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VERIFICATION OF THE PRINCIPLES OF ACCOUNTING FOR THE SIZE OF THE ALLOWABLE FELLINGS IN FOREST MANAGEMENT PLANNING

The timber market in Poland is dominated by raw materials from the State Forests that conduct planned and sustainable forest management based on forest management plans. Previous rules regulating the planning of final felling are mainly based on the maturity of stands expressed in dominant tree species age and on categories of protection. Attention is paid to the shortage of raw timber material compared to demand and the processing capacity of the industry. There is a danger that unevenness in timber supplies could occur because of the age structure of the forests in the coming decades. Due to the unfavourable age structure of forests in Poland, a not fully satisfactory condition of the resources as well as the high demand for timber in Poland, there is a need for increased usage and regeneration the forests. The amount of harvested timber should be a compromise of silvicultural, protective and productive purposes with the local role of forestry as a stimulator of economic development. Implementation of forest management should take into account the continuity and the relative uniformity of timber supplies in the long term (e.g. fifty years), and a quantitative and qualitative improvement in resources. This requires effective forecasting of forestry resources. The paper presents a methodology for classification of forest stands for felling and the concept of a reassessment of existing accounting rules for the size of the fellings used in the practice of forest management and any related necessary amendments to legal provisions

Keywords: forest management in Poland, planning of allowable fellings size

Introduction

The current situation

Throughout history the forest was and remains of great interest to mankind. Perceptions about the multi-functionality of the forests have changed over the

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centuries in accordance with new priorities. The delivery of timber material was the main function of forests in the days of dynamic industrial development. Currently it is expected that forestry will fulfil its productive function as well as its ecological, protective and social functions. The growth of the range and the changes in the ranking of the forestry tasks bring an inevitable conflict of interest. Different ideas about range and intensity of the utilisation of forest resources are the basis of these conflicts. This is because of how ecology and economy are understood in relation to the function of the forest and the factor of time. Society's increased interest in the protection of nature, the forest environment and its aesthetic beauty has ensured that this subject is widely discussed by forest users. The conducting of a balanced forest economy requires the readiness to compromises and the integration of the positions, of all parties interested in the particular services of the forests. These circumstances conclude that the implementation of these assumptions does not depend only on foresters. The concept of a balanced and sustainable development of forestry should be respected in all areas of the economy and by society as a whole.

In this context the significance of the interdisciplinary approach of the forest management planning process increases [Stępień 1995; Bachmann et al. 2002; Luescher et al. 2005; Przybylska 2005b; Sheppard and Meitner 2005]. This process becomes more complex and requires the co-operation between experts from various fields. The representatives of, among others, the timber industry, agriculture, urbanisation, transport, water management, health care, nature preservation, hunting, tourism and recreation, they all usually act in their own interests with regards to the range and the intensity of utilisation of the forest and its resources. This relates to a need to appease the conflicts arising from the determination of the range of the tasks, and the means of their implementation. This correlates to the conduct of the forest economy, relating especially to the intensity of the use of the forests and the widely understood expectations and limitations concerning nature preservation. [Szujewski 2010; Olaczek 2014a, b]. The role of forest management, therefore, in the planning of temporal and spatial organisation of the forests is increased. Current expectations relating to the multi-functionality of the forests, the flexibility and choice of planning are obligatory in forest management [Miś 2004; Poznański 2004].

It should, however, be noted that good plans and programs do not constitute a guarantee of success. There exists a need for change in the way foresters think, acknowledging the need for self-criticism, curiosity and a lack of prejudice. Such undertakings should contribute to the attainment and enforcement of a suitable synchronisation in the realisation of works in the range of forest management and the protection of forest resources. It is also important to retain the feeling of responsibility for the future and the recognition that the forests are not only objects of management but also permanent fixtures of the landscape.

Premise of the verification of the principles of accounting for the size of the fellings

The increase of the involvement of the forests fulfilling a non-productive function, especially the protective ones, will limit the usage intensity and will reduce the significance of the clear cutting system of management, thus enhancing the complex and modified cutting systems (e.g. the increase in surface of actually regenerating stands, called KO-KDO classes participate in the woods – fig. 1).

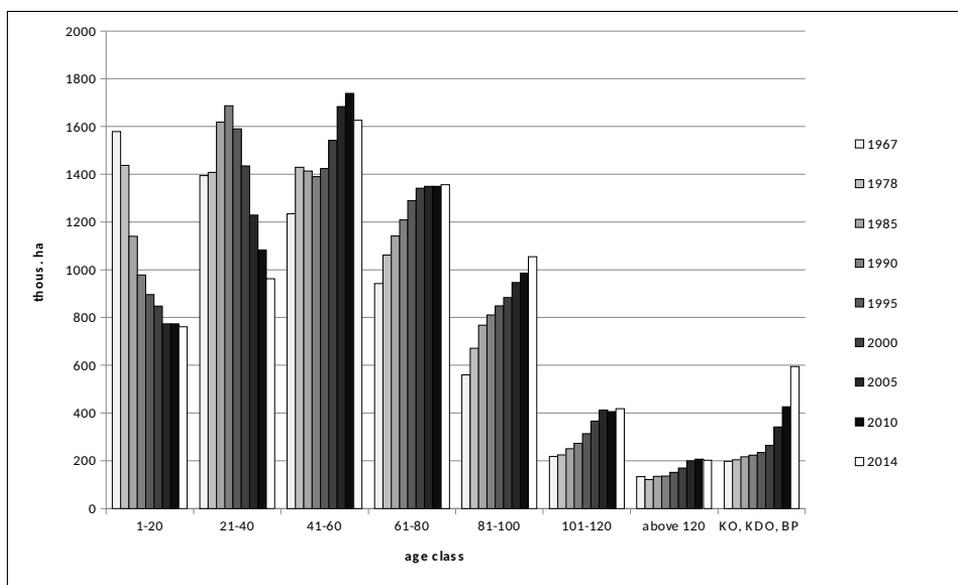


Fig. 1. Change of the forest stand age structure in State Forests between year 1967 and 2014

This will result in the need to consider new conditions relating to the silvicultural and management planning. The need for certain re-evaluation in this instance results from the three following facts.

1 – Unfavourable from an economic point of view, especially in relation to the possible maintenance of the relative constancy of the supply of raw timber material in the future, is the age structure of the Polish forests (fig. 1).

According to data supplied by the Bureau for Forest Management and Forest Geodesy [GDSF 2015] this structure from 1967-2014 showed approximately a twofold drop in participation of the youngest stands (1-20 years old), manifested by the shortage of age class II stands (21-40 years old) and the tendency of an increase in the proportion of 41-100 year old stands.

2 – The unsatisfactory condition of forest resources in many parts of the country. There are a number of factors, which support this opinion: the mismatch of the species composition with the site (continually still large area coverage

with pine and spruce monocultures), low nursery and technical quality as well as the bad health condition of many forest stands, incomplete utilisation of the productive area due to low stocking and reforestation of the stands, the disorder in the forest spatial order, including large total areas of stands with little diversity of age and composition.

Circumstances resulting from the first two facts indicate the urgent need to increase the intensity of the utilisation and regeneration of the forests, while the extent of the utilisation should not be treated as the main purpose, but as a tool of the implementation of the strategic objectives of management. Thus, the quantity of felled raw material is not merely an internal issue of forestry management itself. It should be the result of compromises concerning the principles of forest management that take into consideration silvicultural, conservation and productive objectives, as well as the widely understood role of forestry as a stimulus of the economic growth of our country and its regions. The economic effects of such implementations of usage will result in better supplies of raw timber material to the market. The outcomes of the nature preservation character should allow increases in the diversity of the species as well as the improvement of the age structure of the forest stands, their stability and health condition.

3 – Lastly, the great demand for wood in Poland, and also the expected growth of demand for this material in the future [Ratajczak 2013]. This fact concerns, both, the usable timber, as well as the wood used as an energy source. The change in the concept in the field of regulations concerning the extent of forest utilisation, should satisfy growing demand. The new concept relating to utilisation is based on the conviction that the existence of real premises justifies the possibility of periodical enlargement of forest utilisation integrated with the improvement of the condition of resources.

The possibility of shaping the relationship between the forest functions and timber supply

In the declaration of the third Pan-European Ministerial Conference on the Protection of Forests in Europe, it states that “the task of European forestry sector in the XXI century will be the optimisation of its contribution in the forms of the social, economic, environmental and cultural functions of forests in the on-going development of society” [Klocek 2001]. The declaration is very general in its character and it needs to be more specific regarding which of the functions and at what level they should be implemented, considering the priorities resulting from the expectations of society. Making a judgment and choosing which of these functions from the social, natural, and technical-economical point of view should be the priority, is a complex task and requires the observance of the requirements of balanced forest management [Kurtilla 2001; Szujewski 2002; Przybylska 2005a; Przybylska and Zięba 2009; Zięba 2012].

The advancement of balanced forest management is determined by internal and external conditions. In the first instance, the difficulty of credible assessment of the influence of the current economic decisions on the future forest development is evident, especially in the context of increasing limitations in the intensity of forest management. The consequences of an external character, result from a dynamically increasing influence originating from the surroundings that render the change prognosis difficult. The doubts concerning the possibilities of implementing the concept of a balanced development of forestry are also a concern, the financial consequences of which have yet to be fully recognised. These undoubtedly, will be caused by the increase in demand for non-productive and protective functions of the forests, especially in the areas under the protective care of Natura 2000 [Olaczek 2014a].

The current understanding of the matter relating to the usage of natural resources should be based on present realities. In a situation where natural resources diminish while the human population grows, increasing the expectations, which are only achievable by the responsible use of such resources by man. This calls for the moderation of the usage of large forested areas. Rational usage of forests, therefore, seals the guarantee of the retention of the versatile character of the forests ecosystem. Mankind has the right to satisfy its material and non-material needs, but not at the expense of nature [Benedict XVI 2009]. This approach is a warrant for the economic and civil development of society. For mankind is a part of nature and should, for its own welfare, manage natural assets rationally not provoking a conflict of objectives arising from economic and protective grounds. The formulation of a strategy of forest usage that fulfils the requirements of the supply of timber requires acknowledgment of historic assumptions relating to the way of conducting forest management and the consequences thereof. For many decades man has influenced the forests which, often, contributed to negative changes to the internal structure of stands (species composition, age) and the disturbances of the spatial build of forest complexes. Such changes, to a considerable degree, were caused by the afforestation of large areas after the Second World War. This fact significantly determines the shaping of the present possibilities and exerts an influence on the form and intensity of the acquisition of usable land. In such situations the specifics of forestry demand monitoring of changes and predicting threats in order to limit economic risk and its consequences in the context of retaining the relative stability in the field of timber supply in the long term.

Controlling the timber supply is a complex problem and should result from the multi-topic analyses (at national level) as well as specifying conditions taken into consideration at the stage of formation of regional forest management plans relating to the felling regulation. Two ideologically different concepts concerning the issue of the regulation are feasible [Borecki and Stępień 2012]. The essence of the first concept is the preference given to the "forest way" principle. It signifies the acceptance of the extent of utilisation resulting from

present realities (age structure, state of resources). One may expect that the realisation of this concept will duplicate the present age structure and that it will not ensure the equableness of the usage. Neither will it cause the desirable acceleration of the improvement of the state of resources. The disadvantage of this concept is also the fact that it does not take into account the regional diversification in the encumbrance of non-productive functions which, in turn, does not influence the satisfaction of conflicting functions fulfilled by forests.

The second concept prefers the desirable direction of the development of resources (among others: age and species structure, the condition of the supply, vertical structure, increment) through assignation of the suitable size of the forest utilisation. The essence of this concept is the observance of the relative balance between the utilisation and the improvement of the state of resources simultaneously. Such a task requires the formulation of a prognosis and recommendations concerning the size of felling on a long term scale, i.e. fifty years, with regard to the extent of utilisation and the expectations concerning the minimisation of the contradictions between the principles of equableness and intensification should be fulfilled. The realisation of the postulate of equableness, mainly understood as the improvement of age structure and the state of resources, requires the establishment of the average size of felling yield ($U_{avr.}$) on the basis of the size prognosis ($U_{pr.}$) for the set timescale of prognosis and divergence between the average size and prognoses for individual management periods. The average yield of felling for a given time scale of the prognosis may be found with the use of the following equation:

$$U_{avr.} = \frac{U_{pr.1} + U_{pr.2} + U_{pr.3} + \dots + U_{pr.i}}{n} \quad (1)$$

where: $U_{avr.}$ – average felling yield,
 $U_{pr.1, 2, 3, i}$ – size of cutting prognosis for individual periods,
 $1, 2, 3, \dots, i$ – index of periods of a given time scale of prognosis,
 n – the number of management periods of prognosis.

The divergence between the average and forecast size of felling (R_i) enumerated for individual management periods ($1, 2, 3, \dots, i$) of the given time scale of prognosis may be defined with the use of the following equation:

$$R_i = U_{avr.} - U_{pr.i} \quad (2)$$

where: i – index as per previous equation 1, 2.

The positive sign of the found divergence, that is, if the average yield is larger than prognosis it means that, for the observance of relative equability of felling, there exists a possibility of increase of the utilisation in that period. The negative value, however, points to the supremacy of the prognosis size over the average, which shows the possibility of decrease in felling. The size of increase or decrease of the utilisation depends on a given time scale of prognosis. This

creates the possibility of variant planning of the realisation of the principles of equableness and intensification, as well as flexibility of adjustment to the changes of the situation of the timber market.

In each instance it is necessary to define the principles of determined divergences within the earlier usage (conversion) of the younger stands, as well as selecting the suitable quantity of stands destined for the extension of the time they are retained on the stock. The realisation of the introduced concept requires the formulation of the principles of the detailed classification of stands demonstrative of need and the diligence of interference, as well as the definition of criteria justifying longer retention of some stands. The simultaneous combination of both methods of the conduct for the needs of balancing the divergence may be allowed.

The burden of non-productive functions, especially limitations resulting from protective functions, does influence the intensity of the utilisation [Szujewski 2010; Olaczek 2014a]. It is necessary, therefore, to recognise the regional differentiation of the burden associated with these functions. This should become possible through a methodically uniform system of evaluation and classification of the forest stands within a given managerial-planning body. It therefore indicates the need for the formulation of the principles of forest stand classification that will encompass individual categories of preservation as well as the location of the Nature 2000 areas (the necessity of their “assignment” to forest unit addresses). This should facilitate the development of regional forest management strategies [Szujewski 2002; Zięba 2012; Gieburowski and Janas 2013].

Materials and methods

This research is conceptual in nature. It was based on an analysis of existing legislation and instructions regulating the use of forests in Poland. In analyses, the proposed solutions were tested for their use in the forecast state timber resources based on data from the State Forests IT System (as in 2010), and of large-scale National Forest Inventory (for about 20% of all forests, mostly private, that are not covered by these updated IT systems). The State Forests IT System is the best source of regularly updated information about every forest stand in State Forests in Poland.

Results and discussion

Verification of the principles of accounting for the size of cuttings: current practices

The decisions concerning the methods, timing and intensity of conducted fellings do cause long term effects, thus influencing the age and species structure of the forest, as well as the dynamics of the change in resources [Rosa and Smykała 1985; Borecki et al. 2012]. The main utilisation, especially in the forest stands of clear felling units, is strictly connected with the harvesting of the mature crop. In this instance the principles of defining the size of main utilisation are dependent on the maturity criteria [GDSF 2012]. The problem of monitoring becomes more complex in the case of intermediate felling and is connected with the implementation of nurture fellings in younger stands. The size of intermediate utilisation results from subjective assessment of the silvicultural needs defined at the stage of forest stands inspection during the evaluation of the forest. The actual size of intermediate fellings is known only at the time of the execution of these interventions. Hence, the merchantable volume of those fellings has only a general significance and is treated as a prognosis. This size would lose such nature at the moment when, together with the main allowable felled volume it became a component of complete allowable felling cut.

In the Forestry Act and in the decision that sanctions the forests' management plans the total allowable cut, that is final and intermediate, was seen as the maximum volume of timber estimated for felling over a ten year time period [GDSF 2012]. This meant, that in the case of greater than planned intermediate utilisation (through natural causes), the need for compensation arose, that is, a reduction of planned final utilisation.

Independent of environmental consequences of such conduct – this relates particularly to the units under the shelterwood management system – withholding the implementation of planned positions of the final utilisation considerably disturbed the relationships between the intensity of the process of aging and the process of the felling of stands, as well as the possibility of formation of the desirable age structure of stands. Despite the general acceptance of the need for verification of the method of accounting for the total allowable cut, in the premise of the legal draft to change the Forestry Act (draft dated 14 of August 2013) one may find an entry that does not solve the problem in a satisfactory manner. This entry foresees that the total amount of timber felling yield will be defined in the forest management plan as the final allowable cut expressed in volume and intermediate felling size expressed in area [Forestry Act as stated in 2014].

The incidental removals will not increase the implementation of merchantable volume allowable cut. The above mentioned entry is not entirely clear and requires corrections in the matters relating to area based approach to

the intermediate felling as well as the method of accounting for incidental removals. For the needs of managerial planning this matter is regulated by the entries in the General Director of the State Forests Instruction number thirty that treats the allowable volume of final cuts as “the maximum volume of felling in the duration of the forest management plan”, while the allowable volume of intermediate cuts is determined as “the minimal obligatory area of the intermediate cuts estimated for execution in the duration of the forest management plan and expressed in cubic metres”. There is a noteworthy entry concerning the need for separate accounting for the realisation of both allowable cut volumes “without the possibility of volume compensation” and also allowance for the possibility of exceeding the sizes of intermediate cut usage with regards to the appearance of natural disasters in the forest.

The realisation of forest utilisation during the period between 1984 and 2003 demonstrated [GDSF 2006] that the final allowable cut volume was fulfilled in approximately 86%, while in the intermediate cut - it was approximately 127% (tab. 1). The differences found between the planned and carried out amounts over such a long time period certainly had a negative effect at a national level, as well as at the level of individual units. So far the employed method of defining the allowable volumes of intermediate cut usage did not fulfil expectations.

Table 1. Planned and carried out amounts of timber harvest in State Forests during 1984-2003 period (in thousands m³ of net merchantable volume)

Years	Final cut allowable volume	Intermediate allowable volume	Sum	Carried out final cuts	Percentage of volume	Carried out intermediate cuts	Percentage of volume
1984-1988	9990	7588	17578	8600	86,1	12878	169,7
1989-1993	9297	8034	17331	8198	88,2	9440	117,5
1994-1998	9837	10203	20040	7653	77,8	11773	115,4
1999-2003	10850	12446	23296	9965	91,8	14632	117,6
Average	9994	9568	19561	8601	86,1	12181	127,3

The main cause of the large divergences among planned and performed values in the realisation of intermediate usage appears to be the current definition of the incidental usage. According to the last forest management instructions [GDSF 2003, 2012], the incidental usage is credited to the intermediate or final cut usage. These cuts relate to the removal of, dying trees (deadwood), windthrows and windsnaps. The necessity of logging in the context of these cuts is regionally diverse and occurs virtually every year [Orzechowski and Wójcik 2014]. The participation of incidental cuts in yearly allowable usage volume in State Forests in the years 1990-2009 is illustrated in figure 2. These cuts apply to the removal of, among others, suppressed (dead) trees, broken and wind thrown trees. In the years between 1990 and 2009 the necessity of timber harvesting within those cuts arose every year showing a considerable quantitative differentiation. This participation varies in ranges of between

approximately 15% (in the years 1998, 1999) to approx. 40-45% (in the years 1993, 2002). It is noted that, in order to maintain good health and the sanitary condition of the forest, execution of these cuts should be regarded as a priority.

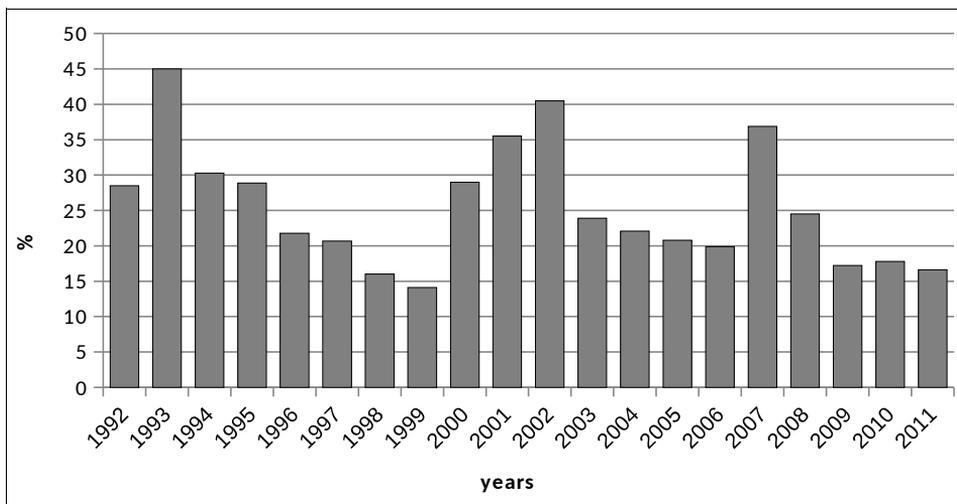


Fig. 2. The participation of the accidental cuts in yearly allowable usage volume in State Forests during years 1990 to 2011 (GDSF 2012)

More often than not, it is interpreted that all incidental usage carried out, outside the areas planned for the final cuts is treated as intermediate usage. Defining the incidental usage in this way originates from the forest management instruction [MLiPD 1957], where the incidental usage is treated as timber utilisation that results as a consequence of sanitary cuts conducted singly or en masse and should not result in the necessity to regenerate.

The definition of the incidental usage was rather different in earlier publications. Jedliński [as per Hausbrandt 1922] claimed that incidental usage includes all un-foreseen uses that occur as an after-effect of circumstances beyond ones control (windthrows, windsnaps, trees damaged by snow). The regulation of the intermediate cut should, therefore, take into account the fact of random occurrences and enable such planning, so that the negative after-effects of the forces of nature in one stand do not necessitate the change in the conduct of the others. The inclusion of the incidental removals of the intermediate or final cut usage and exchangeable compensation of these values brings negative effects to the entire forest unit.

The intermediate cut usage has two functions: the silvicultural and the sanitary, hence, it necessarily follows that, in the intermediate cut usage, one may distinguish two types of cuts: silvicultural and incidental. Rutkowski [1988] defined incidental cuts as an elimination of the sick, dying and dead trees, meanwhile the intensity of these cuts depended on the sanitary condition of the forest stands. He also claimed, that if one wishes to harvest the crop from the

forest (final cut usage) then, the surplus of increment over the size of this usage must be present, originating from the intermediate cuts as well as from the incidental cuts. The entire size must be subject to regulation. The lack of common features between the intermediate and incidental cuts demands that one must not treat them together, instead they should be perceived as two independent types of utilisation

The conditions of accounting of the allowable usage volume in the forest management plan - legal premises

The changes to the existing legal entry relating to the definition of the total allowable volume cut (E_c) and the interpretation of the components of this volume are necessary. The proposal for the calculation of the total allowable volume cut is calculated with the use of the following equation:

$$E_c = E_{UR} + E_{UPR} + U_{PRZ} \quad (3)$$

where: E_{UR} – set for realisation of optimum final allowable volume cut that constitutes the maximum value and may not be exceeded in the given economic period,

E_{UPR} – estimated allowable volume of intermediate cut determined on the basis of State Forests Information System (SILP) data concerning the utilisation carried out in the previous period (without the incidental removals); the proposed calculation of the volume size of this usage with the use of the following equation:

$$E_{UOR(V)} = \sum E_{UOR(P)} \times W_{i \text{ UPR}} \quad (4)$$

where: $E_{UPR(P)}$ – the obligatory allowable intermediate cut area set in the management planning works for individual age sub-classes (ha),

$W_{i \text{ UPR}}$ – the ratio of the intensity of the intermediate usage calculated for individual age sub-classes based on the SILP data concerning executed removals (m^3/ha); taking into account the method of calculating this particular usage, at the stage of its realisation there may be divergences between obligatory allowable volume and the actual size of the usage that should, however, not exceed 75% of the expected increase of the group of forest stands destined for intermediate cuts,

U_{PRZ} – the incidental removals estimated based on data from SILP from the previous management period; if the size of those cuts did not cause the necessity of preparing an appendix; this usage concerns only the volume of the removals that could not be covered under the intermediate usage. In the realization of the plan, the incidental usage may be exceeded in relation to the amount set in the total allowable volume, but by no more than 20% of the total allowable volume that constituted the necessity of preparing the appendix.

The actual size of the utilisation in the management period in individual forest districts as well as in relation to the set allowable volume cut may be larger or smaller. It should be noted, however, that the total allowable volume cut for the regional directorate of State Forests (being the sum of allowable volumes of individual forest districts) has remained an approximation to the realised size of the utilisation.

Accepting the proposed concept of integration of the principle of the equability of usage and the improvement of the condition of resources, the limited size of the usage for State Forests should be the average size of the main utilisation calculated every year for the period of prognosis set in the strategy of SF.

Conclusions

To solve the problems of the age structure of forests in Poland, changes are required in the rules of planning the allowable cuttings size. At the stage of creation of the forest management plan the following modifications have been proposed.

1. In planning the final cut the indexation of stands is needed for the urgency of the required cuts and retention capabilities of stands in the forest. The introduction of a special code is proposed for stand registers, based on the characteristics of individual stands according to the proposed methodology. The final size of the planned use should also take into account the volume of the stands requiring urgent intervention.
2. The approximate allowable volume of intermediate cuts should be calculated on the basis of the obligatory area-based allowable cut in accordance with the formulae proposed earlier.
3. The incidental cuts should be estimated on the basis of the State Forests IT System data from the previous management period.
4. It is important not to connect the planned size of the allowable final, intermediate and incidental cuts, in the forest management plan approved by the Minister. The incidental increase of forest use should not restrict implementation of the remaining tasks.
5. Forest management planning must create, according to a previous proposal, a guarantee of security that limits excessive usage. This guarantee should be calculated using the average size gradually, on the basis of the forecast for the respective periods of the size of the cuts. Adoption of the proposition based on forecasts of the average as the maximum size of the cuts, at present divergences between the average and actual use, creates the possibility of a flexible approach to the needs of the raw wood market.

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