

WATER POTENTIAL OF BEECH FORESTS IN SERBIA

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Abstract

Hill-mountain Serbian area includes the greatest part of beech forests. They differ from each other in growth, age and structure, located alone or consisted of other trees species. The most important management goal is to produce as much as possible woody mass, but, on the other hand, generally some useful forest functions are neglected. There is not so well-known aspect of hydrological forest function that emphasizes the importance of beech for water existence. It attracts a big attention especially in the time when supplies of water are lacking so much. Some modern researches predict increasing that role of beech forests, because some big supplies of high quality water will be located in forests region, especially in its beech parts. There is analyze based on available dates (distribution of forests depending on heights, rainfalls depending on zones, coefficient of water running, etc) that is performed in the scientific paper in order to evaluate benefit of useful waters from forest ecosystems that belong to mountain-hill area of Serbia.

Key words: hydrological function, water, natural supplies, beech forests, benefit of useful waters etc.

Introduction

Water presents one of the most precious natural values and due to its importance, it is increasingly becoming very important for strategic purposes. Greater number of inhabitants, quick development of industrial production and big water demands of agriculture are main characteristics of current century, so it means a big lack of not only drinking water, but also of water for industrial purposes. All predictions about bigger water needs are surpassed, so current needs for it are about 5130 m³ per year. The most water spends agricultural production (about 69), then follows industry with 23 % and households at the end with 8 % (Velašević V., et al., 2002.).

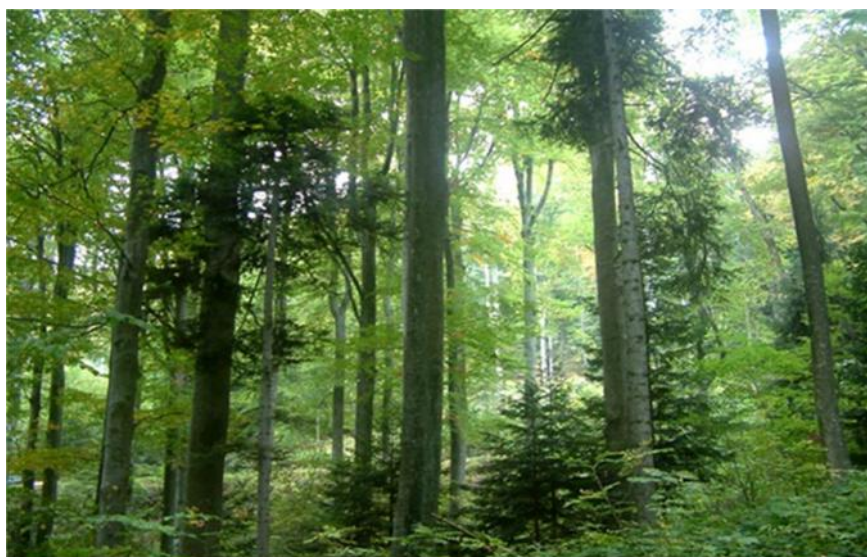
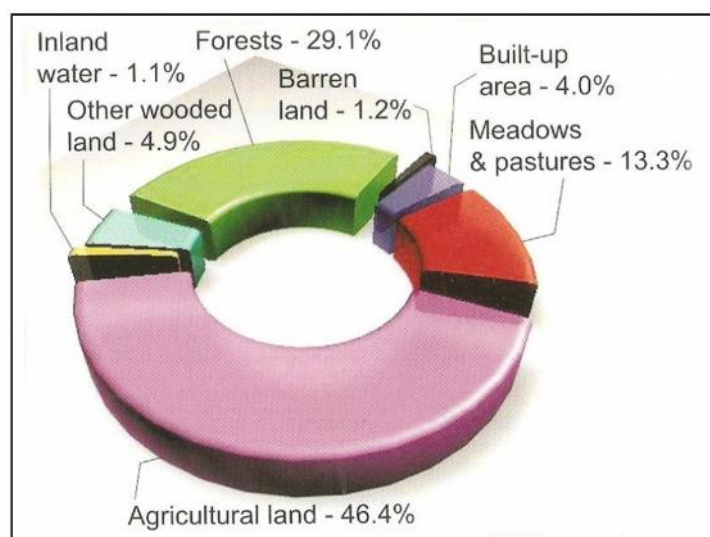


Image 1: Beech and fir forests of Goc mountain

Problem of small water quantity is very serious because of global climate changes such as global warming, which means that people need to take more water. The other big problem is connected with pollution that endangers not only water on the ground, but also underground water. These all are reasons that endanger supplies of good water quality in the world. The aim of this paper is to emphasize all problems of water providing in Serbia and to suggest some ways of using it in mountain - hill forest regions.

Object and research methods

As for structure of land using, Serbia belongs to agricultural countries and the whole surface of forests includes about 29 % from the overall surface (graphic 1), which means that it belongs to mid-forest-developed countries. The whole surface that includes forests is about 2 252 000 ha and about 53 % are state forests and the rest of 47 % are private forests. As for quality structure, there are about 64.7 % of coppices, natural forests make about 27.5 % and then follow artificial structures with 7.8 %. As for species, beech dominates with 29.3 % and there are many different types among it, from oak and beech (*Quercus-Fagetum typicum*) forest to typical beech mountain (*Fagetum moesiaca subalpinum typicum*) forest. As for quantity of useful good quality waters, beech forests are the most desirable plant associations.



Graphic 1: Area structure by land use

The importance of vegetative cover is related to retential abilities of water running, then in keeping possibilities of big water quantity and the presence of it is very important and has the greatest influence to form of hydrological processes at some catchment area. The greatest impact on water cycle in nature belongs to wood, because it presents the most stable ecosystem due to its spatial distribution and complexity. Beech forests come to the first place – these are plant associations with the greatest effect of mediating between rainfalls and water running. In this scientific paper, there are many ecological, hydrological, demographic and other research methods, so there are many analyzes based on it and sinthesis performed for evaluating overall beech forests potential and its importance for useful waters producing.

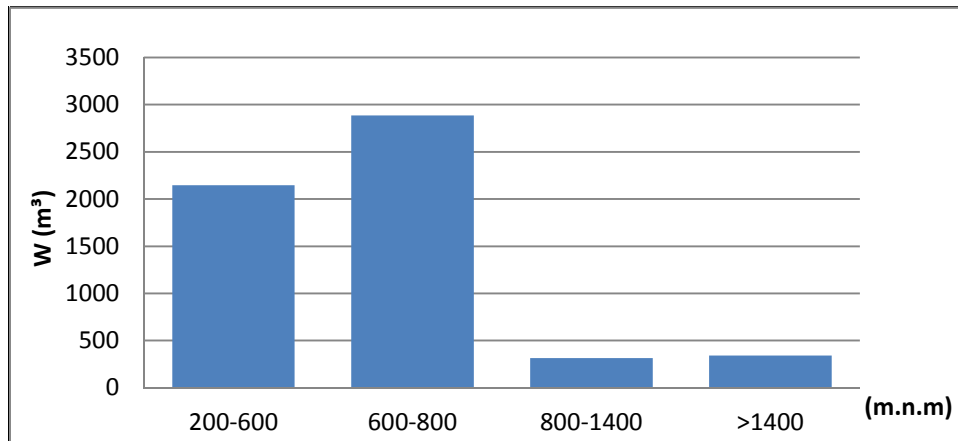
Results of research and discussion

Catchment areas are characterized with regimes of water running, benefit and water quality, and aquatic systems have also some specific biological, ecological and physical characteristics that depend a lot on ways of land using. Planning of land managing at catchment area is a base for planning of water managing, but first of all, it is a base for useful waters benefit that are necessary for industry, agriculture, etc. Mountain-hill area of Serbia is covered with forest vegetation, so therefore it presents resource of great quantity of high waters quality, which is very endangered resource. There aren't some exact measurements of water quantity, that forest ecosystem keeps and distributes in time and space, so because of it, the evaluation of forest state was done. It was done on the base of some available dates about height-distribution of forests, then on the base of average rainfalls depending on heights and it was result of not only domestic, but also foreign researches (Lj. Lj., r. vic ., 1995.). The analyze of these dates was shown in a table 1 and it's very indicative, even though there are only approximative dates about water running and state of water resources in that area.

Table 1: Evaluation of water running from forests of Serbian mountain area

Numb.	Forest associations	Quantity of woods (10 ³ ha)	Heights (m.n.m.)	Average rainfalls (mm)	Water running			
					Coeff. of runoff	Specific runoff	Overall quantity of running water	percent
						q (l·s ⁻¹ ·km ⁻²)	W (10 ⁶ m ³ ·god ⁻¹)	%
1	Oak, oak and beech and other hardwood species	1103,5	200-600	720	0,27	6,16	2145,2	37,7
2	Beech, beech and oak, beech and hornbeam and other hardwood species	945,8	600-800	825	0,37	9,68	2887,05	50,8
3	Beech-fir (spruce)	90,1	800-1400	970	0,36	11,07	314,63	5,5
4	Spruce and others Gymnosperms	112,6	>1400	1080	0,28	9,59	340,5	6
	Overall/average	2252		792	0,32	8,01	5687,38	100

The overall benefit of useful waters from forests of Serbian mountain area is evaluated on about 5687.38 millions m³ and the greatest role in this amount plays area located on heights between 600 and 800 meters, where are beech forests, alone or in associations with oaks and other Angyosperms (tabelle 1, graph 2.)



Graph 2: Diagram of volume of water running from mountain-hill area of Serbia

The lowest area (200-600 meters) is the most widespread, because it covers about 50 % of the whole surface, but it includes just 37,7 % of the overall water quantity, which is expected from the space where are not only forests consisted just from oak trees, but also this one with other species. The area with beech and fir forest give some special hydrological effects, but it covers just about 4 % from the whole surface and has a small participation in quantity, which is about 5.5 % from expected water benefit.

On the base of ground water management GWM (1993.), Serbia has about $5\,670\text{ m}^3\text{s}^{-1}$ or $178\,662 \cdot 10^6\text{ m}^3$ water, and 91 % from it are international waters and just 9 % belongs to domestic waters (table 2).

Table 2: Structure of available waters in Serbia, *GWM (1993.)

Surface 88.361 km^2	flow Q ($\text{m}^3 \cdot \text{s}^{-1}$)	runoff water volume W (10^6 m^3)	rainfalls h (mm god^{-1})
The whole amount of available waters	5.672	178.662	2.022
International waters	5.163	162.635	1.841
Domestic waters	509	16.027	181

*GWM- Ground water management of Serbia

These supplies of waters in Serbia are very small and with its specific water running of $5.7\text{ l}\cdot\text{s}^{-1}\text{km}^{-2}$, provide just 1500 m^3 per inhabitant a year, what means that Serbia belongs amongst the poorest European countries, because just area with 3000 m^3 of it provides enough water quantity (B.,(1993.)). The observation of water potential from forest area (about 29 % from the whole surface) is very logical, because about 35 % of high quality domestic waters can be expected from that area (Nikic Z., et all, (2012.)). Some useful forests functions such as hydrological, erosion protective function, put beech forests at the first place, because it protects land with its construction in the best way (Lj., et all (2011.)). In that, not damaged part of land, there are many bio-chemical processes which provide big quantities of high water quality, forest ecosystem introduces a specific bio-cleaner, as well (Nikic V., et all (2012.)).

Conclusions

As for possibilities of forest ecosystems, there are many advantages of it such as:

- Acceptance of big quantity of rainfalls and its further distribution without destroying of land. Water retention is a famous effect and has a great influence on spatial and time distribution of water in catchment area.
- Big forest lands abilities of infiltration of forest lands decrease harmful water running and increase underground water moving.
- There is a big hydrological importance of beech forests, that cover about 29 % from the whole surface of forest area and have a great influence on a hydrological net of mountain-hill forest area in Serbia. It produces big quantity of high waters quality. of mountain-hill forest area
- Finally it needs to be emphasized that planning of forest managing (ways of using woody mass, roads-building, providing of best hydrological structure) presents planning of water managing at the same time.

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