Genetic and Ecological Basis for Afforestation of Abandoned Agricultural Land in Lithuania

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Introduction

Overproduction in agriculture resulted in a surplus of abandoned agricultural land basically on a low fertility soils. Afforestation may be one of the best alternatives to benefit from the abandoned agricultural land. Afforestation would also decrease the risk of soil erosion, improve ecological conditions and bring profit from production of wood.

In central and western Europe, afforestation is the main solution for use of abandoned agricultural land. Even in such forest-rich countries as Sweden and Finland with woodedness reaching up to 60 %, increase of forest areas via afforestation of abandoned land is foreseen. In less forest-rich countries as Denmark, Great Britain, it is foreseen to increase forest area almost twice the current size mainly by afforesting the abandoned agricultural land.

According to the definitions given in "The National Programme for Utilisation of Abandoned Land on Low Fertility Soils" (from 1998) and the corresponding EU social and economical directives and programmes, as well as in "The Project for General Territorial Planning in the Republic of Lithuania" (from 2001), there are 652690 ha of abandoned land of low suitability for agriculture in Lithuania. Use of this land is stipulated by a number of national legal acts and documents. Afforestation of this land is given a high priority by the resolutions from a number of conferences and recommendations. The legal issues concerning afforestation of abandoned agricultural land are addressed in the Decision of the Government from 1998.04.9 "On Establishment of Forests on Private Land".

Of these 652690 ha of abandoned land of low suitability for agriculture, 163170 ha are suggested to maintain as temporarily reserved land and 489520 ha are suggested to afforest. According to the general territorial plan of Lithuania, it is foreseen to increase the country's woodedness by 6.5 to 8 %. However, it would be purposeful to increase the country's woodedness by 10 to 12 %.

Conditions which secure establishment of stable forests aimed at improvement of environmental conditions in a given area constitute the ecological basis for increase of the country's woodedness. Tree breeding and gene conservation aimed at improvement of certain values of forests serving for a given purpose constitute the genetic basis for increase of the country's woodedness.

The main principles of forest regeneration are laid down in the National Forest Law (from 2001), where the emphasis is given to establishment of forest by considering its ecological benefits and genetic quality. In practise, these principles may easily be forgotten, which may reduce stability, wood yield, quality of the future forests especially when afforesting abandoned agricultural land. In many countries, an emphasis is given to multi-purpose forest use based on sustainable and environmentally sound management. Efficiency of utilisation of abandoned agricultural land for forest production is connected with sound development of site-dependent ecosystems as well as social and economical conditions in certain regions. The priority may be set on the following values: sustainability of forest resources, conservation of biodiversity, improvement of ecological and protective properties of forests as well as improvement of social and economic forest values.

The objective of this paper is to discuss the basic ecological and genetic criteria to be considered when planning the type and species composition of forests on abandoned agricultural land.

Choice of the criteria and the associated discussion were based on our experience with afforestation of abandoned agricultural land, analysis of condition of abandoned land in certain regions, data from forest inventory, the principles of the evaluation method "Strength- Weakness-Opportunities-Threats" used in EU countries (identification of objectives and opportunities for development of territorial plans for entire region and specific areas within a region, possibility to increase forest area and legal basis for establishment of forest on private land).

Improved ecological values and economic benefit: tasks and means

Forests may improve ecological values and bring economic benefit. Ecological values assume the following: securing of sustainability of forest cover for maintenance and enrichment of biodiversity and improvement of environmental conditions. Economical benefit means production of wood for commercial purposes. It would be purposeful to plan the afforestation programmes towards a simultaneous improvement of ecological conditions in the region of interest and achievement of economic benefit from production of wood. To consider both ecological and economic criteria when afforesting the abandoned agricultural land the following tasks and means to implement them may be considered:

I. Establishment of stable forests of high wood yield and quality (genetic basis of afforestation). Stable forests may be interpreted as forests originating from material with sufficient degree of adaptedness to a given environment and with high gene diversity to stand possible environmental stresses under changing environment. Means to achieve this are the following:

1) Conservation and sustainable use of forest genetic resources to secure sustainable development of natural populations representing a given environment and to provide the planting material of sufficient genetic diversity,

2) Establishment and benefit from breeding programmes to rise the gain from the future forests (for species of low commercial value where an expensive breeding programme may not pay off, a network of phenotypically selected seed collection stands may be established),

3) Delineation of climatic zones and development of seed transfer guidelines to avoid losses in wood yield and quality owing to inappropriate transfer of provenances (seed transfer shall be based on the results of provenance tests),

4) Choice of natural versus artificial forest regeneration methods may equally depend on ecological factors in the area concerned and genetic quality and diversity of the parental stand. In case of natural regeneration, the seed trees shall be of appropriate quality.

5) A scheme for control of origin of forest reproductive material may be established,

II. Establishment of species-rich, sound forests to improve ecological values in the region of interest (ecological basis of afforestation). Means to achieve this may be the following:

1) Matching species to the site,

2) Establishment of forests with appropriate species composition and quality to fulfil the functions given,

3) Establishment of mixed forests with a diverse spatial structure,

4) Management towards a multi-aged stand structure,

5) Conservation of valuable biotopes and threatened tree species (especially those, which do not form forests),

6) Choice of tree species and origins which are tolerant to climatic fluctuations and environmental stresses,

7) Guidelines for seed transfer between climatic zones by aiming at preservation of autochthonous tree populations,

8) Restrictions on clear cuttings (to be set for species, site type, time, area),

9) Use of natural regeneration from good quality trees of a variety of species to improve the quality and diversity of the future forest,

10) Restrictions on use of heavy machinery which may damage soil structure; or use of the machinery when soil is frozen.

11) Ban on harmful to environment chemicals,

12) Optimisation of game populations depending on species composition and age of the forest and food resources available,

13) Maintenance of appropriate health condition of the forests by using biological means to control pest populations.

The following factors may be considered as indicators of biodiversity: the dynamics of area of natural and semi-natural forests as well as forest reserves, preservation of threatened species, changes in condition of gene conservation stands, scale of reforestation with indigenous and exotic species, establishment of mixed forest stands, relative proportions of artificially established and naturally regenerated forests.

Species genetic diversity being a component of biodiversity is an important contribution to adaptability and productivity of the new forests. Often biodiversity is considered at the species level only, while genetic diversity within a species being unnoticed. Namely, genetic diversity within a species is the basic prerequisite of sound and sustainable development of the species over time.

Choice of forest regeneration method

Often it is not easy to choose between natural and artificial forest establishment methods. The criteria according to which the choice of establishment method can be made may be subdivided into legally predetermined forest function in a given area, genetic and ecological, social and economical (Table 1). Legally predetermined forest function (e.g. a reserve, protective forest, recreational forests) may set specific requirements on forest establishment methods. Genetic and ecological criteria may be quality of the seed trees (note, that maintenance of sufficient genetic diversity of the parents (number of the seed trees) is of equal importance as the genetic gain), choice of suitable sites for natural regeneration and matching species to the site. Social and economical criteria mean consideration of human and market needs for forest resources from recreational and economical points of view. The main differences between ecological and commercial goals are given in Table 2.

Table 1. Factors influencing the choice of forest establishment method.

Forest function	Genetic and ecological	Social and economical
Strict reserves	Objective	Financial resources
Reserves	Genetic value	Rotation age
Eco-system preservation forests	Edaphic conditions	Production
Recreational forests	Biocenotic factors	Anthropogenic factors
Protective forests	Surrounding environment	Recreation
Areas given other specific function		

Table 2. Forest regeneration concepts.

Ecological	Plantation forests
1. Mixed stands	1. Target product
2. Tolerance of deciduas species	2. High quality wood
3. Preservation of vulnerable species	3. Pure plantations
4. Use of rare species	4. Several tree species
5. Restriction on clear cuts	5. Single-age stand structure
6. Multi-aged stand structure	6. Enhancement of wood yield
7. Long rotation	7. Short rotation
	8. Clear cuts
Breeding towards several values (tolerance, plasticity, quality)	Breeding towards high yield of good quality wood

Comments on strategy for utilization of abandoned agricultural land

Utilisation of abandoned agricultural land depends on agricultural, nature protection, social and economical policy of the country. In many cases, the main efforts are directed towards synchronising ecological needs with commercial benefits (Schroder 1992, Anonymous 1994). Increased species diversity, conservation and sustainable use of forest genetic resources as well as tree breeding aimed to increase adaptedness and commercial values may improve both ecological and economical values of the forests (Wolf 1994, Lenk 1994, Reutz et al. 1996, Weiser 1996). In addition to above mentioned goals, afforestation may aim at improvement of recreational values or establishment of short rotation plantation or energy forests (Anonymous 1997).

As regards ecological values, afforestation priority plans may target the following: areas damaged by erosion, belts along slopes, river valleys or ditches, abandoned shrub land and other abandoned agricultural land (primarily on low fertility soils). In Lithuania, the legal acts concerning afforestation (Decision No. 425 made by the Government from 1998.04.09) allow to establish forest on the following sites: agricultural land on sandy or gravel soils, open sites exposed to erosion, in abandoned agricultural land on soils with fertility score less than 27, when area

of the site is less than 1 ha, when open site is in-between forest stands or water pools.

The following criteria of forest territorial planning are important for ecological condition of the landscape: size of forest tracts, distance between forest tracts, perimeter of forest edges and shape of forest tracts. These criteria affect the size of areas under the influence of forest ecosystems (Pauliukevičius and Kenstavičius 1995). The larger the forest tract, the greater influence it possess on water and temperature regime of open or sparsely wooded areas (Pauliukevičius 1997). Average size of a forest tract in Lithuania is 109 ha. The smallest forest tracts were found in Skuodas district, the largest- in Varėna district (at district mean level). The longest district mean distances between forest tracts were assessed in Vilkaviškis district (1150 m), the shortest- in Varėna district (86 m) (Deltuva 1999). From the ecological point of view, there are no marked problems with territorial distribution of forest tracts in the country. Number, size and territorial distribution of small forest tracts affect ecological condition in the country as well. The area of small forest tracts (of size up to 25 ha) makes up 17.6% of the total forest area in the country. The spatial structure of small forest tracts may further be improved by afforesting the abandoned areas. There are 60300 very small forest tracts (up to 5 ha), average area of which is 2.5 ha (Pauliukevičius and Kenstavičius 1995). Though, according to the National Forest Law, forest tree groups of size greater than 0.1 ha may be considered as forest, groups of trees smaller than 0.1 ha are very important to the environment and habitat diversity.

78 % of the forest in Lithuania originate from natural or semi-natural regeneration and 22% were artificially established. This means high diversity in the country's forests if compared e.g. with Denmark or Great Britain where naturally regenerated forests constitute some 2% and 12%, respectively.

For private land owners, information shall be provided on alternative purposes of forest production by emphasising the importance of ecological and genetic factors.

References

Anonymous 1992. Konzeption zur verstärkten Aufforstung Landwirtchaftlicher Flächen. 1992. AFZ/der Wold, 22 : 1191-1195 (In German).

Anonymous 1997. Information für den Sächsischen Privatwaldbesitzer. Blatt 1. Erstaufforstung (In German).

Anonymous 2000. Lietuvos miškų statistika (Lithuanian forest statistics). Vilnius, 111 p. (In Lithuanian).

Anonymous 2001. Lietuvos miškų valstybinė apskaita (Lithuanian forest statistics). Kaunas, 76 p. (In Lithuanian).

Deltuva L. Lietuvos miškų teritorinio išdėstymo ypatumai (Territorial planning in Lithuania). Miškai ir aplinkotyra trečiojo tūkstantmečio išvakarėse. Kaunas, pp.109-116 (In Lithuanian).

Lenk H. 1994. Erfahrungen in der forstpraktischen Umsetzung züchterischen Forschungsergebnisse. Forstpflanzenzüchtung. Quo vadis?, 1 : 49-55 (In German).

Anonymous 1997. Lietuvos Respublikos Vyriausybės 1997.11.05 nutarimas Nr.1223 "Dėl miškų želdinimo žemdirbystei netinkamoje ir laisvos valstybinės žemės fondo žemėje". Decision No. 1223 made by The Government of Republic of Lithuania from 1997.11.05 "On afforestation of abandoned agricultural land and free state reserve land". Valstybės žinios 102: 122-128 (In Lithuanian).

Pauliukevičius G. 1997. Miškų reikšmė krašto ekologijai (Importance of forests to ecological conditions in the country). Lietuvos mokslas, 5 : 74-84 (In Lithuanian).

Pauliukevičius G. and Kenstavičius J. 1995. Ekologiniai miškų teritorinio išdėstymo pagrindai (Ecological basis for forest territorial planning) . Vilnius, Geografijos institutas, 289 p. (In Lithuanian).

Reutz W.F., Konnert M. and Beh A. 1996. Sind Waldschäden auch eine Frage der Herkunft. AFZ/der Wald, 14 : 759-761.

Schröder G. 1992. Der Niedersächsishe Ministerpresident Gerhard Schröder zum geleit. Langfristige ökologishe Waldentwieklung in der Landesforsten, 3 p.
Schwedens neue Forstpolitik. 1994.

Weiser F. 1996. Bestandesnchkommen-schaftsprüfung von Bergahorn. AFZ/der Wald, 14 : 774-777.

Wolf H. 1994. Künflige Aufgaben der Forstgenetik und Forstpflanzenzüchtung in Sachsen. Forstpflanzenzüchtung. Quo vadis?, 1 : 33-40.