# Using a special empirical model to estimate sediment yield of Koohbord dam watershed in Kohgilouyeh County

**Mohsen Armin*: Assistant Prof., Faculty of Natural Resources and Natural Resources and Environmental Research Institute, Yasouj University, Yasouj, I.R. Iran.**
**Masoumeh Bazgir: Graduated Master of Civil Engineering, Islamic Azad University Yasouj Branch, Yasouj, Iran.**
**Sayed Alisaleh Velayatinejad: Graduated Master of Watershed Management, University of Sari Agricultural Sciences and Natural Resources, Mazandaran, Iran.**

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**Extended abstract**

## 1- Introduction

There are strong links between the availability of water for agricultures and livestock productions, and the incomes for poor rural nation. Rainfall variations, particularly droughts, effect on their living as well One meaning of increasing people's resilience to these shocks is to store water in dams – so that crops can be irrigated and cattle watered during dry seasons. Many of the small dams are constructed in semi-arid regions of Africa which is rapidly filled with sediments and sometimes only after a few years. When dams silt up the rural areas that is relied on them for cattle watering or small-scale irrigations that deprived of the water and food security that dams provide them, and their source of income is seriously affected too. Predicting soil erosions, sediment yields and dam sedimentation rates can be a complex task, it requires professional experts, and in generally it has poorly covered in small dam design manuals. These results in many small dams constructed with little or no consideration of the impact of future siltation of a dam's life or on water yields. This issue is poorly covered in most small dam design manuals, which mostly focuses on civil engineering designing and construction aspects. A capability to estimate future siltation rates in small dams is essential to ensure that: dams are not constructed in catchments with excessively high sediment yields; dams are sized correctly; catchments where the rapid introduction of soil and water conservation or other measures will be essential if a reasonable dam life is being obtained, are identified early enough for remedial activities to have a significant impact on dam siltation.

## 2- Methodology

Sediment yield from a small dam catchment is determined by rates of soil erosion, and the sediment transport ation and deposition processes that control the delivery of eroded sediment via the fluvial system to the catchment outlet. The characteristics of the catchment, including soil types, land use, rainfall distribution and intensity, and conservation activities all affect sediment yields, which in semi-arid regions vary widely from year to year. Koohbord dam watershed with a total area of 38.29 square kilometers in Kohgiluyeh and Boyerahmad province is one of the watersheds without a sedimentation data, which requires the use of empirical models for estimating sediments, so that the obtained data is the basis for the management plans of dam watershed. The used procedure based on an empirical sediment yield predictor that combines quantitative information on the catchment area, annual rainfall and slope, with qualitative factors describing soils, vegetative cover, and evidence of accelerated erosion. The qualitative factors scored in a rapid catchment characterization exercise. Scores for soil type and drainage, erosion status and vegetation cover used with data describing the slope of the main stem river, the catchment area, and the annual rainfall. From the information the sediment yield can predicted, using an empirical function (which is) developed from small dam

* **Corresponding Author:** mohsenarmin2007@gmail.com

catchment and sedimentation data. The catchment annual rainfall and area also will calculate. The slope of the main stem river is obtained from 1:50 000 maps. The elevation difference between the catchment boundary and the river bed at the dam location is divided by the distance, measured along the main stem river, from the catchment boundary to the dam site.

**3- Results**

The results showed that the amount of sediment yield in the Koohbord dam watershed is 13.8 tons per hectare per year, taking into account the sediment delivery ratio of 0.18, this sediment yield rate is equivalent to 45.16 tons per hectare per year for soil erosion. It is estimated that after 20 years the lifetime of the dam, about 27% of the initial capacity of dam's storage is lost. Meanwhile, due to the evaporation, about 32% of dam's volume is lost too.

**4- Discussion & Conclusions**

The catchment must be large enough to ensure that the annual runoff fills a dam. It is suggested a lower limit for the catchment area derived by dividing the dam capacity by 10% of the annual rainfall (Dam capacity in $m^3$, rainfall in m, gives the minimum catchment area in $m^2$). If the runoff coefficient for the catchment were 0.1, a typical value for small, semi-arid catchments, this criterion results in a ratio of dam capacity to annual inflow volume of 1, i.e. the dam would store all of the annual runoff generated in an average year. Minimum extracted watershed area of this indicator (38/7 km2) is approximately equal to the area of the catchment area of the Koohbord dam (38/30 km2) and technically the dam has been properly located. A catchment area larger than the minimum area derived using the criteria described above will increase the probability of the dam filling from emptiness in drier than average years. However, there is also an upper limit on catchment areas, particularly in regions with significant sediment yields. Dams in catchments with a large annual runoff in comparison to their storage volume will have rapid siltation rates, and will require large and costly spillways. A lower limit on the ratio between dam capacities to the annual inflow of 0.1 recommended for small dams, in catchments where significant sediment yields anticipated dams with a capacity to inflow ratio of less than 0.3 are not recommended. In the Koohbord dam watershed, the ratio between the capacities of the dam to the annual flow is 1.2, In fact, the annual flow is 0.8 times the capacity of the dam. It seems that the dam has not been properly located. The ratio of the volume of stored water to the volume of earthwork required to justify constructing a dam (in economic terms) depends on the value of the stored water compared to the dam construction costs. It suggested that this ratio should be above eight, and if it is below five the dam site should reject. In the Koohbord dam watershed, the ratio between the volumes of stored water to the volume of earthwork required to constructing a dam is 12, which suggests that the construction of the Koohbord dam is economically feasible.

**Key Words: reservoir capacity, soil erosion, soil type and drainage, vegetation status.**