MITIGATION TECHNIQUES IN COMPLETE WATER MANAGEMENT.

ARTIFICIAL RECHARGE IN BASINS FORESTRY. MANAGEMENT TECHNIQUES TO PRODUCE WATER

Precedents

There is a group of water management techniques called "mitigation" techniques (they help mitigate peaks in demand) which are little-known but of enormous importance in the progressive management of water from the headwater of every basin. These are generally dykes and infrastructures that laminate the runoff flow and retain significant volumes that would otherwise build up in the lower part of the basins, as well as suitable management of forest masses. Hence the importance of the work of forestry engineers in managing water resources and aquifer recharge (MAR).

This is a solution especially designed for subbasins in the Mediterranean Arc, where floods are a common phenomenon.

The most effective features are those that have been introduced and forest management, the combination of which enables aquifer recharge and reduces the build-up of volume flow. Grupo Tragsa has proven experience in building these, especially in the Community of Valencia region and Andalusia.

According to studies carried out in the context of the DINA-MAR project, aquifer recharge located below forests is greater than that in barren areas with similar precipitation. This fact does not seem to be attributable to features "caused by man", but rather to a natural mechanism.

Management of runoff water

When the terrain gets saturated and cannot retain rainwater, the latter is moved by gravity towards the watercourses and can come to have catastrophic effects.

Suitable forestry management can retain a large part of this water in aquifers. Some examples are:

1.- Repopulation and siviculture for deep artificial recharge in suitable areas.

- Creation of forest masses with a diversity of species adapted to the conditions of the ground, with low water consumption and various strata that foster infiltration.

2.- Mechanical preparation of the soil to encourage infiltration.

For forest areas above aquifers suitable for artificial recharge:

- Creating furrows that favour infiltration and decrease surface runoff.
- Enabling planting and growth of plants.

The creation of contoured furrows or ditches reduces water erosion and increases the time that the water remains on the hillside, fostering natural infiltration, aquifer recharge and the growth of plants put in place. (Photo: TRAGSATEC).

3.- Countryside arranged for aquifer recharge.

A technique applied in Switzerland with good results. This involves diverting part of the water from a river to the interior of a forest arranged for recharge, by means of suitable species and certain work carried out on the ground.

4.- Restoration and maintenance of terraced land.

Terraces are structures that encourage cultivation on hillsides. They have been used since antiquity, and have allowed mankind to extend cultivated areas and help recharge aquifers. Their high degree of abandonment can be mitigated by forest repopulation.

Catastrophic watercourse flood in a town in south-eastern Spain (1960s). This torrential event affected the whole south-east, caused human and material losses, and washed cubic hectometres of water to the sea, paradoxically in an area with endemic problems of drought. (Photograph courtesy of ICONA).

Terraced hillside. A large amount of this corrective work has today been abandoned. Maintaining them and repopulating forests encourages use to be made of runoff waters. Morella (Castellón). (Photo: TRAGSATEC).

5.- Making use of runoff waters.

One of the activities most used in hydrological-forestry correction work is the creation of dykes and dry-stone walls in ravines and watercourses. This work is usually done for other purposes (lamination, retention, consolidation), but it usually also acts as infrastructure to infiltrate the water.

Dyke in a torrent in Sierra Nevada (Granada). It laminates the peak flow volume and increases infiltration (Photo: TRAGSATEC)

The main drawback is the suspended sediments, which clog up the ground and thereby decrease the infiltration rate. This problem is reduced with reforestation of the basin from which the flow comes and by installing dykes in series, which prolongs its useful life.

Dyke in a saltwater torrent (Lanjarón, Granada) during its construction in the 1950s (photo courtesy of ICONA) and today (Photo: TRAGSATEC). The presence of the dyke has encouraged the development of a very valuable ecosystem.

In addition, a positive effect is produced on the vegetation, enabling a diverse and valuable ecosystem to develop.

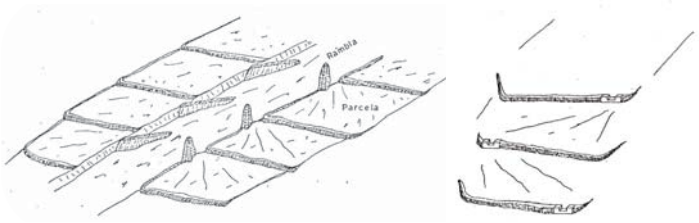
Other examples of work to manage the runoff waters are:

- Collection of water by means of making surfaces impermeable, which is diverted to storage tanks (such as those used in forest fires).

Drainage ditch on a hillside. The collection of rainwater reduces erosion and enables greater use of the runoff water. Navarre. (Photo: TRAGSATEC).

Small dam to reserve water in Cabañeros. (Photo: TRAGSATEC).

- Small dams in river watercourses, acting as small reservoirs for lamination and infiltration.
- Reservoir pools to collect water at the foot of the hillside.
- Ridge gaps: These are long ridges that divert part of the volume flow during a flood and guide it towards cultivated plots. They are commonly used in "ramblas" (natural watercourses to the sea) and are one of the oldest features in Spain for artificial recharge.
- Earth and weed bank jams: These re-dam runoff water by means of earth ridges perpendicular to the river bed, and which have side overflows.



Sketch of ridge gaps in a "rambla" and earth-weed banks. The lines show the path of the water (Taken by Ecología Fuera de Serie. ICONA. 1990).

Moreover, forest formations and their proper management have another series of positive influences on both surface and underground water, such as:

- A greater increase in water quality, which in turn means lower treatment costs and greater health guarantees.
- Conservation of wetland ecosystems with the ecological rewards of this, conservation of biodiversity, prevention of marine intrusion and other problems of pollution, maintenance of the landscape, and as a consequence, greater recreational and cultural worth.

Conclusions

The control of runoff and the management of cloudy waters have become established as measures in mitigating water management.

The infrastructures in forestry basins and along the watercourses, as well as reforestation of recharge areas and their proper management, lead to an increase in the amount of underground water that recharges the aquifers and the availability of water in the affected area. Equally, this forest management fosters many more positive than negative effects in environmental quality.

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