



13-th International
Conference

"EUROPE-INBO 2015"
FOR THE
IMPLEMENTATION OF
THE EUROPEAN
WATER DIRECTIVES

21-24 October 2015 -
Thessaloniki - Greece



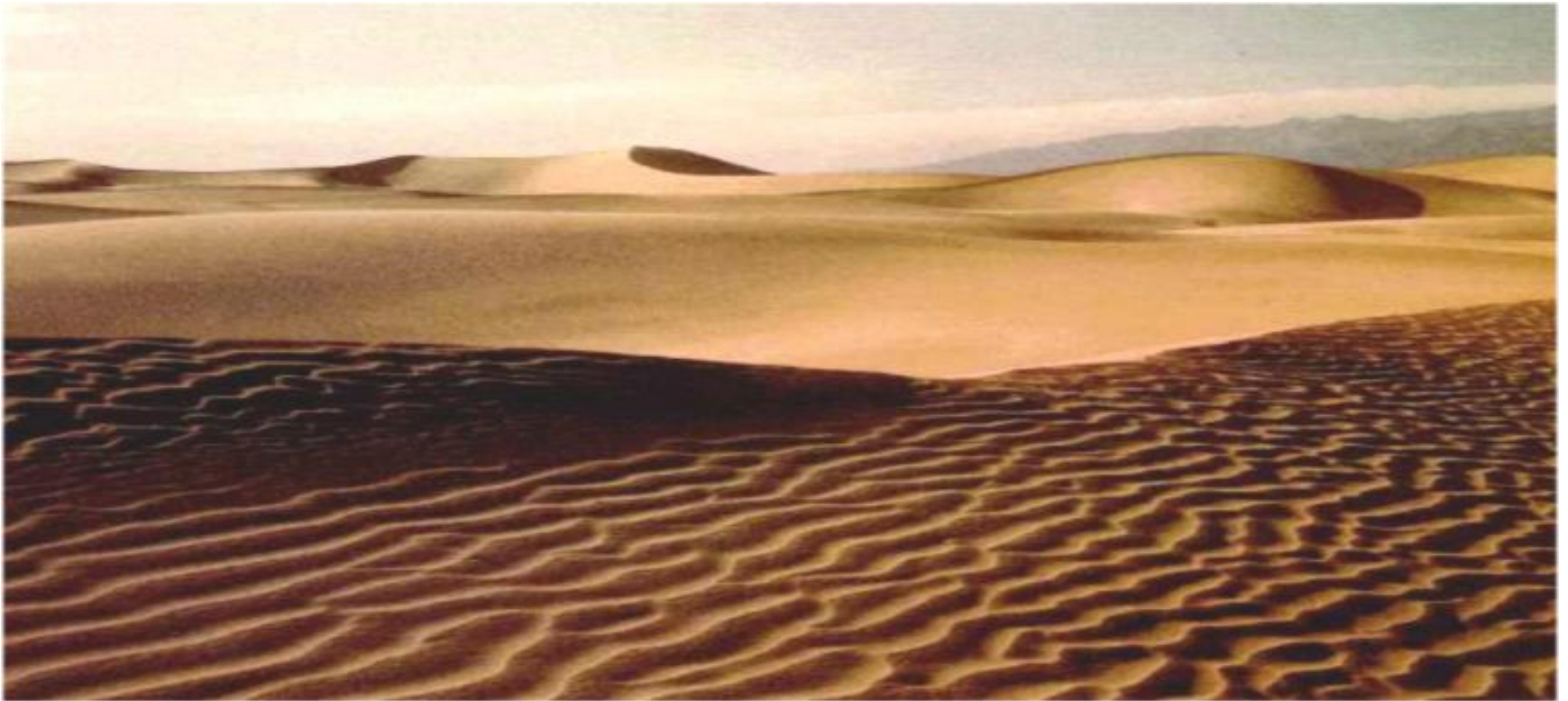
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**Creating underground water
reservoirs in the river basins of
humid and arid areas is one way
of adaptation to climate change**

Global warming now seems to be unavoidable. One of the first consequences will be a change in the hydrological cycles.

Freshwater resources will be directly affected in the coming years.

The lack of water resources is one of the serious problems in arid areas.



A small amount of fresh water is a limiting factor for the development of irrigation, livestock and people.

Water can raise or lower the food and drinking public safety.



Survey of the previous studies and experiences of building UWR shows that their structure was conducted back in Roman times, in Sardinia. UWR were practiced by ancient civilizations in **Africa**, and **India**. Study the possibility of creating new reserves of groundwater in underground tanks in various aspects held in **Bulgaria, Holland, France, Germany, f. Yugoslavia, f. Czechoslovakia, f. USSR, USA, Japan** and other countries.

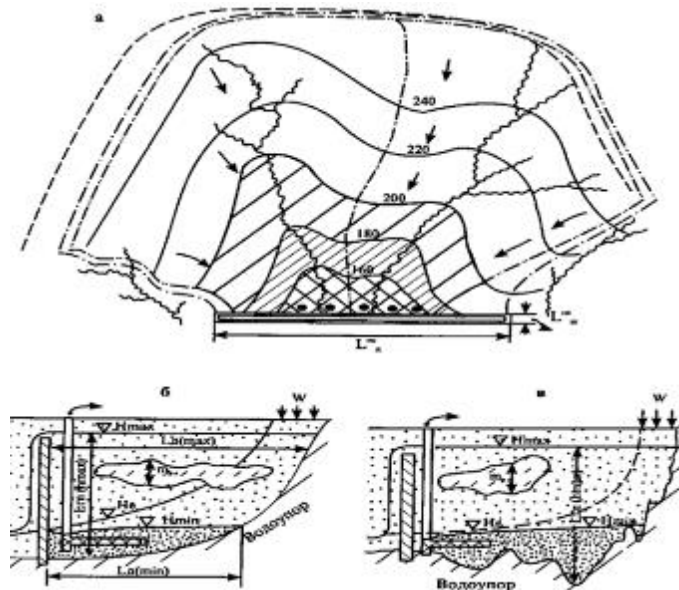


Japan. An underground dam of 66 m (length) and 20 m (height) blocked the outflow of fresh groundwater aquifer horizons in the sea and at the same time has become a barrier against intrusion of salt marine waters on Island in **Nagasaki Prefecture Kaba** .

Similar work was carried out in the cavity of Nara in the **valley Yamoto**. Moreover, in Germany the UWR is used to supply the water to Paulinenaue city [*Endo S., Kitagawa A., Ishizaki K.*].

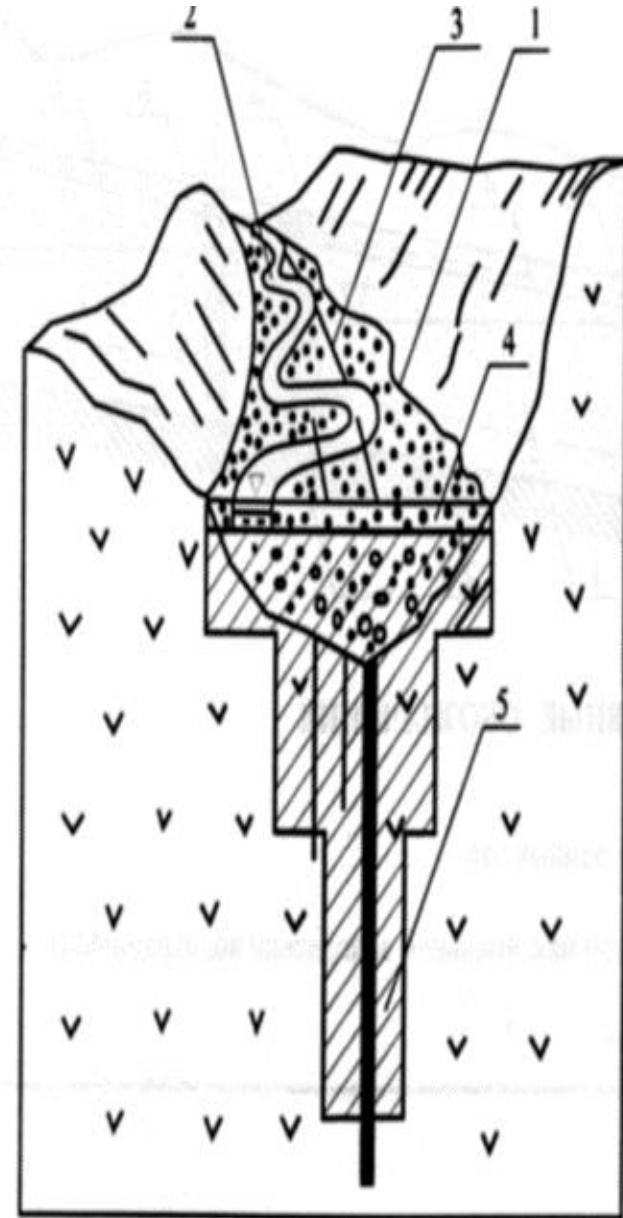


Former Soviet Union. Several cases of UWR are done in Vladivostok [*Golovin V., Leonov B. Zemlenoi V.*]. A small underground dam was built in the valley of Petrovka. It improved the productivity of water intake by 50 %. Also, underground dam of 350 m long in the valley of Lozowy Key and Voroshilovka rivers was increased the productivity of water intake for 1 – 2 m³/day. Moreover, impervious water-proof screen (WS) of 800 m (length) and 1.5 m (height) in valley of Voltchanka and Shusharino rivers was set up to regulate the groundwater flow in the intake Dushkinskom.



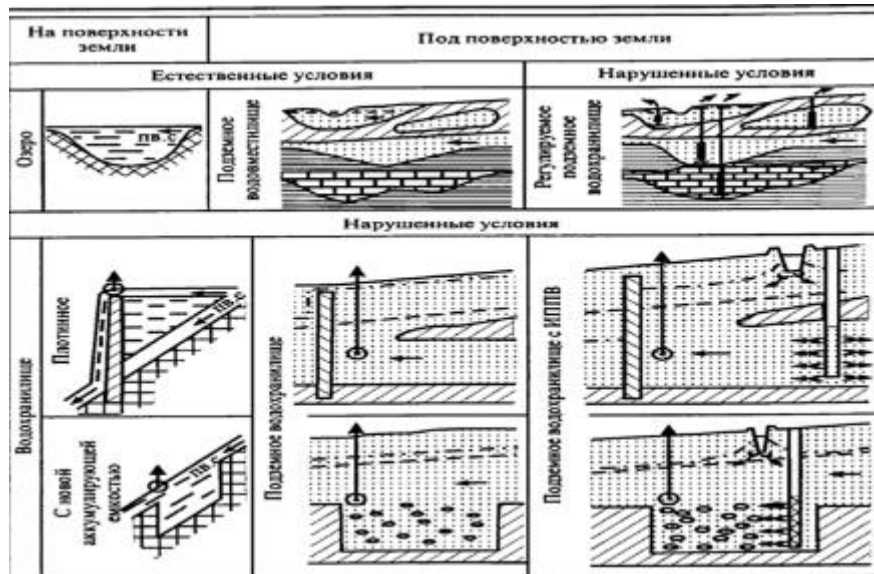
Fractured crystalline rocks can also be used for the accumulation and storage of groundwater [Larson Ingemar]. Favorable conditions for this are observed in the deep valleys (1) or in wadi (2), formed as a result of tectonic activity (3) and having the top glacial alluvial and colluvial deposits (4), and unconsolidated bottom sediments, underlying fractured rocks, playing the role of drains.

Great interest for UWR are open cracks and therefore potentially water-bearing. In this case, across the valley and open tectonic fault zones create an underground WS (5), which accumulates a groundwater runoff before it.



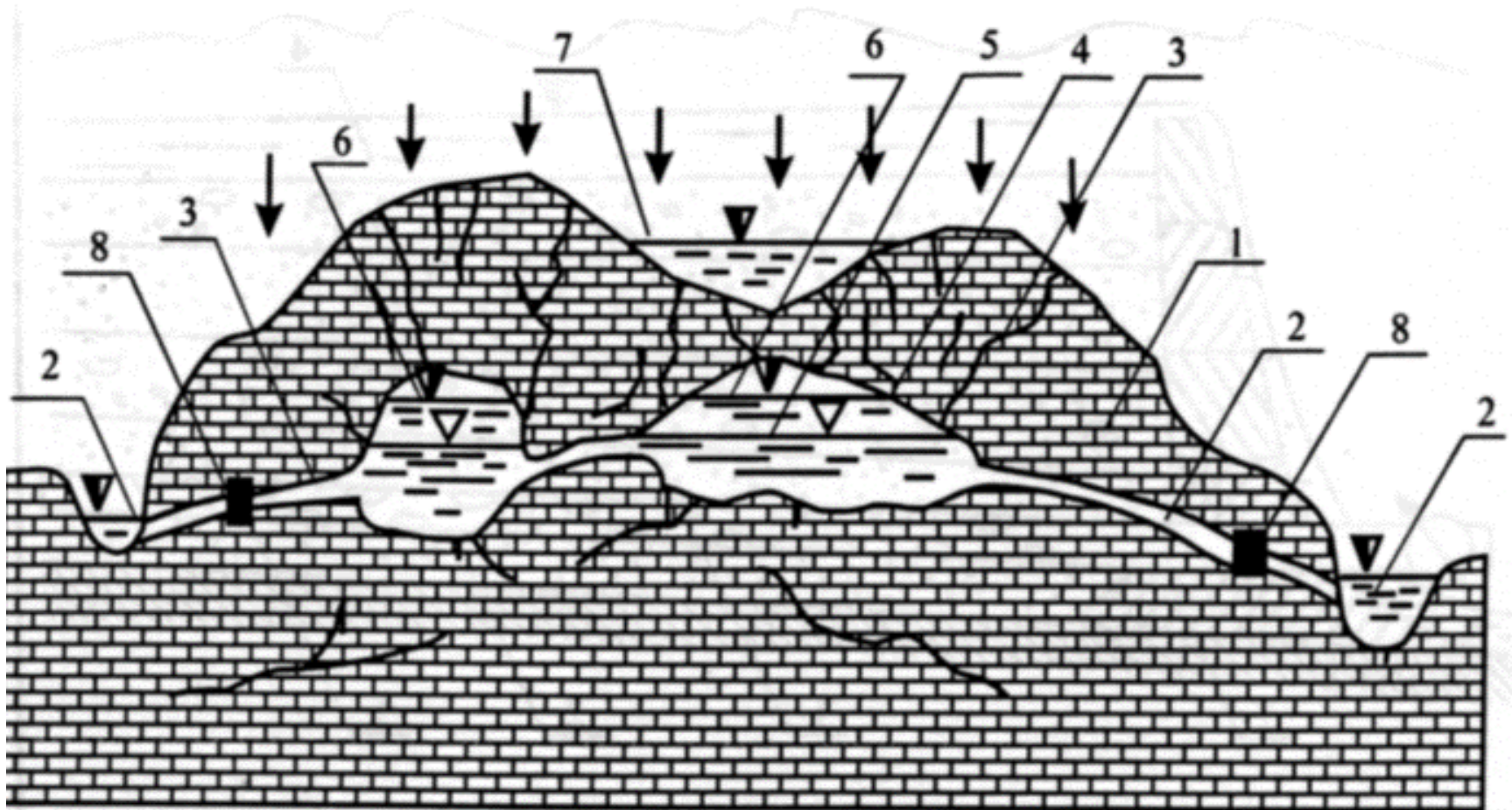
Types of UWR and schemes determine from the hydrogeological conditions. In unconfined aquifers, one of the methods of creating groundwater is the building of the underground constructions (dams, curtains, screens) from a waterproof material, perpendicular to groundwater flow.

Sampling of groundwater from the UWR carried out with a wells, boreholes, drainage galleries, etc., constructions of which is described in a large literature.



Promising to create UWR are the areas with karst rocks
- 1 (limestone, dolomite, marl, gypsum).

If necessary, part of cracks and channels (3) overlap to create additional water storage in the UWR.



If in nature, there are no natural underground water storages, they are made artificial.

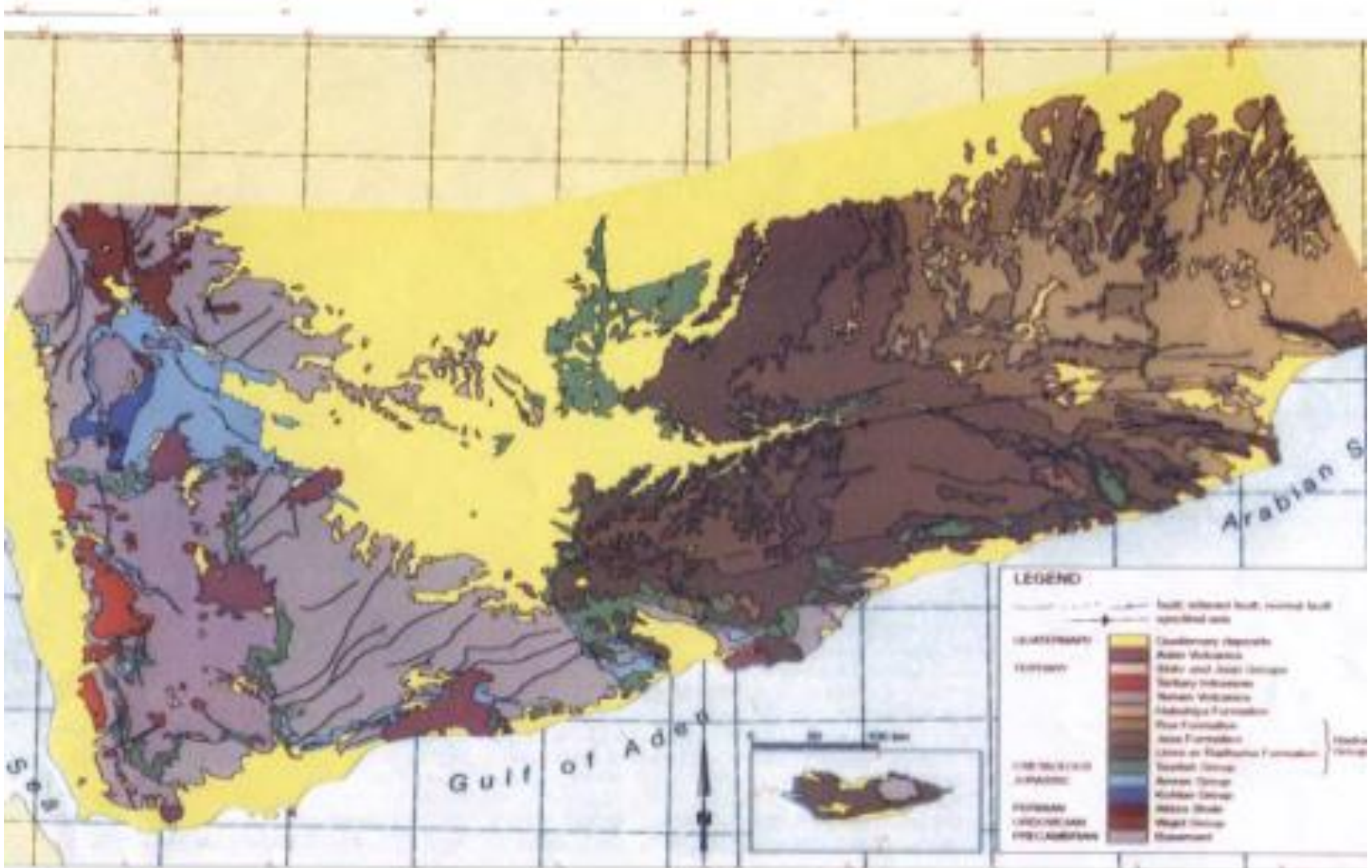
The establishment of such vessels is practiced in developing countries located in arid climates.

For this reduction in the landscape is filled with sand materials and levee.

During the rainy season there is an accumulation of water in artificial containers, and its drawdown by means of drainage in the body of the dams. Sand dam in the river valley are common in the valleys of the periodic surface runoff in Asia and Africa [Akramov A., Ibragimov J., Hodzhizadaev T., El Amani S.].

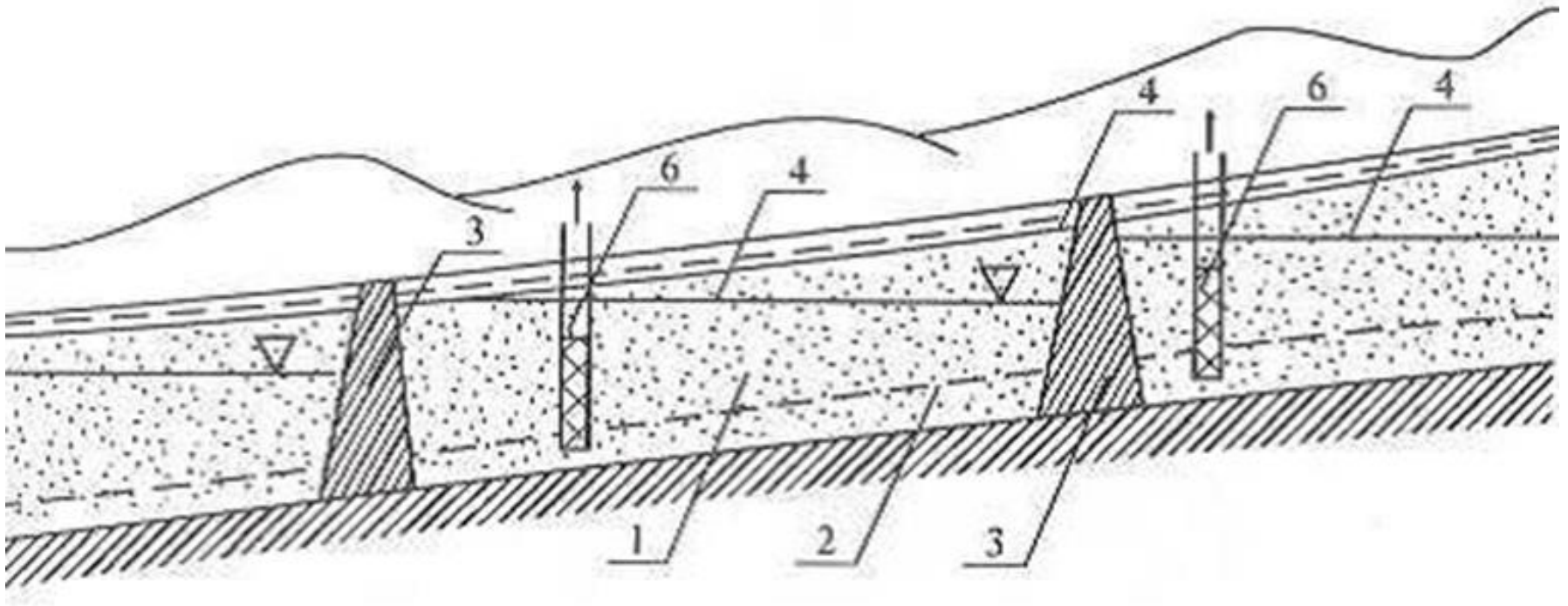


The Republic of **Yemen** has several UWR built by the ancient .



The ancient reservoirs have two classical schemes.

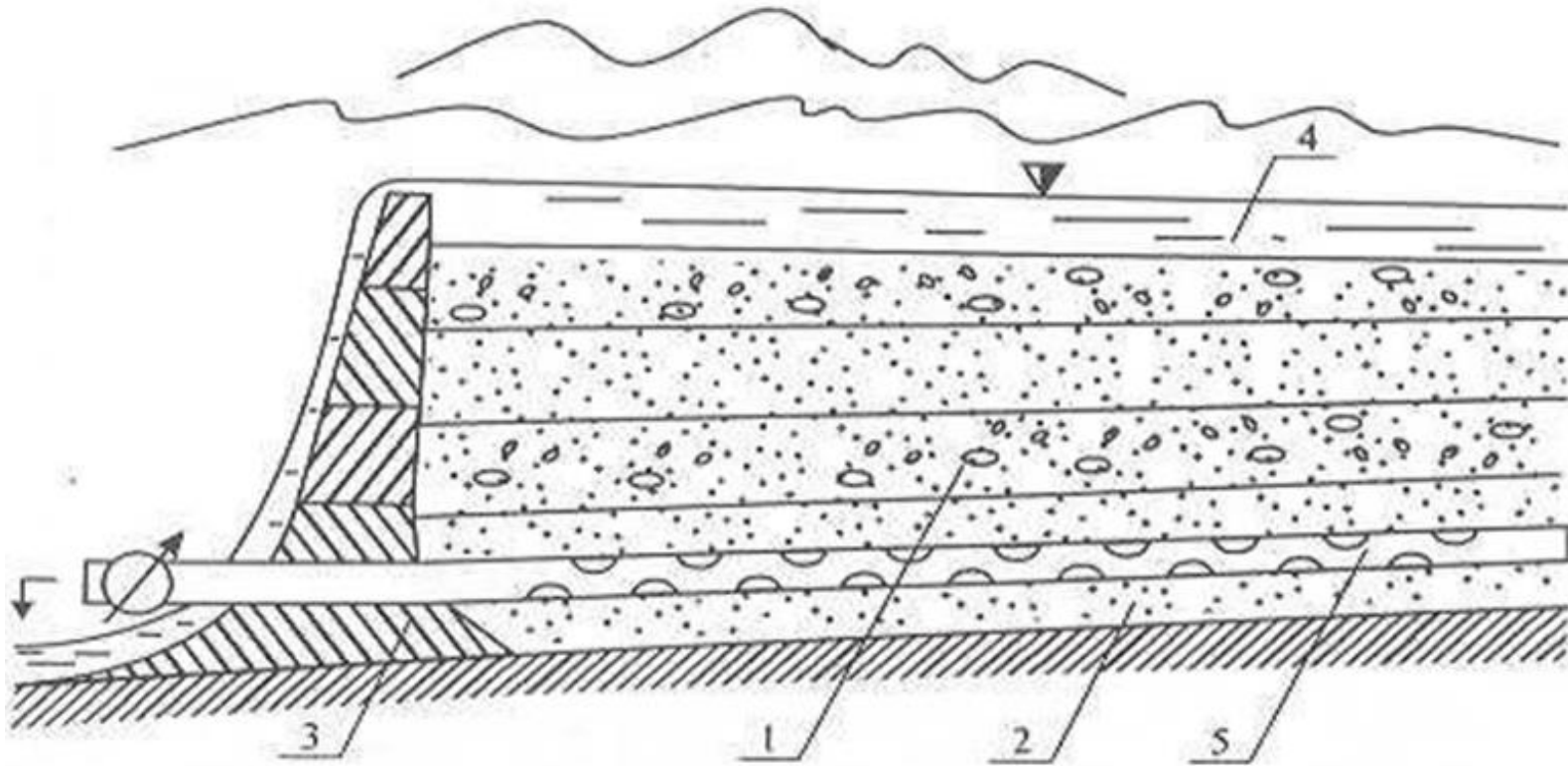
The first scheme.



Underground water reservoir created in sandy sediments of valley,

1: aquifer; 2: natural water level, 3: underground dam; 4: new water level; 5: valley; 6: water well.

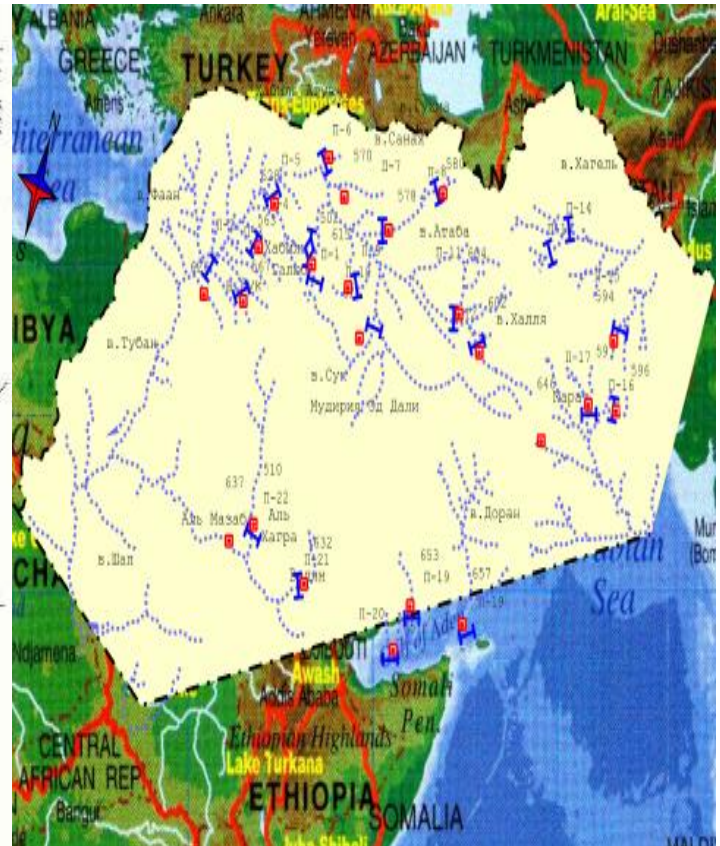
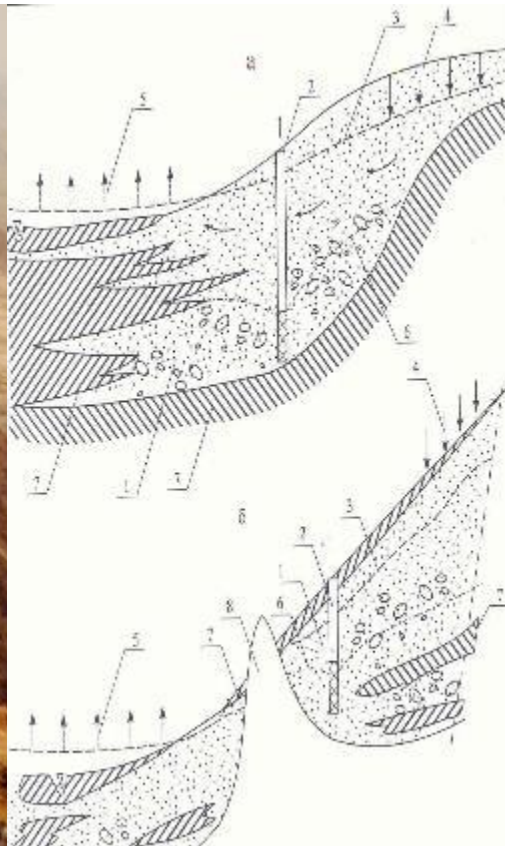
The second scheme



Water reservoir created on rocks of valley

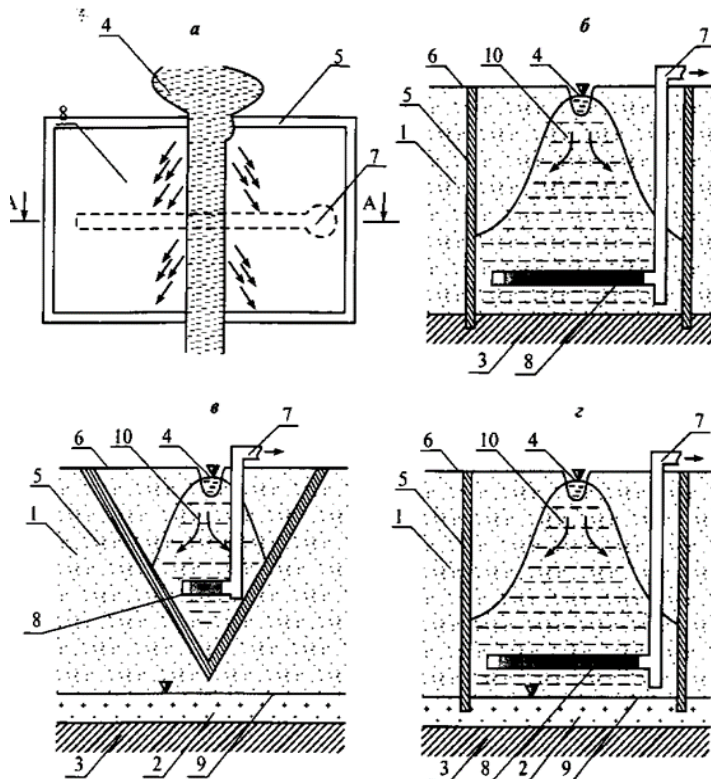
1, 2: sandy sediments; 3: dam; 4: surface water; 5: water intake.

The complex hydrogeological study, which was carried out only in the mountain area, pointed out 77 places for future UWR. [Kalinin M.]



In the arid zone, where the first of the natural surface of the water table has a high mineral content (2), UWR, can be created in the form of a floating lens of fresh water.

Creating a lens of fresh water (10) possible along irrigation canals (4) and in the spring period is due to the runoff surface (takyr runoff).



WS is designed to increase the power (thickness) of groundwater flow. Material to create it can be: clay (heavy loam), metal sheet piling, solution of clay and concrete, synthetic films, rubber, etc. Technical and economic issues in detail can be found in the literature [*Globa V., Yakovlev E., Borisov V., Parizek R., Myers E., Larson Ingemar, Joseph J., Helweg O., Smith G., Matsuo Shin-Ichiro*].



Conclusions

1. Creating **UWR** is one way for solving the water problem in humid and arid areas. It allows increasing the available water resources and sustainable development of the territories.

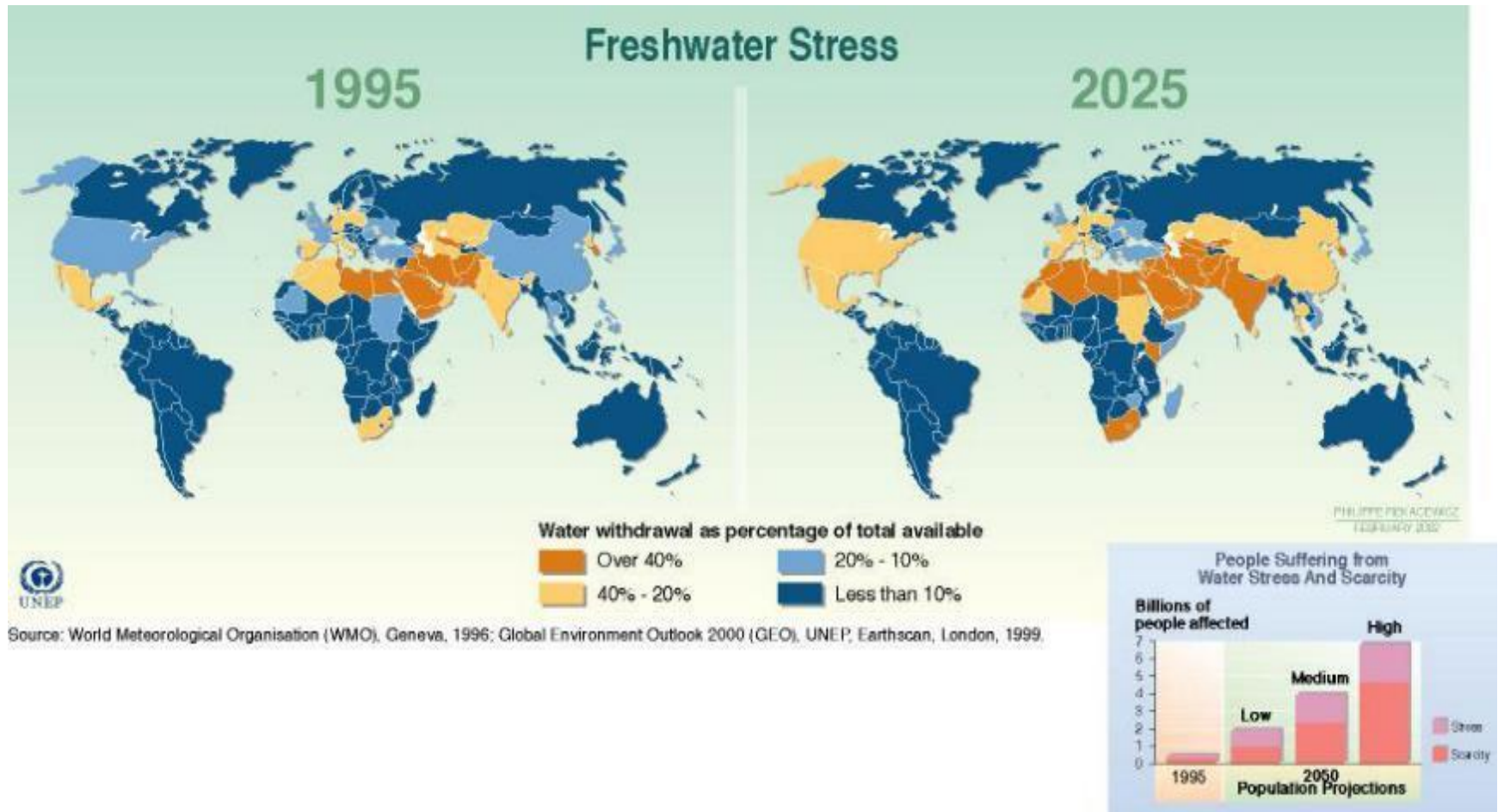
2. Creating UWR allows increasing operating underground water, which increases the water supply to water users, promotes the improvement and preservation of groundwater quality at a high level for a long time, more efficiently without additional expensive activities using the power of exploited groundwater. UWR avoid flooding of large areas of fertile land and minimize an evaporation in compared with surface Water Reservoirs.



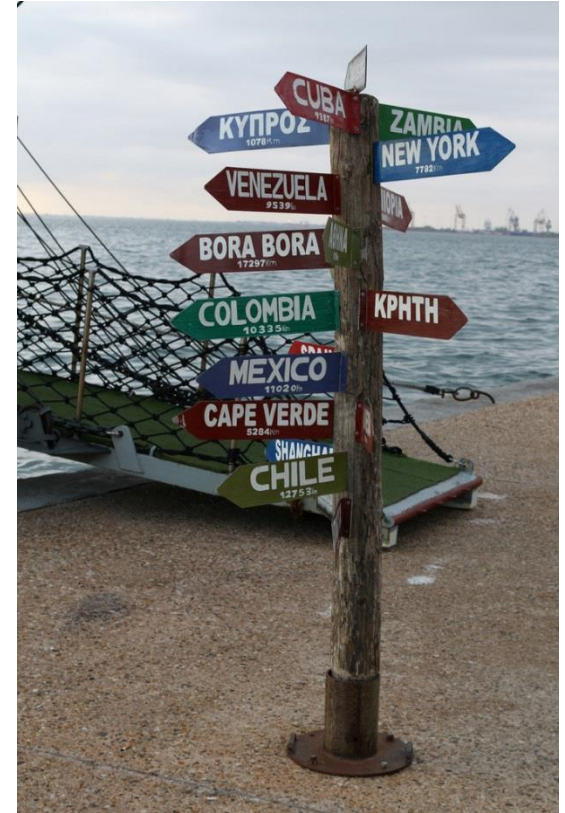
3. UWR is an effective way to improve water supply and water supply in agriculture. However, the effectiveness depends on the correctness of the chosen location for the UWR and the correctness of the chosen design of the dam and water intake.



4. The use of closed-in plan and section of WS will create artificial fresh groundwater resources at the local, pre-selected and fixed sites, which is very important for the semi-desert and desert areas, where almost no underground drainage and used great tools to search for fresh water.



THANK YOU



For more information, please contact
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