OPTIMUM FOREST COVERAGE OF CATCHMENTS OF SMALL RIVERS IN FOREST-STEPPE

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As a result of the growing shortage of fresh water in the world, the search for ways and means of fuller and more rational use of water resources occupies a leading place. Considering this trend, attention should be paid to the transformation of river systems, the purification of water from pollutants, the construction of reservoirs, the artificial replenishment of underground water reserves, but all these measures in most cases require large capital expenditures and, in turn, lead to the disruption of balanced natural ecosystems [1].

The forests of Ukraine are multifunctional by their purpose, but perform mainly ecological and social functions and have limited operational significance.

In order to preserve and increase underground water reserves in the water protection zone of the river basins of the Forest Steppe of Ukraine, along with hydrotechnical structures, forest plantations should be used.

With optimal forestation of the territory and the correct placement of forest plantations (massive and strip) in the territory of the basin, forest plantations, absorbing surface runoff, significantly increase underground runoff. At the same time, they play the role of a filter and adsorbent of chemicals and harmful substances that accumulate in the soil in the process of anthropogenic activity. Reduction of surface runoff prevents soil erosion and its washing away, siltation of rivers, ponds and reservoirs with clay particles, as well as pollution of water sources.

Thus, the increase in underground flow directly and indirectly contributes to the increase of underground water reserves in river basins and their water content in the summer period.

Each catchment is characterized by a certain forest cover optimum, at which the positive influence of forests on river flow is the greatest and provides the greatest increase in underground flow. The methodology for determining the standards of optimal water protection forest cover of small and medium-sized watersheds, quantitative assessment of expected changes in the main components of the water balance and river flow with optimal water protection forest cover, with different placement of forest plantations on the catchment area (uniform and non-uniform) is based on mathematical modeling of the process of the influence of forest plantations on atmospheric precipitation, surface runoff and total evaporation with determination of changes in underground river flow.

The methodology for quantitative assessment of the water-regulating role of the forest is based on a mathematical formula derived from the general

formula of the land water balance /AP = SR + TSR + TE/. The main components of the water balance are: atmospheric precipitation (AP), surface runoff (SR), total evaporation (TE). The total amount of soil runoff (TSR) is determined from the above equation [2].

According to the method, mathematical models of changes in the components of the water balance and river flow are calculated with different forest coverage of the territory from 1% to 100%. The calculation data show exactly how forest plantations affect the river flow in the case of continuous and partial forestation of watersheds and at which forestation we get the greatest increase in underground flow. Forestry in which there is a maximum increase in soil runoff and is the optimal water protection forest.

The calculation of the water conservation forest cover of forest plantations was carried out for 9 catchments of the river Siversky Dinets basin, such rivers as: Velyka Babka, Tetlezhka, Chugovka, Rohanka, Studenok, Udy, Lopan, Kharkiv and Murom. The total studied area is almost 40,000 km^2. It was determined that the optimal water protection forest coverage of the catchments of the tributaries of the middle course of the river Siverskyi Donets ranges from 18 to 23%. Comparing the obtained values of the optimal water protection and actual forest cover of river catchments, it was established that the actual forest coverage of the catchments of the tributary of the river Siverskyi Donets is mostly smaller than the value of the optimal water protection cover forest.

In the case of continuous afforestation of the studied watersheds, as a result of changes in their forest cover, the main components of the river flow will be redistributed, so the amount of precipitation within the regions of the studied watersheds increases by 23.2 - 26.7 mm (4 - 4.5%), the amount of surface runoff decreases by 52.9 - 84 mm (67.8 - 80%), but the soil runoff index increases by 2.8 - 33.7 mm (21.5 - 210.6%), in turn, the evaporation index increases by 74 - 75 mm (14.5 - 15.7%).

Accordingly, the increase in precipitation with optimal water protection forest cover in the studied watersheds is 21-24.3 mm (3.6-4.1%), surface runoff decreases by 35.1-62.3 mm (45-59.3%), evaporation increases by 22 - 28.9 mm (4.3 - 6.1%), but most importantly, the indicator of soil runoff significantly increases by 34.4 - 56 mm (264.6 - 352.1%).

However, even if the actual forest cover of the river catchment corresponds to the value of the optimal water protection forest cover, this does not mean that the forest areas are evenly distributed on the catchment area. During a detailed study of the forest plantations located within the Telizka, Velika Babka, and Chugovka watersheds, it was found that their placement was uneven relative to the watershed area. This necessitated a more detailed analysis of the placement of forest plantations in the catchment area relative to the river flow.

Conclusions. On the basis of mathematical modeling of the process of the impact of forest plantations on the main components of the water balance, it was established that the maximum manifestation of the water protection role of forest plantations, tributaries of the river Siverskyi Donets, is observed at a forest cover of 18 - 23%. This forest cover is optimal in terms of water protection, since when the forest cover changes in the direction of increase or

decrease, the positive influence of forest plantations on the underground component of the river flow is significantly weakened. Quantitative assessment of the impact of forest plantations on the water balance of catchments shows that with optimal water protection forestation, the river runoff due to the underground component significantly increases by 34.4 - 56.0 mm or by 265 - 350%. Thus, the increase in underground flow in the catchments of the tributaries of the river Siverskyi Donets increases by 3.6-4.5 times.

References

1. Voronkov N. A. The role of forests in water protection. - L.: Gidrometeoizdat, 1988. - 287 p.

2. Mykhovich A.G. Water protection forest plantations. - Kh.: Prapor, 1981. - 63 p.