
EFFECT OF SOIL CONSERVATION MEASURES ON SEDIMENT YIELD AT CHATTAR KALAS (AJK)

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ABSTRACT

A study was conducted to evaluate the effect of soil conservation measures on sediment yield in three catchments at Chattar Kalas, Azad Jammu and Kashmir. One catchment was treated with contour bunds for surface erosion control and check dams for channel erosion control; second catchment having sparse natural vegetation was treated only for channel erosion control with check dams and the third catchment was not treated at all. All catchments were provided with sediment monitoring structures. Four years sediment yield data showed that the erosion rate can be reduced to almost half by adopting technical control measures. The average sediment yield from the catchments treated with technical control measures (both for surfacer and channel erosion control) and the catchment treated only for channel erosion control, was 1.00 and 2.0 tonnes/ha/year respectively. On the other hand, the average sediment yield from the untreated catchment was 3.6 tonnes/ha/year.

INTRODUCTION

The economy of Pakistan is based on agriculture which is dependent on irrigation. Though canal irrigation system of country is world biggest but the regular supply of water from the artificial reservoirs such as Tarbela and Mangla has been threatened by the continuous reduction of their storage capacity due to high siltation rate. Based on the present siltation rate workable life span of the Tarbela reservoirs is only 60 years and that of Mangla 160 years. The reservoirs are not only supplying irrigation water but are also sourcer of production of hydroelectricity.

Realizing the acute problems of shortage of electricity and irrigation water, Government of Pakistan is planning new projects for constructing reservoirs on river Indus. For prolonging the life span of the existing artificial reservoirs and the proposed new reservoirs watershed development projects are also being implemented. In addition to afforestation, other soil conservation measures are also being carried out for gully and surface erosion control, such as, contour bunds and contour trenches in rangelands and terraces in agriculture land and check dam in the water channels. In the past some studies were conducted in the scrub and moist temperature zone to determine the effect of afforestation measures, different natural vegetation types, closure of the area to grazing and effect of different landf uses on sediment yield (Hanif, 1989; Abbas and Hanif, 1987; Annon, 1993 and Shah, 1985). But no study was conducted in the past to evaluate the effectiveness of technical control measures on the sediment yield. Therefore it was felt necessary to carry out a study to assess the effectiveness of technical soil conservation measures on the erosion control. The study was conducted at Chattar Kalas in collaboration of Forest Department of Azad Jammu and Kashmir under its Integrated Hill Farming Development Project sponsored by the World Bank.

MATERIAL AND METHODS

The study was initiated during 1988 by selecting three contiguous small catchments of 3.5, 4.0 and 9.7 hectares area near Chattar Kalas on Kohala Road Azad Jammu and Kashmir. The study area is situated on the left bank of river Jhelum. The average annual rainfall of the area is about 11,000 mm

of which 70% is received during monsoon. In the first instance, the experimental catchments were surveyed and their contour maps were prepared. The first catchment with an area of 4 ha was kept untreated as control. The second catchment of 9.7 ha area which was heavily grazed and denuded was treated with contour bunds in the lower portion. The upper part of the catchment had good grass cover and was therefore not treated. The streams were treated with loose stone check dams. The third catchment had already scrub type of vegetation having mainly *Azacia modesta* and *Olea cuspidata* trees comprising 30% cover. Planting of *Robinia pseudoacacia* and *Ailanthus altissima* was conducted but the seedlings did not survive due to heavy grazing pressure. In this catchment only the streams were treated with loose stone check dams. For surface erosion control no technical control measure was adopted. The treatments were completed during 1989-90. All the three catchment included in the study were open to grazing all the year round.

At the outlet of each catchment, a detention dam was constructed for the deposition of silt. A spillway was provided in the centre of the stone masonry wall for the passage of overflow. As it was not possible for the field staff to take the water samples from the outflow, therefore a splitter system was installed to take one tenth of the overflow to siltation tank. For this purpose a metallic conduit of width equal to 1/10th width of the spillway was installed at one third the distance from one bank wall of the spillway to take one tenth portion of the overflow from the spillway to the siltation tank. The size of the siltation tanks was 2 x 2 x 1 m.

Due to high rainfall in the area, the water from the siltation tank was removed during the monsoon season to accommodate the future runoff. Some of the suspended sediment was also removed along with the water from the siltation tank which is not included in the data.

At the end of each rainy season i.e., monsoon and spring, the sediment deposited in the main detention dam as well as in the

siltation tank was measured. The total sediment yield from each catchment was calculated by multiplying the weight of the sediment deposited in the siltation tank by 10 and adding it to sediment deposited in the detention dam. The sediment yield per ha per year was estimated by dividing the total sediment weight by the area of the catchment.

It may be pointed out that the data for year 1990 represent only the sediment deposited only in the main detention dam during winter 1989-90, because the splitter system was not installed at that time.

RESULTS AND DISCUSSION

The processed data on sediment yield collected during the initial four years are presented in the Table 1 and a bar diagram representing the sediment yield from different catchments is shown in Figure 1. It may be seen from both that on an average maximum sediment yield was recorded from the untreated catchment (3.58 tonnes/ha/ year). The average minimum sediment yield of 0.99 tonnes/ha/year was recorded from the catchment treated with technical control measures for both surface and gully erosion control by contour bunds and check dams respectively. On the other hand, the sediment yield from the catchment with natural growth of tree species and treated only for channel erosion control was 2 tonnes/ha/year. The result of study shows that by adopting technical control measures i.e. contour bunds for surface erosion and the check dams for channels erosion control, the erosion rates can be reduced by 72% and by 44% by adopting channel erosion control measures only.

In principal, the sediment yield should have been lower in the case of catchment having some natural forest vegetation but this was not the case. The reason is that firstly, there are some houses with inhabitants in this catchment area and their animals graze heavily in it and secondly no technical control measures for surface erosion control were carried out in it. Due to grazing pressure, the planting of *Robinia pseudoacacia* was also not successful.

The results of the study indicate that for rehabilitation of denuded rangelands, technical soil conservation measures are quite beneficial in mitigating the erosion process during the initial period when the vegetation has not recovered or a protective vegetation cover has not been established.

Although the data on sediment yield presented in this paper do not represent the actual total because a portion of sediment was lost every time siltation tanks were emptied, still, the data give fair estimates of the comparative erosion rates from the catchment

treated with different soil conservation measures.

CONCLUSION

It may be concluded from the study that technical soil conservation measures such as contour bunds for surface erosion and loose stoner check dams for channel erosion are quite effective in reducing the erosion rate from range lands when grazing control is not possible. On an average, technical control measures reduce the erosion rate by 44-72% at a site during monsoon rainfall.

Table 1. Sediment yield from catchments treated with different soil conservation measures.
Sediment yield (Tonnes/ha/year)

Year	Surface and Channel erosion control,*	Channel erosion control measure	Untreated
1990-91	0.25	0.13	0.82
1991-92	1.86	3.8	6.81
1992-93	0.67	1.02	2.25
1993	0.46	1.2	1.68
Summer			
Total	2.99	6.02	10.74
Average	0.99	2.0	3.58

* The data represent sediment deposited only in the detention dam in winter season.

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Fig. 1 Effect of different technical soil conservation measures on sediment yield at Chattar Kalam

