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WATER MANAGEMENT IN FOREST COMPLEXES OF THE UPPER PARTS OF THE PROSNA AND STOBRAWA RIVERS CATCHMENTS

1. Introduction

Presently, in state forests, stronger and stronger emphasis is being put on non-productive multifunctional role of forests in natural environment and also, connected with it, the necessity of basing forest management on ecological principles [7]. Establishing Forest Promotion Complexes in the country having an area ranging from a twenty or so to several dozens thousands ha has been a vital step in that direction. In a set of tasks to be realised in the complexes, stating the hydrological conditions and increasing water storage in forests were defined. One of the aims of „establishing” was a carrying out of scientific research and forest experimentation in that areas. According to Szujecki [3], it is planned to create 20 Forest Promotion Complexes in Poland. They are supposed to cover the forests of all the natural districts of the country. The research, being the basis of the paper, was carried out in the area of the Siemianice Forest Experimental Farm of the University of Agriculture, Poznań. The farm together with the Antonin and Syców Forest Divisions have been included into the Rychtal Forests Promotion Forest Complex [8].

2. Methodology of research

Apart from inventorying and evaluation of the state of the existing land melioration devices in the area of the Siemianice Experimental Forest Farm, survey of all the small natural water reservoirs ponds, existing in the forest areas, was done during the field research. Since both on the review maps of working section in the scale of 1:20000 and those of forest sections in the scale 1:10000, the reservoirs were not present, and there was a complete lack of information about them in the assessment reports of stands (because of their small areas), topographic maps in the scale of 1:10000 were the basis of the inventorying. In the description of the existing reservoirs ponds attention was paid to the shape of their canopy, the height of slopes and the intensity of trees cover which could eventually mean their gradual extinction. Increasing retention capacity of the reservoirs, connecting them with ditches, very often carrying away water from them, was a crucial element in the characteristics. Catchments were delimited for all the reservoirs whose size significantly determined abilities of increasing water storage in them. Catchments were also delimited for marshes selected on review forest section maps and introduced into assessment reports of plans of forest management. A part of marshes, not taken into consideration in the assessment reports, was placed on the basic topographic maps in the scale of 1:10000. Apart from the small reservoirs, during the mentioned field inventorying, two other types of spots were distinguished: the first group of places characteristic of some remains of devices in which there might be ponds or small water reservoirs, the other which could be taken into consideration as future reservoirs because of the area configuration and flowing water-courses.

3. Location and basic characteristics of the researched spot

As far as the organisational system is concerned the forests of the Siemianice Forest Experimental Farm are managed by the Siemianice Forest Division which consists of two working sections: Laski with the area of 3324 ha and Wolczyn with its 2613 ha. The boarder line of two voivodships, namely Kalisz and Opole, crosses the Division.

According to geo-physical division of Europe and Poland [1] the forests of the Siemianice Forest Experimental Division are situated in the subprovince of the Mid-Polish Lowland-318 in decimal classification. In further detailed division the Laski Working Section

forest are situated within the reach of the Southern Great Poland Lowland (318. 1/2) on the Wysoczyzna Wieruszowska (318. 24) which is a denuded moraine plain crossed by the upper Proсна river stream.

The Wolczyn Working Section forests are situated within the reach of the Silesian Lowland (318. 5) on the Oleśnicka Plain (318. 56), bordering in the North and East with the Wieruszowska Wysoczyzna (Highland). It is a moraine plain with monadnocks of glacial forms of Mid-Polish glaciation.

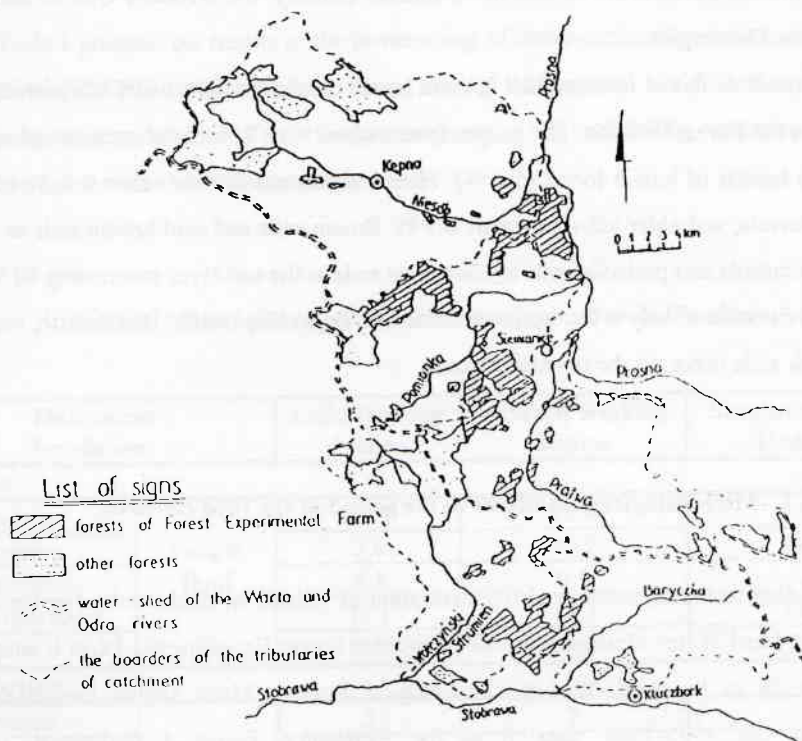


Fig. 1. Situation of Siemianice Forest Experimental Farm forest complexes of the University of Agriculture, Poznań

The Siemianice Forest Division is situated in the watershed area of the Warta and Odra catchment, within the reach of the Prosna catchment, the left bank tributaries of the Niesób and Pomianka rivers, left bank tributary of the Prosna river. Water from the forest, areas is also directly carried away to the Prosna river. The Wolczyn Working Section forests in the southwestern part, are situated in the Pratwa catchment and in the catchments of the Wolczyński Strumień and the Baryczka which have outlet to the Stobrawa. The Siemianice Forest Division forests occur in five bigger and several smaller forest complexes (Fig. 1.).

According to natural-forest division into regions [4], the forests of the Siemianice Forest Experimental Division are located in the Silesian Country, the Wrocław Quarter and the Oleśnicka Plain Mesoregion.

The stands of mixed forests (42.4 %) and humid coniferous forest (39.2 %) cover the largest area in the Forest Division. The proper forests cover – 11.8 % of the area out of which 50 % are the habitat of humid forest (5.6 %). Humid coniferous forests cover 4.4, % of the area, mixed forests, and alder-ash cars jointly 6.7 %. Brown soils and acid brown soils as well as Cambic Arenosols and podzolic soils are dominant soils in the soil layer comprising 80 % of the Forest Division area; only a few percents constitute Typic Hapludalfs. Black earth, marsh, peat and muck soils occur on the remaining area.

4. Meteorological conditions in the period of the field research

According to the climatological regionalization of Poland worked out by the Institute of Meteorology and Water Management, the Siemianice Forest Experimental Farm is situated within the reach of the Łódź-Wieluń Climatological Region. Mean annual temperatures, according to the 1975-1996 data from the Siemianice Forest Experimental Farm meteorological station, ranged from 7.4°C to 10.4°C, while the January minimum mean was – 10.3°C and the July maximum mean was 28.3°C. The annual mean precipitation from the period of 1975-1996 equalled 561 mm, and the winter and summer hydrological half-year, correspondingly 209 and 352 mm. The 1995/96 hydrological year, in which the research was taken up in spring, was characterised by the sum of annual precipitation 50 mm lower than the many years' mean while the winter half-year precipitation was over 90 mm lower. From 1988/89 on subsequent years, except 1989/90 with its precipitation slightly above the mean and very high temperatures, had annual precipitation sums lower than mean values.

Precipitation in subsequent years was lower with simultaneously higher temperatures than many years' mean. The factors had to influence the ground retention, diminishing it. That's why both the hydrological year 1995/96 and the hydrological year 1996/97 spring with their very low precipitation in the winter half-year, frosty December and January but with high March and April mean temperatures, can be regarded as drought periods.

5. Results

Table 1 presents the results of the inventorying of water-melioration devices carried out in the Siemianice Forest Experimental Farm. During the process, the factual state of the equipment as well as the need of their further maintenance and undertaking necessary measures to increase forest water retention were evaluated.

Table 1. Melioration devices in the Siemianice Forest Division

Melioration installations		Laski Working Section	Wolczyn Working Section	Siemianice Forest Division
Ditches:				
Maintenance	Length [km]	25.9	18.8	44.7
Major repairs		7.6	16.2	23.8
Reconstruction		4.1	0.1	4.2
Out-of-operation		15.1	19.3	34.4
Total:		52.7	54.4	107.1
Water gates:				
Maintenance	Number [units]	3	2	5
Major repairs		1	2	3
Reconstruction		5	4	9
Total:		9	8	17

The total length of water courses in the Siemianice Forest Experimental Farm amounts to 107 km. Which means 1.8 km of ditch per 1 km² taking into consideration the total area of the Siemianice Forest Division. The lengths in the Laski and Wolczyn Working Sections are close to each other and amount correspondingly to 53 and 54 km. About 12 km of ditches must

undergo major repairs and reconstruction in the Laski Working Section while 26 km of ditches must undergo current maintenance. Other proportions occur in the Wołczyn Working Section. Maintenance must be carried out on 19 km of ditches while 16 km need major repairs. The length of 34 km of ditches (32 %) is suggested to be out-of-operation. The Laski Working Division should disconnect 15 km (28 % of the ditches inventoried in the Division), while the Wołczyn Division 19 km (35 %) of the ditches. The ditches suggested for disconnection were the ones which occurred in the areas not indicating the need of water ratio regulation. This did not apply to transit ditches, carrying water away from the drained areas. In majority of cases the ditches were either on the decline or the ones covered with a plant growth not indicating any temporary flow or water stagnation. The drained area in the Siemianice Forest Experimental Farm covers 1409 ha; the Laski Division 729 ha and the Wołczyn Division 680 ha.

The field research shows that it is possible to increase ground water retention in forest areas damming it up in ameliorative ditches and water courses. In the Laski Working Section there are nine water gates on water courses but majority of them needs major repairs and reconstruction. The present state of all the damming up devices indicates that they have not been used for a long time. In the Wołczyn Section there are 8 water gates but their condition proves they have not been utilized for a long time either. The future basic task in the Wołczyn Division is undertaking to set swellings on the Pod Lasem Canal working; the canal is the basic water course flowing along the north-western boarder of the Unieszów Forest Section. The Regional Section in Kluczbork, a section of the Provincial Land Reclamation and Water Appliances Management in Opole, can conduct indispensable major repairs of the swelling devices if the Forest Experimental Farm signals such a need and ensures cooperation with farmers as far as exploitation of the equipment is concerned.

Small natural reservoirs, ponds and marshes, existing in forest complexes, which also function as storage reservoirs, play a crucial role in forest water management. Table 2 presents a list of numbers and the area of marshes as well as the area of catchments, as one of the elements of their storage ability evaluation. In the Siemianice Forest Division, according to the assessment reports, there are 23 marshes having areas ranging from 0.01 to 0.72 ha, jointly covering 4.92 ha. The area of their topographic catchments ranges from very small ones, for marshes situated in water-shed areas, to 1.1 km². There are ten marshes directly connected with drainage ditches which either emerge from or cross them. It indicates that the areas have been partly drained and there is a future possibility to increase their storage abilities. Practically

all the marsh areas should be treated as lands of ecological use. Only 8 out of 23 are either protected or should be protected according to applications submitted to the authorities. For the remaining areas no indications in the assessment reports are observed.

Table 2. Marshes and water reservoirs in the Siemianice Forest Division.

Marshes and reservoirs		Laski Working Section	Wólczyn Working Section	Siemianice Forest Division	Catchment area [km ²] from - to
Marshes	Number	15	8	23	0 - 1.1
	Area [ha]	3.94	0.98	4.92	
Ponds	Number	5	6	11	0 - 1.3
	Area [ha]	0.42	0.40	0.82	
Existing reservoirs	Number	2	1	3	0.2 - 2.7
	Area [ha]	0.14	0.03	0.17	
Possible water swellings	Number	-	2	2	4.0; 18.0
Fish ponds (utilized)	Number	1	-	1	Water intake from the Proсна
	Area [ha]	5.06	-	5.06	
Fish ponds (not utilized)	Number	1	2	3	0.2 - 5.0
	Area [ha]	0.50	0.16	0.66	

In the area of the Siemianice Forest Division, presence of 11 ponds ranging in size from 0.1 to 0.15 ha has been found. Their total area of them amounts to 0.8 ha. During the observation ground water level has been spotted in eight of them. The three remaining ones have bottoms with growing plants (calamus, bulrush) and the clearly formed canopy of the reservoirs, not covered with trees on the slopes, might indicate that water stays in them in mean moistened years. The area of the ponds catchments ranges also for marshes from very small ones, in water-shed parts of the land, to 13 km². If water courses cross the ponds, their catchments increase to even 5.0 km², and 8 ponds are connected with water courses which makes it possible to increase water storage in them. In the Siemianice Forest Division, apart from the discussed above ponds, there are presently three small water reservoirs. One of them, situated in the Wólczyn Section with the area of its water level of 0,03 ha, can be significantly enlarged owing to the land conditions and a large catchment of the flowing water course. Local research has also proved that in the Wólczyn Section that there are possibilities to build two reservoirs by help of swelling water in the valley of the course, with a large catchment

(table 2). Reservoirs can also be constructed where 3 former ponds used to be. Today there are dykes left. Two of the former ponds are situated on water courses with vast catchments, which continually convey water, so they can actually be rebuilt. The complex of ponds supplied with the Prosna water positively influences the forest areas of Laski Working Section.

6. Conclusions

1. It can be started on the basis of the research carried out in forest complexes entering into the composition of the Siemianice Forest Experimental Farm of the University of Agriculture, Poznań, that the existing network of basic water sources and drainage ditches, left after major repairs and reconstruction of damaged or broken swelling devices, will enable to increase water storage in drained areas, comprising 24 % of the forest area.
2. Co-operation between foresters and farmers (water companies) is indispensable as far as the problem of utilisation of swelling devices on basic water courses flowing along the forest boarder is concerned.
3. Apart from 3 existing reservoirs, two new ones can be constructed after a period of local observations. They can be built on the collective ditches running along the field channels and having bigger catchments. It is also possible to build reservoirs on the area of the three former ponds where dykes have been left.
4. Both marshes and ponds play a vital role in water management of the researched forest complexes. The majority of the marshes area (60 %) is connected with drainage ditches which indicates their partial drainage. This is why it will be possible to increase their storage capacity building water gates. The same corresponds to ponds; out of 11 inventoried ponds, 8 are connected with water courses.
5. Foresters are obliged to protect both soil and water resources in forests in agreement with the principles of forest management placed on ecological basis. Smaller areas of marshes and existing ponds, frequently not even mentioned in assessment reports, are not plotted on review maps of forest sections in the scale of 1:10000. If foresters are to protect them, they must be mapped.

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Summary

The scientific research, being the basis of the paper, was carried out in the area of the Siemianice Forest Experimental Farm of the University of Agriculture, Poznań. The Farm together with the Antonin and Syców Forest Divisions constitutes the Rychtal Forests-Promotion Forest Complex. It was found out that reconstruction of dilapidated swelling devices on basic water courses and drainage ditches would enable to increase water storage on one fourth of the total forest area.

Marshes and ponds play an important role in water management of the researched forest complexes. Building of the water gates on the ditches will make possible the increase of their water storage capacity. Both marshes and existing ponds should be plotted on forest review maps in the scale of 1:10000 to provide protection for them, according to the rules concerning the case of forest management based on ecological basis.

Streszczenie

Badania będące podstawą pracy były prowadzone na terenie Leśnego Zakładu Doświadczalnego Siemianice Akademii Rolniczej w Poznaniu, który wszedł wraz z Nadleśnictwem Antonin i Syców w skład Leśnego Kompleksu Promocyjnego Lasy Rychtałskie. Stwierdzono, że odbudowa zniszczonych urządzeń piętrzących na ciekach podstawowych i rowach melioracyjnych umożliwi zwiększenie retencji wody na około jednej czwartej powierzchni lasów.

W gospodarce wodnej badanych kompleksów leśnych istotną rolę odgrywają także bagna i oczka wodne. Budowa zastawek na rowach wychodzących z nich umożliwi zwiększenie ich zdolności retencyjnych. Dla zapewnienia ochrony istniejących oczek wodnych i bagien, zgodnie z wytycznymi w sprawie gospodarki leśnej na podstawach ekologicznych powinny być one nanoszone na mapy przeglądowe leśnictw w skali 1 : 10000.