

## LOGGING AND REALIZATION OF WOOD HARVESTED IN PLANTATIONS OF INTRODUCED FOREST TREE SPECIES IN EASTERN BULGARIA

Dinko Dinev<sup>1</sup>, Lyubcho Trichkov<sup>2</sup>

<sup>1</sup>Oak Forest Experimental Station  
Burgas, Bulgaria  
e-mail: dinevds@abv.bg

<sup>2</sup>Executive Forestry Agency  
Sofia, Bulgaria  
e-mail: lptrichkov@iag.bg

**Keywords:** logging, plantation, introduced forest tree species, technology, market of wood

**Abstract:** *There are mostly young plantations of Green Douglas fir (*Pseudotsuga douglasii* Vir.), Black pine (*Pinus nigra* Arn.), Atlas cedar (*Cedrus atlantica* Man.), Red oak (*Quercus rubra* L.) and others where the planned thinnings are not regularly done. That leads to a worsening of the wood structure (consistence) of the young plantations, to a decrease of their resistance, to a drop in wood quality, to a raise of the fire risk and to a missed utilization of wood.*

*The reason for such a state, - far from being good, - consists, along with the scarce means, of: the unsteady market of the technological wood and the insufficiently developed home market of wood, also including: fluctuation of demand and a trade policy non-adapted to market economy; a missing data system that makes unable a precise assessment to be given to wood demand and supply; assortment selection non corresponding either to demand or to final consumer requirements, and others.*

*There are mainly animal haulage force and adapted farm tractors which are used for wood harvesting, and some less exploited short cable systems on slope terrains, being the mechanization extremely insufficient.*

*Taking into consideration all those serious difficulties which make the branch placed at a disadvantage nowadays, it is obvious this problem should be solved extremely hard and not at once. Guidelines of priority shall be pointed out, aiming at a stage solution of the above said problem, as to guarantee a gradual introduction of up-to-date machinery and technologies into the timber production. For example, lately, some new machines were created in Bulgaria, by our research scholars and engineering companies, and being the tests come off, the introduction of these machines into the timber production can be already realized.*

### 1. Introduction

According to the forestry strategy in Bulgaria, a change should be made in the existing models of the forest resources use, in the assistance of the incentive measures for the updating of the wood harvesting engineering and the application of recent technologies in logging, as well as in the development of wood home market; so should it be provided a stabilization in demand along with the adaptation to the market economy of the trade policy.

The systems of assortments harvesting are representative for an efficient method which is to be applied to thinnings, and especially, to artificial coniferous plantations (Miller R., 2001).

As it is pointed out by Popovici, E., Benetto, E., Rousseaux, P., 2002, taking into account the costs cultivation and the advantages resulting from the technological chip production, in the future, that same technology will be more and more outlining as a prominent.

And when a market of energy appears, it may result decisive that wood, obtained by new tree species, - which ones, usually, are also of a faster growth, - could be used for chip production (Rippengal, R. & I. Bright, 2002).

Afforestation by introduced species in Bulgaria is a task we approach to, paying the attention that is required, as to guarantee steadiness of the future plantations and their adaptability to the changeable climatic conditions. The afforestations in the forest stock, where plains and forest shelter belts are comprised, are determined and realized according to the respective forestry projects. The afforestation of the agrarian lands inappropriate for agriculture is still to scarcely implemented, regardless of the measures for their owners' assistance, provided by the Regulation on Application of the Act on Forests.

In the Eastern Bulgaria, there is an extremely scarce use of the mechanized haulage in logging within the plantations of the introduced forest tree species. In most of the cases, it is counted on those farm tractors which have been adapted to wood harvesting. It is to be mentioned, of course, in the past, some experiments were made where different small-sized specialized tractors were used, with the wish their production in series started, but the changes which occurred meanwhile, stopped the development of that process. Only now, by the approval of the recent Act on Forests and the subsequent restructuring of the forest sector, an increase may be expected of the degree of mechanization.

Nowadays, the main means, applicable to the cuttings (which are thinnings, by their substance) within the above examined plantations, are the light chain saws, horses and tractors.

## 2. Materials and methods

Getting familiar with the raw materials base, which the wood harvesting is being done on, is a precondition for an objective determination of the volume and the limit of use. In the Eastern Bulgaria, there are young plantations of the Green Douglas' fir (*Pseudotsuga douglasii* Vir.), the Atlantic cedar (*Cedrus atlantica* Man.), the Red oak tree (*Quercus rubra* L.) and others, where the planned thinnings are not regularly made (Fig.1).



**Figure 1.** Map where the location of the examined introduced forest tree species in the Eastern Bulgaria are shown.

Roads for haulage of a 3 up to 3,5 meters width are made, in each fourth meter, and more often it is realized by cutting every fifth or seventh row.

Systems of technological schemes, adapted to thinnings within young plantations, have been developed in our country, which ones should be wider applicable. By the moment, they missed to be applied in mass, due to the low interest in, expressed by the Users: as Forestry Boards were in the past, and logging firms nowadays. There are mainly factors of a subjective nature, which, to one or other extent, hamper the introduction of the new technical means.

The most recent methods for the sites examination have been applied to the testing and the analysis of the results gained from the study. It is mainly the analytical-research method which is applied to the examination and the analysis of all the components of the technological process.

### 3. Results and discussion

Wood harvesting in the cultures of the introduced forest tree species does not differ too much from that one made in the thinnings within the young plantations, in Bulgaria, as the types of the haulage means, used for the purpose, are few. That is why a study is being pointed out by us, further on, being a representative one for our country.

The development of the wood harvesting in our country is not based on such social and economical factors as providing for different specialists to be available, requirements for the forest environmental protection, price formation and others are, that is to say, it is not subjected to the available conditions. Some data reflecting the labor productivity change in a group of workers, averagely representative for our country, are being indicated as to illustrate the above exposed (Fig.2).

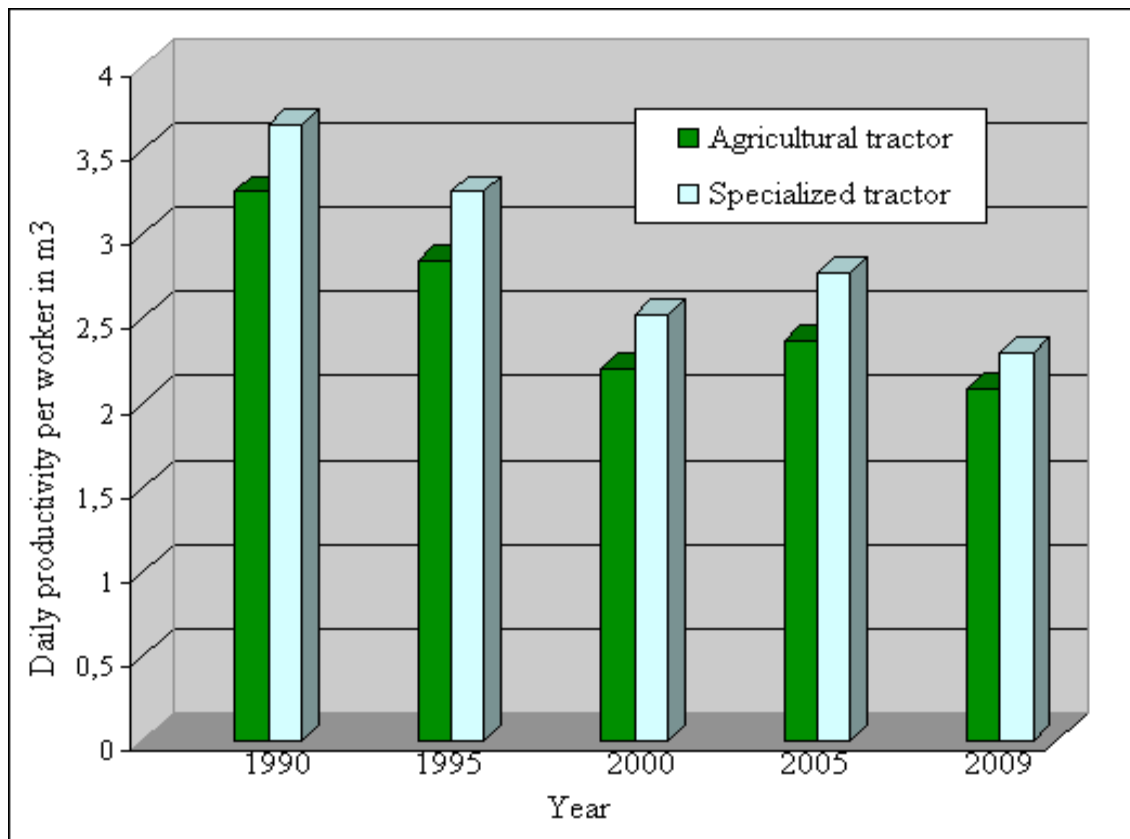


Figure 2. Worker` s daily productivity in wood harvesting in Bulgaria.

The average daily natural work delivery calculated for a worker belonging to a group, which used for the operations a farm tractor adapted to logging, was 3,25 m<sup>3</sup> in 1990, 2,84 m<sup>3</sup> in 1995, 2,20 m<sup>3</sup> in 2000, 2,31 m<sup>3</sup> in 2005 and 2,08 m<sup>3</sup> in 2009, while in such groups of workers who operated by a specialized tractor, the values, resulted for those same years, were 3,65 m<sup>3</sup>; 3,25 m<sup>3</sup>; 2,52 m<sup>3</sup>; 2,77<sup>3</sup> and 2,30 m<sup>3</sup>, respectively. It is evident, there is a significant decrease up to 2000 and a slight increase in 2005, followed by a subsequent drop in the labor productivity in 2009.

The reasons for what was previously evidenced are complex, being the most serious ones the prolonged idle time that exerted a negative influence, due to the repair of the above said machines, and the discontinuous loading both during the work and in the month.

That means, the logging firms technical and productive potentials are limited, in our country. It is due to several reasons as wear and tear equipment (technical means), low paid work, missing qualified personnel in wood harvesting, lack of investments in new updated equipment and technologies and others are. Solutions can be found out, of course, one of which is related to the forthcoming modifications in the Act on Forests and the other normative documents governing the activities in Bulgarian forests and to the subsequent structural changes, resulting from, which are to be made within the forestry sector.

Table 1 shows the taxation characteristics of the cultures of the introduced forest tree species in the Eastern Bulgaria. The great variety, both in age and resulting from the schemes of afforestation by the examined cultures, is quite evident. That determines a necessity of using different technologies in cutting. As the choice of the means of haulage in our country is too restricted at the moment, there are predominantly haulage of assortments by horses and, in very rare cases, haulage of tree-lengths by tractor with a winch, which are applied.

**Table 1.** Taxation characteristics of plantation of introduced forest tree species total in Eastern Bulgaria

Tree species	Area, ha	Total resources, m <sup>3</sup>	Average age, years	Average diameter, cm	Average annual yield, m <sup>3</sup>	Schemes afforestation, m
1. Black Pine ( <i>Pinus nigra</i> Arn.)	94593,84	19085758	21 - 40	11 - 24	308702,4	2x1; 2x1,5; 2,5x1; 3x1
2. Atlas cedar ( <i>Cedrus atlantica</i> Man.)	1124,63	14941	3 - 35	4 - 20	80,1	1,5x1; 2x1; 2x2
3. Green Douglas fir ( <i>Pseudotsuga douglasii</i> Vir.)	1108,03	327691	20 - 45	14 - 30	5154	1,5x1; 2x1; 3x1
4. Red oak ( <i>Quercus rubra</i> L.)	7048,22	700001	5 - 42	4 - 20	7564,44	1x1; 1,5x1; 2x1; 2x1,5; 2,5x1; 2x3; 3x1
5. Sea Pine ( <i>Pinus maritime</i> Lam.)	211,64	34947	20 - 40	14 - 20	486,5	1,5x1; 2x1

It is interesting to be mentioned, the volume of the wood harvesting in the black pine cultures is high (308702,4 m<sup>3</sup>/averagely, in a year), being the used method of harvesting a assortment-type one. Taking into consideration the fact, a great part of the cutting remains within those same plantations as waste, and the subsequent chipping up in pieces of the assortments in plant conditions, an appropriate technology can be recommended for a complex assimilation of the biomass and a part of waste, using the method of chip production within the plantations themselves. Moreover, such chips can be used, further on, for other products which might result of a higher value.

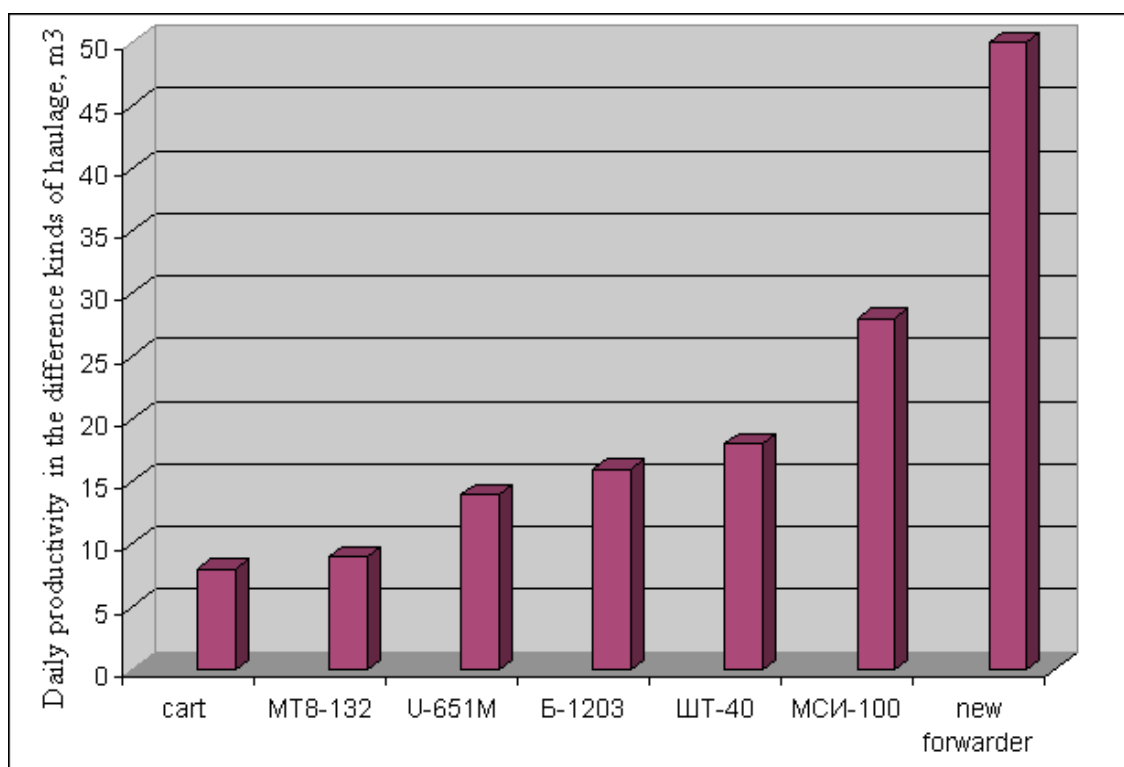
The Atlantic cedar, the Black pine and other introduced coniferous species are used, in the Eastern Bulgaria, even in some rich sites, for the accelerated coarse and average type of wood, being the turnus of no more than 30-40 years.

Years ago, some experiments were conducted in the introduced cultures, being the trees felling and the bucking made by light chainsaws produced by Shtil and Husqvarna Companies, while the branches

trimming was made by axes or chainsaws. The haulage of the material was realized by „Universal-651” farm tractor adapted for harvesting and the specialized „MT8-132” and „ИИТ-40” small-sized forest tractors, as well as by „Б1203” small-sized assortment tractor of manual loading and unloading and „МСИ-100” assortment tractor of a hydro-manipulator and the horse-pulled carts. The haulage roads were perpendicularly made to the rows, at a distance of 40 meters and a width of 2-2,5 meters or 3-3,5 meters, depending upon the kind of the used means of haulage.

Each tractor was watched while working within a period of 2-3 weeks, in the cultures available on plain terrains, in summer working conditions. The average volume of the stems, in the loads on run, was from 0,05 up to 0,098 m<sup>3</sup>. The average volumes of the loads were from 0,657 up to 104 m<sup>3</sup>. An exclusion resulted in the average volume of the loads hauled by „MT8-132” tractor, in the Black pine culture, which one was of 0,398 m<sup>3</sup>

Fig.3 shows the daily productivity in Bulgaria and the difference existing in the use of all and any means of haulage in the black pine cultures.



**Figure 3.** Daily productivity where different kinds of haulage means are used in wood harvesting within the sites of Black pine cultures.

According to the technology, approved in Bulgaria, and based on „МСИ-100” Bulgarian assortment tractor, when the characteristics of the forest-exploitation conditions is the same, and forwarders of a wide spread in Europe are used for, as well as considering the experience of these countries which are advanced in harvesting, in our country is possible such a daily productivity in haulage to be achieved as of 50-60 m<sup>3</sup>, that means, about twice more, when the work is done within the sites of cultures by the introduced forest tree species.

Nowadays, the technological schemes applied to thinnings, in our country, are being based on haulage machines used for main cuttings. Such kinds of machines are „Universal-651”, „T-40A” tractors and others. The tractors are farm kind ones, equipped by winches, forecarriages and other accessories.

The load forming is made by winches, on the tractors themselves. The pre-gathering operation of the stems is quite labor-consuming, as in most cases it is a manual work, due to the use of inappropriate mechanical means. The small sizes of the stems cannot permit loads of a greater volume to be formed, which is the reason fore the low efficiency of the machines.

Along with tractors, there is also the animal haulage force which is used for wood material haulage. For that purpose, the wood materials are loaded on a horse-pulled cart. It has been - and is - practicing especially in the Eastern Bulgaria, in the introduced cultures, as they are available on comparatively plain terrains.

Table 2 shows data resulted from an observation made in the Red oak culture. There can be seen a comparatively good productivity (5 m<sup>3</sup> / man-day) which is due to the short haulage distances (100 m). The materials obtained from are logs for plain sawing - 31 m<sup>3</sup>, technological wood - 125 m<sup>3</sup> and firewood - 51 m<sup>3</sup>.

**Table 2.** Taxation characteristics and technology work in red oak plantation

Taxation characteristics of plantation							
Age, years	Area, ha	Resources, m <sup>3</sup> /ha	Average diameter, cm	Average height, m	Density, Nr./ha	Completeness	Scheme afforestation, m
25	11,9	139	16	14	333	1,0	3 x 1
Production parameters in logging							
Kind of felling	Output of yield, m <sup>3</sup>	Use intensity, %	Skidding distance, m	General costs, €	Cost price, €/m <sup>3</sup>	Productivity, m <sup>3</sup> /day	Technology work
Thinning	208	20	100	1622	7,8	15	Felling, delimiting, haulage by animal, 3 workers

Taking into consideration the above said, these cultures are created on plain terrains, and the inter-row space in the examined culture are wide which enables the access to the cut wood. Compared to what is being done in the countries where the logging mechanization degree is high, it can be stated that such cultures provide ideal conditions for a mechanized harvesting to a high extent.

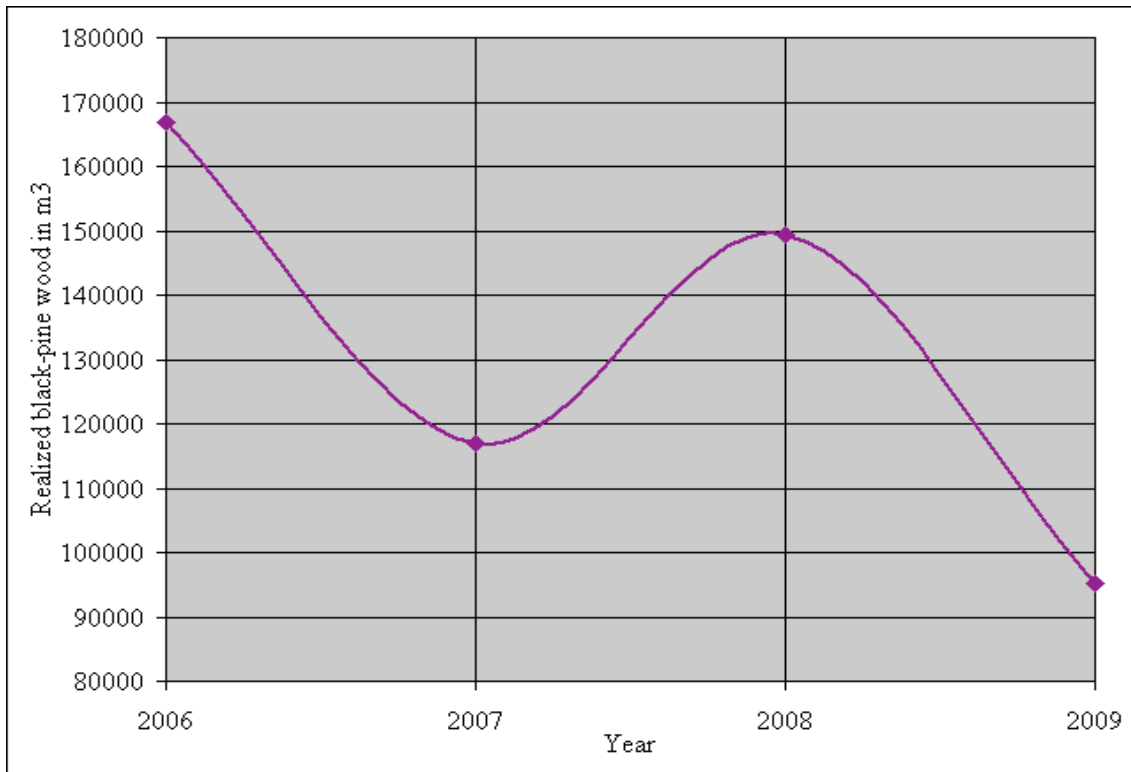
Just to give an example: in the course of some earlier studies, conducted in our country, experiments were carried out for the application of the highly mechanized methods of work, as felling by light chainsaws, haulage by tractors and delimiting and bucking out by machines were. Those experiments were conducted within Black pine cultures. For that purpose, when the whole trees were hauled, „Universal-651” and „IIT-40” tractors were used for, while it was „Stripper III” Processor to be used on the stack, for branches delimiting and bucking. A comparatively good daily productivity as of 28 m<sup>3</sup> was achieved, at a haulage distance of 200 m, by a group consisting of 4 workers. Hence, when the tractor use is combined with the processor (delimber-bucker) one, it is quite possible that very good results could be achieved in thinnings done in coniferous cultures.

In the course of the recent years, the wood realization by introduced forest tree species, in Bulgaria, is being evidenced in three directions: supply of plants and factories by wood for wooden boards production, firewood to be used by the local population, and export.

Fig. 4 it shows the realization, in the Eastern Bulgaria, of Black pine wood used by Kronospan-Bulgaria for panels and boards production, the oriented strand boards (OSB) comprised.

The variable character of purchase by one of the greatest consumers of such wood in Bulgaria is evidenced by years. A particular decrease in the use of such wood is noted in the year when the economic crisis occurred: 2009 compared to 2006, by 1,8 times approximately.

Cedar wood is used for production of internal and external woodwork; in the future, after coarse-sized wood harvesting, it will be possible such wood to be used for furniture production, as well as for peeled and carved veneer one. It can be also used, traditionally, for making of wood structures, plank-board floorings, cabinets (because of its repellent properties to moths). Cedar wood cannot be attacked either by fungi or by insects. Wood produced by thick tree branches can be applied to making of products related to internal and external design and decoration.



**Figure 4.** Characteristics of the realized black-pine wood for industrial processing in the Eastern Bulgaria.

Cultures, created by introduced forest tree species in the Eastern Bulgaria, as well as pure and mixed cultures, where various schemes of afforestation and cuttings are applied to, from the forestry point of view, are to be taken as a motivation for further reliable conclusions.

It is said, for example, regardless of the made rides, the trees form very soon canopies there (s.fig.5a) and in a couple of time, a natural regeneration is evidenced within the introduced cultures (s.fig.5b), and especially, in the rides.



**Figure 5.** Canopy in rides (a) and natural regeneration (b) of the introduced black-pine culture.

It is the natural regeneration, - also evidenced within the plantations of the introduced forest-tree species, - which, in a combination with the active undertakings for its stimulation, as a form of the forest management, meets, to the best extent, the conditions available in the country and the complex functions which are being developed by our forest ecosystems. As a base for the solution of intervention is considered the assessment of the plantation state and complex valuation, the site potential and the economical analysis of the possible approaches to achieve that objective.

It is the natural regenerative potential for creation and cultivation of a new generation of forest, which is used within plantations of such a composition of species that meets the conditions available in the respective site, and appropriate regenerative cuttings are being done therein. If the natural regeneration within the cultures of the introduced forest tree species is scarce and/or a worsening of the structure is evidenced, a stimulation is to be made by artificial regeneration using appropriate local or introduced forest tree species for the purpose.

### **3. Conclusions**

The main means for logging in Bulgaria are the light chainsaws, the farm wheel tractors, adapted to wood harvesting needs, and the horses.

That productivity, comparatively higher, which was gained in the past, when a assortment tractor haulage was being used (taking into consideration the fact, that same kind of tractors were made in Bulgaria), resulted unable to impose the above said machine, due to its significant technical imperfections. Nevertheless, if forwarders are used (made by widely recognized companies), the productivity may raise up to 2 times, compared to that one of the above mentioned assortment tractor, and up to 7 times, compared to the animal power, nowadays used in mass in our country.

Wood harvesting activities in Bulgaria are being exerted by private specialized firms. As about those methods and technologies of work, proposed in our country, - which ones are new and more innovative to be applied to the assimilation of the young plantations, - they have not been introduced into work, yet, for the reasons, as following: inefficient prospective thinking and missing interest in the use in practice; scarce investments due to a lack of stability and long-term availability of sites for wood harvesting, and, to the great extent, to the frequently variable functions and structure of the productive units in our country.

### **References**

- Miller, R. (2001). Gentle Logging System Evaluation. Published by Michigan State University Upper Peninsula Tree Improvement Center Escanaba, Michigan, 1-7.
- Popovici, E. , Benetto, E. and Rousseaux, P. (2002). The recycling of wood ash in forests. Wood energy, N°6, 46-47.
- Rippengal, R. & Bright, I. (2002). Proving of Woodfuel Harvesting in Undermanaged Woodlands in the East of England, p.32.
- State Forestry Agency. (2003). National forest policy and strategy sustainable development of forest sector in Bulgaria, 54.
- Dinev, D. (2003). Studies and results of thinnings in the forests in Bulgaria. Methods, technologies and machines. 262.