

## Survey paper

# Principles of long-term sustainable forest development implemented as the background for ecological forest management

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### Abstract

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Forests are supposed to meet the requirements not only of the today developing society but also of next generations living a one or two hundred years after us. Being threatened by a range of harmful agents, including the global climate change, and providing manifold public benefits, the forests need global management driven in nature-close, ecological ways. The issues of long-term validity, permanency and ecological orientation of forest development can be successfully resolved only by consistent implementation of the following basic principles of forest management: principle of sustainable development, stabilisation, ecologisation, optimisation and economization.

### Keywords

ecological forest management, sustainable forest development,

### Introduction

In the recent days, little time and effort have been committed to deliberate the general trends in the Slovak forest management. The issue, however, is critically important in context of the present crisis. Are not the economic pressures pushing our forests towards the total crash? Where is the line allowable to recede? The assets are: our land, our nature, our health, our national wealth: The answer to these questions is to us, the foresters. We are responsible for our forests.

In the mid-eighteen century, only 6% of Slovak forest stands were older than 60 years that means suitable for some use, due to devastation by extensive mining and metallurgy. This state of art forced implementation of a system of long-term planning coping with the essential ecological rules driving the forest growth and development. Planning is a tool enabling to control

the management in such a way as to bring benefits for the owner and the society.

The primary factor of correct forest management is the law of long forest growth period. The life cycles of individual forest woody plants cover 200–500 years; in the biological-economic context, this period has been reduced to 100 years. The main task for forest management, implied by the long-term character of forest management process, is to guarantee permanent forest development in such a way as to guarantee fulfilling the main forest functions in accordance with the social needs also 100–200 years later. The requirements for long-term planning in forest management and final forest management plans directly follow from the fact that this system, applied in Slovak forests for the last 200 years, has survived two world wars, five revolutions and a spectre of political regimes. It is true, however,

that this planning was subjected to certain pressures under each serious transformation (AUTHORS' COLLECTIVE, 2006).

At present, the forest management begins intruded with alien, business-related "novelties" neglecting the limits set by ecological laws ruling the forest life. The independent national organisations performing long-term planning for the recent 100 years (recently the Lesoprojekt) have been transferred to private owners. Business aims are taking more and more priority: maximum profits (increasing allowable cuts), expenses limited to minimum (neglected protection, prevention, silviculture ...) and implementing the principle of short-term economic return (cuts shifted to lower age categories).

Among the social interests, the highest-rated have become the business and its paradigm – enhancing the competition success in achieving the maximum benefits. Nevertheless, the long-term forest growth and development are ecological affairs, not possible to comply with commercial-economic requests. It has been a hard labour to hamper the activities leading to the privatisation of national forests. These hidden interests can be averted only by the general public mention: "We will not disclaim our forests!" (KONÔPKA et al., 2010).

The private forests mostly did not allow formation of a genuine proprietary „family relation“. It was not possible due to the geo-strategic position of Slovakia. We always served as a "cordon sanitaire" between the West and East, and this role was connected with fatal combat losses. Today, the dominant is interest for wood harvesting as a source of income. The public benefits of forests are out of interest, as these cannot be expressed in money.

The most serious issue in meeting the requirements of long-term sustainable forest development is the total allowable cut. The long-term perspective seems reaching beyond the mental capacities of many persons. The forests have become over-burdened. The primary cause is natural disturbances and certain liberty due to implementing the concept of nature-close silviculture, more intensive tending included. The second reason is the delayed legislation, not reflecting the essential changes to the forest condition.

The efforts of Slovak forestry over the recent 50 years (despite stresses) have resulted in an especially favourable condition of Slovak forests today. The stands entering the regeneration phase, that means the phase of biological-commercial maturity, exceed the target arrangement. Most of cutting variables in the effective regulation do not regard the principle of sustainable production, as they neglect the fact that by 40 years, mature stands will be lacking and the allowable cuts will be strongly limited. There is an urgent need for updating the allowable cut indicators – to prevent excessive cuts today and steep decrease in allowable cuts in the future. The improvement measures are ready for use.

The best guaranty of objective planning of long and short-term forest development in forest management can be provided at the national level.

The society acknowledges forest management only in terms of wood production. The non-wood-producing forest functions are understood as automatic externalities. We agree that the role of wood production in Slovakia is very important, as wood is our most valuable raw material, produced, moreover, under especially favourable conditions. This material can be obtained with minimum costs, by applying large-size clear cuts, associated naturally, with negative effects and unsatisfactory serving the non-production functions. For the man, however, these functions have several times higher value than the wood production. To serve these function optimally, the forests must be managed intentionally for this purpose. They must create a sound natural environment, providing permanent protection against a range of harmful factors, damping flood waves, consolidating skidding areas, preventing soil erosion, guaranteeing equilibrium in the landscape, storing carbon, entrapping airborne pollutants, and similar. The urgent priority of these tasks is also evident from the program of ecological landscape revitalisation, lowering flood risks included. These roles can be only served by forests whose structure is not very diverse from the structure of natural forests: close-to-the-nature forest. This forest type, characterised with a high degree of biotic diversity, can only be attained by applying close-to-the-nature management, understood, at the present level of knowledge and management possibilities, as ecologically oriented forest management. This is the idea declared by the Slovak forestry since the beginning of forestry university studies in Slovakia (Forest Institute at the Mining Academy in Banská Štiavnica established in 1808). However, to manage forests in this way is a more complex task, demanding more efforts and higher costs (GREGUŠ, 2010).

The idea about covering all the costs necessary for a hundred-year protection and growing of forests and even about guaranteeing their non-wood-production functions (ecosystem services) with the money obtained for the harvested wood is a mistake. Unlike in the common business, the wood price is not created based on the costs required but determined by the free market according to the demands and supply. This trend is evident from Germany where the German Constitutional Court in 1990 ratified a decision declaring that the public and national forests have to serve environmental purposes and increasing wood production. Without the support the forest management is enjoying abroad, the forest management in Slovakia will finish in condition not possible to treat economically. Apart from this fact, endangered natural environment (also forests) starts to be a ethical problem also at the spiritual level.

Forest management in Slovakia should be redirected to ecological goals, not only for serving public-be-

nefit functions. The primary request follows from the literally catastrophic health condition of our forests. More than  $\frac{3}{4}$  cuts are forced due to harmful agents. A great share is to the global factors causing forest decomposition, disturbances in the management goals, problems in the aims, increasing demands on efforts and costs in the management context (MACHAVA et al., 2008).

Declaring that the forests have been well-equipped to manage these problems by themselves is erroneous, irresponsible and criminal. The present forests are the result of a two-hundred-year management, and they have not yet developed capacities necessary to cope with modern harmful factors.

The issue of long-term and sustainable forest development can be met appropriately only through meticulous applying of generally accepted basic principles of forest management, as in the past, these principles originated namely with the purpose to ensure positive forest development into the far future.

### **Basic principles of long-term and sustainable development of forests**

The basic principles are the leading concepts controlling in decisive extent the whole process of forest management; underlining, at the same time, primarily the future aspect. Our forestry, in concert with the central European knowledge, has derived these principles from the long-term historic experience approved with the new scientific knowledge. They address equally the public-benefit functions as well as the wood production aspect.

### **The principle of sustainable development**

The essential presupposition for sustainable forest development is long-perspective planning. This requirement is natural due to the very long period of forest growth, while the forest growth is ecologically complex and permanently endangered. The result of this planning – forest management plan provides guaranty for improvements and systemic orientation of forests towards the delineated aims. Forest management protects forests from implementing of short-perspective commercial interests which would represent danger for providing public benefits and lead to forest exploitation by cutting (BAVLŠÍK et al., 2010).

The short-term planning includes also monitoring (checking) of whether and to what extent the forest development and its management show a progress or a decline. It is a common interest of the whole society to control the sustainable development in this way in all forests in Slovakia, at least at ten-year intervals. A well-reasoned requirement is to ensure the continuity with the hitherto obtained developmental parameters.

The principle of sustainable development concerns all forest management activities. The require-

ments of the today generation must not be beyond the limits following from the justified demands of the next generations.

In accordance with the principle of sustainable development are all the measures supporting ecological laws ruling the forest dynamics, protective measures against harmful factors and the measures applied in ecological silviculture.

The principle of sustainable development requires a unique, forest management-specific of stand lay-out organisation system. All the stands (trees) determined for cutting must have their replaces, corresponding in quality and quantity. To meet this requirement is imperative for ensuring permanent, continual and well-balanced meeting of all forest functions, primarily the production (GREGUŠ, 1976).

The today Slovak forestry works with the system of ten-year age classes seeming the best-suited for most of our forests. The system of diameter classes defined in the selection system is too complex, not applicable in the common practice. For the future, the system of growth degrees (after adjustment) seems promising. It is necessary to approve the final definition of the naturalness degrees (hemerobia – similarity measure with natural forests), necessary first of all for the purpose-oriented management ways.

For the system of age classes in the understory management system and the system of diameter classes in the selection system, there have already been determined the target layouts obligatory to follow in regeneration cutting with the aim to ensure continuity in performing forest functions.

The system of age classes is recommend to follow as obligatory also in the future, at least in relation to the average stand age (considering the fact that forest stands are getting uniform in age in context of ecological management) until a new, consistent supplementary system of stands intended for cutting has been created.

### **The principle of stabilisation**

In the recent time, there has been a turn-over in forest management priorities due to effects of harmful factors. There arise urgent needs to remove the existing damage, extend protective measures and perform all interventions with focussing on strengthening the forest stability. On the edge of interest is improving the forest stands resistance against singular attacks by abiotic factors (especially wind and snow...). Apart from this static stability; there is highly required also ecological stability (homeostasis), ensuring stand resistance against influences by biotic factors and their capability to restore their original state. A special care is needed for the most serious bark beetle calamity. The just mentioned auto-regulation-oriented „doing nothing“ is indisputably contra-productive. The threatening climate change must not be neglected (KONŌPKA, 1999).

We may hope that the impaired forest stability would be handled with progressive and extensive implementation of ecological forest management concepts in accord with the principle of ecologisation. This process will require a long time.

### **The principle of ecologisation**

Ecologisation means permanently extended knowledge concerning natural mechanisms driving forest ecosystems, and meticulous implementation of these laws in forestry practice. There are necessary to promote, as much as possible, processes of self-regeneration (natural regeneration), self-control (self-thinning, self-regulated changes in tree social status, competitions ...) and self-dependence (resistance against attacks by harmful agents). There has been generally accepted that the more diverse natural biocoenoses manifest more resistance (exceptions are possible) that less diverse communities. Nature-close forests should manifest a high degree of biotic diversity: patchiness (approx. in size of regenerated segment), a mix of site-native and resistant species, diverse architecture and age. This idea depends on a range of technological, economic, organisation and other conditions it carried out (BUBLINEC, 2000).

This concept is in the best accord with the selection management system, in our „large-area“ practice, however, playing a role of an exception. More background for the ecological management implementation is provided in the understorey system. This system cannot be understood exclusively as a tool for obtaining regeneration and removal of parent stand, it also means improving quality of the upper stand layer, promoting increase in this layer and orientation towards ecological forest management (BUBLINEC and GREGOR, 2002).

Extraordinary complexity associated with implementation of ecological principles in management of forest ecosystems requires a many-year experience and knowledge concerning the local conditions. And continual stand-check is records. Very helpful would be model stands for monitoring the ecological responses to specific interventions. Naturally, such an effective systemic approach is not possible with shifting effective foresters here and there according to the results of the recent selections in the country (forest management separation from politics).

### **The principle of optimisation**

The principle of optimisation for providing public benefits and serving wood production functions is also a management purpose. The maximum obligate effect is possible to achieve only with especially high costs. The public interest is, however, serving function in an optimum way which can only be accomplished by appropriate management. But this is not easy, as at least 90% of the results obtained in forests are determined by the nature.

Optimum serving the public-benefit functions requires more complex approach (orientation on ecological forest growing, biotic diversity).

As for the production, appropriate management may ensure the natural maximum corresponding to the current forest state. It requires, however, focusing the overall concept of long-term planning and realisation in this way, regarding the rules governing increment creation. Woody plants have the highest increment creation rate at an age of 30–50 years, later, their growth decelerates. The final maximum production is obtained by timing the regeneration cuts in periods when the current increment creation is the same as the average of the former ones. This is the period of cutting maturity (well-known intercept of culmination of the total average and the total running increment in the value). After this point, each annual increase is lower than the average; so there occur increment losses. The forests switch from their role of wood producers to the role of goods for sale. This fact is the issue point for determining the cutting priorities. There is verified the axiom about the allowable cut equal to the increment created. There is an evident need for prohibition of cutting forests (trees) in stage of fast increment creation and maintaining stands in stage of slow increment creation (increment losses). The cutting itself should be implemented in accord with the generally used management approaches, taking in consideration also other principles.

The tending interventions regard the primary goals of stability, quality or increment creation set up based on considering the local conditions and requirements.

### **The principle of economization**

The saving principle is the generalised principle how to rule the management in such a way as to meet the established goals as precisely as possible, with maximum profits and minimum costs.

In accordance with the rules of the current general economy, forest management also should seek economic independence. However, as we have just mentioned, the public-profit functions of the forests are accessible free and the wood costs are not as high as to compensate the many-year investments into the whole silvicultural process. The basic idea is that the community has to acknowledge that the public-profit activities mean ecological services and as such, they deserve appropriate financial rewards. The national strategy should support the restoration of national wood industry meeting the needs of Slovak forests and producing final products with corresponding competition values.

We mention here the three expenses-saving ways characteristic for forest management:

- Minimum demands on human work – by using as many as possible self-controlling, self-restoring and self-protecting properties of forest ecosystems



- Preventive measures applied to protect against harmful factors effects
- Early elimination of pests in their initial stages.

### **Moral aspects in forestry**

The zeitgeist of the modern time with selfish demands for inappropriately high living standard makes all the wheels rushing downwards a self-destructive spiral of hedonistic consumption, without any respect for the genuine social well-being. A healthy, good-looking and rationally managed forest is indisputably a valuable social good. The management approach for such a forest cannot be backed up with the idea of financial profit but it should seek forest development proposals.

Forest management comprises coping with extensive forest complexes, difficult accessible areas, long lasting, almost impossible-to-cover growth processes, diverse natural conditions and extraordinary climatic turbulences. Despite the comprehensive management system is at disposal, the freedom in decision is considerable. This freedom will even increase if the directives of forest management lose their effectiveness in context of effects caused by harmful agents. These complex activities are very far from easy to control. Under these circumstances, many things depend on the personal qualities of individual foresters, their education level, experience, discipline and goodwill to act in accordance with general ethical rules and with ethical rules valid in forestry.

Forestry ethics is the personal conviction about correctness of acting for profit of positive forest development and the sense for responsibility to serve the duties required by the community and by the forest owner. The forestry ethics may be appreciated as the most powerful asset for permanent and sustainable forest development. Neither the existing legislation nor financial stimuli can serve for this purpose satisfactorily. Their frequent products are foresters as „shock-working plan compliers“. To act in accordance with forestry ethics is not an easy matter. Forestry operations are heading many difficulties under conditions very far from optimum. We may only suppose that the major part of foresters has a good-will to use each possibility for implementing the forestry ethical rules as these people had decided for their forestry study motivated by their love for forests and by their will to devote to this love all their professional life. Such a motivation is essential. Personal conviction is an extraordinary effective tool, overcoming really big barriers. Let's enjoy our work in forests, let's enjoy the results achieved in forest stands.

Despite that the forestry ethics is a long-used and generally recognised term, its rules have not been worded exactly yet. That is why we would like to propose here a possible wording. Naturally, agreement will be needed in more detail. This design is only an incentive.

We propose to define these principles in wording of accepted basic principles of long-term sustainable development of forests. As these ideas are oriented to forest improvement, it should be correct to acknowledge them as ethical standards.

*The principle of sustainable development* indisputably requires cyclic long-term planning, ensuring forest development for the future. The final management plan needs to be prepared in cooperation with the local manager responsible for its implementation.

Permanent performing all the forest functions will be ensured by designing and implementation of a special system of spatial arrangement (lay-out) in which the stands (trees) intended for cutting will have their standby parallels in all age classes.

Interventions in forest stands are carried out in compliance with principles of forest development sustainability then and only then they regard forest protection or seek a close-to-nature forest.

*The principle of forest stabilisation* requires permanent monitoring of health condition of forest stands and occurrence of pests in these stands. No delay is allowed for applying protective measures against pests and negative agents or for damage restoration.

This principle requires permanent and multifaceted improvement of forest stability (resistance) and preventive measures against effects of harmful agents. The backing-up idea for ensuring forest stability is the requirement for forest management oriented on ecological aspects.

*The principles of ecologisation* mean acting in concert with the perfect nature's innate autoregulation processes ruling forest ecosystems – the processes we have already got familiar with. Promotion of biotic diversity has a significant role. Gathering experience from the given locality is a necessary prerequisite for assisting in the natural development of young and medium-old forest growth phases; in implementing principles of natural forest regeneration and in lifelong resistance against harmful agents.

Ecologisation is taken in concern especially in understorey cutting, exceptionally in selection cutting. Needed to mention is also permanent upgrading of one's knowledge level (self-education).

*The principle of optimisation* of public-profit functions is best-complied with the selection cutting method. In most stands, however, one must manage with understorey methods, especially if small-area shelterwood regeneration is in question.

Optimum and, naturally, maximum production can be achieved by literal implementing the rules for appropriate using the regularities in increment creation in tended and in naturally regenerated forest stands. In regeneration process, the cutting intensity is primarily controlled by requirements for natural regeneration; it is necessary, however, to increase the cutting intensity with increasing cutting maturity. Stands at high matu-

rity degrees need is reconstruction by artificial regeneration.

Allowable cuts must be derived in such a way as not to decrease the forest increment creation rate and not to exceed the cut reserves. Cuts beyond allowable amounts mean serious violation of principles of optimisation and permanent production.

To observe *the principle of economization* is a self-evident and generally valid obligation in area of public benefits equally as in area of wood production. In forest management, the highest priority is not to revenues but to meeting the tasks set for forest development. Maximum gains under minimum costs are only of secondary importance under compliance with these tasks.

A specific feature of forest management associated with economization is the effort to reduce the share of human work by using auto-regulation properties of forest ecosystems.

It is evident that forestry ethics is in accordance with the responsibility to act with provisions of Law, to respect the principles of the Ethical Codex of Forests of the Slovak Republic, S.E., as well as to maintain the laws the Lord gave to the mankind almost thousand years ago – the commandments of Decalogue.

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## References

- AUTHORS' COLLECTIVE. 2006. *Slovenská lesnícka doktrína* [Slovak forestry doctrine]. Nitra: Slovenská akadémia pôdohospodárskych vied; Zvolen: Národné lesnícke centrum. 6 p.
- BAVLŠÍK, J., KUČERA, K., RUMAN, K. 2010. *Hospodárskoúpravnícke plánovanie a trvalo udržateľné hospodárenie v lesoch* [Forest regulation planning and sustainable management of forests]. Zvolen: Národné lesnícke centrum. 128 p.
- BUBLINEC, E. 2000. Minulosť, prítomnosť a budúcnosť lesných pôd Slovenska [Past, present and future of forest soils in Slovakia]. In AUTHORS' COLLECTIVE. *Pedofórum*. Bratislava: Výskumný ústav pôdoznateľstva a ochrany pôdy, p. 52–64.
- BUBLINEC, E., GREGOR, J. 2002. Lesné pôdy a ich funkcie [Forest soils and their functions.] In *Prvé pôdoznateľské dni v SR. Vedecká konferencia pôdoznateľcov Slovenska s medzinárodnou účasťou. Račková dolina, Vysoké Tatry, 17.–19. 6. 2002*. Bratislava: Výskumný ústav pôdoznateľstva a ochrany pôdy, p. 284–290.
- GREGUŠ, C. 1976. *Hospodárska úprava maloplošného rúbaňového lesa* [Regulation forest management of small-area clear-cuts]. Bratislava: Príroda. 306 p.
- GREGUŠ, C. 2010. *Dlhodobý a trvalý rozvoj slovenských lesov* [Long-term sustainable development of Slovak forests]. Lesmedium SK. 30 p., (Suppl. to the journal *Les a letokruhy*, No. 11–12).
- KONÔPKA, J. 1999. *Grafikony statickej stability smrekových porastov na Slovensku* [Static stability charts of spruce forest stands in Slovakia.] Odborná lesnícka štúdia č. 1. Zvolen: Lesnícky výskumný ústav. 22 p.
- KONÔPKA, J., KOVALČÍK, M., MORAVČÍK, M. 2010. *Krízový manažment v lesnom hospodárstve* [Crisis management in forestry]. Zvolen: Národné lesnícke centrum. 74 p.
- MACHAVA, J., BUBLINEC, E., GREGOR, J. 2008. Predchádzajúci imisný tlak na smrekové ekosystémy v LS Hrable a LHC Nálepko a možnosti ich regulácie [Late stress by airborne pollutants acting on spruce ecosystems in FE Hrable and FMU Nálepko and possibilities how to control this stress]. *Phytopedon*, 7: 249–256.
- Program ekologickej revitalizácie krajiny – vládne nariadenie č. 744/2010* [Programme of ecological revitalisation of landscape – Regulation of the Government SR No. 744/2010].

## Uplatňovanie zásad dlhodobého a trvalého rozvoja lesov ako základ ich ekologického obhospodarovania

### Súhrn

Lesné hospodárstvo nemožno riadiť podľa zásad krátkodobej ekonomiky (zvyšovanie výnosov, úspora nákladov, skracovanie návratnosti). Cieľom obhospodarovania lesov musí byť ich zveľaďovanie a nie zisk. Veď les je naša krajina, naša príroda, naše zdravie a naše národné bohatstvo. Musí sa riadiť zásadami dlhodobosti, lebo jeho úlohou je zabezpečiť, aby lesy plnili všetky potreby rozvíjajúcej sa spoločnosti aj o 100 či 200 rokov.

Ohrozenie našich lesov radom škodlivých činiteľov, vrátane globálnych klimatických zmien a úloha poskytovať veľavýznamné verejnoprospešné funkcie si vynucujú smerovať celé obhospodarovanie lesov na prírode blízke, teda ekologické hospodárenie.

Nastolenú problematiku dlhodobosti, trvalosti a ekologickej orientácie rozvoja lesov možno správne riešiť len dôsledným uplatňovaním základných princípov lesného hospodárstva. Tieto princípy sú vedúcimi koncepciami, ktoré rozhodujúcim spôsobom usmerňujú celý proces obhospodarovania lesov. Konkrétne tvoria tento systém princípov:

- a) *Princíp trvalosti (trvalej udržateľnosti) rozvoja* si vynucuje, vzhľadom na dlhodobosť lesa a lesného hospodárstva, aj dlhodobosť plánovania. Kľúčovou podmienkou jeho fungovania, v podrastovom ekológii blízkom hospodárskom spôsobe, je vytvorenie špecifickej sústavy usporiadania porastov. Za všetky porasty určené na ťažbu musia byť v rastovom rade k dispozícii vhodné náhradné porasty. Vo výberkovom spôsobe je náhradnosť viazaná na hrúbku stromov.
- b) *Princíp stabilizácie* vyžaduje prednostne sa sústrediť na posilňovanie odolnosti lesov, realizovať preventívne opatrenia a odstraňovať vzniknuté škody.
- c) *Princíp ekologizácie* je založený na prehlbovaní poznávania prírodných zákonitostí v lesných ekosystémoch a ich maximálne možnom uplatňovaní v lesníckej praxi.
- d) *Princíp optimalizácie* verejnoprospešných funkcií a produkcie je aj účelom hospodárenia. Optimálna produkcia (prírodné maximum) sa dosiahne ťažbou orientovanou podľa zákonitosti prírastku. Intenzita ťažby musí stúpať so zvyšujúcim sa stupňom rubnej zrelosti, teda v súlade s narastajúcimi prírastkovými stratami.
- e) *Princíp hospodárnosti* je zásada riadiť hospodárenie tak, aby sa zámary stanovených úloh splnili čo najdôkladnejšie, pritom podľa možnosti s maximálnym prínosom a pri minimálnych nákladoch.

Práca vyúsťuje do návrhu textácie zásad lesníckej morálky.

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