THESIS

RESERVOIR SEDIMENTATION PATTERNS IN SMALL DAMS

Submitted by

Usman Iqbal

(2010-PG-WRE-38)

FOR THE DEGREE OF

MASTER OF SCIENCE
IN
WATER RESOURCES ENGINEERING

CENTRE OF EXCELLENCE IN WATER RESOURCES ENGINEERING
University of Engineering and Technology
LAHORE, PAKISTAN

2012

RESERVOIR SEDIMENTATION PATTERNS IN SMALL DAMS

ABSTRACT

Dams are built to store runoff water for later use for municipal, industrial and irrigation purposes. Dam sedimentation decreases the reservoir life due to continued deposition of sediment load which enter the reservoir with inflowing water. Sediment gets deposited over the dead as well live storage space. It is matter of great importance to know the sediment rate, and sediment depth wise deposition pattern to project reservoir life, usefulness and sustainability in the future. USBR has developed typical sediment deposition pattern curves based on the reservoir storage shape category; and these pattern curves are mostly used without any validation for the local conditions.

More than 60 small dams have been constructed in Pothohar area of Pakistan for irrigation purposes. This study was carried out to ascertain the sediment loads and sediment depth wise distribution pattern in these small dams. For this purposes initial topographic contour data and later time hydrographic survey data of seven small dams in the Pothohar region (Tainpura-I, Tainpura-II, Pira Fatehal, Jammargal, Dungi, Jabbi, and Rawal dams) was collected. Hydrographic survey was also carried for Tainpura-I dam as part of this study. The depth wise sediment deposition was determined by comparing the storage volume at two time periods. The total sediment deposition was also determined. The reservoir's shape category was determined from the slope m of the depth versus storage graph on log-log scale. The reservoirs' sediment accumulation at 25, 50 and 75% depth, and at dead storage level was

determined from the field data and compared with the USBR typical deposition pattern curves and any differences in results was noted.

The depth-storage shape of reservoirs for small dams in Pothohar area of Pakistan is as USBR Type III (m = 1.64 to 2.47, category = Hill) for 86% dams (6 Nos.) and USBR Type II (m = 3.03, category = Flood plain - Foot Hill) for 14% dams (1 No.). The dead storage depth of small dams varies from 39 to 88% (average 63.5%) of gross storage depth. The sedimentation pattern curves for small dams' reservoirs follows USBR sedimentation pattern curves weakly with maximum difference/error of about 11.2 to 20.8% at different depth levels. The sediment load for small dams in Pothohar area varies from about 1100 to more than 11,000 (average 4683) m^3/yr per sq. km of the catchment area. The reservoir zero level change is 0.23 to 0.91 m/year with average rise of 1.93 ft/yr or 0.59 m/year. This will affect the performance of irrigation outlets, which are likely to become inundated by the sediment deposition.

It is recommended to extend this study for which extensive hydrographic survey of 3 to 5 small dams be conducted more frequently say 2 years and sediment deposition pattern for Pakistan be established. Loss of storage due to sediment accumulation is very severe issue for sustainability of small dams in Pothohar. It is recommended that all future dam designs should incorporate provisions of dam raising and incorporate removal of sediment deposits to extend useful life of small dams. The outlet may be provided with differential level inlet area to compensate against the possible blocking in future due to sediment.