ECONOMIC ANALYSIS OF NORMATIVE VERSUS PRACTICAL MANGEMENT OF CONIFEROUS STANDS IN LITHUANIA

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ABSTRACT

Economic outcomes from a particular forest stand depend on many factors but the underlying cause is the prevailing silvicultural practices, following management regulations and tradition. This study examines Scots pine and Norway spruce stands of average productivity in Lithuania. The findings of the study revealed considerable differences between theoretical program developed according to management regulations and practical forest management in situ. Discrepancy between theoretical and practical forest management leads to the uncertain forest economy, and decision making.

Another factor having considerable effect on economic outcomes is wood prices and producing costs. After a huge jump in wood prices over the last two years, economic indicators have significantly changed. This fact indicates uncertainty that has to be considered in the long-term forestry projects.

Economic outcomes were calculated employing methodologies that are widely used in the Nordic countries. In Scandinavia the model of costs and income discounting is present that makes it possible to pursue economically efficient forestry. In Lithuania various methods of calculating economic outcomes without discounting are still used that pursues traditional forestry (based on maximum possible volume of certain assortments at the age of final felling). As a part of methodology a survey was carried out with the aim to investigate practical forest management in Lithuania. Results of this study can be used for comparative analyzes with other countries in Baltic Sea region.

1. INTRODUCTION

1.1 PROJECT BACKGROUND

Thesis aims to investigate actual issues in Lithuanian forest management including differences between theoretical and practical management programs. At the same time it helps us to answer important questions about forest economy at the stand, forest enterprise and even national levels in the Baltic Sea region.

Forest economics is unique because forestry involves long production periods and uncertainty also produces multiple outcomes (Klemperer 1996). Because of the long forest rotation period a lot of factors have to be taken into account when economic indicators are calculated. It is very important to create a typical thinning program that would exist in practice and could represent forest treatments in certain country. Theoretical and practical thinning programs differ considerably in Lithuania, for this reason economic outcome analysis becomes more interesting and challenging task.

At the very beginning a discussion about existing forestry problems between the group of international students (Estonia, Lithuania, Poland and Ukraine) and supervisors started. Although all of the four countries have more or less identical forestry history the forest management traditions differ. The decision was made to investigate economic outcomes from the identical pine and spruce stands. For this reason stands of the same productivity had to be chosen in all four countries in case the obtained results will be compared among the countries. The following criteria for all pine and spruce stands were defined: (i) the height of the pines reach 24 meters and spruce 28 meter at age of 100 years, (ii) only state owned productive forests are investigated. Other criteria such as forest management program (regeneration, protection, thinning etc…) were accepted to be as close as possible to the forestry practice in home countries.

In this project, investigations on economic outcomes are carried out in only typical pine and spruce stands that are of the same productivity in all of the considered countries. Besides the considered tree species are important in forestry practice within the countries of the Baltic Sea region. Investigation object is only state owned forests because the private forest sector is under development at the moment and some of small territorial ownerships are still neglected, or in the process of restitution.

1.2 OBJECTIVES

Sustainable forestry consists of the three main aspects: ecological, social and economic. In Scandinavian countries economic aspect is strongly considered, while in Lithuania forest economy is still a field for investigation.

The aim of those theses is to investigate the economic outcomes from typical pine and spruce stands with the focus on the main three factors that influence outcomes. Key factors strongly influencing economic outcomes are: forest management, wood prices and wood producing costs. Forest management program is one of the factors that is still unclear in Lithuanian forestry. Due to this, theoretical and practical management programs are precisely analyzed in the study.

To meet the aim of study it is necessary to raise a hypothesis that could be confirmed or rejected by the results. Initially several hypotheses where formed:

1. According to NPV analyzes with the interest rate of 3 percent, the net present value is below zero. Because economic aspects are not relevant in Lithuanian forestry;
2. Economic results are different according to the practical and theoretical management programs.
3. Wood prices and wood production costs have equally increased over 2006 and 2007.

1.3 IMPORTANCE OF CONIFEROUS IN LITHUANIA

Geographically Lithuania is located in the centre of Europe and has fragments of the temperate deciduous forests of the central Europe and boreal coniferous forests of the Northern Europe. Forests were very important during the last centuries; they helped the country to withstand both World wars and other crises. Nowadays Forest is one of the main branches of industry in Lithuania and is also considered to be the most important natural recourse. According to Lithuanian statistics department (www.stat.gov.lt/en) 32.5 percent of country's land is covered by forests and more than a half of them are coniferous.

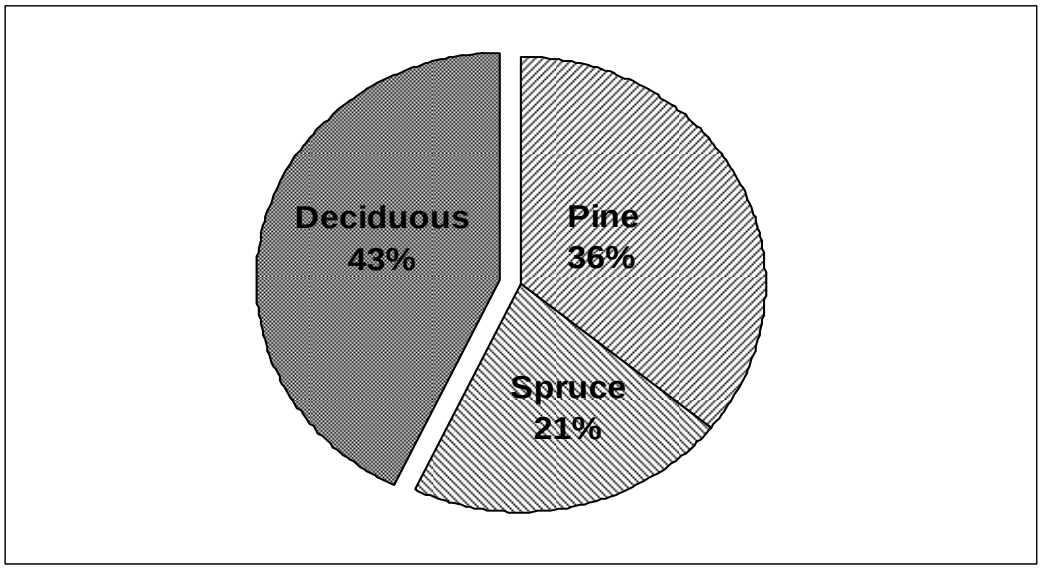

Figure1. *Proportion of coniferous and deciduous forests in Lithuania. (Source: VMT 2006)*

Picea abies and *Pinus sylvestris* are native species in Lithuania. Other not native pine and spruce species are found in Lithuania as well; however they have no statistical or economic importance. During the last century coniferous forests declined. Several reasons could have contributed to this decline: natural factors (global warming, increase or decrease in ungulates, invasions of insects or diseases), forest management (harvesting level, amount and intensity of thinning, forest regeneration, demand for forest production), and disasters (wind blows, forest fires and pollution), and changes in the policy of forest protection during the last century (Brukas and Kenstavičius 2003).

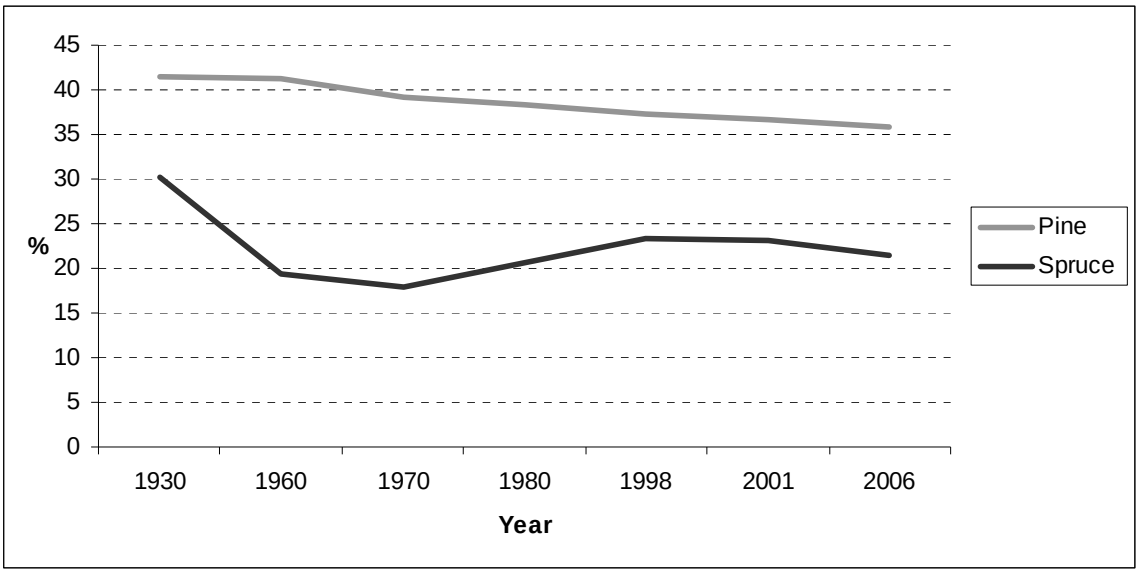

Figure2. *Coniferous decline in Lithuania. (Source: VMT 2006)*

Due to methodology and lack of technique old statistical data from the beginning of the last century can not be reliable, but the data of the last few decades reveal obvious decline in coniferous. In general, forest area in Lithuania increased from 20 percent in 1920 to 32.5 percent at present. Areas under other tree species like oak, ash, birch and alder are relatively increasing and occupy clear cut areas after coniferous (VMT 2006). That phenomenon was more significant for the last two decades due to delayed forest regeneration and abandoned agricultural lands, but the situation has changed because of more strict state control and EU regulations. Recently, the running EU program allows framers to afforest ate pure agricultural lands and at last get subsidies for the next fifteen years. Purpose of this program is to manage abandoned agricultural lands and increase forest land in Lithuania (LRS 2002). A forestation is supposed to be carried out on poor agricultural lands and most likely with pine. Consistently, the areas under coniferous in Lithuania are likely to increase during the next few years.

Pine and Spruce wood is in demanded of pulp and furniture industries in Lithuania and neighboring countries.

1.4 HISTORY OF FOREST ECONOMY

The last century forest economy in Lithuania is difficult to analyze because of political regime and changes in ownership, but it is possible to do that in separate periods (Brukas 1993):

1) Between the World wars - from 1922 when most of Lithuanian forests were nationalized, national currency appeared and accounting system of economic indicators was managed in better way.
2) During soviet times- from 1961 when all reorganizations stopped and clear borders between state forests and collective farm forests were defined.
3) After restitution of the independence- when again national currency was restituted, reorganization chaos slowed down and new forest law was passed, that happened in 1995.

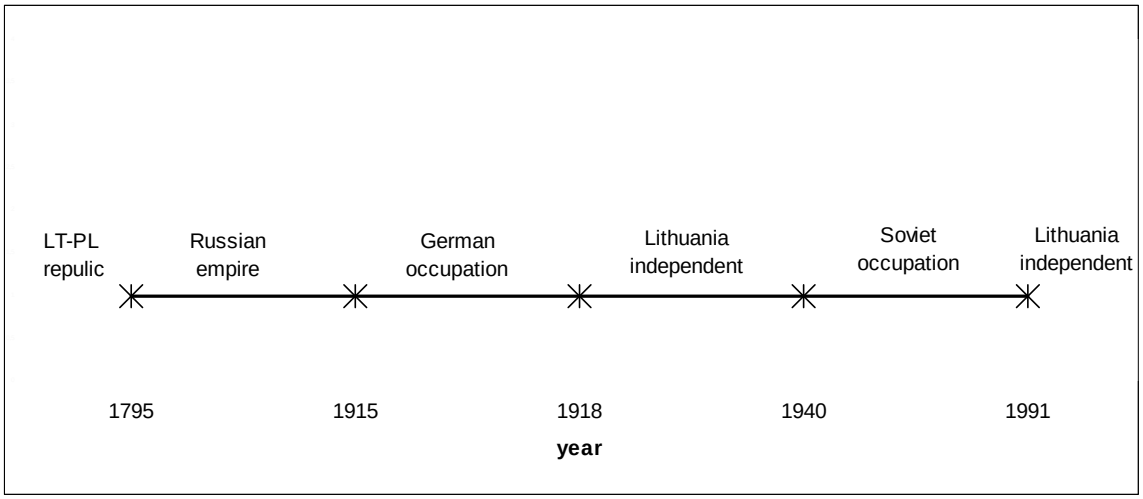

Figure 3. *Crucial changes in Lithuania over the past centuries. (Source: Mankus 2003)*

Figure 3 reveals the most crucial changes of the last century in Lithuania when different political systems were introduced. Forests were not behind all these processes, forest law changed several times, as well as economic methods from market economy to planned and back. These factors also influenced wood consumption for example between the first and second world wars the increase in forest consumption was significant. In 1936 consumption made 6.7 m3 per hectare even much more than nowadays, and most of the wood was sold as standing forest and used in the local market. Around 16 percent of the wood was exported outside Lithuania and 71 percent consumed by local people and other organizations (Brukas 1993). During the period between the

World wars, revenues from forests were very high. More than a half of income went to the state budget and only a small part was attributed to costs. For example of 27.5 mil Lt of income allocated to forest regeneration, administrative and other costs only 7.5 mil. and 20 mil., respectively went to state budget (Brukas 2003) . In other periods the proportion of income and costs was considerably different. During the soviet times annual income from the forest sector made at an average 52 mil. rubles and 47 mil were attributed to costs (Brukas 2003). When the Soviet Union collapsed, the proportion of income and costs stayed more less the same 319 mil Lt and 309 mil Lt respectively (Brukas and Kičas).

The period between World wars was economically successful, and had huge influence on the development of the country. Negative aspects that appeared during that period were: little assignations for forest regeneration, forest sciences, forest management and technical infrastructure and delayed concern about nature protection, although these processes started in other countries (Brukas 2003).

The second analyzed period was completely different. During the Soviet times, economy changed from market to planned, prices were fixed and only in the year 1992 were again market regulated. Although in soviet times new technologies emerged in the forestry sector, the number of workers with low salaries remained at the same level, what shows that nobody cared about the efficiency in forestry sector. Socialistic way of thinking was typical of the soviet times, and no real economic methods where introduced. Despite the negative things some positive things during the soviet times also took place: high investments in development of forestry (land reclamation, road construction, forests sciences), mechanization was integrated in forest operation, etc. In general, forest economy during Soviet times was inefficient due to low fixed wood prices, high production costs, and no motivation to increase forest productivity.

The third period, when Lithuania became independent, can be equated with many reorganizations and creation processes. During the transition period (1990-1995) difficult economic indicators are difficult to analyze because of currency changes and high inflation. New forest law and regulations were passed just at the end of 1994. Afterwards, a new stage started in forest sector in Lithuania with principles based on forest economy, ecology and social life. New forest technique was imported from the Western Europe and a lot of contractors appeared in forest sector. New market regulated prices and lower production costs made the work more profitable. Restitution processes in private forest sector started (Brukas and Kičas).

1.5 REVIEW OF RELEVANT FACTORS

Before analyzing economic outcomes from particular forest stand, review of a whole forest sector was made. Mainly statistical sources were used to prepare a short overview of economic results of the state forest sector in Lithuania. Share in GDP, income and costs balance also some influencing factors are presented. Literature review, mostly reports from general forest enterprise and state forest survey service were analyzed. Weakness of the results is that they are very general and represent all tree species and all site productivities.

1.5.1 Share in gross domestic product

Gross domestic product, hereafter GDP, of a region is one of the ways of measuring the size of its economy. The GDP of a country is defined as the total market value of all final goods and services produced within a country in a given period of time (usually a calendar year) (Wikipedia 2007).

During the last years, the gross value added in forestry and forest industry was rapidly growing and its share has increased from 3.0% (2000) to 4.1% (2005) in total gross value added.

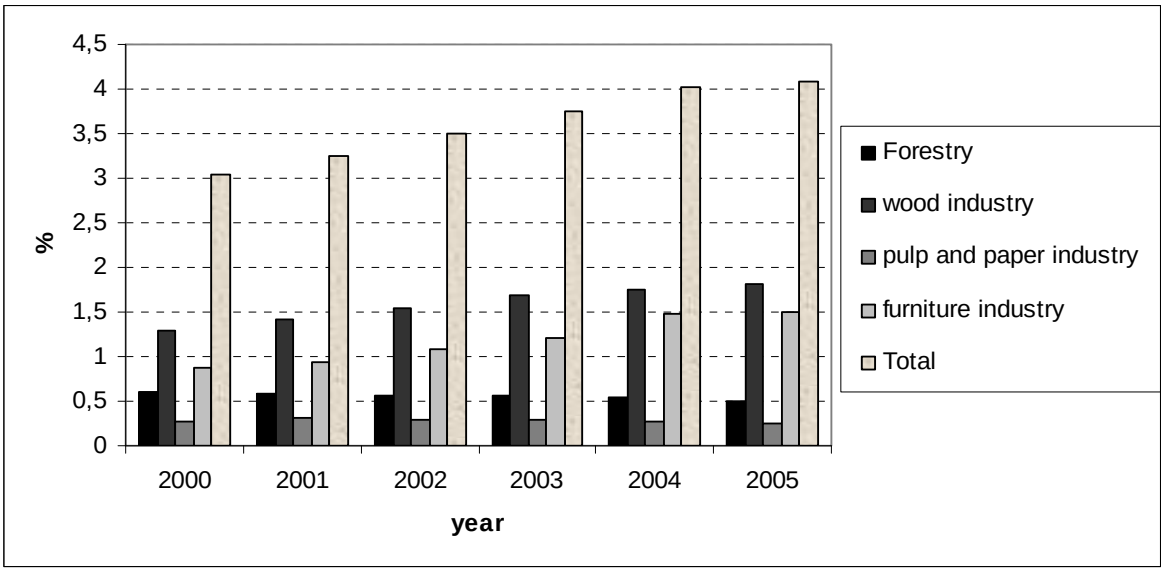

Figure 4. *Share of forest sector in GDP (Source: VMT 2006).*

Forest sectors in market value increased during the last five years, but not equally in all industries. In forestry sectors substantial decline was recorded - 20%, in wood industry - increase by 29%. Pulp and paper industry - slight decrease by 12%, furniture industry increase was substantial 42%.

1.5.2 Economic results of the state forest enterprises

Directorate General of State Forests under the Ministry of Environment is an institution, designated for economic management of the state forests, which are attributed to 42 state forest enterprises spread all over Lithuanian territory. All enterprises together are responsible for 1,4 mil hectares of forests. Forest enterprises are divided in 399 forest districts with average area of 2600 hectares. They manage and coordinate regeneration and maintenance of these forests, their protection (GMU 2007). State forest enterprises produce various goods and services, not only wood.

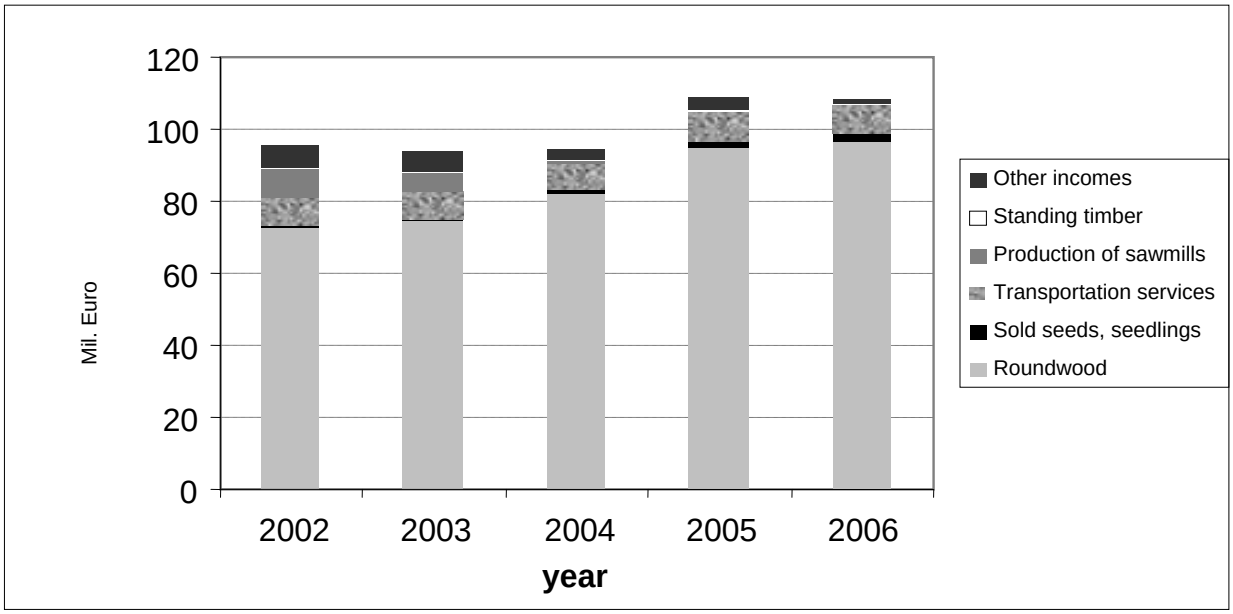

Figure 5. *Dynamics and structure of forest enterprises income (Source:GMU 2006).*

It follows from Figure 6, that main income came from round-wood it comprised around 84 percent of all income. Other revenues vary from 0.7 to 7.6 percent. Income from sawmills melt, since all wood processing sawmills were sold-off.

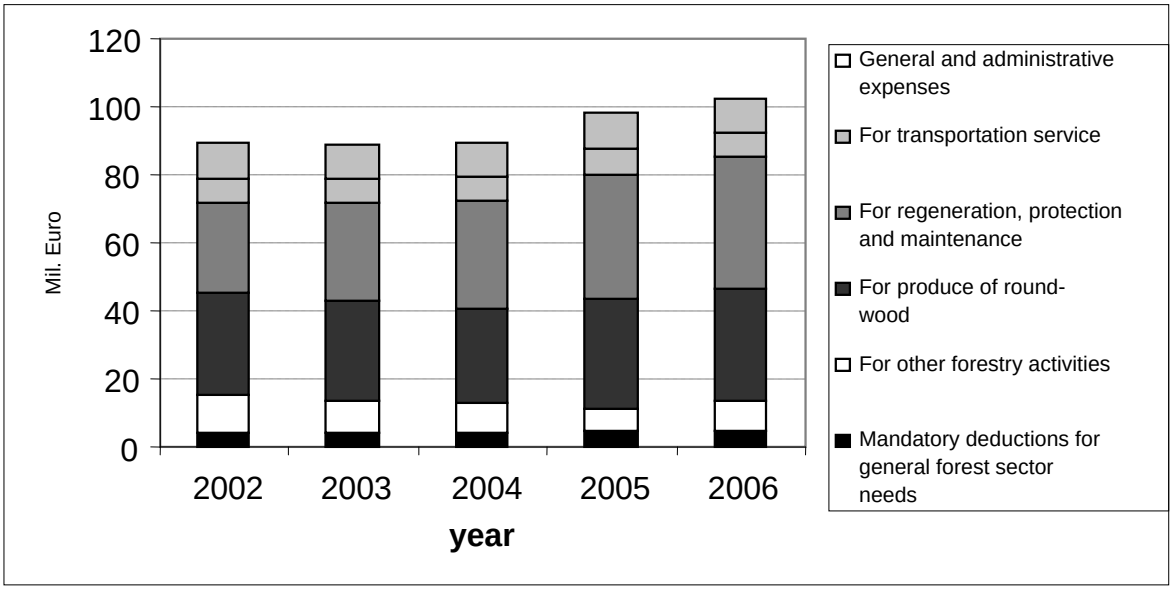

Figure 6. *Dynamics and structure of expenses incurred by forest enterprises (Source: GMU 2006).*

Costs incurred by forest enterprises are also varied: the highest amount (35 percent) of expenses incurred by state forest enterprises were attributed to forest regeneration, protection and maintenance, followed closely by the expenses (33 percent) attributed to round-wood production that included harvesting costs and extraction to the road side. Other expenses incurred by state forest enterprises varied from 5 to 11 percent. In general, all expenses increased during the last years due to growing fuel and labor costs. Administrative costs contribute to 11 percent and were still very high; and made around 31 Euro per hectare every year. Those costs directly depend on the number of employees, which is considerably higher Lithuania than in Scandinavian countries.

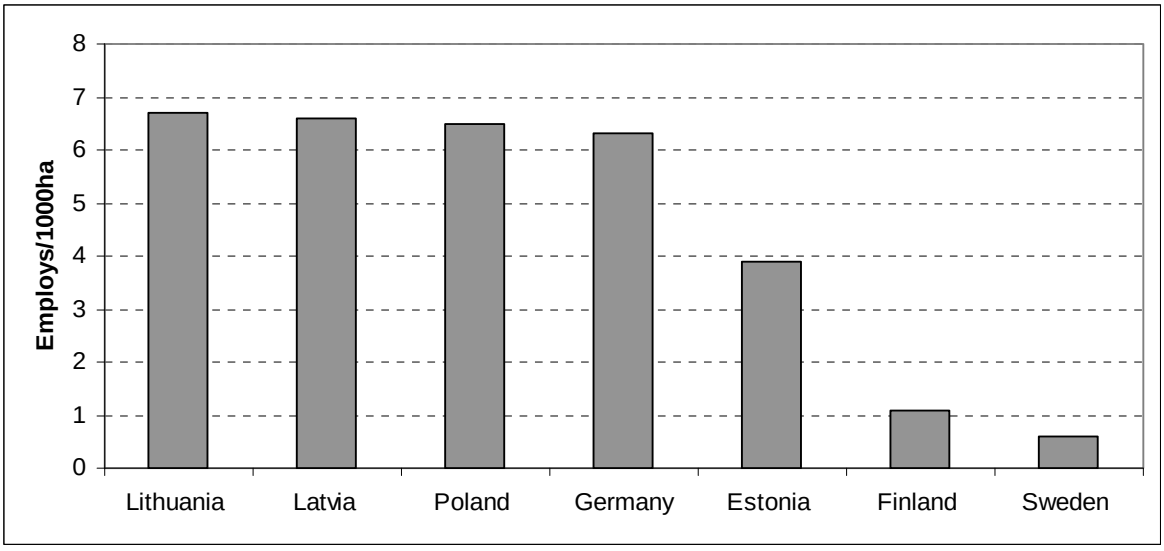

Figure 7. *Number of employees in different countries (Source VMT 2006).*

High number of employees in forestry sector could be connected with traditions and low salary, however during the last ten years salary increase made 270 percent from 210 € in 1996 to 560 € in 2006, at the period when inflation rate was not significant (VMT 2006). But somehow with rather high and various costs state forest sector is still profitable in Lithuania.

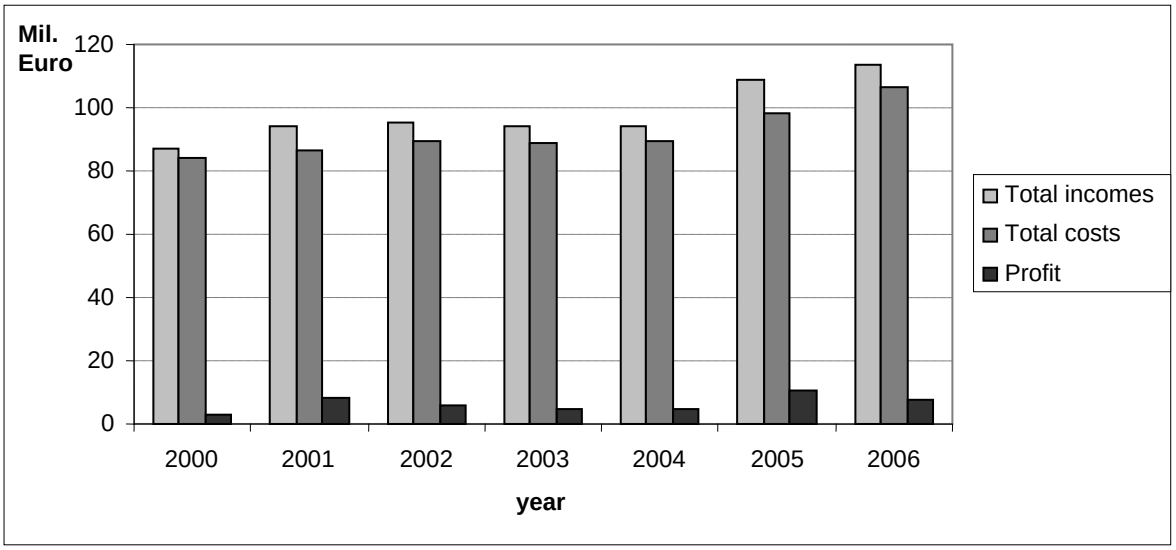

Figure 8. *Dynamics and structure of cash flow in state forest sector (Source: VMT 2000-2006).*

Profit of the state forest enterprises vary from 2.9 to 10.6 mil. € per year. Peak of profit was reached in 2005 when about 1 mil m3 where felled by storm. Profit rate from total income varied between 3 percent in the year 2000 to 10 percent in 2005. Increasing A trend towards increase in income and costs was mainly recorded due to wood prices and wood production costs.

2. METHODOLOGY

Methodology part presents materials and instruments that were used during this project, and step by step actions were taken in the quest for results. These basic features are described in great detail. To summarize the methodology part and make it more understandable a graph below was developed.

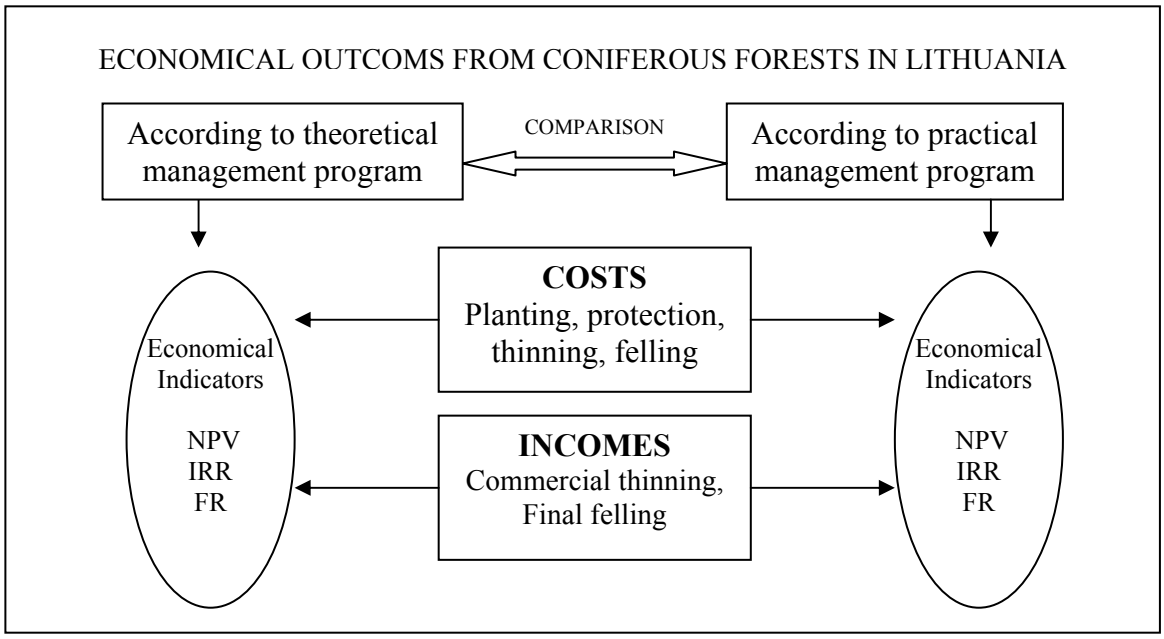

Figure 9. *Methods employed in economic outcome analyses*.

2.1 ECONOMIC INDICATORS

In Lithuania, economic efficiency of the forest enterprises is represented by the balance between income and costs, however these indicators are insufficient to evaluate forest efficiency. (Mizaras 1997). Not only income and costs balance can be used to evaluate forest efficiency and decide how to manage economically.

In order to find out how investors can use standard tools of financial analysis to evaluate forestry decisions- to decide how much to pay for forest properties and management practices and to measure how profitable forests investments are. (Klemperer 1996). Klemperer and other authors of the forest economy, represent a number of financial indicators that can be counted and used in forestry.

Properly designated financial indicators can be successfully used in forestry. By using economic indicators we can design management of stand, predict cash flow, evaluate forests before purchasing or selling it, to choose right tree species and etc. In this project these indicators will be used to evaluate how economically efficient are state forests in Lithuania. Traditionally in Lithuania forest economy is analyzed by using other criteria, but this thesis analyze Lithuanian state forest economy according to criteria that are prevailing in the Nordic countries that pursue economically efficient forestry. Those indicators are: net present value (NPV), internal rate of return (IRR) and forest rent (FR).

NPV (net present value) - it is the present value of revenues minus the present value of costs (Klemperer 1996).

$$\text{NPV} = \sum_{t=1}^{T} \frac{R_t - C_t}{(1+i)^t}; \quad (2.1)$$

Where:

R- Revenues in the subscripted years;

C- Costs in the subscripted years;

T- Rotation age;

t- Year in which revenues are received or costs are incurred;

i- Interest rate.

Interest rate refers to earning rates on financial instruments like bank account, bonds, certificates or deposit; or the rate charged on loans; or the rate used in discounting future values to arrive at present values. It is also referred to as compound interest (Klemperer 1996).

Weakness of NPV calculation is that this indicator strongly depends on interest rate *r* and it is chosen freely. For this reason there is no guaranty that the results will be factual (Mizaras 2002). Other studies of Brukas et al. (2001) represent factors that can be used to determine of interest rate. The main factor is opportunity cost of capital. For example if a bank gives a long term credit with 5 percent interest then opportunity costs criterion will be five percent. But it is not easy to determine r in forestry because of uncertainties due to long rotation periods. Some economists argue that for long term investments in forestry *r* should be higher than opportunity

costs due to the related risks and uncertainties. But too high *r* in forestry practice will replace slow growing species by fast growing species and rotation ages should be shortened. In Lithuania a compromise between financial objectives and consequences *r* can be set to 2-4 percent. *In Lithuania, a real r of 0-2 percent is suggested for state forestry. A post-tax r of 2 percent is advocated for private forestry. With potential project specific deviations downward to 0 or upward to 4 percent* (Brukas et al. 2001). Discounting even with low rates can significantly change optimal rotation ages in Lithuania, especially for slow growing species. An *r* as low as 2 percent results in a decrease in optimal rotation ages of 5 years for spruce and up to 35 years for pine (Brukas et al. 2001).

IRR (internal rate of return) marginal revenue is marginal value growth percent of the stand. It tells what interest rate of return in the form of growth the firm can expect from successive additions to investment in growing stock (Duerr 1993). In other words it is a discount rate (i) at which NPV equals zero.

$$\sum_{t=1}^{T} \frac{R_t}{(1+i)^t} = \sum_{t=1}^{T} \frac{C_t}{(1+i)^t} \quad ; \quad (2.2)$$

Where:

R- Revenues;

C- Costs;

T- Rotation age;

t- Year in which revenues received or costs are incurred;

i- Interest rate.

FR (Forest rent) - all revenues minus all costs divided by rotation length, which leads to outcome corresponding to applying NPV using discount rate of zero. Brukas et al. (2000)

$$FR = \sum_{t=1}^{T} \frac{R_t - C_t}{T} \; ; \; (2.4)$$

Where :

R- Revenues at year t;

C- Costs at year t;

T- Rotation length;

t- Year in which revenues received or costs are incurred.

The forest rent approach includes timber prices and regeneration costs, which correspond to the Faustmann Model with a zero rate of interest. However, this still excludes an alternative investment option and assumes that a forest owner does not have a loan (or that a forest business has control over unlimited capital). Following forest rent may potentially lead to excess investments in forestry that cause large economic losses (Hyytiäinen & Tahvonen 2003).

2.2 ANALYTICAL STEPS

Step 1. Theoretical management program.

This management program is called theoretical because calculations are based on forestry theories (management rules), inventory data was used to present the results according to theoretical program (see figure 10). At the beginning of the management program development process surveys for national forest enterprises was prepared and send by email or handed to all 42 existing forest enterprises in Lithuania. The surveys included question about existing forest management program for pine and spruce stands, thinning intensity, average prices, etc. …). Unfortunately, this venture was unsuccessful and only one forest enterprise responded to the request, this amount of information was insufficient to make any analysis and create typical management program for Lithuania. Second action that was undertaken in developing management program was forest taxation data collection from forest inventory. From approximately 1.5 million forest stands in Lithuania only stands required for this thesis were chosen according to initial group agreement. Those were: pure pine and spruce stands, belonging to state forests and of certain productivity, 24 and 28 meters height, respectively, and aged 100. But in forest taxation database there was no such criteria as height at a certain age, and then

another criterion “Bonity class” was used. According to the forest inventory (Repšys et al. 1983) second bonity of spruce aged 100 reach 30.1-26.2 meters height and second bonity of pine represents 27.4-24.3 meters.. The average stand productivity of those two bonities was found employing interpolation method.

Another very important aspect in the process of developing management program was thinning intensity. According to thinning rules in Lithuania and advice of rules creator (A.Juodvalkis) thinning intensity can be calculated according to the stocking level. In Lithuanian forests thinning is prescribed when stocking level is 0.8 and more. After thinning the stocking level is supposed to be 0.7-0.75 subject to the stand age for younger stands (aged 20-40) stocking level is 0.7 and for older stands (aged 40-70) stocking level is 0.75. Consistently, the difference between stocking level before thinning and stocking level after thinning was decided to be thinning intensity. From inventory database only stands were taken with higher minimum allowable stocking level then is defined in rules. If stocking level is lower then minimum allowable it is means that stand was treated recently and can’t be object of analysis. Actual volumes for theoretical management program where also taken from stands that has higher then minimum allowable stocking level.

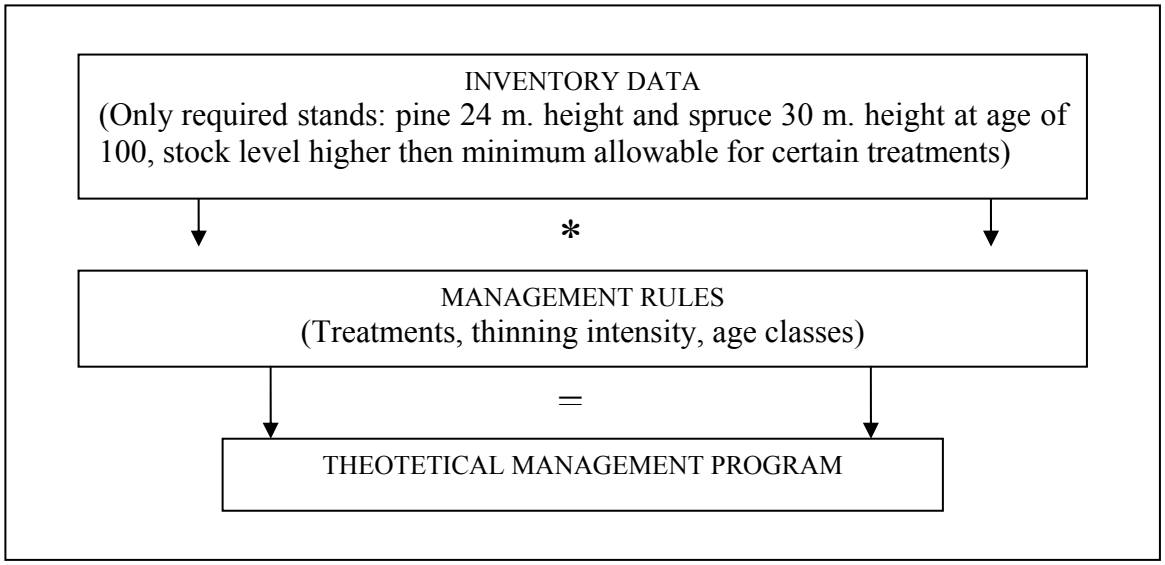

Figure 10. *Process of developing theoretical management program.*

Step 2. Practical management program.

Personal consultations with practical foresters indicate that there exist big differences between theoretical thinning program and practice what leads not only to the necessity to develop practical thinning program but also to the necessity to compare it with theoretical one. Consequently, the comparison analysis constituted the greatest part of the project.

State forest survey service provided statistical data on the pure pine and spruce stands that were treated during the last decade. According to the treated areas and extracted volume, thinning intensity in different age classes was calculated. Some inaccuracies arise in pre commercial thinning intensity, because foresters do not estimate volume of the young stands. Thinning frequency was estimated by comparing area of the thinned stands with the area of stands that can be potentially treated according to the forestry rules. For example, it was assumed that the potential area for thinning was a hundred percent, whereas the area that was treated was a proportion from the potential area. So the sums of the proportion expressed frequency. Thinning frequency and intensity were analyzed and attributed to certain age classes that were common in practice.

Step 3. Comparison of theoretical and practical management programs.

Developed theoretical and practical management programs do not answer the key questions: why these differences exist, what the reasons for that are? A small survey was prepared, not attempting to achieve statistical inference but rather qualitative insights in to the problem, the reasons behind the differences between theoretical and practical management programs. Three main interest groups were interviewed: scientists, management planners and foresters. Of the twenty seven approached respondents in all interest groups fifteen filled in questionnaire form: eight forest managers from forest districts, four scientists and three management planners. Fifteen is not a big number of the respondents, but the survey was developed with the purpose to find out the opinion of the responsible persons. The small group included scientists responsible for the development of the forestry rules in Lithuania while others were from academic level. In the department of management planning only three respondents were interviewed. Before asking concrete questions, theoretical and practical management programs where introduced to the respondents. Questionnaire consisted of four questions:

1. Does practical management program reflect forest management in reality? If not, can you suggest a program based on your experience?
2. What are the reasons for different thinning frequency in theories and practice?
3. What are the reasons for different thinning intensity in theories and practice?
4. Can you suggest concrete actions to be taken to reduce differences between theories and practice?

Questionnaires were delivered by e-mail, or personally visiting responsible institutions. All the answers were systematized and presented as result of survey.

Step4. Income.

To evaluate economic outcomes, it is necessary to make income and costs analyzes. In this project income is just the amount of money that is received from wood production, other forest products or social functions are not included. Income from timber production is simply wood prices multiply by amounts of extracted wood. Wood prices are published on the web page of General forest enterprise (www.gmu.lt). Prices are differentiated by assortment size (large, medium, and small) also pulp wood and firewood prices are presented. For saw-logs average price was estimated using interpolation method between the amount of the extracted sow logs in different size classes and prices. Prices of fire wood were attributed according to heat classes (second for pine and third for spruce). Pulpwood price is stable and have no variation according to the size or other criteria.

Extracted wood is not always the same size, for example in the first commercial thinning saw-logs make just a few percent and mostly pulpwood and firewood are produced. For this reason different assortments and different prices are attached during certain thinning. To obtain this correlation between stand diameter and different assortments the taxation normative for Lithuanian and Kaliningrad forests was used, and polinomian

trends were represented.

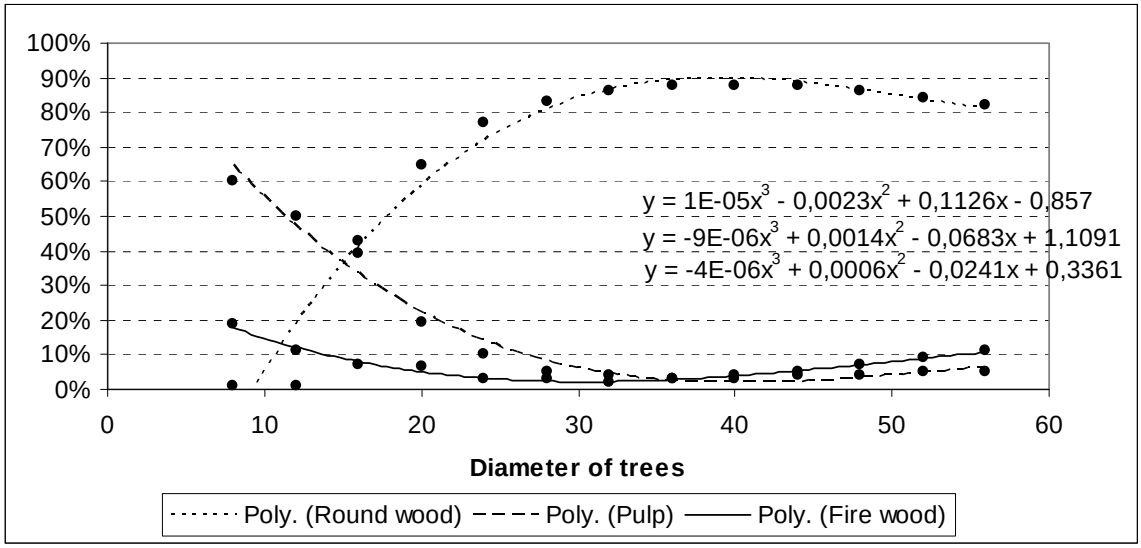

Figure 11. *Correlation between tree diameters and different wood outcomes (Source: VMKU 1987).*

Because of the huge jump in wood prices compared to the price trend over the last decade, comparative analyses of real wood prices had to be done. To compare wood prices of the 2006 and 2007, all income from 2006 had to be multiplied by rate of inflation. According to Lithuanian department of statistics (www.stat.gov.lt) annual inflation in 2007 if compared with 2006 made 7.6%.

Step 5. Costs

All costs that are incurred during the rotation must be included in calculation of economical indicators. However, the administrative costs for state forests are excluded because the results will be used for the comparison and these costs are calculated employing different methodology in different countries. Other main costs (regeneration, thinning, final felling costs) were obtained form the survey. Costs survey was made by using phone lines and interviewing a number of private companies (contractors) that proceed forest works. Besides, the author of this study pretended to be a private forest owner holding a big estate of pine and spruce stands of various ages. The following questions were asked: "What is the average fare for soil scarification?" "How costly is it to regenerate one hectare of pine and spruce stands?" "How many seedlings do you plant per hectare?" "What is the price of PCT per ha and commercial thinning per m3 with extraction to the road side, final felling and etc..?" All the answers were analyzed and average costs for forest work where set. This method, however, can bring in some inaccuracy due to differences between forest enterprise and private owner statuses.

Step 6. Calculation of economical indicators.

When the management program was developed and inputs in counting financial indicators were set, other actions in the quest for results could be taken. By using formulae (2.1; 2.3) economic indicators where calculated. According to the technical maturity, rotation age for pine is 100 years and for spruce 70, but management plans developed for ten year period thus in practice the final felling is carried out in pine stands aged 105 and spruce stands aged 75. When NPV, IRR and FR were found, economic analysis was conducted.

3. THE RESULTS

3.1 WOOD PRICES

3.1.1 Inflation

The wood prices in Lithuania fluctuated during last decades since market economy was introduced. But enormous jump in wood prices was observed in the last two years. The increase can be associated with the inflation and economy growth in Lithuania.

Table 1. *Inflation rate in Lithuania during the last two years (source: LSD 2007)*

2006M01	2006M02	2006M03	2006M04	2006M05	2006M06	2006M07	2006M08	2006M09	2006M10	2006M11	2006M12	2007M01	2007M02	2007M03	2007M04	2007M05	2007M06	2007M07	2007M08	2007M09	2007M10	2007M11	2007M12
0.5	0.0	0.3	0.7	0.4	0.2	0.5	-0.1	-0.1	1.1	0.8	0.2	0.0	0.3	0.6	0.9	0.5	0.2	0.7	0.3	1.4	1.5	1.1	1.1
Annual 4.7%												Annual 9.0 %											
Total 14.1%																							

Table 1 shows the inflation rate from the beginning of 2006 till the end of 2007. According to the department of statistics inflations was not significant during the last decade it fluctuated from 1 to 3 percent. But during the last two years the increases in inflation rate was observed and had to be included in calculations of the real prices.

Nominal wood prices

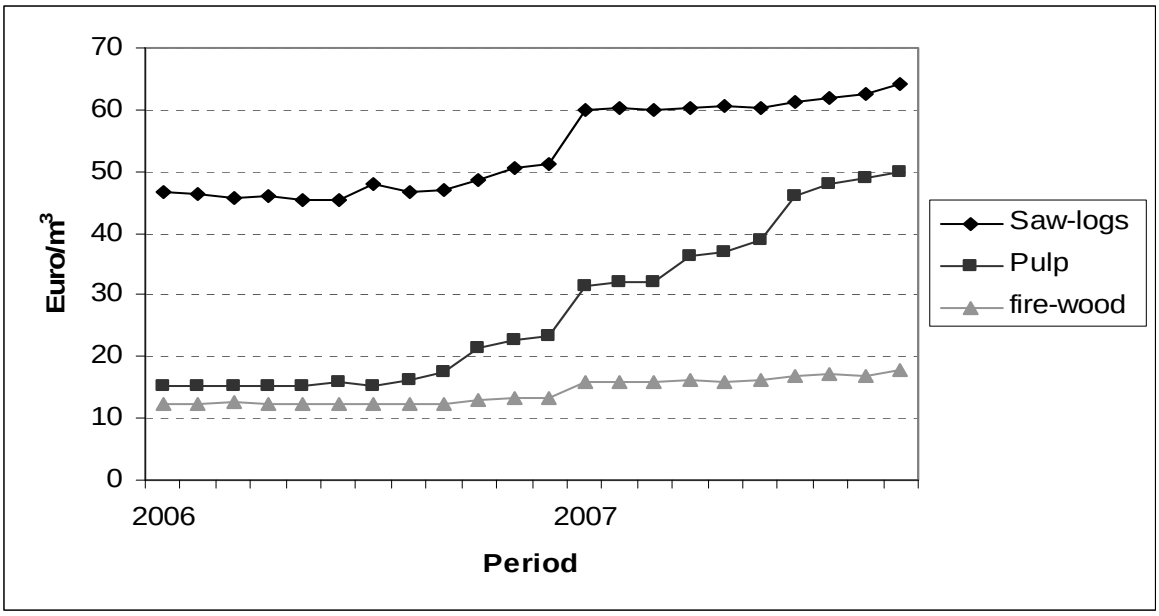

Figure 12. *Dynamics of nominal coniferous wood price over the period 2006-2007 (Source: GMU 2007).*

Increase in coniferous wood prices, from the beginning of 2006 till the end of 2007 was enormous. Saw-log prices increased by 38 percent, pulp-wood by 225 percent and fire-wood by 43 percent. According to the ministry of economy, increase in wood prices could be connected only with the increase in demand for furniture, building construction wood, pulp-wood for cellulose industry and consumption of firewood (UM half year report 2007). Figure 12 reveals that the main increase in demand for all assortments was recorded in January,2007 and the second significant increase in demand for pulp-wood was observed in July,2007. The results allow making an assumption that the increase in wood prices might not only be associated with demand and supply in wood markets, but also with issue how to increase profitability of the state forest enterprises. The second very important factor that resulted in changes in wood prices was the changes in export and import changes. In the year 2007 Russia increased export taxes by 2.5 times, and in the coming years plans an increase from 10 € per m3 to 50 € per m3 of raw wood (Avotas and Ceras). For example Finland annually imports 16 mil. cubic meters from Russia, but now as the Russian wood is becoming more and more expensive the demand for the wood from the Baltic Sates is increasing (Avotas and Ceras).

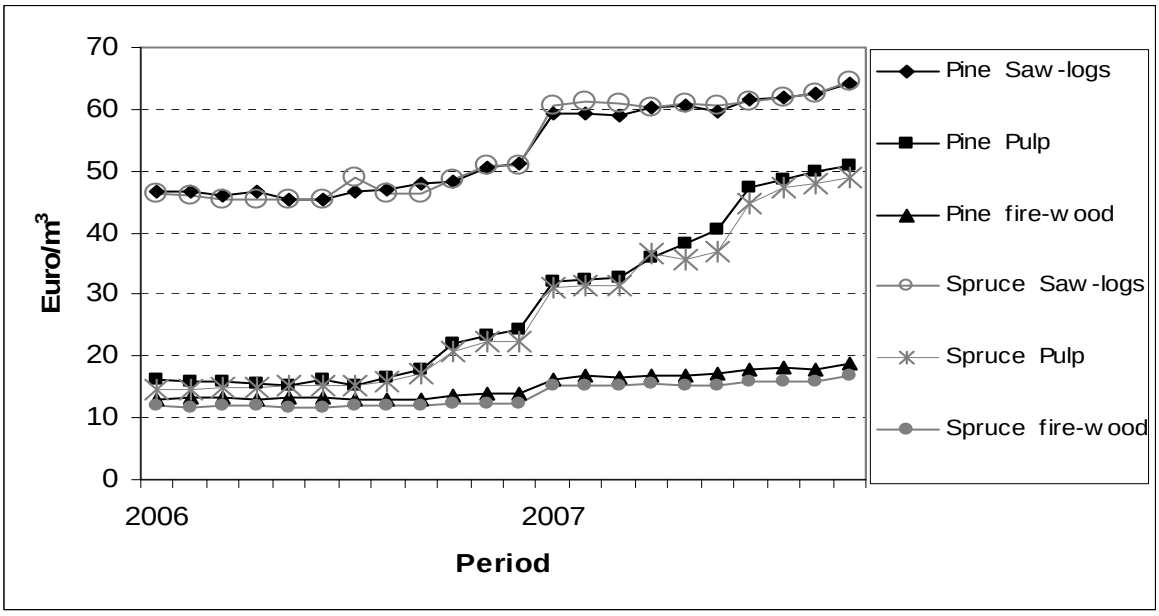

Figure 13.*Dynamics and comparison of nominal pine and spruce wood prices(Source: GMU 007).*

Nominal prices of pine and spruce have the same tendencies. Pine fire-wood was more expensive all over the considered period as fire-wood price is set according to heat classes and is second for pine and third for spruce. Pine pulp-wood had higher price than spruce, and only in some periods they were equal. Both pine and spruce saw-logs prices competed all over the considered period.

Real wood prices

Real wood prices are equal nominal wood prices, minus inflation at certain periods.

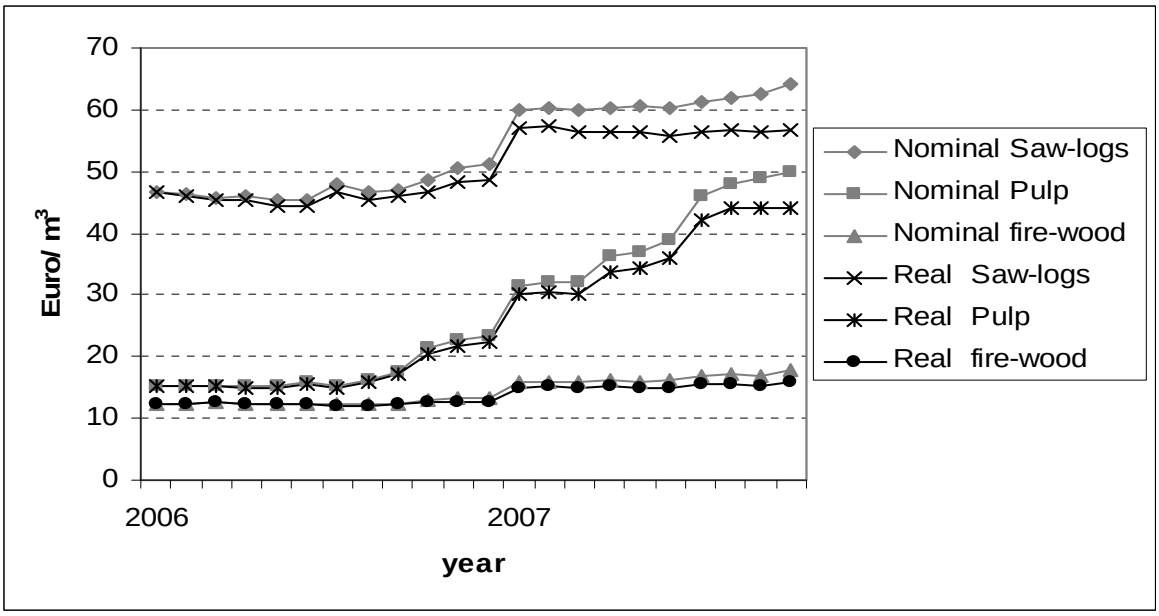

Figure 14. Comparison *of real and nominal coniferous wood prices over the period 2006-2007 (Source: GMU 2007, LSD 2007).*

It follows from Figure 14 that real wood prices increased over the considered period although the inflation rate was excluded. Realistically, saw-log prices increased by 22 percent, pulp-wood by 188 percent and fire-wood prices increased by 26 percent.

3.2 MANAGEMENT PROGRAM

3.2.1 Forest management in Lithuania

In Lithuania silvicultural treatments are based on optimal light conditions in the stand. And the main purpose, which is achieved the maximum possible volume at the age of final felling. According to the theories of Juodvalkis and Kairiūkštis light is the natural factors that can be efficient regulated in the forest stand. Consistently, stand treatments are supposed to be based on light regime in order to achieve maximal productivity Kairiūkštis et al. (1979). However,

economic considerations were not taken into account when designing this management program. Forestry normative and management are based on the theories, introduced thirty years ago.

In Lithuanian state forests all treatments are supposed to be carried out according to the management plan. Forest management plan (FMP) is fundamental in administrating forest sector in Lithuania. Management plans are arranged for all forest property (LRAM 2005). Forest management in state forests is guided by the prescriptions in the forest management plan for the forest enterprise and by a series of national regulations covering each area of forest management(regeneration, thinning, felling, protection etc…), which offer detailed technical guidelines for forest managers that have to be followed. FMP is done by using last inventory data (LRAM 2005). FMP cover only ten year period because of that Lithuanian forester can hardly understand management for all rotation, starting from planting of seedlings and ending with final felling. For purpose to see typical management program in coniferous stand, survey was made. Results of the survey also revealed differences between theoretical and practical management programs, at the same providing the opinions of the scientists and foresters on the causes for existing differences.

3.2.2 Differences between theoretical and practical forest management

Employing the methods described in the methodology section, differences between theoretical and practical forest management were found. The tables below represent a theoretical model, how stands are supposed to be managed according to the existing rules (table 2a, 3a). According to the facts (annual reports from forest enterprises) contrariwise practical management program was prepared (see next page, table 2b, 3b).

Table 2. *Theoretical and practical pine stand management programs.*

(a) **Theoretical**

Age cl.	Treatments	Intensity %
1	No treatments	
2	PCT	15
3	1 CT	17
4	2 CT	16
5	3 CT	15
6	4 CT	15
7	5 CT	15
8	Sanitary cuttings	0.3
9	Sanitary cuttings	0.3
10	Sanitary cuttings	0.3
11	Final felling	100

(b) **Practical**

Age cl.	Treatments	Intensity %
1	No treatments	
2	PCT	20
3	1 CT	25
4	No treatments	
5	2 CT	25
6	No treatments	
7	3 CT	20
8	Sanitary cuttings	2
9	Sanitary cuttings	2
10	Sanitary cuttings	3
11	Final felling	100

Table 3. *Theoretical and practical spruce stand management programs.*

(a) **Theoretical**

Age cl.	Treatments	Intensity %
1	PCT	23
2	PCT	25
3	1 CT	19
4	2 CT	17
5	3 CT	17
6	4 CT	16
7	Sanitary cuttings	0.3
8	Final felling	100

(b) **Practical**

Age cl.	Treatments	Intensity %
1	PCT	20
2	PCT	20
3	1 CT	30
4	No treatments	
5	2 CT	25
6	Sanitary cuttings	4
7	Sanitary cuttings	4
8	Final felling	100

Tables above represent theoretical and practical management programs from the beginning to the end of the rotation. Age classes it is ten year period, that represent maturity of stand and approximate time for treatments. Pre commercial thinning (PCT) intensity was not accurate as the estimation was made according to the harvested volume, but in young stand volume was not a very important factor. Anyway, PCT intensity is less important in calculating economic outcomes, because this treatment gives no income just costs are incurred.

Theoretical and practical management models show differences between frequency as well as intensity of the commercial and sanitary thinnings. According to the rules thinning is supposed to be carried out every ten years with lower intensity, but in practice treatments are carried out more seldom with higher intensity. Survey results provide partial explanation of the

causes of the phenomenon. Scientists, foresters and management planners were interviewed to obtain their opinions.

3.2.3 Reasons for differences (results of survey)

Scientists

Two of four scientists agree with practical management program that was prepared based on the statistical data. The rest of the respondents partly agree on thinning frequency, and suggested their own practical management model. One scientist thinks that in practice pine stands are thinned only two times with about 30 percent intensity and sanitary cuttings are carried out two times with the intensity of 4 percent. But in general all scientists agree that in practice thinnings have to be carried out not so frequent and with higher intensity than according to the rules. According to scientists, existing differences between theory and practice can be explained by several reasons. Each scientist gave one explanations:

1. Lower thinning frequency in practice than in theory is associated with economic reasons, that it is not economically efficient to harvest stand every ten years as it is written in the rules.
2. All activities in practice are supposed to be done following the management plan. But during the last decade management plans were behind the schedule due to forest land restitution process and complicate national forest inventory. Consequently, forest managers can not precede treatments in time because of delayed management plans. Then thinning frequency and intensity itself was not the same as it was supposed to be according to the theoretical management program.
3. All actions are imperfect, starting from creation of management rules to forest management in practice. Because of those reasons thinning frequency and intensity in practice are far from thinning rules.
4. It can be that thinning intensity in practice is higher because of gray economy.

According to the scientists particular actions should be taken to reduce differences between theoretical and practical management program, each respondent brings different opinion:

1. Revise wood measurement before and after treatments.

2. Put more control on management practice.
3. Create a new theory of forest dynamics.
4. Put more efforts on young stand management.

Representatives of forests inventory and management planning

Interviewed respondents from the Forest management institute, agree on discrepancy between normative and practice. Respondents represent two main reasons which raise differences between theoretical and practical forest management:

1. Forest management normative is far from practice. The main reason for differences in thinning regime in practice is that all treatments are projected according to the stock level, but proceeded according to the number of stems. Number of stems it is very sensitive dimensions that directly depend on tree diameter. For example, in stand where average diameter is 12 cm and stock level 1.0 the number of trees equals 1600. At the same time if the mean diameter is 13 cm then number of trees drops to 1364 (-15%). So in most cases foresters can not proceed thinning even if the stock level is high, but the number of trees is insufficient. Because of the imperfect normative a forester has no rights to thin such a stand; otherwise he can be penalized by forest inspection.
2. Other reason for discrepancy is that forest manager does not precede treatments on time, especially pre commercial thinning is carried out too late. Also, there is a possibility that foresters overuse causes for sanitary cuttings.

According to the planners to improve current situation, concrete actions should be undertaken:

1. Two planners think that solution could be a correction of the current normative that has to be made more liberal.
2. One planner thinks that foresters should be encouraged to do pre commercial thinning on time, then will be less uncertainty's in future stands.

Forest managers

Seven of eight respondents agreed on the prepared practical management program, one forester suggested his own model in which thinnings were more seldom and carried out with higher intensity than in the prepared practical program. Six of eight forest managers for differences blamed incorrect thinning normative. Two respondents indicated that thinning periodicity and intensity are wrongly projected in the management plan. And two managers indicated both reasons, incorrect normative and bad management planning.

Half of the interviewed forest managers also brought other reasons for differences between theories and practice:

1. The comeback to the same stand every ten years is too expensive, and economically not efficient. For example, there are no differences one or thousand cubic meters you will extract from the stand anyway costs incurred for documents preparation and technique transportation will be the same. For this reason thinnings should be more seldom and with higher intensity.
2. Usually strip roads are done too late and this factor increases thinning intensity in the middle aged stands.
3. Theories and practice are far from each other, because forest is a living organism influenced by many factors, and it is difficult to exactly predict or plan its growth. For this reason the situation defined in the management plan and reality pass each other.

All foresters suggest concrete actions in the quest for decrease differences between theoretical and practical forestry.

1. The new management rules (normative) for all thinnings are supposed to be more recommendatory but not so strict like now. [2 respondents]
2. To liberalize all cuttings, but at the same time to forbid commercial thinnings that are economically inefficient. [1]
3. Improve communication between management planners and foresters. [1]
4. Functions of the management planning are supposed to be transferred to forest districts, because only foresters know real situation in his/her estate. [1]
5. During the preparation of the management plan, the calculations of the volumes to be potentially extracted should be to be done more accurate. [1]

6. To increase intensity of sanitary cuttings. [1]
7. There is no need of concrete actions, because recent situation is satisfactory. [1]

The summarized survey results indicated that forest managers at state enterprises were not satisfied with the current normative. Six of eight managers blamed forest normative for differences between theories and practice. Two forest managers were not satisfied with planning of treatments. They wanted to get more freedom in decision making process and manage forest in more economical way, with lower number of thinnings and higher intensity. All interviewed foresters felt big pressure from forest inspection and had no influence on decision making process. Seven of eight forest managers agreed with practical program, estimated during this project. One manager slightly improved and changed thinning intensity but not frequency.

Opinion of the management planners was slightly different. Two of three interviewed respondents agreed with prepared practical program, the third did not agree with the practical program, even theoretical program according to him was not correct. In spite of the fact that management rules regulate thinning every ten years, theoretical program is supposed to be developed according to the yield model. Otherwise theoretical program with frequent thinning can lead to low volume stands at the end of rotation. Two planners indicated incorrect normative as a main reason for differences that in some cases is even contradictory. One respondent mentioned young stand treatment as a cause for differences between practice and theoretical model. He thought that foresters did not precede PCT at the time and then faced problems later. Due to that high number of treatments were delayed and carried out with higher intensity.

Scientist brings different opinion: Of four interviewed scientists one is responsible for the development of the normative. He agrees on prepared practical program and can see differences between theories and practices. According to the creator of rules all these differences are temporal due to transition period and natural disturbances. One of the scientists does not agree with the prepared practical program and suggests practical program where thinnings are more frequent with higher intensity. Two scientists blamed foresters for differences between theories and practice, one - natural processes and fourth blamed the whole forestry system in Lithuania. He thinks that forestry is not efficient and to improve it a new system and forestry theory have to be developed.

3.3 INCOME AND COSTS

3.3.1 Costs

Costs are considered to be one of the main indices in calculation of the economic outcomes. It is very important how big investments will be done at the beginning of the whole project. With higher initial costs, project is more risky and vice versa (W. David Klemperer 1996). In forestry, costs are supposed to be incurred during all rotation period, starting from the stand planting and finishing with final felling. In Lithuania, according to the rules all clear cuts must be regenerated, and treated by pre commercial thinning, even though those treatments bring only costs and no income.

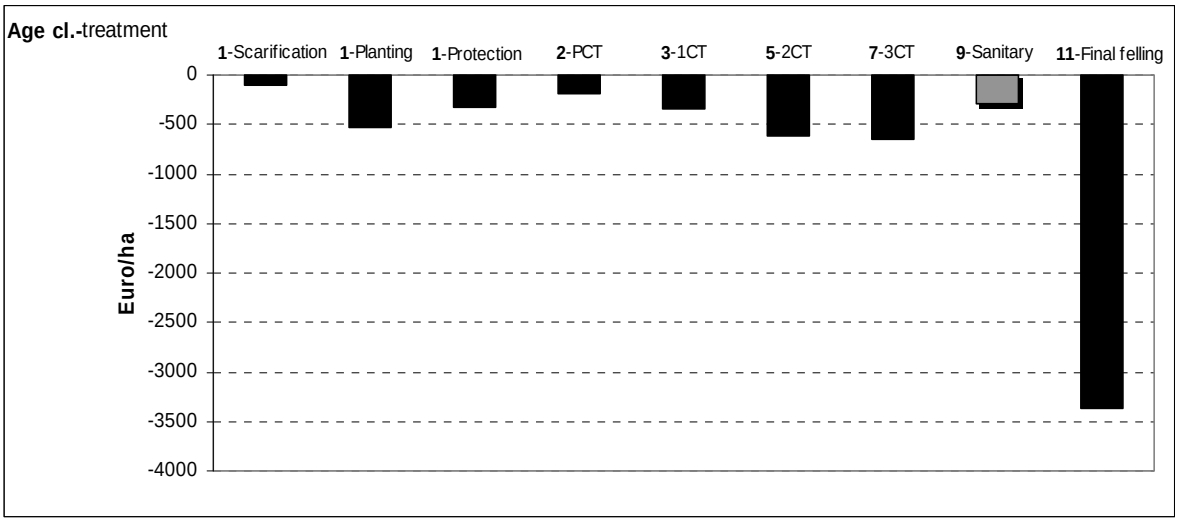

Figure 15. *Costs structure in typical pine stand during whole rotation period (Source: results of survey).*

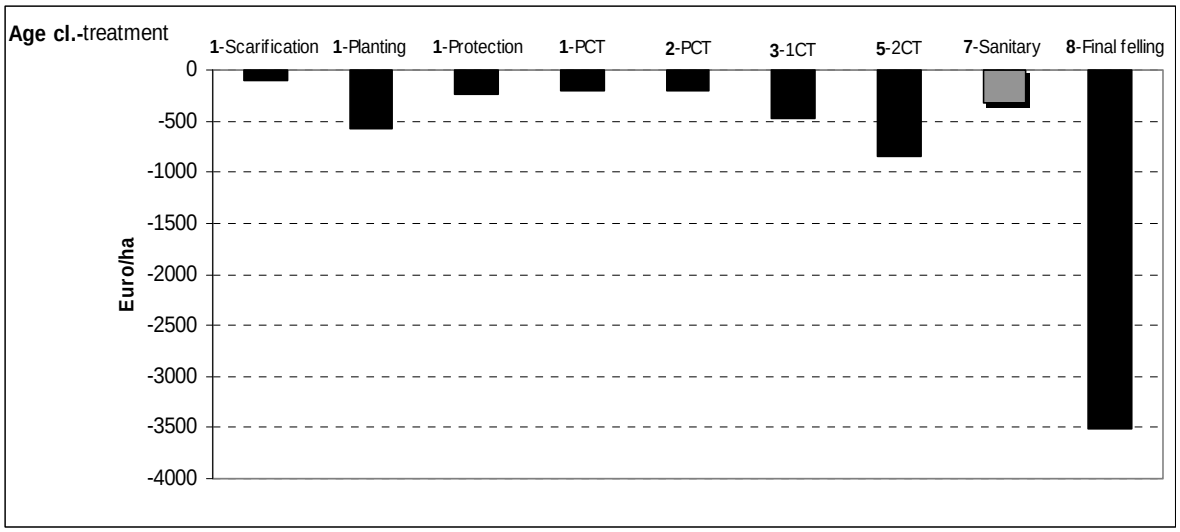

Figure 16. *Costs structure in typical spruce stand during whole rotation period (Source: results of survey).*

It follows from figures 15 and 16 that costs structure differs for pine and spruce stands. Due to different rotation length, in pine stand typically three commercial thinnings are carried out during the whole rotation and two thinnings in spruce stand. There are some differences in prices for PCT (pre commercial thinning): young spruce stands are usually more labour demanding than pine stands. For this reason PCT in spruce stands is by 50€ per hectare more expensive. Also, commercial thinning and final felling are by 2-3 percent more expensive in spruce forests than in pine forests. Important aspect that bears mentioning is sanitary cuttings.

Costs incurred during those cuttings (grey column on figures) are unclear or even can be called "mysterious". According to the management rules from 0.3 to 0.5 percent of stand volume can be taken by sanitary cuttings, in some cases this amount can increase two or threefold. In this project, analyzes of the factual data obtained from the annual reports of the thirteen forest enterprises revealed that the intensity of sanitary cuttings makes around 3 percent. And one more interesting fact from "Lithuanian statistical yearbook of forestry 2007" The amount of wood taken from sanitary cuttings is almost twofold higher than the volume from all other thinnings together. Volume from sanitary cuttings last year made 0.65 mil. m3 and from commercial and PCT together only 0.45 mil. m3. (VMT 2007). Even though there were no storms or other relevant causes that resulted in dead wood increase in state forests last year. Due to uncertainties mentioned above, the costs associated with sanitary cuttings are supposed to be excluded.

Another group of costs that are uncertain is administrative costs (enterprise, districts administration, fire protection service, etc…). Last year in Lithuanian state forests those costs made around 35€ per hectare (VMT 2007) and this number is a sum of many activities. As the results from this project will be used to compare economic outcomes in different countries so we decided not to include administrative costs in economic analyzes. Otherwise it can be difficult to develop a model to compute these multiple costs in different countries where specific methodologies are used.

Nowadays in state forests all thinnings and final felling are carried out by contractors, so prices for treatments depend on market. There are a number of small and big companies (contractors) that precede various treatments in state forests. Earlier all forest enterprises had their own technique and brigade of forest workers, but now this function is disposed to contractors. Wood producing costs are not the same everywhere even within such a small country like Lithuania.

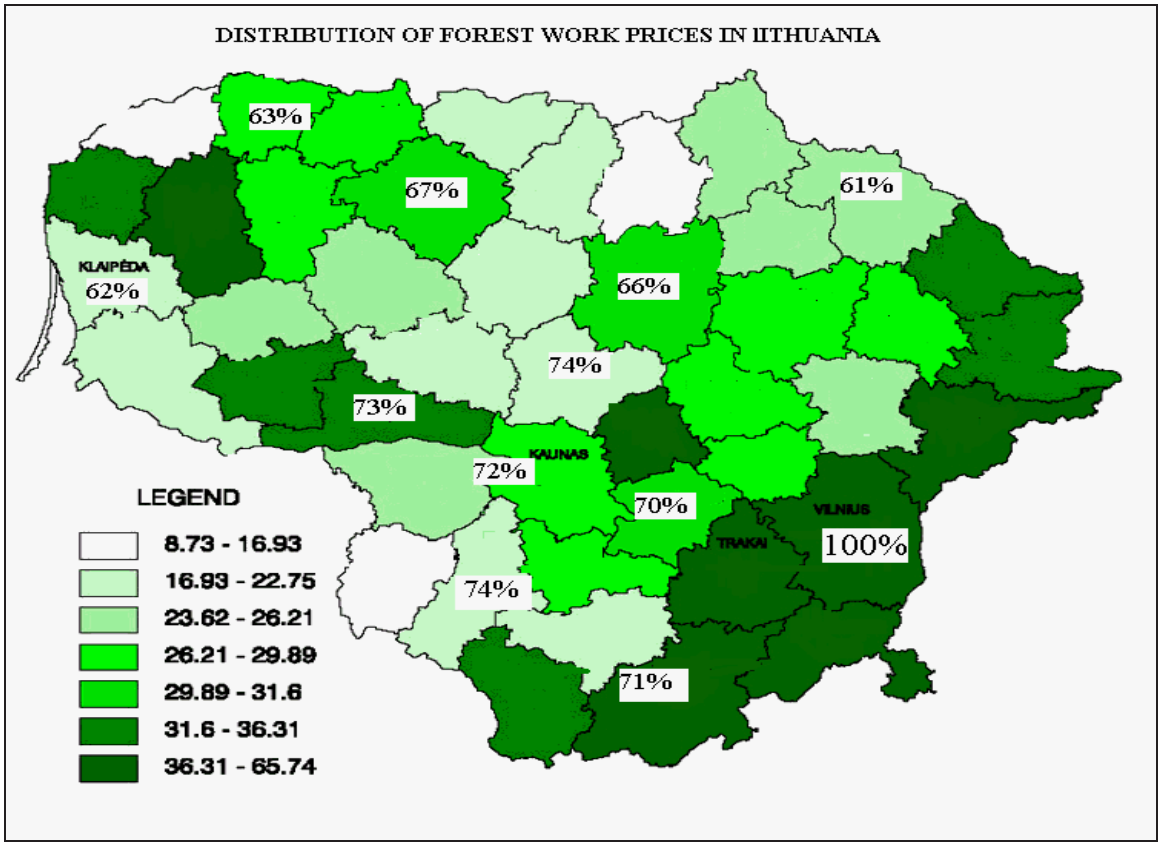

Figure 17. *Differences in prices for forest works based on survey of contractors (hundred percent represents highest price, lower prices are relative values).*

Figure above shows all 42 forest enterprises, intensity of color represents forest distribution in Lithuania. The highest price for stand treatments is found in the districts around Vilnius (in picture expressed by hundred percent). It can be related with large number of forests also with population and higher payments. For example, harvesting and extraction to the road side of 1m3. of coniferous wood during the final felling in districts around Vilnius cost 16€. But the same works in the north of Lithuanian can be done for 10€. Also, other forest works like planting or PCT are more expensive around big cities.

As the survey was made in the year 2007 all the costs mentioned above represent only particular period. To see dynamics, and fluctuation of wood production prices over time, statistical data from general forest enterprise was used.

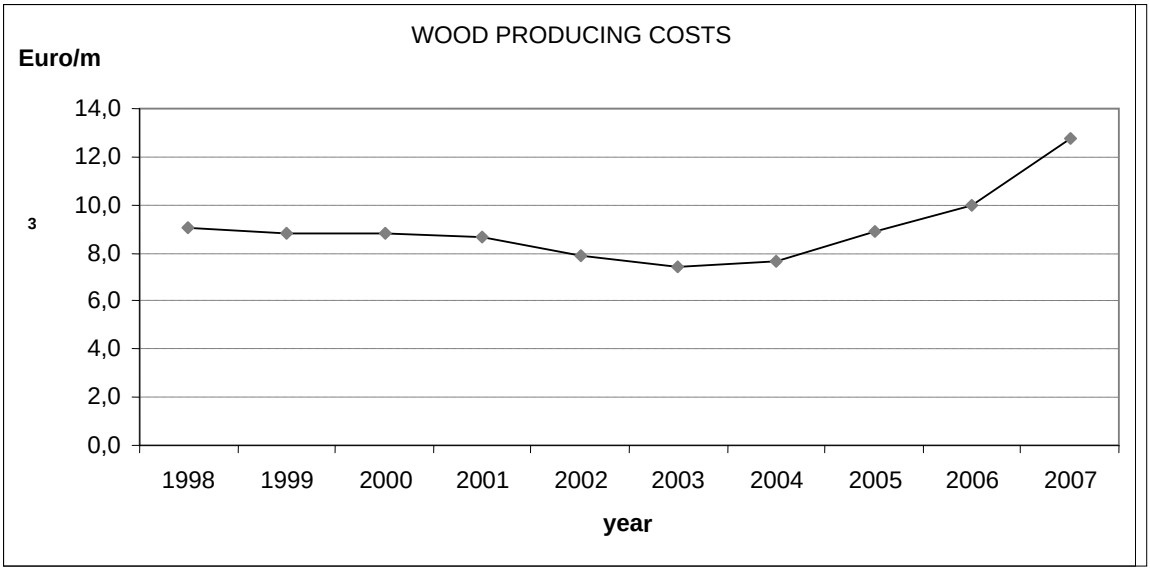

Figure 18. *Differences of wood producing costs over nine years. (source: GMU 2006)*

3.3.2 Income

In forestry, income starts to flow just after 20 years after planting or even later, but the main income is only received at the end of the rotation period. Of course, there can be some cash flow from non wood production like hunting, recreation, etc. but in this project only income from wood production is presented. Income has positive correlation with wood prices in the market. Thus after a price jump during the last year income from wood production increased significantly.

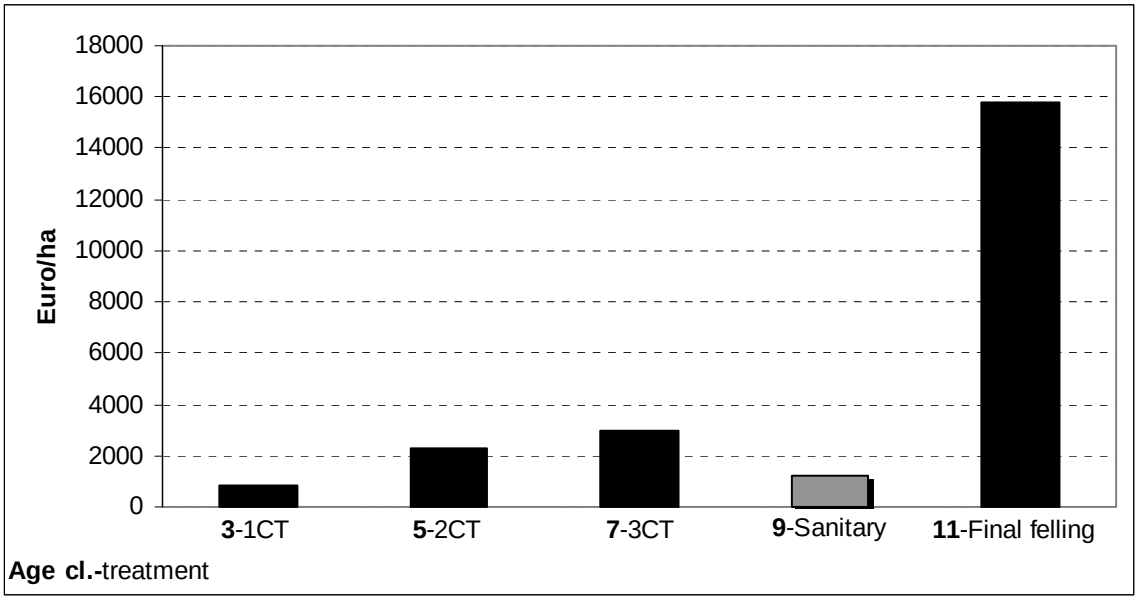

Figure 19. *Income structure in typical pine stand over the whole rotation period (Source: GMU 2007 and results of investigation).*

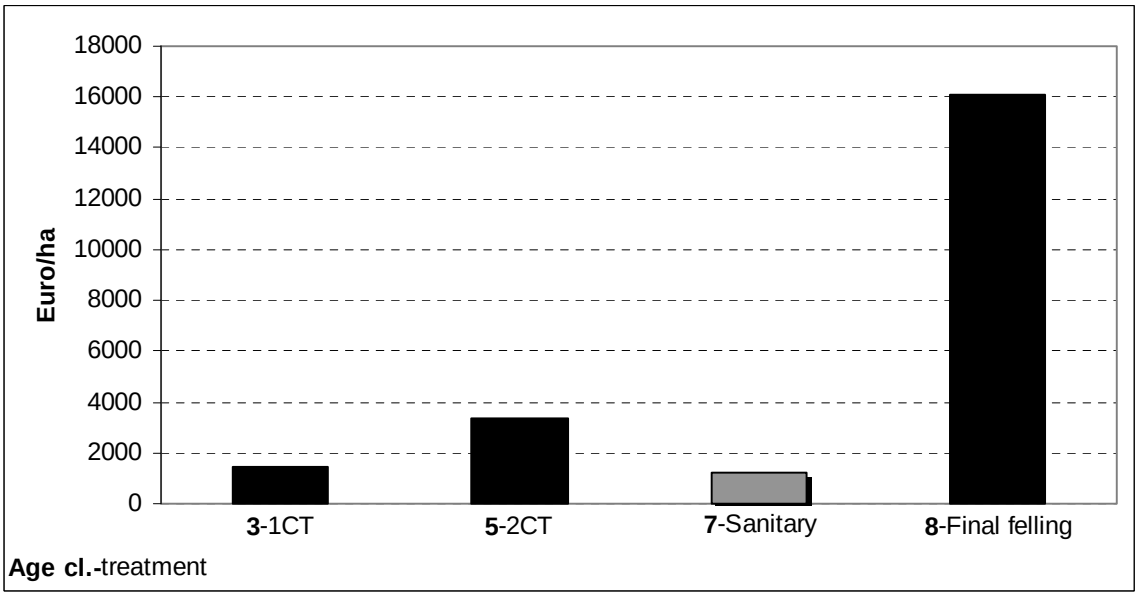

Figure 20. *Income structure in typical spruce stand over the whole rotation period (Source: GMU 2007 and results of investigation).*

Figures above show income structure from pine and spruce stands, managed under typical program. First commercial thinning is usually carried out at the age of twenty five with little

income due to low stand volume and produced log structure. In the first commercial thinning the main part, more than sixty percent of wood consists of pulpwood and only fifteen percent of sow-logs. Then second and third commercial thinnings bring more income because more sow-logs and of higher volume are extracted. Final felling gives the highest incomes. Typically at the end of the rotation around sixteen thousand Euro are received from pine and spruce stands.

"Mysterious" income from sanitary cuttings is impossible to estimate. There is no data revealing what kinds of wood are cut. According to the rule only dead wood is supposed to be extracted after sanitary cuttings. But at the same time statistics shows that volume taken during sanitary cuttings is two or even threefold higher than all volume from thinning, and then it is difficult to believe that only dead wood is taken during sanitary thinning. According to the survey results around eight percent of volume is taken during the sanitary cuttings, thus the grey column in figures above represents that.

3.3.3 Income and costs balance

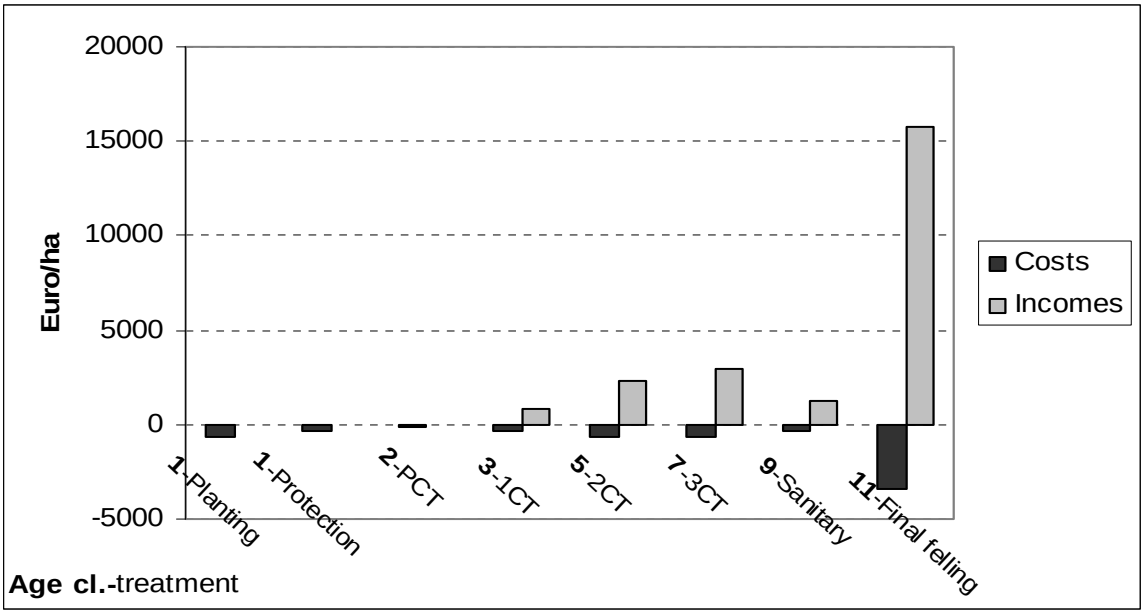

Figure 21. *Income and costs balance in typical pine stand over the whole rotation (Source: survey results, GMU 2007 and results of investigation)*

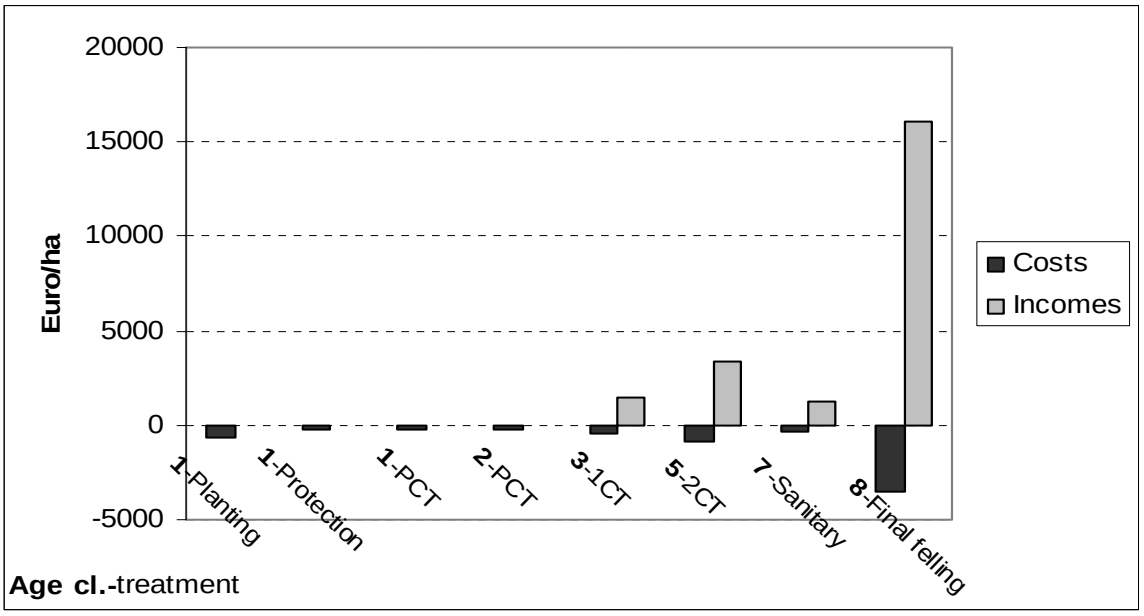

Figure 22. *Income and costs balance in typical pine stand over the whole rotation (Source: survey results, GMU 2007 and results of investigation)*

Figures above represent all income and costs over the whole rotation period. Income received over the whole rotation period exceed all costs considerably. In general, income from pine and spruce stands is 3.5 times higher than costs (income-23000€; costs 6000€) these numbers look nice if time factor and discounting are forgotten.

3.4. ECONOMIC OUTCOMES

3.4.1 Economic outcomes according to the practical management program

Table 4. Typical pines stand economical indicators, according to the prices of 2007 (*source: result of thesis*).

PINE 2007				
Age	Treatment	Incomes	costs	Cashe flow
0	Planting		-644	-644
1	Protection		-111	-111
2	Protection		-111	-111
3	Protection		-111	-111
15	PCT		-187	-187
25	1 thinning	825	-377	448
45	2 thinning	2313	-700	1613
65	3 thinning	2958	-782	2176
105	Final felling	15801	-3448	12353

NPV *r* = 3%	**436**
IRR	**3,5%**
FR	**147**

Table 5. Typical spruces stand economical indicators, according to the prices of 2007 (*source: result of thesis*).

SPRUCE 2007				
Age	Treatment	Incomes	costs	Cash flow
0	Planting		-703	-703
1	Protection		-81	-81
2	Protection		-81	-81
3	Protection		-81	-81
7	PCT		-202	-202
15	PCT		-202	-202
25	1 thinning	1419	-674	745
45	2 thinning	3345	-1025	2320
75	Final felling	16107	-3884	12223

NPV *r* = 3%	**1075**
IRR	**4,2%**
FR	**186**

Table 6. Typical pines stand economical indicators, according to the prices of 2006 (*source: result of thesis*).

PINE 2006				
Age	Treatment	Incomes	costs	Cash flow
0	Planting		-522	-522
1	Protection		-100	-100
2	Protection		-100	-100
3	Protection		-100	-100
15	PCT		-152	-152
25	1 thinning	436	-306	130
45	2 thinning	1521	-567	954
65	3 thinning	2121	-633	1488
105	Final felling	12014	-2792	9222

NPV *r* = 3%	**44**
IRR	**3,1%**
FR	**103**

Table 7. Typical spruces stand economical indicators, according to the prices of 2006 (*source: result of thesis*).

SPRUCE 2006				
Age	Treatment	Incomes	costs	Cash flow
0	Planting		-570	-570
1	Protection		-73	-73
2	Protection		-73	-73
3	Protection		-73	-73
7	PCT		-164	-164
15	PCT		-164	-164
25	1 thinning	734	-546	188
45	2 thinning	2196	-832	1364
75	Final felling	11667	-3147	8520

NPV *r = 3%*	**364**
IRR	**3,5%**
FR	**119**

3.4.2 Economic outcomes according to the theoretical management program

Table 8. Typical pines stand economical indicators, according to the prices of 2007 (*source: result of thesis*).

PINE 2007				
Age	Treatment	Incomes	costs	Cash flow
0	Planting		-644	-644
1	Protection		-111	-111
2	Protection		-111	-111
3	Protection		-111	-111
15	PCT		-187	-187
25	1 thinning	561	-256	305
35	2 thinning	923	-385	538
45	3 thinning	1390	-421	969
55	4 thinning	1791	-516	1275
65	5thinning	2218	-587	1631
105	final felling	14506	-3164	11342

NPV *r = 3%*	**514**
IRR	**3,7%**
FR	**142**

Table 9. Typical spruces stand economical indicators, according to the prices of 2007 (*source: result of thesis*).

SPRUCE 2007				
Age	Treatment	Incomes	costs	Cash flow
0	Planting		-703	-703
1	Protection		-81	-81
2	Protection		-81	-81
3	Protection		-81	-81
7	PCT		-202	-202
15	PCT		-202	-202
25	1 thinning	902	-433	469
35	2 thinning	1564	-609	955
45	3 thinning	2462	-699	1763
55	4 thinning	2544	-670	1874
75	final felling	15810	-3853	11957

NPV *r = 3%*	**1475**
IRR	**4,6%**
FR	**209**

Table 10. Typical pines stand economical indicators, according to the prices of 2006 (*source: result of thesis*).

PINE 2006				
Age	Treatment	Incomes	costs	Cashe flow
0	Planting		-522	-522
1	Protection		-100	-100
2	Protection		-100	-100
3	Protection		-100	-100
15	PCT		-152	-152
25	1 thinning	297	-205	92
35	2 thinning	536	-308	228
45	3 thinning	902	-337	565
55	4 thinning	1224	-413	811
65	5thinning	1591	-470	1121
105	final felling	11029	-2531	8498

NPV *r = 3%*	**77**
IRR	**3,1%**
FR	**98**

Table 11. Typical spruces stand economical indicators, according to the prices of 2006 (*source: result of thesis*).

SPRUCE 2006				
Age	Treatment	Incomes	costs	Cashe flow
0	Planting		-570	-570
1	Protection		-73	-73
2	Protection		-73	-73
3	Protection		-73	-73
7	PCT		-164	-164
15	PCT		-164	-164
25	1 thinning	464	-346	118
35	2 thinning	973	-487	486
45	3 thinning	1658	-559	1099
55	4 thinning	1769	-536	1233
75	final felling	11345	-3082	8263

NPV *r = 3%*	**647**
IRR	**3,9%**
FR	**134**

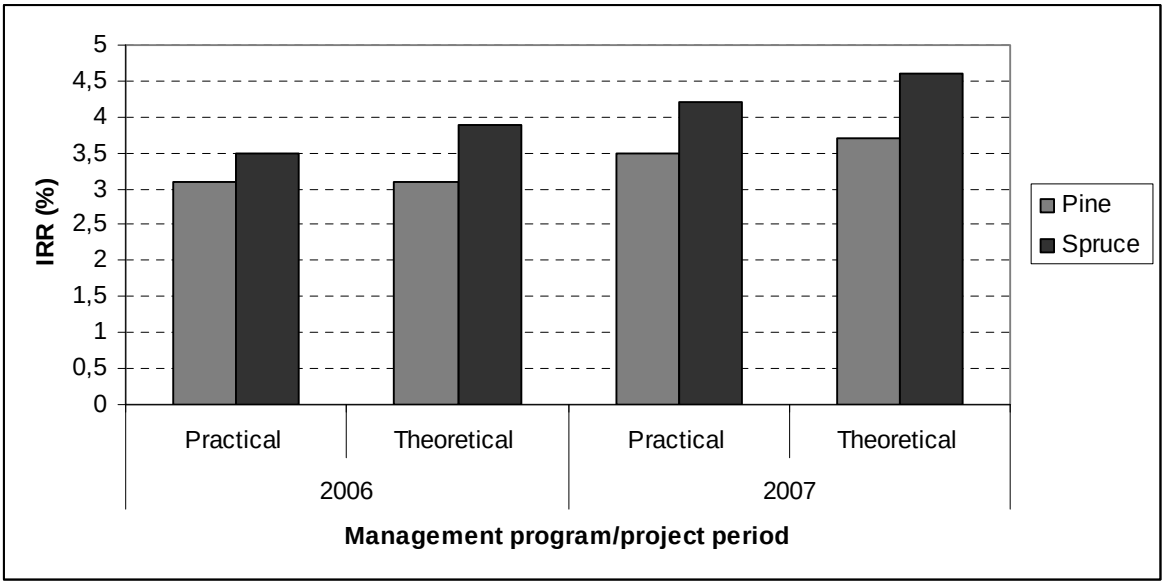

Figure 23. Changes in IRR

Economic indicators are closely related with wood prices and production costs at a certain period. Significant increase in IRR could be observed in the year 2007. Internal rate of return has increased by 12 percent in pine project and 17 percent in spruce. It means that wood prices in one year increased more than production costs and it made forestry projects more profitable in the year 2007.

According to the practical management program NPV and FR were positive in all considered periods. NPV was higher in the year 2007 it was more than a thousand Euro for spruce and over four hundred for pine. In the year 2006 NPV was lower and reached only 44 Euro for pine, and 360 for spruce. FR fluctuated between one and two hundred Euro in all considered periods.

A calculation according to the theoretical management programs brings better results. IRR is higher by 6 percent according to the theoretical management program then practical.

4. DISCUSSION

4.1 THEORY VERSUS PRACTICE

Efficient forestry is supposed to be based on reliable theories and practice resulting in implementation of sustainable forest management. The first Lithuanian forest law passed in 1918 stopped forest destruction (LARM 2003). At present forest law regulates forest regeneration, protection and management that lead to sustainable forestry (LRS 1994). In cooperation with experts and following the principles of forest law forest management rules are formulated. These rules are obligatory for all forest estates in Lithuania. Despite regulation by forest rules management plans have to be prepared for all forest property. All those regulations mentioned above have to be implemented in practical forestry, and controlled by forest inspection.

This project proved that forestry practice is far from theory. Reason for that can be a number of regulations mentioned before and lack of communication between practitioners and those who create forest rules. According to the forest managers forest is a living organism influenced by many factors due to what management rules can not be implemented in all cases. Thus, a number of rules and regulations just cumber forest practice. Forest practitioners believe that new management rules for thinning have to bear more recommendatory character than compulsory and management plans have to be prepared on a voluntary basis. According to the managers they do know forest conditions in estates so this knowledge can potentially be used in the planning process.

However, not all groups involved in forestry think liberal way like foresters. Some scientists that are responsible for creation of the management rules believe that more restrictions have to be included with the purpose to reduce differences between theory and practice.

This controversy between forest managers and rules creators leads to differences between theoretical and practical forest management. Collaboration between those two groups can improve current situation and reduce differences. More practical matters have to be integrated in the new forest rules.

Another important aspect observed during this study is management planning. Forestry involves long production periods and uncertainty (Klemperer 1996). In state forest districts only tactical plans are present, because management plans are prepared just for ten years. But there is no strategy for long term planning at district level. Because of that managers can hardly

understand management of a single stand during the whole rotation period. This traditional way of planning can be the reason for differences between practice and theory. Mores studies have to be done on this topic

4.2 UNCERTAINTIES

Profitability of forestry projects is closely related with wood prices and production costs. This study examines and compares prices from two last years. But even in short considered period it is clear that forestry projects are associated with many uncertainties. Whole rotation period in Lithuanian pine forest means hundred years. So many hardly predictable changes can arise during the whole rotation. Results of the study show that internal rate of return increases by seventeen percent in only two years. However, wood prices depend not only on demand and supply in the market but also on political decisions like import-export taxes and other regulations. In general, wood prices used to fluctuate over time. During the last decade wood prices had a trend of slight decrease, but now significant jump is observed. Because of that future dynamics in wood prices are hardly predictable and forestry projects associated with many uncertainties.

Not only increase in wood prices but also wood production cost was observed. Growing economy and the lack of labour stipulate higher salaries. Prices for fuel and wood producing tools have significantly increased during last four years. Production costs in the year 2007 were by 20 percent higher than in 2006 and around 40 percent higher than in 2004. Ten years before increase slightly decrease was observed. But in general wood has prices increased more than production costs. That means, forestry projects counted on 2007 prices are more profitable then projects from 2006. There is a doubt that wood prices will Forestry projects are very sensitive for wood prices and production costs, but prices and costs used to fluctuate over long periods.

5. CONCLUSION

Lithuanian forestry is based on optimal light conditions and the main purpose, which is achieved the maximum possible volume at the age of final felling. But there are no economic considerations in management program. Even those economic outcomes from average pine and spruce stands are positive. By employing economic indicators that are used in Scandinavian countries it was proved that internal rate of return is between 3 and 4 percent.

In Lithuania differences between theoretical and practical forest management are present mainly because of incorrect forest normative and lack of communication between theoreticians and practitioners.

According to the theoretical management program frequent thinning has to be operated with lower intensity. But in practice it seems to be opposite only two or three commercial thinning are carried out with higher intensity. Amount of sanitary cuttings in practice is different then is suppose to by according to theories are but is difficult to investigate precisely due to the reason that intensity depend on abiotic and biotic factors.

Result of this study shows that those differences can be reduced by more liberal forest normative. Numbers of regulations just cumber forest practice and initiate differences between theoretical and practical forestry in Lithuania. But economic outcome is even higher in forestry projects according to the theoretical management program.

Another factor significantly influencing economic outcomes is wood prices and production costs. After a huge jump in wood prices during the last years, economic indicators increased by fifty percent and more. And this fact indicates hardly predictable economic outcomes in future. Fluctuating prices are supposed to be considered as uncertainties in long term forestry projects.

Real sow-log prices during the last two years increased by 22 percent, pulp wood by 188 percent and fire wood by 26 percent. Those significant changes increased profitability of forestry projects in Lithuania. Wood production costs have also changed. Since 2004 a slight increase in wood production costs has been observed. During the last years it made 20 percent due to increase in salaries and lack of labour. Wood production costs are not the same even within small country like Lithuania; treatments are more expensive around big cities.

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