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METHOD OF CALCULATED CUTTING AREA DETERMINATION IN THE FORESTS OF UKRAINE FOR SEPARATE FORESTRY BASED ENTERPRISES

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There is presented the calculated cutting area determination method developed on fundamentally new basis where the object of model application is simultaneously all economic sections of enterprise areas covered with forests and incorporated in calculation of the main usage. Forests usage optimization in the enterprises of the Kiev regional administration of forest and hunting sectors at existing and new methods proves high efficiency of the last one.

Optimization of forests usage, calculated cutting area, permanent and temporary economic sections.

INTRODUCTION

Process of the main forest usage which is a deck-house of shelter woods is the result of forestry activity of a few generations of specialists in forestry on growing of the forest during many decades.

Scientifically grounded forest harvesting on the method of classes of age within the limits of economic sections is carried out on the basis of acceptance of one of few most optimal on certain criteria, so-called calculation cutting areas calculated without fail.

According to “Methodology of calculation cutting areas” that is active in Ukraine, ways for calculating main volume of cutting areas in Ukraine are considered: normal, first and second age-dependent, rational and on the state, and also cutting area on an increase, which settles accounts additionally.

According to this method, acceptance of calculation cutting area is based on that in a deck-house must accept only shelterwoods, thus the accepted cutting area must be maximal from the ones that are calculated, in the earliest possible dates must reach the normal one and must be not smaller cutting area than from the previous period.

All these terms are met by rational cutting area, the most acceptable to the forest deficit conditions of Ukraine, allowing to include in a calculation up to 50% areas of senior stands of the last class of the pre-mature stands of this economic section, which will be cut in the second half of auditing period.

However the rational cutting area also has disadvantages. The main one is a gradual accumulation during forest harvesting of ripe wood supplies in an economic section.

Therefore there was an idea to optimize forest harvesting not on every economic section separately (they are very different and, according to forest management terms, they require optimization on a pedigree and age-dependent structure), but on their aggregate in the object of forest management.

PRE-CONDITIONS TO DEVELOPMENT OF METHOD

Orlov M.M. [5] at the beginning of XX century suggested to jointly examine economic plans in objects with an opposite age-dependent structure. Though he's speaking about lengths – planting of one breed at different territory. A scientist marks that if exceptionally pre-mature stands and ripe stands are placed in one length, and saplings and middle-mature stands are placed in the other one, and if they get associated, forest harvesting can be normal.

Further development of optimization idea of forest harvesting is a explanation by V.V. Komkov [2] of the phenomenon of system effect, essence of which consists of that a cutting area, expected for sections, incorporated in a group, cannot be less sum of cutting areas, expected for every section separately.

An algorithm, program and theoretical bases of forest harvesting calculation, is presented in the fourth chapter (author S.N. Kashpor) of textbook «Forest management» [1]. Later, in the process of implementation of budgetary program by forestry department of NUBiP of Ukraine, a methodology was improved. Thus the renewed variant of «Method of determination of calculation cutting area» [4] was approved by Scientific and technical council of the State agency of forest resources of Ukraine (protocol №1 from 27.02.2013).

METHOD OF DETERMINATION OF CALCULATION CUTTING AREA

1. According to this method during the forest management a calculation cutting area on the deck-houses of the main usage is determined (further calculation cutting area), which is evaluated on forest management conferences.

2. Approval and authorization of calculation cutting areas is carried out in obedience to the proper instruction, ratified by the order of Ministry of ecology and natural resources of Ukraine.

3. A calculation cutting area is an organizational-technical index, which, leaning against principles of the normal forest, serves as basis for planning a cutting area fund and regulates the annual maximum volume of wood purveyance.

4. A calculation cutting area is determined in the possible for exploitation forests of every forestry enterprise within the categories, economic parts, economies, economic sections and methods of deck-houses.

5. Taking into account the folded system of forest resources accounting, basis of calculation is a method on an area.

6. Distributing of area serves as initial information covered the Sylva of ground to age-class and age of ripeness.

7. All calculation economic sections that take part in the calculation are divided to permanent (basic) and temporary ones.

8. The basic method of calculation is a model, which, possessing the phenomenon of system effect, allows to quickly pass to even forest harvesting within the limits of object of calculation, minimizing losses from bringing in a main deck-house all plantings, except for ripe ones.

8.1. Simultaneously all economic sections are the object of model application included in a calculation the main use covered the Sylva of grounds of enterprise with the clear cutting method of deck-houses and class size of 10 years age.

8.2. Groups are formed from every permanent section and proper temporary ones. An index (w) is assigned to every group, and it’s assigned to every section - (w, z), thus z always is equal to 1 in permanent sections.

8.3 Ratio is always the following between the initial age class of the ripe plantings and deck-house turnover - $m^{(w,z)} = T^{(w,z)}/10$.

8.4. First of all ranging of plantings is carried out on a ripeness:

$$F_1^{(w,z)} = \sum_{i=m^{(w,z)}}^{n} S_i^{(w,z)}; \qquad F_{m^{(w,z)}}^{(w,z)} = S_1^{(w,z)};$$

$$F_j^{(w,z)} = S_{m^{(w,z)}-j+1}^{(w,z)} \quad \text{при } j = 2,3,\ldots,m^{(w,z)} - 1.$$

8.5. Next steps are calculation of cutting area of the even usage for the w group of sections $L_H^{(w)} = \sum_z \sum_{j=1}^{m^{(w,z)}} F_j^{(w,z)} \Big/ T^{(w,1)}$ and object of calculation in whole $L_H = \sum_w L_H^{(w)}$, and also choice of the smallest initial class of age of the ripe planting $I = \min\left(m^{(w,1)}\right)$ among basic economic sections.

8.6. Consequently, annual size of the main usage for the whole enterprise is

$$L = \min\left(\min_k \left| \sum_w \sum_z \sum_{j=k}^{I} F_j^{(w,z)} \Big/ (2k-1)/5 \right|; L_H \right) \text{at } k = 1,2,\ldots,I.$$

8.7. A similar scheme is used for w group of sections

$$\alpha^{(w)} = \min\left(\min_k \left| \sum_z \sum_{j=k}^{I} F_j^{(w,z)} \Big/ (2k-1)/5 \right|; L_H^{(w)} \right),$$

however to become a calculation cutting area, $\alpha^{(w)}$ it is necessary to «survive a competition» outside $\beta^{(w)} = L \cdot G^{(w)}/G$, where $G^{(w)} = \sum_z \left(F_1^{(w,z)} + 0{,}5 \cdot F_2^{(w,z)}\right)$ and $G = \sum_w \sum_z \left(F_1^{(w,z)} + 0{,}5 \cdot F_2^{(w,z)}\right)$. Especially perceptibly $\beta^{(w)}$ can influence on end-point at prevailing of the ripe planting in the age-dependent distributing of one group of sections and lack – in other ones.

8.8. Further the algorithm of solving task looks the following way:

$$\eta^{(w)} = \begin{cases} 0 & \text{at } \alpha^{(w)} \le \beta^{(w)} \\ \alpha^{(w)} & \text{at } \alpha^{(w)} > \beta^{(w)} \end{cases};$$

$$\mathrm{H} = \sum_w \eta^{(w)};$$

$$\theta^{(w)} = \begin{cases} \beta^{(w)} & \text{at } \alpha^{(w)} \le \beta^{(w)} \\ 0 & \text{at } \alpha^{(w)} > \beta^{(w)} \end{cases};$$

$$\Theta = \sum_{w} \theta^{(w)};$$

$$L^{(w)} = \begin{cases} \beta^{(w)} \cdot (L - \mathrm{H}) / (L - \Theta) & \text{at } \alpha^{(\mathrm{w})} \le \beta^{(w)} \\ \alpha^{(w)} & \text{at } \alpha^{(\mathrm{w})} > \beta^{(w)} \end{cases}.$$

8.9. Finally, for $z \ge 2$

$$\gamma^{(w,z)} = \left(F_1^{(w,z)} + F_2^{(w,z)}\right) / 10;$$

$$\Gamma^{(w)} = \sum_{z} \gamma^{(w,z)};$$

$$L^{(w,z)} = \begin{cases} \gamma^{(w,z)} & \text{at } \Gamma^{(w)} \le L^{(w)} \\ \gamma^{(w,z)} \cdot L^{(w)} / \Gamma^{(w)} & \text{at } \Gamma^{(w)} > L^{(w)} \end{cases};$$

$$L^{(w,1)} = L^{(w)} - \sum_{z} L^{(w,z)},$$

where $L^{(w,1)}$ i $L^{(w,z)}$ – size of the main usage on an area accordingly in permanent and temporary economic sections.

8.10. Additionally two statistics accounts are settled:

– coefficient of changeability (for every economic section)

$$V^{(w,z)} = 100 \cdot \sqrt{D^{(w,z)}} \Big/ \overline{F}^{(w,z)},$$

$$\text{where } \overline{F}^{(w,z)} = \sum_{i=1}^{m^{(w,z)}} F_i^{(w,z)} \Big/ m^{(w,z)} \text{ and}$$

$$D^{(w,z)} = \sum_{i=1}^{m^{(w,z)}} \left(F_i^{(w,z)} - \overline{F}^{(w,z)}\right)^2 \Big/ \left(m^{(w,z)} - 1\right);$$

a x - square of criteria (for the object of calculation in total)

$$\chi^2 = 100 \cdot \sum_{i=1}^{14} \frac{\left(p_i - \tilde{p}_i\right)^2}{\tilde{p}_i} \Big/ \sum_{i=1}^{14} p_i,$$

where $p_i = \sum_{w} \sum_{z} F_i^{(w,z)}$ and $\tilde{p}_i = \sum_{w} q_i^{(w)}$ *at* $i = 1, 2, \ldots, 14$, and

$q_i^{(w)} = 10 L_N^{(w)}$ at $i = 1, 2, \ldots, m^{(w,1)}$,

each of which in the normal forest equals to zero.

8.11. A calculation is carried out by the program LIKA.

9. For the economic sections of forestry enterprises with the clear cutting method of deck-houses and not 10-years-old classes of age, cutting areas are calculated by a programmatic method:

- Even use $L_N^{(S)} = \frac{\sum_{i=1}^{n} S_i}{m \cdot \Delta}$; (9.1)

-first age-dependent $L_1^{(S)} = \frac{\sum_{i=l_{np}}^{n} S_i}{(m - l_{np} + 1) \cdot \Delta}$; (9.2)

- second age-dependent $L_2^{(S)} = \frac{\sum_{i=l_{cpв}}^{n} S_i}{(m - l_{cpв} + 1) \cdot \Delta}$; (9.3)

- rational, modified $L_R^{(S)} = \min\left(\min_k \left| \frac{\sum_{i=m-k+1}^{n} S_i}{5 + \Delta \cdot (k-1)} \right|; L_N^{(S)} \right)$ (9.4)

where *I = 1, 2, ., m, ., n* are classes of age;

m - is an initial class of age of the ripe planting;

Si - is an area of planting of I-go class of age;

Δ - it is duration of class of age;

L_{np} - is an initial class of age of the Pre-mature stands;

lcpв - is an initial class of age of the middle-mature stands, included in a calculation the second age-dependent cutting area;

k - is number of cycles of calculation, changes from *1* to *m.*

In economic sections which include less than four classes of age in a medieval group, in a calculation the second age-dependent cutting area the only one higher form of this group is included, and at presence of four and more than classes are two senior classes.

10. Transition from cutting areas on an area in cutting areas on a supply carried out on the basis of correlation $L^{(M)} = L^{(S)} \cdot \frac{\sum_{i=m-1}^{n} M_i}{\sum_{i=m-1}^{n} S_i} = L^{(S)} \cdot \overline{M}$, where M_i and S_i - accordingly stocked the area of planting the certain economic section of I class of age.

11. At 2-dosen gradual deck-houses the area of the ripe planting is multiplied by $10/(\lambda+10)$, and at 3-dosen – on $10/(2\lambda+10)$. Yearly cutting area received on an algorithm for clear cutting deck-houses is increased accordingly two or three times $L^{(S)}_{\lambda/2} = 2L^{(S)}$ or $L^{(S)}_{\lambda/3} = 3L^{(S)}$.

Regardless of number of doses a cutting area supply is calculated on a formula $L^{(M)}_{\lambda} = L^{(S)} \cdot \overline{M}$, in which a average supply $\overline{M}$ on 1 hectare at application of 2-step foster cutting deck-houses touches the ripe planting with plenitude no less than 0,6, and 3-step foster cutting – 0,8.

12. Acceptance of calculation cutting area, calculated on the basis of pp. 8 - 11 carried out taking into account next terms.

12.1. In temporary economic sections, with majority of the Pre-mature stands, ripe and over mature stands, the maximum from the calculated cutting areas is accepted.

12.2. In basic economic sections in a deck-house, taking into account ripening, must act only shelterwoods present at the moment of calculation area (at gradual deck-houses - supply) of which is enough no less than for 5 years.

12.3. Reserves of wood cut down on condition of the even age-dependent distribution, must not exceed the general middle increase.

12.4. The total calculation cutting area of all economic sections of calculation object must in possibly short terms attain the size of cutting area of the even usage.

12.5. Total calculation cutting area of next calculation period must not yield to the one of previous period.

13. At voluntarily-selective deck-houses determining one is a cutting area on a supply, which is calculated on a formula $L^{(M)} = \dfrac{\sum\limits_{g} P_g \cdot M_g}{1000}$, where *Pg* and *Mg* – accordingly the projected percent of selection and general supply in a g code planting, included in a calculation voluntarily-selective deck-house. The accepted

cutting area must not exceed the cutting area of the even use, calculated for planting, brought over to this method of deck-houses.

14. The accepted cutting area can not yield to the cutting area on the state, which is calculated on a formula $L_C^{(S)} = \frac{S_C}{t} = \frac{M_C}{t}$, where S_C and M_C – accordingly general area and supply of stands, requiring a main deck-house on the state, which the Pre-mature stands, ripe and over mature stands, damaged fires, wreckers behave to, by illnesses and because of the elemental natural phenomena and technogenic influences with the degree of loss these planting biological stability; t – production possible term of their felling.

15. Degree of rounding off calculated and accepted calculation cutting areas on an area makes 0,1 hectare, and on a supply - 0,01 thousand cubic meters.

Verification of model for retained 14 state forest enterprises of the Kiev area, that calculated on a new method a calculation cutting area makes 96,4% of normal cutting area, while cutting area, calculated on an operating method – only 74,4%.

CONCLUSION

1. Received results testify the necessity of transition of forestry of Ukraine on the new method of calculation of the main usage, when optimization of calculation cutting area is carried out on the aggregate of economic sections of forestry enterprise.

2. Main advantage of new method is more effective usage of the ripe forest in basic economic sections with the speed-up process of replacement of temporary sections on basic ones.

3. A narrow place, braking introduction of this method, is disparity to it normative-legal base of forestry industry of country. For example, very problematic is placing of optimum calculation cutting area in accordance with operating Rules of deck-houses of the main use [7], in obedience to which at application of clear cutting deck-houses size of cutting area at the coniferous forests must not exceed 3 hectares.

4. At this stage it is necessary to adapt and introduce new Method of determination of calculation cutting area in forestry of country and production amalgamation «Ukrgoslesproekt».

МЕТОДИКА ОПРЕДЕЛЕНИЯ РАСЧЕТНОЙ ЛЕСОСЕКИ В ЛЕСАХ УКРАИНЫ ДЛЯ ОТДЕЛЬНОГО ЛЕСОХОЗЯЙСТВЕННОГО ПРЕДПРИЯТИЯ

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Представлена разработанная на принципиально новой основе методика определения расчетной лесосеки, где объектом применения модели остаются одновременно взятые все хозяйственные секции покрытых лесной растительностью включенных в расчет главного пользования участков предприятия. Оптимизация лесопользования на предприятиях Киевского областного управления лесного и охотничьего хозяйства по действующей и новой методикам доказывает высокую эффективность последней.

Оптимизация лесопользования, расчетная лесосека, постоянные и временные хозяйственные секции.