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The main findings of the dissertation

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The urban water management and the households' rainwater harvesting

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Introduction

Good quality fresh water is essential for humanity. Water is a condition of our biological existence, and it is a natural key resource for the society and the economy – but this resource is wrongly managed by mankind. In the densely populated areas of our planet the extreme exploitation of non-renewable water sources is getting more and more typical. The number of the areas where there are problems with water management is increasing. However, the enormous quantity of pollutants with which the human race contaminates the water resources is even limiting the utility even of the non-used natural water stock. The fresh-water crisis is typically most observable in the big cities and urban agglomerations. These areas are the main sources of water contamination, and generally these are the areas where high-quality clean water is handled in the most lavish way. The settlements which face the scarcity of good-quality water have to fight against the damages caused by the excess water quantities. The hydrological conditions of the man-made residental areas are entirely different from the conditions of the natural environment. The built-up areas and the paved surfaces modify the character of the runoff, the infiltration and the evaporation. Therefore the increasing areas of settlements are frequent sources of sudden floodings (flood waves), and pollution flows.

The prognosticated urbanisation trends and the process of climate change project the strengthening of the negative effects which concern the municipal water management in the 21st century, in the most densely populated regions of our planet. The big question of this century is the following: how will the urban water management be able to tackle of the lack of cheap and good quality fresh water, and how will it control the waters which threaten the municipal areas.

The recognition of the growing problems of urban water management in the 1970s and 1980s gave birth to the new ideals of stormwater control and of freshwater saving. Instead of the traditional approach of the quick and compulsory carrying away of the stormwater, appeared the principle of the municipal rainwater retention! The new views of the architecture, of the urban-development and planning (like ecological architecture or sustainable development of the settlements) have multiplied the methods of the infiltration, evaporation or welfare-ecological utilisation of the rainwater in the settlements.

The municipal and the domestic rainwater-harvesting is one of the new methods of modern urban water management, because the collection and utilization of the rainwater is able to reduce with high-efficiency a number of the elements of the urban water crisis.

The millennial method of urban rainwater retention has had its renaissance in the past 25 years both in the developed and in the developing world. The rainwater harvesting is the most complex method among the new solutions of municipal stormwater management – as a result of this activity, we can not only moderate the negative effects of the urban runoff but we can also significantly reduce the domestic and industrial freshwater use. It is important to note that the advantages of the municipal rainwater collection and use are limited. This activity is not able to reduce the local elements of the difficulties of regional water management (for example river floods or the inland water problems); and most cases it does not reduce the cost of the construction and maintenance of the drinking water related infrastructure. There are some doubts about the process of the domestic rainwater harvesting. These doubts are connected with the quality of the collected water, and with the slow return on the expenses of the investment.

Hungary has accumulated a huge backwardness in the development of the modern methods of the municipal rainwater management; the local governments and investors usually insist on the old methods of the treatment of the rainwater (rapidly carrying it away). Only in the past few years have been realized some projects in the field of modern rainwater management.

Until the last years nobody had been engaged in researching the characters and possibilities of the rainwater harvesting in Hungary. The neglection of this water management sector is extremly strange, as domestic rainwater collection and utilization have a long history in Hungary; and the current developing conditions of the modern rainwater harvesting are definitely good.

I. The main objectives of the work

1. Overview of the situation of the three most significant sectors (the drinking water supply, the communal waste water collection, and the municipal stormwater drainage) of the Hungarian urban management:

2. Review of the new ways of the municipal rainwater management. Description of the past and current trends of the rainwater harvesting of the residental areas.

3. Study of the social, geographical and hydrological elements of the households' rainwater harvesting in a Hungarian sampling settlement. The elaboration of the methodological components of the research. Production of basic data about the households' rainwater harvesting – among other for the further research of this sector in our country. Presentation of some of the few Hungarian examples, and the assessment of the future possibilities of communal and domestic rainwater harvesting.

4. Assessment of the economic and water chemical side of the urban rainwater harvesting, and refutation of the misgivings about the sector with the measured or calculated data.

II. The applied methods and the data sources

When writing the work, the most important method was to become acquainted with the Hungarian and foreign literature of the sector. The libraries and the world web helped me see through the components of the urban rainwater harvesting. The presentations of the Hungarian Hydrological Society, and the Hungarian Water Utility Association, the Hungarian Sewage Water Technology Association and the Ministry of Environment and Water were very useful for me to follow the actual trends of the sector. At my requests firms, contractors, local governments and bureaus provided information and data at my disposal. I would like to thank the researchers and specialists who selflessly helped my research.

I obtained the used statistical data from the Hungarian Central Statistical Office, the Hungarian Water Utility Association, the Ministry of Environment and Water, and from the different annexes of laws.

I am listing my further research methods in two groups. Among the human geographical methods I can mention the questionnaire survey among the households of the village Nagykovácsi and the municipal-governments interviews (in some settlements). With some students I asked 458 households about their domestic water management, in the summer of 2005 in Nagykovácsi (Pest county). This research was the first in our country to document the features of the municipal rainwater collection and use – even if only in one settlement. I have not found any similar surveys in the foreign special literature of the rainwater harvesting either. The interviews with local governments and the telephone interviews helped me to know more about other typical settlements where the rainwater harvesting plays an important

role. Some of the visits at the authorities (like Budajenő, Hatvan, Nagykovácsi, Telki) were very useful and informative.

Among the methods which are closer to hydrology, I would like to mention the studying of an aerial photograph of Nagykovácsi (taken in 2005), and the chemical analysis of the waters in the same village. I bought the aerial photograph from the Institute of Geodesy, Cartography and Remote Sensing. The comparison of this picture with the results of the questionnaire survey was very interesting, and gave some further information about the importance of the local rainwater management. Nagykovácsi (in the summer and autumn of 2007) was also the scene of the chemical analysis of the change of the rainwater running off from different surfaces, and storeyed for 66 days in cistern and in the open air. My colleague (Katalin Fehér) and I collected the water samples from different sources, and we analysed the samples in the laboratory of the Eötvös Lorand University Department of Environmental and Landscape Geograpy. Even if in the course of this research we could only investigate the main chemical parameters of the water samples, it was very interesting, because nobody had ever conducted similar research in Hungary before, and I have not read about the similar type of the comparsion of the differently stored roof top rainwater.

III. About the special literature

The special literature of the Hungarian municipal water management is quite rich. The topic of the water supply and the sewerage installation is not alien to Hungarian geographers (for example Hanusz 1894/b, Láng 1953, Gábris-Miholics 1971, Somogyi 1992); and with the publications of the authors being technical graduates a small library might be established (eg. Linhardt 1934, Lászlóffy 1940, Jakab 1952, Andai 1959, Nagy 1970, Markó 1989, Öllős 1990, Bertók et al. 2006).

The situation of the literature about Hungarian rainwater harvesting is just the opposite. The number of the published works is little and the number of the publications has only increased in the past few years. Before the 1990s, the existence of the rainwater utilization is only mentioned in one or two articles by specialist authors (eg. Hanusz 1902/b, Lászlóffy 1940, Vajda 1957). The first articles about the modern rainwater harvesting in Hungarian language were published only in the mid 1990s, mostly following the German technical literature (eg. Vaday 1994, Pálfi 1996, 1998, Vajdáné 1998). The theoretical investigation of the urban rainwater collecting and use appeared in the Hungarian scientifical

reviews only after the turn of the millennium (eg. Dulovicsné 2003, Dienes 2003, Horváthné-Wisnovszky 2003, Germ 2004, Gayer 2005/a, Sali 2005, Kónya 2006, Gayer-Ligetvári 2007, Varga 2007); and this topic has started to interest Hungarian geographers too (for example Rakonczai 2004, Bugya-Wilhelm 2004, 2006, Ronczyk-Wilhelm 2006).

IV. Results and conclusions of the research

1. Reviewing the three main elements of the Hungarian urban water management, much geographically interesting information has been presented, and some maps have been constructed. I would like to state the importance of the research which explored the spatial structure of the drinking water- and sewer system service companies' desintegration; until this research no maps have been constructed about the result of the desintegration.

I hope I could call the attention of Hungarian geographers to the undiscovered interesting investigation themes of the municipal water management sector – in addition to the description of the developement of the water supply- and waste water collection.

2. This is the first general work in Hungary in which the history and the current international trends of the municipal rainwater harvesting are written. In addition to the overview of the special literature, the work contains the experiences of some Hungarian examples.

3. When writing the dissertation, I had to find out some new methods of the human geographical investigation of the rainwater harvesting. The further development- and territorial extension of these research methods might give us much interesting information about the rainwater management in Hungary.

4. This was the first research in Hungary in which the subject of the investigation is the changes of the chemical parameters of households' collected rainwater. I have not found any examples for the comparative investigation of the chemical changing of the differently stored roof top rainwater even in the non Hungarian technical literature. The chemical measurements were able to refute the misgivings about the households' collected rainwater – concerning the investigated parameters, and the sampling suburban settlement, environment. The running off roof top rainwater suffered a significant deterioration – according to the foreign technical

literature; but the quality of the collected and filtered (2 mm hole diameter filter) rainwater was still extremely good. The water is able to retain its good quality for months in properly maintained rainwater storage cisterns. The investigation showed that – in the case of our research conditions, and according to the measured chemical parameters – the residential utilisation of the rainwater (like irrigation of the garden, toilet flushing, laundry and cleaning) has extremely low public health risk.

5. Regarding the investment return calculations of the economic literature it has been supported that in case of the total cost account of the urban water related services (this is expected by the European Union) the construction of rainwater collecting cisterns (this is the most expensive element of the households' rainwater harvesting) might be a refunding investment in Hungary – even without the authorities' financial support.

6. This was the first time that detailed data have been collected about the character of the households' rainwater harvesting in Hungary. The attention of the research has included the documentation of the number, the size, the types of rainwater collecting constructions, the estabilishing of the volume, the using methods of the rainwater, the recognization of the water-saving rate, the nearby volume of the running off stormwater, and the damages resulted from the stormwaters. The questionnaire survey conducted in Nagykovácsi, and the local governments' interviews have revealed that in some settlements of our country the rainwater collection and use is not as much a subordinate activity as it is usually known in the professional circles.

7. We have appointed the regions where in the coming decades (especially because of the estimated effects of the climate change) the importance of the municipal (residental) rainwater collecting and use might increase: these are the area of the mountains, the region between the river Danube and Tisza, and lands on the left bank of the river Tisza.

8. The research has also shown that in Hungary there is a special scope of the urban water management which can profit from the backwardness of the development of sewage conduit. Because of the long time delayed improvements of the sewer systems, a large number of Hungarian households have built domestic wastewater disposal systems; these constructions might have been a huge importance from the point of view of the development of the rainwater harvesting in the residental areas. As a consequence of the present building-up

campaign of public sewer systems, many of these domestic constructions are becoming unnecessary, and are getting perished – although these could cheaply be converted into rainwater collecting cisterns. This once built domestic waste water disposal constructions (over 1 million units) could be an important cornerstone of the development of the fresh water saving, and the new way of municipal rainwater management.

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