ANALYSIS OF ARIDITY-IN-PROGRESS IN THE DANUBE-TISZA INTER-STREAM AREA

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ABSTRACT

Under the impact of the significant lack of precipitation explained by the supposable change in climate in Hungary and the anthropogenic factors begun in the second half of the 19th century, and culminated in the second half of the 20th century, an aridity process has started from the second half of the 1980s in the Hungarian Great Plain. The tendency to a moderate drought significantly grew in all seasons but the tendency to extraordinary droughts became stronger in spring and in autumn only. The regional distribution shows a bad condition mainly in the regions of Hungarian Great Plain. In international comparison, according to the definition of the UNO Agreement on struggle against desertification and drought, the total area of Hungary can be qualified as an “area overtaken by drought”.

Key words: aridity, groundwater level, agriculture, precipitation

The climate of Hungary is being formed by the oceanic, Mediterranean, and continental climatic effects together. These together with the topographic effects of the Carpathian basin result in a climatic variability. The variation in temperature in Hungary follows well the global alterations, indeed it indicates some higher warming-up value than that. The most definite variation has been experienced in the temperature trend. The average on a country-wide scale follows well the global alterations, it indicates some higher warming-up value than that. Its breakdown by seasons shows greater deviations anyway. While the winter and the spring temperatures increase mainly in accordance with the annual average, the summers better (about 1°C) and the autumns less (0.4 to 0.5°C) follow this warming-up.

The warming-up has accelerated during the 30 years past in Hungary. The minimum and the maximum temperatures have increased. Several local differences between the average temperatures of the last two decades exceed half a centigrade degree as well. The warming-up has been more significant chiefly in the eastern and the north-western part of the country. The number of the (summer) dog-days exceeding the different temperature threshold limit values that affects the living beings significantly.

The annual amount of precipitation has decreased considerably in the 20th century; first of all in spring when the seasonal precipitation total is 75 % of that at the beginning of the century. The total of the summer’s precipitation has essentially not changed during the hundred years past. There were dry summers previously as well but the harmful effect of the recent dry periods is much stronger. The decrease in autumnal and the winter precipitation has been of 12 to 14 %. The winter precipitation does not influence seriously the annual precipitation total since the average amount of precipitation of the winter months is the least, in comparison with the other months. However, its effect upon the vegetable world is very significant as its dominant part soaks in the soil thereby its role played in the water relations is important. If the top soil layer is not filled with water at the beginning of the vegetation period, serious agricultural damages may be expected.

In Hungary, the main hazard point of the changeability in the atmospheric resources is the drought in the agriculture but excess surface waters, floods, frost-bites, hails, local deluges and thunderstorms as well should be expected (Fig. 1), and it has to be prepared for possibly preventing them, decreasing and repairing the damages, making the legal background and the conditions of the recompense.

Ref.: Z. Dezsény (2005)

Figure 1. Distribution of elemental damages by damage species in Hungary (in 2005)

Localisms in the variations of groundwater in the Danube-Tisza inter-stream area

From the second half of the 1980s very complex changes have affected the water resources of the Hungarian Great plain. Besides the series of disadvantageous anthropogenic actions, a continuous lack in precipitation had arisen in the region and as a result of those a considerable degradation of ground-
water-levels befell (Fig. 2 and 3). The significant degradation has caused farming difficulties in the agriculture and additionally it has induced essential changes in the life of some areas. The serious environmental changes called a series of technical researches into action; it is accounted in the *National Environment-Protection Programme* (1997), too, to be one of the areas requiring especial measures, however the investigations to explore the changes as a function of time and area in detail have not been available yet.

![Figure 2](image1.png)

**Figure 2.** Variation in the annual mean groundwater level in the Danube-Tisza inter-stream area (location: Szank)

![Figure 3](image2.png)

**Figure 3.** Decline of water-table in the Danube-Tisza inter-stream area
Main causes of the decline of water-table

a) Lack of precipitation. From the beginning of the 1980s till the middle of the 1990s the area was overtaken by a continued lack of precipitation. During the period of over ten years the amount of precipitation fallen approached not even once the annual average precipitation of otherwise low value below 560 mm or even it varied usually about 450 mm and, occasionally and locally, below that as well. The decrease in precipitation in the Danube-Tisza inter-stream area is more or less true as a long-term trend – the major part of the measuring stations verify that – however, as almost all the data series gained, the evaluation of the precipitation quantity includes problematic elements. The phenomenon of aridity-in-progress as a process with its direct attendants (e.g. drought or decrease in crop yield) can also be evaluated in a difficult way since there might be a bad yield in a year with average precipitation as well if the distribution of precipitation was disadvantageous or the less precipitation may be supplied with irrigation.

b) The decade of the 1980s was the most intensive period of the groundwater withdrawal; the groundwater withdrawal increased to its value of two and a half in the Danube-Tisza inter-stream area. The decrease of initial water-table happened to the groundwater-bearing layers became more acute in some regions. It was especially significant there (e.g. in the periphery of Kecskemét, it reached 20 to 25 m as well by 1990) where the seepage from the ground is dominant (negative pressure-state areas). In these areas, the high-degree lowering of the layer-waters produced sucking action upon the groundwater above as well (Figure 4).

c) In many places, by lack of surface-water resources, the intensive agricultural growing was irrigated from the top groundwater or from the layer-water of less depth (B. Csatáry – L. Csordás., 1994). After the decomposition of the large-scale-production agriculture this effect became considerably stronger. The effect practically ‘doubles’ the factors acting towards the decrease of the groundwater since, if there is precipitation available, it can be supplemented from that and, as against it, if there is not available precipitation, not only the supplement fails but the water draw-off for irrigation also becomes more intensive.

d) Canals and other drainage works were built for draining the waters counted to be superfluous, in the former wet weather-periods. These ‘creatures’, in the dryer period as well, ‘fulfilled their function’, namely, in the case of a temporary water-cover, they drained the waters, checking the seepage.

e) The land use has been changed in many places. The forestation for improving the ratio of wooded area was typical. However, it was effected through planting quick-growing poplars but with high water demand.

f) The earlier investigations hardly paid attention to that that the Danube-Tisza inter-stream table-land could scarcely receive supplement to the subsurface waters from the ‘hinterland’ areas for its
especial character (its highest parts are above the level of the rivers by 40 to 80 m) since there is not a geomorphic background of that.

Only one factor has acted towards an increase in the groundwater resources; because of the lack of canalization, the communal sewage has seeped. (This together with the unprofessional agricultural activity has led to such a deterioration of quality of the groundwater that the water resource can hardly be used directly) (Rakonczai, Kovács 2005).

Irrigation – as one of the tools counted to be important for moderating drought damages

In the Danube-Tisza inter-stream area as well as in the other regions of Hungary, the most current irrigation technology is the sprinkler (rain) application system. However, this solution has its own disadvantage for it can be used only at an extremely low efficiency in the case of a soil drought conjugating with dog-days. The water amount delivered is not utilized acceptably since its one part evaporates when spraying it out in the air and, as to its other part, it – when contacting with the soil surface warmed up; almost nothing reaches the rooting zone of plants. In the case of atmospheric drought, irrigation does not mean a real solution because then the problem is not that there is not water in the soil but that the plants are not able to absorb water as at the rate as they are forced to evaporate it. In that condition, better the humidifying effect of the irrigation means a positive effect for the plantage. Another negative effect of the sprinkler irrigation is the deterioration in soil structure of significant measure. The water drops shot to the height up, impacting against the soil surface, compact it and decays its structure.

Soil – as a factor influencing the tendency for drought

The water supply of the plants and their sensibility against drought are determined by the pedological conditions. The packed layer close to the top soil layer, that does not allow the water sprinkled to seep into the depth, makes it to be apt for aridity whereby the soil will be oversaturated quickly and then – might be desiccated in a short time; accordingly, the water budget of the soils is very extreme.

The soils of heavy composition, perhaps alkali and expansive-contraction ones are of bad property alike that are to be found in the region Jászság and the Tisza-Zagyva inter-stream area in many places. The major part of the water seeps through the soil cracks without utilization (occasionally causing a harmful increase in groundwater) and then, when soaking, these cracks will be closed thereby they will not allow the lower layers of the soil to be moistened which cannot be filled suitably. Additionally, the water uptake of the plants is made difficult by that that the water-supply capacity of these soils too is significantly worse; their adherent-water content is great and the usable water reserve is little.

As a general tendency, it can be told about the soils of the Jászság, the plain of Heves, and the flood-basin of Szolnok that chernozem or meadow-chernozem soils could be formed on the highest loess terrains where the groundwater is quite deep and its level elevates periodically only so quite a little water effect acts upon the soil. As against that, the hydrologic conditions are determining in the evolution of the meadow soils and this is a permanent water effect accordingly this soil type is characteristic on the lower terrains. In terms of pedology, the building of the storage reservoir in Kiskure had had an importance of which attendant had been that the groundwater with high salt content elevated in the region and the area of alkali soils increased there (Stefanovits – Filep – Füleky, 1999).

Precipitation conditions

In the period from 1980 till 2004, the average annual quantity of precipitation was 461 mm. The annual precipitation amount varied between 307 mm (1982) and 800 mm (1999) in the analysed period of 25 years. According to my calculations, the months with the most precipitation were July, June and, after them in order, May. The average of July has been increased by those four cases in the course of the 25 years when precipitations over 120 mm occurred while, taking them out of the average, it decreased from 59 mm down to 41 mm (Figure 5).

The trend of the climatic water supply can be traced well in accordance with the course of the sum curve of the monthly precipitation and the evaporation as a difference that can be corresponded to the variation by time concerning the region. The difference of the precipitation and the real evaporation shows the variation of the natural water supply in the actual month (Novák, 1999).

It can be seen well in Figure 7 that the area has been suffering from a permanent lack of water since 1983, in comparison with the base year 1980, and that has been worsened on through the droughty weather of the 1990s. Between 1994 and 1999 the level line varied about the lack of water of 800 mm, in comparison with the beginning value and the years after, with plentiful precipitation (800 mm precipitation fallen in 1999), were capable of improving the conditions. The increasing trend was broken by the years with significant lack of precipitation and then the favourable year 2004 showed a climatic water supply, starting with an apparent better trend again.

The key-questions for the future in the agriculture are the soil tillage taking the conservancy of
**Figure 5.** Course of annual and growing-season amounts of precipitation (1980 - 2004)

**Figure 6.** Course of average yields of winter wheat and sunflower, and precipitation quantity of growing season in the region of Jászapáti (1983 - 2004)

**Figure 7.** Monthly sum of precipitation and evaporation difference in the region of Jászapáti (1983 - 2004)
precipitation as well as the drought, and occasionally the plenty of precipitation into consideration, the improvement of the irrigation and the saving and conservancy of the water resources related to that. The technology fitted to the endowments of the growing area and the demand of plant, the introducing of species proof against drought or extreme effects into production as well as their improvement, the use of species capable of accommodating themselves to the local conditions, the modifications of the plant-growing structure ratios or growing plants for energy production mean a determinative role.

References