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QUANTIFICATION OF RUNOFF, SOIL LOSS AND SILT DEPOSITION IN AGRICULTURAL WATERSHED

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ABSTRACT

Watershed development programme has been implemented at Wagarwadi in Aundha Tq. of Hingoli district. The various soil and water conservation measures adopted are nala bunding, gully control structures, cement plug, loose boulder dams etc. The total runoff of 142.4, 206.0 and 193.0 mm received during the year 1997-98, 1998-99 and 1999-2000, respectively. The average sediment concentration of 4.33, 1.41 and 1.06 gm/liter was observed in the year 1997-98, 1998-99 and 1999-2000, respectively. It is also seen that 1622.575, 1327.58 and 942.56 tones of soil is found to be deposited at different structures. Due to adoption of soil and water conservation programme, the silt has been deposited in the watershed itself rather than to transport from the watershed.

Keywords: watershed, runoff, soil loss, silt deposition.

INTRODUCTION

Excessive biotic and abiotic interferences have caused considerable degradation to our natural resources of land, water, vegetation and groundwater aquifers. Total geographical area of 329 million hectares of India is finite, cropped area of 142 m ha is almost constant during the last 15 years and only 39 m ha (11.7% of geographical area) of the forests have crown density of more than 40%. Demands on land, water and vegetation are increasing day by day due to demographic reasons. About 50% of the total geographical area is afflicted with different manifestations of land degradation. Rise in water table, salinization and other environmental degradation in the canal command areas are quite common. Over-exploitation of sweet ground water aquifers, ingress of saline sea water in the coastal ecosystem, culture. Almost 50% of the Indian agriculture is likely to remain rainfed even after realizing irrigation potential fully. Excessive soil erosion in the catchments, siltation of reservoir, negative environmental impacts of mega river valley projects and reluctance of international agencies for funding of large dams in an other current scenario of the development. Sustainable livelihood, evergreen revolution and environmental securities through resource conservation strategies are the major concerns of Agenda-21 of the United Nations Conference on Environment and Development (UNCED). These challenges are expected to be fulfilled through integrated watershed management programmes at micro level with the help of community empowerment.

The study has been conducted at Wagarwadi watershed in Hingoli district of Maharashtra. The area of the watershed is 324 ha comprising 155.52 ha as cultivable, 90 ha under forest and horticulture and remaining under pasture development. The average rainfall of area is 879 mm with an average number of rainy days as 48. Most of the soil in this region is medium to deep black soil. Soil and water conservation measures adopted are nala bunding, gully control structures, cement plug, loose boulder dams etc.

MATERIALS AND METHODS

Runoff and soil loss

Runoff measurements have been carried out at natural water course no 1 and 2 flowing through the watershed. At different time intervals, values of velocity and corresponding height of water flow and area were determined. Based n three values, the discharge were computed. The average discharge, duration and the total runoff volume was measured for the year 1997-98, 1998-99 and 1999-2000. Also, runoff was measured with the help of automatic stage level recorders, which were installed at different locations in the watershed and nalas. The sum of the total runoff volume measured at both the sections yielded the total volume of runoff from the watershed, which was finally expressed in terms of depth of runoff. Measurements of runoff and sediment were taken for the periods in which the runoff had taken place. The runoff samples were collected for estimation of soil loss. The runoff sample of 1 liter has been collected and oven dried. The weight of silt found in each sample is measured and analysed by considering total runoff and area so that the soil loss per hectare is obtained.

Silt deposition

The silt deposition in each structure was measured after post-monsoon season. The average depth and area of silt deposited at every structure viz., graded bund, contour trenches, nala bund, diversion drain, cement plug etc. were measured. Then from analysis of data, the volume and weight of silt deposited were calculated for the year 1997-98, 1998-99 and 1999-2000.

RESULTS AND DISCUSSIONS

Runoff and soil loss

The rainfall, runoff and soil loss measured during the year 1997-98, 1998-99, 1999-2000 is presented in Table-1. The total rainfall of 927.3 mm was recorded in 10 meteorological standard week (MSW). The runoff was

measured during each runoff producing storm. The total runoff of 142.4 mm was recorded which is 15.35 per cent of the total rainfall received during the monsoon season of the year 1997-98. For analysis of sediment loss, the runoff volume of ten liters was collected during each runoff producing storm. The average sediment concentration of 4.33 gm/liter was calculated for this year i.e. the total sediment loss of 1997.6 tones was observed from the total watershed area of 324 ha which is 6.16 tones/ha/year which is in permissible limit.

Similarly, for the year 1998-99, the total runoff was recorded at 206.0 mm (15.60%) against the rainfall of 1320.8 mm and average sediment concentration of 1.41 gm/liter was calculated for this year i.e. the total sediment loss of 1745.6 tones was observed which is 5.39 tones/ha/year, which is in permissible limit. Similarly, for the year 1999-200, the total runoff was recorded as 193.0 mm (24.59%) against the rainfall of 784.7 mm and the average sediment concentration of 1.06 gm/liter was calculated for this year i.e. the total sediment loss of 662.83 tones was observed which is 2.04 tons/ha/year.

Silt deposition

The silt deposited at different structures for the year 1997-98, 1998-99 and 1999-2000 are presented in Tables 2, 3 and 4, respectively. It is seen that 1622.575, 1327.58 and 942.56 tones of soil is found to be deposited at different structures viz. graded bund, nala bund, cement plug, diversion drain, contour trenches etc. in the year 1997-98, 1998-99 and 1999-2000, respectively. Due to adoption of soil and water conservation programme, the silt has been deposited in the watershed itself rather than to transport from the watershed.

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Table-1. Year-wise rainfall, runoff and soil loss in Wagarwadi watershed.

Year	**Rainfall** (mm)	**Runoff** (mm)	**Total runoff volume** (lit)	**Average sediment conc. gm/lit**	**Total soil loss tons**	**Soil loss per ha**
1997-1998	927.3	142.4 (15.35%)	4.61 x 10	4.33	1997.6	6.16
1998-1999	1320.8	206.0 (15.60%)	12.38 x 10	1.41	1745.6	5.39
1999-2000	784.7	193.0 (24.59%)	6.25 x 10	1.06	662.83	2.04

Table-2. Silt deposition at different structures (1997-98).

Structure	**Depth of silt deposition** (m)	**Area of silt deposition** (m^2)	**Volume of silt deposition** (m^2)	**Weight of silt deposition** (tons)
Diversion drain	0.050	445.0	22.250	33.375
Graded bund I	0.065	790.0	51.350	77.025
Graded bund II	0.495	475.0	235.125	352.690
Nala bund I	0.386	225.0	98.430	147.645
Nala bund II	0.274	46.0	12.600	18.900
Cement plug I	0.050	96.0	4.800	7.200
Cement plug II	0.215	590.0	126.850	190.275
Loose boulder dam	0.150	1700.0	255.000	382.500
Contour trenches	0.115	2394.0	275.310	412.965
Total silt deposited = 1622.575 tons				

Table-3. Silt deposition at different structures (1998-99).

Structure	**Depth of silt deposition** (m)	**Area of silt deposition** (m^2)	**Volume of silt deposition** (m^2)	**Weight of silt deposition** (tons)
Diversion drain	0.04	405.0	16.20	24.30
Graded bund I	0.05	675.0	33.75	50.63
Graded bund II	0.50	450.0	225.00	337.50
Nala bund I	0.30	205.0	61.50	92.25
Nala bund II	0.25	42.0	10.50	15.75
Cement plug I	0.04	90.0	3.60	5.40
Cement plug II	0.20	520.0	104.00	156.00
Loose boulder dam	0.15	1480.0	222.00	333.00
Contour trenches	0.10	2085.0	208.50	312.75
Total silt deposited = 1327.58 tons				

Table-4. Silt deposition at different structures (1999-2000).

Structure	**Depth of silt deposition** (m)	**Area of silt deposition** (m^2)	**Volume of silt deposition** (m^2)	**Weight of silt deposition** (tons)
Diversion drain	0.035	390.0	13.65	20.48
Graded bund I	0.042	605.0	25.41	38.12
Graded bund II	0.46	435.0	200.10	300.15
Nala bund I	0.22	180.0	39.6	59.40
Nala bund II	0.17	37.0	6.29	9.40
Cement plug I	0.036	81.0	2.92	4.37
Cement plug II	0.14	475.0	66.5	99.75
Loose boulder dam	0.11	1210.0	133.1	199.65
Contour trenches	0.08	1760.0	140.8	211.2
Total silt deposited = 942.56 tons				