NATURAL DISASTERS IN HUNGARY

Summary of report no. 7611/2/1796

VITUKI Budapest, Hungary

Introduction

The study is aimed to give an overall review about the potential danger of natural disasters in Hungary and to propose joining to the International Decade for Natural Disaster Reduction (IDNDR) of UN, (Resolution no. 42/169 of 11th December, 1989 of the General Assembly). The study was prepared by the Water Resources Research Centre (VITUKI) with contributions of several institutions involved in datural sisasters in Hungary and was financed by the former Ministry of and Environment and Water. As an introduction the study outlines the main goals of the Decade, the definitions of natural disasters, the types of them according to the Report of the Secretary General (1989) and the definitions of risk and damage accepted in the report of EHSD (1990).
In the study it is stated, that in Hungary the following natural disasters must be considered:

- drought
- floods
- earthquake
- hail
- windstorms
- fire

By ranking them floods are regarded as the most dangerous phenomena, followed by drought. Natural fire disaster has not yet happened in the country's history and windstorms are regarded of less importance, while as a result of the investigations hail must no more regarded as a natural disaster, (the damage caused should be a part of production costs). Concerning earthquakes the most important task is to prepare an appropriate guide with national validity.
In the following the two major types of Hungarian natural disasters, drought and floods are dealt with in a detailed manner.

Drought

Definition: Drought is a long lasting hot period with lack of precipitation, falling mainly on the agriculture, (Palfai, 1991).The drought index (PAI) used in general in Hungary is given below:

$$PAI=k_t k_p k_{gw}\frac{t_{iv-viii}}{P_{x-viii}}$$

where

k_t	-temperature correction factor (dimensionless)
k_p	-precipitation correction factor (dimensionless)
k_{gw}	-groundwater correction factor (dimensionless)
$t_{iv-viii}$	-mean temperature in period April-August (°C)
P_{x-viii}	-depth of precipitation in period October-August (mm)

The higher the value, (in unit: °C/100mm), the more serious the drought is, according to the classification of Table 1.

Table 1. Classification of droughts

Drought	PAI (°C/100mm)
slight	6-8
average	8-10
serious	10-12
extreme serious	> 12

Based on historical records the most serious droughts between years 1000 and 1900 is condensed in Table 2.

Table 2. Historical droughts

Century	Serious droughts occurred in years
11th	1015, 1022
12th	1142, 1147
13th	1276, 1277
14th	1363
15th	1473, 1478, 1479
16th	1540, 1585
17th	1638
18th	1718, 1790, 1794
19th	1841, 1857, 1863

During the 19th century drought occurred in 26 years, while in the 20th century (between 1901 and 1990) in the following years occurred this type of disaster, in a nation wide scale.

1904, 1905, 1911, 1917, 1918, 1921, 1922, 1923, 1928, 1930, 1931, 1932, 1934, 1935, 1943, 1946, 1947, 1950, 1952, 1961, 1962, 1968, 1971, 1973, 1976, 1983, 1984, 1986, 1989, 1990.

Among them the seven most serious are tabulated below.

Table 3. The seven most serious droughts in the 20th century

Ranking	Year	$t_{iv-viii}$ (°C)	P_{x-viii} (mm)	PAI (°C/100mm)
1	1952	18.9	266	10.7
2	1990	17.4	268	8.8
3	1935	17.5	271	8.7
4	1946	19.8	325	7.8
5	1950	19.2	313	7.4
6	1947	19.1	317	7.1
7	1983	18.3	308	6.9
average value of period 1931-1990		17.2	390	4.7

The area distribution of drought factor values observed in 1990 is plotted in Figure 1. It shows that 90% of the country was affected and PAI > 12 values were reached in two sub-areas of the Great Hungarian Plain.

The drought is a special type of natural disasters, since the damages are caused slowly, during a relative long period, in contrast with e.g. earthquakes, and the consequences can be decreased by appropriate forecasting and measures (irrigation). There is no need to maintain a "drought fighting service", but it is important to develop forecasting methods (in the framework of National Meteorological Service) and irrigation facilities. Former agroecological studies pointed out that an area of maximum 800,000 ha can be profitable irrigated in Hungary, even in the long range.
Figure 2. shows the extension of the irrigated area (the area where irrigation facilities were implemented) and the irrigated crops vs. time in the last few decades.The total discharge capacity of the pumping stations is presently 379 m^3/s.The distribution network consists of 1566 km state owned purely irrigation channel belonging to water associations.
The forthcoming years will be a milestone in the irrigation practice due to the land privatization, market oriented economy and the arid period.

Floods

Owing to the topographical and climatic conditions,(Antal and Starosolszky, 1990), in Hungary flood control is of outstanding importance.
A quarter of the area of the country is below the level of the floods.Figure 3.One third of the cultivated area and 50% of the population is found on this flood-plain.The value of residential and industrial settlement,network of communication and other establishments involved is about 30% of that of the national property.In Europe flood control is of similar significance only in the Netherlands.
The area protected against floods by a system of 4.200 km long dikes is about 2.3 million ha. Main dikes have been built in the valley of the Danube in 1.300 km, while in the valley of the Tisza in 2.900 km length. This protecting system has become a basis of safe utilization and development of the areas involved. This unique situation determines the importance of flood control in Hungary.

According to the accepted definition flood is, in hydrological sense, a rare, extreme (high stage) event of the water regime. It begins with the spilling of the water over the bankline of the water course and ends when the water stage during the recession falls below this level. Along a given stretch of a given river an event is regarded as flood if the stage attains or exceeds the prescribed level corresponding to the first degree of alert, according to the national regulations of flood control and land drainage. The design flood level is in general the icefree flood level of 1% probability. There are certain (high priority) areas where 0.1% of probability or icy flood levels are considered. Due to the different characters the icy and icefree floods are strictly separated from each other in the Hungarian flood control practice. During the floods of 1965 (along Danube river) and of 1970 (along Tisza river) the heights and also the durations surpassed the values of ice free floods occurred before. This fact called the attention to the importance of the duration and as a result of a corresponding study the expression of design flood was introduced including not only the design flood level but also the duration. When designing the cross-section of the levee a free-board of 1m height is generally considered.

An overall review of the water regimes of important Hungarian rivers is given in Table 4.

Table 4. Water regime characteristics of important Hungarian rivers

River	Station	Fluctuation of water level (cm)	Discharges		$\frac{Q_{max}}{Q_{min}}$
			Q_{min} (m^3/s)	Q_{max} (m^3/s)	
Danube	Rajka	698	570	10300	18
	Budapest	794	615	8600	14
		(875)	(580)		
	Mohács	902	618	7850	13
Rába	Sárvár	622	6.5	800	123
Ipoly	Balassagyarmat	493	3.5	360	103
Dráva	Barcs	666	185	3050	17
Tisza	Záhony	1060	47	3750	80
	Szolnok	1181	60	3820	64
	Szeged	1210	95	4700	49
Szamos	Csenger	998	8	1350	169
Bodrog	Sárospatak	672	4	1250	313
Sajó	Felsőzsolca	513	2.4	545	227
Fehér-Körös	Gyula	996	1	610	610
Fekete-Körös	Sarkad	1041	1	810	810
Kettős-Körös	Békés	1106	2.3	905	393
Hármas-Körös	Gyoma	1034	4.5	1800	400
Maros	Makó	725	22	2450	111

Flood forecasting is performed regularly by the Water Resources Research Centre (VITUKI). The operational forecasting model used in the everyday practice combines physical data with the statistical evaluation of the unavoidable uncertainties. The model parameters can be updated by a recursive algorithms.

During extraordinary floods fighting activity (Starosolszky, 1991) is performed under the guidance of a Government Commissioner or Government Committee having the authority over employees, equipments, materials, vehicles, etc. of state agencies and firms, and being authorized to summon assistance from the population, armed forces and the police, and being assisted by the Government Commissioner's Staff, which is organized in the three categories:

(i) Engineering Staff
(ii) Supply Staff
(iii) Flood Fighting and Drainage Emergency Service

Actual flood fighting is performed by the competent District Water Authority (DWA). The head of DWA is a personally responsible leader of district emergency control.

It should be mentioned that as a consequence of political changes certain regulations, by-laws etc. have became incompatible with the new constitution. Further legislation is needed for that matter.

Conclusions

The disasters which can theoretically occur in Hungary are listed and ranked in Table 5.

Table 5. Danger of disasters in Hungary

Disaster	Probability %	Observed/potential damage HUF 10^6**	Risk factor	Rank
drought	6.0	50000	3000	2
floods	<1.0	380500	3805	1
earthquake	9.0	1218	110	3
hail*	100.0	2237	2237	-
windstorm	10.0	600	60	4
fire	<1.0	-	-	5

* Hail is not regarded as natural disaster in spite of the high risk factor.
** USD 1 ~ HUF 80

The potential danger and the probability of occurrence can be only roughly estimated in most of the cases. The most reliable data are available concerning floods, which represent the major concern in this regard. Thanks to the traditionally well-developed flood control system (level system, regulations, service, etc.) the actual damage is inferior to the potential one by several order of magnitude.

It is grate importance for Hungary to join to the IDNDR, especially in the fields of information exchange and training.

It is advisable to create a National Committee for this Decade in order to assure close contact with the secretary of IDNDR and to promote the Hungarian utilisation of the corresponding international achievements.

Further legislative tasks are also needed in the country for efficient disaster reduction.

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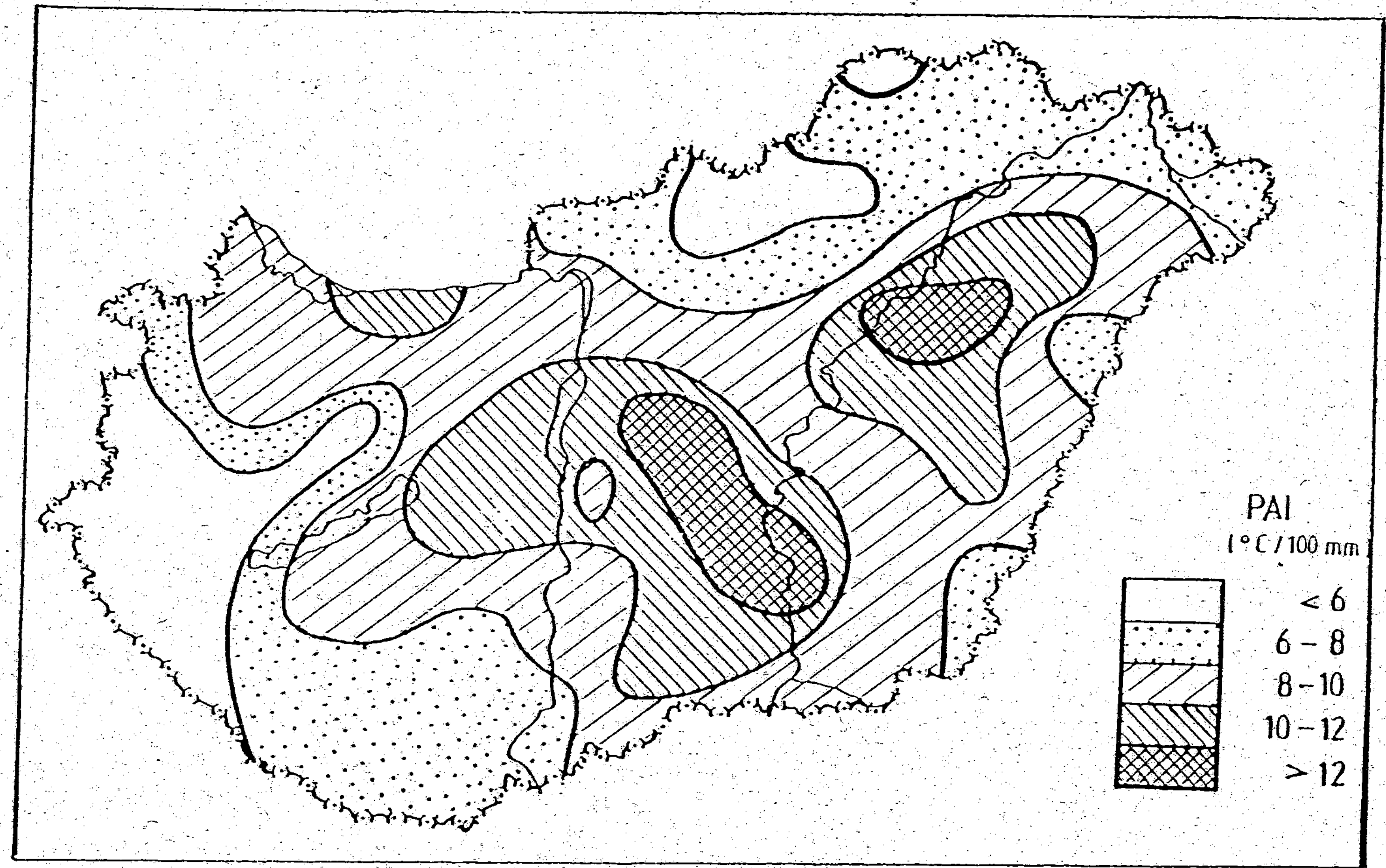

Figure 1. Areal distribution of drought index in 1990

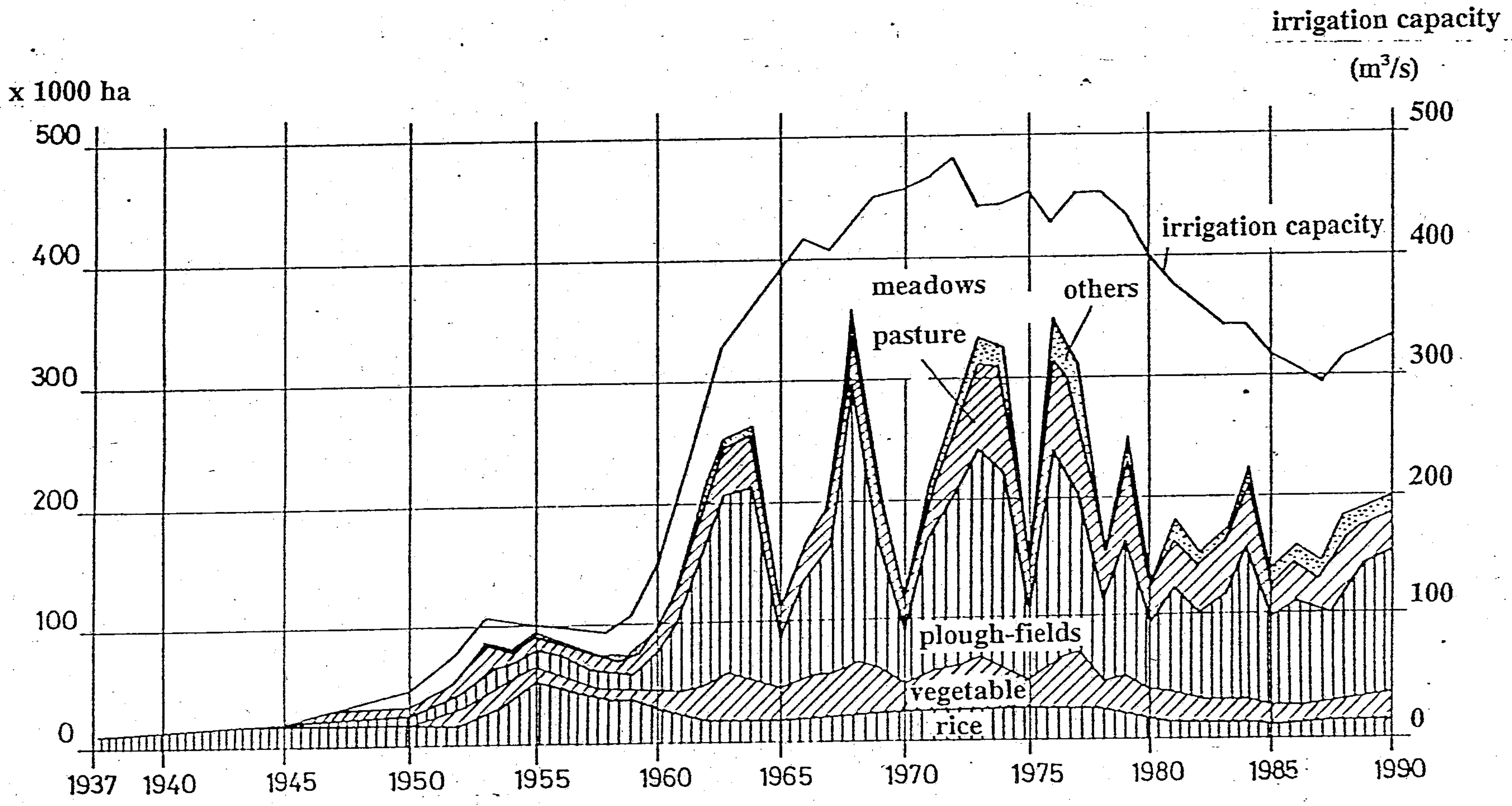

Figure 2. Irrigated areas and irrigation capacity

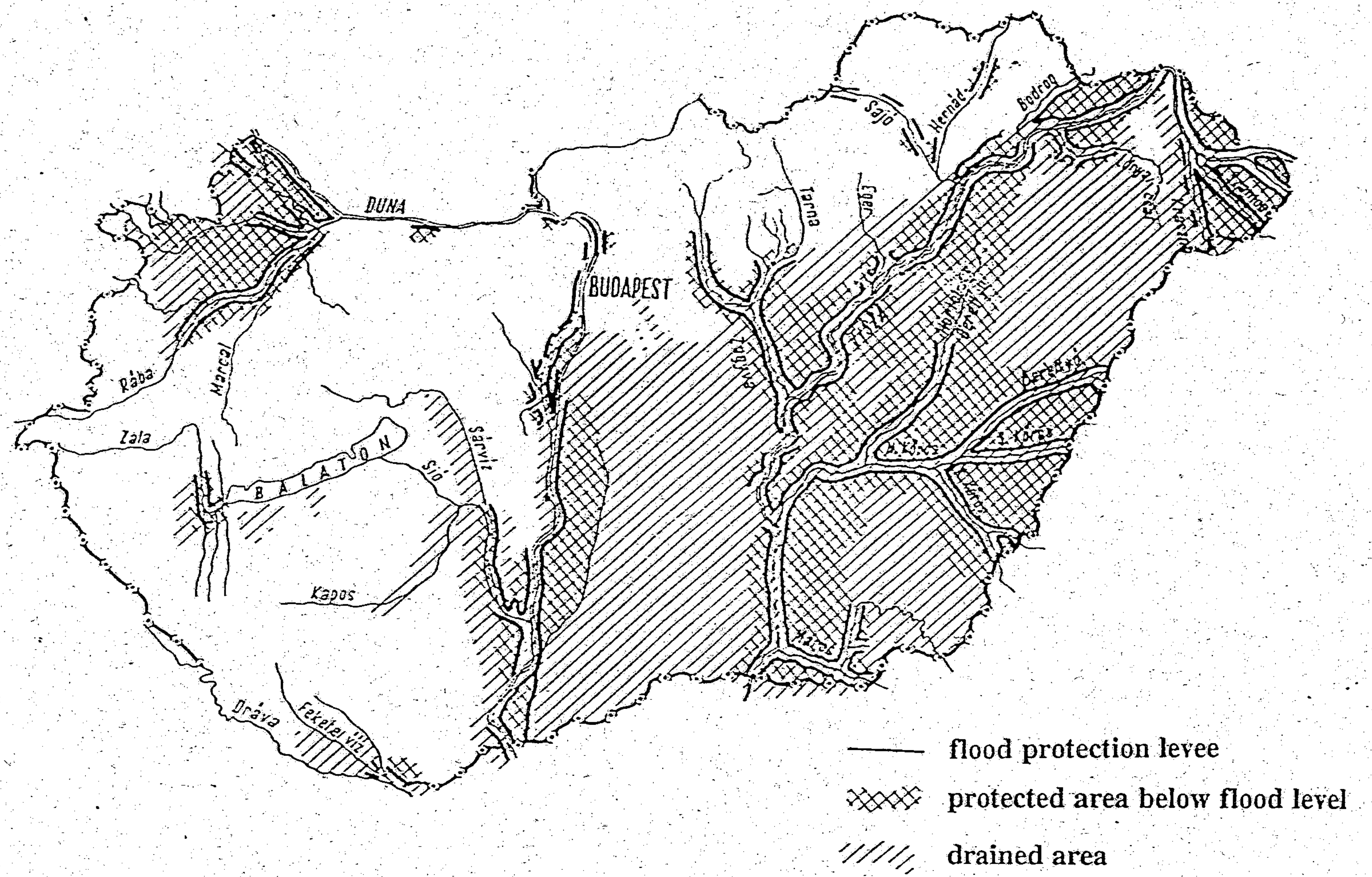

Figure 3. Area exposed to inundations of floods and overland flow in Hungary, with the major defence lines shown