BULETINUL Universităţii Petrol – Gaze din Ploieşti	Vol. LVIII No. 3/2006	93 - 100	Seria Ştiinţe Economice

The Economic Importance of Waters inside the Hydrographic Basin of Prahova River

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Abstract

In the last decade, in the conditions of implementing the market economic structures, the way of using water resources has become a major problem, the institution paying attention to the unitary administration of surface and depth waters keeping, at the same time, their natural properties, breaking their impurifying and pollution. The use of waters in the zone of the studied basin has maintained, compared to other regions at a high level, both as a volume and diversification of the uses, being explained by the great number of settlements (2 metropolises, 12 towns and over 60 villages) with the population of about 745.000 inhabitants, but owing to the presence of a lot of industrial units which need a lot of water.

Key words: *hydraulic wheel, hydropower station, dam type Wess, underground waters, industrial need, antropolasine lakes, domestic use*

The Use of the Rivers' Waters

The running waters inside the Prahova fluvial system have the most end different uses, both for the domestic consumption and the industrial one, irrigation of the agricultural surfaces or in pisciculture.

This use implies a considerable volume of water, partly returned to the respective rivers, so that disturbances can't take place in their hydrological regime.

A lot of documents dating from the first half of the XVIII century reveal the fact that the hydraulic wheel was used in the rural places from Prahova for milling then to start the installations necessary to process the wood, textiles, in tanneries, and so on.

In some places of the basin important works were made for a better use of the water energy, for example, the two mill ponds: the first on the left of Teleajen river, 26 km long, between Măgurele and Berceni, the second one with a "plug" from Prahova (near Floreşti) and outlet in the river Sweet Cricov.

The two drains (sewers) have been equipped with wheels since 1830 to draw out the water necessary for irrigation in vegetable growing, an activity practised on a large scale along the two valleys.

A more attentive analysis of the use the waters of the rivers, reveals some differences from an under basin to another, as well as from a relief unit to another, asked by the hydrological features of the fluvial organisms as well as by consumption necessities.

The Use of the Rivers' Water to Produce Electric Energy

The first hydroelectric factories were arranged at the end of the XIX century at Câmpina, Peleş and Sinaia. The first one, UHE Câmpina, was built in 1897 by „The Romanian International from Amsterdam" (Internaţionala Română din Amsterdam) by a derivation dam being built on Prahova River, a pipe with a falling of 200 KW. This hydroelectric factory produced the necessary energy for supplying the first drillings in the oil industry, made with installations electrically drived.

In the same year, 1897, to light the Peleş Castle, hydropower station Peleş, was built on the river with the same name, with a 70 KW turbine. On the same river, a micro hydropower station necessary for producing the electric energy to light the castle and the road to the railway station has been working since 1884. This was the first hydropower station in Romania.

A year later, in 1898, UHE SINAIA I was started the biggest power station from Romania which produced the electric energy at that time, with a capacity of 5 GWh/year.

The hydroenergetic arrangement with the factory in function today at the water thread, was made by the Society Lohmayer from Frankfurt on Main, for a medium debit of installed of 7 m^3/s, being realised by a falling derivation of 20,6 m.

Only for industrial necessities, in 1912 UHE Sinaia II was running at Sinaia, with three micro hydropower stations waterfall, placed on Prahova River, lower than the hydroelectric power station Sinaia I.

The three capacities installed between 3-5 m^3/s and falling of 6 m each, had a production capacity of 2,7 GWh/year.

Other micro hydropower stations were arranged on the main tributaries of Prahova River. So, on the Doftana Valley eight places were identified which assure optimal (the best) functioning conditions lower Paltinu accumulation.

Units Teşila I, Negraş 1 şi Negraş 2 are working. The micro hydropower station Teşila 1, placed on the river Doftana next to Valea Doftanei (Doftana Valley) has been working since 1985, is on the river (without an accumulation lake) using an water installed debit of 6 m^3/s, with a falling of 32 m.

These parameters led to the equipment of the micro hydropower station Teşila 1 into two hydro energetic groups of 0,8 MW each, with an installed power of 1,6 MW and a production of 6,5 mil KWh/year.

The other units (Negraş 1 şi Negraş 2) are situated on Negraş stream, an important affluent of Doftana River in the superior basin.

The micro hydropower stations on the Negraş, without an accumulation lake, (on the water grain) have a power of 0,64 MW and use a water falling of 12 m.

All the centrals mentioned above have as a beneficiary The Electric National Company, CONEL.

The Use Rivers' Waters for Irrigation

The use rivers' waters for irrigation are another important use of the water resources of the fluviatil organisms from the inferior basins of the Prahova River.

The agricultural production is one of the most important branches where water is used.

At the global level, agriculture uses about 55 % of the water volume taken out of the rivers.

Industry uses about 25%, and the populations necessities are satisfied by 10%. To produce one tone of cereals you need about 1000 tones water[1]. This value includes the humidity evaporated by plants or by soil round it, but it doesn't contain the losses of water owing to the inefficient irrigation systems.

Crops take their necessary humidity from precipitations, irrigations or from combining these two sources. As the climate conditions are less favorable to growing plants (cereals, technique plants or vegetables) by the reduced quantities of precipitations, high temperatures, the intensive evaporation and frequent draught from the hot season, the viable solution that enables a good control of water in the soil was – irrigation – using the rivers' waters.

This way, local arrangements for irrigations have been realized, gathering water in ponds (main pipes) and its transfer through smaller drains towards zones with less water reserves in the soil from the high field.

In the first part of the last century (1830) the first arrangements for irrigation, were realized submissive later to rearrangements. Today in Prahova inferior basin, are working for big arrangements for irrigation:

The System Iazul Morilor – Prahova, the System Buda, Leaotul and Iazul Morilor – Teleajan.

The Buda System – started to work in 1975, the most extensive of all, it irrigates a surface of 1471 ha. It has a total installed debit of 1,5 m^3/s, and uses the water from Prahova river.

The maximum volume of water taken is about 2,7 mil. m^3/year, that is 22 242 m^3/day, and the annual average 1814 m^3/h. The Iazul Morilor Prahova system dates from 1830, and it uses the water from Prahova river with an installed debit of 2,5 m^3/s. It insures the irrigation of 400 ha from the mountain field.

The maximum volumes taken from Prahova in a gravitational way, (its flowing being favorised by the slant generated by the dejection cane) are provided at 1,5 mil. m^3/year, 17,711 m^3/day and the yearly medium volume/ha is about 3985 m^3 water.

The length of the channel measures 25 km between Floreşti and Băltița, were is the junction with Cricovul Dulce (Sweet Cricov River) and it provides the necessary of water for the vegetable basin Filipeştii de Târg – Brătăşanca – Măneşti.

The Leaota System has been working since 1830 with an installed total debit of 4,6 m^3/s; it provides water for 94 ha from the longitudinal axle of the alluvionar cone created by Prahova and Teleajan.

Leaotul channel takes water from Prahova (the hydrotehnic knot Nedelea) and after 47 km it flows in the same river, after that it was initially diriguided towards Teleajan.

The maximum volume of water taken from Prahova is 170.500 m^3/h.

The Iazul Morilor – Teleajan System unfolds an area of 140 ha. It was build in 1830 an it uses water from Teleajan. The total installed debit is of 1 m^3/s, and the maximum volume of water taken gravitationally is about 208.600 m^3/year.

The thoroughfare channels measures 26 km between Măgurele and Berceni.

With the view to the for systems presented in the chart XII-1, were arranged form irrigation in 1998 about 2100 ha from the inferior basin of Prahova river.

In the superior sector of the basin, the clear and fast waters of Azuga, Doftana or Teleajan rivers, populated by a rich ichtiofauna (dominated by trout) is a creative element of a medium good for fishing and leisure.

[1] ***, FAO, Yield Response to Water (Roma, 1989)

So, we can mention the trout pound from Azuga with a surface of 1,25 ha, having the source of water Azuga river, were it captivates a volume of 450.000 m^3/year for eight basins.

The industrial needs but especially *the domestic need*, uses reduced volumes of water because of the high level of pollution mainly near municipalities and towns, which initially appeared and developed a wing to this fluvial organism.

As for the supplying with water of the industrial polygon Brazi, on Prahova river at Nedelea, there was build a dam type Wess, equipped with five metal obstacles.

Nedelea accumulation, realized by the dam supplies a debit of 3 m^3/s, for the industrial needs and 6,6 m^3/s for irrigation.

A destructive use of the water from Prahova basin is the collector and transport pipe of waste products of all kinds (industrial and domestic) from the urban areas.

The possibilities of using Prahova and Teleajan waters are limited because of the impurities generated by the worn out domestic and industrial water.

When these waters are insufficiently epurated by accumulation in chains the pollution of the river is realized.

The Use of the Lakes' Waters

The lacustrine units from Prahova basin have a lot of social-economical uses.

We'll mention some of the most important. The accumulation lake on Doftana river was built to assure a quantity of drinkable and industrial water for Ploieşti, Câmpina and industrial polygon Brazi – Teleajan; the producing of a medium quantity of electric power of 26,5 GWh/year; the irrigation of 22000 ha in the agricultural area near Ploieşti; enjoyment, tourism, fishing.

The facilities of the aquatic unit took place between 1967-1972. Paltinu barrage (dam) has a volume of 56 mil. m^3 and a surface of 170 ha.

There are three different ways of taking care of regularized waters from Paltinu dam:

- a free exploitation regime, were the volume of the lake enables to furnish supplementary debits hydro-energetically used;
- an exploitation regime, when the debits furnished to beneficiaries are those foreseen in the annual delivery debits plan for use; in this situation the hydroelectric power station, with an installed power of 10 MW is working in a subordinate regime to the utilities, using for compensation the buffer lake Voila;
- an exploitation system with restrictions to insurance of 97% where the debits are only for drinkable and industrial water, reduced according to the available debits to some consumers in some proportions, in according to their importance.

For those in Prahova area, water, after it has been treated flows about 42 km through out a pipe with a diameter of 0,80 – 1,00 m, made of premo pre compressed pipes which can carry 1,2 m^3/s and resist to pressure of 4-10 atmosphere.

The aquaduct Măneciu, situated on the river Teleajan has a lot of usages: providing Ploieşti with water – Teleajan – Brazi with an interconnected with the accumulation Paltinu inside the hydrotehnical system Prahova – Teleajan, taking into account the fact that the water-storage dam/basin offers water of a bad quality and in insufficient quantities.

By its reserved water volume (600 mil. m^3 it is provided) a supplementary debit of water of 200 l/s, that makes a better supplying (feeding) with water of the settlements on the Teleajan valley.

The lake has a length of 4 km and a surface at the normal retention level of over 100 ha, enabling the building of UHE Maneciu with an installed power of 10 MW and a production capacity of about 30 mil KWh/year.

The clear water of the two lakes are populated by a rich ichtiofauna where predominates the umber and miller´s thumb – a fact that attracted *fishing* as an agreement modality.

The main way of using water is *pisciculture*. This is practiced in an organized frame in the ponds built in the basins of the small affluent of Prahova river.

By its surface and economical importance, remark able are those belonging to the Maia farm. This construction is supplied from Maia river and it includes five compartments with a total surface of 95 ha. The dominant species is the carp and the crucian.

It's going to be built the pond Țuianca near Gherghița which will be supplied with water from Țuianca river a small affluent on the right of Prahova.

We also *mention usage of reed and rush* which are abundantly in the inferior basin, used locally to cover the domestic annexes or for different knittings.

The antropolasine lakes from Prahova basin, which belong to the category of the mineral waters were and are used for *the health protection*, being known for their balneoterapeutic importance.

Salty waters and mud from Slănic, Telega and Țintea are highly recommended to treating and preventing affections like rheumatism, affections of the nervous peripheral system, gynecologic, cardio-vascular and dermatologic affections.

The therapeutic affection of the antropasaline lakes is due both to the high water mineralization and the sapropelic mud of a black color - the product of the anaerobe bacteria action on the bottom of the lakes (Baia Baciului, Baia Neagră, Baia Verde).

The chemical composition of the mud contains mineral substances, chlorine, bromine, sulphat, nitrate, bicarbonate, potassium, sodium, calcium, magnesium, iron, alluminium, ammonia, titan, in proportion of 52%, as well as reduced quantities of organic substances which contain humic acid, proteic substances and cellulose.

The concentrated cloruro-sodic waters from Slănic have a similar composition to those from Salies de Bearn Salins Montiers (France), Droit Wich (England), Satzunghen Oberhausen (Germany) or Salso Maggiore (Italy).

The Usage of the Underground Waters

The underground waters owing to their advantages in parallel to surfaces waters (most of them being drinkable without a prior treatment, constant debits in time exploitation possibilities near the consumer) are the main source of supplying the urban and rural areas with water. They are used especially for *domestic use* and *in the industrial* and *agricultural domains.*

Hydro geologically speaking the basin has rich resources of underground water inside the lime stones and conglomerate from Bucegi mountains, Strata from Cândeşti poliocene deposits as well as the freatic aquifer, Strata in the meadows from the terraces of the rivers especially in the inferior and middle basin of Prahova river. On Prahova river were 998 drillings of using water in 1998, 447 of them belong to 32 systems and 551 spread throughout the territory. From the total of existing number of drillings, 61% (606) are realised in the alluvial aquifer complex, and 39% (392) in the depth aquifer strata.

Most of the drillings belong to the industrial and zootechnic units (82%), followed by those made by the local communities for the local use in proportion of 14,5 % respectively those executed for the agricultural section (irrigation) with 3,5 %.

The water volume taken out of the aquifer complexes in 1998 was about 75,764 thousand m^3.

This is as follows 67,4 % from the underground selected water comes out from the depth acvifere complexes, 27,3% are furnished by the freatic aquifer, 3,5 % from streams and 1,8% from drainages.

The alluvionar cone Prahova – Teleajen is the main hydro structure inside the basin, with the surface of the 935 km^2 and an acvifer potential estimated by A. Cinetti (1990) at 7,7 m^3/s.

The alluvionar cone contains ten captures with a total debit of 2230 l/s.

Of the underground volume of water exploited in 1998, about 55,3 % was used for the industry necessities, 41,8% for the population necessities and 2,9% for agricultural needs (including irrigations).

Prahova alluvionar cane offers exploited of 5.200 l/s, 1.690 l/s (32,5%) of the debit is used by population, and 3.100 l/s for the industry necessities.

In the area of Bucegi mountains most springs supply the touristic resorts with water situated in the superior valley of Prahova: Sinaia, Poiana Țapului, Buşteni, Azuga.

The most important stream situated on the Spumoasa Valley, Urlătoarea (Buşteni), for the preparation of the paper paste, although the supplying of the touristic resorts is deficient for many years mainly on the top seasons.

Aquifer complexes with rich debits appear in the sedimentary places in the axes of the synclinals in the subcarpatian zone.

It can be mentioned the catches on the tire factory from Floreşti (Victoria), Băicoi, Urleta, Bordeni – Scorțeni, all of them in Silištea synclinal.

In the year 1998, in Prahova area there were 193 units which used underground water and had a number of 254 drillings for the water exploitations, necessary for the population, industry and agriculture supply, endowed with debit measure systems.

You can see that the high volume of underground water of the town Ploieşti used by its inhabitants and industry (23,2% mil. m^3 / year) as well as by the petrochemical industry (S.C. Petrobrazi, S.C. Astra Română and Rafinăria Vega), with a total need of 10,9 mil. m^3.

Concluding we can say that the hydrographic basin of Prahova river has rich resources of drinkable surface and underground water capable of supplying the necessities of the town. The great number of inhabitants, the industry development and the agricultural needs are only some of the facts we will have to take into account in the future.

It can be said that the high standard of living of the society is conditioned by the total volume of water that a society uses.

A high level asks for great amounts of water both for domestic needs and public services, industry, agriculture, and generally speaking for the maintaining and a high standard of living. The volume of drinkable water transported throughout the water pipes is now of 75,5 mil m^3, Ploieşti and its surroundings need 62,6 % drinkable water from Prahova basin.

The volume of water used in industry (in 2000) was of 829,4 mil. m^3, 710,6 m^3 represents the recycling waters (85,7%).

The oil refinery needs a great amount of water (industrial water) 445,0 mil m^3 (53,7%) fallowed by the energetic industry with a necessity of 293,0 mil. m^3 (35,3%).

Only this two industrial activities use about 90% of the industrial water used in the studied basin.

In the table 1 is presented the industrial water consume divided on activity branches relatively speaking to those from Japan.

The agricultural activities inside the basin benefit of a total volume of water of 13,5% m^3, 55,8% used in pisciculture and 29,9% for irrigation.

Table 1. The volume of water used in different industrial activities and the proportion the volume of recycled water (2000) in Prahova county[2]

Industrial activity	The volume of water used	The volume of recycled water	The quantity of recycled water	The quantity of recycled water in Japan
Food industry	3,900	340	8,7	32
Paper industry	10,821	5,371	49,6	43
Petrochemical industry	445,031	390,007	87,6	90
Chemical industry	6,436	2,429	37,7	82
Rubber industry	944	219	23,2	75
Equipment industry	28,012	19,950	71,2	65
Thermic and electric energy industry	293,040	272,000	92,8	-

Nowadays the existing infrastructure allows the insurance of great quantities of water that can be furnished, to population and industry.

On the superior Prahova Valley, the deficit of water can be observed, that's way an accumulation lake on Azuga river should be built with a water volume of 130 mil. m3 and a surface of 75 ha which would supply with drinkable water the resorts Azuga, Buşteni, Sinaia, Comarnic and Breaza used also to produce the electric energy for pisciculture, enjoyment for 2015 it is estimated a consumption of water of 430 l/day/a person in Ploieşti and Câmpina, 320 l/day/a person in the other towns from Prahova basin, 210 l/day/a person in limitrophe villages.

The new payment system for the water services has influenced favorably the protection and the consumption of water in our district, by a decrease of the water loses, the purge and evacuation of the used waters, it is in fact a source of fund of the waters in the district.

Referring to the underground waters, a better work is recommended, a correspondingly equipment of the wells with excellent pumps as well as an efficient turning to account of the mineral streams by tourist facilities to polarise the main beneficiaries.

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[2] according to S.G.A. Prahova

Importanța economică a apelor în cadrul bazinului hidrografic al râului Prahova

Rezumat

În ultimul deceniu, în condițiile implementării structurilor economiei de piață, modul de folosire a resurselor de apă a devenit o problemă de mare însemnătate, instituțiile abilitate în domeniu acordând o atenție deosebită gospodăririi unitare a apelor de la suprafață şi subterane, urmărindu-se, totodată, păstrarea proprietăților naturale, împiedicarea impurificării şi a poluărilor. Utilizarea apelor în zona bazinului studiat s-a menținut în raport cu alte regiuni la un nivel ridicat, atât ca volum, cât şi ca diversificare a folosințelor, fapt explicat prin numărul aşezărilor omeneşti cu populație totală de 745 000 locuitori, dar şi a prezenței unor unități industriale mari consumatoare de apă.