

## **SUBSTANTIATION OF SELECTIVE FOREST MANAGEMENT IN SIBERIA**

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In the forests of Siberia the three types of principal felling are currently in use:

*localized clear felling, selective felling, and shelterwood.*

*Localized clear felling* implies logging a stand in a logging area completely in one cut. This type includes both - clear felling with a following regeneration, as well as the one with the preservation of the advance and young growth of the economically valuable species providing the natural regeneration of the forest. To promote the natural regeneration of a forest in a logging area, seed trees are preserved.

Clear felling is conducted in the even-aged stands of the exploited forests. In the protection forests only the felling under systems involving narrow coupes is prescribed in the conditions, where the other methods do not yield a due forest management effect. Clear felling with the preservation of the advance and young growth is conducted in the coniferous stands with the canopy closure of up to 50% and in the deciduous stands with the one of up to 70% and provided there is a viable advance and young growth of the coniferous species sufficient for the natural regeneration of the forest. In the areas where there is no advance and young growth of the economically valuable species the activities are undertaken to promote the natural regeneration of the forest.

In the mountainous forests clear felling brings about sharp disturbances of the water-protective functions of the forests, that entails an intensive increase of the erosion processes. Following a clear felling the succession of the deciduous stands

by the coniferous ones takes a long time complicating the regeneration of the coniferous forests. However these drawbacks do not mean a need for a total displacing of clear felling by the other logging methods. It is necessary to use all the logging methods in a sensible and well-founded way. **At present clear felling remains to be the dominating method of the industrial logging making up about 98% of the general forest logging in Siberia.**

*Selective felling* consists in a periodic removal of a part of the trees of the certain age, size, quality, or condition. The area remains constantly covered by the forest with the canopy closure of 40-50%. The ecosystem's ability to fulfill the water-protective functions is preserved.

Selective felling is used in the stands on well-drained soils in the forests of the green zones and in the water-protective and soil-protective ones. The intensity of timber extraction with this felling type is less than 40% of the growing stock. Such a felling requires a number of the technical complications justified for the protection forests.

Intensive selective felling (the intensity by the growing stock of 40 - 50%) has passed a test as an industrial alternative to clear felling in the uneven-aged coniferous stands. They allow logging up to half of the growing stock in a concentrated way without a long interval between successive adjacent loggings facilitating the transport development of the territory and forest use. With this felling type 20-30% of the total number of stems is cut periodically and the area remains to be constantly covered with forest. A calculated period for the growing stock regeneration is 30-40 years with the logging intensity of 40-50%, which defines the term of a following cut of the selective felling.

One of the paramount goals of *shelterwood* is providing conditions for a successful natural regeneration by the main species. It ensures a gradual release of the

advance growth and second layer from shadowing promoting their adjustment to the new conditions of the light regime, wind, and hydrothermics in the conditions, where a release in one or two cuts could bring about drying out or frosting of the stands. A release of the coniferous advance growth and second layer in two cuts in the conditions of Siberia softens or reduces to a great degree an urgent problem of the species succession in the logged areas.

Even shelterwood consists in an even thinning of the stands during one age class. The classical four-cut logging is usually recommended for the stands with the canopy closure of 100% and with no advance growth.

Long-term shelterwood is conducted in two cuts (the intensity by the growing stock is 50-60%) for the reason of not only ensuring the natural regeneration, but also providing the conditions for a gradual transition of the young and maturing generations into the mature ones. They are conducted in the uneven-aged stands with no less than 400-600 trees per hectare that are from the young and maturing generations. This felling type is of little efficiency in the stands with the canopy closure of more than 80% and in the areas with weakly drained soils. However in the uneven-aged pine forests long-term shelterwood (in comparison with clear logging and, moreover, concentrated one) has significant advantages for the forest management and use.

Strip shelterwood presupposes cutting down the stand during one age class in two or three cuts on the strips alternating in a certain order with the width not exceeding an average height of the stand and the length of up to 250-300 m. They are conducted in the coniferous and deciduous stands with the second coniferous layer and advance growth of the valuable species.

Strip shelterwood in two cuts is conducted in the medium-closed deciduous or coniferous stands with the presence of a weakly suppressed advance growth even

under the conditions of its insufficient numbers. The width of the logged down and left strips corresponds to the average height of the stand (20-35 м). The second cut is conducted in 6-8 years.

Strip shelterwood in three cuts is conducted in the highly closed stands with the advance growth or the second layer of the coniferous species. In the first cut strips are logged down with the width equal to an average height of the stand, and the “coulisses” are left with the width equal to a double height of the stand. The cuts are to be repeated in 6-8 years. For the last cut the strips are left equal to 18-20 м. The direction of the strips is perpendicular to the direction of the strong winds.

Fellings other than clear felling, in spite of their high ecological and management efficiency for Siberia, have a number of restrictions. Selective felling is not conducted in the conditions of frequent wind throws, weakly drained soils, or of a low canopy closure and growing stock of the stands, in the conditions of an insufficient number of young trees (less than 300-400 stems per ha) and in the even-aged stands. Like selective, shelterwood is not conducted in the conditions of the over-moist soils and weak resistance to wind. An obligatory condition of shelterwood is the presence in a stand of a sufficient amount of the advance and young growth of the economically valuable species or the favorable circumstances for the appearance of a subsequent regeneration.

#### Substantiation and Efficiency of Selective Forest Use

To date in Siberia there were only clear loggings with a small exception of less than 2%. In quite a number of the conditions, particularly the mountainous ones, such fellings bring about sharp disturbances of the protective forest functions and damage from the loss of the soil fertility. A long-term succession of the deciduous species by the coniferous ones, accompanying clear felling, complicates and raises the price of growing a new valuable stand. In doing so, in the uneven-aged stands

there is an under-use of the natural potential of the stands productivity, as a result of logging their immature part.

One of the most important issues of selective forest use is determination of its optimum intensity, allowing to combining best the purposes of forest use, regeneration, and preservation of the protective functions of the forest. The felling with the intensity of less than 35% with the mechanized forest logging in Siberia is often inefficient economically. Under the existing technology of forest logging the percent of timber, logged down completely in the technological areas is very high. The fellings with the intensity of 60-80% of the growing stock, in the majority of the conditions, reduce sharply resistance to wind of the left part of the stand. The most efficient felling for the majority of the conditions has proved to have the intensity of 40-50% of the growing stock. The calculated period of the growing stock regeneration with such a logging is from 30 to 50 years.

With reference to this type of logging there have been designed the technological methods, providing conservation of the soil, advance growth, young part of the stand, and the ecological functions of the forest. A high total efficiency of the selective forest use is provided by the following components:

- Continuous activities of the forest logging enterprises are stimulated, since the logged areas enter the next logging cycle in 30-50 years. In doing so, the use of timber per area unit becomes greater by 10-30% due to an additional increment of the left young part of the stands and a continuous reproduction of the forest resources;
- There is no need for an artificial forest regeneration, a succession of the coniferous species by the deciduous ones is prevented, and the expenses for the following forest tending grow shorter;
- Fire hazard decreases, since the area of the open parts of the logged areas becomes smaller;

- The ecological functions of the forest are preserved and a high nature protection efficiency of the forest use is ensured.
- The complex forest productivity is used to the most.

The forest management and water-protective advantages of selective logging are obvious. From the viewpoint of forest use there is both an increase of the labor input and prime cost of the logged timber (by 10-30%) at the expense of complicating the technology of logging, and a certain reduction of them (by 10-15%), by means of enlarging the volume of the tree-length log. A maximum decrease of the logging productivity was noted only with the logging of the intensity below 40% of the growing stock. Under the experimental logging with the intensity of 40-50% by the growing stock the noted decrease of the productivity did not exceed 10%. A purely exploitation loss of such a size is compensated by the economy on reforestation alone, which is evidenced by an analysis of the experimental-production selective logging with the intensity of about 50% in the mountainous forests of Siberian pine in Krasnoyarsk region. Thereby, selective logging in the conditions of Krasnoyarsk region turned out to be economically acceptable also from the point of view of forest use. A still higher economic effect from an introduction of selective forest use is reached when calculating the logged timber not by one-time use, but by one rotation of clear felling (conditionally 100 years). The prime cost of forest logging, transportation and the one at the industrial log depot is by 10-15% lower on the average than with clear felling.

#### Efficiency of Shelterwood

Shelterwood conducted in the even-aged forests is characterized by a high forest management and nature protection efficiency. At the same time, when doing even shelterwood with the use of power saws and skidders with the Russian choker rigging, there is a decrease in the labor productivity by 15%. The strip-shelterwood

logging designed and introduced in production allows felling trees with the machines of the grapple type (LP-19A) with the conservation of the forestry and nature protection advantages which provides an increase in the labor productivity ten-fold in comparison with using power saws and skidders rigged with chokers. Strip-shelterwood is conducted with the intensity of thinning a stand in the first cut of about 45-50%, however not evenly, but in strips. Since 1994 this felling has been included into the Rules of Principal Logging in the Forests of Eastern Siberia.

When using the multi-functioning logging machinery this method turned out to be more efficient than even-shelterwood. In the logged down strips after undertaking the first cut there was no drying out of the advance growth, even of fir and spruce. At the same time, there occurred an accelerated development of the preserved young growth and its canopy closing in the individual groups and clumps. Such a felling has proved efficient also in the coniferous-deciduous stands with a heightened canopy closure. The advance growth and second layer of the coniferous species reacts positively to a partial first cleaning as well as to the protection by the left strips, and these strips use well the lateral light.

The experience of using the Scandinavian technology and the assortment technique of felling shows an increase of the complex productivity when developing the logging areas. In comparison with the existing technology the disturbance of the forest ecosystems is minimum. The machines can work successfully also in thinning with an average volume of the tree-length log from 0,1 up to 0,5m<sup>3</sup>. A high accuracy of cutting the tree-length logs is provided as well as the information on the amount and structure of the logged timber. An average distance if skidding with a forwarder is 300-700 m.

The economic estimation of the strip-shelterwood has shown that there was no decrease of the labor productivity in comparison with clear felling. By the perspective calculation of the optimum forest use in Central Siberia the selective

felling and shelterwood should make up from 20-30% in the forests on the plains and up to 50% in the mountainous ones from the general logging volume (the forests of a heightened protective importance, all the uneven-aged forests, and all the stands with a high canopy closure, including the deciduous ones with the second coniferous layer or advance growth).