ROHINI
COLLEGE OF ENGINEERING AND TECHNOLOGY
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DEPARTMENT OF AGRICULTURAL ENGINEERING

AI3402 SOIL AND WATER CONSERVATION ENGINEERING

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Sedimentation

Sediment is fragmented material, which is transported or deposited by water, air or ice as natural agents. Eventually sediment settles out and accumulates after transport; this process is known as *deposition*. Among all, water is the most widespread agent of sediments transport. Therefore, sediment yield from soil surface and its transportation by water is commonly considered for study purposes. When land disturbance activities occur, soil particles are transported by surface water movement. Soil particles transported by water are often deposited in streams, lakes, and wetlands. This soil material is called *sediment*. Sediment is the largest single nonpoint source pollutant and the primary factor in the deterioration of surface water quality. Land disturbing activities such as road construction and maintenance, timber harvesting, mining, agriculture, residential and commercial development, all contribute to this problem. There are three basic types of sediments: rock fragments, or clastic sediments; mineral deposits, or chemical sediments; and rock fragments and organic matter, or organic sediments. Dissolved minerals form by weathering of rocks exposed at the earth's surface. Organic matter is derived from the decaying remains of plants and animals.

Sedimentation: It is the processes of letting suspended material settle by gravity. Suspended material may be particles, such as clay or silts, originally present in the source water. More commonly, suspended material is created from material in the water and the chemical used in coagulation or in other treatment processes, such as lime softening. Sedimentation is accomplished by decreasing the velocity of the water being treated to a point below which the particles will no longer remain in suspension. When the velocity no longer supports the transport of the particles, gravitational force will remove them from the flow. Sedimentation is a general term for the processes of erosion, transport and deposition.

Sedimentology: It is the study of sediments and sedimentation.

Sources of Sedimentation

Sediment is delivered from two broad erosion sources. The first being sheet erosion and second being channel type erosion. Sheet erosion is primarily an upland source of sediment while channel type erosion; resulting from the concentrated flow of water; is comprised mainly of gully erosion, valley trenching, streambed and stream bank erosion.

The sources of sediment can be listed as below:

1. Erosion from agricultural, forest and waste lands,
2. Movement of soil mass due to landslides, slumps and soil creeps,
3. From gully by concentrated runoff,
4. Stream bank erosion including cutting of banks and scouring from bed,
5. Erosion caused by occurrence of flood in the watershed,
6. Incident to the roads, railroads, cleaning of houses, industries etc. and
7. Mining and dumps left as waste materials over the ground surface.

In sediment analysis, the estimation of total sediment load carried away through any stream has primary importance because based on the total sediment load, several preventive measures can be adopted. The relative contribution of different sediment sources varies from catchment to catchment. Therefore, consideration must be given to those sources whose contribution is more effective and steps should be taken for controlling them.

Factors Affecting Sedimentation of Water Resources

Several factors affect the separation of settleable solids from water. Some of the common types of factors are:

1. Land Use and Soil Type: Sediment yield is closely related to the soil type and land use. Vegetation provides cover on the soil surface in the form of blanket to protect it from the impact force of the rainfall. The energy of rain drop is dissipated resulting in reduction of splashing effect over the ground surface. At the same time vegetation also creates a hindrance in the flow of runoff; resu1ting in the reduction of flow velocity and ultimately causing minimal scouring of soil particles from the soil surface. Furthermore, the infiltration rate gets enhanced, which reduces the runoff and thereby sediment yield, too.

Soil type is an important variable to affect the sediment yield. For example if there are two types of soil, one is sandy and the other is clay soil; the sandy soil has greater problem of particles detachment due to its coarser characteristics, while the clay soil can not be detached easily due to finer nature. In sandy soil, the soil loss (sediment yield) is more compared to the later one. However, once detached, the clay particles can be transported more easily.

2. Catchment Size: There is an association between the rate of sediment production and size of catchment area, because of the fact that the total runoff yield is dependent upon the aerial extent of watershed. The peak flow per unit area decreases as the area increases while the period of surface runoff increases with area. The reason behind this is that; a catchment of lager area has greater time of concentration. As a result, more time is available to the water for infiltrating into the soil. Ultimately there would be higher runoff and soil loss or sediment yield. In a small size catchment there is a reverse trend. The relationship between sediment yield per unit area and catchment area is shown in Fig. 19.1.

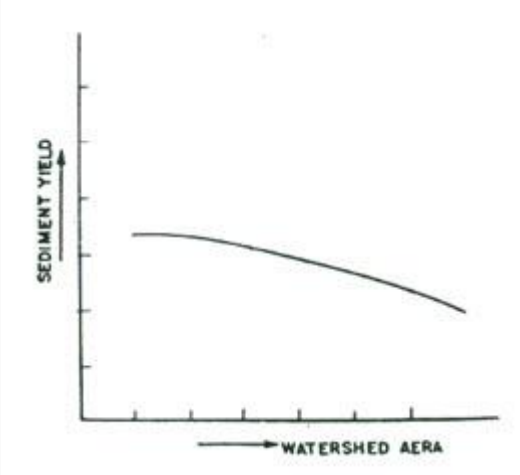

Fig. 19.1. Relationship between Sediment Yield and Area of Watershed. (Source: Suresh, 2009)

3. Climate and Rainfall: The relationship between sediment production and mean annual rainfall of the area has been investigated by several scientists. The general relationship between them is shown in Fig. 19.2 from which it can be seen that under dry conditions there is no surface runoff and no sediment movement, while under high rainfall conditions, there is a peak flow of surface runoff resulting in greater sediment yield.

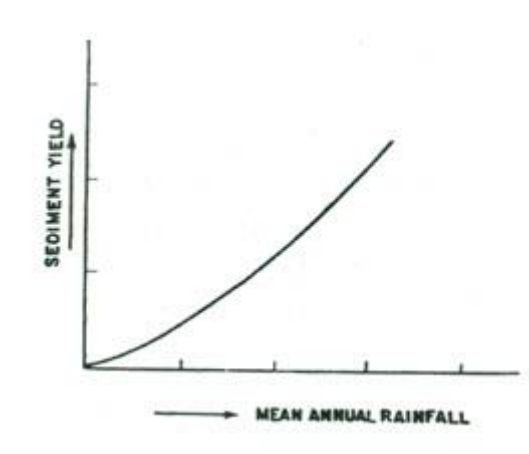

Fig. 19.2 Relationship between sediment yield and mean annual Rainfall. (Source: Suresh, 2009)

4. Particle Shape: The shape of the particle affects its settling characteristics. A round particle, for example, will settle much more readily than a particle that has rugged or irregular edges. All particles tend to have a slight electrical charge. Particles with the same charge tend to repel each other. This repelling action keeps the particles from congregating into flocs and settling.

5. Water Temperature: Another factor responsible for sedimentation process is the temperature of the water. When the temperature decreases, the rate of settling becomes slower. With the highest temperature, the settling process becomes much faster as density of water decreases at higher temperature