SECOND NATIONAL CONSULTATION DIALOUGE in Hungary

1. General Data

Country:	**Hungary**
Organizer:	**GWP Hungary**
Date & Place:	**16 October 2014, Budapest, General Directorate of Water Management**
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	Vámos, Károly TIVIZIG vamos@tivizig.hu Virágné, Kőházi-Kisss Edit KÖTIVIZIG viragne.kiss.edit@kotivizig.hu **Abbreviations:** ATIVIZIG – Lower-Tisza Water Directorate BM – Ministry of Interior DE – Debrecen University DE AGTC – Debrecen University Centre for Agricultural and Applied Economic Sciences FM – Ministry of Agriculture GWP HU – GWP Hungary HAKI – Research Institute for Fisheries, Aquaculture and Irrigation KITE – KITE Agricultural Service and Trade plc. OVF – General Directorate of Water Management OMSZ – National Meteorological Service KÖTIVIZIG – Middle Tisza Water Directorate MÖE – Hungarian Association of Irrigation MTA – Hungarian Academy of Sciences SZIE – Szent István University TIVIZIG – Trans-Tisza Water Directorate VTOSZ – National Centre of Water Management Associations
Attachments: (attendance list, photos, etc.)	*Agenda and attendance list* *photos see: http://www.antart.hu/andris/aszaly20141016v2.zip* *GWP HU website see* *http://www.gwpmo.hu/index.php?option=com_content&view=article&id=192&catid=4*

2. Agenda

Objective : Presentation and discussion about the draft of the Guidelines for Drought Management Plans with the aim to contribute to its completion – elaboration of comments to the Guidelines and provide national experience according to the templates in Annexes I – VI

Special objectives: Contribution to the development of the national water management strategy

Agenda: attached

Main points of discussion: the status and expected results of WMO-GWP IDMP; Hungary's contribution to the development of the Guidelines for Drought Management Plans through direct commenting of the draft and through compiling input for the six annexes.

3. Report (max 3000 characters)

Organization of the consultation dialogue was supported by the General Directorate of Water Management (OVF) through logistical arrangement and through expert contribution, which are highly appreciated. Participants have received the draft guidelines and the Slovak case study in advance to be prepared for the meeting. After the two general introductory speeches each annexes was introduced by an expert. The experts were invited to prepare a few thought-provoking slides of the particular annex. This was followed by a moderated discussion. Participants were active in each case providing munition for the compilation of the country's contribution. Also comments were made on the text of the draft guidelines (sent later to the activity leader).

The compilation of the annexes was based on the introduction and the discussion followed and was made by the expert whose activity is acknowledged.

Detailed minutes (in Hungarian) was prepared and made it available at the IDMP website of the GWP Hungary, see http://www.gwpmo.hu/index.php?option=com_content&view=article&id=192&catid=4

All other documents (presentations, photos) are also available there.

4. Conclusions

Outcome of the public consultation:

The major outcome of the drought consultation is the finalization of the six annexes for the Guidelines for Drought Management Plans. It is also important to mentione that the drought awareness is increased and a good cooperation has been developed between GWP Hungary and the General Directorate of Water Management.

Brief information about actual status of production of DMP:

The national water management strategy is under preparation in Hungary. It will incorporate the findings of the IDMP. The National Water Management Council (re-established recently) will also discuss the DMP in connection with the river basin management planning.

Proposals for further steps focused on elaboration of (comments to the draft of the Guidelines and national experience according to the templates in Annexes I – VI):

Comment to the draft of the Guidelines:

DMP PROPOSAL

Dear Colleagues,

I have reviewed the accompanying materials - Guidelines for Drought Management Plans and for the 3.3. "Inventory Data for DMP development" chapter would like to make the following additions:

I feel that this chapter is the most important part of the study, whereas the future concrete work can be arranged within it. To collect data, we must establish uniform methods. The data collection, the processing, evaluation of results, the development and enforcement of an action plan in a single framework needs to be implemented. This goal could be best provided by a single GIS platform. Let us call this the Integrated European Agriculture and Water Resources Geographic Information System. I suggest for using the ESRI ArcGIS software and widespread

geo database structure.
To determine which data to collect and in what format, special working groups should be established in each country. Every country should be involved, who are interested in the EU's agricultural, forestry, water management and environmental strategy development in some way.
The committees would require the following professionals:
- water management
- agricultural
- forestry
- soil protection
- environmental
- meteorological
- GIS

The criteria for GIS data collection should be established by the committees in such a detail that the geospatial professionals are able to create the layers and the associated structured databases. The committees shall determine the method of data collection and processing for that information specialist professionals can draw up the data collection, processing and analysis software. The data processing process could be implemented in the individual countries and the results would be displayed on a standardized GIS platform. The action plans will be made in the knowledge of this. Both the action plan and its implementation should be displayed by using GIS.
Why is it so important to create such a unified system? This unified approach implies that agriculture and water management in European countries will be assessed in a uniform manner. Using this method we can also identify the plants that thrive best in the area and it can be converted into a single Europe-wide system of agricultural subsidies. So it would support only those crops, which would be produced in the most optimal way in that field. The subsidization would include not only agricultural production, but also the development of water management. This system can create a change in attitude of the EU's decision-making process, and they would judge the EU agriculture as a whole. Using this knowledge the EU could support directly those individual plants for production which is cultivated in the most optimal way.

Debrecen, 24 September 2014.

Sincerely,

József Kollár
Trans-Tisza Water Directorate (Hungary)
water utilization team leader

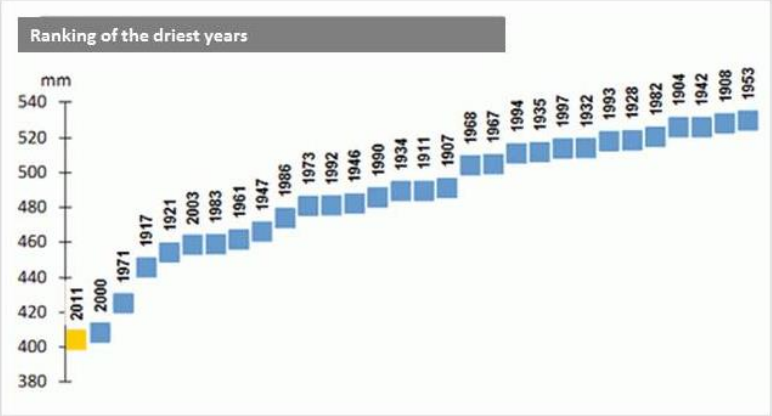
Templates for elaboration of the national experiences included into Annexes of the Guidelines - deadline 31 December 2014

Annex I: Examples of the national methodologies for assessment of historical drought

Country: Hungary

Indicators used for the historical data assessment:

Droughts of old times are known only from historical sources. Information recorded in the form of texts have been reported severe droughts from the 1660s (e.g. 1683), but extremely dry years were 1718, 1790 and 1794 as well. From the second half of the 19th century with the operation of only a few observation stations, measured meteorological data shows the occurrence of droughts in the years of 1841, 1857 and 1863. Droughts in the 20th century can be quantified easier because the availability and reliability of data has been increased. In Hungary one of the most widely used drought index is the Pálfai Index (PAI), which characterizes the drought with a single numerical value concerning a whole agricultural year. According to PAI values extreme droughts occurred in 1904 (10.7), 1935 (10.05), 1952 (12.35) and 1990 (8.87). (The long term average of the index is 5.23 ° C / 100 mm.) Further severe droughts have been experienced in the three years between 1992-94, in 2000 and in 2003. After the extremely wet year of 2010 Hungary faces with an exceptional dry year in 2011 with only 404.4 mm precipitation. The figure of the 30 driest years also shows that among the 15 driest years we can find five years after 1990 (OMSZ):



Short methodology of assessment of long-term series of meteorological data or picture illustrating evaluation of the historical data for the chosen parameters/indicators:

The value of the PAI index is calculated by the product of a baseline value and three correction factors. The baseline factor is a quotient of the mean temperature between April and August and the weighted monthly mean precipitation in the period of October – August. The monthly correcting factors (0.1 to 1.6) take into account the number of hot days, the duration of rainless periods and the groundwater level under the surface. According to the values the following categories of droughts have been identified:

Category	Type of the drought in a given year	PAI (^{o}C/100 mm)
I.	No drought	< 4
II.	Slight drought	4 – 5
III.	Moderate drought	5 – 6
IV.	Medium drought	6 – 7
V.	Severe drought	7 – 10
VI.	Exceptional drought	< 10

It is worth to mention that the occurrence of a drought do not depend only from water scarcity; it can happen due to high temperature too when water is available.

The determination the of PAI based on daily values is difficult, so for easier practical use and more comparability a new and simpler formula, the Palfai's Drought Index (PaDI) has been developed which is based on monthly mean air temperature and monthly sum of precipitation.

Annex II: Examples of the national drought indicator systems

Country: Hungary

Parameter/indicators included or proposed into the national drought indicator system:

The national drought indicators/parameters are essential mainly for water management and agriculture. Therefore the methodologies have been developed in accordance with these requirements: they give indispensable information for the most effected fields to take the appropriate measures.
During the decision-making process concerning the implementation of the tasks of water management, water resource management and water damage prevention, the appropriate knowledge of the actual – the period of at least one month - water balance situation has a key role.
A forecast can be made by evaluating the actual measured data and their deviation from the averages of a longer period (at least 30 years) and with considering the expected water balance situation (appropriately reliable forecast, the use of more scenarios).
With the aim of a fast and reliable overview and evaluation of the water balance situation, there have been informative publications in our country for almost two decades (with changing and developing contents). One of the most important publications is the national **Integrated Water Balance Guide and Forecast**.

This monthly publication uses data arriving from the National Meteorological Service and from the 12 Directorates of Water Management of the country. It is suitable for analysing and comparing water balance extremities (e.g. drought, inland excess water). The publication consists of two parts with relating contents:

The first part contains the assessment of the water balance situation of the month under review. It is created by the General Directorate of Water Management
The second part contains the water balance forecast for the next month. It is created by the Lower-Tisza District Water Directorate.

The detailed content of the publication: **Situation assessment:**

- The spatial distribution of the rainfall in the month under review (map)
- The spatial distribution of the difference between the current and the average monthly rainfall (map)
- The sum of the daily rainfall of 10 stations in the month under review (chart)
- The spatial distribution of the mean temperature in the month under review (map)
- The spatial distribution of the difference of the mean monthly temperature between the current and the average month (map)
- Mean daily temperatures of 10 stations in the month under review (chart)
- The spatial distribution of soil saturation (expressed in percentage) in the 0-20 cm, 20-50 cm and 50-100 cm soil layer (map)
- The changes of soil saturation per decade at 10 stations (expressed in percentage) (chart)
- The depth of the ground-water level below the surface in the lowland areas of Hungary in the month under review (map)
- The changes of the ground-water level compared to the previous month in the lowland areas of Hungary (map)
- The level of ground-water compared to the monthly average of many years in the lowland areas of Hungary (map)
- The changes of ground-water level in the month under review at 10 stations (chart)
- The maximum excess water inundation per drainage system in the month under review (map)
- The volume of water drained from the inland water systems in the month under review (map)
- Inland excess water data of the Water Management Directorates and national aggregate (charts)
- Evaluation and summary

Forecast :

Weather forecast created by summarizing the different period forecasts of the National Meteorological Service. Calculation of

the Moving (Rolling) Water Balance Index (RWBI) for the month under review and its forecast for one month (chart and map).

Inland excess water forecast:
Approximate forecast of the probability of summer and autumn inland excess water depending on the summer and autumn hydrometeorological situation. The forecast of the winter-spring inland excess water index in the beginning of November and December in two versions (chart, map)
Forecast of the Pálfay drought index (PAI) for July-August and assessment of the year in October (chart, map)

Methodologies used for evaluation of the chosen parameters/indicators:

Calculation of the Pálfai Aridity Index (PAI)

In Hungary the Pálfai drought index (PAI) worked out for users in agriculture and in water management has been used for numerical characterization of droughts since the beginning of the 1980s.
This index characterizes the strength of the drought for an agricultural year with one numerical value, which has a strong correlation with crop failure.

There are indices for the characterization of the severity of an arid situation (dryness) by a value derived from only few meteorological and/or hydrological parameters. The great advantage of such indices is that long-term data series could be produced by them.

The formula to calculate the base-value of the aridity index has been introduced by Pálfai (1984) as follows:

$$PAIo = \frac{t\ IV-VIII}{P\ X-VIII} * 100 \qquad (1)$$

where PAI_o – base-value of the aridity index ($^oC/100$ mm),

$t_{IV-VIII}$ – mean value of air temperature of the period of April – August (^oC),
P_{X-VIII} – precipitation depth summed up by the weighed monthly values of precipitation of the period of October - August (mm).

Monthly weights for the precipitation values are based on the conditions of moisture-storage and on the changing general water demand of the crops. Estimates of the weighing factors are the following (with due regard on the overall natural condition of the Carpathian basin): 0.1 in October, 0.4 in November, 0.5 from December to April, 0.8 in May, 1.2 in June, 1.6 in July, 0.9 in August. It is evident that July is the most critical period from the point of view of water supply.
When the values of PAI_o were compared to the well-known Palmers "drought-index", strict correlation was found between them (Pálfai, 1990).
For the more accurate expression of aridity the base-value of PAI_o should be corrected by the following factors (Pálfai et al., 1995).
Temperature (hot days) correction factor:

$$kt = \sqrt[6]{\frac{n+1}{\bar{n}+1}} \qquad (2)$$

where k_t – temperature correction factor,
n – number of the hot days ($t_{max} \geq 30^oC$) in period of June-August (d),
$\bar{n}$ - long-term country-wide average of the n value (d); in Hungary this value is 16 days.
Precipitation correction factor:

$$kp = \sqrt[4]{\frac{\tau\ max}{\bar{\tau}\ max}} \qquad (3)$$

where k_p – precipitation correction factor,

τ_{max} – the longest rainless period (if the sum of precipitation in two consecutive days does not exceed max 5-6 mm) between the middle of June and middle of August (d),

$\bar{\tau}_{max}$ – long-term country-wide average of τ_{max} (d); in Hungary this value is 20 days.

Groundwater correction factor:

$$kgw = \sqrt{\frac{H}{\bar{H}}} \qquad (4)$$

where k_{gw} – groundwater correction factor,

H – mean depth of groundwater table below ground level in the period of November-August (m),

$\bar{H}$ – long-term value of H on the given area (m).

The use of this correction factor is important on plain area. Practically it is best to use the data of the nearest 2 or 3 groundwater wells in the surrounding of meteorological station or observation point.

The final value of the aridity index – defined as *PAI* – is obtained from the base-value (PAI_o) by correction:

$$PAI = k_t\, k_p\, k_{gw}\, PAI_o\,, \qquad (5)$$

where the correction factors are those described above.

According to the Hungarian experiences, the threshold value of the Pálfai Aridity Index shall be at *PAI*=6.0. Smaller values are for wet years at a particular site, larger values would indicate the different severities of dryness. These may be categorized as follows: *PAI*=6-8 moderate drought, 8-10 medium drought, 10-12 heavy drought, >12 extremely heavy drought.

Calculation of the modified Pálfai Aridity Index (PaDI)

For easier practical use we have worked out a new, simpler method for the calculation of these factors, which is based on monthly mean air temperature and monthly sum of precipitation.

The new formula of the base-value of the modified index named Palfai's Drought Index (PaDI) is:

$$PaDI_o = \frac{\left[\sum_{i=apr}^{aug} T_i\right] \;/\; 5*100}{c + \sum_{i=oct}^{sept} (P_i * w_i)}$$

where

$PaDI_0$ – base-value of drought index, °C/100 mm

T_i – monthly mean temperature from April to August, °C,

P_i – monthly sum of precipitation from October to September, mm,

w_i – weighting factor,

c – constant value (10 mm).

The weight factors (w_i) of precipitation (in Table 1) express the difference between the moisture accumulation in soil and the water demand of plants.

1. Table Weight factors

Month	**w_i weight factors**
October	0.1
November. December	0.4

January-April	0.5
May	0.8
June	1.2
July	1.6
August	0.9
September	0.1

Calculation of PaDI

PaDI = *PaDIo* * *k*1* *k*2 * *k*3

PaDI – Palfai Drought Index, °C/100 mm
k1 – temperature correction factor,
k2 – precipitation correction factor
k3 – correction factor, which characterizes the precipitation circumstances of the previous 36 month.

Among the correction factors the temperature factor k1 represents the relation between examined and annual summer mean temperature, the precipitation factor k2 represents the relation between examined and annual summer precipitation sum and k3 represents the effect of precipitation circumstances of previous 36 month.

We calculated the PAI and PaDI values, and spatial distribution for 68 Hungarian stations from the year 1931 onwards.

Annex III: Examples of the national drought classification and early warning systems

Country: Hungary

Indicators included into drought warning system:
The agro-meteorology information is handled by the Hungarian Meteorological Service, as follows: temperature, precipitation, and sunshine duration data. The map service contains 5, 10, 30, 90 days databases and its variance. The automatic measure instruments describe the temperature of soil and available water content data in the upper 5cm soil layer. The data is available here: http://www.met.hu/idojaras/agrometeorologia/csapadek/
The data from daily or weekly water report give information for the hydrological drought data calculation. The data is available here: http://vizallasjelentes.hu/

Thresholds for chosen indicators for four drought stages (normal, pre-alert, alert, emergency):

Pálfai's drought index (PAI) isn't in the warning system. It is used to evaluate well documented, other indicators with science aim in Hungarian. An important problem, that the end users don't know the drought forms and its interpretation, so they don't use widely (crop production). In the case of drought forecast less, but widely used drought indices should be efficient. Knowledge lack of rendering at the end users (for example crop production – vintage effect)
Less, but more general and tested indices are needed.

Answer on questions:

- *is monitoring system sufficient for running of early warning system or requires upgrading ?*
  The new proposed warning system should use the methodology of European Drought Observation. This information should be converted for the Hungarian end users (agriculture, General Directorate of Water Management, local government).
- *are there technical means available for timely dissemination of warnings?*
  The tools are suitable, but there are some technical difficulties in the homogenous dissemination: data owners' different interest and knowledge, data consistency, data quality. It has to make a decision what type of data is suitable for the drought forecast: data from state offices (detailed, checked quality, expensive) or cheaper multitudinous data.

- *How often should be actual data updated – daily or weekly?*
  Depending on the aims and end users it is needed alerting in practice, but generally weekly data is sufficient.

Annex IV: Examples of national organizational structures to deal with drought

Country: Hungary

Competent authority: Ministry of Interior

Proposed composition of Drought Committee indicating involvement of all actors on three levels:

- *governing level*
- *professional level*
- *affected stakeholders*

For managing the duties of a Drought Committee instead of creating a new body we propose the use of the already existing National Water Management Council. Government Decree 1382/2013. (VII.27.) regulates the establishment and operation of the Regional Water Management Council (TVT), the Sub-Basin Water Management Council (RVT) and the National Water Management Council (OVT).
The OVT delivers its tasks of river basin management planning at national level. The membership of the Council laid down in the Decree would ensure the involvement of all relevant actors in the process. OVT members are: a state leader appointed by the Minister of the Interior (Chair of the OVT), professional representatives of relevant national bodies. Furthermore representatives of different ministries from the following fields: environmental protection and nature conservation, water management, governance of water management bodies, local authorities, regional development and spatial planning, agricultural policy, agricultural and rural development, fisheries management, health, transportation, energy policy, government and world heritage. Members are also delegated from the civil society including GWP Hungary, business sector and professional and scientific organizations into the Council. The idea is that the Drought Committee would operate as a sub-committee of the OVT, or with the extension of its mandate.
The operating area of RVT is the respective areas of the sub-basins of Danube, Tisza, Drava and Lake Balaton. RVT members are representatives of TVT's operating in the sub-basin, public administration bodies, affected NGOs, water users and professional scientific organizations. Finally, TVT's operating area is equal with the operating areas of the 12 Water Directorates. Their membership is similar to the other two bodies but according to their operating area.
Among the duties of the Drought Committee the most important would be, following the WMO-GWP IDMP concept, to supervise and coordinate the national drought policy development process. In details: to produce and update the drought management plan; to design and make operational the drought monitoring programme and early warning system. It would be responsible for preparations of assessments of drought impacts; providing information to the public; activating the mitigation measures according to severity of drought stages (pre-alert, alert, emergency). It should assess the on-going and past droughts; implement the drought mitigation programme; cooperate on drought issues on the transnational level; and develop research, science and educational programmes.
Due to this integrated approach every task could be performed in the appropriate level in accordance with the principle of subsidiarity. This composition can be effective only if the OVT's advisory role is integrated in the decision-making process. Furthermore there is a need for a permanent or temporary body representing the interests of farmers concerning EU agricultural subsidies.

Schema of organizational structure for drought management is recommended:

Annex V: Examples of national program of measures for preventing and mitigating drought

Country: Hungary

There are not too many places in the world where serious threat of flood, drought and inland can occur as well. The Carpathian Basin, in particular the Hungarian part of the Tisza valley is such a place. The better cognition and prediction of flood, inland and drought are extremely important for the whole society and the economy. We must be prepared for their occurrence, defend against them if it necessary and adapt to them as far as possible.
Based on the situation of the country the measures used for prevention and mitigation of the drought and adverse water shortages situation can be divided into three identified groups of measures, as follows:
List of the measures identified on the base of the national situation in drought management structured at least into three groups:

- *organizational*

According to the CLXVIII 2011. Law 12§ paragraph 6 of management of the meteorological and other natural risks affecting the agricultural production:
After drought damage the harm reduction benefits will be paid, if the Minister issues a bulletin about the drought situation no later than 31 October. This is clearly the competence of the minister (who is) responsible for the agricultural policy.
According to the LVII 1995. Law of the water management Annex 1, point 30 the definition of the water damage recovery is: organized activity against the harmful much or little water including the construction, reconstruction, development, operation and maintenance of defenses to prevent the damage, and the recovery after the defense.
According to the 232/1996. (XII.26.) government regulation of the rules of protection against damages caused by water (from 01.01.2014) 1§ 2 points technical tasks of defense are:
preservation of the protective capacity and functionality of protective works – on the protective works or along – during the period of the floods, inland waters and the water shortages. These tasks are the competence of the minister (who is) responsible for the water management.
In the sector of water management the development of the regulation based on commensurable parameters for protection from drought and water shortage is in progress.

- *operational*

Based on the hydro-meteorological situation the forecasts and water needs we should focus on the preparation, prevention and preventive interventions the most. We must monitor continuously the implementation and effectiveness of preventive measures, after that should we introduce the protection against water shortage, maybe water restrictions. The main steps of the operational tasks are:

- Data collection: forecast of the drought situation (for example: national hydrological forecast) hydro-meteorological prognosis, small water hydrological forecast of water directorates, census of water needs (ecological agricultural: irrigation, fish ponds, rice), technical condition of protective works (water distribution system), quantitative and qualitative monitoring of groundwater and surface water resources.

- Planning of interventions: Requirements of service permits, rules, protection plans, water flow investigations, modeling, preventive / operational action plans, optimization of water resources plans (Tisza-Kőrös Valley Collaborative Water Management System, agricultural water supply restriction plans),
- Implementation and evaluation of interventions: increase the water supply, Training of reserve water bases, retention of the locally formed water resources (draining only the harmful water), use of water retention operating system, commissioning of reservoirs, keep the maximum operating water level (backwaters, reservoirs, channels), regional water transfer, agricultural water supply, water distribution,
- Restriction is the most critical element of water shortage remediation: If water restrictions must be introduced to more areas at the same time, this should happen to the same extent. According to the water management law 15 § paragraph 5. : The order of the restriction is the opposite of the water demands satisfaction order. The decree 2/1997. (II.18.) KHVM on the agricultural water supply works regulation provides for the restriction of the agricultural water use.

In the absence of statutory provision the introduction of ISO quality management system is also suitable for the regulation of procedure, the Middle Tisza Water Directorate is a good example for this.

- *preventive*

- Record of the regional water management
  - By the Water Framework Directive the appointed goals to water bodies and the measures necessary to reach those are summarized by the River Basin Management Plans /legal background: 127/2010. (V.21.) government decision of River basin management plans for Hungary.
  - In the 2007-2013 EU cycle within the framework of the Regional Operation Program, it was possible to naturally develop the inland water systems under the requirements of the Water Framework Directive.
  - The Environment and Energy Efficiency Operational Program provides opportunity to implement projects based on complex and integrated planning.
  - As part of the National Drought Strategy the possibilities of lowland storage options have been tested and explored by the Water Directorates, the construction of the reservoir projects have been started.
  - Mapping of the available water resource potential has begun.
  - Implementation of land management (for example: on the field of reservoirs to reduce flood peaks.)

- Necessary developments for maintaining and carrying forward the achieved results:
  - exploration, quantitative-qualitative preservation, enrichment of the existing available surface water resources (for example further steps of Complex Tisza Lake Project),
  - development of complex water distribution system (for example Jfcs. Zagyvai-ág)
  - gravity switching of the operating and not operating pump systems
  - retention of the upcoming (inland) water, development of the inland water systems, lowland reservoirs and backwaters
  - landscape-oriented developments (for example: field of the flood levels reducing reservoirs)
  - exploration and monitoring of underground water resources

Annex VI: Examples of the national research programme supporting drought management

Country: Hungary

Examples of supported researches concerning drought in last years:
Hungarian Scientific Research Fund (OTKA):

- Complex evaluation of the environmental changes on Great Hungarian Plain using geography, geoinformatics and remote sensing (2005-2009)
- Natural hazards and the protection (2003-2007)
- Assessment of geographical effects of climate change with remote sensing methods (2009-2012)

Operational Programmes of Hungary Development Plan:

- Complex agricultural risk management system

List of suggested actions for the national research program supporting drought management (eventually supplemented by short description of the action):

- Developing of integrated (cross border) drought monitoring system and data base
- Investigation of runoff, concentration and evapotranspiration
- Establishing of reference farmlands to investigate the complex effects of irrigation
- Developing the models on calculation of crop losses resulting from drought
- Verification of drought indices with data of crop losses
- Developing of drought forecasting and early warning procedures
- Investigation on droughts based on the results of regional climate models