TRANSNATIONAL INTEGRATED MANAGEMENT OF WATER RESOURCES IN AGRICULTURE FOR EUROPEAN WATER EMERGENCY CONTROL (EU.WATER)

REGIONAL REPORT

Tisza river basin – Hajdú Bihar county, Hungary

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Trans-Tisza Region Environmental, Natura Protection and Water Inspectorate

Debrecen, 2010
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1. Tisza river basin – Hajdú Bihar county, Hungary

1.1. Location and topography of the area

Hajdú-Bihar is an administrative county in eastern Hungary, on the border with Romania. It shares borders with the Hungarian counties Szabolcs-Szatmár-Bereg, Borsod-Abaúj-Zemplén, Jász-Nagykun-Szolnok and Békés. The capital of Hajdú-Bihar county is Debrecen. Together with Bihor County in Romania it constitutes the Biharia Euroregion.
The area of the county does not form a geographical unit; it shares several features with the neighbouring areas: from northeast the sand hills of the Nyírség spread over the county borders. The western part is the Hortobágy (“Puszta”), a large flat area of the country.

The county of Hajdú-Bihar occupies the eastern part of Hungary. Most of its territory is completely flat and is part of the Pannonian Plain region (called the Grand Plain in the country). The highest point hardly rises over 170.5 metres in the north.

The wind and rivers formed and shaped the land for thousands of years. First the area of the present-day Hungary was occupied by an inland sea. Then, after some underground movement, the huge peaks of the Carpathians rose from this sea. The wild and rapid rivers of the mountains slowly made that inland sea disappear. Later, the great Hungarian plain was formed by the alluvial deposits of the rivers, the wind began to work and from the great rocks became smaller and smaller sand-grains, the so-called loess. This covers thickly the Hajdú-Bihar plain as well and makes a fertile soil.

There are two great rivers in this area, the Tisza and the Körös. The Hortobágy area was formed by the first one. It used to be the flood area of the Tisza river and after the river was controlled, the Hortobágy became dry, resulting in special fauna.

Hajdú-Bihar County came into being as a result of the administrative rearrangements made in 1950, as a result of the unification of Hajdú County and the part of Bihar County situated in Hungary, as well as the incorporation into this new county of several settlements of Szabolcs-Szatmár-Bereg County. Debrecen lies 220 km away from Budapest, the nation’s capital.

The total area of the county is 6,211 sq. km. The northeastern part of this territory is occupied by the sandy hills of the Southern Nyírség, the central is called Hajdúság, where the winds have drifted fine loess deposits on which extremely fertile chernozem soils formed, the western-northwestern part is occupied by the picturesque Hortobágy and the Borsod floodplain, while the southern part is made up by the Berettyő-Körös region (Nagy- and Kis-Sárrét, Berettyő-Kálló area, Érmellék, the Bihar Plateau).

1.2. Climate

Although Hajdú-Bihar County extends on a small area and there are no big height differences among regions, significant climatic variations can be recorded both from the West to the East, and from the South to the North. The climate of the county is drier in the summer and slightly colder in winter than in the Great Plain.

Hajdúság, situated in the central part of the county, represents, from all points of view, the transition between the colder and rainier Nyírség and the warmer and drier Közép-Tiszavidék (Mid-Tisza Region), and the Hortobágy. It is here that climatic influences from the surrounding regions meet. This is the area where the warm climate of the Southern Nyírség, with moderately dry and cold winters, meets the dry climate of Hortobágy with moderately hot summers and the warm climate of the Körös region with moderately dry, hot summers.

The number of sunshine hours in the county is relatively high. The annual number of sunshine hours is 2,020-2,150; the annual average temperature ranges between 10.5-11.0 °C and it increases from the North to the South. The average temperature is highest in July when it ranges between 20.5 and 22 °C and often exceeds 22 °C in Hortobágy. Winter usually brings
frost; the coldest month in winter is January. In the Kőrös-region, the average temperature in January is -2.5 °C, and it reaches and even exceeds -3 °C northeastern regions. Because of the cold winter, spring comes late. The last frost occurs between 20-25 April, but every three or four years it also occurs in the month of May.

Hajdú-Bihar County is one of the driest regions in the Great Plain, while the southern part of Hortobágy is one of the driest regions in the country. Here, the annual amount of rainfall is less than 500 mm. The amount of rainfall reaches 550 mm in Hajdúság and in the Berettyő-Kőrös Region, and 600 mm in Southern Nyírség, 300-350 mm of which fall during the crop-growing season. The month with the heaviest rainfalls is June (55-75 mm), the driest is January (25-35 mm). The annual amount of rainfall is distributed unevenly throughout the year, and a typical characteristic of the continental climate is that the amount of rainfall in the wettest month is 2.5 higher than in the driest month. The annual amount of rainfall, mainly because of its distribution, is not sufficient to ensure the safety of agricultural crops. Annual water shortage is highest in Hortobágy (150-175 mm), but also in the best agricultural area, in Hajdúság, as the amount of rainfall here is only around 100-150 mm. The average number of days when the ground is covered by snow is between 30 and 40 (highest in Hajdúság and Nyírség), which is below the national average. Another problem is that the snow-blanket in the area is quite thin; moreover, the strong winds prevent snow from covering the ground evenly, which increases the risk of freezing in the case of autumn crops.
1.3. Soil Types

The terrain of the county is quite varied as the neighboring regions also extend into its territory. The northeastern part of the county is occupied by the sandy hills of Southern Nyírség. The two regions of Hajdúság, Hajdúhát and Hajdúság proper, can be found stretching from North to South in the central part of the county. The western part of the county is occupied by Hortobágy, one of the regional units in the Mid-Tisza Region. The southern edge of the county, occupied by the Berettyő-Kőrös region, stretches over the administrative boundaries of the county.
Hajdú-Bihar County lies in the eastern part of the country and its almost featureless territory made up by plains is entirely a part of the Great Hungarian Plain. The highest point in the county (170.5 m), can be found in the Nyírség region, north of Fülöp, while the lowest point can be found in the southeastern part of the county, in the area of the Hamvas and Sárrét Canals, South of Püspökladány and Szerep, close to the boundary of the county, where the height of the ground above sea level is below 85 m.

The geographical characteristic of Hajdú-Bihar County is that its surface is covered in young, loose, smooth and very thick sediments of continental origin. The diversity of the scenery of the county is a consequence of the changes that took place in the modern geological era. Rivers springing from higher grounds brought and deposited clay- and sand-bearing sediments into the former continental sea that was gradually changing into a lake. The now filled up and dry area underwent other important transformations in the Pleistocene as a consequence of tectonic movements and climatic changes. The energy of the rivers increased as the area sank further and the neighboring grounds (the Carpathians) continued rising. During the Pleistocene, rivers deposited 100-200 m thick, mainly sandy sediments on the Pannonian foundation.

As the Körös region sank, river floods ceased in the Nyírség and Hajdúság area, thus the wind became the chief agent in shaping the now dry surface. From the silt in the Nyírség area, the northern winds gathered up sand on which shifting sands, humic sands and brown forest soils formed. In Hajdúság, the winds drifted fine loess deposits, on which extremely fertile chernozem soils formed.

The surface of Hortobágy and of the Berettyó-Körös region was further shaped by rivers. As a matter of fact, Hortobágy came into being due to the Tisza River. Up until the flood control works in the 19th century, it used to be the floodplain of the Tisza River. In the beginning, the river eroded and wasted the deposits formed in the Pleistocene and then gradually filled the area with stream depositions several meters thick. Under the influence of water, alkaline soils (solonetz and solonchak) and meadow soils formed. The Berettyó-Körös region underwent similar transformations in the Holocene. The muddy sediments, loess and argillaceous deposits that precipitated from floods covered the silt here, as well. The types of soil characteristic to the region are meadow and alluvial soils, as well as solonetz soils in some places.
1.4. Agriculture in Hajdú-Bihar County

With a territory of 621,056 hectares, Hajdú-Bihar County is the fourth largest in the country. The total area under cultivation is 544,472 hectares, 334,203 of which is arable land. The county ranks second in Hungary in this respect. This is what determines the importance of the county from the point of view of agricultural output.

The natural conditions are favorable for the cultivation of all kinds of crops. Besides co-operatives, private and family farms also play an important part in this sector. Half of the area of the county is in the use of private farms.

The structural change influenced land division according to lines of cultivation to a slight degree. 14.3% of the county’s area is uncultivated land. The most frequently cultivated plants are corn, wheat, sunflower, sugar beet and potato.

Livestock farming is the most productive agricultural branch in the county. It holds more than 45% of the whole agricultural output of the county. Cattle-breeding is the most important kind of livestock-farming in the county. Swine-breeding has gone through a number of crisis periods in the past 10-15 years, as there were only short periods when production costs were recovered. The population of livestock has been increasing.
1.5. Surface waters

**Characteristics of surfaces water systems in the area**

In the project area there are only a few natural water flows with significant runoff. In north – north-west there is Tisza. There is only a little money for the establishment and maintenance of inland water systems, but at the same time the vulnerability against inland water flooding has increased in the settlements and in agricultural areas too in the last decade.

Regarding flood-control it is important to mention that most of the project area is imperiled. Due to the flood release cultivation and the life of the settlements are saver in the areas along our rivers. Flood-control became more and more complicated in the last decades because of the altered (accelerated) rain gathering in the basin and because the extreme hydro meteorological situations became more frequent.

Regarding water management, most of our stock of water is originated from Tisza. The users obtain its water through the Irrigation-system of Tiszalök, whose most important two elements are the Keleti-főcsatorna / Eastern-main canal and the Nyugati-főcsatorna / Western-main canal. However this biggest irrigation system of our country has been established for irrigation, it also serves other significant water management tasks such as water supply for ponds, conservational tasks (ecological water demand, water supply for wetlands), supply of drinking-water and water for industry, taking in inland waters and water quality control tasks (dilution of contaminated surface waters, refreshing waters). Besides these it is essential for life in itself and has an important role in forming the landscape.

Based on the above mentioned it can be said that in one part of the year the experts have to struggle against flood and in the other part of the year against lack of water. Equalized supply
of water can be ensured by appropriate water management in case of extreme conditions e.g. with storage of water that is applicable in more of our areas. Except the water system of Eastern- and Western-main canals our surface waters also serve as receivers of sewage and waste water of settlements, agriculture and industry.

Regarding water quality, our water flows are mainly in the categories of „generally protected” and „periodic water flow”. Concerning pollutant load, water flows under conservational protection are authorized separately. According to the Water Framework Directive of EU we have to reach the good conditions of waters till 2015. It is important to note that the more significant users of environment (sewage emitter) have to comply with the Hungarian laws harmonized according to EU provisions since 31st of October, 2007 that means that the „toleration” time’s up for them. Beyond this toleration time, in case of significant or frequent exceeding of threshold limits, the sewage emitters are obliged to prepare pollution reducing schedule and are obliged to realize it by the authority.

So the effective laws do not allow the constant and harmful pollution even besides paying penalty. The obvious aim is to comply with the threshold limits, to eliminate and to avoid the harmful pollution. The common deadline for toleration time is 31st of December, 2010. In sensitive areas, for emitters who emits sewage above 10 000 population equivalent the deadline is more severe: 31st of December, 2008, in non sensitive areas emitters who emits sewage above 15 000 population equivalent the deadline is less severe: 31st of December, 2015.

The Eastern-main canal / Nyugati- főcsatorna (NYFCS) is 70 225 m long, high-running canal that located along the settlements of Tiszavasvári, Újtikos, Polgár, Folyás, Újszentmárgita, Hortobágy, Gyökérkút, Szásztelek. The main canal supply water for irrigation for the areas between Tisza and Eastern-main canal / Keleti főcsatorna and supply water for ponds. The main canal is operated by Tiszamenti Vízmővek Rt. according to a concession contract for a period of 20 years (1995-2015).

Simultaneously with the establishment of the Western-main canal (1963-1965) the irrigation canals N-I, N-II and N-III were established too that ensure the water supply for irrigation in the area between Király-stream and Western-main canal.

There are authorized irrigated sites and ponds in the settlements of Tiszavasvári, Tiszacsege, Polgár, Hortobágy, Tiszadada and Tiszadob that have water supply from the Western-main canal.

The Eastern-main canal / Keleti- főcsatorna (KFCS) branches from the left bank 520+150 section of river Tisza above the dam of Tisza-řék. The main canal runs along the peripheries of settlements of Tiszalők, Tiszavasvári, Hajdúnánás, Hajdúböszörmény, Balmazújváros, Nagyhegyes, Hajdúsáboz, Hajdúszovát, Tetétnak, Kaba, Földes, Berettyőújfalu and Bakonszeg.

The Eastern-main canal is an above controlled canal. For water saving operation, under controlling can be used in case of which manhandle is needed.

The main canal had been divided into two water bodies according to what is included in the plan of catchment basin management. The so called Eastern-main canal North water flow
water body is the line segment between sections 0+000-4+677 of the main canal and the Eastern-main canal South water flow water body is the line segment between sections 4+677 – 98+156 of the main canal.

The South water bodies was divided into three “böge”-s. The “böge” No I. is located between sections of 4+677- 44+550 of Eastern main canal. This is the place (4+677-4+795) where sluice of Tiszavasvári was established. The capacity of the sluice is 45 m³/s.

In the “böge” No I. a communication canal was built in 1998 between Eastern and Western-main canals that can pass a maximum of 12,5 m³/s water. This establishment ensures water passing in the period of sluice renewals.

The is located in the section of 44+555 of Eastern-main canal between the comb of Balmazújváros and the comb of Hajdúszoboszló in the section of 65+435. In the comb of Balmazújváros a maximum of 35 m³/s water can be passed to the “böge” No III.

The line segment between the comb of Hajdúszoboszló and the end-section (65+435- 98+156) is the “böge” No III. The constant water supply can be ensured by the water level controlling water works that separates “böge”-s.

The Eastern and Western-main canals’ communication canal, the K- I.- main canal, the K -III. –main canal, the K -IV. main canal, the K-V reservoirs, the K-V-1 roundabout canal and the combs of Hortobágy, Magdolna-stream and Brassó-stream can be operated from the “böge” No I.

The K- VI. main canal, the HTVR canals, the K-VII-Köszely, the K-VIII main canal, the K-IX main canal, the K-XI-Ö-Berettyó water passing line and the water tapping of Korpád-stream, Pece-stream, Hamvas, Sárréti, Tilalmaséri, Köleséri are supplied with water from the “böge”-es No II.-III.

According to the 4. § of decree of KvVM (Ministry of Environment and Water) No. 6/2002. (XI.5.) the line segment of Eastern-main canal from river Tisza to Balmazújváros is designated as drinking-water base (category A3). The place of water taking out is determined as the section of 48+340.

The entire line of the Eastern-main canal — from the issue to the sluice of Bakonszeg — is designated as fishy water (bream water).

Regarding the above described, we examine the quality of water at four places from the issue to the end-section.

The Inspectorate’s main task is to perform inland water examination in the Eastern and Western-main canals and its inland water canals — in the frame of water quality control — because of the water utilizations that are sensitive for water quality (industrial, ponds, conservational). The schedule of inland water intake into the main canals is determined on the basis of the inland water examinations.

In case of the establishments with agricultural water utilization we have to mention — besides Eastern and Western-main canals and its irrigation canals — the authorized establishments that were built up in the frame of Hajdúsági Multifunction Water Management System / Hajdúsági Többcélú Vízgazdálkodási rendszer (HTVR). Such as: H-I/1 feeding line, L-1 feeding line, L-1 feeding canal, equalizer reservoir, L-1 reservoir, H-III feeding line, H-III-1 feeding line. These water works ensures the irrigation water for the areas in the peripheries of
settlements of Balmazújváros, Debrecen, Nagyhegyes, and Ebes — east to the Eastern main canal.

In the project area there are irrigated sites of significant size in Nagyhegyes, Hajdúszovát and Hajdúnánás-Tedej.

The most important canals that have two functions are — in connection with ensuring water for irrigation and regarding the way of water supply — Hamvas main canal, Hortobágy main canal, Sárréti main canal, Kati-stream, Tilalmas canal, Ürmös-stream and Kösely-Hajdúszováti through cut.

**Water stock:**

The utilizable water stock of river Tisza has to supply water in area of four Directory of Water Management (TIKÖVIZIG, KÖTI-KÖVIZIG, KÖR-KÖVIZIG, ATI-KÖVIZIG) according to the Co-operate Water Management System, called Tisza-Körös völgyi Együttműködő Vízgazdálkodási Rendszer (TIKEVIR).

The amount of utilizable water stock for the 4 Directory is 40 000 l/s from which there is 25 000 l/s water in the area of TIKÖVIZIG (that is the project area) (from this 500 l/s is directly from Tisza and 24 500 l/s from Eastern and Western main canals) and 15 500 l/s must be transmitted to TIKEVIR.

The main water taking outs from river Tisza are the sluices of Tiszavasvár (Eastern-main canal, Western-main canal). The water level and runoff of Western-main canal are affected by the operation of the barrage of Tiszalök and the floods in Tisza.

There are more opportunity for delivering water to Körösvölgy through the Western-main canal (Reje, Király-stream, Árkus I., Árkus II.). The amount of delivered water is always regulated by the current water-stock-sharing order of Tisza-völgy (e.g. 1/2007. VKKI oder of chief director).

In the “böge” of Western-main canal I.-II.-III., the amount of engaged water for irrigation — according to the data processed till April of 2009 — is 581,47 l/s. Beyond this — till the above mentioned date — the water demand of authorized ponds is 5406 l/s. Based on the above described the total amount of engaged water in Western-main canal is 5987 l/s, while the amount of water available — according to what is included in the plan of water-limitation in 2009 of TIKÖVIZIG — is 12 400 l/s that means that there are plus water stock in the Western-main canal.

Regarding the Eastern-main canal it can be also stated that — based on the above referred plan — the amount of available water stock exceeds the amount of engaged water (for irrigation, for ponds and for industry and households).

In case of rivers Berettyó and Sebes-Körös in the area of the project, there are no available natural water stock, so in this case we can only talk about conditional water utilization.

In the right bank of river Sebes-Körös the water demand is 137 l/s for irrigation and 246 l/s for ponds, according to data processed till April of 2009.

According to the plan of water limitation of 2009 — in the area of the project — 11 111 l/s plus water stock is(was) available.
1.6 Hydrogeology and ground water quality

1.6.1 Hydrogeological description of the area

The project area is located in the great landscape of Alföld and the more important small landscapes concerned are the followings: Hortobágy, Hajdúhát, Dél-Hajdúság, Dél-Nyírség, Nagy-Sárrét, Berettyő-Kálló köze, Bihari-Sík.

The location of the small landscapes are shown in the following map:
Small landscapes in the area

In the project area there are detritus water reservoirs from Pliocene-Pleistocene age from which water is available. The water of these Pliocene age water holding formations in about 1300 m deep cannot be used as drinking-water because of its high temperature and high concentration of salt and gas, however it can be used as thermal water. The water utilization for drinking water, for industrial and agricultural use takes place form the Pleistocene alluvial beds that hold cold freshwater. The public utility water is taken from the deeper Pleistocene groundwater that are the most appropriate regarding both its quality (better chemical characteristics, greater natural protection) and quantity (great thickness, existing also in regional spread, better hydro geographical parameters etc.).

In the area the formations of quaternary this way the Pleistocene river sediments are usually rich in water, has good water conducting ability and their frequency is about 50 % within the water body both horizontally and vertically. Between these formations there are the ridge and the floodplain facies that are semi-permeable because of the floury clay and clay layers in them. The quality of underground waters is usually objectionable because of containing methane, arsenic, ammonia, nitrate, iron, manganese. For providing drinking-water, the water from the pumps has to be treated nearly everywhere.

Hortobágy

The elevation of the small landscape is between 80-110 m, it is typical floodplain. Its geomorphologic forms are the left beds of river Tisza, belt banks and strongly abraded shifting sand forms. Primarily it is characterized by fine deposition (clay and mud) and on the surface there is usually muddy-clay loess. In hydrodynamic aspect the area of Hortobágy can be considered as tapping area. Here the hydraulic gradient increases approaching the deeper layers this way the water leakage to deeper beds is not possible naturally. The upwelling zone is indicated by the both the high shallow groundwater and the salinization at the eastern edge of Hortobágy.

Hajdúhát

The elevation of the small landscape is between 93-162. This plain covered by loess and loess-mud is located between Nyírség and Hortobágy. The deposition of the rivers is together with loess at some places. In the south parts there is 2-10 m thick loess and muddy river deposition. Significant clay occurrence is connected to it too (Hajdúböszörmény, Hajdúnánás, Debrecen). The area of Hajdúhát can be characterized by transient pressure conditions. Here the vertical communication between the beds is minor compared too the horizontal water leakage.

Dél-Hajdúhátság

The elevation of the small landscape is between 88-110 m and it is an alluvial fan covered by loess-mud. The surface is poorly structured vertically. On the Pliocene layers of great thickness there is even 200 m Pleistocene river deposition in some places.
In the area of South-Hajdúság (e.g. the area between Hajdúböszörmény–Nagyhegyes–Debrecen) the level of shallow groundwater is at 8-15 m under the surface in some places.

**Dél-Nyírség**

The elevation of the small landscape is between 100-162 m and it is an alluvial fan covered by sand. Its surface is structured by NNE-SSW valleys. The slop is S-SW. In the examined area there are broad wind-furrows and smaller deflation holes. The deposit near to the surface is mostly 1-25 m thick shifting sand. The area of Nyírség is confirmed to be a leakage feeding area, the vertical hydraulic gradient is negative that means that there is opportunity for the shallow groundwater to filter into deeper beds.

**Nagy-Sárrét**

The elevation of the characteristic small landscape of Berettyó-plain is between 85-100 m and that is developed at the west part of the alluvial fan of Sebes-Körös. Most of the surface is covered by floodplain mud and clay.

**Berettyó-Kálló köze**

The elevation of the small landscape is between 88-130 m and it is an alluvial fan covered by loess and sand. The geomorphologic forms are mainly created by rivers. More than ¾ of the surface is covered by Holocene floodplain and marsh mud and clay among of which there are Pleistocene floodplain infusion loess and mud covered areas. The area of Berettyó-Körös vidék cannot be considered as a rich area in deeper groundwater. The small landscape is an upwelling area in hydrodynamic aspect.

**Bihari-sík**

The elevation of the small landscape is between 87 and 103 m, the alluvial fan of river Sebes-Körös. There are Holocene and Pleistocene deposition on its surface and near to its surface; their thickness together reaches even 30-50 m. The deposition becomes more and more finer approaching the surface. Gravel can be found at Ártánd and Biharkeresztes.

**1.6.2. Groundwater quality**

The county may well be poor in surface waters, but it is rich in groundwater. When it comes to groundwater, the picture is quite different. Groundwater lies deeper above the elevated Pannonian block. Thus, groundwater above the elevated Pannonian block lies 6-20 m deep in Hajdúság, 3 m deep in the Southern Nyírség, but only 1-2 m meters below the surface in Hortobágy. The salt content of groundwater ranges on a wide scale. It is highest in Hortobágy, 2-3 g/l, but it can also be as high as 10-20 g/l.

The depth waters in Hajdúság also have national importance. Some of the deep wells in the area spring medicinal thermal waters to the surface. Thermal and medicinal baths have been built in several settlements of the county. Debrecen, Hajdúszoboszló, Hajdúböszörmény, Berettyóújfalu, Biharnagybajom, Komádi, Kőrösszegapáti, Hencida, Sárrétudvari and recently Balmazújváros are famous for their thermal waters.
1.6.3. Groundwater utilization

In case of groundwater utilization, there are two different types such as direct utilization – from pumps or wells – and indirect utilization that have similar effects as direct water utilization e.g. when inland waters are tapped by canals. In our project area, the spread of public utility water works from the mid 60’s and the fact that water consumption became general led to overconsumption of ground waters. The amount of water utilized by public water works increased by nearly 500 % between 1965 and 1990. From the late 90’s this increment stopped. Stagnant status was characteristic and in some places there were also some reduction.

Besides the utilization of shallow groundwater the utilization of ground water from deeper beds increased a lot due to several non regular and unauthorized pumps. According to estimations the amount of water utilized by farms, illegally irrigated areas or hobby gardens is nearly equal to the industrial water demand of the whole region.

Description of the area of water consumption of greater importance:

Water supply of settlements
In Hungary, drinking-water – including partly water for industrial plants – is mostly (more than 94%) supplied from groundwater. The other water utilizations are of less importance compared to drinking-water consumption. The rate of water utilization for drinking-water is high in every types of water-bodies except the warm water-bodies that are warmer than 30 °C, where water is utilized for bath and energetic reasons.

In the project area there are 88 settlements. The water demand of these settlements is supplied from groundwater by water works. In 7 settlements of these, water is supplied from
thermalwater, in the other settlements drinking-water is supplied from porous bodies (that is ground water from deeper beds).

**Industrial water utilization**

Utilization of underground water bodies by industry is significantly less than that of water supply of settlements. In the area the food-industry is significant and beside food-industry the engineering industry and chemical industry are also considerable.

**Agriculture**

Agriculture and food-industry were always significant in Hungarian economy and also in the project area. Due to the political-economical changes between 1990 and 2007 the performance of agriculture – mainly that of stock-raising – relapsed significantly. The use of fertilizers and chemicals decreased due to the reduction of productiveness and this had a good effect on the quality of surface- and ground waters.

As for agriculture it can be established that filed cultures are dominant in the peripheries of the settlements. Raised plants are the followings: corn, wheat, barley, potato, cabbage, tobacco, horseradish és fruits (apple, sour cherry, raspberry, red currant, strawberry, cherry, peach, grape, etc.).

The irrigating farming in Hungary is in a hard situation, the area of fields that are irrigated is nearly 2% of the seeding area. 75 % of the agricultural area that can be irrigated is located in Alföld. The amount of authorized area that can be irrigated has only altered a little. The amount of areas that are effectively irrigated altered more significantly: the different between two years can be even 30%.

Along bigger rivers or more significant water flows that have constant stock of water (main canals) the water for irrigation is available. In some places it is not allowed to irrigate because of the quality of water. Water of good quality for irrigation is available mainly along Tisza and the canals that distribute the water of Tisza.

It is not rare in our area that there are no water flows that could ensure water for irrigation. In areas like this cultivation with irrigation cannot even be ensured by appropriate water management (e.g. water reservoir). In these areas and where the availability of surface water for irrigation is limited because of quality or quantity problems the water for irrigation is provided from ground waters.

Till today it was common that the designers designed water supply for irrigation from deeper beds where the quality and refill is appropriate. However the current regulations limit the use of water from these deeper beds for irrigation. One of the restriction is that groundwater (primarily shallow water) can only be used for irrigation when there are no opportunity for using surface water. The other restriction is that groundwater from deeper beds can only be used for micro-irrigation – if possible without using those beds that are also used by water works of settlements. The aim of these restrictions is obviously to save ground waters but their applicability can be queried.

Stock-raising is also significant in this area since there are thousands of stock-raising farms (pig, store cattle, poultry) and most of them are of great numbers. The water generally provided from own pumps is used for water the animals and used in liquid manure technology.

Food-industry (e.g. vegetable-fruit processing plants, slaughterhouses, canneries) ensure its technological water demand from own pumps.
In our area there are 14 baths that ensure their own cold water and cooling water for thermal-water pool from own pumps.

Water utilization between 2004 and 2007 in the project area (thousand m³/year)

<table>
<thead>
<tr>
<th>Utilization</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock-raising</td>
<td>4117</td>
<td>4452</td>
<td>4198</td>
<td>3942</td>
</tr>
<tr>
<td>Irrigation</td>
<td>1351</td>
<td>947</td>
<td>926</td>
<td>1155</td>
</tr>
<tr>
<td>Industry</td>
<td>3595</td>
<td>3566</td>
<td>2833</td>
<td>2511</td>
</tr>
<tr>
<td>Drinking-water</td>
<td>29862</td>
<td>28979</td>
<td>29564</td>
<td>30548</td>
</tr>
<tr>
<td>Bath cold</td>
<td>1077</td>
<td>1073</td>
<td>984</td>
<td>1369</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40002</strong></td>
<td><strong>39017</strong></td>
<td><strong>38505</strong></td>
<td><strong>39525</strong></td>
</tr>
</tbody>
</table>

It is clear from the above table that the amount of drinking-water supplied by water works is multiple of the total of the other categories. The water utilization of agricultural irrigation and stock-raising together is nearly equal to water consumption of industry and baths together. It can be observed that while water consumption of industry decreased from 2004, water consumption of agriculture was stagnant but that of baths increased. The reasons of these counter-processes can be e.g. the economic crisis and the great development program of baths in this area started some years ago.

**Classification of quantitative and chemical status of underground water (draining limit, threshold limit)**

The necessary measurements to the realization of the aims of „Water Framework Directive“ (2000/60/EC) are included in the water catchment basin management plan (WCBMP). During the planning of water catchment basin management – that is happening these days – the classification of underground waters and water bodies that are the basic units (maps No 1-2.) is based on the quantitative and chemical (quality of water) aspects. Classification of water body is determined by the worse value. All of the classifications have two class: good or low.
Map No 1.: Underground shallow porous water bodies in the project area
The essence of tests for **quantitative status** is to evaluate the impact of water utilization through pumps on the water stock, on the status of ecosystems that depend on underground water, on the ecological runoff of water flows, on the runoff of wells and the alteration of water quality.

The criterion of good quantitative status of underground water body is that the volume of direct and indirect water utilization do not exceed the amount of applicable water stock.

On the basis of distribution of direct water utilization from pumps that are well expressed in numbers, in the project area water utilizations for drinking-water are the most significant and beside this the agricultural water utilization (irrigation) and the industrial (economical) water utilization are also significant.
The above mentioned is well confirmed by the table No 1. that includes the authorized water utilization and the real consumptions in 2009 in the project area:

<table>
<thead>
<tr>
<th>Aim of utilization</th>
<th>Authorized (m³)</th>
<th>Consumption (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>public purposes</td>
<td>32 987 383</td>
<td>28 365 918</td>
</tr>
<tr>
<td>economic (industrial)</td>
<td>3 978525</td>
<td>2 559 655</td>
</tr>
<tr>
<td>irrigation</td>
<td>1 737 021</td>
<td>714 271</td>
</tr>
<tr>
<td>stock-raising</td>
<td>3 617 370</td>
<td>2 839 359</td>
</tr>
<tr>
<td>bath</td>
<td>1 021 474</td>
<td>755 694</td>
</tr>
<tr>
<td>Total:</td>
<td>43 341 773</td>
<td>35 234 897</td>
</tr>
</tbody>
</table>

The basis of the **quality examinations** is the determination of so called **threshold limit** concerning pollutants that differs in every types of water. Threshold limit means that concentration of pollutant in case of which the so called receptors (man through drinking-water and food, and water, wetland and terrestrial ecosystems) can be dangerously polluted. In Hungary, these threshold limits are determined per water bodies and types of water bodies for the following components: NO$_3^-$, NH$_4^+$, conductivity, Cl and SO$_4^{2-}$, TOC, Cd, Pb, and Hg. In case of pesticides, tri- and tetrachloro-ethylene and AOX, the threshold limit is determined in national level.

Our two porous water bodies are in poor status primarily because of the diffuse origin nitrate pollution. (Because of its significance, we emphasize that one of the water body is in poor state also because of the endangered status of the drinking-water base!)

Most of the nitrate come from the agriculture and less has municipal origin.
1.7 Pollution sources

1.7.1 Pollution sources of surfaces waters

In this chapter four main pollution sources were examined.

Point-sources of pollution

Municipal sewage/wastewater

In the project area there are 31 municipal wastewater-treatment sites. These wastewater-treatment sites treat a total of 40 settlements’ wastewater. The treated wastewater of the sites is generally let into surface water flows. It is the characteristics of the project area that there are numerous intermittent water flows. This means that these water flows do not have own water stock during most of the year. This way it can happen that in some periods the only water source is the treated wastewater in most parts of the water flow. Subsequently, the water quality of some parts of the intermittent water flow is frequently determined by the treated waste water.

Some wastewater-treatment site that has outworn construction and technology do not emit treated wastewater. This is the reason why the oxidation lake system that follows the mechanical treating phase is not isolated, subsequently not watertight. Besides evaporation, the leakage to the soil is also so significant that the potential surface in-taker does not receive treated wastewater. It is also important regarding these sites that the hydraulic charging reaches only a part of the designed one (about 40-60 %) since the drainage is only low
proportioned compared to the number of houses. These settlements (Kaba, Hortobágy, Vámospércs) have already possess permissions for extension of its drainage systems.

The methodologies used by the wastewater-treatment sites in the project area are very divers. Except the wastewater-treatment sites of the three above mentioned settlements all the sites possess at least mechanical and biological treatment phases. In cases of settlements whose treated wastewater is received by sensitive water flows, there are also a third treating phase too. In most of the cases this means chemical phosphor elimination.

In the last decade some of the wastewater-treatment sites had been extended and updated (Debrecen, Hajdúszoboszló). The improvement of the quality of emitted wastewater led to an improved water quality in the in-taker water flows too. Based on the above described it is understandable since in this project area there are no great water flows and intermittent and small water flows are dominant.

Because of the main topic of the project, we note that about 10-15 years ago the irrigation from the upper section of one of the polluted water flow (Kösely canal) had to be forbidden by the authority because of the bad water quality.

After the updating and intensification of existing wastewater-treatment sites the pollution of the water flows is expected to be reduced but at the same time the wastewater of settlements that have no drainage system will be a newer pollution source in the surface water flows.

**Industrial waste water**

There are 10 significant ones among the industrial and institutional wastewater emitters. The others are smaller, among them there are some that have less than 10 m$^3$/d emission. The institutional wastewater emitters are typically small emitters (< 20 m$^3$/d). There are two industrial plant that emit a significant amount of cooling water beside the technological wastewater and this has a good impact on the wastewater quality that flows into the in-taker except in the summer period. Some institution and plants in Debrecen will be connected to the municipal drainage system in the near future. The reason of this is the not adequate and outworn wastewater setting.

It is not typical to regularly exceed the threshold limit among industrial plants. In the last years, more emitters have updated its wastewater treatment. Among the institutional emitters it happens sometimes that there is constant exceeding of threshold limit through years, so they have to pay penalty constantly too. The reason of this is that small amount of wastewater that cannot be treated biologically.

The industrial wastewater emitters do not emit hazardous substances beyond threshold limits.

**Baths**

The used/waste water emission of baths in the area of the project has a special significance. The baths usually have salt water reservoirs from which the water is released in late fall. The reason why the salt water reservoirs expanded in this area is that there are only water flows with small runoff and the water of the baths would have a bad impact on their water quality regarding the sodium and salt content. The seasons of bathing and irrigation are at the same time and water with high concentration of sodium cannot be used for irrigation. Since the high concentration of sodium declines the quality of the soil and could lead to salinization. With using salt water reservoirs the problems of irrigation water can be avoided.
The salt water emission of baths could cause problems only in case of those water flows in the project area where Eastern and Western-main canals cannot supply water for irrigation. These are the so called two-function canals and those water flows that have small own water stock but there is demand for irrigation in their neighborhood. According to the Water Catchment Basin Management Plan prepared on the basis of the water Framework Directive of the EU the emissions of baths have to be reconsidered and have to be re-regulated.

**Ponds**

The sinking of ponds can be considered as intermittent and point-like intakes. It is typical that they charge the in-taker once or maximum twice a year for a period of some weeks but with a lot of stored water that determines the water quality of in-taker in that time. In the project area this kind of charging occurs mainly in case of Kösely main canal, Kadarcs-Karácsonyfoki main canal, Királyéri main canal, Hortobágy main canal, Árkus main canal, Selypes-éri canal and Alsó-Kadarcs canals.

**1.7.2. Point-like pollution sources in the agriculture**

**Stock-raising sites**

In case the treatment of manure does not comply with the requirements of Good Agricultural Practice, the great stock-raising sties can be significant point-like pollution sources for the underground waters and in some cases for the surface waters too. The sites that possess integrated pollution control permissions have to comply with the above mentioned requirements at the latest of 31st of October, 2010. The liquidation of manure reservoirs that are not used anymore will last one year further.

In the stock-raising deep litter technology is used in one hand that does not product a great amount of wastewater but this also can consider as point-like pollution source because of the storage of the manure – in most cases on an area without coating. In case of stock-raising with liquid manure technology when the requirements are not complied with and the leakage from non-isolated reservoirs can cause pollution.

In the examined areas there are 7247 stock-raising sites and more than half of them (4472) are located in the water catchment area of Hortobágy-Berettyó subunit* and only 2775 site are in the area of Berettyó subunit*.

*Water Catchment Basin Management Plan (hereinafter: WCBMP)
When preparing the WCBMP it could be seen that from the 500 great stock-raising sites most of them were in the area of Hortobágy-Berettyó subunit, a total of 354 sites (see on the map below).

Due to the hard economic situation in the past few years greater stock-raising sites were closed. Earlier in some of the big beeves raising sites and in the past few years in some intensive pig raising sites the raising has been finished.

According to the records of the Inspectorate there are at least 42 sites empty.
There are some new sites too, mostly poultry-raising ones although not as many as were closed down, mainly in the area of Tiszavasvári-Tiszadob.

In the area examined in the frame of EU.Water program beeves, pig, sheep and poultry are primarily raised.

Regarding their environmental impact there the following types of beeves-raising sites:

Large-scale beeves-raising site:
There are raised more hundreds of beeves in these sites that are intensive milking ones. Here works more worker and there is a head of site, a veterinary for the tasks that require special knowledge. Squeezing with machines takes place in the dairy house that is usually near to the stalls. In these sites beside the production of litter-manure there are a lot of manure-polluted precipitation too and the treatment and storage of liquid manure from cleaning the dairy house and ways causes problems. At the same time the operators are more and more frequently look for alternative solutions for the treatment of the technological wastewater from the dairy houses. The wastewater-treatment sites usually refuse the reception of milky wastewater because of its amount and special biological properties.

Family farms:
A maximum of 50 beeves are typical that can be raised by a family. Squeezing is performed by machines here too, but there are no separate dairy house in every places. They have to handle similar problems like in case of large-scale stock-raising but in smaller scales.

Store cattle raising site
The sites that only perform feeding of animals do not product as many manure and liquid manure because of the way of raising that is based on pasturage. The situation is similar in case of heifer raising too that takes places separately in an independent site.

In the beeves raising sites the polluted precipitation comes from the top of the stalls and silo-containers requires further special attention.

Status of pig-raising sites and their environmental problems
In most of the sites that possess integrated pollution control permissions the appropriate reconstruction of the manure storage has already started or even finished that has to be followed by the update of the technology of raising. Since the technology of raising influences the amount of (liquid) manure that is produced.
With the isolation of reservoirs and construction of new reservoirs only some critical points remain in the delivering system that has to be isolated and controlled well beside their monitoring.

Poultry raising sites
The raising of water-poultry has decreased entirely and the former bathwater system is also outworn that pollutes waters less.
The chickens for their meat are raised in more thousands or even hundreds of thousands numbers in sites. These sites are equipped with entirely automatic system and water saving drinking system. The produced great amount of manure is sometimes taken by mushroom growers but in most cases it is used in fields. Its storage is difficult since according to the provisions there cannot be any manure container in the area of a poultry raising site.
In the egg producer sites a sludge-like manure is produced due to keeping the animals in cages that needs special treatment and its use requires special attention.

In case of the use of manure we have to prevent diffuse pollution.

**Diffuse pollution sources in agriculture**

**Stock-raising sites and use of manure**

The grouping of point-like and diffuse pollution sources are in overlap to some extent. In case of pollution from agriculture, most of the emitter can be considered as point-like emitters however the large-scale stock-raising sites and cultivation (organic and chemical fertilizers, soil erosion etc.) are typically diffuse sources. However deciding whether a source is point-like or diffuse can depend on the scale too: since a lot of point-like sources together in a bigger area can be considered as diffuse source (e.g. the drainpipes of agricultural areas or the more thousands small stock-raising sites in a smaller area).

The alimentary substances stock of agricultural areas divers because of the different cultures and different ways of cultivations. The smallest scale of statistical data for the total agricultural area is the county level.

The agricultural pollution comes from the past great plus of alimentary substances in the upper layers of the soil that is mainly accumulated phosphorous. This stored plus reaches the surface waters by hydrological processes, mainly by runoff and erosion.

The pollution from organic fertilizers can be calculated from the number and type of raised animals in the peripheries of settlements, accepting that beeves produce 60 kg Nitrogen/year, pigs 10 kgN/year, sheep and goat 9 kgN/year and poultry 0,4 kgN/year (Csathó-Radimszky 2004).

This calculation cannot take into account that practice that the manure produced in a site is delivered to other places too. To the field use of liquid manure produced in the sites, the size of the area where it can take place only increased by 100 hectare since the WCBMP has been prepared. Beside this there are constant applies for permission of new irrigation areas or for the continuance of the permission of the existing ones.

The updating of treatment of liquid manure would lead to an increased amount of field use too. Since the new reservoirs would not allow the evaporation nor the leakage. On the other hand due to the development (updated raising technologies, water saving cleaning) and the reduction of areas that can be polluted the amount of liquid manure produced will reduce too. Due to the modern treatment of liquid manure the role of the liquid manure in the refill of alimentary substances can increase. During the storage there is a smaller loss of alimentary substances in the less liquid manure that is diluted with water that could make the field use even more economic.

These all can realize in case of the precise field use and keeping the authorized doses with that the diffuse pollution can be prevented.

With the help of the modern equipments/injectors that are purchased in case of development the achievement of these can be resolved according to the data of special literature.

Same way the updated storage of litter-manure could have a positive impact on prevention of pollution because of the better content and applicability.

**Use of wastewater**

In 2009 the soil protection authority has permitted the use of treated wastewater from dairy houses and canneries in fields in 1140.38 hectare area but it happened only on 504,28 hectare area according to the reports.
The use of dried out sewage sludge occurred on 807.14 hectare that is a 17% increase compared to what is included in the WCBMP. This partly due to the extended drained systems.

**Biogas plants**

In the examined area there are several biogas plants planed to be established. Some of them will be installed to beeves and pig raising sites in order to use the in site producing raw material energetically. In case of pig raising sites the production of biogas can be realized by adding appropriate amount of filamentary crops and in case of beeves raising sites by adding liquid manure in fermenting plants. In the plants even this way remaining materials are produced that need storage and then use. One section of this remaining material is sold as compost to black mould or used for littering in beeves raising sites. The fermented liquid phase that is already poor in alimentary substances is poured out this way it could not cause charging and pollution in the environment.

**Control and monitoring**

Due to the regular control required by laws and the extension of monitoring systems we can get an even clearer picture on the impact of the agricultural activity on environment. Following the data collection their setting out and their definition is of great importance. With the audit (control of efficiency of material- and energy-management) ordered in the IPPC permissions we can follow up the amount of used water in case of bigger sites. The reasonable use of materials and energy is also important for the operator because of the cost efficiency.

**1.7.3. Hydrography**

Hajdú-Bihar County has few rivers, and there are no big rivers in the area. The Tisza River flows along the northwestern boundary of the county only on a 53-km section. The Berettyó River and, on a short section, the Sebes-Kőrös River flow through the southern part of the county. Although less important in terms of flow, the Hortobágy and the Kősely, as well as Kálló Rivers flowing across Southern Nyírség, are characteristic live waters of the county. The whole county is part of the drainage basin of the Tisza River; the rivers running through the western part of the county flow directly into the Tisza, while those in the larger, eastern part reach the Tisza through the Berettyó and Kőrös Rivers. As a consequence of the low amount of rainfall, the specific flow in the riverbeds is low and smaller watercourses receive water only when snow melts or in the case of bigger thunderstorms.

The Eastern Canal, built in the 1950s, which connects the Tisza with the Berettyó River, is extremely important, as the network of canals connected to it ensures the irrigation of the driest areas in the county, as well as the diversion of inland waters in the spring. Most of the surface waters in the county are used for irrigation and fish farming and, to a lesser extent, in industry, except for the Eastern Main Canal, which has been the main source of drinking water supply in Debrecen for decades. The Western Main Canal is an important source of water supply for the Hortobágy National Park.

The still waters in the region have different origins. The natural still waters in the area remained in the old riverbeds (Kadarcs Lake, Kungyörgy Lake, Pince Moor). Lakes also
remained in the moors (Nagydarvas and Kisdarvas) and in the cut-off bends of the Tisza River. The number of artificial still waters has grown in the past few years. These are used for different purposes. In the alkaline soil areas, fishponds (Hortobágy, the Köröös-region) or reservoirs (Borsós, Nagy-plain, Szálka-plain) were built. 25.9% of the total surface of fishponds in the country are located in Hortobágy. The Erdőspuszta lakes were created near Debrecen for the purposes of tourism and recreation.

The county may well be poor in surface waters, but it is rich in groundwater. When it comes to groundwater, the picture is quite different. Groundwater lies deeper above the elevated Pannonian block. Thus, groundwater above the elevated Pannonian block lies 6-20 m deep in Hajdúság, 3 m deep in the Southern Nyírség, but only 1-2 m meters below the surface in Hortobágy. The salt content of groundwater ranges on a wide scale. It is highest in Hortobágy, 2-3 g/l, but it can also be as high as 10-20 g/l.

The depth waters in Hajdúság also have national importance. Some of the deep wells in the area spring medicinal thermal waters to the surface. Thermal and medicinal baths have been built in several settlements of the county. Debrecen, Hajdúszoboszló, Hajdúböszörmény, Berettyóújfalu, Biharnagybajom, Komádi, Körösszegapáti, Hencida, Sárrétudvari and recently Balmazújváros are famous for their thermal waters.

**HYDROPHYSICAL CATEGORIES of SOILS**

**Hajdú-Bihar County - North Great Plain**

![Hydrophysical categories of soils map](image)

**Legend**

- **Very high infiltration rate and permeability, low water holding capacity and water retention**
- **High infiltration rate and permeability, moderate and low water retention**
- **Good infiltration rate, permeability, water holding capacity and water retention**
- **Medium infiltration rate and permeability, high water holding capacity and good water retention**
- **Medium infiltration rate, low permeability, high water holding capacity and high water retention**
- **Low infiltration rate, very low permeability and high water retention and unfavourable water management**
- **Very low infiltration rate and extremely low permeability, very high water retention and extreme water management**
- **Good infiltration and permeability, very high water holding capacity and water retention**
2. Nature Conservation

Hajdú-Bihar County has internationally recognized natural monuments. The roots of environment protection in Hungary can be traced to Hajdú-Bihar County, more precisely to its center, Debrecen, as a part of the Great Forest (Nagyerdő) in Debrecen was the first region in the country to become an environmentally protected area in 1939. Moreover, the first national park of the country, the Hortobágy National Park, also came into being in Hajdú-Bihar County. The Park received the honor of being declared a World Heritage site on December 1, 1999, by decision of the UNESCO World Heritage Committee. The flora and fauna of the park are unique.

80% of the area of the Hortobágy National Park can be found in Hajdú-Bihar County. The characteristics of the grass-covered Hungarian plain in the 18th-19th century have been preserved here almost unchanged. The conservation of the unique flora and fauna of the National Park (www.hnp.hu) is an important task. Due to the relative integrity of the park and to nature conservation activities, the wildlife in Hortobágy today reflects the original species, especially as far as birds are concerned. The original area of the park is a biospheric reservation, while a quarter of it is protected area according to the Ramsari Agreement regarding the protection of water birds. In the past, primeval domestic animals (grey cattle, long-wooled sheep) grazed in large herds on the vast, naturally formed alkaline steppe; today their number is much lower, but they still play an important part in the conservation of the genes.

Besides the protected natural monuments, there is also a landscape protection area in the county. The 7,000-hectare Hajdúság Landscape protection Area consisting of 22 distinct zones and formed by the action of the winds, with its enchanting landscape of wind-formed sand-hills intermingled with birch moors is situated in the Southern Nyírség sand-hill and grove region. The forest combinations containing the whole range of protected plants (flatland and lily-of-the-valley oak-groves, sand plain lawns and sand plain meadows) are also rich in wildlife. Wild boars can be found in birch woods, deer on the edge of the forests and, as a result of repopulation, pheasants are once again common.

The Bihar Plateau with its varied landscape became a landscape protection area in 1998; it lies in the Berettyó-Körös region and it borders upon 33 settlements in Hajdú-Bihar County. The landscape protection area includes the Nagy- and Kis-Sárrét region, the Bihar Plateau, the Érmellék and the Berettyó-Kálló area. Water birds build their nests on the seasonal and artificial lakes that are also important stopping places on the route of migrating birds. The most important forest in the Bihar Plateau, whose boundaries are set by the Berettyó and Sebes-Körös Rivers, is the Miklósfő-forest in Hencida due to the woody grasslands in its central clearing. However, the most important and famous natural relic in the Bihar plains is the bustard.

Other environmentally protected areas of national importance can also be found in the county. The most famous one is the Debrecen Nagyerdő (Great Forest), which besides being a protected area, is also the natural relic the city is famous for. The area occupied by lily-of-the-valley oak-groves is 1,200 hectares, 200 of which is covered with more than 150-year-old common oak trees.
3. Questionnaire for Tisza river basin – Hajdú Bihar county, Hungary
Questionnaire (Qs) for data collection on water and nitrogen management in agriculture

**Project Title:** Transnational integrated management of water resources in agriculture for the EUropean WATER emergency control

**Date:** 4 November 2009

**In the framework of:** WP3 "Knowledge capitalization and sensitive areas maps"

**Responsible Partner:** Aristotle University of Thessaloniki, Greece

**Introduction**

This Qs has been prepared by the Aristotle University of Thessaloniki in the framework of the European-funded project EU-WATER in order to facilitate the collection of available data regarding water and nitrogen management in the designated target areas of the project. The aim of this task is to standardize the mapping process for the development of the GIS platform.

All partners are requested to fill in the Qs for their target areas. Each question is appropriately explained with added clarifications (red font) wherever necessary. Most questions are straightforward and require a short answer (yes, no, %, quantity etc.); if however, you need to elaborate any of your answers, please expand the size of the cells, as needed.

**General**

1. Date
2. Partner name
3. Country
4. Name of the target area
5. Target area coverage (km²)
6. Agricultural area coverage (km²)
7. Total population (No)
8 Active population (%) (age>15)
9 Number of cities/towns/villages
10 Population density (no. / km²)

**Production sectors and economic data of the target area**

1 Main production sectors (in terms of employment).
   Please give approximate percentage of employment in the most important production sectors of the area (especially in agriculture and Public Services)

<table>
<thead>
<tr>
<th>Sector</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Forestry</td>
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<tr>
<td>Tourism</td>
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<tr>
<td>Public Services</td>
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<tr>
<td>Other</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

2 Main production sectors (in terms of income).
   Please give the income distribution to the most important sectors

<table>
<thead>
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<th>%</th>
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</tr>
<tr>
<td>Tourism</td>
<td>2.1</td>
</tr>
<tr>
<td>Public Services</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>68.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

3 Main agricultural products
   Please mark the right answer below; if possible, provide type and quantities (tones)

<table>
<thead>
<tr>
<th>Product</th>
<th>Mark</th>
<th>Type and Quantity (ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>x</td>
<td>1503774 ton</td>
</tr>
<tr>
<td>Fruits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4 Livestock heads
   Please give numbers of livestock heads

<table>
<thead>
<tr>
<th></th>
<th>System</th>
<th>Heads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>in pasture</td>
<td>stabulated 81000</td>
</tr>
<tr>
<td>Pigs</td>
<td>in pasture</td>
<td>stabulated 479000</td>
</tr>
<tr>
<td>Birds</td>
<td>stabulated 3807000</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>stabulated 297000</td>
<td></td>
</tr>
</tbody>
</table>

5 Percentage (%) contribution of the target area in the total Gross National Product (GNP) of the country

6 Unemployment rate
   Please mark the right answer

   0-5%
   5-10% X
   10-15%
   >15%

7 Is there a development plan for the area?
   Please mark the right answer

   Yes X No

8 Total percentage of enterprises that receive EU grants for agricultural production (i.e. CMO, CAP, Rural Development Program)

   % 99
   Comment (if necessary)

Legislation
1 Are there any protected sites within the target area? (Places of natural interest, Natura 2000 sites, National Parks, natural heritage areas etc.)

   Yes X No
   Hortobágy National Park, Natura 2000 sites

   Comment (if necessary)
2 Is the WFD in operation?

Yes No
X

3 Have management zones (based on river basins) been developed in the framework on WFD?

Yes No
X

4 Is the NFD in operation?

Yes No
X

5 Are there any designated "nitrate-vulnerable zones" (NVZs) in the target area in the framework of NFD?

Yes No
X

Climate and meteorology

1 Meteorological stations

Do you have monthly data from at least two meteorological stations (number, coordinates, altitude, datasheets)(Minimum parameters monthly rainfall and temperature)? If no, please answer Qs 2-7 below.

Yes No
X

If yes, this data will be entered in appropriate form in the database

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2 Average Temperature of summer growing season (May to October)

Value Unit
18,21 °C

3 Average Temperature of winter growing season (November to April)

Value Unit
3,56 °C

4 Average Precipitation of summer growing season (May to October)

Value Unit
49 mm

5 Average Precipitation of winter growing season (November to April)

Value Unit
37 mm

6 Average Reference Crop Evapotranspiration of summer period (May to October)

Value Unit
76,6 mm

7 Average Reference Crop Evapotranspiration of winter period (November to April)

Value Unit
9,38 mm
## Crops Data

1. Crops / Irrigation / Fertilization. Please fill in the table for the main crops

<table>
<thead>
<tr>
<th>Crop</th>
<th>Wheat</th>
<th>Maize</th>
<th>Sunflower</th>
<th>Barley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (ha)</td>
<td>34127</td>
<td>115239</td>
<td>43871</td>
<td>9405</td>
</tr>
<tr>
<td>Winter or summer crop</td>
<td>summer</td>
<td>summer</td>
<td>summer</td>
<td>winter</td>
</tr>
<tr>
<td>Irrigation method (e.g. drip irrigation)</td>
<td>pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation amount (mm)</td>
<td>80-240</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average crop factor of the growing season for the calculation of evapotranspiration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen fertilization rates and type (kg N/ha) and methods (basal, surface and number of applications)</td>
<td>80-150 kg/ha</td>
<td>80-150 kg/ha</td>
<td>80-150 kg/ha</td>
<td>80-150 kg/ha</td>
</tr>
<tr>
<td>Average yield (kg/ha)</td>
<td>7035</td>
<td>7740</td>
<td>2148</td>
<td>2500</td>
</tr>
</tbody>
</table>

2. Origin of irrigation water (groundwater or surface water)

<table>
<thead>
<tr>
<th></th>
<th>Groundwater</th>
<th>Surface water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

3. Irrigation water pricing method

Please mark the right answer

- Method A: Cost per ha for every crop (e.g. consumption is not considered)
- Method B: Consumption-based pricing (e.g. type of crop is not considered)*
- Method C: Both consumption and type of crop are considered
- Other method (please describe)

*In this method private wells (p.w.) are included (cost based on electric power or oil consumption)

4. Cost of irrigation water

Please give cost of irrigation water for each of the above methods

<table>
<thead>
<tr>
<th>Crop</th>
<th>Rice</th>
<th>Maize</th>
<th>Greenhouses etc</th>
<th>etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method A (€/ha for every crop; multiple values)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method B (€/m³; single value)</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Method C (€/m³/crop)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other method</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Pollution sources

1. **Point sources**
   - Please mark the point sources identified in the target area
   - Urban wastes (hospital, hotel, garage, car repair etc.)
   - Pit active or filled up with various waste types or abandoned used as inert wastes dump
   - Abandoned waste fields
   - Industrial wastes
   - Cattle breeding wastes
   - Fuel storage tanks (Petrol or gas station)
   - other (please add)

2. **Non-point sources**
   - Please mark the non-point sources identified in the target area
   - Agricultural practices (spreading of fertilizers and pesticides)
   - Surge of sea water
   - Storage and disposal of manure
   - Stockpiling of materials
   - Road salting
   - other (please add)

### Nitrogen management

1. **Are there any practices in order to limit nitrogen leaching?**
   - Please mark the right answer
   - crop rotations
   - soil winter cover
   - catch crops
   - application of dissolved fertilization in irrigation water (e.g. during drip irrigation)
   - surface application of fertilizers in doses
   - other (please describe)

2. **Are there any Fertilization Plans in place?**
   - Yes
   - No
   - Comment (if necessary)

3. **Is fertilization applied in regions close to water bodies (lakes and rivers)? Please note that**
minimum restricted distance from water bodies is 2m, while in case of slopy areas the distance is proportionate to the % of slope (e.g. the maximum distance of fertilization for areas with 5% slope is 5m from water bodies)

4 Are there any rivers and lakes that show eutrophication symptoms or bring high nitrogen fluxes to coastal water and sea?

5 Do soil analysis take place in the target area? If yes, how often?

6 Do manure analysis take place in the target area? If yes, how often?

7 Which approximately is the average dose of nitrogen in the manure applied in the region?

8 Have specific limits been set for the application of livestock manure?

9 Time sampling to collect info and existing water quality data for nitrogen species?

GIS data (existing data will be entered in appropriate fields in the GIS platform)

1 Digital Data. Do you have digital data of the following elements?

- Digital boundaries of the study area (polygon)
- Digital data for land use (polygons)
- Digital Elevation Model - DEM (raster)
- Digital soil type classes (polygons)
<table>
<thead>
<tr>
<th>Digital data of agricultural fields-sectors (polygons)</th>
<th>X</th>
<th>upload your .kmz file</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital data for surface waters i.e. lakes, rivers (polygons)</td>
<td>X</td>
<td>upload your .kmz file</td>
</tr>
<tr>
<td>Digital data for ground waters i.e. waterwells and aquifers (points and polygons)</td>
<td>X</td>
<td>upload your .kmz file</td>
</tr>
<tr>
<td>Digital data of point pollution sources (points)</td>
<td>X</td>
<td>upload your .kmz file</td>
</tr>
<tr>
<td>Digital data for protected areas (polygons)</td>
<td>X</td>
<td>upload your .kmz file</td>
</tr>
</tbody>
</table>