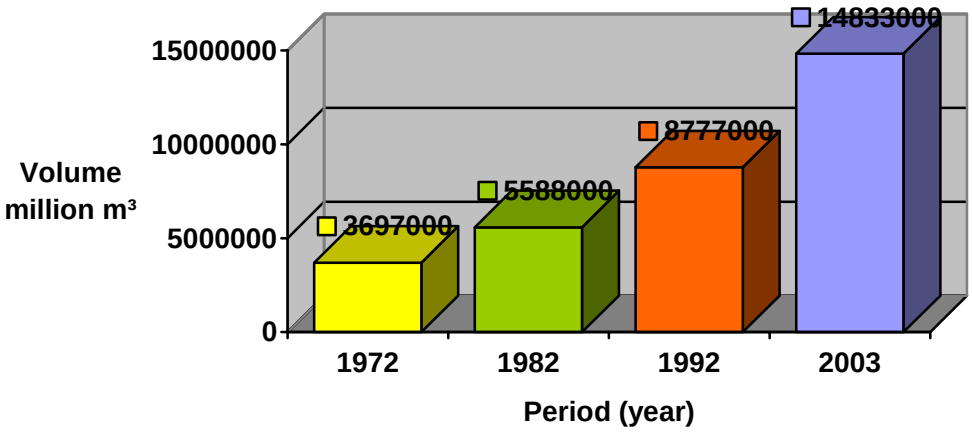
During the 1970s through to the middle 1990s, plantations in the former "homelands" were managed independently from those of the RSA. This unfortunate event contributed to the deterioration of plantation management in these areas. Forestry officials were seconded from central Government for periods of on average four years to the "homelands" and then replaced by others, which resulted in a lack of continuity with resultant negative impacts.

## The pulp and board industry

Sappi used Wood for the first time in 1948 to make paper in their Springs mill [31].

The pulp and paper industry started as many relatively small processors of who later amalgamated and rationalized their production capacity. Over the years nearly all these processors were taken over by the two large pulp and paper companies in this country who are today global players. In 1972, the paper and board consumption of roundwood timber was 3 697 000 m³. This grew to 5 588 000 m³ in 1982 to 8 777 000 m³ in 1992 and to an astounding 14 833 000 m³ in 2003 [24].

**Figure 1: Volume intake by the paper and board industry: Growth over the period 1972 to 2003**




## The mining timber industry

In 1972 the consumption of roundwood was 2 800 000 m³ and stayed at that level for the next 10 years. In 1986 the use of mining timber peaked at 3 300 000 m³ and thereafter steadily declined to the present level of 700 000 m³ per annum. The decline can mainly be attributed to the replacement of wood being used as mine props, by other materials and the stagnation of the mining sector.

## Co-operatives or Institutions representing growers

A number of organizations that represented timber growers and processors were founded [32].

a) In 1957 South African Timber Growers Association (SATGA) was formed to take care of the interests of private timber growers.
b) The South African Wattle Growers Union (SAWGU) was formed as early as 1937 to promote the interests of wattle growers.
c) The Forest Owners Association (FOA) was established in 1970 to represent the large growers who also had processing interests.
d) The Federation of Timber Growers Association (FTGA), established in 1977 served the common interests of SATGA, SAWGU and FOA.

e) The Central Timber Co-operative (CTC) was formed in 1970 to promote the marketing of the members' timber; members included Natal Co-operative Timber Company Limited (NCT), Natalse Landboukoöperasie Beperk (NLK), Transvaal Wattle Growers, Laeveldse Koöperasie Beperk.
f) In 1941 South African Lumber Millers Association (SALMA) was established to promote the interests of sawmillers.
g) The Association of Pulp and Paper Manufacturers (APPM) was established in 1957 for the development of the pulp and paper industry in South Africa.
h) The South African Mining Timber Manufacturers Association (SAMTMA) was established in 1966 to promote the interests of mining timber manufacturers.
i) SATGA and FOA amalgamated in 2002 to form Forestry South Africa (FSA) and are structured to represent most large, medium and small timber growers in this country.
j) At the present CTC, SAWGU, APPM and FSA are still active

# 4 RECENT TRENDS

## 4.1 Indigenous Forests

**Conservation**

The Department of Forestry implemented a policy for indigenous forests on state land in 1967. Subject to certain conservation principles, the indigenous forests are now managed to approach sustainable yield levels. The selective removal of trees is part of the multiple use management of forests [39].

**Research**

Research of indigenous forests was started when a research station was established at Saasveld in 1964. Research was concentrated in the Cape Midlands and Tsitsikamma indigenous forests, and mainly aimed at the maintenance and restoration of the natural diversity. This station was however closed in 1972 and the planning and management functions were placed under the Forestry Regional Organization. Presently the Department of Water Affairs and Forestry is the custodian of the indigenous forests and continues to manage them according to the above principles.

The commercial planting of many indigenous species were tried as early as the 1880s, but failed even on the best sites. A probable explanation could be that the relationship between forest trees and certain mycorrhiza or bacterial organisms are lacking in open veld [30]. Exotic pines were found to be ten times more productive than indigenous species.

In 1927 ten indigenous species were planted in compartment form at Diepwalle, in the Cape Midlands, with similar results.

During 1982 *Podocarpus falcatus* was planted in three provenance trials at Woodbush, Frankfort and Jonkersberg. The objective is to test different provenances and identify suitable genetic material for a breeding programme. Selected individuals at Woodbush and Frankfort showed promising growth rates when measured in 2001, at the age of 19 years, mean diameters of 13,5 cm and 11,6 cm were measured respectively [4].

**Marketing of products from indigenous forests**

Timber harvesting occurs on 20% of the Knysna and Tsitsikamma indigenous forest areas. The yields are however low because only over-mature trees are harvested. An average of about 3 750 m³ is sold on auction annually. More than half of the volume is of the exotic *Acacia melanoxylon*, which was planted in open spaces of the indigenous forests. Only about 150 m³ stinkwood and 750 m³ yellowwood is sold annually [3]. At the height of the indigenous forest exploitation in 1911, the harvest of sawtimber for that year amounted to 167 000 m³ [9]. It is planned to increase the yield again from the present levels, once a sound balance has been restored by the present scientific management practice.

## 4.2 Plantation Forestry

**Ownership**

The ownership of commercial exotic plantations has gradually changed from predominantly publicly owned to predominantly privately owned, over the last century. It is the intention of the Government to privatize/restructure all commercial forestry under their management. This process is approaching its conclusion. The Government will then concentrate on policy, regulating and monitoring the forest industry and developing social forestry.

Table 2 illustrates how the commercial plantation ownership has changed over the last 23 years. The shift in preferred species can also be seen.

**Table 2: Commercial forestry areas by period, ownership and species [24]**

| Year | Ownership | *Pinus* | *Eucalyptus* | Wattle | Other | Total |
|---|---|---|---|---|---|---|
| 1980 | Public | 263 263 | 36 845 | 7 233 | 3 295 | 310 636 |
| | Private | 293 301 | 355 643 | 132 148 | 4 727 | 785 819 |
| 1990 | Public | 277 344 | 44 142 | 6546 | 3 600 | 331 632 |
| | Private | 333 667 | 469 078 | 103 455 | 3 467 | 909 667 |
| 1998 | Public | 335 719 | 68 889 | 5 779 | 4 397 | 414 784 |
| | Private | 387 520 | 492 332 | 104 024 | 3 140 | 987 016 |
| 2003 | Public | 236 512 | 62 961 | 2 805 | 3 007 | 305 286 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Private | 472 682 | 478 479 | 110 459 | 4 720 | 1 066 339 |

Table 2 shows a marked increase in the *Eucalyptus* area, which is privately owned from 1980 to 1990. This is due to new afforestation and a shift from wattle to *Eucalyptus*. Publicly owned plantation area increased by about 21 000 ha, mostly pine. From 1990 to 1998 publicly owned area still increased. This is the period when SAFCOL was formed and the acquisitions of the Shannon Estate and the Lourensford Estate contributed to this growth. Over the same period private ownership grew by almost 10%, mainly pines. During the last five years a marked ownership shift from publicly owned to privately owned plantations took place. The effect of the sale of the KwaZulu-Natal and Eastern Cape SAFCOL plantations to Siyaqhubeka and Singisi mainly contributed to this shift. It is interesting to note that there was a slight reduction in the total planted area over that period, probably due to delineation of riparian zones and the exit policy applied to certain Cape and Mpumalanga plantations. It can be expected that at least 70% of the remaining publicly owned plantations would be transferred to the private sector by 2006.

**Products**

The growth of the pulp and paper industry over the past 20 years was phenomenal, while over the same period, the consumption of mining timber declined due to the stagnation of the mining industry and the use of alternative products in mines.

**Table 3: Roundwood intake by year and primary processors (rounded to nearest 1 000 m³) [24]**

| Processor | 1980 | 1990 | 2000 | 2003 |
|---|---|---|---|---|
| Saw & veneer mills | 3 697 000 | 4 341 000 | 3 407 000 | 4 242 000 |
| Pulp, paper & board | 4 214 000 | 8 866 000 | 11 842 000 | 14 833 000 |
| Mining mills | 2 587 000 | 2 811 000 | 799 000 | 707 000 |
| Pole treatment | 238 000 | 331 000 | 321 000 | 383 000 |
| Match factory | 32 000 | 33 000 | 34 000 | 34 000 |
| Charcoal plants | 328 000 | 522 000 | 267 000 | 235 000 |
| **TOTAL** | **11 096 000** | **16 904 000** | **16 670 000** | **20 434 000** |

The figures in Table 3 correlate closely to the plantation production figures, indicating little import or export of roundwood. The pulp, paper and board sector grew from 4 214 000 m³ to 14 833 000 m³ or with 252% over the last 23 years. The total of all products grew from 11 096 000 m³ to 20 434 000 m³ or with 84%. From Table 1 it can be calculated that the planted area grew by

only 25% over the same period. It follows that the plantations have become more productive over the last 23 years.

## Contribution to the economy

The investment value of the South African Forest and forest products industry was at replacement cost estimated as R35 billion in the year 2000 [17]. The forest and forest products industry exported products worth R9,920 billion or 3,63% of total exports in 2003 and total imports were valued at R5,053 billion which leaves a trade balance of R4,867 billion. The forest products GDP were R14.59 billion or 1,2% of total GDP in the same year [24].

In 2000 it was estimated that the forest and forest products industry employed 140 000 people, another 560 000 jobs were created upstream and downstream and that each job supported four dependants. This translates into 3 million people who are supported by the industry [17].

## The Environment

Foresters are well aware of the impacts which commercial afforestation can have on the hydrology, biodiversity and landscape. The industry is committed to practice sustainable forestry and has over the last five or six years embarked on a certification system and today about 80% of the commercial plantations are certified by either FSC or ISO14001 or both. Organisations like NCT offer group certification schemes to their smaller grower members' to make it more affordable for them [28].

The afforestation permit system was implemented in 1972 (amended 1995) to control new afforestation on a scientific basis to minimize the impact on water resources. Limited permits were issued in the last ten years.

## Communities

Traditionally commercial forestry was focused on biological studies and forest management. Community forestry was neglected in the past, when Government

focused on woodlots for fuel and building material. A paradigm shift is needed to address community forestry holistically to include development of the local economy, farm forestry, agroforestry, community or village plantations, woodlots and woodlot management by rural people. Some of the larger commercial forestry companies are already supporting outgrower schemes whereby small landowners are advanced capital to establish small commercial plots for a cash crop. The small growers are also supported with technical advice, assisted with the purchasing of plants and with the marketing of their products. These small growers are mostly individuals who own small plots of land. Community forestry has lately gained impetus through changes in the programmes of the Department of Water Affairs and Forestry [3].

Local communities are normally favoured by forestry companies or growers when employment opportunities arise or when contracts for forestry work are allocated. Communities close to commercial plantations sometimes also benefit from access to fire wood, thatch grass and grazing for their stock.

## 4.3 Research

South Africa has a long history of forestry research and has pioneered many practices, which are followed in other countries [18]. Silvicultural research was started in 1910, forest products research in 1920, hydrological research in 1936 and tree improvement research in 1958 [32].

These early initiatives were mainly driven and funded by Government. In 1983 the directorate of Forestry made the following policy statements regarding research [17]:

*"While the State will in future maintain a low profile in the timber growing and wood processing sectors, it will increase its contribution to those facets of the forestry industry that are essential for the creation and maintenance of a healthy economic and scientific climate in which industry can grow and prosper. It can therefore be expected that the State's involvement in research, conservation, extension and training will increase.*" The Directorate also undertook to expand in tree improvement, forest botany, site research, forest protection and fire research. South African Forest Research Institute (SAFRI) was then structured to fulfil the above promises. In 1990 this Research Unit was transferred to the CSIR. Government funding in the order of R10 million per annum continued for the next five years to give the unit, now called Environmentek, a chance to complete research which was in progress and to establish a viable Research unit. After the five years Environmentek scaled down considerably and concentrated on tree improvement and pulpwood studies.

Today, Government funding of forestry research has declined to a low level and with an uncertain future, resulting in many experienced scientists leaving this

field. The Forestry companies responded positively by starting in-house research and funding cooperative research at a number of institutes and tertiary education centres. The most important are the following:-

- **ICFR – Institute for Commercial Forestry Research**
  The Research Centre is based in Pietermaritzburg. Although it was initially started as the Wattle Research Institute in the 1940s, it now caters for silviculture, growth and yield research for all the major genera. This centre is widely supported by the forest industry for cooperative research. It is also funded by Forestry South Africa (FSA).

- **FABI – Forestry and Agricultural Biotechnology Institute**
  FABI is based at the University of Pretoria and is regarded as a world-class centre in Forest Pathology, Entomology and Biotechnology. This institute is funded by the University of Pretoria and by the forest industry in the form of memberships and the funding of individual projects.

- **CSIR**
  Environmentek is based in Pretoria and has smaller offices in Durban, Nelspruit and Stellenbosch. They mainly cater for tree improvement, conservation, community forestry, biotechnology and research in pulp and paper. This organization has scaled down and lost local clients in recent years but gained some clients internationally, mainly South America.

- **US – University of Stellenbosch**
  The former faculty of Forestry was recently absorbed by the Agricultural faculty and has lost industry support in the last few years. This centre does limited research in silviculture, growth and yield, forest economics, community forestry, wood technology and forest engineering.

- **PET – The Port Elizabeth Technikon**
  PET does limited research in Forest Engineering and Fire protection.

- **CAMCORE**
  CAMCORE is an international Research Organisation based at the North Carolina State University in Raleigh. This organisation is supported by forestry companies of mainly the southern hemisphere. CAMCORE is a centre of excellence for gene conservation of the species originating from Central America and Mexico and planted commercially in the southern hemisphere. Trials are planted and selections are made by most member companies. South Africa has three members.

In-house research for specific company needs is also conducted by all the major companies.

## 4.4 Human Resources

### Tertiary education

Formal forestry training in South Africa was started at Tokai in 1906 under the auspices of the University of Cape Town [44]. During 1932 the training centre for foresters was moved to Saasveld, near George, where foresters are still trained today. During 1932 the faculty of forestry was also established at the University of Stellenbosch where the emphasis was on scientific forestry training. Like many other centres, Saasveld was reserved for the white population and training colleges for black foresters were established at Fort Cox in the Eastern Cape and Swartkops in KZN during the period of the previous Government. Graduates from the latter two centres were mostly deployed in the former "homelands".

Forestry scientists are still trained at the University of Stellenbosch, which also caters for courses in community forestry. Saasveld was incorporated in the Port Elizabeth Technikon and now covers a wide variety of disciplines including Forestry, Agriculture and Nature Conservation. The University of Natal recently introduced a special forestry course in their Agricultural Faculty and The University of Pretoria established FABI where post graduates are enrolled in tree pathology, entomology and biotechnology.

Forestry has become an unpopular career choice [54 and 58]. The reasons are poor research funding from Government and poor remuneration compared to other professional careers; e.g. technology, finance, legal and the medical fields. Currently the University of Stellenbosch has a low intake of forestry students and receives little support from the industry. This trend may in future lead to a shortage of Forest Scientists to the detriment of the forest industry.

### Technical and practical training

The larger forestry companies conduct their own in-house training, which focuses on operational training, fire protection, safety, supervision, etc. The Forest Industry fully supports the National Qualifications Framework (NQF) and has developed standards for most sectors in the industry.

For about two decades (80s and 90s) the Timber Industries Manpower Services (TIMS) operated a number of technical training centres for the timber industries. The closure of this service was a great loss to the industry and the gap in capacity has never been filled fully by in-house training [49].

Over the last decade the trend in the forestry sector is to outsource silviculture and some harvesting operations to entrepreneurs and at the same time reduce the permanently employed component. Contractors are normally not geared to give their workers the same level of training as the companies did. The short-term nature of forestry contracts is a problem for most contractors as it creates

uncertainty and complicates sourcing of finance and contributes to their reluctance to invest in costly training.

# 5 OPPORTUNITIES

## 5.1 Nationally

### Plantation Forestry

#### Increase productivity of existing plantations

South Africa has little scope to expand the planted area due to the shortage of suitable land, for which it has to compete with agriculture and the stringent policies regarding changes in land use. For this reason productivity must be increased on existing plantations by better site-species matching, better silviculture and the use of improved genetic material. Most growers follow these practices.

The approximately 60 000 ha commercial plantations which are still managed by DWAF, is an exception. The productivity is low due to lack of expertise, fires and relaxed management. Before any new afforestation is embarked on, these plantations should be rescued before they disappear totally and become jungles. Infrastructure, although in a poor state of repair, is already in place and with proper management the present loss of about R300 million per annum could be turned around to a break-even situation within ten years.

#### "Waste" management

It has been suggested that the 20th century will be remembered in history as the age of waste [45]. Waste management has improved tremendously over the last two decades through yield optimization in the field, utilization of sawmill residues for pulping, new sawmill technology, etc. There is however still scope for small business to utilize available residues. The population also need to be educated to recycle forest products like paper. The recycling of 3 tons of paper for instance conserves the equivalent fibre of 17 trees.

The world will run short of energy in the forms we know and every effort should be made to make use of alternative or renewable resources. Sawmills are in a unique position to generate energy/electricity from sawmill waste. At the first Products Research Conference in South Africa in 1985, a report was presented about a sawmill in New Zealand which generated 17 000 tons of waste and used it to generate 2 300 tons of charcoal, 2 gigawatt-hours electricity and 15,6 terajoules heat for kilns. The system on its own ran at a profit. In 2000 there were 78 sawmills and Veneer Plants, 12 mining timber mills and 29 pole treatment plants in South Africa and some of them could surely contribute to the generation of electricity [20].

Biomass gasification in combination with combustion burners are viable options to generate electricity. The NTRI at the CSIR had early success with producer gas [38]. The complications with the above are usually the cost of the timber resource/waste. The resource is usually not at the right place in the right form and becomes costly to collect and transport.

To make this a profitable field of investment the Government should formulate a clear policy on the value of and recognise alternative energy sources from renewable resources [22].

## Alternative Forest Products

### Chemicals

The extraction of chemicals from pine trees is one of the oldest industries [8]. Turpentine and resin were once essential for the construction of wooden sailing ships. "Resin tapping" was practiced in Government plantations in KwaZulu-Natal from the 1960s until recently. Most of these materials can today be recovered after the process of chemical pulping of pinewood.

There are many other wood based chemicals which can/are extracted from wood and used in making diverse products like laundry detergents, toothpaste, adhesives, printing ink, dyes, animal feed pellets, textiles, artificial vanilla, synthetic plastic, rayon fibre, etc [8].

The biomedical science of ancient remedies are just beginning to be understood. Medical compounds from trees have long been used - aspirin for instance contains sylicylic acid from the bark of Salix (willow tree) [8]. There must be many opportunities in this field. However research and eventual registration of a medical product is a capital intensive and time-consuming process before it can be marketed.

In South Africa, the industry takes up more carbon dioxide than it releases. There is a potential to sell this stored $CO_2$ to companies in developed countries to help offset their emissions. Such sales occur under the legal framework of the Kyoto Protocol, which was signed by Government and not companies. Sales will therefore need Government endorsement. Mechanisms for this are not in place yet, but could be created in future [41].

### Pine Needles

It has been reported that the use of pine needles has become a multi-million dollar business in North America. Pine needles are used in a multiple of applications; such as landscaping, land rehabilitation, in flowerbeds, in pathways, on steep banks, for pet bedding, in livestock barns, for reduction of water loss in irrigation [53]. The collection of the needles is labour intensive. Locally the negative effects of needle removal from plantations will first have to be investigated.

Pine bark

Pine bark is widely used in tree nurseries as growing medium. Sufficient quantities are available on sawmill sites to make the collection and partial composting a profitable business.

Honey farming

Honey farming is a by-product in forestry. *Eucalyptus* nectar is popular with honey farmers who place their beehives in commercial plantations. A negative aspect of this activity is that honey thieves often use a smoking rag, when robbing a hive. Many fires are started in this way by honey hunters.

Other uses of trees

Trees are used for a variety of purposes other than commercial gain, e.g. drift sand reclamation, erosion combat, windbreaks for dwellings and orchards, protection of stock, fodder for stock.

Furniture timber

Manufacturers of high quality furniture and cabinetmakers are dependent on the limited indigenous timber, which is auctioned each year, and on imported timber. In an effort to address this local shortage of furniture timber, the then Department of Forestry embarked on a programme to plant suitable species for furniture in the beginning of the 1980s [51]. In the Tsitsikamma and Knysna areas *Acacia melanoxylon* (blackwood) was planted and in Limpopo and Mpumalanga the species *Gmelina arborea, Khaya nyasica, Cedrela toona, Chukrasia* and *Tectona grandis*. The silviculture was intensive and costly and growth was slower than the pines and when SAFCOL was established, this programme was abandoned because it was regarded as unprofitable. There are still a few of these plantings; a fine example is at Woodbush. The need to revive the programme should be investigated.

Trees in the city

City dwellers are enthusiastic tree lovers and most gardens in the cities support an abundance of trees of all shapes and sizes. Invariably some of these trees become troublesome or too large. Hundreds of these trees must be removed daily. This is a source of fibre, which could be sold or given to a processing plant, which uses such material. The municipalities could invest in mobile chippers or trees could be dumped at a central spot where chipping could be done. The viability of such a programme should be investigated.

## Indigenous Forests

### Planting even aged indigenous timber for furniture

Attempts have been made in the past to plant indigenous trees in plantation form and valuable species like stinkwood, yellowwood, kiaat and others have

been tested. While a species like kiaat is not easily established, others like stinkwood and yellowwood were found to be growing too slowly. Slow growth is a relative term when comparing South Africa for instance, to Scandinavia where rotations are in excess of 100 years.

The establishment of the *Podocarpus falcatus* provenance trials mentioned in paragraph 2.1 was the first attempt to select genetic material for a specific site. These selections look promising and such research should be initiated for other valuable species. Different silvicultural practices and fertilization should also be tested.

**Reclamation**

Indigenous species have been used to stabilise sand dunes, reclaim eroded land, stabilizing road cuttings after road construction and lately 30 indigenous species were tested on toxic mine dumps [16].

**Traditional uses**

People in rural areas have learned over many years how to use nature [47]. This valuable knowledge of local people can be tapped for the benefit of all. The possibilities of domesticating indigenous fruit trees, of which there are many, could be investigated. The marula tree is a fine example. Marula is spread throughout semi-arid areas and has multiple uses. Rural communities eat the fruit, make jam, oil is extracted from the kernels, leaves are fed to livestock and used for medicinal purpose and as a sedative, bark extract is also used for medicine, e.g. dysentery, diarrhoea, rheumatism, insect bites, burns and the roots for bilharzias, coughs, eyes, hyper tension and the gum for ink. The juice is used to make beer and even a South African liqueur and the wood for carving. There are many more such useful indigenous trees.

In the past community forestry was neglected and limited to planting woodlots of exotic species for fuelwood in an attempt to protect the natural resources [27]. Many of these projects were failures because the needs of the rural poor were not addressed, rather what Government thought they needed. Unsuitable species were for instance planted, e.g. *eucalyptus*, which is a poor fuelwood [52]. Fuelwood is still the main source of energy for most rural households and demand exceeds sustainable supply in many areas. Rural women have a sound knowledge of the uses of trees and shrubs and are the direct users of fuelwood and are important stakeholders in rural community projects.

**Fodder supplement for livestock**

Numerous reports have been written on the benefits of leaves of indigenous trees as a source of supplement fodder in the dry seasons. The pods of African Acacias produce more protein per hectare than a grain crop [11]. Small farmers will however not plant acacias until it can be converted into cash, however acacias in their natural state may be at risk once it gets a monetary value.

Government could therefore play a role in promoting the planting of indigenous trees by educating rural communities regarding their fringe benefits.

## 5.2 Internationally

The relative stable political climate in the Southern Africa Development Community (SADC) countries south of the Congo River has opened new possibilities for cooperation in the expansion and development of the forestry industry in Southern Africa. The New Programme for African Development (NEPAD), chaired by our president Mr Thabo Mbeki, does not specifically address forestry or the forest products industry, but agricultural development features strongly [29].

The total plantation area of the SADC countries totals 2 481 000 ha of which 62,6% is in South Africa, 6,5% in Swaziland, 5,7% in Zimbabwe, 5,7% in Angola and 5,4% in Tanzania and the rest of the countries have less than 5%, except Namibia which has no plantations. The SADC is a small player in global terms but within the SADC locally South Africa is a giant player in forestry. There is little economic activity in forestry and forest products outside South Africa except Swaziland which produces 200 000 metric tons of pulp per annum. The Forest Products trade in US$, according to FAO figures for 2000 were as follows: Imports by SADC countries amounted to 598 000 000 dollars and Exports to 956 300 000 dollars. Of this South Africa contributed 486 400 000 on the import side and 827 700 000 on the export side [29].

The most suitable areas for afforestation in the SADC area lie from Northern Mozambique across to Angola. It is estimated that 25 000 000 ha is climatically suitable for afforestation but this does not mean that the area is available for forestry. Even if only 10% is afforestable, the plantation area in SADC could be doubled to 5 million ha. There are two requirements for success, namely capital and technology. Capital in the SADC region is estimated to cost 30% to 60% more than in other parts of the world. Negotiating for the building of processing plants and infrastructure will only be possible once the plantations have been established and a sustainable resource can be assured.

The importance of visionary long term planning cannot be over-emphasized. Plantations have in the past been established in some SADC countries without long term planning. A good example are the 50 000 ha low quality pine plantations at Zomba, in Malawi, which cannot be utilized due to the lack of infrastructure and the low value of the product.

SAFCOL has in the past, investigated various ventures in the neighbouring countries. A short summary is given below regarding possibilities/opportunities of some SADC countries [56].

Zimbabwe

The Zimbabwe Forestry Company (ZFC) (formally the Zimbabwean Forestry Commission), has a planted area of 40 000 ha. Border Timbers has 25 000 ha and the Wattle Company another 25 000 ha. The infrastructure is well developed and the full value chain exists, with the result that the roundwood is processed locally. The plantations are situated in the Eastern highlands, which have sufficient rainfall for forestry. There is little potential for expansion because forestry competes with other land uses like agriculture, for which there is a high demand.

ZFC has a good research facility. A further advantage for the forest and forest products industry in Zimbabwe is the proximity of the Beira harbour through which products can be exported. ZFC is in a process of privatization and could be an opportunity for the acquisition of a forestry asset by private investors.

Mozambique

Under the right circumstances/conditions Mozambique has a huge potential for expansion. Although the infrastructure is at present poor, various forestry projects have been initiated in the past. The total afforested area is reported to be 141 000 ha (FAO). Ifloma, in the Manica province, which was acquired by Komatiland Forests, is planted to eucalyptus and pine. South of Maputo there are some *Eucalyptus* plantations and in northern Mozambique there are plantations which are not utilized due to a lack of infrastructure and/or processing plants. When developing new plantations access routes to markets or facilities are important.

Mozambique has a huge potential for the development of an industry utilizing their indigenous savannah forests, which are, at the present, operated unscientifically and with massive wastage.

Namibia

Namibia is a dry country and has little potential for commercial afforestation. However, like Mozambique, Namibia has a resource of indigenous savannah woodland, which is presently probably not managed optimally.

Botswana

Botswana is also dry and has little potential for commercial afforestation. The savannah woodlands are utilized for fuelwood.

Malawi

Malawi has about 50 000 ha low quality pine plantations in Zomba and the Viphya plateau. It is not economical to transport this timber to a processing plant in another country. Malawi is environmentally sensitive for further afforestation due to the great lakes, which they plan to develop for tourism. It can be assumed that the potential for afforestation is low. However the existing

plantations could be replanted with good quality genetic material and better silviculture could be applied to improve their quality.

Angola

From a climatic point of view Angola has the biggest potential for afforestation in the SADC Region. An area of 150 000 ha has already been planted to eucalypts along the Lobito corridor, however infrastructure is lacking. From a 1998 study it was found that another 100 000 ha could be planted in this area to produce 3 million tons of fibre per annum, which would be sufficient to support a profitable pulp plant [13].

The efficient utilization of indigenous trees in the Cabinda province has a huge potential.

Tanzania

The Commonwealth Development Corporation (CDC) owns two forestry companies namely Tanwat which manages 20 000 ha of wattle, eucalypts and pine and KVTC which manages 10 000 ha teak plantations. KVTC is a environmentally certified management unit. At Suahill, the Government has 100 000 ha pine plantations but little value adding is done and the Government plans to privatize their plantations but lack privatization expertise. Tanzania has huge scope to expand their commercial forestry operations.

Zambia

Zambia Forestry and Forest Industry Company (ZIMCO) has 62 000 ha *Eucalyptus* plantations in the copper belt. The product is mainly mining timber and poles of low value, which could not be exported profitably.

One of the problems in SADC is the lack of a standardized border control procedure. At each border post a different set of documentation and licenses apply, which makes importing and exporting cumbersome because transport vehicles have to spend a long time in queues, sometimes for days, which adds unnecessarily to the cost of the product.

# 6 THREATS

## Global Warming

Global warming presents threats and opportunities to forestry companies. It is not known what the effect of global warming will be on the climate, whether it will become wetter or drier in a specific region. Species which are suitable at present may not be suitable in future or sites which were previously not suitable for forestry may become suitable. Proactive research and strategy for climatic change could separate the winners from the losers in the industry [41].

**Markets**

The over-production of wood fibre in the southern hemisphere may effect price negatively. Forestry is a long-term investment and it is very difficult to predict the markets in 10 years (fibre) or 25 years (sawtimber). There is little demand for pulp in the SADC countries and pulp or pulpwood produced locally will have to be exported initially. The South American and East Asian countries, especially Brazil, have expanded their fibre wood production over the last ten years and this may lead to overproduction of fibre wood.

**HIV/AIDS**

It is expected that HIV/AIDS will continue to rise and peak between 2005 and 2010 [3]. In a recent report it was found that in the forestry sector, the semi-skilled workers, drivers and chainsaw operators are particularly affected by this pandemic [49]. Not only do new operators have to be trained to replace this human resource at a faster rate, but also young people are reluctant to work in the plantations or on farms, resulting in the scarcity of drivers and chainsaw operators in this sector.

## 7 CLOSING REMARKS

The 1999 Hans Merensky Foundation lecture was delivered by E.K. Sadanandan Nambiar, an Australian academic, who gave this sound advice to South Africa [34]:-

*"Think globally, but act locally - in other words be realistic, practical and develop in situ and close to the source of the resource."*

This is indeed sound advice and Southern Africans must make more use of local expertise to develop a long-term strategy for the whole region. Many failed projects in Africa are the result of short-term involvement of donor countries on an *ad hoc* basis.

# REFERENCES


1. Anon., 1973. Bosbestuur, Die Geskiedenis van Bosbestuur in Suid-Afrika. Lecture Notes : Faculty of Forestry, University of Stellenbosch. pp 129-140

2. Anon., 1968, Afforestation and Water Supplies in South Africa Report by Interdepartmental Committee of Investigation, Department of Forestry. pp 115

3. Anon., 2000/01. South African Yearbook. Government Communication and Information System.

4. Anon., 2002. Tree Improvement. SAFCOL Biennial Research Report

5. Armstrong, A.J; and Van Hensbergen, H.J., 1996. Impacts of Afforestation with Pines on Assemblages of Native Biota in South Africa. S.A. Forestry Journal 175 : 35-42

6. Armstrong, A.J., Benn, G., Bowland, A.E., Goodman, P.S., Johnson, D.N., Maddock, A.H. and Scott-Shaw, C.R. 1998. Plantation Forestry in South Africa and its impact on Biodiversity. S.A. Forestry Journal 182 : 59-65

7. Bembridge, T.J. and Tarlton, J.E., 1990. Woodfuel in Ciskei : A Headload Study. S.A. Forestry Journal 154 : 88-93

8. Bowyer, J.L., Shmulsky, R. and Haygreen, J.G., 2003. Forest Products and Wood Science: An Introduction, Blackwell Publishing Co.

9. Brink, A.J. and Van der Zel, D.W., 1980. Die Geskiedenis van Bosbou in Suid-Afrika Deel 1 : Die Inheemse Bosse. S.A. Forestry Journal 114 : 13-18

10. Brink, A.J. and Van der Zel, D.W., 1980. Die Geskiedenis van Bosbou in Suid-Afrika Deel 2 : Plantasiebosbou. S.A. Forestry Journal 115 : 17-27

11. Barnes, R.D., 2001. The African Acacias – A thorny subject. S.A. Forestry Journal 190 : 9-18

12. Cellier, G.A., 1993. The Changing Landscape – is there Room for Forestry in the New South Africa? S.A. Forestry Journal 167 : 57-61

13. Crickmay & Pöyry, 1998. Forestry Resource Scan-Lobito Coridor. Spatial Development Initiative, Report on behalf of DBSA, DTI, CSIR

14. Darrow, K.D., 1983. Pine oleoresin : a minor Forest Product of major importance ? S.A. Forestry Journal 125 : 97-99

15. Department of Forestry, 1969. The management of man made forests and industrial plantations : Problems and Solutions. Forestry in S.A. 10 : 7-14

16. Dharamraj, N.M., Gaum, W.G. and Hildebrand, A., 1999. An investigation into the establishment of indigenous trees on treated mine residue soils in South Africa. S.A. Forestry Journal 186 : 33-39

17. Directorate of Forestry, Department of Environmental Affairs, 1983. Policy Statement with regard to the future of forestry Research. S.A. Forestry Journal 127 : 1-2

18. Dyck, W.J., 1995. Forestry Research in South Africa. A review of forestry research in South Africa for the Department of Water Affairs and Forestry and Forest owners Association. pp 23

19. Edwards, M.B.P., 2000. What if all the S.A. timber plantations were to disappear? S.A. Forestry Journal 189 : 1-2

20. Fung, P.Y.H., 1985. Forest Products Research. Abstract of proceedings IUFRO Symposium

21. Gandar, M.V., 1984. Wood as a source of Fuel in South Africa. S.A. Forestry Journal 129 : 1-9

22. Garbutt, D.C.F. and Van Breda, P.V. 1979. The potential in South Africa for obtaining fuel from Wood. S.A. Forestry Journal 111 : 54-57

23. Geldenhuys, C.J., 1975. Die Kunsmatige vestiging van Inheemse Bos in die Suid-Kaap. Forestry in S.A. 16 : 45-53

24. Godsmarck, R.C., 2003. South African and Forest Products Facts-2003. Forestry South Africa

25. Grut, M. 1975. Long Rotation Forest Products in Southern Africa. S.A. Forestry Journal 95 : 11-20

26. Ham, C. And Theron, F., 1998. Community Forestry – Project Implementation Through Communities as a Whole or Through Interest Groups ? S.A. Forestry Journal 181 : 45-49

27. Ham, C. And Theron, J.M., 1999. Community Forestry and Woodlot Development in South Africa : Past, Present and Future. S.A. Forestry Journal 184 : 71-79

28. Ham, C., 2000. Certification : Situation analysis of private timber growers in South Africa. S.A. Forestry Journal 187 : 59-64

29. Job, J.L., 2002. Southern Africa. Woodbasket of the future. S.A. Forestry Journal 195 : 5-10

30. King, N.L., 1951. Tree Planting in South Africa. Reprint from Journal of the South African Forestry Association No. 21

31. Laurens, H.C., 1982. Developments and Trends in the Forest Products Sector in South Africa. Jubelee Addition Saasveld 50 : 133-143

32. Louw, W.J.A., 1987. Forest Management II. Lecture Notes. Saasveld : 14-16

33. Myburgh, J.C., Nänni, U.W., Wicht, C.L. and Van der Zel, D.W. 1970. Results of the Multi catchment experiments at the Jonkershoek Forest Hydrological Research Station, South Africa. 1940-41 to 1964-65. Forestry in S.A. 11 : 1-2

34. Nambiar Sadanandan, E.K., 1999. Pursuit of Sustainable Plantation Forestry. S.A. Forestry Journal 184 : 45-62

35. Pirie, G.H., 1982. Railway plantations and railway sleepers in South Africa – 1910 – 1938. S.A. Forestry Journal 122 : 59-62

36. Pott, R.Mc.C., 1997. Plantation Forestry in South Africa and its Impact on Biodiversity and Water. S.A. Forestry Journal 180 : 45-48

37. Poynton, R.J. Undated. Tree Planting in Southern Africa, The Genus Acacia Miller

38. Scharfetter, H. and Gore, W.T., 1982. Introduction of Producer Gas as an alternative Fuel – South African Case Example of a programme for applying Technology. S.A. Forestry Journal 120 : 45-49

39. Seydack, A.H.W., Van Daalen, J.C., van Dijk, D., Reynell, D., Heyns, H., Jooste, A., Ferguson, M., Pitchford, W., Durrheim, G. And Williams, D., 1990. Yield Regulation in the Knysna Forests. S.A. Forestry Journal 152 : 50-61

40. Shackleton, S.E., Shackleton, C.M., Cunningham, T., Lombard, C., Sullivan, C.A. and Netshiluvhi, T.R., 2002. knowledge of *Sclerocarya birrea* subsp. *caffra* with emphasis on its importance as a non-timber forest product in South and Southern Africa : A Summary. Part 1 : Tasconomy, ecology and role in rural livelihoods. S.A. Forestry Journal 194 : 27-41

41. Sholes, R.J., 2003. Forestry and Climatic change. S.A. Forestry Journal 198 : 1

42. Sonntag, A.E., 1982. A national Forestry Guide Plan for South Africa. S.A. Forestry Journal 121 : 1

43. Steyn, J.W., 1961. Ontwikkeling en Werksaamhede gedurende die afgelope halfeeu van die departement van Bosbou van die Unie van Suid-Afrika. Forestry in S.A. 1 : 1-11

44. Steyn, J.W., 1982. Die Ontwikkeling van die Saagmeul bedryf in Suid-Afrika. Jubilee Addition Saasveld 50 : 129-132

45. Stratten, P.M., 1975. Short rotation Forest Products in Southern Africa. S.A. Forestry Journal 95 : 5-13

46. Tempelhoff, J., 1991. Die Ontginning van Noord Transvaal se Houtbronne in die Negentiende Eeu en Vroë Bewaringsmaatreëls. S.A. Forestry Journal 158 : 67-74

47. Van Eck, H., Ham, C., and Van Wyk, G., 1997. Survey of Indigenous Tree Uses and Preferences in the Eastern Cape Province. S.A. Forestry Journal 180 : 61-64

48. Van der Zel, D.W., 1995. Accomplishments and Dynamics of the South African Afforestation Permit system. S.A. Forestry Journal 172 : 49-58

49. Van der Zel, D.W., 2000. The human element in forest sustainability. S.A. Forestry Journal 188 : 1

50. Van Niekerk, D.J.T., 1974. An analysis of Timber Supply and Demand in South Africa. S.A. Forestry Journal 91 : 5-13

51. Von Den Bussche, G.H., 1982. The Establishment of Hardwood Plantations for the Production of Furniture and Joinery Timber in Transvaal. Part 1 : Planning and Progress. S.A. Forestry Journal 121 : 11-16

52. Williams, A. And Schackleton, C.M., 2002. Fuelwood use in South Africa : Where to in the 21st Century? S.A. Forestry Journal 196 : 1-7

53. Zwolinski, J., and Quicke, h., 1998. Commercial harvesting of Pinestraw in the South-Eastern United States. S.A. Forestry Journal 181 : 21-23

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