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MANAGEMENT OF WATER RESOURCES IN WEST-POMERANIAN PROVINCE

Jerzy Wira, Daniela Wira

Department of Water Environment Engineering, Technical University of Szczecin.
50 Piastów Ave, 70-311 Szczecin, POLAND

Abstract

The basic purposes of the water economics are as follows:
1. Satisfaction of users' needs in the water.
2. Protection of the quality and quantity of water resources.
3. Protection against water element (protection against flood, sea shore protection).
4. Use of the waters for needs of the water transport and water recreation.

Water economics are one of the most important factors of the balance between the economic and social progress and the natural environment.
The main purpose of them is to protect the water resources and to secure the appropriate quantities and the appropriate quality of waters in time and space for the rational and permanent satisfaction of the current and future needs connected with the social and economic development of the region.

key words: water needs, surface waters, underground waters

SURFACE WATERS [1 , 2 , 3]

West-Pomeranian Province is characterised by the very well developed river network. Main River is Odra River with the major tributaries (Myśla, Słubia, Kurzyca, Rurzyca, Tywa, Płonia, Ina and Gunica).

Within the limits of the Province are also the rivers with the direct estuary to the Baltic Sea (Rega, Parsęta, and Wieprza), Zalew Szczeciński (Świniec and Wołczenica) as well as to Noteć (Drawa River).

Rivers of the West-Pomeranian Province are characterised by:

- differentiation of resources expressing themselves by the outflow volume „q" in l/s x km^2, which amounts to: from 7.6 l/s x km^2 (littoral rivers) to 2.3 l/s x km^2 (rivers of the Southern part of the Province except of Drawa).
- low resources use degree (except of basin of Miedwie Lake).
- very low waters retention degree.

Table 1

Characteristics Of Rivers Of West-Pomeranian Province, [2]

No	River basin of	F [km^2]	Outflow $q_{average}$ [$l/sxkm^2$]	Flow $Q_{average}$ [m^3/s]	Agriculture needs satisfaction degree by the current flow [%]	Remarks
1	Słubia	146,6	2,32	0,34	25,5	
2	Kurzyca	135,0	2,32	0,31	26,4	
3	Rurzyca	416,1	2,32	0,97	28,4	
4	Tywa	256,4	3,39	0,87	24,1	
5	Płonia	1101,0	3,39	3,73	-	High quality waters basin - „Miedwie" water intake
6	Wołczenica	477,8	5,19	2,48	9,5	Planned high quality waters basin
7	Ina	2189,4	5,30	11,6	15,1	
8	Gowienica	369,5	5,84	2,16	9,9	
9	Świniec	454,9	6,91	3,24	8,9	
10	Rega	2724,9	7,63	20,8	28,7	
11	Myśla	1334,0	3,50	4,67	bd	
12	Parsęta	3159,0	9,36	29,5	bd	
13	Wieprza	2169,9	11,15	24,2	bd	
14	Drawa	3190,0	5,48	17,5	bd	

The biggest impoundment lake is Miedwie lake (V_u = 19million m^3) being the main source of potable water for the city of Szczecin. The reservoir „Połczyn Zdrój" with the anti-flood function is in construction.

On the territory of the Province is exploited also a number of reservoirs for power needs (Rejowiec, Likowo on Rega River, Rosnowo, Niedalino on Radwia River as well as Borowo on Drawa River).

Płonia River basin up to the Żelewo water-level indicator (Miedwie Lake basin) is determined as the high quality waters basin (Miedwie water intake).

Within the limits of the West-Pomeranian Province are the high lake concentration areas. Post-glacial lakes are in the area of the lake-lands: Myśliborskie, Choszczeńskie, Drawskie, Ińskie, Bytowskie, Wałeckie, Dobiegniewskieo, Szczecineckie.

Alongside the seashore are situated the shallow littoral lakes, characterised by large areas.

It is assumed, that on the territory of the Province is 1 649 lakes with the area exceeding 1 ha, what constitutes about 18 % of the total quantity of such lakes in Poland.

Distribution of lakes in the West-Pomeranian Province according to the surface area is as follows:

Table 2

Distribution Of Lakes In The West-Pomeranian Province [2]

No.	Area in ha	Number of lakes	% share in the total number of lakes in the West-Pomeranian Province
1.	1 – 10	1 031	62,5
2.	10 – 50	448	27,2
3.	50 – 100	86	5,2
4.	100 – 1000	77	4,7
5.	1000	7	0,4
Total:		1 649	100,0

To the lakes with the biggest waters capacity belongs: Miedwie, Drawsko, Lubie, Pile, Siecino.

Developed surface waters resources have been determined for a part of the West-Pomeranian Province. They are a reserve of the surface waters resources, which can be flown out from the particular balance section without breaking the ecological balance.

DEVELOPED SURFACE WATER RESOURCES [1 , 2 , 3]

Table 3

Developed surface waters resources [2]

No.	Name of the balance region	Area (km^2)	River	Closing section	Basin area to the closing section (km^2)	Developed Q (m^3/s)
1	2	3	4	5	6	7
1	Rega and adjacent coastal area	2860,0	Rega	Morze	2738.170	17.580
2			Tributary from Trzebiatów	Niechorze Lake	78.60	0.531
3			Stara Rega	Resko Przymorskie Lake	43.230	0.298
4			Lubieszowa	Brojce	59.030	0.190
5			Rega	Trzebiatów	2339.030	16.800
6			Rega + Sarnia	Trzebiatów	2701.000	17.260
7			Mołstowa	Rzesznikowo	200.590	0.760
8			Mołstowa	Bielikowo	364.500	1.790
9			Rekowa	Płoty	109.890	0.370
10			Gardominka	Gardomino	74.650	0.460
11			Rega	Smolęcin	2037.700	11.940
12			Ukleja	Taczały	240.300	1.220
13			Sępólna	Siwkowice	212.900	1.100
14			Reska Węgorza	Lesięcin	154.320	0.590
15			Brzeźnicka Węgorza	Lesięcin	178.910	0.350
16			Rega	Resko	1128.720	4.830
17			Rega	Zerżyno	1264.900	5.650
18			Rega	Niemierzyno	118.450	0.460
19			Rega	Golniewo Dolne	257.330	1.010
20			Łoźnica	Łobez	85.230	0.370
21			Rega	Łobez	609.100	2.700
22	Rurzyca, Tywa	1090.8	Rurzyca	Nawodna (near/Nawodna)	336.200	0.950
23			Rurzyca	above mouth	410.200	1.060
24			Kalica	above mouth	111.600	0.300
25			Tywa	Żórawie	245.800	0.690
26			Tywa	Żórawki	247.000	0.690
27			Wieprza	Broczyno *)	379.100	2.720
28			Wieprza	Korzybie *)	905.000	7.020
29			Wieprza	Stary Kraków	1552.200	13.100
30			Wieprza	Darłówko	2227.100	19.200

No.	Name of the balance region	Area (km^2)	River	Closing section	Basin area to the closing section (km^2)	Developed Q (m^3/s)
31	Wieprza and adjacent coastal area	2572.2	Studnica	Ciecholub *)	370.800	2.420
32			Grabowa	Krąg	224.000	1.720
33			Grabowa	Grabowo	446.300	4.180
34			Grabowa	Żukowo Morskie	553.400	5.260
35	Left-bank basin of Lower Odra River		Myśliborska Struga	mouth	55.600	0.049
36	Left-bank basin of Lower Odra River	644.0	Gunica	to Rów Wołczkowski	106.900	0.014
37			Rów Wołczkowski	mouth	58.700	0.025
38			Gunica	Tatynia	205.000	0.190
39			Gunica	mouth	232.020	0.302
40			Bukowa	mouth	72.140	0.023

*) – section outside the limits of the West-Pomeranian Province

UNDERGROUND WATERS [2]

Underground waters are on the territory of the West-Pomeranian Province mainly in the sandy-gravel Quaternary and Tertiary formations as well as, as a matter of secondary importance, in the cracked, carbonate – sandy formations of Cretaceous and Jurassic periods.

Quaternary levels are the richest reservoir of the underground waters and they are on the depth of from a dozen up to 50,0 m, locally deeper. The most favourable hydrological conditions of Szczecin sub-region are: in the lower Ina River Basin, in the Odra River Valley as well as in the area of Gryfice – Nowogard – Dobra (two water bearing levels) on the area of existence of the mining structures, where the depth of the water bearing formations amount to 20 – 40 m. In the sub-region of Koszalin the usable levels of the Quaternary period, being the most important and the richest reservoir of underground waters, exist most frequently on depths 15 – 50 m – locally e.g. in the upper river basin of Parsęta and Wieprza deeper (within the range of 50 – 150m). Depth of the water bearing formations amount as a rule to 10 – 20 m in the littoral area and locally, e.g. in the belt Czaplinek – Szczecinek it does not exceed few metres.

Underground waters of the usable importance in the sub-region of Szczecin of the Tertiary formations exist in the central and Southern parts of the sub-region. Roof of those formations is located on the depth of 50 – 100 m, and their depth does not

exceed as a rule 10,0 m. Except of the Southern part of the sub-region, where it exceeds locally 40,0 m.

An underground water of the Tertiary system formations appears in the sub-region of Koszalin mainly in the Eastern and Southern parts of the sub-region. Depth of their appearance as well as the depth of the Tertiary water bearing levels are characterised by the considerable differentiation. In the South – East part of the area in question, the waters of the Tertiary levels, appear at the deepest levels (150 – 250 m) and they are characterised by the considerable depth. In the coastal belt it prevails the shallower levels (50 – 100 m) with the depth below 10 m.

In the area of the sub-region of Szczecin, the water-bearing Cretaceous formations appear on the small area of the North – East part of the sub-region – area of Trzebiatów City as well as in the coastal zone of the synclinorium of Szczecin. The roof of formations is generally situated on the depth of 50 – 150 m., and their depth does not reach 20.0 m

Jurassic water-bearing level appears in the North – Eastern part of the sub-region and on Wolin Island as well. The roof of formations is generally situated on the depth of 30 – 100 m locally 150 – Wolin, and their depth amounts to from a dozen up to 40,0 m. Ther water-bearing Jurassic formations developed as the usable levels appear only in the North-Western part of the sub-region of Koszalin, where they appear on depths 30 – 150 m.

Underground waters quality of the West-Pomeranian Province in the Quaternary and Jurassic levels can be assessed as the medium one. Deeper Quaternary levels, as well as Tertiary and locally Cretaceous levels, are characterised by the increased mineralization caused by the inflow of brines. Locally in the coastal areas too, the low quality of the underground waters of the Quaternary levels is determined by the inflow of seawaters into it.

Characteristic feature of the distribution of the underground waters resources is its irregularity. On territories of the highest water needs, i.e. in the Northern part of the West-Pomeranian Province, there are no important resources, and the considerable resources are in the Southern and Central part of the Province.

The biggest unit resources exceeding 200 m^3/day/km^2 are in the Valley of Ina River from Stargard Szczeciński to Goleniów, as well as in the Valley of Odra River from Gryfino to the mouth i.e. to Odra Brook. Rich in the underground waters, at the level of 100 – 200 m^3/day/km^2 are also the Municipalities located in the Valley of Ina River from Stargard Szczeciński and upwards as well as the municipalities of Cedynia and Trzebiatów. The poorest underground waters resources are in the territories situated alongside the seashore 10 – 50 m^3/day/km^2 as well as the municipalities of Pyrzyce, Bielice, Stare Czarnowo, Wolin (in land part), Kamień Pomorski and Gryfice (10 – 50 m^3/day/km^2).

DEVELOPED UNDERGROUND WATERS RESOURCES

Table 4

Developed underground waters resources [2]

No.	Name of the balance region and sub-region	Resources determined on	Area (km^2)	Water bearing level	Developed resources Qd	
					(m^3/d)	(m^3/h)
1	*2*	*3*	*4*	*5*	*6*	*7*
	Left-bank basin of Lower Odra River	**30.06.1997**	**644.0**	**Q + K_2**	**126170.00**	**5257,00**
1	Zalew Szczeciński	30.06.1997	179.0	Q + K_2	20510.00	854.60
2	Gunica	30.06.1997	285.0	Q	60060.00	2502.50
3	Western Odra River	30.06.1997	180.0	Q	45600.00	1900.00
	Rurzyca –Tywa	**31.12.1997**	**1090.8**	**Q +Tr+ K_2**	**141000.00**	**5875.00**
4	Omulna basin – Dąbie lake	31.12.1997	129.8	Q + K_2	14400.00	600.00
5	Tywa basin – Kiełbicze lake	31.12.1997	391.8	Q	47880.00	1995.00
6	Rurzyca basin – Cedyński Channel	31.12.1997	569.2	Q+Tr	78720.00	3280.00
	Rega and the adjacent coastal area	**1994**	**2860.0**	**Q+K+J**	**499920.00**	**20830.00**
7	Coastal area	1994	159.0	Q +K +J	9936.00	414.00
8	Lower Rega	1994	298.8	Q +K +J	25776.00	1074.00
9	Mołstowa	1994	364.5	Q +K +J	72024.00	3001.00
10	Central Rega	1994	319.6	Q +K +J	35784.007	1491.00
11	Sąpólna, Ukleja	1994	453.2	Q	72960.00	3040.00
12	Węgorza, Rega	1994	655.8	Q +K +J	154680.00	6445.00
13	Upper Rega	1994	209.1	Q +K +J	128760.00	5365.00
	Wieprza and the adjacent coastal area *)	**1994**	**2572.2**	**Q +Tr +K**	**542976.00**	**22624.00**
14	Lower Grabowa	1994	107.1	Q + Tr	15225.00	636.00
15	Basin of Bukowo lake	1994	101.1	Q + Tr	3970.00	165.00
16	Coastal area of Wieprza	1994	120.5	Q + Tr +K	15327.00	639.00
17	Coastal area of W – S	1994	245.0	Q + Tr +K	12013.00	501.00
18	Central Grabowa	1994	222.3	Q + Tr	66644.00	2777.00
19	Lower Wieprza	1994	548.4	Q + Tr	119541.00	4981.00
20	Upper Grabowa	1994	224.0	Q	71210.00	2967.00
21	Central Wieprza	1994	180.9	Q + Tr	32804.00	1367.00
22	Studnica	1994	372..6	Q + Tr	108398.00	4516.00
23	Upper Wieprza	1994	450.3	Q + Tr	97814.00	4075.00
	Jamno Lake	**1998**	**683.0**	**Q + Tr +J**	**112224.00**	**4676.00**
24	Czerwona	1998	183.0	Q + Tr +J	11424.00	476.00
25	Dzierzęcinka- Wyszewka	1998	500.0	Q + Tr +J	100800.00	4200.00
26	Upper Radew	1998	471.0	Q + Tr +J	122088.00	5087.00
27	Lower Radew	1998	260.0	Q + Tr +J	46176.00	1924.00
28	Parsęta- Radew	1998	120.0	Q + Tr +J	27072.00	1128.00
29	Pokrzywnica	1998	422.0	Q + Tr +J	127608.00	5317.00

30	Lower Parsęta	1998	340.0	Q + Tr +J	122400.00	5100.00
31	Dębosznica	1998	300.0	Q + Tr +J	54000.00	2550.00
	Dziwna	**10.1998**	**1139.1**	**Q +K +J**	**136902.00**	**5704.20**
32	Upper Wołczenica	1998	190.9	Q +K +J	15933.00	663.90
33	Central and Lower Wołczenica	1998	123.2	Q +K +J	14957.60	623.30
34	Grzybnica	1998	135.6	Q +K +J	13180.30	549.20
35	Niemica	1998	122.8	Q +K +J	21135.20	880.60
36	Wołcza	1998	141.5	Q +K +J	17348.10	722.80
37	Upper Stuchowska Struga	1998	78.9	Q +K +J	15706.30	654.40
38	Smaller Tributaries	1998	293.0	Q +K +J	22817.30	950.70
39	Coastal area	1998	117.4	Q +K +J	15824.20	659.30
	Wolin Island	**31.10.2000**	**225.5**	**Q**	**35000,00**	**1458.00**
40	Przytór	2000	40.39	Q	3860.00	160.00
41	Międzyzdroje	2000	19.74	Q	5200.00	217.00
42	Wapnica	2000	8.15	Q	720.00	30.00
43	Centralna	2000	113.89	Q	21760	907.00
44	Wolin	2000	8.79	Q	1340.00	56.00
45	Wschodnia	2000	47.83	Q	2120.00	88.00
46	Międzywodzie	2000	16.31	Q	-	-

*) – balance sub-region exceeding the limits of the West-Pomeranian Province

Organisation units established to implement the tasks in the field of the water economics management and administration of waters and the hydro-engineering structures and equipment are the Regional Water Economics Management Offices (Regionalny Zarząd Gospodarki Wodnej - RZGW).

The West-Pomeranian Province is situated on the territory of operations of RZGW Szczecin and RZGW Poznań.

Grounds for the waters resources balancing in RZGW Szczecin is the distribution of the operation area into the balance units referred to as balance regions.

At the moment, RZGW Szczecin has prepared drafts of the conditions for use of the waters in the five balance regions within the area of its operation, which has covered in the considerable degree the territory of the West-Pomeranian Province. There is no similar data for the areas covered by the operation of RZGW Poznań.

CONCLUSIONS

- The most important dangers, which may limit the possibility of use of the water resources of rivers of the West-Pomeranian Province, are as follows:
  - poor sanitary condition of the waters,
  - high concentrations of biogenic and organic pollutions,
  - eutrophication processes taken place.
- Reasons of such situation are as follows;
  - insufficient methods of wastes collection and treatment in towns and villages of the Province and especially absence of the equipment guaranteeing the removal of biogenic compounds,

- no equipment for the rainwater treatment coming from the build-up areas,
- poor technical and operational condition of a number of waste treatment plants,
- shortages in sewage systems and waste treatment plants, especially in the rural areas,
- field pollutions.

- In order to protect lakes against their degradation it should be constantly carried out and supervised the following actions:
- It should be performed the studies of those lakes with the surface area exceeding 100ha, which have not been assessed according to that programme insofar. It would allow full investigating of the condition of all big reservoirs in the Province
- It should be performed the repeated examinations of the lakes, where the poor quality of the waters has been found (out of class and chosen lakes of III class). If the poor waters condition is confirmed, it would allow indicating the lakes for being covered by the "repair" programme.
- To arrange the waste management in the basins of the lakes:
- To protect the water basins against the unfavourable affects of the agricultural use of the basin area; in the direct basins of the lakes it should be introduced the bans on locations of the non-bedding farms as well as the agricultural use of the wastes.
- Increase of the nitrites concentrations is noticed in the North-West and East regions of Poland, mainly on the areas of existence of the shallow circulation waters.
- At the moment, the programme of the regional monitoring of underground waters is at the stage of creation. Regional monitoring of the West-Pomeranian Province shall cover the whole territory of the Province. Besides the general tasks, implemented by the majority of the regional monitoring of the Provinces, the regional monitoring of the West-Pomeranian Province shall implement additionally the tasks specific for that area:
  - protection of the fresh water resources in the zones where exists a danger of ingression of the salty waters coming from the surface water reservoirs (from Zalew Szczeciński, Zatoka Pomorska and Baltic Sea, littoral rivers in the area of occurrence of the inflow of the sea waters) as well as of the ascension of the salt waters from the deeper situated levels of the mineralised waters,
  - investigation of consequences of the exploitation of waters in the zones where the deficiencies in the underground waters appear, as well as consequences of the economic and agricultural activities in the areas of existence of the underground water reservoirs of the strategic and perspective importance for the water supplies of the Province,
  - control and identification of the trans-border influence and dangers to the underground waters.

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GOSPODARKA ZASOBAMI WODNYMI W WOJEWÓDZTWIE ZACHODNIOPOMORSKIM

Streszczenie

Gospodarka wodna stanowi jeden z najważniejszych czynników zachowania równowagi pomiędzy rozwojem gospodarczym, społecznym i rozwojem środowiska przyrodniczego.

Głównym jej celem jest ochrona zasobów wodnych i zapewnienie odpowiednich ilości i odpowiedniej jakości wody w czasie i przestrzeni dla racjonalnego i trwałego zaspokojenia bieżących i przyszłych potrzeb związanych z rozwojem społecznym i gospodarczym regionu.