

Strategical Peculiarities of Forest Cover Enlargement in Lithuania

EDVARDAS RIEPŠAS

Lithuanian University of Agriculture, Department of Silviculture

Studentų 11, Akademija,

LT – 4324 Kaunas distr: Lithuania

Introduction

Lithuanian land stock is 6530 thousand ha. Forests occupy 1998,4 thousand ha. Forest cover is 30,9% according to the data of January 1, 2001 (Lithuanian State Forest Registration, 2001), which is one of the lowest indices not only in Baltic countries, but also among Central and Eastern Europe countries and is just slightly higher than the average forest cover in Europe. The forest cover in neighbouring countries is significantly higher: in Latvia – 44,6%, in Estonia – 47%, in Belarus – 36%, in Sweden – 67%, in Finland – 68%. The forest cover index is lower only in Germany (28%) and Poland (28%). However, forest cover enlargement is foreseen not only in Poland, Germany, but even in such wooded countries as Sweden and Finland. Some European countries foresee to increase their forest cover twice (Denmark, the United Kingdom) or several times (Ireland). This process is influenced by the perception of forest importance not just for social and economic development of individual countries but in general for global scale preservation of the environment good for human being to live, and for mankind to exist. Forest is understood as one of the most important landscape components, which determine preservation of biodiversity, sustainable ecosystems and the landscape itself. At present forest protective, recreational, conservation and various other social-cultural functions are appreciated much more than the timber produced. However, the demand for timber is continuously increasing.

The favourable conditions for forest cover enlargement in Lithuania are created by uncompetitive agriculture. The agricultural land of low productivity (lower than 32 points) occupies 19% of all agricultural land and almost half (8%) of the area is moderately and strongly abraded land. Damaged land occupies 775,6 thousand ha. The vacant national land stock is 775,6 thousand ha. However, there are 314,9 thousand ha of reclaimed land where drainage systems do not work. The area of over 600 thousand ha can be dedicated for new forests (Kundrotas, 2001). In some districts forest cover is very low (Vilkaviškis district – 9,1%, Skuodas district – 14,9%), consequently, large land areas are out of zones of favourable forest influence. The lack of forests is observed in natural frame territories, suburbs and prestige areas of recreation.

In Lithuania forest cover enlargement is related not only to the optimisation of agricultural land exploitation,

natural frame formation and other inside actualities, but also to the integration into the European environmental stabilisation systems, as well as to the experience and support from the European Union countries.

Since World War II 313 thousand ha of non forest land have been afforested in Lithuania (Karazija, Danusevicius, 1997). The vast area of abandoned land has overgrown by forests spontaneously. Many plantations have not achieved the aim set, because of insufficient care. Rich experience of forest cover enlargement has been gained, however, the comprehensive analysis has not been done up till now. There are only few works of forest plantations planted in non forest land evaluation (Daujotas, 1967; Lukinas, 1968; Gradeckas, 1968; Brukas, 1981; Bušinskas, 1992; Tebėra, 2000; Riepšas, 2000). The analysis of our own and foreign experience, determination of factors influencing this process, evaluation of forest structure and territorial (spatial) distribution, preparation of strategical scenarios and program for forest cover enlargement are very important in preparation for the new stage of forest cover enlargement. This paper is expected to be useful in solving some of the above mentioned problems.

Materials and methods

The data, used in the analysis, have been taken from the project of general plan of the Lithuanian Republic territory (2001), special plans (organisation of land exploitation, forest management, environment preservation, recreation and others) of various territory levels, literature sources, sociological research data (the data was collected from 37 Lithuanian forest enterprises and national parks according to a specially prepared form).

The SWOT (Strength-Weakness-Opportunities-Threats) method, which is used in the implementation of integrated development programs in the European Union countries, has been used in the data analysis. The essence of this method is to determine development goals and opportunities for the entire planned territory and for separate territory units (in our case for the entire Republic and administrative districts). The development goals are formulated following the summary principle and making simplified matrix (Table 1).

The following principles of sequence have been observed in preparation of the paper:

- analysis of forest cover enlargement experience;
- planning unit description;

	A. Stimulating factors	B. Restrictive factors
I. Opportunities	I A. Basic goals Selection	I B. Preparation goals Strengthening
II. Threats	II A. Stabilizational goals Neutralisation	II B. Saving goals Minimising

Table 1. Generation of goals system

- general evaluation of the situation;
- explanation of development tendencies;
- determination of factors (stimulating and restrictive), influencing forest cover enlargement, and potentials (opportunities and threats);
- prognosis of forest cover enlargement volumes;
- prognosis of forest cover enlargement means;
- prognosis of future forests priority functions;
- determination of program realisation rate.

Three possible scenarios of forest cover enlargement - minimum, optimum and maximum – have been chosen and differentiated into 3 territorial levels: state, region and district.

Results

Experience of forest cover enlargement

In Lithuania the conversion of inappropriate for agricultural lands into forests goes back to the XVI century. According to the Valakas Reform law (1557), the areas inappropriate for agricultural purposes were left for natural afforestation. However, the reverse process went on much large scale. Forests areas decreased consequently up to 1948. In general, in Lithuania forest planting began in the last quarter of the XVIII century. There is no reliable data about forest planting in agricultural lands till the XX century. In the past there were no economic-social incentives: low land rent, in comparison with agriculture, low cost of exported wood, predomination of selective cutting and abundance of ungulates that damaged young forest plantations (Lukinas, 1968). It is known that in the XIX century the seashore dune in the Curonian Lagoon was afforested. Pine plantations were grown in Telšiai region (1839), larch plantations in the Degsnė (planted in 1849) and Vidgiris (1859) forests (Lukinas, 1984; Riepšas, 2000). Various means of plantation cultivation were practised. Coniferous seeds used to be sown in entirely ploughed sand grounds. In springtime pine seeds used to be sown in rye field or they were sown together with oats (Lukinas, 1984). Big planting material (1-5 years of age) was planted in pits prepared by spade – like in a garden.

In 1907 the first work (prepared by Liudvikas Pliateris) concerning forestry questions was published in Vilnius. This work suggested some means of pine sowing and planting in soded ground applying entire or strip land preparation based on the forest cultivation experience in Lithuania. In 1908-1909 and later circulars of State Wealth and Land Exploitation department provided detailed description of effective forest planting works - group mixing, ground preparation in knolls, etc.

In the period between wars (1918-1940) in land management legislation provided the straightening of forest edges, abolishment of insertions of agricultural areas and patches by the means of afforestation. In woodless districts saplings and seeds might be available free of charge for forest planting in lands where the forest had not been before. The data about how much forest was planted in agricultural lands during the period between wars have not been found. The documentary processing of land dedication for afforestation was very simple. Often it was enough to have the decision report of commission of three people (the commission included the owner and representative of local authority).

More significant afforestation of non forest lands started after World War II (Table 2).

Table 2. Average annual volumes (thousand ha) of forest planting in non-forest lands in 1921-2000

Year	Planted in non-forest land	Planted total
1921-1930	?	1,6
1931-1940	?	4,6
1941-1950	1,5?	8,1
1951-1960	11,8	17,6
1961-1970	11,8	14,2
1971-1980	3,0	10,6
1981-1990	3,2	10,3
1991-2000	0,25	7,9

In the period 1946-1950 the area of 15 thousand ha of non forest land was afforested. Part of the area was sands or land damaged in various ways (Riepšas, 2000). The biggest afforestation volume of non forest lands was in 1951-1970 – even 11,8 thousand ha per year. Those plantations often were badly cared of (they suffered from overgrazing, vegetation overgrowth and damage of beasts, insects, fungi). Part of the plantations was planted with one-year old seedlings because of lack of planting material. Over 40% of those plantations did not reach the goal set, because of the reasons mentioned above. According to the Forest Management data plantations remained planted with spruce - 73%, pine - 62%, ash - 29%, larch - 12%, oak - 10%. The reasons for the plantations' death are the following: 23-50% of all plantations died because of competition with vegetation, 29-47% - because of wild animals' damage. In the post-war conditions lack of many things, even of specialists-foresters was suffered. Nevertheless, the obtained results were rather good. In Lithuania in the post war period there were more mixed plantations planted than in most West European countries. Mixed plantations planted in some years of the 7th decade made up to 64% of all planted forests. Plenty of eroded hills were afforested in Lazdijai, Varėna, Zarasai districts, etc. The strip plantations of 7-9 rows were planted on the top of arable slopes for the purpose to protect crop against obstruction. The protective field belts were started to plant (Šilutė, Pasvalys districts). On slopes of Kaunas Sea over 1100 ha forest plantations were planted in 1958-1963. About 60 species of trees and shrubs were planted. Different mixed planting schemes were applied even in areas smaller than 1 ha. In those plantations about 50 research objects of high value for science and training were established. At present the age of these plantations is about 40 years. Most of them are in a good state. These are pine plantations mixed with birch (5-6 rows of pine, 1 row of birch), pine plantations mixed with various bushes, mixed plantations of pine and spruce (1 row of pine, 1 row of spruce; 2 rows of pine, 2 rows spruce; 3 rows of spruce, 1 row of pine and other), birch plantations mixed with black alder and white alder, pine plantations mixed with oak, mixed plantations of ash, black alder and birch (mixed by various areas considering the relief), oak plantations mixed with spruce, oak plantations mixed with lime and maple (2 rows of oak, 1 row of lime, maple) and many other mixing variants, pure plantations. Various planting material and soil preparation methods were applied. At that time it was used to plant densely, mostly up to 20 thousand saplings per 1 ha.

In the first years following the independence reestablishment, during the first years very little was planted in non forest lands. The volume of planting has significantly increased since 1998 – 562 ha, 1999 – 787 ha, 2000 – 822 ha. The main planting took place in abandoned and damaged lands.

The research of the condition (biodiversity, sustainability, productivity) of plantations planted in agricultural lands was insignificant. The research data of various authors is often difficult to compare and even contradictory. In the holdings of forest enterprise in Nemenčinė at present there are 82% (1451 ha) forest plantations planted in agricultural land. Some planted alien tree species (larches, poplars) have disappeared. The state of forest plantations aged 30 years and older ones is mostly satisfactory (56% of area), good – 38% of the area, bad – 6% of the area. Poor state is mostly the result of root sponge injury. Planted tree species are predominantly damaged by soft deciduous replanted by themselves in productive lands.

In the holdings of training forest enterprise in Kazlų Rūda the productivity of pinewood grown in agricultural land is rather high. It is even by 5% higher than the productivity of the same stands growing in forest land. The productivity of spruce plantations planted in agricultural areas is 8% lower than that of the plantations planted in similar soil conditions but in forest lands (Tebėra, 2000).

In the post-war years the forest cover in Lithuania increased about 10%. However, naturally regrown forests determined this increase (from 19,7% in 1948 to 30,9% in 2001). There is no exact data about the forest cover increased by planting and by natural regrowing in abandoned lands. In the last 5 years inventory has been done by Forest Management and Planning institute, which shows that new naturally regrown plantations make even 72% of all new forest area that has appeared in the last 20 years. In most cases abandoned meadows and pastures overgrow with forest naturally (53% of the whole overgrown with forest area). Then follow wetlands and peatbogs (41%). The percentage of naturally overgrown arable (4%) and other land (2%) is significantly lower.

The lands of low productivity but with normal irrigation in most cases overgrow with birches (45%) and pines (47%), rarely with spruces (5%). More productive soil overgrows with white alders (55%) and birches (31%). Spruces and pines predominate only in 7% of the area. The most productive lands with normal irrigation overgrow with white alders and aspens (88%), of valuable species only ash (6%) appears.

The meadows and pastures in temporary wet soil overgrow mostly with birch (76%) and coniferous (17%). The richer the land the stronger predomination of overgrowing white alders and aspens (up to 90% of area) is observed.

In wetlands and marshes the overgrowth with birch and black alder predominates. Just only in pure land pines and birches grow exclusively. In the innings birches overgrow rather than black alders.

The exploited peatbogs, if the peat layer left does not exceed 30 cm, rapidly overgrow with birches and pines. Later birches suppress pines and the birch wood of low productivity forms. When peat layer is thicker the overgrowth takes slow rate. The peatbog overgrows with cotton grasses, shrubs and marsh regenerates.

Referring to the forest inventory data in 481 thousand ha, in Lithuania every year 4000-5000 ha of abandoned non forest land (2,5-3,0 thous. ha in agricultural land) overgrow naturally. Mostly trees species of low economic importance overgrow, especially white alder woods. The productivity

of overgrowing species reaches just 35% of target species productivity. However, their spatial spread is the best from the ecological point of view. Natural overgrowth of forests is better in more productive lands.

Peculiarities of Lithuanian forests territorial spread

The major indices of forests territorial spatial spread, influencing their ecological impact on landscape, are as follows: forest plot area, distances among forest plots, perimeters of forest edges and forest shape. The zone of favourable ecological forest impact on non forest lands depends on the mentioned above rates (Pauliukevičius, Kenstavičius, 1995).

At present existing the largest forest plots formed in the XVIII century (Končius, 1970). The major part of forest plots and wooded territories extends in meridian direction (from the North to the South, Southeast, Southwest) and is determined by geological and geomorphological land organisation (relief, soil), which formed after last Valdajus glacier melting and other natural and historical - anthropogenic transformations in landscape.

The present structure of Lithuanian agrarian landscape was mostly impacted by country reformations in the middle of the XX century, when the program of land reclamation and individual farmsteads removal was implemented. Single trees, their groups and small groves, impeding mechanized field works, were rapidly removed. The total area of agroplantations significantly decreased, their shape became regular. The biggest compact forest plots remained in moraine and alluvial plains. The bigger forest plots, the bigger adequate forest influence on moisture circulation, thermal regime in less wooded or woodless territories (Pauliukevičius, 1997). In Lithuania the average forest plot is 109 ha. The smallest average forest plot is in Skuodas district, the biggest – in Varėna district. The biggest average distance between forest plots is established in Vilkavīškis district (1150 m), the smallest – in Varėna district (86 m) (Deltuva, 1999).

The heaviest biosphere background pollution (40%) with sulphur nitrogen compounds is caused by polluted air masses coming from the Southwest (industrial Western Europe countries). These pollutants are partially absorbed by forests, extending parallelly to seashore. However, these forests weaken dangerous power of winds, its devastating impact. The flows rising up over huge forests in Southeast make influence on insolation inflow, cloudiness and thermal regime of the lower atmosphere layer. The biggest forest plots in East Lithuania extend to neighbouring countries, they enter into nodal territories of "European green lung" system. From this point of view, the role of pinewoods, mixed (spruce, pine) woods is invaluable (Pauliukevičius, 1997).

The present forest cover and forests spatial spread do not meet the requirements for sustainable landscape and qualitative environment. Preparation of the program of forest cover enlargement in Lithuania requires special attention to be paid to natural frame formation, forests enlargement in zones of ecological balance, in damaged and easily vulnerable territories.

Along with landscape stabilisation, Lithuanian forests enable full supply with wood and other forest production. The variety of territorial productivity is determined by the variety of soil and differences in climatic conditions. Four districts of natural forest productivity, that mainly differ in species composition of stands, have been distinguished (Kuliešis, 1997):

- mixed spruce forests in Samogitia (spruce woods occupy more than the third, deciduous up to 38% of the forests area);

- productive mixed deciduous-coniferous forests in Central Lithuania (deciduous occupy more than 54% of the forests area);

- mixed pine-spruce forests in Southeast Lithuania (pinewoods and spruce woods occupy more than 76% of the forests area);

- pure pinewoods in South Lithuania (pinewoods occupy more than 85% of the forests area).

There have been established 2-3 subdistricts (very productive, productive, moderate productivity, low productivity) in each of the above mentioned districts.

The subdistricts territories of the most productive mixed pine-spruce forests in Southeast Lithuania, the productive mixed coniferous-deciduous forests in Central Lithuania and the productive pure pinewoods in South Lithuania are the best for intensive wood cultivation (Kuliešis, 1997).

In Lithuania forests have been districted according to the supply of other forest products (mushrooms, berries, etc.), relevance to recreation, as well as according to the priority environment functions.

According to the main indicators characterising forest fund, as well as the area of protected territories, Lithuania is close to the average of the European Union member states.

According to the forest land area for one citizen, wood volume per 1 ha, wood volume for one citizen and annual wood increment Lithuania exceeds the European average. The indices indicating the percentage of private forests area in total forest land area, and the cutting volume m³/ha per year are significantly lower (Lietuvos miškų statistika, 1998).

In Lithuania protected areas occupy 11,9% of entire territory, while the average in the European Union countries is 11,9%. In Lithuania the territory of protected areas is relatively bigger than that in Belgium, Finland, France, Greece, Italy, Portugal, Spain, Sweden, Island (Philips, 1995).

The most significant difference is based on the fact that in Lithuania only 22% of forests are of cultural origin, while the remaining 78% are naturally growing (natural or seminatural) stands. This causes the biodiversity in Lithuanian forests richer than that in developed European countries, where coniferous monoculture often predominate.

Opportunities of forest cover enlargement

The forest cover enlargement is influenced by juridical, organisational, socio-economic, ecological-environmental factors (Fig. 1).

The major factors stimulating forest cover enlargement:

- Lithuanian integration into the European Union (EU);
- existence of unproductive, abandoned and damaged lands;

- opportunities to obtain support from the EU, various funds, etc.;

- necessity of ecological and environmental conditions improvement;

- professional training;
- new workplaces creation.

The major factors restricting forest cover enlargement are as follows:

- unfavourable legislation (the Land Law, the Territory Planning Law regulating investments, crediting, sponsorship, concessions, etc.);

- unprepared forests development strategy;

- unfinished land reform;

- unprepared schemes of forests spread;

- complicated requirements for documentation;

- limited possibilities to receive bailout;

- probability of fungous diseases, insects, beasts, fire damage;

- probability of anthropogenic damage;

- problems of planting material provision.

These factors have different influence on forest cover enlargement volumes at each stage. Until 2020 it is advisable to establish 3 stages of forest cover enlargement process. The major factors at separate stages are presented below, factors of the same impact at all stages are omitted.

I. Preparatory stage (2003-2005)

Stimulating factors:

- Lithuanian aim to join the EU;

- Possibility to receive bailout.

Restrictive factors:

- unfavourable legislation;

- unprepared forests development strategy;

- unfinished land reform;

- unprepared schemes of forests spread;

- complicated requirements for documentation;

- limited possibilities to receive bailout;

- problems with planting material provision.

The first stage may be called preparatory stage. During this stage some legislation and following documents have to be changed, harmonised with other Lithuanian and the EU legislation. The following tasks are planned to be accomplished: preparation of forestry development strategy, finishing land reform, preparation of forests spread schemes, simplification of documentation requirements, preparation of nursery development program and beginning to cultivate planting material according to the volumes of forest cover enlargement program. At this stage the volumes of forest cover enlargement should be the lowest ones and arranged in increasing order.

II. Development balancing stage (2006-2010)

Stimulating factors:

- society, land owners interest;

- Lithuanian negotiating obligations to the EU;

- support from the European Union;

- control of the European Union institutions;

- provision with planting material.

Restrictive factors:

- insufficient support from the LR and EU government;

- increasing anthropogenic factor together with spread of towns, industry, recreation.

Manifestation of some factors essential to the first stage because of insufficient neutralisation, lack of civil responsibility of officials and owners' initiative, bureaucracy barriers.

Continuous forest cover enlargement due to improving relationship with society, support stabilisation, dealing with planting material problem, improvement of forest propagation technologies, etc. should be characteristic of the second stage. The forest cover enlargement program might be corrected.

III. The balanced development stage (2011-2020)

Stimulating factors:

- society interest and support;

- international obligations;

- support from the EU and the state (LR).

Restrictive factors:

- dealing with global ecological and environmental problems;

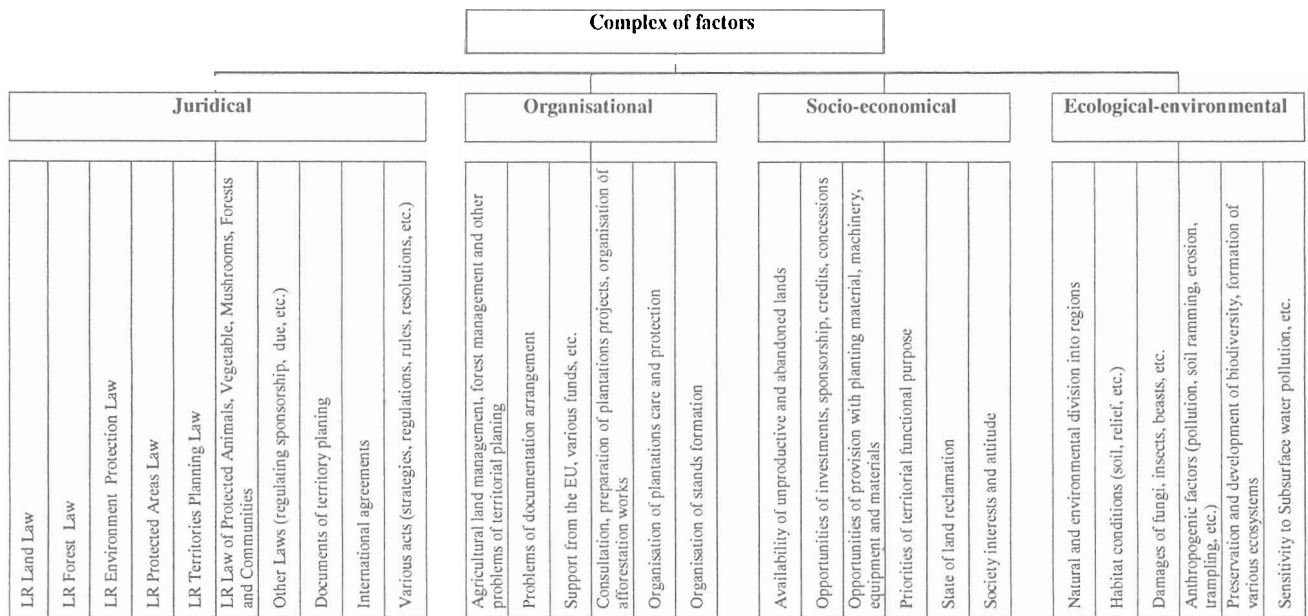


Figure 1. Environment factors influencing forest cover enlargement

- partial manifestation of some factors, characteristic of other stages of forest cover enlargement;
- occurrence of new, unpredictable problems.

At this stage it might be necessary to correct forest cover enlargement program because of hardly predictable changes in economy.

The preparation of reliable scenarios is impeded by the absence of prepared conformable forestry development strategy. The scenarios presented in Table 3 may be considered just as orientational ones. Over 600 thousand ha of uncompetitive agricultural lands area (the land produc-

tivity score is lower than 32) make the economical base of foreseen forest cover enlargement up to 37-38% in optimal scenarios. It is proposed to conserve temporary about 160 thousand ha of that area and afforest the remaining part (Eidukevičienė et al., 1998). Having prepared forestry development strategy the necessity to correct forest cover enlargement program may occur. The forest cover enlargement program should be designed following modern principles, applied in the EU – beginning from local planotops and completed at State level.

Table 3. Strategic forest cover enlargement scenarios *

Program levels	Types of scenarios		
	minimum	optimum	maximum
State	To increase the forest cover by 2-3%, mainly due to natural overgrowth. The problems of state land rational exploitation and landscape ecological optimization are not solved.	To increase the forest cover by 7-8% by the means of stimulating and regulating natural overgrowth and planting. This partially meets the state needs for landscape optimization	To increase the forest cover by 10-12% by applying natural overgrowth and planting as much as possible. The balance of territorial structures in country landscape is reached
Regions	To increase the forest cover by about 30% of the total volume provided in the general LR territory plan for the individual regions. The problems of regional land rational exploitation and landscape ecological optimization are not solved	To increase the forest cover according to the volume provided in the general LR territory plan for the individual regions. This partially meets the region needs for landscape optimization	To increase the forest cover by 130-160% of the total volume provided in the general LR territory plan for the individual regions. The balance of territorial structures in region landscape is reached
Districts	To increase the forest cover by about 30% of the total volume provided in the general LR territory plan for the individual districts. No forest-spread schemes are under preparation. The area selection depends on the commission, set up, which includes the district authority representatives, landowner and authorized person from the concerned institution. The problems of district land rational exploitation and landscape ecological optimization are not solved.	To increase the forest cover according to the volume provided in the general LR territory plan for the individual districts. The simplified forest spatial spread schemes without differentiation according to the afforestation (natural forest overgrowth) sequence are prepared. This partially meets the district needs for landscape optimization	To increase the forest cover by 130-160% of the total volume provided in the general LR territory plan for the individual districts. The detailed forest spatial spread schemes differentiated according to the sequence of afforestation (natural forest overgrowth) importance in individual planotops are prepared. The balance of territorial structures in district landscape is reached

* This scenario is not time related

Conclusions

1. In Lithuania there are over 0,6 million ha of unproductive and abandoned agricultural lands where forest cultivation is expedient.

2. In Lithuania the present forest cover and spatial forest spread do not meet the sustainable landscape and qualitative environment requirements.

3. The obtained experience in forest planting in damaged lands and agricultural lands is rich, however, it has not been analysed sufficiently. The more detailed research might enable to prepare the recommendations for afforestation of damaged and agricultural lands and avoid mistakes in the process of forest cover increase.

4. Large areas of abandoned lands, especially productive ones, overgrow with forest naturally. The spatial spread and species composition of naturally overgrown forest often do not answer the purpose set for future forest. The research is necessary to prepare recommendations for the land selection for natural overgrows.

5. The present conditions for forest cover enlargement are unfavourable, because of the unfinished land reform and some unfavourable legislation. The government of the Lithuanian Republic does not provide finances for this purpose. The possibilities to get financial support from other sources are limited.

6. In future more favourable conditions for the development of this process are expected, because of growing state economy and improving legislation. The support from the European Union is expected to become more realistic, especially when Lithuania joins this Union; the interest of society and landowners is expected to grow.

7. Landscape optimisation and agricultural land use balance maintenance require increasing forest cover at least up to 37-38%.

8. It is purposeful to distinguish three stages in the program of forest cover enlargement development: preparatory, development balance and balanced development.

9. The rates of forest cover enlargement essentially depend on the subsidies to forest planting and the level of agricultural development.

References

- Brukas A.** 1981. Agroželdinių problemos [Problems of Agroplantations]. *Mūsų gamta*, 10: 6-8 (in Lithuanian).
- Bušinskas P.** 1992. Želdiniai kolūkių ir tarybinių ūkių miškuose 1966-1988 m. [Plantations in Forests of Collective and Soviet Farms in 1966-1988]. In: Lietuvos miškų ūkis. Vilnius: Mokslas, p. 53-54 (in Lithuanian).
- Daujotas M.** 1967. Miško želdinimas Lietuvoje [Forest Planting in Lithuania]. *Girios*, 11: 2-3 (in Lithuanian).
- Deltuva L.** 1999. Lietuvos miškų teritorinio išsidėstymo ypatumai [Peculiarities of Territorial Distribution of Lithuanian Forests]. In: Miškai ir aplinkotyra trečiojo tūkstantmečio išvakarėse: jaunųjų mokslininkų konferencijos pranešimai [Forests and Environmental Sciences on the Eve of the Third Millennium: Presentations at the Conference of Young Scientists]. *Girionys*, p. 109-116 (in Lithuanian).

- Eidukevičienė M. et al.** 1998. Žemės išteklių naudojimas Lietuvoje žemės reformos ir perėjimo į rinką laikotarpiu [The Land Stock Use in Lithuania in the Transition Period from Land Reform to Market]. Klaipėda: Klaipėdos universitetas, 76 p. (in Lithuanian).
- Gradeckas A.** 1968. Spygliuočių želdinimas [Coniferous Planting]. In: Lietuvos TSR miškų ūkis. Vilnius: Mintis, p. 46-50 (in Lithuanian).
- Karaziya S., Danusevičius J.** 1997. Miškai. Valdžios požiūris [Forests. Governmental Attitude]. *Kauno diena*, 100 (15127): 19 (in Lithuanian).
- Končius A.** 1970. Erdvinė Lietuvos miškų struktūra [The Territorial Structure of Forests in Lithuania]. *Girios*, 7: 3-6 (in Lithuanian).
- Kuliešis A.** 1997. Lietuvos miškų rajonavimas pagal medynų produktyvumą [Division of Lithuanian Forests into Districts According to Stand Productivity]. In: Lietuvos mokslas. Vol. 5. Vilnius: Lietuvos mokslų akademija, p. 54-63 (in Lithuanian).
- Kundrodas A.** 2001. Apželdinimo vaidmuo aplinkosaugos politikoje [The Role of Afforestation in Environmental Policy]. *Mūsų girios*, 10: 1-2 (in Lithuanian).
- Kuliešis A.** 1999. Danijos patirtis apželdinant nederlingas žemes [Danish Experience in Afforesting Unproductive Lands]. *Mūsų girios*, 10: 3 (in Lithuanian).
- Lietuvos miškų statistika [Statistics of Lithuanian Forests]. 1998. Kaunas: Valstybinis miškotvarkos institutas, 71 p. (in Lithuanian).
- Lietuvos miškų valstybinė apskaita [National Record of Lithuanian Forests]. 2001. Kaunas: Valstybinis miškotvarkos institutas, 76 p. (in Lithuanian).
- Lukinas M.** 1968. Miško veisimo raida [Development of Forest Cultivation]. In: Lietuvos TSR miško ūkis. Vilnius: Mintis, p. 26-35 (in Lithuanian).
- Lukinas M.** 1984. Miško veisimas Lietuvoje iki pirmojo pasaulinio karo [Forest Cultivation in Lithuania Before World War I]. In: LMŪMTI darbai, 24: 169-179 (in Lithuanian).
- Pauliukevičius G.** 1997. Miškų reikšmė krašto ekologijai [The Role of Forests in Country Ecology]. In: Lietuvos mokslas. Vol. 5. Vilnius: Lietuvos mokslų akademija, p. 74-84 (in Lithuanian).
- Pauliukevičius G., Kenstavičius J.** 1995. Ekologiniai miškų teritorinio išsidėstymo pagrindai [Ecological Peculiarities of Territorial Spread of Forests]. Vilnius: Geografijos institutas, 289 p. (in Lithuanian).
- Phillips A.** 1995. Challenge of Restoring Europe's Nature and Landscapes. In: Nature Restoration in the European Union. Proceedings of Seminar. Denmark, p. 19-36.
- Riepšas E.** 2000. Experience and Problems of Reforestation in Lithuania. In: Integration Environmental Values into Lithuanian Forestry. Forestry Discussion Paper № 31 of Royal Veterinary and Agricultural University, p. 3-12.
- Tebėra A.** 2000. The Productivity of Stands Planted on Agricultural and Erosion Lands. In: Integration of Environmental Values into Lithuanian Forestry. Forestry discussion Paper No 31 of Royal Veterinary and Agricultural University, p. 29-35.