



A cost comparison between mechanisation and manual labour in a privately-owned forestry farm

C Uys



<https://orcid.org/0000-0003-3180-9948>

Mini-dissertation submitted in partial fulfilment of the
requirements for the degree *Master of Business
Administration* at the North-West University

Supervisor:

Prof AM Smit

Graduation May 2018

Student number: 23057823

Acknowledgements

I would like to make use of this opportunity to thank my loving wife Tammlyn for the tremendous support she gave me throughout the two years of this MBA studies by always having a positive word of reinforcement when the motivation is low. To my parents Anton and Mariaan a special thanks for the opportunity given to me to further my studies by not only paying, but supporting and motivating (sometimes forcefully, which was duly needed) me throughout the six years spent at university.

I would also like to thank my sister Antoinette and her husband Dr Theunis, whom on very short notice helped me out with the technical editing of this dissertation. To Professor Anet Smit a special thanks for giving me guidance and support in this dissertation when I asked for help. To Michaela Haigh a special thanks for helping me out with the last technical edits.

Then to each member of the BEE-TEAM (a-k-a, the winning team) a warm round of applause. Without the support of a proper functioning team like us, this MBA would be close to impossible to complete. Studying and working together on completing this degree made me a better person and I learned a lot from each and every one of you.

To my Labrador retriever Marley. Thank you for lying beside me, sleeping and snoring while I wrote this dissertation. You could have played with your friends on the farm but you chose to stay with me. I thank you dearly.

Kind Regards

Abstract

Globally the world has mechanized most industries. South Africa still trails most developed countries but is currently progressing into a 4th generation of mechanization. In particular, the agricultural sector should investigate the possible advantages to be obtained by mechanisation. Large technological advancements in the forestry harvesting process have been developed over the last 2 decades internationally. This technological advancements however comes at high cost as most of the machines are imported and are costly to operate. Small scale forestry farmers need to keep up to date and check whether it will be feasible for them to implement such advancements. Failure to keep up with technological advancement may lead to small scale farmers becoming uncompetitive and priced out of the market.

This research study aims to investigate the feasibility of implementing the mechanical tree harvesting process compared to the traditional manual labour process, for the small scale forestry farmer in the harvesting of eucalyptus trees. This study includes 5 case studies of forestry farmers on the Highveld area of Mpumalanga. Information for each case study was obtained via oral interviews. The cost involved in mechanical harvesting was obtained from literature and adapted to suit the purpose of this study. The cost for manual labour harvesting was developed by analysing the literature as well as from interviews conducted with manual tree harvesting companies and experts in the field.

This study revealed that for one of the cases it would be advisable to mechanise the harvesting process of the eucalyptus trees. For the other cases it was recommended not to mechanise the process as the costs of manual labour was significantly less compared to the cases that will benefit from mechanisation. On average the manual labour harvesting method was R16.52 per ton less than for the mechanical process. However if one takes into consideration the minimum wage increase to be implemented in 2018 in South Africa and assuming that all other costs remains constant, then things changed dramatically. The increase in minimum wage will result in the mechanisation process being more profitable and an average saving of R4.05 as compared to manual labour.

Key words

Forestry, small-scale farmer, mechanisation, manual labour, costing.

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CHAPTER 1: AN INTRODUCTION TO A COST COMPARISON BETWEEN MECHANISATION AND MANUAL LABOUR IN A PRIVATELY-OWNED FORESTRY FARM

1.1 INTRODUCTION

In difficult economic times, businesses need to investigate all the possibilities to increase their profit and productivity. Farmers are constantly challenged with increasing capital investments and severe droughts, all impacting their triple bottom line (Schirmer, 2004; Mussa et al., 2014). As South Africa is currently moving into the 4th generation of mechanisation, the agriculture sector also needs to investigate the possible advantages offered by mechanisation (RSG, 2017). As in most of their processes, private small scale forestry farmers currently make use of manual labour to harvest trees. The forestry industry is known for high labour turnover, absenteeism and a high accident rate. Therefore, forestry farmers should investigate other options to increase the productivity as well as the safety of their employees and possibly the profits of their farming operations (ILO, 2012). This study aims to investigate the profitability for the small scale forestry farmer to mechanise the tree harvesting process. This study is based on real life scenarios of forestry farmers in the Highveld region of Mpumalanga in South Africa. Calculations will be made by means of a Microsoft Excel spread sheet where after a conclusion and recommendations will follow on whether it would be profitable for the small scale forestry farmer to mechanise the tree harvesting process.

1.2 BACKGROUND INFORMATION

1.2.1 Agriculture industry of South Africa

Agriculture in South Africa has a vital role to play in building a strong economy (Department Agriculture, 2017). Farmers in South Africa and over the world are constantly challenged by increasing costs of capital investments and if these costs are not duly considered, farmers will go bankrupt (Schirmer, 2004).

South African farmers face unique challenges such as droughts, farm attacks and land reform (Mussa *et al.*, 2014). Drought in particular is a serious concern as South Africa is a semi-arid country. The impact of drought, other than dwindling water supplies, is

the effect drought has on the production of staple crops in South Africa. In 1992/1993, undoubtedly one of the most widespread droughts of the last 45 years, maize had to be imported to South Africa (Department of environmental affairs, 2017). The knock-on effect of crop failure resulted in the population moving from rural areas into urban areas farm labour lay-offs, farm closures as well as an increasing financial debt in the agricultural sector (Department of environmental affairs, 2017). The more recent drought of 2015-2016 again affected the profitability of farmers and highlighted the challenges faced by South African farmers. South African farmers should now, more than ever, manage their cost of production to an absolute minimum while still achieving the maximum productivity in order to operate sustainably over the long term.

The state land audit report of 2013 describes that 79% (96 550 791 ha) of land in South Africa is privately owned of which 1.3% (1 340 268 ha) is used in the forestry sector. Compared to other sectors like agriculture and fisheries (4 027 051 ha) forestry takes up much less land usage (Department of Rural Development and Land Reform, 2013).

1.2.2 Forestry industry of South Africa

Timber plantations cover around 1.3 million hectares of land in South Africa (Forestry South Africa, 2017) with 3 types of trees dominating these plantations: wattle, covering 12%; pine, covering 44% and eucalyptus, covering 44%. Of the 1.3 million hectares 49% of plantations are in Mpumalanga (305835ha), 20% in Natal (120920ha), 19% in the Eastern Cape (118326ha), 8% in the Western Cape (47312ha) and 4% in Limpopo (26919ha) (Forestry South-Africa, 2017). Of the commercial farms only 3.7% (45 304.87ha) are small scale forestry farmers (Forestry South Africa, 2017). The wood produced from all plantations are used in the manufacturing of hundreds of products such as pulp and paper, cellulose (which is used in many other processes) transmission poles, mining supports, furniture, charcoal, adhesives and many more.

According to the latest publication of Statistics South Africa (2017) on forestry, logging and related services the total income for the forestry sector was R16 573 million, the total expenditure R14 180 million, the carrying value of assets at the financial year end R10 442 million and the capital expenditure on assets R1 146 million. According to these statistics the capital expenditure of 6.92% per annum is the industry norm.

1.2.3 Mechanisation

Farm mechanisation is a vital consideration for agricultural production. Without mechanization farmers would struggle to progress from merely self-sustaining production sufficient to surplus production export. The continuous growth of demand places pressure on the dwindling resources of mother earth. This increasing demand drives the need for sustainable mechanisation (Kienzle *et al.*, 2013). Mechanisation in forestry is becoming increasingly vital due to the competitive nature of global timber markets (SA Forestry, 2015). This means that in order to compete on an international level, the South African forestry industry has to harvest and process timber as cost effectively and sustainably as possible.

The first instances of mechanisation in the agricultural sector in South Africa occurred in the 1850's in the Cape colony mainly in wheat production which was caused by the loss of control over labour (Schirmer, 2004). Changes in the forestry market with higher pulp and cellulose demand, as well as, increasing labour cost has changed the way in which pulp is produced. The changes in production were specifically done with mechanisation in mind in order to increase productivity and drive down costs. Timber must be harvested and handled in the shortest possible time to ensure maximized output and increase profits. Considerable decreases in manual labour needs, together with large increases in productivity, can be achieved by making use of mechanisation processes in the forestry management activities (Bluszkowska & Nurek, 2014).

Historically timber harvesting was done manually in Southern Africa. In the forestry environment, like most production environments, production operations requires substantial physical input. The physical input can be provided by manual labour or human operated machinery (Demir, 2010). In the current technological era, many advancements have been made in the mechanisation of the timber harvesting process. Machines such as the debarker (replacing the axe man), processor (replacing the axe man and some parts of the chain saw operator), loaders, skidders, skylines, tractors, forwarders and feller buncher have been developed to reduce manual labour, increase the productivity and increase safety in the tree harvesting process. Safety is one of the major concerns in forestry. Technology and mechanisation enables forest workers to harvest timber in a safe manner (McEwan, 2017).

The level of harvesting mechanisation currently implemented at Mondi (largest producer of timber in South Africa) stands at 82% and some areas of the Mondi plantation is 99% mechanised (Mondi, Sustainable development report. 2011). Similar levels of mechanization is found in other major forestry companies in South Africa. Thus, mechanisation appears to be beneficial to the forestry sector due to benefits such as increased productivity, safety and reduction in labour problems (Marshall, 2004:158).

Timber harvesters are all very expensive in the South African market as most of them are imported. Large capital investments are required for timber harvesting machines, especially in South Africa since all machines are imported. The operating costs of harvesting machines are significant with the ever fluctuating fuel prices and maintenance costs (SA Forestry, 2015). The cost of a mechanical harvester can vary from R 1 million up to R10 million depending on the brand and age of the machine and what its capabilities are. The research and planning to mechanise the timber harvesting process requires knowledge of the economic, technical and management characteristics of the forest business and its trading environment (Demir, 2010).

Determining whether these capital investments are feasible against the traditional manual labour method would be essential for the survival and economic progress of a forestry company.

1.2.4 Manual labour

Forestry continues to be one of the most dangerous industrial sectors in the world and there are discouraging trends of rising accident rates, high occurrence of occupational diseases and early retirement among forestry workers. Physical hazards such as the climate, motor manual work, noise and vibration, chemical hazards and machine safety is some of the concerns to the safety of forestry workers (Department of Labour, 2017).

Before the forestry mechanisation process started a few years ago, tree harvesting was regarded as desperation employment. The turnover of labour in the forestry sector was at 20 to 50% and absenteeism ranged from 10 to 20% (Mondi, Sustainable development report 2011). The total number of employees in the forestry sector in 2008 was 106 844 and decreased by 17.44% in 2016 to 88 200, (Forestry SA, 2017. Forestry SA, 2008). Large labour consumption in forestry harvesting processes is

above all, the result of the character and task awareness mode in mechanisms undertaken in forestry. Large quantities of labour is necessary to achieve the desired output of pulp.

The current minimum wage as of 1 March 2017 in the forestry sector of South Africa is R15.39 per hour (Ramutloa, 2017). The South African government announced that the minimum wage will increase to R20 per hour by the 1st of May 2018 (Sefako-Musi, 2017). This increase will greatly impact the profits of forestry farmers. The increase in minimum wage necessitates farmers to explore other avenues of reducing labour costs. Mechanization provides one solution however great consideration is needed to weigh the cost/benefit.

1.3 PROBLEM STATEMENT

The following problem statement was derived for this study.

A study on the profitability to mechanise the harvesting process for the small scale forestry farmer. By comparing the costs associated between the manual and mechanical harvesting process this problem could be resolved.

1.4 OBJECTIVES

1.4.1 Main objective

The main objective of this study is to determine the best cost solution between mechanical timber harvesting and manual labour timber harvesting for the privately owned small scale forestry farmer in South Africa.

1.4.2 Secondary objectives in literature

- To provide a background of the forestry industry.
- To conceptualize the trend of mechanisation in the forestry sector.
- To put the role of manual labour in the tree harvesting process into context.
- To explain the costs associated with mechanisation and manual labour in the tree harvesting process.

1.4.3 Secondary objectives in the empirical study

- To define the population and sample of the study.
- To collect the necessary data by means of interviews and financial data.
- To analyze the data.

- To come to a conclusion and recommendation for the privately owned forestry farmer.

1.5 RESEARCH DESIGN

1.5.1 Literature review

The literature review of this study will be based on information collected from scientific journals, books, articles and other research documents. Databases such as EBSCOhost, Lexus Nexus, Emerald, Google Scholar, Internet sources, and Sae Publications were consulted to gather the secondary resources related to the study.

1.5.2 Empirical study

To gather the primary information an empirical study will be conducted with a descriptive research design by using a qualitative survey method. The data will be analysed by means of a case study research design.

1.5.2.1 Population

The population of the study will include all small scale forestry farmers in South Africa. The study population is mostly located in Mpumalanga, Kwazulu-Natal (KZN), Limpopo, Eastern Cape and the Western Cape where the most of the commercial forests are located in South Africa. The population regarding the data collection in relation to costs collection would be forestry machine manufactures and both mechanical and manual labour timber harvesting companies.

Data on the cost involved in acquiring and maintaining a mechanical timber harvesting operation as well as the cost for a manual labour operation will be collected. The data will be analysed to obtain a cost comparison between a mechanical and manual labour operation. For the purpose of this study only the harvesting and not the extraction and loading of pulp, will be analysed.

1.5.2.2 Sample

The case study research method usually selects a small geographical area or a very limited number of individuals as the subjects of study (Zainal, 2007). The sample size for this study will include a mechanical and a manual labour harvesting company as well as two companies that sell mechanical harvesters. The required financial data of

the sample population will be collected. Additionally, five case studies will be conducted on actual timber farmers. A conclusion is made based on the financial data and the result of the case studies. The sampling strategy for this study will be conducted on a non-probability-purposive sampling. The harvesting companies are currently harvesting on a contractual basis for larger forestry companies in the Highveld region of Mpumalanga. The companies selling the harvesting equipment are situated in Nelspruit and Richards Bay. The farmers that will participate in the study are also situated in the Highveld region of Mpumalanga and deliver their pulp wood on a contractual basis to paper manufacturers.

1.5.2.3 Research method

This study will take the form of an exploratory case study with multiple case studies as design. The case studies aim to analyse the specific issues within a specific environment, organization and situation. This study will analyse the timber harvesting process in the forestry industry with regards to the small scale forestry farmer, specifically with regards to costs. Exploratory case study data collection methods can include interviews, questionnaires and experiments. Data collection and analysis within the context of the study can include a combination of qualitative and quantitative data analysis to be able to capture the complications of real-life situations, so that the situation can be studied in depth and better understood (Dudovskiy, 2016).

1.5.2.4 Data collection

The data collection method for this study would be qualitative. The data collection will be structured interviews with structured questions for the farmers and the harvesting company managers to investigate the costs and productivity associated with both mechanical and manual tree harvesting processes. By making use of the qualitative data collection method, case studies can explain both the process and outcome of a phenomenon through complete observation, reconstruction and analysis of the cases under examination (Zainal, 2007). The review of financial data obtained from forestry machine manufactures will also be analysed.

This study will be conducted at a specific point in time and therefore will be a cross-sectional study. Costs and financial data can vary over time, therefore the data will

only be accurate for a specific period and should be adapted as changes in costs occur.

Interviews with the financial managers of the harvesting companies were conducted for relevant costs and the productivity for both mechanical and manual operations. Data collection from the farmers are also done by means of interviews. Questions included the amount of hectares planted, distance to the buyer, species of trees planted and annual harvesting plans. These factors influence the costs as well as the measured yield per hectare on the plantations. These factors can therefore provide an indication of the profitability of the operation.

The running costs of the machinery will be collected from the manufacturers of the machinery. Information such as the fuel consumption, repair costs and operating cost will be collected.

1.5.2.5 Data analysis

The data collected from the literature and empirical study, will be analysed to calculate the total costs associated with the harvesting process. A costing model for machine costs in the forestry biomass supply chain, created for the European Cooperation in Science and Technology (COST), will be used to calculate the costs of the mechanical harvesting process (Ackerman *et al.*, 2014). A costing model for the manual tree harvesting process will be developed by taking information from the literature and the empirical study. This cost will be expressed as a total cost per year and a cost per unit of production. The costs of the mechanical and manual harvesting process will then be compared to establish which process is the most profitable.

These calculations will be applied on the five forestry farming case studies to indicate if the investment is profitable or not for each farmer. Thereafter overall conclusions and recommendations will be made.

1.6 DEMARCATION OR LIMITATIONS OF THE STUDY

The industry that will be analyzed is the private forestry sector in South Africa. This study will only look at the costs of the harvesting process of eucalyptus trees (commonly referred to as gum trees) for the use of pulp, and not the loading and extraction of the timber or the harvesting of pine trees.

Information will be collected from respondents on the Highveld area of Mpumalanga in South Africa. Financial data will be collected from companies in the industry which also operate in the Highveld area of Mpumalanga. The data is viewed with objectivity to let the facts speak for themselves. The situation of five private forestry farmers is analyzed with regards to their timber harvesting processes in isolation and the results could therefore not be generalized to the whole population or complete processes relating to production and processing of timber.

To analyze the costs of the different operations use is made of financial statements and cost based information obtained from manual and mechanical harvesting process orientated companies as well as companies that supply tree harvesting machinery. A program is then created on Microsoft Excel with this financial information whereby real life scenarios of private forestry owners is analyzed. Recommendations will be provided on whether it would be financially viable to mechanise the timber harvesting process for the farmer. Thereafter an overall recommendation will be given on whether mechanisation for the private forestry owner is viable or not based on the conclusions of the financial analysis.

1.7 SUBSTANTIATION OR CONTRIBUTION OF THE STUDY

The researcher will ensure that the sample is a correct and consistent representation of the total population. The data collected is correct, accurate and consistent and gives a true reflection of what is happening in the industry. The data collected will be aligned with the literature study to ensure a high degree of reliability. The researcher will also ensure that the conclusions that are drawn are reasonable and appropriate given the aims and background of the study. Having obtained a reasonable sample size by analyzing more than one case study gives the opportunity to the researcher to generalize the findings to the population (Zainal, 2007). The researcher will therefore conduct the analysis of the five forestry farmers' situations.

All managers need to make decisions on whether to make capital investments in machinery or expansion of workforce or to divest. . Sufficient, reliable data is the most important factor in this decision and is not always available to base a well thought-through decision on. This study will contribute to the forestry farmers' decision making in relation to mechanisation of the harvesting process in their own businesses in South Africa. This study will give information of what would be the necessary amount of

capital to start up mechanical harvesting and maintenance versus the costs of manual labour.

1.8 PROPOSED CHAPTER LAYOUT

For this research document the following layout is established:

- Chapter 1: Introduction
- Chapter 2: A literature review of mechanisation and manual labour in the forestry sector
- Chapter 3: The empirical study which includes the collection of the data, analysing the results and the discussion.
- Chapter 4: The conclusion and recommendations
- References and annexures.

CHAPTER 2: A LITERATURE REVIEW OF MECHANISATION AND MANUAL LABOUR IN THE FORESTRY SECTOR

2.1 FORESTRY INDUSTRY

A comparison of the South African forestry industry with the rest of the world's forestry industry reveals that South Africa has a distinct advantage in a valuable resource that needs to be protected and managed in order to be sustainable and contribute to the economy. South Africa is eleventh on the list of the largest plantation areas in the world, with China, India and Russia at the top with 46.6, 32.5, and 17.3 million hectares of forests each (Forestry SA, 2017). Forestry in South Africa is the second largest land user in the agricultural sector where maize uses 3.2 million hectares, forestry 1.3 million hectares, wheat 0.8 million hectares and sugar 0.4 million hectares (Forestry SA, 2017).

South Africa mainly produces 3 types of timber: eucalyptus (gum), acacia (wattle) and pinus (pine). The pine tree species is primarily used for saw timber for the furniture and building industry, eucalyptus species is used primarily for the pulp and paper production and the wattle species is used for paper and charcoal production (Sappi, 2017). South Africa's 1.3 million hectares of plantations are spread over the country as illustrated in figure 2.1.

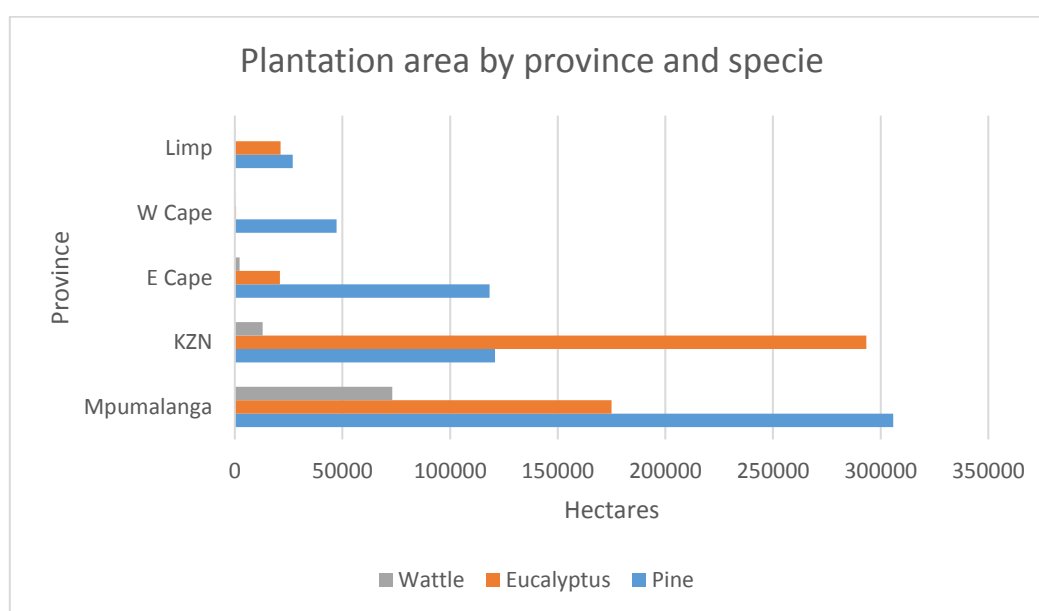


Figure 0.1 Plantation area by province and specie (Adapted from: Forestry SA 2017, Facts and figures).

From figure 2.1 it is noticeable that the pine tree species takes the largest portion of the land usage in Mpumalanga and the eucalyptus species the most land usage in Kwazulu Natal (KZN). There are 175 032 ha eucalyptus planted in Mpumalanga and 239 404 ha eucalyptus planted in KZN (Forestry SA, 2017).

The value of the paper and pulp industry in South Africa for 2015 amounted to R28 billion and the direct contribution to the balance of trade of South Africa was R5 billion (PAMSA, 2015). The sales volumes for timber in South Africa in 2016 is illustrated in Table 2.1.

Table 2.1 Sales volumes of timber 2016 in SA (Adapted from: Forestry economic services CC, 2016).

Product	2016
Poles	328 000 m ³
Pulpwood	10 881 000 tons
Mining timber	433 000 tons
Saw logs	4 447 000 m ³
Charcoal and other	353 000 tons

From the sales volumes in Table 2.1 it can be seen that the pulpwood is the largest contributor in the forestry sector. This is mainly due to the large export market for paper and packaging. Sappi exports 70% of the products manufactured at their Ngodwana paper mill and most of their products are produced at their Saiccor mill (Sappi, 2017).

In 2016, a total of R42.9 billion was invested in the forestry sector of South Africa of which 41.8% was invested in Mpumalanga (Forestry SA, 2017). The total book value of investments in the forest products sector for 2016 was R 21.8 billion.

Table 2.2 Investments in forest products sector 2016 (Adapted from: Forestry South Africa, 2017).

Machinery and equipment	83.5%
Movable assets	1.7%
Land and buildings	11.9%
Other	2.9%

The total investment in machinery and equipment in 2016 was 83.5% of the R21.8 billion, which gives an investment of R18.2 billion. This is likely due to the capital investments needed to mechanise certain processes in the forestry environment (Zhang *et al.*, 2016).

2.2 MECHANISATION IN FORESTRY

Historically, from 1950 to 1960, motor-manual as well as manual systems were used and were characterized by the widespread use of horses, oxen and some small mechanised extraction equipment. With the introduction of the chainsaw in the 1960's, productivity increased dramatically (Sandewall *et al.*, 2015). More and more mechanisation took place as the use of agricultural tractors increased as well as the introduction of the articulating skidder from Canada which gave rise to an increase in productivity from 2 m³/man-day up to 7 m³/man-day (Längin *et al.*, 2010:16). The 1970 to 1980's saw a huge development in mechanisation as the first two-grip harvester was introduced and developed in Scandinavia. The 1980's showed an increase in productivity from 10 m³/man-day up to 14 m³/man-day due to the introduction of single grip harvesters in harvesting operations (Ackerman *et al.*, 2010:17). Consequently, the influence on the labour force has been far-reaching as the productivity was increased by using less employees and more machinery. According to the Occupational Outlook Handbook from the United States Department of Labor, a job decline of 4% is projected until 2024 in the forestry sector of the United States (Bureau of Labor Statistics, 2016). Comparing the employment figures in the South African forestry sector of 2008 (106 844 employees) to the employment figures of 2016 (88 200 employees) a decrease of 18 644 (17.44%) jobs can be seen in the 8 years (Forestry SA, 2017).

An assortment of tree harvesting systems and machinery is available to forestry contractors and tree harvesting companies today. These options can range from basic manual operations and semi-mechanised systems to fully mechanised processes. The mechanical methods used today are sophisticated and technologically advanced, requiring properly trained and capable operators (Visser & Stampher, 2015). In South Africa, mechanised timber harvesting systems have increased in forestry operations (Ramantswana, 2013). Land and terrain conditions have an effect on the harvesting method to be used and the kind of equipment to be used. Ground based harvesting

systems are generally restricted by a gradient between 0% to 60%, where after aerial extraction (Sky lines and sometimes even helicopters) and manual felling operations are necessary for steeper gradients (Ackerman *et al.*, 2010).

2.3 TREE HARVESTING PROCESSES

Tree harvesting methods as practiced in South Africa are as follows:

- The full tree (FT) method occurs when trees are felled either by manual chainsaw or a mechanical feller buncher, and all biomass above the stump is transported to the roadside. This is one of the most widely used methods internationally and usually is part of a mechanised operation as skidders are necessary to extract the full length trees to roadside. This method has limited application in South Africa (Ramantswana *et al.*, 2013).
- The tree length (TL) method takes place when trees are felled, debranched and topped in the compartment and only the stems are extracted to roadside. This method is mostly moved away from as the cutting and the debranching of the tree is done by means of manual chainsaw operators (Benjamin *et al.*, 2013).
- The cut-to-length (CTL) method is where trees are felled, debranched, debarked, crosscut and topped in the compartment. The round wood assortments are then extracted to roadside. This method is the most widely used method internationally. This method is largely used in South Africa especially with mechanised operations where the trees are processed infield by means of a processor (Williams, 2017).

Tree harvesting equipment can be divided into 3 main categories:

- Processing and felling equipment
- Primary transport equipment (extraction from infield to roadside)
- Loading equipment

Processing and felling can either be done manually, motor-manually or fully mechanised. The equipment used in the manual felling and processing would include the handsaw and axe. Equipment used in motor-manual operations would include the chainsaw and axe. Fully mechanised felling and processing operations would make use of highly sophisticated hydraulic harvesters (figure 2.2) which completes the whole process from felling, de-limbing, debarking and cross-cutting the tree into preset

chosen lengths. Factors that can influence the productivity of tree harvesting machines can include the size of the tree, the level of processing and quality required, species of trees harvested, branching density and size, the terrain, the undergrowth of the plantation and the climate conditions (Alam *et al.*, 2014:18). Some of the disadvantages of owning tree harvesting machine can include the high ownership and operating cost, larger timber volumes needed to be viable and the mechanical availability of the machine (Fath, 2001). All these factors need to be taken into consideration when the harvesting planning is done.



Figure 2.2 Illustration of a mechanical tree harvester (SP Maskiner, 2017).

Primary transport, or commonly referred to as extraction, is the transport of timber from the stump infield to the roadside or depot where larger trucks load and deliver the wood to the buyer. Primary transport can be done either by manual labour or mechanical machines. This mechanical extraction machines could include a 3 wheeled logger, tractor and trailer, skidder, or a forwarder (Mbosso *et al.*, 2015:129).

Loading of the wood can be done either manually or by means of machines. Depending on the size of operations and the task at hand, this machines can range from 3 wheeled loggers up to a 20 ton hydraulic excavator with a grab (Kenney *et al.*, 2014).

2.4 MANUAL LABOUR IN FORESTRY

South Africa currently has 37 217 000 people in the active work force of which 6 177 000 are unemployed. 11 193 000 people are employed in the formal sector, 2 761 000 are employed in the informal sector and 835 000 are employed in agricultural sector (Stats SA, 2017). The total number of employees in the forestry sector is 80 200 and they earn an average annual salary of R83 895, which would include managers and trained/skilled staff (Forestry SA, 2017).

The tree harvesting process by means of manual labour includes the use of chain saws and axes. The chainsaw operator would fell, de-branch, and cross-cut the tree to specific lengths, where after the axe men would de-bark the poles. The chainsaw operator would usually earn a salary slightly above minimum wage as they require specific skills as well as being involved in dangerous work while the axe men usually earn a minimum wage as minimum skills are required (Walmsley, 2009).

The productivity per chainsaw per man day is determined by the tree size, tree species, branch intensity, terrain, and climate conditions, especially wind (Gülci *et al.*, 2016:359; Ngulube *et al.*, 2014). The advantages of the manual labour method includes low capital costs and a large application scope as the slope, ground condition and roughness and the tree size have little to no influence on the productivity (Dos Santos & Migunga, 2014). The manual de-barking of eucalyptus trees involves a person using an axe to remove the bark and cambium of the tree. The productivity of the manual de-barker depends on the sharpness of the tools, the pole size, the tree species, the branch size and quantity, the terrain slope and the health and fitness of the labourer. The advantages of this method is job creation and low capital investment while the disadvantages could be high labour turn over, low productivity and safety risks (Ackerman *et al.*, 2010).

2.5 SAFETY

Safety in both mechanical and manual tree harvesting operations is of great concern. The accident rate in the forestry industry is significantly higher than in other sectors: the fatal accident rate in the United States forestry in 2013 was 19 times higher than other sectors, revealing that forest work is the most dangerous, with loggers being the most exposed (Albizu-Uriónabarrenetxea *et al.*, 2013:395). One of the benefits of

mechanical harvesting operations is that it is regarded as safer because of less people on the ground (Wall, 2012). Although mechanical harvesting is safer, there is still the possibility of fatal accidents with mechanical harvesters which are often difficult to avoid due to their unpredictable nature. For example, it has happened that a piece of the cutting chain broke off from the mechanical harvester head and penetrated the cabin of the machine hitting the operator in the neck and he subsequently died from his injuries (Department of Labour and Industries, 2014).

As part of addressing the health, safety and environmental concerns raised in forestry, the Forestry Stewardship Council (FSC) was established in 1993. Their main goal is to promote sustainable forestry via means of ensuring that forests are managed in an environmentally friendly, socially responsible and economically viable manner (FSC.org, 2017).

2.6 COSTING

2.6.1 Relevant costing

All business decisions involves choosing between at least two alternatives in which one must compare the costs between the situations or scenario's (Seal *et al.*, 2015). The costs that differ between the scenarios are considered relevant costs as costs that are the same will not impact on the outcome of the analysis. For example, in a costing decision between mechanical and manual labour tree harvesting the office, building and housing costs would be the same in each situation and would therefore be irrelevant costs, and appointing a trained harvester operator would be relevant costing as you would only need a trained harvester operator in a mechanical operation.

2.6.2 Process costing

The process costing method is used when a single product is mass produced or manufactured on a continuous basis for long periods of time, and where the costs related with individual units of production cannot be separated from each other (Seal *et al.*, 2015; Bragg, 2017). The process of manufacturing is usually divided into departments as per the separately identifiable steps in the manufacturing process. Different inputs and expenses such as materials, labour and overhead costs is added to the product costs in each department. In process costing, the costs are accumulated by the department and allocated to a unit of production.

2.7 COSTING IN THE FORESTRY INDUSTRY

Harvesting contractors and forestry farmers need to perform a process costing for each project or contract that they will be conducting to be able to determine if a project is economically viable. Each situation will be different as the location and external factors such as the slope, tree size, tree species and volumes to be harvested will differ (Saunders *et al.*, 2012). The process costing in tree harvesting will include the three departments of harvesting, extraction and loading/short hauling to the mill or buyer. The costs in each department should then be converted to a price per ton or m³ and added together to obtain the total cost for the process.

A costing model has been developed by the European Cooperation in Science and Technology (COST) Action FP0902 to determine the costs of machines in the forest bio-mass procurement chain as shown in figure 2.3 (Ackerman *et al.*, 2014). All the calculations in the costing have been standardised and are based on current costing and procedures in forestry. This model requires the following inputs:

- Machine type: Specifying the machine being studied in the model.
- National currency in which the calculations must be done.
- The costing unit: the unit of production the costs are expressed in (e.g. m³ or tonnes).
- Fixed cost inputs: Fixed or standing costs are costs that need to be recovered by machine owners regardless of the amount of work a machine does or the revenue it earns.
- Variable cost inputs: Variable or running costs are incurred when the machine is working.
- Operator: The total cost of employing the operator, including wages, benefits and overhead costs.
- Productivity: Contains aspects of productivity, machine utilization, working days or hours and the profit margin.

The costing model then gives a detailed breakdown of the costs per cubic meter (m³), productive machine hour (PMH), scheduled machine hour (SMH), cost per day, week, month or year from which conclusions can be drawn. Furthermore, it provides indications and recommendations based on other studies to assist the user where

assumptions need to be made on costs and the productivity of the machine. The model also splits the costs of the base machine and the attachments on the machine such as the harvester head. The authors also noted that when calculating the cost for a chainsaw, the cost must be added as an attachment machine as the base machine calculation does not allow for the use of chains, cutter bars and sprockets

	A	B	C	D	E	F	G	H	I	J	K	L
	The "COST" model for calculation of Forest Operations Costs											
3	Date:						Version Number: 1.1					
4	INPUT:						OUTPUT:					
6	Machine type	Harvester					Fixed costs	Annual	Monthly	PMH	Cost/Green tonnes	% of Total
7	Country specific currency	Rands					Depreciation					
8	Unit of costing	Green tonnes					Base machine	332 800,00	27 733,33	200,00	25,74	18,72%
9	Machine fixed cost inputs						Attachment	0,00	0,00	0,00	0,00	0,00%
10	Purchase Price or Replacement Cost						Total	332 800,00	27 733,33	200,00	25,74	
11	Base machine	4 000 000,00					Interest on Average Annual Investment					
12	Attachment	0,00					Base machine	307 968,00	25 664,00	185,08	23,82	17,32%
13	Salvage value (Enter either % or monetary cost figure)						Attachment	0,00	0,00	0,00	0,00	0,00%
14	Base machine	20%					Interest Total	307 968,00	25 664,00	185,08	23,82	
15	Attachment	0%					Insurance	10 000,00	833,33	6,01	0,77	0,56%
16	Base machine (monetary cost figure)	0,00					Garaging for machine	0,00	0,00	0,00	0,00	
17	Attachment (monetary cost figure)	0,00					Machine Tax/Registration	4 500,00	375,00	2,70	0,35	0,25%
18	Expected Economic Life (PMH)						Machine Transfers	0,00	0,00	0,00	0,00	0,00%
19	Base machine (PMH)	16 000,00					Total Fixed Costs	655 268,00	54 685,67	393,79	50,68	36,85%
20	Attachment (PMH)	0,00										
21	Interest rate	12%					Variable costs	Annual	Monthly	PMH	Green tonnes	% of Total
22	Machine Tax/Registration (Base machine & attachment)	4 500,00					Fuel	436 001,28	36 333,44	262,02	33,72	24,52%
23	Machine Insurance (Base machine & attachment)	10 000,00					Oil and lubricants	21 800,06	1 816,67	13,10	1,69	1,23%
24	Machine transfers	0,00					Maintenance and repairs					
25	Garaging for Machine	0,00					Base Machine	332 800,00	27 733,33	200,00	25,74	18,72%
26							Attachment	0,00	0,00	0,00	0,00	0,00%
27	Machine variable cost inputs						Total	332 800,00	27 733,33	200,00	25,74	18,72%
28	Fuel - cost (cost/litre)	11,91					Additional tracks/chains	16 640,00	1 386,67	10,00	1,29	0,94%
29	Fuel consumption (l/PMH)	22,00					Tyres and other main running gear	0,00	0,00	0,00	0,00	0,00%
30	Oil and lubricant cost	5,00%					Total	16 640,00	1 386,67	10,00	1,29	0,94%
31	Maintenance and repair cost						Consumable 1	0,00	0,00	0,00	0,00	0,00%
32	Base machine	80%					Consumable 2	0,00	0,00	0,00	0,00	0,00%
33	Attachment	0%					Consumable 3	0,00	0,00	0,00	0,00	0,00%
34	Base machine - Annual monetary cost figure	0,00					Consumable 4	0,00	0,00	0,00	0,00	0,00%
35	Attachment - Annual cost figure	0,00					Consumable 5	0,00	0,00	0,00	0,00	0,00%
36	Running gear:						Other	2 000,00	166,67	1,20	0,15	0,11%
37	Number of additional tracks/chains	2,00					Total Variable Costs	869 241,34	67 436,78	486,32	62,59	45,51%
38	Cost per track/chains	50 000,00										
39	Estimated track/chains set life (PMH)	10 000,00					Operator Costs	Annual	Monthly	PMH	Green tonnes	% of Total
40	Track/chains cost per Set	100 000,00					Operator wages (normal time)	104 000,00	8 666,67	62,50	8,04	5,85%
41	Number of tyres or other main running gear	2,00					Other operator costs	1 000,00	83,33	0,08	0,08	0,06%
42	Cost per tyre or other main running gear	0,00					Operator benefits and overheads	62 100,00	5 175,00	37,32	4,80	3,49%
43	Estimated tyre or other main running gear set life (PMH)	5 000,00					Total Operator Direct Costs	167 100,00	13 925,00	99,90	12,92	9,40%
44	Tyre or other main running gear cost per set	0,00										
45							Net Costs (excluding profit margin)	1 631 609,34	135 967,45	980,01	126,19	91,76%
46	Consumables											
47	Consumable 1, purchase price per unit	0,00					Company overheads and management costs	146 450,93	12 204,24	88,01	11,33	8,24%
48	Consumable 1 life (PMH)	50,00					Profit margin (%)	0,00%				
49	Consumable 2, purchase price per unit	0,00					Gross Costs (including profit margin)	1 778 060,28	148 171,69	1 068,02	137,52	100,00%
50	Consumable 2 life (PMH)	50,00										
51	Consumable 3, purchase price per unit	0,00					Profit Margin (before tax)	0,00	0,00	0,00	0,00	0,00%
52	Consumable 3 life (PMH)	50,00										
53	Consumable 4, purchase price per unit	0,00										
54	Consumable 4 life (PMH)	50,00										
55	Consumable 5, purchase price per unit	0,00										
56	Consumable 5 life (PMH)	50,00										
57	Other annual items cost	2 000,00										

Figure 2.3 Forestry machine costing model (Source: Ackerman *et al.*, 2014)

2.8 COSTS IN FORESTRY MECHANISATION

Costing for forestry machinery is usually sub-divided between capital cost, which includes the fixed costs, and operational costs which includes the variable costs (Saunders *et al*, 2012). Machines can include vehicles, harvesters, loggers, transport trucks, forwarders and tractors. The machine costs can be divided into fixed costs and variable costs. Fixed costs can include interest, depreciation, insurance and licensing fees. Variable costs can include fuel, oil and lubricants, repairs and maintenance, and tyres and or tracks. This costs is then expressed either as a cost per machine hour or a cost per productivity in cubic-meters or tons (Belbo *et al.*, 2014). Figure 2.4 indicates that the process costing includes all machine costs, personnel costs and other overheads.

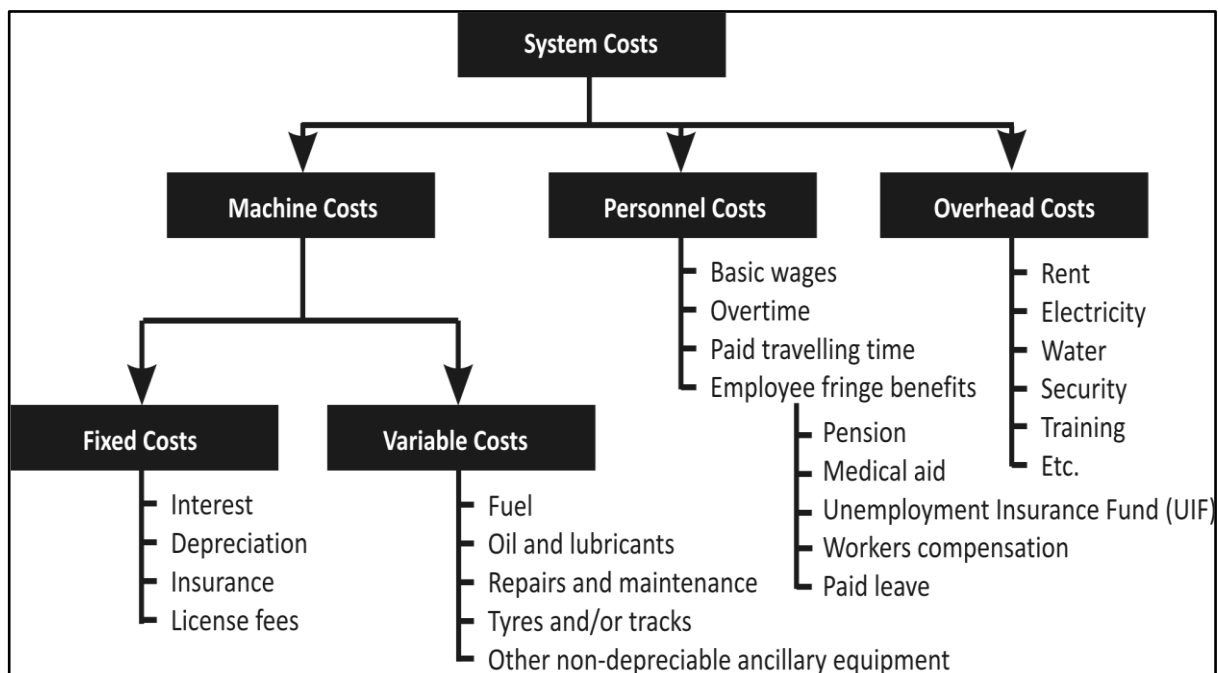


Figure 2.4 Process costing breakdown. (Adopted from: Ackerman *et al.*, 2010).

The hourly cost of the machine plus the operator is called the machine rate. The machine rate is divided into labour costs, operating costs and ownership costs. Labour costs includes the wages of the operator. Operating costs includes the variable costs such as fuel, oil repairs and maintenance. Ownership costs includes the fixed costs of the machine such as the purchase price of the machine, salvage value, depreciation costs, interest costs, insurance and licensing fees. By adding all this costs together, divided by the expected life span of the machine in hours, a cost per machine hour is

calculated. Dividing this per hour machine cost by the productivity in that machine hour, would give the cost per ton or m³.

Assumptions and estimations need to be made to determine, for instance, machine life in hours, maintenance costs as a percentage of the capital costs, life of the tracks or tires of the machine as well as the downtime required for maintenance and breakdowns (Belbo *et al.*, 2014). Previous studies conducted in South African mechanical harvesting companies have shown that the mechanical availability of a harvester is about 74% and the utilization of the machine can be up to 68.8% (Ackerman *et al.*, 2017). Maintenance and repair costs expressed as a percentage of the capital cost of the machine, can be the most unpredictable of all the costs (Adebayo *et al.*, 2007) and is highly dependent on the type and age of the machine as well as the availability of parts and skills of available repairers. Other operating costs include fuel and oil costs. According to the most manufacturers of hydraulic excavators, the recommended service interval for hydraulic oil is 2000 machine hours and the service interval of the engine oil is every 250 machine hours (Hitachi, Caterpillar, and Volvo). The average oil and lubricant consumption per machine hour added up to 2.62 litre per machine hour or 0.08l per m³ of production in a previous study conducted (Ackerman *et al.*, 2017).

2.9 MANUAL LABOUR COSTS

When looking at the motor-manual tree harvesting costs, the main factors are labour and labour productivity (Liepins *et al.*, 2015). The capital investments are much lower compared to mechanical harvesting as the only machines and tools used is a chain saw and axes. Fixed costs in manual harvesting includes the cost of obtaining chainsaws and hatchets. Variable costs can include the labour, fuel and lubricants, and personal protective clothing costs. Table 2.3 provides a summary of the consumptions associated with the operation of a chainsaw excluding the investment return and labour cost of the chainsaw. From table 2.3 can be derived that the largest operating consumption associated with a chainsaw is the fuel consumption and then chain lube. The life expectancy of a chainsaw is lower than other larger machineries at 1000 machine hours (Anna, Diego, 2011). Thus if the daily productivity of a chainsaw is 28 m³ in a 8 hour productive day (Vusic *et al.*, 2012), then the chainsaw can deliver 3500 m³ until the end of its life span. The chainsaw would then last 125 days which

would mean that for a full year's production with 260 working days, 2.08 chainsaws would be needed per chainsaw operator.

Table 3.1 Consumption of a chainsaw (Adapted from Popovici, 2013)

Specification	Consumption
Fuel	0.428 l/m ³
Chain lube	0.177 l/m ³
Mixture oil	0.015 l/m ³
Chains	0.01 pcs/m ³
Auxiliary materials (Files)	0.02 pcs/m ³

Personal protective equipment (PPE) is crucial for forest workers as the accident, death and injury rate in the forestry sector is very high (Albizu-Uriónabarrenetxea, 2013). The Occupation Health and Safety Act (181 of 1993) states that all employers of forestry workers must, by law, provide the necessary protective clothing and equipment free of charge to all the employees that require it. This equipment and clothing includes: safety helmets, safety footwear, hearing protection, eye protection, safety gloves, leg protection, rain coats and chainsaw operator pants (Department of Labour, 2017).

Transportation costs must also be included in the cost of a manual labour team. A study conducted in 2017 by the Department of Agriculture Fisheries and Forestry showed that the total cost for a 3 ton truck stood at R6.88 per km (Department of Agriculture, Forestry and Fisheries, 2017). The fuel price at the time was at R12.95 and the oil price at R29.46. Interest was calculated at 12%.

2.10 CONCLUSION

The forestry industry of South Africa makes a great contribution to the country's economy. Despite this promising outlook, forestry famers must still consider options of improving productivity and increasing their profits in line with other countries' efforts to do the same. Determining the costs involved in mechanisation and manual labour in the tree harvesting process requires for both situations that the relevant costs are subdivided and allocated to fixed and variable cost. In mechanisation, the capital investment is much larger than in manual labour harvesting. Managerial estimations

and assumptions are needed to do the costing for the mechanisation process, such as the cost of repairs and the productivity of the operator. In manual labour the productivity of the labour force has a significant impact on the production of the company as absenteeism and safety greatly impact the cost. The following chapter will take a more detailed look at the individual costs and the effects they have on a small scale forestry farmer's business.

CHAPTER 3: AN EMPIRICAL STUDY - DATA COLLECTION, RESULTS AND ANALYSIS

3.1 INTRODUCTION

This chapter will outline the research method, population of the study, how the sample was selected, data collection methods and the results of the study.

3.2 RESEARCH METHOD

This study undertakes the form of an exploratory case study with a multiple case study design. This case study analyses the specific issues related to cost drivers within the forestry environment with regards to the tree harvesting process, for small scale forestry farmers in South Africa. This study design provides the opportunity to examine what is unique and what is common across the individual cases and to reflect on the theory developing from the findings.

3.3 POPULATION

The population of the study includes all small scale forestry farmers in South Africa. The study population is mostly located in Mpumalanga, Kwazulu-Natal (KZN), Limpopo, Eastern Cape and the Western Cape where the most of the commercial forests are located in South Africa. The population regarding the cost collection would be forestry machine manufactures and both mechanical and manual labour tree harvesting companies.

3.4 SAMPLE

The sample size for the financial data required for the study includes a mechanical and a manual labour harvesting company as well as two companies that sell mechanical harvesters. The scenarios of five tree farmers in the Highveld area of Mpumalanga were analysed. The sampling strategy for this study will be conducted on a nonprobability-purposive sampling. Respondents in the Highveld region of Mpumalanga will be selected. The harvesting companies are currently harvesting on a contractual basis for larger forestry companies in the Highveld region of Mpumalanga. The companies selling the harvesting equipment are situated in

Nelspruit and Richards Bay. The farmers that will participate in the study are situated in the Highveld region of Mpumalanga and are delivering their timber on a contractual basis to paper manufacturers.

3.5 DATA COLLECTION

Data collection methods for this study includes in-depth interviews and questionnaires. Data collection and analysis within the context of the study includes a combination of qualitative and quantitative data analysis to be able to capture the complications of the real-life situations of the farmers, so that the situation can be studied in-depth and better understood (Dudovskiy, 2016). The questionnaires were filled in by the researcher while in interview with the forestry farmers. The interviews were conducted at the respondents' offices in order for them to have access to the required statistical data concerning their forestry harvesting operations.

In-depth interviews were conducted with forestry harvesting managers. The interviews took place at the offices of the respondents as in order for them to have access to the data required. The conversations were recorded with the approval of the respondents. The respondents gave permission for their names to be made available for research purposes. Both Neethling and Bekker are the operational managers at mechanical harvesting companies in the Highveld region of Mpumalanga. Bekker manages 3 harvesting machines and various other forestry equipment and has 4 years' experience in this industry. Neethling is the operational manager of 8 mechanical harvesters and various other forestry machines and has 6 years' experience in this field. Stansfield is the regional sourcing manager at a well-known forestry company in the procurement department for tree harvesting contracts. Nthunzi is the owner of a manual labour tree harvesting company that operates in the Highveld region of Mpumalanga. He currently has 5 harvesting teams which consists of 1 chainsaw operator, 1 pusher and 10 de-barkers in each team. They harvest eucalyptus year-round and in summer they harvest wattle for small scale forestry farmers.

3.6 RESULTS

The following information was obtained in the in-depth interviews with the harvesting managers as well as from quotations obtained from companies supplying the

machinery and equipment necessary for the costing. This data was used to populate the excel spread sheet to analyse the scenarios of the forestry farmers.

3.6.1 Productivity

3.6.1.1 Mechanical harvester productivity

The productivity of a machine is dependent on the hours of operation vs the hours of maintenance and breakdowns, the rest-allowances of the operator and other waiting times as well as the tree size, number of trees per hectare and operator skill. For every 9 hour working shift there should be about 45min of daily maintenance where the machine is greased, all the oils are checked and filled up and the cutting chain is sharpened or changed as well as checking the rest of the machine for any breakdowns. Machine availability for production depends on the age of the machine and number of breakdowns. Machine breakdown time should be based on historical information and estimated to determine the productive time as an accurate prediction is not feasible. Machine availability is estimated to be at around 80% (Stansfield, 2017; Bekker, 2017; Neethling, 2017). On a 9 hour shift, an operator should be allowed at least 30 mins to eat and rest which translates to 6% of the hours per shift (Department of Labour, 2017). Other waiting times include when the operator needs to change the cutting chain or clean the guide bar of the saw unit. These tasks are usually simple and take no more than 2% of the shift time. Taking all these factors into consideration it can be concluded that of a 9 hour shift, only 6.02 hours are productive machine hours which gives a machine utilization of 67%. A suitably qualified harvester operator should be able to harvest 55 trees per machine hour with an average tree size of 0.2m^3 (Neethling, 2017; Stansfield, 2017; Bekker, 2017). This translates to 11m^3 or 8.46 tonnes per productive machine hour. The standard industry conversion for eucalyptus pulp wood is $1\text{ ton} = 1.3\text{m}^3$ (Oester & Bowers, 2009).

3.6.1.2 Manual labour productivity

Time studies that have been conducted in eucalyptus harvesting showed that the average chain saw operator can fell, de-limb and cross-cut 140 trees, with an average size of 0.2m^3 per tree, in a 9 hour work day, which should translate to an average of 21.5 tons per day depending on the species (Nthunzi, 2017). On an average 8 2.4 meter poles come from a tree that is 0.2m^3 in size.

The average de-barker can debark 100 2.4 meter poles in a 9 hour working day (Ciobanu, 2013; Montorselli *et al.*, 2010). This means that for every chainsaw operator felling and cross-cutting, a manual harvesting team should have 10-12 debarking labourers. Each chainsaw operator should also have one person assisting them in the felling of the tree to guide the felling direction of the tree as well as handling the measuring stick for the cross cutting of the tree. The weather conditions should also be taken into consideration when determining possible productivity. Rain and high fire danger index periods prohibits the manual labour team from conducting their work safely (Nthunzi, 2017).

3.6.2 Mechanisation costs

The cost of a machine should be consolidated towards determining annual ownership cost, monthly ownership cost, a cost per ton or m³ and a cost per machine hour to get clear understanding of what the machine costs entail (Stansfield, 2017).

For a new mechanical tree harvester (excavator with processor head) the rule of thumb used in the industry for maintenance costs is around 80% of the capital cost of the machine (Stansfield, 2017; Bekker, 2017; Neethling, 2017). The oil costs are usually expressed as a percentage of fuel consumption of the specific machine as oil is consumed at a consistent positively correlated rate with fuel (Stansfield, 2017). In the industry, the oil cost for a machine with extensive hydraulics is calculated at 15% of the fuel consumption of the machine (Bekker, 2017; Neethling, 2017). The life of the tracks of the machine is also estimated at around 10 000 machine hours and should be included in the costing (Stansfield, 2017). The average salary of a harvester operator is at R450 per shift depending on the experience of the operator (Bekker, 2017; Neethling, 2017).

Table 3.1 shows the price, including Value Added Tax (VAT), for machinery and equipment as per quotations received in 2017 (annexure 1, annexure 2, annexure 4 and annexure 7).

Table 3.1 Machinery and equipment cost

Product/machine	Price per item
Hitachi ZX20056 excavator	R 1 687 200.00
SP 591 LX G3 harvester processor	R 2 290 260.00
Husqvarna 61 chain saw	R 6 999.00
Hatchet	R 279.51
Round file	R 25.00
Flat file	R 58.90
Guide bars	R 530.00
Chainsaw chain	R 325.00

Table 3.2 shows the price of fuel and other consumables as received by quotations in 2017. These prices however can fluctuate from month to month as its dependent on the rand/dollar price and Brent-crude oil prices. See quotes in annexure 3 and annexure 6.

Table 3.2 Fuel and oil prices

Product	Price per liter excluding vat
Petrol unleaded 93	R 13.74
Diesel 50 ppm (wholesale)	R 11.91
Chain lube (210 L containers)	R 15.52
2-Stroke oil (20 L containers)	R 76.00
2-stroke oil cost per litre petrol (500ml 2-stroke per 20l fuel)	R 1.90
Hydraulic 68 oil (210 L containers)	R 21.42
Engine oil (15w 40) (20L containers)	R 39.50

3.6.3 Manual labour costs

Average salary of a chainsaw operator in South Africa is R22.50 per hour or R200 per day (Nthunzi, 2017). The de-barker receives a wage based on production of R1.50 per de-barked pole. Thus if the de-barker produces an average of 100 poles a day, they will receive a wage of R150 per day (Nthunzi, 2017).

Other costs that need to be identified and negotiated on each project is whether transportation is required for the labourers or not. In most operations, the workers are transported by means of a 3 ton truck that's fitted with the correct seats and protection to transport the employees to and from work (Nthunzi, 2017).

As personal protective equipment (PPE) is required by law in any harvesting operation it must be included in the costing. Quotations obtained from work wear companies and consolidated in table 3.3 shows the average price per item in 2017. See annexure 5 for detail.

Table 3.3 Prices for personal protective equipment and clothing

Product	Price excluding vat per item
Overalls	R 133.00
Safety boots	R 225.00
Rain coat	R 212.00
Leg protectors	R 130.00
Hard hat	R 20.50
Gloves	R 28.50
Reflector jackets	R 45.00
Chainsaw helmet	R 420.00
Chainsaw operator gloves	R 240.00
Chainsaw operator pants	R 853.00
Chainsaw operator jacket	R 240.00

3.6.4 Data collection for the forestry farmer scenarios

The 5 interviews were conducted with the forestry farmers in the Highveld region of Mpumalanga. Each farmer provided information on the hectares utilized for forestry and methods of tree harvesting on their farms. The farmers all deliver their eucalyptus

trees to a pulp and paper mill in Ngodwana. The farmers are FSC approved and as part of this FSC certification they require a harvesting plan spanning 5 years that indicate the possible production for each year.

3.6.4.1 Farmer 1

Farmer 1 owns a 998 ha farm in the Carolina district and produces pine (72 ha), wattle (35 ha) and eucalyptus (491 ha) trees for pulp wood on his farm. The farmer currently makes use of a mechanised process to harvest the trees. They utilize their harvesting machinery by harvesting the trees produced by them as a priority and any spare capacity of the machines is contracted to other small scale forestry farmers. The main drivers for mechanizing their harvesting process was to limit the impact of loss of control over, productivity of, the labour force. Introduction of machination also increased productivity and profits for the company in his view. Transportation is required for the employees to and from work. The farm is ± 25 km from town where the labourers are picked up. Only 10 ha of his eucalyptus trees is planted on a slope of more than 35% which enabled the use of machinery. The timber production projections for the next 5 years are shown in table 3.4.

Table 3.4 Farmer 1 estimated production for the next 5 years

Year	Eucalyptus	Pine	Wattle
2018	8 500 Tons	0 m ³	0 Tons
2019	7 000 Tons	0 m ³	0 Tons
2020	9 000Tons	0 m ³	0 Tons
2021	8 000 Tons	10 000 m ³	1 150Tons
2022	7 800 Tons	6 500 m ³	0 Tons
Total	40 300 Tons	16 500 m ³	1 150 Tons
5 year Average annual production	8060 Tons	3300 m ³	230 Tons

3.6.4.2 Farmer 2

Farmer 2 owns a 780 ha farm in the Warburton district and produces pine (120 ha) and eucalyptus (410 ha) trees for pulpwood. Use of a manual process is in place to harvest the trees. Currently, they utilize manual labour in the harvesting process and machinery is used to load and extract the pulp wood. He also indicated that they make use of a contractor for labour as he currently does not have the time capacity to oversee the harvesting process. They will consider mechanization of the harvesting process as if the productivity and safety will be increased. A decrease in costs will also be a driver for mechanising the harvesting process. Transportation is provided to employees to and from work. The farm is ± 30 km from the village where the labourers live. 10 ha of his eucalyptus and 100 ha of his pine trees is planted on a slope of more than 35%. His production projections for the next 5 years are shown in table 3.5.

Table 3.5 Farmer 2 estimated production for the next 5 years

Year	Eucalyptus	Pine	Wattle
2018	9000 Tons	0 m ³	0 Tons
2019	7 000 Tons	9 000 m ³	0 Tons
2020	6 000Tons	12000 m ³	0 Tons
2021	6 500 Tons	0 m ³	0 Tons
2022	7 000 Tons	5000 m ³	0 Tons
Total	35 500 Tons	26 000 m ³	0 Tons
5 year average annual production	7100 Tons	5 200 m ³	0 Tons

3.6.4.3 Farmer 3

Farmer 3 owns a 2800 ha farm in the Warburton district and produces pine (970 ha) and eucalyptus (820 ha) and wattle (210 ha) trees for pulp and saw wood on the farm. Manual labour process is utilized to harvest the pine and wattle trees and a mechanised process to harvest the eucalyptus trees. The loading and extraction is done by means of mechanical machinery. He indicated that the main reason for

mechanising the harvesting process is the increase in productivity and the control over production. Farmer 3 said “It is easier to control the amount produced in a month with the use of machinery”. He makes use of contractors for labour for the manual tree harvesting process. Transportation is provided for employees as the farm is 12 km to the closest residential area. ±10 ha of his eucalyptus and ±40 ha of his pine trees is planted on a slope of more than 35%. His production projections for the next 5 years are shown in table 3.6.

Table 3.6 Farmer 3 estimated production for the next 5 years

Year	Eucalyptus	Pine	Wattle
2018	14 000 Tons	12 000 m ³	0 Tons
2019	12 000 Tons	9 800 m ³	6 800 Tons
2020	14 900 Tons	10 000 m ³	7 000 Tons
2021	13 400 Tons	12 500 m ³	3 000 Tons
2022	13 000 Tons	11 000 m ³	6 500 Tons
Total	67 300 Tons	55 300 m ³	23 300 Tons
5 year average annual production	13 460 Tons	11 060 m ³	4 660 Tons

3.6.4.4 Farmer 4

Farmer 4 owns a 1700 ha farm in the Lothair district and produces pine (320 ha) and eucalyptus (780 ha) trees for pulp and saw wood on his farm. They currently makes use of manual labour process to harvest both the pine and eucalyptus trees. The loading and extraction is done by means of machinery. It was indicated that the main reason he will look into mechanising the harvesting process is for increased productivity and loss of control over the labour force as absenteeism increases tremendously. It was also indicated that transportation will be provided to the employees to and from work. The farm is 20 km from town where the labourers are picked up. ±25 ha of his eucalyptus and ±80 ha of his pine trees is planted on a slope of more than 35%. The production projections for the next 5 years are shown in table 3.7.

Table 3.7 Farmer 4 estimated production for the next 5 years

Year	Eucalyptus	Pine	Wattle
2018	12 500 Tons	9 000 m³	0 Tons
2019	13 000 Tons	0 m³	0 Tons
2020	13 900 Tons	0 m³	0 Tons
2021	11 500 Tons	10 500 m³	0 Tons
2022	14 300 Tons	7 800m³	0 Tons
Total	65 200Tons	27 300 m³	0 Tons
5 year average annual production	13 040 Tons	5 460 m³	0 Tons

3.6.4.5 Farmer 5

Farmer 5 owns an 1840 ha farm in the Amsterdam district and produces pine (407 ha), eucalyptus (812 ha) and wattle (133 ha) trees for pulp and saw wood on his farm. They currently makes use of manual labour in the harvesting process. The loading and extraction is done by means of machinery. It was indicated that the main reason he will look into mechanising the harvesting process is for increased profits and increased productivity as well as the safety factor for employees. It was also indicated that transportation will be provided for his employees as his farm is 37 km to a township and he does not have the capacity to house them on his farm. ±20 ha of his eucalyptus and ±50 ha of his pine trees is planted on a slope of more than 35%. The production projections for the next 5 years are shown in table 3.8.

Table 3.8 Farmer 5 estimated production for the next 5 years

Year	Eucalyptus	Pine	Wattle
2018	11 900 Tons	0 m³	0 Tons
2019	13 300 Tons	7 200 m³	3 200 Tons
2020	12 500 Tons	0 m³	1 000 Tons
2021	10 800 Tons	0 m³	0 Tons
2022	13 500 Tons	13 000 m³	1 850 Tons
Total	62 000Tons	20 200 m³	6 050 Tons
5 year annual average production	12 400 Tons	4 040 m³	1 210 Tons

3.7 DATA ANALYSIS

3.7.1 The mechanisation costing model

The model was adopted from literature. In the costing some assumptions have to be made. The assumptions are based on a rule of thumb used in the industry and from the literature. The assumptions includes:

- Maintenance costs at 100% of the capital cost.
- Oil costs at 15% of the fuel consumption.
- A residual salvage value of 20% of the machine price.
- 16 000 hour machine life.
- 10 000 machine hour life of tracks.
- An interest rate of 12%.
- Licensing and insurance at 1% of the machine price.
- Labour overheads as 10 % of labour wage.
- An average tree size of 0.2 m³.
- 260 working days per year.
- A production of 8.46 tones PMH.
- Machine utilization of 70%

In order to come to a conclusion for each farmer the researcher had to add to the costing model a part B in order to allow for non-productive days per year where the harvesting work has been done and the machine is not working. The owner of the machine will still have to pay the operator and allow for ownership cost of the machine. In this costing model only the required annual production must be entered. This model then gives the total cost per ton including the costs of the non-productive days. Table 3.9 shows an image of the costing model part B.

Table 3.9 Mechanical costing model part B

Farmer no:	1	
Gross cost per ton assuming a full years production	R 137,96	per ton
Required annual production	8060	Tons
Estimated annual production assuming a full year production	13857,5	Tons
Over production capabilities	5797,5	per annum
Production capabilities per day	53,30	per day
Annual days of non-production	109	days
Labour cost per day	R 622,69	per day
Labour costs of non-productive days	R 67 733,12	per annum
Total cost for productive days	R 1 111 957,60	per annum
Total fixed machine cost per non-productive day	R 2 577,91	per day
Total fixed machine cost for non-productive days per year	R 280 412,24	per annum
Total cost per year	R 1 460 102,97	per annum
Total costs in Rands per ton	R 181,15	per ton

3.7.2 The manual labour costing model

This costing model was developed by the researcher by taking information from the literature and the personal interviews. The following assumptions is based on the literature and rule of thumb from the industry.

Assumptions:

- A transport cost of R6.88 per km as per literature.
- An interest rate of 12%.
- Labour overheads as 10 % of labour wage.
- An average tree size of 0.2 m³.
- 260 working days per year.
- A chainsaw life span of 6 months.
- Repair cost factor of 60% of a new machine for a chainsaw.
- 3% of the net wages allowed for medical expenses

In this costing a breakdown of the labour, chainsaw, tools, PPE and transportation costs is analyzed. All the grey and yellow filled areas are inputs to the model. The model starts out by calculating the daily and monthly tons to be harvested.

The labour cost is divided into costs of leave, sick leave, unproductive days, statutory costs such as UIF, and the staff costs. The productivity of each labourers is also indicated in tons per day to give an indication of the production possible per day. Management labour costs is allocated at 10% of the total labour costs. Transport costs of the employees is calculated by the average distance per month times the cost per km at R6.88 as per literature study, divided by the annual production. Protective clothing and tools is allocated to the labourers with the number of pairs per year per labourer and then worked to a cost per ton. The chainsaw costs is calculated with a 12% interest rate for financing the asset. The fuel usage is assumed at 7 liters per day and the chain lube at 2 liters per day. The chainsaw repair costs by rule of thumb is 60% of the value of the machine.

The total harvesting cost per ton is then calculated by adding the cost of labour, chainsaw costs, tool costs, PPE costs and the transportation costs. Figure 3.1 shows part A of the costing model and figure 3.2 shows part B of the costing model

Manual labour tree harvesting costing				Farmer 0			
Eucalyptus manual harvesting				Rate per ton			
Tree size = 0,2				R 184,14			
Felling task = 115 trees							
Production - 23 tons/cutter							
Terrain 0-35%							
Calculation inclusive of leave and sickleave provision							
NO overheads and/or indirect costs							
CALCULATION OF HARVESTING RATE							
VOLUMES TO BE HARVESTED							
What is the annual (or annualized) tonnage or volume to be harvested?				complete		tons	
				10000			
Volume per:		month	prod.day				
		833,3	40,3				
What species to be harvested?				Hardwood			
PRODUCTION DAYS PER YEAR							
How many working days in this year? (5days times 52 weeks)				260	cst/day	cst/month	cst/year
How many statutory leave days in this year?				12	249,02	5147	61758
How many days/labourer provided for sick leave/year?				10	207,52	4289	51465
How many days/labourer provided for leave/year?				15	311,28	6433	77198
How many days per year for un-productive time(red days etc.)?				3	62,26	1287	15440
Total				830,08	17155	205860,50	20,59
Labourer days available per year						220	
Production days per year						248	
Loss of production days / labourer / year						28	
Average working days / month						20,67	
STATUTORY COSTS AND PROVIDENT FUND							
Indicate the relevant percentage in each case:				%	cst/mth	cst/year	cst/ton
WCA (% of gross wage + salaries)				1,89	2092,44	25109	2,51
UIF (% as with workman's compensation)				1	1107,11	13285	1,33
What % of nett wage do you allow for medical expenses?				3	3019,40	36233	3,62
TOTAL=					6219	74627	7,46
CALCULATION OF STAFF COSTS.							
				PRODUCTIVITY			
				Cutter 13,44 ton/day			
				Stripper 1,68 ton/day			
Salaried staff							
OVERHEAD STAFF ONLY			OVERHEAD STAFF ONLY			UNSKILLED STAFF	
No. of Managers	Name/ describe	Gross monthly salary	No. of	Name/ describe	Gross monthly salary	No. of	Nett daily wage
1	Manager	10065					
TOTALS			1		R 10 064,67	0	0
Wage earners, daily paid staff.							
SKILLED STAFF			SKILLED STAFF			UNSKILLED STAFF	
No. of Supervisor Drivers	Name/ describe	Nett daily wage	No. of	Name/ describe	Nett daily wage	No. of	Nett daily wage
1	Snr Induna	220,00	3	Chainsaw operator	R 200,00	24	debarkers R 150,00
						0	
						3	pushers R 150,00
TOTALS			1		R 220,00	3	R 600,00
						27	R 4 050,00
SUMMARY:							
No. of overhead units =		1	Total overhead =		/DAY	/MTH	/YEAR
					487,00	10 064,67	120 776,00
No. of skilled wage earners =		4	Total skilled =		820,00	16 946,67	203 360,00
							20,34
No. of unskilled wage earners =		27	Total unskilled =		4 050,00	83 700,00	1 004 400,00
							100,44
Total mandays/mth:		641	TOTAL =		5 357,00	110 711,33	1 328 536,00
							132,85
AVERAGE WAGE Unskilled		: = R	150,00		PER DAY		
AVERAGE WAGE Unskilled		: = R	3100,00		PER MONTH		
AVERAGE WAGE Skilled		: = R	205,00		PER DAY		
AVERAGE WAGE Skilled		: = R	4236,67		PER MONTH		
COST OF TRANSPORT							
Your no. of salaried staff:		=	1				
Your no. of wage earners:		=	31				
complete							
TRANSPORT							
Cost per KM			R 6,88				
Distance traveled per day in km			74				
Distance traveled annually in km			18352				
Transport costs per annum			R 126 261,76				
Transporting vehicles needed			2				
Total transport costs per annum			R 252 523,52				
		/working day	/month	/year	/ton		
Transport			R 1 018,24	R 21 043,63	R 252 523,52	R 25,25	

Figure 0.1 Manual labour costing model part A

PROTECTIVE CLOTHING (SAFETY)								
Skilled	1	Cs.oper.	3					
Unskilled	27							
Please complete the table.								
Calculating done by: no.of people x no.of item/year x price.								
Item		no.of staff using	no/year	cost per item		cost/ month	cost/ year	cost/ ton
Two piece overalls		31	2	133,00		687	8246	0,825
Steel toe cap boots		31	2	225,00		1163	13950	1,395
Rain coat - two piece		31	1	212,00		548	6572	0,657
Leggings		24	0,75	130,00		195	2340	0,234
Poly/rubber/plastic gloves		28	12	28,50		798	9576	0,958
Hard hats		28	1	20,50		48	574	0,057
Other Safety glasses		28	2	15,00		70	840	0,084
Other Bibs		31	1	45,00		116	1395	0,140
Other Hardhat with ear muffs		3	2	130,00		65	780	0,078
Cutter protective clothing: no.of operators & mechanic:					3			
Cs. hard hat with visor and ear mu		3	2	420,00		210	2520	0,252
Visors		3	1	0,00		0	0	0,000
Ear muffs		3	2	0,00		0	0	0,000
Cs gloves		3	4	240,00		240	2880	0,288
Cs. pants		3	2	853,00		427	5118	0,512
Cs. tops		3	2	240,00		120	1440	0,144
All personnel including cutters:				Total	R	4686	56231	5,623
cutters				Total	R	997	11958	1,196
TOOLS								
Calculating done by: no.of people x no.of item/year x price.								
Item		no.of staff using	no/year	cost per item		cost/ month	cost/ year	cost/ ton
Fire extinguishers large		1	1	492,75		41	493	0,049
Fire extinguishers small		1	1			0	0	0,000
Hatchets		24	1	279,51		559	6708	0,671
Hatchet sharpening files		24	3	58,90		353	4241	0,424
Chainsaw equipment								
Chain		3	12	325,00		975	11700	1,170
Guidebars		3	6	530,00		795	9540	0,954
Round files		3	12	25,00		75	900	0,090
Flat files		3	6	58,90		88	1060	0,106
fuel cans (Combi can)		3	1	427,00		107	1281	0,128
Other sprocket		3	4	198,00		198	2376	0,238
Tools excluding chainsaw equipment =				R		953	11442	1,144
Tools : chainsaw equipment =				R		2238	26857	2,686
CHAINSAW COSTS								
Please complete the table.						cst/mth	cst/yr	cst/ton
How many chainsaws, INC. spare saws do you use for this team?					3,3			
How many chainsaws are working daily?					3			
What is the lifespan of a chainsaw in months? (NB must be > 0)					6			
What is the current replacement price of a chainsaw?					6999	3985,30	47824	4,782
How many liters of fuel do you use per chainsaw per day?					5			
What is your cost of fuel/liter (the petrol x 2-stroke mix) ?					15,64	4848,40	58181	5,818
How many liters of chainlube do you use per chainsaw per day?					3			
What is your cost of chainlube per liter?					15,52	2886,72	34641	3,464
What is your Repair Cost Factor for Chainsaws?					60 %			
					699,90	2099,7	25196,4	2,520
					Gr tot. R	16058,22		
					Total R	13820,12	165841	16,58
					Cst / saw / hr =R		39,24	
At what interest rate can you finance assets?				12 %				
(This figure is used to calculate the interest on your capital layout for chainsaws)								
					T O T A L CHAINSAW COST PER TON: R			
					19,27			
Total harvesting costs per ton :					Total harvesting costs:			
Labour costs		R 132,85			Labour costs		R 1 328 536,00	
Chainsaw costs		R 19,27			Chainsaw costs		R 192 698,61	
Tools cost		R 1,14			Tools cost		R 11 441,79	
PPE cost		R 5,62			PPE cost		R 56 231,00	
Transportation costs		R 25,25			Transportation costs		R 252 523,52	
Total:		R 184,14			Total:		R 1 841 430,92	

Figure 0.2 Manual labour costing model part B

3.8 CASE ANALYSIS

In the mechanisation costing process the costs for each farmer will be the same as the machine capabilities and costs remains the same in each situation. The difference comes in at the required annual production in part B of the costing. The costing model for the manual labour team differs in each situation as the farmers have different production needs thereby needing different amounts of labour. The inputs for the mechanisation costing model part A can be seen in figure 3.3.

A	B	C	D	E
INPUT:				
Machine type	<i>Harvester</i>	Operator costs		
Country specific currency	Rands	Number of operators/shift		1
Unit of costing	Green tonnes	Average net wage (cost/hour)		50,00
Machine fixed cost inputs		Subsistence allowance		0,00
Purchase Price or Replacement Cost		Other operator costs		1000,00
Base machine	1687 200,00	Social charges – as % (a), or absolute value (b)		
Attachment	2 290 260,00	a) Social charges (pensions/levies etc.) as a percentage		30,00%
Salvage value (Enter either % or monetary cost figure)		b) Social charges (pensions/levies etc.) real number, per year		0,00
Base machine	20%	PPE (costs per year)		1500,00
Attachment	20%	Training (costs per year)		2 000,00
Base machine (monetary cost figure)	0,00	Phone charges (costs per year)		1000,00
Attachment (monetary cost figure)	0,00	Insurance (employers liability) (costs per year)		2 000,00
Expected Economic Life (PMH)		Operator transport (costs per year)		2 000,00
Base machine (PMH)	16 000,00	Productivity and operations (general input)		
Attachment (PMH)	16 000,00	Number of working days per year		260,00
Interest rate	12%	Number of shifts per day		1,00
Machine Tax/Registration (Base machine & attachment)	0,00	Scheduled hours per shift		9,00
Machine Insurance (Base machine & attachment)	40 000,00	Production (units/PMH)		8,46
Machine transfers	0,00	Average size of unit (or work object) eg. tree volume		1,00
Garaging for Machine	0,00	Productivity: Green tonnes/PMH		8,46
Machine variable cost inputs		Machine Utilisation		0,70
Fuel – cost (cost/litre)	11,91	Overheads machine + operator/s – as % (a), or absolute value (b)		
Fuel consumption (l/PMH)	22,00	a) Overhead costs as (%) over fixed and variable costs		10,00%
Oil and lubricant cost	15,00%	b) Overhead costs as absolute value (costs per year)		0,00
Maintenance and repair cost		Pre-emptive calculations		
Base machine	100%	Scheduled hours/annum		2340
Attachment	100%	Productive hours/annum		1638
Base machine – Annual monetary cost figure	0,00	Estimated annual productivity (production/annum)		13 857,48
Attachment – Annual cost figure	0,00	Social charges (pensions/levies etc.)		35 400,00
Running gear:		Company overheads for machine + operator(s) (costs per year)		159 081,53
Number of additional tracks/chains	2,00	Expected Economic Life (EEL years)		
Cost per track/chains	50 000,00	Base machine		9,77
Estimated track/chains set life (PMH)	10 000,00	Attachment		9,77
Track/chains cost per Set	100 000,00	Salvage value (SV)		
Number of tyres or other main running gear	2,00	Base machine		337 440,00
Cost per tyre or other main running gear	0,00	Attachment		458 052,00
Estimated tyre or other main running gear set life (PMH)	5 000,00	Number of sets over useful life:		
Tyre or other main running gear cost per set	0,00	Additional tracks/chains		1,6
Consumables		Tyres or other running gear		3,2
Consumable 1, purchase price per unit	0,00			
Consumable 1 life (PMH)	50,00			
Consumable 2, purchase price per unit	0,00			
Consumable 2 life (PMH)	50,00			
Consumable 3, purchase price per unit	0,00			
Consumable 3 life (PMH)	50,00			
Consumable 4, purchase price per unit	0,00			
Consumable 4 life (PMH)	50,00			
Consumable 5, purchase price per unit	0,00			
Consumable 5 life (PMH)	50,00			

Figure 0.3 Inputs in the costing model part A

Inputs in the model included:

- Base machine price at R1 687 200.00 including VAT.
- Attachment price at R2 290 260.00 including VAT.
- Salvage values at 20% of machine price.
- Expected economic life of 16 000 machine hours.
- Machine insurance at 1 % of the purchase price.
- Fuel cost at R11.91.
- Oil cost at 15% of fuel consumption.
- Tracks at R100 000 per set with a life span of 10 000 machine hours.
- Operator wage of R50 per hour.
- Other operator costs at R1000 per year.
- Social charges such as UIF, pension, sick pay, and holiday pay at 30 % of wages.
- PPE costs at R1500 per year.
- Training at R2000 per year.
- Operator phone charges at R1000 per year.
- Insurance for employers' liability at R2000 per year.
- Machine insurance at R40 000 per annum
- Operator transport at R2000 per year.
- Maintenance and repair cost at 100% of the machine value.
- Interest rate of 12%.

The productivity and operations input includes the following:

- 260 work days per year.
- One shift per day.
- 9 scheduled hour per shift.
- 8.46 tons per PMH.
- A machine utilization of 70%.
- Overhead costs of 10% on fixed and variable costs.

The pre-emptive calculations from the costing indicates the following:

- Scheduled hours per annum at 2 340 hours.
- The productive hours per annum at 1 638 hours.

- The estimated annual productivity at 13 857.48 tons.
- The base machine and attachment's expected economic life at 9.77 years.
- A salvage value of R400 000 each for the base machine and the attachment.

The outputs from the costing model part A can be seen in Figure 3.4. From the output of this model it can be seen that fuel cost makes up the most of the costs at 22.45% of the total costs. Total fixed costs is R671 676.33 (35.13%) and variable cost R 919 139.54 (48.08%). Operator costs and company overheads is R161 900.00 (8.47%) and R 159 081.59 (8.32%) respectively. The total cost per ton is calculated at R137.96 assuming a full years' production.

OUTPUT:					
Fixed costs	Annual	Monthly	PMH	Cost/Green tonnes	% of Total
Depreciation					
Base machine	138 181,68	11 515,14	84,36	9,97	7,23%
Attachment	187 572,29	15 631,02	114,51	13,54	9,81%
Total	325 753,97	27 146,16	198,87	23,51	
Interest on Average Annual Investment					
Base machine	129 769,30	10 814,11	79,22	9,36	6,79%
Attachment	176 153,06	14 679,42	107,54	12,71	9,21%
Interest Total	305 922,36	25 493,53	186,77	22,08	
Insurance	40 000,00	3 333,33	24,42	2,89	2,09%
Garaging for machine	0,00	0,00	0,00	0,00	
Machine Tax/Registration	0,00	0,00	0,00	0,00	0,00%
Machine Transfers	0,00	0,00	0,00	0,00	0,00%
Total Fixed Costs	671 676,33	55 973,03	410,06	48,47	35,13%
Variable costs	Annual	Monthly	PMH	Green tonnes	% of Total
Fuel	429 188,76	35 765,73	262,02	30,97	22,45%
Oil and lubricants	64 378,31	5 364,86	39,30	4,65	3,37%
Maintenance and repairs					0,00%
Base Machine	172 727,10	14 393,93	105,45	12,46	9,03%
Attachment	234 465,37	19 538,78	143,14	16,92	12,26%
Total	407 192,47	33 932,71	248,59	29,38	21,30%
Additional tracks/chains	16 380,00	1 365,00	10,00	1,18	0,86%
Tyres and other main running gear	0,00	0,00	0,00	0,00	0,00%
Total	16 380,00	1 365,00	10,00	1,18	0,86%
Consumable 1	0,00	0,00	0,00	0,00	0,00%
Consumable 2	0,00	0,00	0,00	0,00	0,00%
Consumable 3	0,00	0,00	0,00	0,00	0,00%
Consumable 4	0,00	0,00	0,00	0,00	0,00%
Consumable 5	0,00	0,00	0,00	0,00	0,00%
Other	2 000,00	166,67	1,22	0,14	0,10%
Total Variable Costs	919 139,54	76 594,96	561,14	66,33	48,08%
Operator Costs	Annual	Monthly	PMH	Green tonnes	% of Total
Operator wages (normal time)	117 000,00	9 750,00	71,43	8,44	6,12%
Other operator costs	1000,00	83,33	0,07	0,07	0,05%
Operator benefits and overheads	43 900,00	3 658,33	26,80	3,17	2,30%
Total Operator Direct Costs	161 900,00	13 491,67	98,30	11,68	8,47%
Net Costs (excluding profit margin)	1 752 715,87	146 059,66	1 069,50	126,48	91,68%
Company overheads and management costs	159 081,59	13 256,80	97,12	11,48	8,32%
Profit margin (%)	0,00%				
Gross Costs (including profit margin)	1 911 797,46	159 316,46	1 166,62	137,96	100,00%

Figure 0.4 Outputs from the costing model part A

3.8.1 Farmer 1

3.8.1.1 Mechanisation cost analysis

The production projection for farmer one is an average of 8060 tons per annum of eucalyptus over the next 5 years. Table 3.10 shows the required production with the total cost for the farmer if he would mechanise the harvesting process.

Table 3.10 Mechanisation costing part B farmer 1

Farmer no:	1	
Gross cost per ton assuming a full years production	R 137,96	per ton
Required annual production	8060	Tons
Estimated annual production assuming a full year production	13857,5	Tons
Over production capabilities	5797,5	per annum
Production capabilities per day	53,30	per day
Annual days of non-production	109	days
Labour cost per day	R 622,69	per day
Labour costs of non-productive days	R 67 733,12	per annum
Total cost for productive days	R 1 111 957,60	per annum
Total fixed machine cost per non-productive day	R 2 577,91	per day
Total fixed machine cost for non-productive days per year	R 280 412,24	per annum
Total cost per year	R 1 460 102,97	per annum
Total costs in Rands per ton	R 181,15	per ton

From this calculation it can be seen that for farmer one, 109 of the 260 work days will not be used on average over the next 5 years. The labour cost of non-productive days amounts to R67 733.12 per annum, the total costs for productive days amounts to R1 111 957.60 and the total fixed costs for non-productive days per year amounts to R280 412.24. The total cost of mechanising the harvesting process for farmer one would amount to R181.15 per ton or an average of R1 460 102.97 per year over the next 5 years.

3.8.1.2 Manual labour cost analysis

An image of the complete costing for farmer 1 can be seen in annexure 8. Farmer one's average annual production over the next 5 years is 8 060 tons per annum which translates to 32.5 tons per productive day and 671 tons per month. To reach the production target, farmer one would need two chainsaw operators with a production of 16.23 tons each per day, 16 de-barkers with a production of 2.03 tons each per day and two pushers to assist the chainsaw operators. This would mean that the chainsaw

operators will not work to full potential but with only one operator the target production will not be made. The fuel consumption of each chainsaw would therefore decline to 5 liters per saw. Only one transport truck will be needed for this harvesting team. The location of the farm is ± 25 km from where the labourers will be picked up and the truck would therefore drive about 50 km per day. Table 3.11 shows a summary of the manual labour costing per ton and the total costs per year for farmer 1.

Table 3.11 Manual labour costing summary for farmer 1

Total harvesting costs per ton :			Total harvesting costs:		
Labour costs		R 112,37	Labour costs		R 905 696,00
Chainsaw costs		R 15,94	Chainsaw costs		R 128 465,74
Tools cost		R 0,97	Tools cost		R 7 792,11
PPE cost		R 4,73	PPE cost		R 38 137,50
Transportation costs		R 10,58	Transportation costs		R 85 312,00
Total:		R 144,59	Total:		R 1 165 403,35

From table 3.11 it can be seen that labour costs is the largest cost at R112.37 per ton or R905 696 in total. The total cost to manually harvest trees for farmer one amounts to R144.59 per ton or R1 165 403.35 in total.

3.8.1.3 Manual labour cost analysis based on 2018 minimum wages

Based on the 2018/2019 minimum wages of R20 per hour and the assumption that all other costs remains constant the following will be true for farmer 1 in the next financial year. In table 3.12 is a summary of the costing.

Table 3.12 Manual labour cost analysis based on 2018 minimum wages

Total harvesting costs per ton :			Total harvesting costs:		
Labour costs		R 133,02	Labour costs		R 1 072 104,00
Chainsaw costs		R 15,94	Chainsaw costs		R 128 465,74
Tools cost		R 0,97	Tools cost		R 7 792,11
PPE cost		R 4,73	PPE cost		R 38 137,50
Transportation costs		R 10,58	Transportation costs		R 85 312,00
Total:		R 165,24	Total:		R 1 331 811,35

From this table it can be seen that the labour cost will increase with R20.65 to R133.02. The total harvesting cost will increase to R165.24 assuming that all other costs remains the same.

3.8.2 Farmer 2

3.8.2.1 Mechanisation cost analysis

The production projection for farmer two is an average of 7100 tons per annum of eucalyptus over the next 5 years. Table 3.13 shows the required production with the total cost for the farmer if he would mechanise the harvesting process.

Table 3.13 Mechanisation costing part B farmer 2

Farmer no:	2	
Gross cost per ton assuming a full years production	R 137,96	per ton
Required annual production	7100	Tons
Estimated annual production assuming a full year production	13857,5	Tons
Over production capabilities	6757,5	per annum
Production capabilities per day	53,30	per day
Annual days of non-production	127	days
Labour cost per day	R 622,69	per day
Labour costs of non-productive days	R 78 948,96	per annum
Total cost for productive days	R 979 516,00	per annum
Total fixed machine cost per non-productive day	R 2 577,91	per day
Total fixed machine cost for non-productive days per year	R 326 845,32	per annum
Total cost per year	R 1 385 310,28	per annum
Total costs in Rands per ton	R 195,11	per ton

From this calculation it can be seen that for farmer two, 127 of the 260 work days per year, will not be used on average over the next 5 years. The labour cost of non-productive days amounts to R78 948.96 per annum, the total costs for productive days amounts to R979 516.00 and the total fixed costs for non-productive days per year amounts to R326 845.32. The total cost of mechanising the harvesting process for farmer two will amount to R195.11 per ton or a total cost of R1 385 310.28 on average over the next 5 years.

3.8.2.2 Manual labour cost analysis

An image of the complete costing for farmer 2 can be seen in annexure 9. The average annual production for farmer 2 over the next 5 years is 7 100 tons per annum which translates to 28.6 tons per productive day and 591.7 tons per month. To reach the production target, farmer two would need two chainsaw operators with a production of 14.31 tons each per day, 14 de-barkers with a production of 2.04 tons each per day and two pushers to assist the chainsaw operators. This would mean that the chainsaw

operators will not work to full potential but with only one operator the target production will not be made. The fuel consumption of each chainsaw would therefore decline to 4.3 liters per saw. Only one transport truck will be needed for this harvesting team. The location of the farm is ± 30 km from where the labourers will be picked up and the truck would therefore drive about 60 km per day. Table 3.14 shows a summary of the manual labour costing per ton and the total cost per year for farmer 2.

Table 3.14 Manual labour costing farmer 2

Total harvesting costs per ton :			Total harvesting costs:		
Labour costs		R 116,04	Labour costs		R 823 856,00
Chainsaw costs		R 17,33	Chainsaw costs		R 123 035,53
Tools cost		R 0,97	Tools cost		R 6 879,69
PPE cost		R 4,92	PPE cost		R 34 904,00
Transportation costs		R 14,42	Transportation costs		R 102 374,40
Total:		R 153,67	Total:		R 1 091 049,62

From table 3.14 it can be derived that labour costs is the largest cost at R116.04 per ton or R823 856 in total. The total cost to manually harvest trees for farmer one amounts to R153.67 per ton or R1 091 049.62 in total.

3.8.2.3 Manual labour cost analysis based on 2018 minimum wages

Based on the 2018/2019 minimum wages of R20 per hour and the assumption that all other costs remains constant the following will be true for farmer 2 in the next financial year. In table 3.15 is a summary of the costing.

Table 3.15 Manual labour costing based on 2018 minimum wages

Total harvesting costs per ton :			Total harvesting costs:		
Labour costs		R 137,17	Labour costs		R 973 896,00
Chainsaw costs		R 18,09	Chainsaw costs		R 128 465,74
Tools cost		R 0,97	Tools cost		R 6 879,69
PPE cost		R 4,92	PPE cost		R 34 904,00
Transportation costs		R 14,42	Transportation costs		R 102 374,40
Total:		R 175,57	Total:		R 1 246 519,83

From this table it can be derived that the labour cost will increase with R21.13 to R137.17. The total harvesting cost will increase to R175.57 assuming that all other costs remains the same.

3.8.3 Farmer 3

3.8.3.1 Mechanisation cost analysis

The production projection for farmer three is an average of 13 460 tons per annum of eucalyptus over the next 5 years. Table 3.16 shows the required production with the total cost for the farmer if he would mechanise the harvesting process.

Table 3.16 Mechanisation costing part B farmer 3

Farmer no:	3	
Gross cost per ton assuming a full years production	R 137,96	per ton
Required annual production	13460	Tons
Estimated annual production assuming a full year production	13857,5	Tons
Over prodcuton capabilities	397,5	per annum
Production capabilities per day	53,30	per day
Annual days of non-production	7	days
Labour cost per day	R 622,69	per day
Labour costs of non-productive days	R 4 644,06	per annum
Total cost for productive days	R 1 856 941,60	per annum
Total fixed machine cost per non-productive day	R 2 577,91	per day
Total fixed machine cost for non-productive days per year	R 19 226,20	per annum
Total cost per year	R 1 880 811,85	per annum
Total costs in Rands per ton	R 139,73	per ton

From this calculation it can be seen that for farmer three, only 7 of the 260 work days will not be used on average over the next 5 years. The labour cost of non-productive days amounts to R4 644.06 per annum, the total costs for productive days amounts to R1 856 941.60 and the total fixed costs for non-productive days per year amounts to R19 226.20. The total cost of mechanising the harvesting process for farmer three would amount to R139.73 per ton or R1 880 811.85 on average per annum over the next 5 years.

3.8.3.2 Manual labour cost analysis

An image of the complete costing for farmer 3 can be seen in annexure 10. Farmer three's average annual production over the next 5 years is 13 460 tons per annum which translates to 54.3 tons per productive day and 112.17 tons per month. To reach the production target, farmer 3 would need three chainsaw operators with a production of 18.09 tons each per day, 27 de-barkers with a production of 2.01 tons each per day and three pushers to assist the chainsaw operators. This would mean that the chainsaw operators will not work to full potential but with only one operator the target

production will not be made. The fuel consumption of each chainsaw would therefore be 5.3 liters per saw. Two transport truck will be needed for this harvesting team. The location of the farm is ± 12 km from where the labourers will be picked up and the truck would therefor drive about 25 km per day. Table 3.17 shows a summary of the manual labour costing for farmer 3.

Table 3.17 Manual labour costing summary farmer 3

Total harvesting costs per ton :			Total harvesting costs:		
Labour costs		R 107,82	Labour costs		R 1 451 296,00
Chainsaw costs		R 14,58	Chainsaw costs		R 196 189,46
Tools cost		R 0,95	Tools cost		R 12 810,42
PPE cost		R 4,50	PPE cost		R 60 620,00
Transportation costs		R 6,34	Transportation costs		R 85 312,00
Total:		R 134,19	Total:		R 1 806 227,88

From table 3.17 it can be concluded that labour costs is the largest cost at R107.82 per ton or R1 451 296.00. The total cost to manually harvest trees for farmer three amounts to R134.19 per ton or R1 806 227.88 in total.

3.8.3.3 Manual labour cost analysis based on 2018 minimum wages

Based on the 2018/2019 minimum wages of R20 per hour and the assumption that all other costs remains constant the following will be true for farmer 3 in the next financial year. In table 3.18 is a summary of the costing.

Table 3.18 Manual labour costing based on 2018 minimum wages

Total harvesting costs per ton :			Total harvesting costs:		
Labour costs		R 128,09	Labour costs		R 1 724 096,00
Chainsaw costs		R 14,32	Chainsaw costs		R 192 698,61
Tools cost		R 0,95	Tools cost		R 12 810,42
PPE cost		R 4,50	PPE cost		R 60 620,00
Transportation costs		R 6,34	Transportation costs		R 85 312,00
Total:		R 154,20	Total:		R 2 075 537,03

From this table it can be seen that the labour cost will increase with R20.27 to R128.09. The total harvesting cost will increase to R154.20 assuming that all other costs remains the same.

3.8.4 Farmer 4

3.8.4.1 Mechanisation cost analysis

The production projection for farmer four is an average of 13 040 tons per annum of eucalyptus over the next 5 years. Table 3.19 shows the required production with the total cost for the farmer if he would mechanise the harvesting process.

Table 3.19 Mechanisation costing part B farmer 4

Farmer no:	4	
Gross cost per ton assuming a full years production	R 137,96	per ton
Required annual production	13040	Tons
Estimated annual production assuming a full year production	13857,5	Tons
Over production capabilities	817,5	per annum
Production capabilities per day	53,30	per day
Annual days of non-production	15	days
Labour cost per day	R 622,69	per day
Labour costs of non-productive days	R 9 550,98	per annum
Total cost for productive days	R 1 798 998,40	per annum
Total fixed machine cost per non-productive day	R 2 577,91	per day
Total fixed machine cost for non-productive days per year	R 39 540,67	per annum
Total cost per year	R 1 848 090,05	per annum
Total costs in Rands per ton	R 141,72	per ton

From this calculation it can be seen that for farmer four, only 15 of the 260 work days will not be used on average over the next 5 years. The labour cost of non-productive days amounts to R9 550.98 per annum, the total costs for productive days amounts to R1 798 998.40 and the total fixed costs for non-productive days per year amounts to R39 540.67. The total cost of mechanising the harvesting process for farmer four would amount to R141.72 per ton or a total of R1 848 090.05 on average per annum over the next 5 years.

3.8.4.2 Manual labour cost analysis

An image of the complete costing for farmer 4 can be seen in annexure 11. The average annual production for farmer 4 over the next 5 years is 13 404 tons per annum which translates to 52.6 tons per productive day and 1086.7 tons per month. To reach the production target, farmer four would need three chainsaw operators with a production of 17.53 tons each per day, 26 de-barkers with a production of 2.02 tons each per day and three pushers to assist the chainsaw operators. This would mean

that the chainsaw operators will not work to full potential but with only one operator the target production will not be made. The fuel consumption of each chainsaw would therefore be 5.3 liters per saw per day. Two transport trucks will be needed for this harvesting team. The location of the farm is ± 20 km from where the labourers will be picked up and the truck would therefor drive about 40 km per day. Table 3.20 shows a summary of the manual labour costing for farmer 4.

Table 3.20 Manual labour costing summary for farmer 4

Total harvesting costs per ton :			Total harvesting costs:		
Labour costs		R 108,16	Labour costs		R 1 410 376,00
Chainsaw costs		R 15,05	Chainsaw costs		R 196 189,46
Tools cost		R 0,95	Tools cost		R 12 354,21
PPE cost		R 4,56	PPE cost		R 59 449,50
Transportation costs		R 10,47	Transportation costs		R 136 499,20
Total:		R 139,18	Total:		R 1 814 868,37

From table 3.17 it can be seen that labour costs is the largest cost at R108.16 per ton or R1 410 376.00. The total cost to manually harvest trees for farmer four amounts to R139.18 per ton or R1 814 868.37 in total.

3.8.4.3 Manual labour cost analysis based on 2018 minimum wages

Based on the 2018/2019 minimum wages of R20 per hour and the assumption that all other costs remains constant the following will be true for farmer 4 in the next financial year. In table 3.21 is a summary of the costing.

Table 3.21 Manual labour costing based on 2018 minimum wages

Total harvesting costs per ton :			Total harvesting costs:		
Labour costs		R 128,45	Labour costs		R 1 674 992,00
Chainsaw costs		R 15,05	Chainsaw costs		R 196 189,46
Tools cost		R 0,95	Tools cost		R 12 354,21
PPE cost		R 4,56	PPE cost		R 59 449,50
Transportation costs		R 10,47	Transportation costs		R 136 499,20
Total:		R 159,47	Total:		R 2 079 484,37

From this table it can be seen that the labour cost will increase with R20.29 to R128.45. The total harvesting cost will increase to R159.47 assuming that all other costs remains the same.

3.8.5 Farmer 5

3.8.5.1 Mechanisation cost analysis

The production projection for farmer five is an average of 12 400 tons per annum of eucalyptus over the next 5 years. Table 3.22 shows the required production with the total cost for the farmer if he would mechanise the harvesting process.

Table 2.22 Mechanisation costing part B farmer 5

Farmer no:	5	
Gross cost per ton assuming a full years production	R 137,96	per ton
Required annual production	12400	Tons
Estimated annual production assuming a full year production	13857,5	Tons
Over production capabilities	1457,5	per annum
Production capabilities per day	53,30	per day
Annual days of non-production	27	days
Labour cost per day	R 622,69	per day
Labour costs of non-productive days	R 17 028,21	per annum
Total cost for productive days	R 1 710 704,00	per annum
Total fixed machine cost per non-productive day	R 2 577,91	per day
Total fixed machine cost for non-productive days per year	R 70 496,05	per annum
Total cost per year	R 1 798 228,26	per annum
Total costs in Rands per ton	R 145,02	per ton

From this calculation it can be seen that for farmer five, 27 of the 260 work days will not be used on average over the next 5 years. The labour cost of non-productive days amounts to R17 028.21 per annum, the total costs for productive days amounts to R1 710 704.00 and the total fixed costs for non-productive days per year amounts to R70 496.05. The total cost of mechanising the harvesting process for farmer five would amount to R145.02 per ton or R1 798 228.26 on average per annum over the next 5 years.

3.8.5.2 Manual labour cost analysis

An image of the complete costing for farmer five can be seen in annexure 12. Farmer five's average annual production over the next 5 years is 12 400 tons per annum which translates to 50 tons per productive day and 1033.3 tons per month. To reach the production target, farmer five would need three chainsaw operators with a production of 16.67 tons each per day, 24 de-barkers with a production of 2.08 tons each per day and three pushers to assist the chainsaw operators. This would mean that the

chainsaw operators will not work to full potential but with only two operators the target production will not be made. The fuel consumption of each chainsaw would therefore decline to 5 liters per saw. Two transport trucks will be needed for this harvesting team. The location of the farm is ± 37 km from where the labourers will be picked up and the truck would therefor drive about 74 km per day. Table 3.23 shows a summary of the manual labour costing for farmer five.

Table 3.23 Manual labour costing summary for farmer 5

Total harvesting costs per ton :			Total harvesting costs:		
Labour costs		R 107,14	Labour costs		R 1 328 536,00
Chainsaw costs		R 15,54	Chainsaw costs		R 192 698,61
Tools cost		R 0,92	Tools cost		R 11 441,79
PPE cost		R 4,53	PPE cost		R 56 231,00
Transportation costs		R 20,36	Transportation costs		R 252 523,52
Total:		R 148,50	Total:		R 1 841 430,92

From table 3.24 it can be seen that labour costs is the largest cost at R107.14 per ton or R1 328 536.00. The total cost to manually harvest trees for farmer one amounts to R148.50 per ton or R1 841 430.92 annually. It is also noted that the transportation cost for farmer 5 is much higher than for the other farmers at R20.36 per ton compared to the average of R10.45 per ton for the other 4 farmers.

3.8.5.3 Manual labour cost analysis based on 2018 minimum wages

Based on the 2018/2019 minimum wages of R20 per hour and the assumption that all other costs remains constant the following will be true for farmer 5 in the next financial year. In table 3.24 is a summary of the costing.

Table 3.24 Manual labour costing based on 2018 minimum wages

Total harvesting costs per ton :			Total harvesting costs:		
Labour costs		R 127,16	Labour costs		R 1 576 784,00
Chainsaw costs		R 15,54	Chainsaw costs		R 192 698,61
Tools cost		R 0,92	Tools cost		R 11 441,79
PPE cost		R 4,53	PPE cost		R 56 231,00
Transportation costs		R 20,36	Transportation costs		R 252 523,52
Total:		R 168,52	Total:		R 2 089 678,92

From this table it can be derived that the labour cost will increase with R20.02 to R127.16. The total harvesting cost will increase to R168.52 assuming that all other costs remains the same.

CHAPTER 4: CONCLUSION & RECOMMENDATIONS

4.1 INTRODUCTION

The main goal of the study was to determine the best cost solution between mechanical and manual labour timber harvesting for the privately owned forestry farmer in South Africa. In the process of accomplishing the main goal certain secondary goals were also reached. Determining the processes and methods used to harvest timber and the costs associated with each method assumed a high degree of importance in the literature and empirical study. In order to better understand the costs associated with each harvesting method, five case studies on small scale forestry farmers in the Highveld region of Mpumalanga was performed. The data from the forestry farmers was collected by means of interviews. The data of the relevant costs involved in the harvesting was collected from the literature and by means of interviews and quotations from various timber harvesting companies and specialists in the forestry sector.

A costing model was developed for the European Cooperation in Science and Technology (COST) to calculate the cost of machines in the forestry bio-mass procurement (Ackerman *et al.*, 2014). The model was used to ensure more reliable results, but for the purposes of the case study analysis, the model needed to continue with a section B to analyse the results for drawing a conclusion. In this study a costing for the manual labour harvesting method was developed by incorporating information from literature and the empirical study.

4.2 CONCLUSIONS

By comparing the costs of each method in the specific farmers' situation the following conclusions can be derived.

4.2.1 Farmer 1

Farmer 1 has an average production projection of 8 060 tons per annum over the next 5 years. The costs to mechanise his harvesting process will amount to R181.15 per ton or R1 460 102.97 in total per year on average. The cost of manual labour will be much lower at R144.59 per ton or R1 165 403.35 annually. The mechanised harvesting method results in a cost of to R36.56 per ton or R294 699.62 annually more

compared to the manual labour method. It is therefore not recommended for farmer 1 to mechanise his harvesting process.

Considering the 2018/2019 minimum wages increase to R20 per hour will substantially increase the manual labour costing to R165.24 per ton, assuming all the other costs remain constant. Therefore, even considering the minimum wage increase the cost associated with mechanisation it is still not be viable for farmer 1 to mechanise the harvesting process.

4.2.2 Farmer 2

Farmer 2 has an average production projection of 7 100 tons per annum over the next 5 years. The costs to mechanise his harvesting process will amount to R195.11 per ton or R1 385 310.28 in total per year. The cost of manual labour will be much lower at R153.67 per ton or R1 091 049.62 annually. The mechanised harvesting method costs R41.44 per ton or R294 260.66 annually more for than the manual labour method. It is therefore not recommended for farmer 2 to mechanise his harvesting process.

The manual labour costs will substantially increase based on the 2018/2019 minimum wages increase to R20 per ton, resulting in costs of R175.57 per ton, assuming all the other costs remain constant. Compared to the cost to mechanise it will still not be viable for farmer 2 to mechanise his harvesting process.

4.2.3 Farmer 3

Farmer 3 has an average production projection of 13 460 tons per annum over the next 5 years. The costs to mechanise his harvesting process will amount to R139.73 per ton or R1 880 811.85 in total per year. The cost of manual labour will be lower at R134.19 per ton or R1 806 227.88 annually. The difference in the costs amounts to R5.54 per ton or R74 583.97 annually more for the mechanised harvesting method. It is therefore not recommended for farmer 3 to mechanise the harvesting process.

Based on the 2018/2019 minimum wages of R20 per hour the costs will dramatically increase in the manual labour costing to R154.20 per ton assuming all the other costs remain constant. Compared to the mechanisation costing it will be viable for farmer 3 to mechanise the harvesting process with a saving of R14.47 per ton.

4.2.4 Farmer 4

Farmer 4 has an average production projection of 13 040 tons per annum over the next 5 years. The costs to mechanise his harvesting process will amount to R141.72 per ton or R1 848 090.05 in total per year. The cost of manual labour will be lower at R139.18 or R1 814 868.37. The difference in the costs amounts to R2.54 per ton or R33 221.68 annually more for the mechanised harvesting method. It is therefore not recommended for farmer 4 to mechanise the harvesting process.

Based on the 2018/2019 minimum wages of R20 per hour the costs will dramatically increase in the manual labour costing to R159.47 per ton assuming all the other costs remain constant. Compared to the mechanisation costing it will be viable for farmer 4 to mechanise the harvesting process with a saving of R17.75 per ton.

4.2.5 Farmer 5

Farmer 5 has an average production projection of 12 400 tons per annum over the next 5 years. The costs to mechanise his harvesting process will amount to R145.02 per ton or R1 798 228.26 in total per year. The cost of manual labour will be higher at R148.50 or R1 841 430.92. The difference in the costs amounts to R3.48 per ton or R43 202.66 annually less for the mechanised harvesting method. It is therefore recommended for farmer 5 to mechanise the harvesting process.

Based on the 2018/2019 minimum wages of R20 per hour the costs will dramatically increase in the manual labour costing to R168.52 per ton assuming all the other costs remain constant. Compared to the mechanisation costing it will be viable for farmer 5 to mechanise the harvesting process with a saving of R23.50 per ton.

4.3 OVERALL RECOMMENDATION

In 4 out of the 5 of the case studies it was concluded that mechanisation would not be beneficial for the small scale forestry farmer. The reason for the one exception is that the location for farmer 5 is much further from where the labour is picked up therefore increasing the labour costs dramatically. Farmer five's transport costs is at R20.36 per ton where the other farmers transport costs is at R10.47, R 6.46, R14.42 and R10.58 per ton.

The average harvesting costs for the 5 farmers for mechanical harvesting is at R160.55 per ton, and R144.03 per ton for manual labour. It would therefore translate

to an average saving of R16.52 per ton by making use of the manual labour harvesting method for the small scale forestry farmer.

The largest cost in the mechanisation process is the cost of fuel which accounts for 22.37% of the total cost. The largest cost in the manual harvesting process is labour which accounts for roughly 70% of the total cost. It can therefore be seen that the increase in the labour costs as from May 2018 could change the costs significantly. An increase in the fuel price could also have a dramatic effect on the costs of the mechanical harvesting.

At this stage it is therefore not recommended for small scale forestry farmers to mechanise the harvesting of eucalyptus trees. However, the result is different when considering the 2018/2019 minimum wage of R20 per hour. Taking into consideration the new minimum wage and assuming that all other costs remain the same, the average manual harvesting cost for the 5 farmers is at R164.60 per ton. While, the average mechanical harvesting costs of the 5 farmers is R160.55 per ton, it could therefore be possible that from the next financial year it could be recommended for certain small scale forestry farmers to mechanise the harvesting process.

Each farmer should however conduct his or her own costing to determine what is best for their farming situation as each farmer has different circumstances.

4.4 LIMITATIONS OF THE STUDY

When looking at the limitations of this research, certain factors need to be taken into consideration. Limited information pertaining to the cost of manual and mechanical timber harvesting was found in literature. No other studies were found which compared the cost of manual and mechanical harvesting. As this study was only conducted on the Highveld area of Mpumalanga and only dealt with the harvesting of eucalyptus trees, it cannot be generalised for the whole population or for other harvesting processes.

As this study works with costs that fluctuates from month to month, such as the fuel price, the results can only be valid at a specific time period. Since most of the machinery is imported the cost of machinery can also fluctuate based on the fluctuation of the exchange rate. A large amount of assumptions were made in the costings model. The model can therefore not reflect the true cost associated with each process. As this

case analysis is based on the average production over the following 5 years, it is assumed that costs will remain the same during this period. Since the study only compared the cost of two methods, inflation was not taken into account.

Another factor that is not considered in this study is the absenteeism of labourers. The costings are made on the assumption that the labourers do not take any unpaid or unexpected leave. The labour cost could therefore be underestimated as absenteeism will impact the daily production.

4.5 FURTHER RESEARCH

Further research can be conducted by taking the whole harvesting process into consideration from the cutting of the trees until delivery to the buyer. This research can also be replicated in the harvesting of pine trees. Different farmer situations can also be investigated to get more accurate results. Other research can be conducted by taking two blocks of eucalyptus trees with similar stand and yield and then conducting mechanical harvesting in the one block and manual harvesting in the other. Since the environment will be very similar a more direct measure of the time, costs and possibly the increase in yield in between methods will be obtained.

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ANNEXURES

Annexure 1

HITACHI

Reliable solutions

Date : 08th November 2017

Quote Number Q00118

ATTENTION :

Dear Sir / Madame,

We have pleasure in submitting our offer for the following:

ONE ONLY NEW HITACHI ZX200-5G TRACKED EXCAVATOR POWERED BY AN ISUZU CC-6BG1T ENGINE, DEVELOPING 125kW @ 2100 R.P.M. AND EQUIPPED WITH A 0.9M³ BUCKET WITH AN OPERATING WEIGHT OF 19800KGS.

Otherwise generally in accordance with the attached specification.

<i>PRICE :</i>		
Ex Stock	1,480,000.00	<i>EA. NET EXCL. VAT</i>
VAT	207 200.00	
<i>TOTAL</i>	<i>R1,687,200.00</i>	<i>EA. NET INCL. VAT</i>

(One million, six hundred and eighty seven thousand and two hundred rand only)

Strobe light, Fire Ext, Window Guard, Battery lockout, included in price.

FOR CONDITIONS OF TENDER AND SALE SEE REVERSE

© Hitachi Construction Machinery Southern Africa Co (Pty) Ltd.

Reg. No. 1951/002418/07
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P.O. Box 1171, Nelspruit, 1200
South Africa
TEL: +27(0) 13 753 2667/8 FAX: +27(0) 13 752 7788
WEB: www.hitachi-c-m.com/za

Directors: *T. Takase, *K. Suzuki, *S. Hirota, *S. Konno, *T. Hosomi, F. Abrahams (*Japan)

Annexure 2

					
LOGMECH Specializing in Forestry Equipment		Tel: +27 (35) 9400014 eMail: ticky@logmech.co.za leon@logmech.co.za Internet: www.logmech.co.za			
QUOTE DATE : 7 NOVEMBER 2017					
QUOTATION & SALES ORDER					
SP 591 LX-G3 HARVESTER HEAD				R 1 650 000.00	
HYDRAULICS Min pump capacity Max working pressure		METRIC 166 L/min 25-30 Mpa		DELIMBING Movable knives Fixed knives Diameter minimum Diameter tip to tip Proportional pressure LogHold	
FEEDING Hydraulic motors Max opening Feeding force Feed speed Proportional pressure		500/315, 630/400, 800/500 cc 640 mm 30 kN 0-7 m/s Yes		WEIGHT & DIMENSIONS Width closed Width open Height excluding tilt frame Weight excluding rotator	
FELLING / CUTTING Cutting diameter Chain speed Saw motor Saw unit		600 mm 40 m/s 20 cc Automatic - Supercut 100		RECOMMENDATIONS Optimum tree size dbh Max rec. tree size dbh	
CARRIERS The SP591LX can be fitted to a variety of different carriers such as conventional forest machines or excavators.				Diameter breast height, measured 1.3m up from the ground	
FITMENT Electrical work Roll cage & Side protection 6mm & 12mm Belly plates Nose Cone				Hand pump oil filter All steel and flex pipes Bullet proof glass	
				R 190 000.00	
HYDRAULIC MODIFICATIONS Hydraulic cooler & 2-Pump Combine kit				R 104 000.00	
ADDITIONAL EQUIPMENT Fire suppression				R 65 000.00	
NOTES : SP591LX HARVESTER HEAD TO BE FITTED ON : HITACHI ZAXIS-200					
TERMS & CONDITIONS Free Delivery and commissioning on site Quote valid for 7 days, due to exchange rate fluctuations			COST HARVESTER HEAD R 1 650 000.00 FITMENT & MODIFICATION COSTS R 294 000.00 ADDITIONAL EQUIPMENT R 65 000.00		
NOTE: PRICES QUOTED ARE EXCLUDING VAT			TOTAL EXCLUDING VAT R 2 009 000.00		
CUSTOMER DETAILS			CUSTOMER ACCEPTANCE: PLEASE COMPLETE THIS SECTION AND RETURN TO US.		
			DATE : _____ PRINT NAME : _____		
			CUSTOMER SIGNATURE : _____		

Annexure 3

E-mail: ermelo@winkelhaak.co.za BTW NR 4540190180 TEL : (017) 819 5427/9 FAKS : (017) 819 5443 SEL : 076 175 5651 WINKELHAAK VERSPREIDERS (ERMELO) BK POSBUS 1958 ERMELO 2350 CK 2000/062947/23	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="2" style="text-align: center;">Tax Invoice</th> </tr> <tr> <td style="width: 50%;">Date</td> <td style="text-align: right;">17/08/2017</td> </tr> <tr> <td>Page</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Document No</td> <td style="text-align: right;">IN367616</td> </tr> </table>	Tax Invoice		Date	17/08/2017	Page	1	Document No	IN367616
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Code	Description	Quantity	Unit	Unit Price	Disc%	Tax	Nett Price
CUT210	CUTTER BAR 210LT	1.00	210L	3,050.00		14.00%	3,050.00
50/2150/620	CALTEX Delo GOLD 20 Lt	1.00	20LT	780.00		14.00%	780.00
	469462 17/8						

Received in good order Signed _____ Date _____
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© Sage South Africa (Pty) Ltd

Sub Total	3,359.65
Discount @ 0.00%	0.00
Amount Excl Tax	3,359.65
Tax	470.35
Total	3,830.00

Annexure 4

Copy Quotation

Highveld Forest and Garden

Postnet Suite 1809
Private Bag X9013
Ermelo
2350

Tel : (017) 819 2804
Fax : (017) 819 2804
admin@highveldforest.co.za
VAT Nr : 4640229359

Date :	30/10/17
Page :	1
Document No :	QU112808

Cash / Kontant

Account	Your Reference	Tax Exempt	VAT Number	Sales Code	Expiry
99		N		2	30/10/17 Inclusive

Code	Description	Quantity	Unit	Unit Price	Disc%	Tax	Nett Price
505698156	ROUND FILE 5.5MM	1.00	each	25.00		14.00%	25.00
581614801	TWO STROKE 20L	1.00	each	1,520.00		14.00%	1,520.00
501841468	CHAIN 34 HQV (501 84 14 68)	1.00	each	325.00		14.00%	325.00
508913168	GUIDE BAR 18" HUSQ	1.00	each	530.00		14.00%	530.00
967062315	61 CHAINSAW 61.5cc-2.9kw 15 6.1kg	1.00	each	6,999.00		14.00%	6,999.00

Offer only valid for 30 days
from the date of Quotation

Received in good order

Signed :

Date : _____

Sub Total	8,244.73
Discount @ 0.00%	0.00
Amount Excl VAT	8,244.73
VAT	1,154.27
Total	9,399.00

Annexure 5

WORKWEAR DEPOT (PTY) LTD

NELSPRUIT
16 Eastern Boulevard
Riverside Park
Nelspruit, 1200
Tel: +27 13 752 4142 Fax: +27 13 752 4165

Quotation

160747

Page 1 of 1

Reg. # 1973/003675/07 Vat Reg. # 4400111961

Customer:

Contact:
Tel: 013 752 4142

Fax:

Our banking details:

NedBank
Coastal & Inland Business Unit
Acc: 1005497001
Branch: 164826

Account No.	Salesperson	Customer ref.	Date
EFTA003	MICHELLE VAN DER MERWE	PPE	16/10/17

Stock code	Description	Quantity	Unit Excl.	Discount	Net Excl.	Amt. Excl.
20101-OLU-00-36	JON CONTI TRS 65/35	1	157.02	%	157.02	157.02
20106-OLU-03-M	JON CONTI JKT 65/35	1	165.79	%	165.79	165.79
12210-BLK-00-08	BOVA CHELSEA BOOT	1	683.33	%	683.33	683.33
22001-NAV-04-L	JON RAINUIT	1	218.42	%	218.42	218.42
70410-NCL-00-STD	ZEMBE LEG PROTECTORS	1	86.84	%	86.84	86.84
30111-YEL-04-L	PW LEATHER COWHIDE GLOVE	1	78.07	%	78.07	78.07
42160-NCL-00-STD	FFP1 DISPOSABLE MASK 20'S	1	69.30	%	69.30	69.30
81060-BLU-00-STD	SAFETY HELMET	1	17.54	%	17.54	17.54
60120-CLR-00-STD	PW VS 9390 CLEAR SPECS	1	28.07	%	28.07	28.07
27011-ORA-05-XL	HI VIZ VEST - ZIP AND ID	1	34.21	%	34.21	34.21
50251-HIV-00-STD	HL EARMUFF HELMET L1	1	288.60	%	288.60	288.60
70310-NCL-00-STD	CHAINSAW HELMET COMPLETE	1	297.36	%	297.36	297.36
70120-BLN-04-L	PW CHAINSAW TRS	1	814.91	%	814.91	814.91
70215-BGN-06-2XL	JON CHAINSAW JKT	1	139.47	%	139.47	139.47
23903-BLK-05-XL	JON T SHIRT 180G	1	104.39	%	104.39	104.39

16/10/17 bene

This Quote is Valid for 30 Days

Customer Acceptance

Total Value(excl)	3183.32
Total discount	0.00
Total Value	3183.32
Total freight	0.00
Total VAT	445.66
Total Value(inc)	3 628.98

Annexure 6

E-mail: ermelo@winkelhaak.co.za BTW NR 4540190180 TEL : (017) 819 5427/9 FAKS : (017) 819 5443 SEL : 076 175 5651 WINKELHAAK VERSPREIDERS (ERMELO) BK POSBUS 1958 ERMELO 2350 CK 2000/062947/23	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="2" style="text-align: center; padding: 2px;">Tax Invoice</th> </tr> <tr> <td style="width: 50%; padding: 2px;">Date</td> <td style="padding: 2px;">24/10/2017</td> </tr> <tr> <td style="padding: 2px;">Page</td> <td style="padding: 2px;">1</td> </tr> <tr> <td style="padding: 2px;">Document No</td> <td style="padding: 2px;">IN370689</td> </tr> </table> Deliver to CAROLINA	Tax Invoice		Date	24/10/2017	Page	1	Document No	IN370689
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Code	Description	Quantity	Unit	Unit Price	Disc%	Tax	Nett Price
DIESEL50	DYNAMIC DIESEL (.005% SULPHUR)	2,800.00	Lt	11.91	0.00%		33,348.00
50/2150/620	CALTEX Delo GOLD 20 Lt OOM ANTON BESTEL EPOS	1.00	20LT	790.00		14.00%	790.00

Received in good order

Signed _____ Date _____

© Sage South Africa (Pty) Ltd

Sub Total	34,040.98
Discount @ 0.00%	0.00
Amount Excl Tax	34,040.98
Tax	97.02
Total	34,138.00

Annexure 7

HINTERLAND CAROLINA
017 8431040
C/O Voortrekker & Du Toit Street
Carolina



Registration Nr.: 2012/035806/07
VAT Registration Nr.: 4920262732
HINTERLAND SA (PTY) LTD

Hinterland

KWOTASIE

KWOTASIE

V410

Kwotasie Nr.: A419-T05-293562

Bladsy Nr.: 1/1

Datum: 2017/10/30 03:50:02 PM

Tak: HINTERLAND CAROLINA

Tel: 017 8431040

Adres: C/O Voortrekker & Du Toit Street
Carolina

Bestel Nr.:

Lyn	Aantal	Produk	Reknr.	Eenheidsprys		Totaal	Korting	BTW	Lyntotaal
				BTW(inkl)	BTW(ekskl)			Bedrag	
1	1.00	6009513703709	308055	58.90	51.67	51.67	0.00	7.23	58.90
		FILE RASP FLAT 8INCH (200)							
2	1.00	6001844053102	308055	279.51	245.18	245.18	0.00	34.33	279.51
		HATCHET 900G							
T O T A L E						296.85		41.56	338.41

VOORWAARDES:

- Hierdie kwotasie is geldig tot 2017/11/13
- Hierdie kwotasie is onderhewig aan voorraad beskikbaarheid
- Promosies word uitgesluit
- Brandstof pryse is onderhewig aan prysaanpassing maandeliks

BANK BESONDERHEDE:

Bank: ABSA Bank Bpk
Rekeninghouer: HINTERLAND SA(PTY)LTD
Rekeningnommer: 40-8101-1894
Takkode: 630-499
Verwysingsnommer: A419-T05-293562

Annexure 8: Manual labour costing farmer 1

Manual labour tree harvesting costing			Farmer 1		
Eucalyptus manual harvesting			Rate per ton		
Tree size =	0,2		R 144,59		
Felling task =	115	trees			
Production - 23 tons/cutter					
Terrain 0-35%					
Calculation inclusive of leave and sickleave provision					
NO overheads and/or indirect costs					
CALCULATION OF HARVESTING RATE					
VOLUMES TO BE HARVESTED					
What is the annual (or annualized) tonnage or volume to be harvested?			complete	tons	
			8060		
Volume per:			month	prod.day	
			671,7	32,5	
What species to be harvested?			Hardwood		
PRODUCTION DAYS PER YEAR					
How many working days in this year? (5days times 52 weeks)			260	cst/day	complete
How many statutory leave days in this year?			12	166,02	cst/month
How many days/labourer provided for sick leave/year?			10	138,35	cst/year
How many days/labourer provided for leave/year?			15	207,52	cst/ton
How many days per year for un-productive time(red days etc.)?			3	41,50	
			Total	553,39	11437
				137240,33	17,03
Labourer days available per year			220		
Production days per year			248		
Loss of production days / labourer / year			28		
Average working days / month			20,67		
STATUTORY COSTS AND PROVIDENT FUND					
Indicate the relevant percentage in each case:			%	cst/mth	cst/year
WCA (% of gross wage + salaries)			1,89	1426,47	17118
UIF (% as with workman's compensation)			1	754,75	9057
What % of nett wage do you allow for medical expenses?			3	2058,40	24701
			TOTAL=	4240	50875
				6,31	
CALCULATION OF STAFF COSTS.					
PRODUCTIVITY					
Cutter 16,25 ton/day					
Stripper 2,03 ton/day					
Salaried staff					
OVERHEAD STAFF ONLY			OVERHEAD STAFF ONLY		
No. of Managers	Name/ describe	Gross monthly salary	No. of	Name/ describe	Gross monthly salary
1	Manager	6861			
TOTALS 1 R 6 861,33 0 0 0 0					
Wage earners, daily paid staff.					
SKILLED STAFF			SKILLED STAFF		
No. of Supervisor Drivers	Name/ describe	Nett daily wage	No. of	Name/ describe	Nett daily wage
1	Snr Induna	220,00	2	Chainsaw operatc	R 200,00
TOTALS 1 R 220,00 2 R 400,00					
UNSKILLED STAFF			UNSKILLED STAFF		
No. of	Name/ describe	Nett daily wage	No. of	Name/ describe	Nett daily wage
16	debarkers	R 150,00	0		
2	pushers	R 150,00			
TOTALS 18 R 2 700,00					
SUMMARY:					
UNITS			UNITS		
No. of overhead units =	1	Total overhead =	/DAY	/MTH	/YEAR
No. of skilled wage earners =	3	Total skilled =	332,00	6 861,33	82 336,00
No. of unskilled wage earners =	18	Total unskilled =	620,00	12 813,33	153 760,00
Total mandays/mth: 434		TOTAL =	2 700,00	55 800,00	669 600,00
			3 652,00	75 474,67	905 696,00
AVERAGE WAGE Unskilled : = R 150,00 PER DAY					
AVERAGE WAGE Unskilled : = R 3100,00 PER MONTH					
AVERAGE WAGE Skilled : = R 206,67 PER DAY					
AVERAGE WAGE Skilled : = R 4271,11 PER MONTH					
COST OF TRANSPORT					
Your no. of salaried staff: = 1					
Your no. of wage earners: = 21					
complete					
TRANSPORT					
Cost per KM R 6,88					
Distance traveled per day in km 50					
Distance traveld annually in km 12400					
Transport costs per annum R 85 312,00					
Transporting vehicles needed 1					
Total transport costs per annum R 85 312,00					
			/working day	/month	/year
Transport			R 344,00	R 7 109,33	R 85 312,00
					/ton
					R 10,58

Annexure 8 continue farmer 1

PROTECTIVE CLOTHING (SAFETY)								
Skilled	1	Cs.oper.	2					
Unskilled	18							
Please complete the table.								
Calculating done by: no.of people x no.of item/year x price.								
	Item	no.of staff using	no/year	cost per item		cost/ month	cost/ year	cost/ ton
	Two piece overalls	21	2	133,00		466	5586	0,693
	Steel toe cap boots	21	2	225,00		788	9450	1,172
	Rain coat - two piece	21	1	212,00		371	4452	0,552
	Leggings	18	0,75	130,00		146	1755	0,218
	Poly/rubber/plastic gloves	19	12	28,50		542	6498	0,806
	Hard hats	19	1	20,50		32	390	0,048
	Other Safety glasses	19	2	15,00		48	570	0,071
	Other Bibs	21	1	45,00		79	945	0,117
	Other Hardhat with ear muffs	2	2	130,00		43	520	0,065
Cutter protective clothing:		no.of operators & mechanic:			2			
	Cs. hard hat with visor and ear mu	2	2	420,00		140	1680	0,208
	Visors	2	1	0,00		0	0	0,000
	Ear muffs	2	2	0,00		0	0	0,000
	Cs gloves	2	4	240,00		160	1920	0,238
	Cs. pants	2	2	853,00		284	3412	0,423
	Cs. tops	2	2	240,00		80	960	0,119
All personnel including cutters:				Total	R	3178	38138	4,732
cutters				Total	R	664	7972	0,989
TOOLS								
Calculating done by: no.of people x no.of item/year x price.								
	Item	no.of staff using	no/year	cost per item		cost/ month	cost/ year	cost/ ton
	Fire extinguishers large	1	1	492,75		41	493	0,061
	Fire extinguishers small	1	1			0	0	0,000
	Hatchets	16	1	279,51		373	4472	0,555
	Hatchet sharpening files	16	3	58,90		236	2827	0,351
Chainsaw equipment								
	Chain	2	12	325,00		650	7800	0,968
	Guidebars	2	6	530,00		530	6360	0,789
	Round files	2	12	25,00		50	600	0,074
	Flat files	2	6	58,90		59	707	0,088
	fuel cans (Combi can)	2	1	427,00		71	854	0,106
	Other sprocket	2	4	198,00		132	1584	0,197
Tools excluding chainsaw equipment =				R		649	7792	0,967
Tools : chainsaw equipment =				R		1492	17905	2,221
CHAINSaw COSTS								
Please complete the table.						cst/mth	cst/yr	cst/ton
How many chainsaws, INC. spare saws do you use for this team?					2,2			
How many chainsaws are working daily?					2			
What is the lifespan of a chainsaw in months? (NB must be > 0)					6			
What is the current replacement price of a chainsaw?					6999	2656,87	31882	3,956
How many liters of fuel do you use per chainsaw per day?					5			
What is your cost of fuel/liter (the petrol x 2-stroke mix) ?					15,64	3232,27	38787	4,812
How many liters of chainlube do you use per chainsaw per day?					3			
What is your cost of chainlube per liter?					15,52	1924,48	23094	2,865
What is your Repair Cost Factor for Chainsaws?					60 %			
					699,90	1399,8	16797,6	2,084
					Gr tot. R	10705,48		
					Total R	9213,41	110561	13,72
					Cst / saw / hr =R		39,24	
At what interest rate can you finance assets?					12 %			
(This figure is used to calculate the interest on your capital layout for chainsaws)								
					T O T A L CHAINSaw COST PER TON: R			
					15,94			
Total harvesting costs per ton :					Total harvesting costs:			
Labour costs		R 112,37			Labour costs		R 905 696,00	
Chainsaw costs		R 15,94			Chainsaw costs		R 128 465,74	
Tools cost		R 0,97			Tools cost		R 7 792,11	
PPE cost		R 4,73			PPE cost		R 38 137,50	
Transportation costs		R 10,58			Transportation costs		R 85 312,00	
Total:		R 144,59			Total:		R 1 165 403,35	

Annexure 9: Manual labour costing farmer 2

Manual labour tree harvesting costing				Farmer 2			
Eucalyptus manual harvesting				Rate per ton			
Tree size = 0,2				R 153,67			
Felling task = 115 trees							
Production - 23 tons/cutter							
Terrain 0-35%							
Calculation inclusive of leave and sickleave provision							
NO overheads and/or indirect costs							
CALCULATION OF HARVESTING RATE							
VOLUMES TO BE HARVESTED							
What is the annual (or annualized) tonnage or volume to be harvested?				complete		tons	
				7100			
Volume per:				month		prod.day	
				591,7		28,6	
What species to be harvested?				Hardwood			
PRODUCTION DAYS PER YEAR							
How many working days in this year? (5days times 52 weeks)				260		cst/day	
How many statutory leave days in this year?				12		147,57	
How many days/labourer provided for sick leave/year?				10		122,98	
How many days/labourer provided for leave/year?				15		184,46	
How many days per year for un-productive time(red days etc.)?				3		36,89	
Total				491,90		10166	
				cst/month		cst/year	
				3050		36597	
				cst/ton		5,15	
				2541		30498	
				3812		45747	
				762		9149	
				121991,40		17,18	
Labourer days available per year				220			
Production days per year				248			
Loss of production days / labourer / year				28			
Average working days / month				20,67			
STATUTORY COSTS AND PROVIDENT FUND							
Indicate the relevant percentage in each case:				%		cst/mth	
WCA (% of gross wage + salaries)				1,89		1297,57	
UIF (% as with workman's compensation)				1		686,55	
What % of nett wage do you allow for medical expenses?				3		1872,40	
TOTAL=				3857		46278	
				cst/year		cst/ton	
				15571		2,19	
				8239		1,16	
				22469		3,16	
				6,52			
CALCULATION OF STAFF COSTS.							
PRODUCTIVITY							
Cutter 14,31 ton/day							
Stripper 2,04 ton/day							
Salaried staff							
OVERHEAD STAFF ONLY			OVERHEAD STAFF ONLY			UNSKILLED STAFF	
No. of Managers	Name/ describe	Gross monthly salary	No. of	Name/ describe	Gross monthly salary	No. of	Name/ describe
1	Manager	6241					
TOTALS	1	R 6 241,33	0		0	0	0
Wage earners, daily paid staff.							
SKILLED STAFF			SKILLED STAFF			UNSKILLED STAFF	
No. of Supervisor	Name/ describe	Nett daily wage	No. of	Name/ describe	Nett daily wage	No. of	Name/ describe
1	Snr Induna	220,00	2	Chainsaw operatc	R 200,00	14	debarkers
						0	
						2	pushers
TOTALS	1	R 220,00	2		R 400,00	16	
							R 2 400,00
SUMMARY:							
		UNITS					
No. of overhead units	=	1	Total overhead	=	302,00	6 241,33	74 896,00
No. of skilled wage earners	=	3	Total skilled	=	620,00	12 813,33	153 760,00
No. of unskilled wage earners	=	16	Total unskilled	=	2 400,00	49 600,00	595 200,00
Total mandays/mth:	393		TOTAL =		3 322,00	68 654,67	823 856,00
AVERAGE WAGE Unskilled		: = R	150,00		PER DAY		
AVERAGE WAGE Unskilled		: = R	3100,00		PER MONTH		
AVERAGE WAGE Skilled		: = R	206,67		PER DAY		
AVERAGE WAGE Skilled		: = R	4271,11		PER MONTH		
COST OF TRANSPORT							
Your no. of salaried staff:		=	1				
Your no. of wage earners:		=	19				
complete							
TRANSPORT							
Cost per KM			R 6,88				
Distance traveled per day in km			60				
Distance traveld annually in km			14880				
Transport costs per annum			R 102 374,40				
Transporting vehicles needed			1				
Total transport costs per annum			R 102 374,40				
		/working day	/month	/year	/ton		
Transport		R 412,80	R 8 531,20	R 102 374,40	R 14,42		

Annexure 9: Manual labour costing farmer 2 continue:

PROTECTIVE CLOTHING (SAFETY)										
Skilled	1	Cs.oper.	2							
Unskilled	16									
Please complete the table.										
Calculating done by: no.of people x no.of item/year x price.										
	Item	no.of staff using	no/year	cost per item		cost/ month	cost/ year	cost/ ton		
	Two piece overalls	19	2	133,00		421	5054	0,712		
	Steel toe cap boots	19	2	225,00		713	8550	1,204		
	Rain coat - two piece	19	1	212,00		336	4028	0,567		
	Leggings	16	0,75	130,00		130	1560	0,220		
	Poly/rubber/plastic gloves	17	12	28,50		485	5814	0,819		
	Hard hats	2	1	20,50		3	41	0,006		
Other	Safety glasses	17	2	15,00		43	510	0,072		
Other	Bibs	19	1	45,00		71	855	0,120		
Other	Hardhat with ear muffs	2	2	130,00		43	520	0,073		
Cutter protective clothing:		no.of operators & mechanic:			2					
	Cs. hard hat with visor and ear muffs	2	2	420,00		140	1680	0,237		
	Visors	2	1	0,00		0	0	0,000		
	Ear muffs	2	2	0,00		0	0	0,000		
	Cs gloves	2	4	240,00		160	1920	0,270		
	Cs. pants	2	2	853,00		284	3412	0,481		
	Cs. tops	2	2	240,00		80	960	0,135		
All personnel including cutters:				Total	R	2909	34904	4,916		
cutters				Total	R	664	7972	1,123		
TOOLS										
Calculating done by: no.of people x no.of item/year x price.										
	Item	no.of staff using	no/year	cost per item		cost/ month	cost/ year	cost/ ton		
	Fire extinguishers large	1	1	492,75		41	493	0,069		
	Fire extinguishers small	1	1			0	0	0,000		
	Hatchets	14	1	279,51		326	3913	0,551		
	Hatchet sharpening files	14	3	58,90		206	2474	0,348		
	Chainsaw equipment									
	Chain	2	12	325,00		650	7800	1,099		
	Guidebars	2	6	530,00		530	6360	0,896		
	Round files	2	12	25,00		50	600	0,085		
	Flat files	2	6	58,90		59	707	0,100		
	fuel cans (Combi can)	2	1	427,00		71	854	0,120		
	Other sprocket	2	4	198,00		132	1584	0,223		
Tools excluding chainsaw equipment =				R		573	6880	0,969		
Tools : chainsaw equipment =				R		1492	17905	2,522		
CHAINSAW COSTS										
Please complete the table.										
How many chainsaws, INC. spare saws do you use for this team?					2,2	cst/mth	cst/yr	cst/ton		
How many chainsaws are working daily?					2					
What is the lifespan of a chainsaw in months? (NB must be > 0)					6					
What is the current replacement price of a chainsaw?					6999	2656,87	31882	4,490		
How many liters of fuel do you use per chainsaw per day?					4,3					
What is your cost of fuel/liter (the petrol x 2-stroke mix) ?					15,64	2779,75	33357	4,698		
How many liters of chainlube do you use per chainsaw per day?					3					
What is your cost of chainlube per liter?					15,52	1924,48	23094	3,253		
What is your Repair Cost Factor for Chainsaws?					60 %					
					699,90	1399,8	16797,6	2,366		
					Gr tot. R	10252,96				
					Total R	8760,89	105131	14,81		
					Cst / saw / hr =R		37,58			
At what interest rate can you finance assets?					12 %					
(This figure is used to calculate the interest on your capital layout for chainsaws)										
					T O T A L CHAINSAW COST PER TON: R					17,33
Total harvesting costs per ton :					Total harvesting costs:					
Labour costs		R 116,04			Labour costs		R 823 856,00			
Chainsaw costs		R 17,33			Chainsaw costs		R 123 035,53			
Tools cost		R 0,97			Tools cost		R 6 879,69			
PPE cost		R 4,92			PPE cost		R 34 904,00			
Transportation costs		R 14,42			Transportation costs		R 102 374,40			
Total:		R 153,67			Total:		R 1 091 049,62			

Manual labour tree harvesting costing				Farmer 3			
Eucalyptus manual harvesting				Rate per ton			
Tree size = 0,2				R 134,19			
Felling task = 115 trees							
Production - 23 tons/cutter							
Terrain 0-35%							
Calculation inclusive of leave and sickleave provision							
NO overheads and/or indirect costs							
CALCULATION OF HARVESTING RATE							
VOLUMES TO BE HARVESTED							
What is the annual (or annualized) tonnage or volume to be harvested?				complete 13460		tons	
Volume per:				month 1121,7		prod.day 54,3	
What species to be harvested?				Hardwood			
PRODUCTION DAYS PER YEAR							
How many working days in this year? (5days times 52 weeks)				260		cst/day	
How many statutory leave days in this year?				12		276,69	
How many days/labourer provided for sick leave/year?				10		230,58	
How many days/labourer provided for leave/year?				15		345,87	
How many days per year for un-productive time(red days etc.)?				3		69,17	
Total				922,31		19061	
Labourer days available per year				220			
Production days per year				248			
Loss of production days / labourer / year				28			
Average working days / month				20,67			
STATUTORY COSTS AND PROVIDENT FUND							
Indicate the relevant percentage in each case:				%		cst/mth	
WCA (% of gross wage + salaries)				1,89		2285,79	
UIF (% as with workman's compensation)				1		1209,41	
What % of nett wage do you allow for medical expenses?				3		3298,40	
TOTAL=				6794		81523	
CALCULATION OF STAFF COSTS.							
PRODUCTIVITY							
Cutter				18,09 ton/day			
Stripper				2,01 ton/day			
Salaried staff							
OVERHEAD STAFF ONLY			OVERHEAD STAFF ONLY			UNSKILLED STAFF	
No. of Managers	Name/ describe	Gross monthly salary	No. of	Name/ describe	Gross monthly salary	No. of	Nett daily wage
1	Manager	10995					
TOTALS	1	R 10 994,67	0		0	0	0
Wage earners, daily paid staff.							
SKILLED STAFF			SKILLED STAFF			UNSKILLED STAFF	
No. of Supervisor Drivers	Name/ describe	Nett daily wage	No. of	Name/ describe	Nett daily wage	No. of	Nett daily wage
1	Snr Induna	220,00	3	Chainsaw operator	R 200,00	27	debarkers
						0	
						3	pushers
TOTALS	1	R 220,00	3		R 600,00	30	R 4 500,00
SUMMARY:							
No. of overhead units		=	1	Total overhead	=	532,00	10 994,67
No. of skilled wage earners		=	4	Total skilled	=	820,00	16 946,67
No. of unskilled wage earners		=	30	Total unskilled	=	4 500,00	93 000,00
Total mandays/mth:		703	TOTAL =			5 852,00	120 941,33
AVERAGE WAGE Unskilled		: = R	150,00	PER DAY			
AVERAGE WAGE Unskilled		: = R	3100,00	PER MONTH			
AVERAGE WAGE Skilled		: = R	205,00	PER DAY			
AVERAGE WAGE Skilled		: = R	4236,67	PER MONTH			
COST OF TRANSPORT							
Your no. of salaried staff:		=	1				
Your no. of wage earners:		=	34				
complete							
TRANSPORT							
Cost per KM		R 6,88					
Distance traveled per day in km		25					
Distance traveld annually in km		6200					
Transport costs per annum		R 42 656,00					
Transporting vehicles needed		2					
Total transport costs per annum		R 85 312,00					
/working day		/month	/year	/ton			
Transport		R 344,00	R 7 109,33	R 85 312,00	R 6,34		

Annexure 10 continue farmer 3

PROTECTIVE CLOTHING (SAFETY)								
Skilled	1	Cs.oper.	3					
Unskilled	30							
Please complete the table.								
Calculating done by: no.of people x no.of item/year x price.								
Item	no.of staff using	no/year	cost per item		cost/ month	cost/ year	cost/ ton	
Two piece overalls	34	2	133,00		754	9044	0,672	
Steel toe cap boots	34	2	225,00		1275	15300	1,137	
Rain coat - two piece	34	1	212,00		601	7208	0,536	
Leggings	27	0,75	130,00		219	2633	0,196	
Poly/rubber/plastic gloves	31	12	28,50		884	10602	0,788	
Hard hats	31	1	20,50		53	636	0,047	
Other Safety glasses	31	2	15,00		78	930	0,069	
Other Bibs	34	1	45,00		128	1530	0,114	
Other Hardhat with ear muffs	3	2	130,00		65	780	0,058	
Cutter protective clothing:	no.of operators & mechanic:			3				
Cs. hard hat with visor and ear mu	3	2	420,00		210	2520	0,187	
Visors	3	1	0,00		0	0	0,000	
Ear muffs	3	2	0,00		0	0	0,000	
Cs gloves	3	4	240,00		240	2880	0,214	
Cs. pants	3	2	853,00		427	5118	0,380	
Cs. tops	3	2	240,00		120	1440	0,107	
All personnel including cutters:				Total R	5052	60620	4,504	
cutters				Total R	997	11958	0,888	
TOOLS								
Calculating done by: no.of people x no.of item/year x price.								
Item	no.of staff using	no/year	cost per item		cost/ month	cost/ year	cost/ ton	
Fire extinguishers large	1	1	492,75		41	493	0,037	
Fire extinguishers small	1	1			0	0	0,000	
Hatchets	27	1	279,51		629	7547	0,561	
Hatchet sharpening files	27	3	58,90		398	4771	0,354	
Chainsaw equipment								
Chain	3	12	325,00		975	11700	0,869	
Guidebars	3	6	530,00		795	9540	0,709	
Round files	3	12	25,00		75	900	0,067	
Flat files	3	6	58,90		88	1060	0,079	
fuel cans (Combi can)	3	1	427,00		107	1281	0,095	
Other sprocket	3	4	198,00		198	2376	0,177	
Tools excluding chainsaw equipment = R					1068	12810	0,952	
Tools : chainsaw equipment = R					2238	26857	1,995	
CHAINSAB COSTS								
Please complete the table.					cst/mth	cst/yr	cst/ton	
How many chainsaws, INC. spare saws do you use for this team?					3,3			
How many chainsaws are working daily?					3			
What is the lifespan of a chainsaw in months? (NB must be > 0)					6			
What is the current replacement price of a chainsaw?					6999	3985,30	47824	3,553
How many liters of fuel do you use per chainsaw per day?					5,3			
What is your cost of fuel/liter (the petrol x 2-stroke mix) ?					15,64	5139,30	61672	4,582
How many liters of chainlube do you use per chainsaw per day?					3			
What is your cost of chainlube per liter?					15,52	2886,72	34641	2,574
What is your Repair Cost Factor for Chainsaws?					60 %			
					699,90	2099,7	25196,4	1,872
					Gr tot. R	16349,12		
					Total R	14111,02	169332	12,58
					Cst / saw / hr =R	39,95		
At what interest rate can you finance assets?					12 %			
(This figure is used to calculate the interest on your capital layout for chainsaws)								
					T O T A L CHAINSAB COST PER TON: R			
					14,58			
Total harvesting costs per ton :					Total harvesting costs:			
Labour costs		R 107,82				R 1 451 296,00		
Chainsaw costs		R 14,58				R 196 189,46		
Tools cost		R 0,95				R 12 810,42		
PPE cost		R 4,50				R 60 620,00		
Transportation costs		R 6,34				R 85 312,00		
Total:		R 134,19			Total:	R 1 806 227,88		

Annexure 11 manual labour costing farmer 4

Manual labour tree harvesting costing				Farmer 4			
Eucalyptus manual harvesting				Rate per ton			
Tree size =		0,2		R 139,18			
Felling task =		115 trees					
Production -		23 tons/cutter					
Terrain 0-35%							
Calculation inclusive of leave and sickleave provision							
NO overheads and/or indirect costs							
CALCULATION OF HARVESTING RATE							
VOLUMES TO BE HARVESTED							
What is the annual (or annualized) tonnage or volume to be harvested?				complete 13040		tons	
Volume per:		month prod.day					
		1086,7 52,6					
What species to be harvested?				Hardwood			
				complete			
How many working days in this year? (5days times 52 weeks)		260		cst/day	cst/month	cst/year	cst/ton
How many statutory leave days in this year?		12		267,47	5528	66333	5,09
How many days/labourer provided for sick leave/year?		10		222,89	4606	55277	4,24
How many days/labourer provided for leave/year?		15		334,34	6910	82916	6,36
How many days per year for un-productive time(red days etc.)?		3		66,87	1382	16583	1,27
		Total		891,57	18426	221109,42	16,96
Labourer days available per year				220			
Production days per year				248			
Loss of production days / labourer / year				28			
Average working days / month				20,67			
STATUTORY COSTS AND PROVIDENT FUND							
Indicate the relevant percentage in each case:				%		cst/mth	cst/year
WCA (% of gross wage + salaries)				1,89		2221,34	26656
UIF (% as with workman's compensation)				1		1175,31	14104
What % of nett wage do you allow for medical expenses?				3		3205,40	38465
				TOTAL=		6602	79225
CALCULATION OF STAFF COSTS.							
				PRODUCTIVITY			
				Cutter 17,53 ton/day			
				Stripper 2,02 ton/day			
Salaried staff							
OVERHEAD STAFF ONLY			OVERHEAD STAFF ONLY			UNSKILLED STAFF	
No. of Managers	Name/ describe	Gross monthly salary	No. of	Name/ describe	Gross monthly salary	No. of	Name/ describe
1	Manager	10685					
TOTALS	1	R 10 684,67	0		0	0	0
Wage earners, daily paid staff.							
SKILLED STAFF			SKILLED STAFF			UNSKILLED STAFF	
No. of Supervisor Drivers	Name/ describe	Nett daily wage	No. of	Name/ describe	Nett daily wage	No. of	Name/ describe
1	Snr Induna	220,00	3	Chainsaw operator	R 200,00	26	debarkers
						0	
						3	pushers
TOTALS	1	R 220,00	3		R 600,00	29	R 4 350,00
SUMMARY:		UNITS		/DAY	/MTH	/YEAR	/TON
No. of overhead units	=	1	Total overhead =	517,00	10 684,67	128 216,00	9,83
No. of skilled wage earners	=	4	Total skilled =	820,00	16 946,67	203 360,00	15,60
No. of unskilled wage earners	=	29	Total unskilled =	4 350,00	89 900,00	1 078 800,00	82,73
Total mandays/mth:	682		TOTAL =	5 687,00	117 531,33	1 410 376,00	108,16
AVERAGE WAGE Unskilled	: = R		150,00 PER DAY				
AVERAGE WAGE Unskilled	: = R		3100,00 PER MONTH				
AVERAGE WAGE Skilled	: = R		205,00 PER DAY				
AVERAGE WAGE Skilled	: = R		4236,67 PER MONTH				
COST OF TRANSPORT							
Your no. of salaried staff:	=	1					
Your no. of wage earners:	=	33					
complete							
TRANSPORT							

Annexure 11 continue farmer 4

PROTECTIVE CLOTHING (SAFETY)								
Skilled	1	Cs.oper.	3					
Unskilled	29							
Please complete the table.								
Calculating done by: no.of people x no.of item/year x price.								
Item	no.of staff using	no/year	cost per item		cost/ month	cost/ year	cost/ ton	
Two piece overalls	33	2	133,00		732	8778	0,673	
Steel toe cap boots	33	2	225,00		1238	14850	1,139	
Rain coat - two piece	33	1	212,00		583	6996	0,537	
Leggings	29	0,75	130,00		236	2828	0,217	
Poly/rubber/plastic gloves	30	12	28,50		855	10260	0,787	
Hard hats	30	1	20,50		51	615	0,047	
Other Safety glasses	30	2	15,00		75	900	0,069	
Other Bibs	33	1	45,00		124	1485	0,114	
Other Hardhat with ear muffs	3	2	130,00		65	780	0,060	
Cutter protective clothing:	no.of operators & mechanic:			3				
Cs. hard hat with visor and ear mu	3	2	420,00		210	2520	0,193	
Visors	3	1	0,00		0	0	0,000	
Ear muffs	3	2	0,00		0	0	0,000	
Cs gloves	3	4	240,00		240	2880	0,221	
Cs. pants	3	2	853,00		427	5118	0,392	
Cs. tops	3	2	240,00		120	1440	0,110	
All personnel including cutters:				Total	R	4954	59450	4,559
cutters				Total	R	997	11958	0,917
TOOLS								
Calculating done by: no.of people x no.of item/year x price.								
Item	no.of staff using	no/year	cost per item		cost/ month	cost/ year	cost/ ton	
Fire extinguishers large	1	1	492,75		41	493	0,038	
Fire extinguishers small	1	1			0	0	0,000	
Hatchets	26	1	279,51		606	7267	0,557	
Hatchet sharpening files	26	3	58,90		383	4594	0,352	
Chainsaw equipment								
Chain	3	12	325,00		975	11700	0,897	
Guidebars	3	6	530,00		795	9540	0,732	
Round files	3	12	25,00		75	900	0,069	
Flat files	3	6	58,90		88	1060	0,081	
fuel cans (Combi can)	3	1	427,00		107	1281	0,098	
Other sprocket	3	4	198,00		198	2376	0,182	
Tools excluding chainsaw equipment =				R	1030	12354	0,947	
Tools : chainsaw equipment =				R	2238	26857	2,060	
CHAINSaw COSTS								
Please complete the table.					cst/mth	cst/yr	cst/ton	
How many chainsaws, INC. spare saws do you use for this team?					3,3			
How many chainsaws are working daily?					3			
What is the lifespan of a chainsaw in months? (NB must be > 0)					6			
What is the current replacement price of a chainsaw?					6999	3985,30	47824	3,667
How many liters of fuel do you use per chainsaw per day?					5,3			
What is your cost of fuel/liter (the petrol x 2-stroke mix) ?					15,64	5139,30	61672	4,729
How many liters of chainlube do you use per chainsaw per day?					3			
What is your cost of chainlube per liter?					15,52	2886,72	34641	2,656
What is your Repair Cost Factor for Chainsaws?					60 %			
					699,90	2099,7	25196,4	1,932
					Gr tot. R	16349,12		
					Total R	14111,02	169332	12,99
					Cst / saw / hr =R	39,95		
At what interest rate can you finance assets?					12 %			
(This figure is used to calculate the interest on your capital layout for chainsaws)								
T O T A L CHAINSaw COST PER TON: R							15,05	
Total harvesting costs per ton :					Total harvesting costs:			
Labour costs	R 108,16	Labour costs			R 1 410 376,00			
Chainsaw costs	R 15,05	Chainsaw costs			R 196 189,46			
Tools cost	R 0,95	Tools cost			R 12 354,21			
PPE cost	R 4,56	PPE cost			R 59 449,50			
Transportation costs	R 10,47	Transportation costs			R 136 499,20			
Total:	R 139,18	Total:			R 1 814 868,37			

Annexure 12: Manual labour costs for farmer 5

Manual labour tree harvesting costing				Farmer 5			
Eucalyptus manual harvesting				Rate per ton			
Tree size = 0,2				R 148,50			
Felling task = 115 trees							
Production - 23 tons/cutter							
Terrain 0-35%							
Calculation inclusive of leave and sickleave provision							
NO overheads and/or indirect costs							
CALCULATION OF HARVESTING RATE							
VOLUMES TO BE HARVESTED							
What is the annual (or annualized) tonnage or volume to be harvested?				complete		tons	
				12400			
Volume per:				month		prod.day	
				1033,3		50,0	
What species to be harvested?				Hardwood			
PRODUCTION DAYS PER YEAR							
How many working days in this year? (5days times 52 weeks)				260		cst/day	
How many statutory leave days in this year?				12		249,02	
How many days/labourer provided for sick leave/year?				10		207,52	
How many days/labourer provided for leave/year?				15		311,28	
How many days per year for un-productive time(red days etc.)?				3		62,26	
Total				830,08		17155	
				cst/month		cst/year	
				5147		61758	
				4289		51465	
				6433		77198	
				1287		15440	
				17155		205860,50	
				cst/ton		cst/ton	
				4,98		4,15	
				6,23		1,25	
				16,60			
Labourer days available per year				220			
Production days per year				248			
Loss of production days / labourer / year				28			
Average working days / month				20,67			
STATUTORY COSTS AND PROVIDENT FUND							
Indicate the relevant percentage in each case:				%		cst/mth	
WCA (% of gross wage + salaries)				1,89		2092,44	
UIF (% as with workman's compensation)				1		1107,11	
What % of nett wage do you allow for medical expenses?				3		3019,40	
TOTAL=				6219		74627	
				cst/year		cst/ton	
				25109		2,02	
				13285		1,07	
				36233		2,92	
				6219		6,02	
CALCULATION OF STAFF COSTS.							
PRODUCTIVITY							
Cutter 16,67 ton/day							
Stripper 2,08 ton/day							
Salaried staff							
OVERHEAD STAFF ONLY				OVERHEAD STAFF ONLY			
No. of Managers	Name/ describe	Gross monthly salary	No. of	Name/ describe	Gross monthly salary	No. of	Name/ describe
1	Manager	10065					
TOTALS	1	R 10 064,67	0		0	0	0
Wage earners, daily paid staff.							
SKILLED STAFF				SKILLED STAFF			
No. of Supervisor	Name/ describe	Nett daily wage	No. of	Name/ describe	Nett daily wage	No. of	Name/ describe
1	Snr Induna	220,00	3	Chainsaw operatc	R 200,00	24	debarkers
						0	
						3	pushers
TOTALS	1	R 220,00	3		R 600,00	27	R 4 050,00
SUMMARY:							
UNITS				UNITS			
No. of overhead units	=	1	Total overhead	=	487,00	10 064,67	120 776,00
No. of skilled wage earners	=	4	Total skilled	=	820,00	16 946,67	203 360,00
No. of unskilled wage earners	=	27	Total unskilled	=	4 050,00	83 700,00	1 004 400,00
Total mandays/mth:	641		TOTAL =		5 357,00	110 711,33	1 328 536,00
AVERAGE WAGE Unskilled : = R				150,00 PER DAY			
AVERAGE WAGE Unskilled : = R				3100,00 PER MONTH			
AVERAGE WAGE Skilled : = R				205,00 PER DAY			
AVERAGE WAGE Skilled : = R				4236,67 PER MONTH			
COST OF TRANSPORT							
Your no. of salaried staff:	=	1					
Your no. of wage earners:	=	31					
complete							
TRANSPORT							
Cost per KM		R 6,88					
Distance traveled per day in km		74					
Distance traveld annually in km		18352					
Transport costs per annum		R 126 261,76					
Transporting vehicles needed		2					
Total transport costs per annum		R 252 523,52					
	/working day		/month	/year	/ton		
Transport		R 1 018,24	R 21 043,63	R 252 523,52	R 20,36		

Annexure 12 continue: manual labour costing farmer 5

PROTECTIVE CLOTHING (SAFETY)								
Skilled	1	Cs.oper.	3					
Unskilled	27							
Please complete the table.								
Calculating done by: no.of people x no.of item/year x price.								
Item	no.of staff using	no/year	cost per item		cost/ month	cost/ year	cost/ ton	
Two piece overalls	31	2	133,00		687	8246	0,665	
Steel toe cap boots	31	2	225,00		1163	13950	1,125	
Rain coat - two piece	31	1	212,00		548	6572	0,530	
Leggings	24	0,75	130,00		195	2340	0,189	
Poly/rubber/plastic gloves	28	12	28,50		798	9576	0,772	
Hard hats	28	1	20,50		48	574	0,046	
Other Safety glasses	28	2	15,00		70	840	0,068	
Other Bibs	31	1	45,00		116	1395	0,113	
Other Hardhat with ear muffs	3	2	130,00		65	780	0,063	
Cutter protective clothing:	no.of operators & mechanic:			3				
Cs. hard hat with visor and ear mu	3	2	420,00		210	2520	0,203	
Visors	3	1	0,00		0	0	0,000	
Ear muffs	3	2	0,00		0	0	0,000	
Cs gloves	3	4	240,00		240	2880	0,232	
Cs. pants	3	2	853,00		427	5118	0,413	
Cs. tops	3	2	240,00		120	1440	0,116	
All personnel including cutters:				Total	R	4686	56231	4,535
cutters				Total	R	997	11958	0,964
TOOLS								
Calculating done by: no.of people x no.of item/year x price.								
Item	no.of staff using	no/year	cost per item		cost/ month	cost/ year	cost/ ton	
Fire extinguishers large	1	1	492,75		41	493	0,040	
Fire extinguishers small	1	1			0	0	0,000	
Hatchets	24	1	279,51		559	6708	0,541	
Hatchet sharpening files	24	3	58,90		353	4241	0,342	
Chainsaw equipment								
Chain	3	12	325,00		975	11700	0,944	
Guidebars	3	6	530,00		795	9540	0,769	
Round files	3	12	25,00		75	900	0,073	
Flat files	3	6	58,90		88	1060	0,086	
fuel cans (Combi can)	3	1	427,00		107	1281	0,103	
Other sprocket	3	4	198,00		198	2376	0,192	
Tools excluding chainsaw equipment =				R	953	11442	0,923	
Tools : chainsaw equipment =				R	2238	26857	2,166	
CHAINSaw COSTS								
Please complete the table.					cst/mth	cst/yr	cst/ton	
How many chainsaws, INC. spare saws do you use for this team?	3,3							
How many chainsaws are working daily?	3							
What is the lifespan of a chainsaw in months? (NB must be > 0)	6							
What is the current replacement price of a chainsaw?	6999				3985,30	47824	3,857	
How many liters of fuel do you use per chainsaw per day?	5							
What is your cost of fuel/liter (the petrol x 2-stroke mix) ?	15,64				4848,40	58181	4,692	
How many liters of chainlube do you use per chainsaw per day?	3							
What is your cost of chainlube per liter?	15,52				2886,72	34641	2,794	
What is your Repair Cost Factor for Chainsaws?	60 %							
	699,90				2099,7	25196,4	2,032	
	Gr tot. R				16058,22			
	Total R				13820,12	165841	13,37	
	Cst / saw / hr =R				39,24			
At what interest rate can you finance assets?	12 %							
(This figure is used to calculate the interest on your capital layout for chainsaws)								
T O T A L CHAINSAW COST PER TON: R					15,54			
Total harvesting costs per ton :					Total harvesting costs:			
Labour costs	R 107,14				R 1 328 536,00			
Chainsaw costs	R 15,54				R 192 698,61			
Tools cost	R 0,92				R 11 441,79			
PPE cost	R 4,53				R 56 231,00			
Transportation costs	R 20,36				R 252 523,52			
Total:	R 148,50				R 1 841 430,92			