

METHODS & TECHNIQUES FOR THE ANTI-EROSION AND ANTI-FLOODING PROTECTION IN MOUNTAINOUS DRAINAGE BASINS IN EVRYTANIA (GREECE)

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Abstract

The object of this study is to depict and evaluate the methods and techniques implemented or scheduled for the anti-erosion - anti-flooding protection in mountainous drainage basins in Evrytania, which exhibit intense erosion phenomena and constitute a danger of flooding for the downstream areas. Among these areas are also inhabited areas, such the town of Karpenisi, and for this reason the optimum way of management of these drainage basins constitutes an important element for the development of the town and also for the “sustainability” of the greater area (Evrytania, Greece).

1. INTRODUCTION

The development and expansion of parts of towns, villages and dwellings in areas close to the streambeds of torrents, can cause flooding, especially in the cases where these torrents exhibit intense hydrogeomorphological erosion and sliding phenomena in their drainage basins (Kotoulas D. 1972, Kotoulas D. 1987, Kotoulas D. 2001, Sapountzis M., et al. 2006). A significant amount of weathered materials are detached from the slopes of the mountain Timfristos and in conditions of repeated downpour or snowfall, are transferred via the torrents and are deposited in the areas downstream. Amongst the drainage basins that exhibit increased geomorphological “vulnerability” where we see intense geomorphological weathering - erosion processes in the geological formations that compose them, there are some (drainage basins), the beds of the torrents that drain them, run through inhabited areas such as villages, dwellings areas, towns like in a part of the town of Karpenisi, in the neighboring dwelling of Xiria in the east and the village of Agia Triada.

2. MATERIALS AND METHODS

2.1 Geographical location of the study area

The greater study area is located at the mountain Tymphristos in Evrytania and more specifically at altitudes of 700 meters and above. The torrents under study Klarotos and Kakorema, drain their drainage basins which are formed in the south slopes of the Tymphristos mountain in Evrytania, they run through the town of Karpenisi and the eastern part of the alluvial fan respectively, where the dwelling of Xiria is located. At the north slope of the Tymphristos mountain, the Agia Triada village is crossed at its boundaries east and west by the torrents Poros and Neraidias.

2.2 Investigation method

For the depiction of the existing situation of the natural environment of the under study drainage basins, as well as for the depiction of the dynamic hydro-geomorphological activities and of the technical and geological characteristics that are formed, there were used topographical, geological and vegetation maps, and meteorological and hydrological data as well as relevant studies which were obtained from the Forest Authorities of Evrytania.

3. RESULTS - DISCUSSION

The unfavorable climatic conditions which prevail at the drainage basins of the upper flow of the torrents Klarotos, Kakorema, Poros and Neraidias combined with the high slopes (>50%), increase the “trailing” ability of the flowing waters and favor the formation of intense axial (ravinal) and slope erosion with significant undermining at the of the foot of the slopes. An important fact is the appearance of widespread phenomena of surface erosion due to “hydrolayer flowing” where the fine aggregates drift, while the coarse -voluminous materials remain in place.

The torrent Klarotos that runs through the town of Karpenisi exhibits potentially increased geomorphological “vulnerability” and the possibility of flooding incidences. Similar characteristics as far as the geomorphological “vulnerability” and the possibility of flooding incidences are also noted, downstream, in the case of torrent Kakorema which discharges into the river

Karpenisiotis , through the alluvial fan where we find the dwelling of Xiria. It is noted that the greater area of the alluvial fan exhibited in the past occasional incidences of flooding, and consists an area which in the future it is possible to face flooding problems, due to unfavorable hydro-geomorphological conditions which occur in the area and due to the presence of the Kakorema torrent, of which the preservation of its streambed in the east end of its alluvial fan requires systematic monitoring and preservation works. The torrents Poros and Neraidias which run through the village of Agia Triada in the north slope of the Timfristos mountain, do not exhibit increased geomorphological “vulnerability” and with the exception of extreme climatic - hydrogeomorphological phenomena and processes, we do not expect serious problems.



Fig. 1a & 1b - Works for the settlement of the torrent Klarotos. Stone dam for the settlement of branch Kotronakia (1a). Picture 1a shows the extra elevation of the dam in order to make it more efficient. Artificial sheeting of the bed of the torrent Klarotos in the town of Karpenisi (1b). (Source: A. Mertzanis)

The works for the re-direction of the torrent Klarotos the first of which were constructed already since 1956, by the Forest Authority, were successful. The streambed was “secured” since it acquired fixed points the ravine and gradient erosion and the sliding and land sliding were put under control and until recently the torrent did not create any flooding problems in the town of Karpenisi, given that, that from time to time the initial works were enforced with complementary smaller scale works which were constructed during the 1971, 1980, 1984, 1987, 1997 and 1998 (Figures 1a & 1b). The works for the re-direction of the torrent were constructed only up to the base of the steep slope, due to technical difficulties and also due to the coarseness of the relief (Kosmas S., et al. 2009).

4. CONCLUSIONS

In order to avert the evolution of the torrential phenomena, the ravine erosion and the deepening of the central streambed which causes the breakdown of the gradients which is worsened by the nature of the geological substrate, what is needed to be done, is to make a continuous effort for the “fixing” of the streambed in the upper part upstream of the last dam. Also it is needed to repeat the planting works in order to replenish the vegetation so that the surface erosion-weathering which supplies the streambed with materials can be restricted and also so that the volume of the flooding flow can be reduced. For the planting works (re-forestation and re-grassing), to be effective first it is necessary to stabilize the ground of the gradients by constructing “small walls” and “dry walls” at the slopes and at locations where small sliding is seen inside the ravines. The use of machinery necessary for this work in these locations is not possible, due to steep morphological gradients which form the relief of the basin combined with the greatly weathered and eroded and gliding soils. The construction of new roads in order to make the area accessible so that the materials needed can be transported is expected to burden even more the situation and further aggravate the erosion-gliding phenomena (Ministry of Agriculture, 1971, Ministry of Agriculture 1983). These averting factors, formulate the context of the implementation of the suggested works of stabilization-restoration of the gradients (re-forestation, re-grassing, agrotechnical), the construction of which presupposes manual work, while in actual fact the implementation of more effective techniques is not

possible: a. Hydro seeding in combination with filling with straw, hydraulic hydro seeding, hydro seeding with the use of a three dimensional grid etc (presupposes the use of hydro seeder), b. Covering of the gradients with grid – geo cells and vegetive soil and c. fences for the containment of rainfall etc.

Finally, for the completion of the works for the aversion of torrential phenomena and for the management of flooding incidences in the town of Karpenisi, the restoration of the damage of the top and the flaps of the old dams which was caused during the 30-40 years from their initial construction as well as from the damage caused by the flowing and crashing materials, from the flowing waters, large stones, and smaller size dry dragged materials is expected. For their more efficient function there will be constructed in the between, parallel walls made of concrete and wiredrawn boxes, dry stonework made from collected stones, as well as a new dam, while for the construction of the works in the upper part of the basin (at Kotronakia) we need to expand the existing road. In the long run, the study group thinks that new dams should be constructed amongst the old ones, in order to further decrease the slope of the bed and increase its width so the speed of the flowing waters and as a consequence the transport ability of the torrent will be further restricted. An important priority is the prohibition of grazing which should be continued for the years to come and the strict control of prohibition.

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