

TORRENT CONTROL IMPACTS OF THE YACUMBO RIVER PROJECT, VENEZUELA

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OBJECTIVES

In the last 40 years in Venezuela a relative intense program of torrent control dam has taken place. This development has been associated mainly with the aid of the Austrian engineers to Venezuelan engineers working in teaching and consulting related to design and building. One of the basins where this action has occurred is the Yacambu River located at the west part of the country. Since 1985 the government has built dams and auxiliary dam in order to reduce mass movement and scouring in a very large hydraulic development.

The Yacambu basin has 326.2 Km² from the upper divide to the dam location. It has 12 small watersheds. It is located between UTM 420.000 and 450.000 East and 1.060.000 and 1.080.000 north. The river development project consists of a dam 162 meters high and a reservoir with a volume of 465 million cubic meters. From this reservoir flows 3.4 cubic meters per second through a tunnel of 24.3 Km long to a semiarid adjacent basin where the water will be used for irrigation and water supply to the Barquisimeto city.

The average annual rainfall is 2040 mm. The rainfall pattern has two periods: dry from December to March and wet from April to November. Due to topographic condition the stream pattern has torrential characteristics. This area has a heavy sediment production. Frequently there is seismic activity associated with the Bocono fault. A quarter of the basin area has a slope between 35 and 50%. Another quarter of the area has a slope greater than 50%. Currently the sediment production has an average of 2611 T/Km²/year. (Swat method)

The present paper has the objectives to identify on a map the location of every dam and auxiliary dam, to evaluate the stability and operating situation, to establish a maintenance program and to evaluate the dam construction effects. The evaluation of the all works is useful in order to make recommendations and adjustment, if necessary to improve the control strategy and design.

METHODOLOGY

A method has been applied to organize the data collection: dam location, stability and operating condition of the different parts of every dam. The effects of every dam have been evaluated taking into account the stabilization of the potential mass movement. We have analyzed aerial photos and maps. We have had interviews, meetings with technicians of the institution who are in charge of the management of the Yacambu Project. All the data collected were fed into a Geographical Information System.

RESULTS

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We have identify 32 check dams, 1 retention dam, 1 groin and 48 auxiliary dams, 82 in all. The 67% of the dams are in good condition and 15 % has stability and operating conditions problems. 31% of the auxiliary dam are in good condition and 10% are in a very bad situation. 59% of these works present small problems related to the flow section and foundations. The construction works are mainly located in the upper parts of the basin (northeast) where there are very intensive torrential processes unstable slopes associated with rains with high erosivity (8000 MJ/ha/mm/year) and very weak rocks (carbonaceous phylites). The type dams built are “check dams” with an average high of 4 m. In addition to these dams there is only one retention dam of 10m. high. Most of the unstable areas are stabilized, stopping the mass movement and the scouring processes. This work has been and is now helping to protect short stretches of the roads and increased the employment of the local population. We have made two recommendations for improvement. One is that there are too many auxiliary dams. There are 48 auxiliary dams to protect 32 check dams. In two torrents there are 3 auxiliary dams for one check dam trying to solve the insufficient foundation of the dam. Building too many auxiliary dams has increased the treatment cost. The second recommendation is to increase funding and completion time of the torrent controls program. Until this moment there are only 3 dams built per year.

CONCLUSION

In general, we think that the torrent control program in the Yacambu basin has reached the point to where a “second phase” is necessary. Check dams have to be built mainly in torrents within instable areas near the intake tower located at the mouth of the tunnel. We recommend improving the design foundation and using modern construction methods. We consider it necessary to apply a maintenance program and the reconstruction of the destroyed dams, when needed.

Finally, we want to point out the experience gained by the Technical Department of the Yacambu Project in the field of torrent control in the tropical mountain region has been invaluable.

Keywords: torrent control, check-dam, maintenance program