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Extended Abstracts

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2.1
Global climate change and water budget

title: **Factors and driving forces affecting water withdrawals in future**

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Limitation of possibilities of conflicts in water management in the European Union countries is mainly provided by the Water Framework Directive 2000/60/WE which created the framework of water policy in the European Union. It is characterized by elasticity in determination of goals, which should include environmental, social and economic aspects.

One of the elements, which has an influence for intensity of conflicts in water management, is climate changes. Among many existing definitions of „climate changes", the most adequate is following description: it is progressing process of both physical and chemical changes in the structure of atmosphere in which factors that cause this process lead to determination of new state of balance of all the climatic system in relation to the initial state.

The project „Influence of climate changes for environment, economy and society" regarding analysis of driving forces and factors that may have an influence for water uptake in the future.

The initiative of project „Influence of climate changes for environment, economy and society" (changes, effects and the methods of their limitation, conclusions for science, engineering practice and economic planning), acronym CLIMATE, which was taken by the Institute of Meteorology and Water Management in 2007, fulfils, in considerable range, the need of creating adaptive activities for climate changes. The project should be realized, in accordance to the schedule, in years 2009–2012, and its financing is also provided by the exploration part of the Operational Program Innovative Economy. The range of this project includes complex knowledge about climate changes and its negative impact for environment, economy and society. Within a framework of the project the solutions, which prevent this impact, should be elaborated, as well as, adaptive activities for new environmental conditions in important fields of economic and social life. Finally, the effects of realized program will become a scientific document, based on solid knowledge, results of which will be directly used by strategic government departments of the country for at least two time horizons: short and long-term.

Analysis, that were taken in the project, also concern future, balanced water resources management in Poland, especially driving forces and factors which may have an influence for water uptake in the future, depending on the path of economic development. Essential in this matter is interpretation of:

- influence of analysed path of Poland economic development for water demand and
- resulting from global economic development, the emission of gas causing greenhouse effect, which have an influence for climate changes, together with precipitation deciding about water resources.

In the CLIMATE project three economic scenarios were accepted as the basis for further consideration. They were elaborated by IPCC (International Panel for Climate Change) with code names accepted in *Special Report of Emission Scenarios* (IPCC Special Report*)*: A1B, A2 and B1. More accurate information about accepted scenarios are included in mentioned report.

Analysed versions will be the basis for conclusions about future water demand in Poland and possible difficulties in realization of balanced development rules. Those versions will be specified, which means that it will be interpreted, how to adapt development trends to Polish conditions. Moreover, it is going to be necessary to interpret them in categories of influence for water demand, which will require assessment of future unitary water usage indicators.

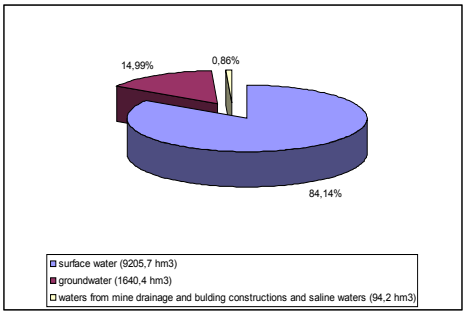

Figure 1. Structure of water uptake in Poland (in accordance to the Central Statistic Office).

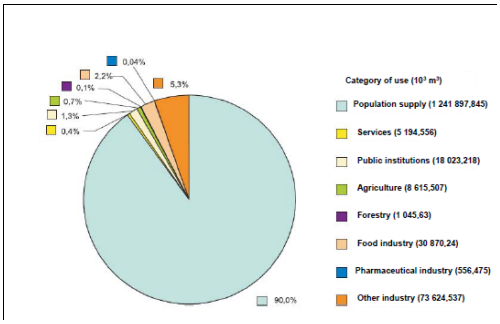

Figure 2. Diagram of usage structure of underground waters in Poland, according to the percentage uptake share registered in particular categories of usage in 2005; next to the categories total uptake is given (Frankowski et al., 2009).

The test of analysis of driving forces and factors that may have an influence for water uptake in the future was made in the groups, which are presented below.

Socio-economic development (economic growth — GDP gross domestic product, change of life conditions (standards), social trust (acceptance of changes, acceptance of expenditure growth), consciousness, ecological education, state policy concerning environmental protection, economic tools (charges, fines, the rule of repayment for water services, investment expenditure), none-economic tools (Integrated Water Resources Management, planning, determination of emission standards, determination of environmental standards)).

The path of economic growth is the basis for all the development scenarios prepared by IPCC. Basing on the water usage and economic data received from the Bank of Regional Data (BDR) and Central Statistic Office (GUS), it has been tested whether there is dependence between the value of GDP growth and water uptake. On the current stage of Polish economy development (after political transformation, industry modernization) this dependence was strongly limited. However, it does not mean that the path of economic growth will not have an influence for the value of water uptake. The influence will be noticed in fields such as conditions of life (improvement or deterioration), it will have an effect on state policy concerning usage of water resources and environment protection. Depending on the value of receipt to the state budget, investment expenditure will be determined, for example for new water-saving technologies.

Understanding climate changes, and simultaneously changes in water management, may be possible thanks to proper level of acceptance among citizens. In order to achieve this goal, one should take care of new educational programs. It is also important to organize process of society involvement properly. Adequate units should provide the information about climate changes, its effects and adaptive activities to as many receivers as possible: schools, offices. Therefore it will be necessary to prepare educational materials, organize trainings and, in schools, didactic lessons (education of children, youth, as well as, adults in the matter of climate and water resources). It will be also essential to co-operate with other more experienced countries. The example of such a country is France. Water agencies realizing water policy of the state, they also take care of promoting rational water resources usage.

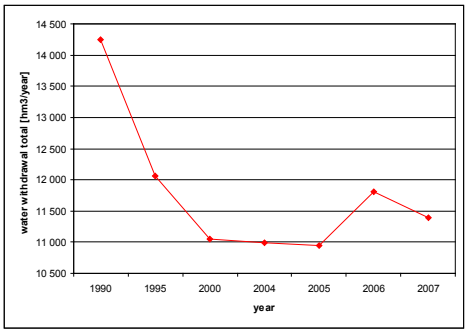

Figure 3. Total water usage in Poland in 1990–2007 (in accordance to the GUS).

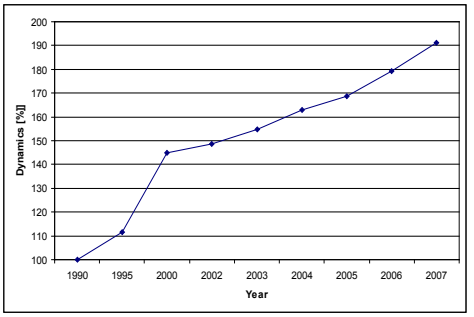

Figure 4. Gross Domestic Product (constant prices, year 1990 = 100%) in Poland in 1990–2007 (in accordance to the BDR and GUS).

Presently, water management is formed by following legal tools: juristic acts regulating aspects of planning and managing, administrative decisions including: water law permits, requirements for environmental parameters and standards of water usage for products and services. It may be assumed that the water price will be different in particular scenarios, however, it will be determined by GDP changes. Certain external factors, like distribution of income, may cause appearance of the new economic tools used for water management and lead to the modification of water law. Nevertheless, it may be presumed that implementation of the rule mentioned above will not be possible for particular water services.

Demographic development (population, life length, ageing of society, urban development).

Essential for water uptake, mainly groundwaters, will be demographic development of the country. Presently, water usage for communal purposes equals 99.6 1/M/d and it mainly comes from underground intakes (according to the GUS almost 70 % of water for communal purposes is uptaken from underground intakes). Global trends present population growth. In Poland, population decrease is forecasted, but for the size of water usage, following factors are also fundamental: life length, ageing of society and level of urban development. The income level will also have an influence and consequently life standard and the level of ecological education of society.

In last few years one can observe the quantity equalization process of water used in households located in urban developed and rural terrains. In households in urban developed terrains water usage for one consumer is falling and in 2008 it reached the value of 37.9 m^3/consumer/year (BDR data). However, in rural terrains one can observe contrary tendency — the growth of water usage for one consumer (33.7 m^3/consumer/year, BDR data), nevertheless, higher water usage still can be observed in urban developed terrains.

Changes of standard and lifestyle result in higher resources usage. Fundamental influence on water usage may have growing number of single households, in which water usage is higher than in households for several people (household for two people consumes 300 l water per day, whereas, single household consumes 210 l of water per day (European Commission, 2005)). Apart from development scenario this tendency will maintain.

Technological development (energetic economy, state policy concerning „technological progress", economic tools (subventions, public help, support of research programs), determination of water usage standards, as well as, electrical energy used by AGD, changes in industrial production technology (changes direction: growth, reduction of water absorption), state energy policy.

The size of future water usage in industry seems to be the biggest unknown, because it is very difficult to anticipate changes that may occur in industrial sector in the next tens of years, which industrial sectors will be dominating and how much water they will use. In spite of falling tendency in water usage for productive purposes, one can assess, that nowadays water absorption of Polish industry is still 2–3 times bigger than West-European industry (State Ecological Policy, 2009–2012), which means that in the future it is possible to achieve water savings in this national economy sector.

Among all industrial branches, nowadays, the biggest quantity of underground waters is used by food and pharmaceutical industry (properly 30 870.24 m^3 and 556.475 m^3, which is together 2.24% of underground waters uptake (Frankowski et al., 2009)). Those are industrial production branches that require good water quality, which is provided by underground waters. Economic development variant has fundamental influence on technological development of the state. Depending on the state budget, the values of investment outlays will be determined for new water-saving technologies, public help, support for research programs concerning innovation. Enumerated factors will have an influence on changes in industrial production technology, losses reduction, water recovery, changes in cooling technology and on direction of water absorption changes for one unit of created product. Also, the state policy in determination of standards of water and electrical energy usage for products and services will have an essential influence on future water uptakes.

Changes in agriculture (state policy concerning agriculture development, economic support of particular sectors of agricultural production through as for example additional payment system, rules of law which have an influence on changes in cultivation structure (energetic plants, biofuels, genetic modified plants), changes in irrigation of cultivation, measurement of uptakes).

According to the European Environment Agency (EEA) almost 24% of water in Europe is uptaken for agricultural purposes and only 1/3 of this water comes back to the water regions. Climate changes may determine deepening of excessive water resources exploitation resulting in decrease of its quality and growth of risk that salt water will mix with underground waters. It especially concerns coastal regions. Some of river and lake ecosystems dependent on water, can also suffer from water deficiency. Such a great water usage in agriculture may suggest bad functioning of price mechanisms. More frequent usage of intensive irrigation system by farmers together with better production efficiency only confirms this fact.

In 2005 about 0,8% (which is 9 661,137 thousand m^3) of underground waters uptake was used for irrigation in agriculture and forestry (Frankowski et al., 2009) (uptake for agriculture and forestry take 10% of total water uptake (State Ecological Policy, 2009–2012)). Essential for water uptake in agricultural sector will be the change in the method of irrigation which considerably depends on weather conditions and cultivation type. For future method of croplands usage the Common Agricultural Policy will have an influence and the system of extra charges for particular crops.

Considering the influence of agriculture for water uptake, what ought to be taken into account is growing amount of plants for energetic usage. Energetic cultivation needs more irrigation than many alimentary plants (plants for consumption), which may cause additional pressure for water resources.

CONCLUSION

Researches carried out in Institute of Meteorology and Water Management may be used for developing rules and structures of balanced managing of natural resources in Poland. Moreover, one should assess how great is the influence, that using those resources, have on environment, quality of life including progressing climate changes. Work is important, considering limitation of possible conflicts occurrence and developing adaptive activities, limiting damages caused as a result of possible climate changes. The path of economic development may determine changes in fields like life conditions, state policy concerning using of water resources and environment protection. Variance analysis will allow to take adaptive actions in economic and environmental policy. Researches carried out within a framework of CLIMATE project will allow to plan probable investment projects, which guarantee limitation of possible water deficiency. Furthermore, educational material will be developed, presenting sensitivity of water system for climate changes.

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