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Impact of Dredging on a Stretch of Doodhganga Stream, Kashmir

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ABSTRACT

The present study deals with the impact of dredging on a stretch of Doodhganga Stream, Kashmir. The role of current velocity was found to be critical in shaping the sediment and the dredging process was seen to critically affect the current velocity in the area. The resulting sediment change was found to have far reaching consequences on the biophysical and chemical characteristics.

Key Words: Dredging, Material winning, Current velocity, Sediment, Stream.

INTRODUCTION

Dredging has been defined as excavating or moving soil or rock by dredger. Dredging is an ancient art but a relatively young science. Traces of man's work involving primitive dredging techniques have been discovered in many places, dating back to thousands of years BC (Linssen, 1975). In such instances, the vessel was probably little more than a raft and the excavating means a man with a bucket. The development of this method of excavation into the spoon and bag dredger and the subsequent proliferation of dredging machines has been well described (Gower, 1967).

The act of dredging is primarily associated with change of the natural environment, the sea, lake, or river bed, or even the coastline. Man-made changes of this type are an interference with, and will have an effect on, the balance of nature. It is therefore essential that any proposed dredging scheme should be viewed in the context of its effect on the environment.

The Doodhganga Stream, one of the principal mountainous streams of Kashmir which takes its origin on the eastern slopes of the Pir Panjal range and empties itself into the Flood-spill channel and is a source of water and other materials to the world famous Hokarsar wetland, has mainly a sandy alluvium and this sand has been removed at different places for years together for construction purposes (material winning). In 1997, the Stream at Kralapora and adjacent vast stretches (5 km upstream and 3 km downstream round this area) - Fig. 1 were extensively dredged for material winning purposes. This activity was undertaken by the local residents for commercial exploitation. But only after two years of dredging, the capacity of the stream in this area to provide the material was lost and the work was abandoned.

In order to study the effects of this activity and to compare the previous sediment with the

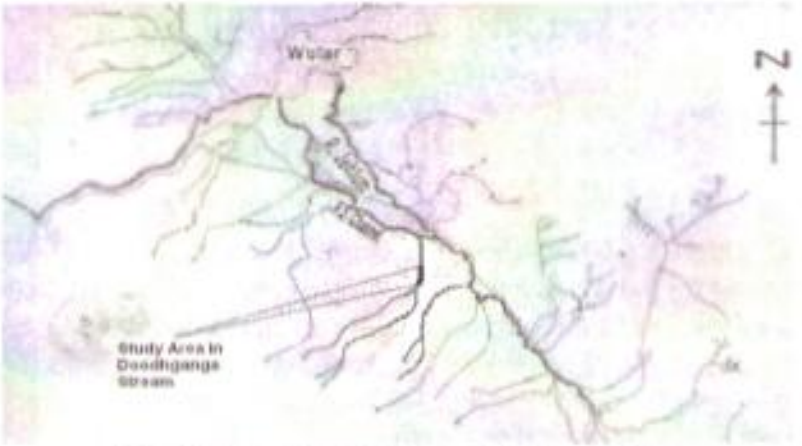

Fig. 1. Map Showing Study Area (not to scale)

present one parameters namely current velocity and the physico-chemical characteristics of the previous[1] and present[2] sediment were taken into account. A survey of the area was also carried out to gauge the impact.

1. The previous sediment, which was fine sand was acquired from a person to whom the sand was provided from the same area. A well mixed sample from the heap of sand was taken.
2. The present sediment was collected in December, 2004 from the study area using a corer and taking a 50 cm deep sediment sample at ten places and then mixing the collected material. A representative sample was taken for lab analysis. [1]

MATERIAL AND METHODS

The methods used for the analysis of different parameters are:

1. Current velocity: It was determined by using a wooden float (3".3".1") and the readings were taken eight times during 2002-2003 and then again four times during 2004-2005 in different seasons. Readings were taken during base flow only.
2. pH (1:2 w/v suspension): By digital pH meter.
3. Conductivity (1:2 w/v suspension): By digital conductivity meter.
4. Water soluble and exchangeable bases—calcium, magnesium, sodium, and potassium—(Bower et al., 1952 and Black, 1965).
5. Ammonium nitrogen (Peech et al., 1947).
6. Available phosphorus (Olsen et al., 1954)
7. Organic carbon (Walkley, 1947).

RESULTS AND DISCUSSION

The factors that determine the manner in which a specific size of a particle behaves are the

water velocity distribution in a river, the degree of turbulence and the river bed profile (Bray *et al.*, 1997). The degree and rate of movement of suspended sedimentary material in streams are functions of the velocity of water flow and the settling velocity of the particles in suspension (Manahan, 1997). As conditions such as lowered stream velocity begin to favour deposition, larger, more settlable particles are released first. This results in sorting such that particles of similar size and type tend to occur together in alluvium deposits (Manahan, 1997). In the Doodhganga Stream, the water current velocity in the study area lowered due to dredging. This velocity drop was critical and led to detrimental effects. The current velocity in the study area was seen to lie in the range of 8.3 cm/s and 15 cm/s.

The sediments in the study area which previously yielded fine sand is now full of silt and mud. This sediment change may be explained in the light of observations of Wetzel and Likens (2000), according to whom the current erodes the channel, determines the degree and type of particle deposition and the nature of the sediments. Current is the single most important factor affecting organisms in the channel.

From Table 1, it is clear that the velocity range in the study area before dredging was in 20 – 40 cm/s range, but now (after dredging) it is in the 1st class of 3 -20 cm/s range, thus explaining the presence of silt and mud. There was also a change in bed characteristics because of dredging. There was creation of baffles in the stream bed, helping finer particles to settle down and also entrapping muddy water during floods and latter allowing the mud to settle down.

On comparing the physico-chemical characteristics of the previous and present sediment (Table 2) the drastic changes brought about in the sediment are quite clear.

All these changes have drastically changed the bio-physical and chemical characteristics of the Stream in the area. Preliminary assessment of the changes and effects brought about as a result of dredging revealed the following.

(i) Silt and mud laden alluvium in place of fine sand.
(ii) Establishment and growth of macrophytes (e.g., *Myriophyllum spicatum, Potamogeton crispus*, etc.) which were previously absent.
(iii) Presence of organisms like freshwater shrimp (*Gammarus* sp.) and small leeches in annoyingly large numbers.
(iv) Destruction of fish habitat which has led to the elimination of *Schizothorax* sp. from the study area.
(v) Loss of recreational value of the stream. Earlier on people used to go to the Stream for bathing, children used to play in the stream. But now nobody likes to go into the Stream.

Keeping these things in mind it is suggested that the activity of material winning should not be carried out in the areas of the stream where the current velocity may be critically affected (transitional

Table1. Relationship of current velocity to sediment composition

Velocity Range (cm/s)	General Bottom Composition	Approximate Diameter (mm)
3 - 20	Silt, mud; (organic debris)	<0.02
20 - 40	Fine sand	0.1 – 0.3
40 - 60	Coarse sand to fine gravel	0.5 – 8
60 - 120	Small, medium to large gravel	8 – 64
120 - 200	Large cobbles to boulders	>128

Modified from Einsele (1966), (Wetzel and Likens, 2000).

Table2. Physico-chemical characteristics of the sediment

Parameter	Previous sediment	Present sediment
pH	8.70	8.40
Conductivity (μScm^{-1})	91	128
Calcium (ppm)	2823	5157
Magnesium (ppm)	51	355
Sodium (ppm)	118	519
Potassium (ppm)	18	66
Ammonium nitrogen (ppm)	284	216
Available phosphorus (ppm)	3.38	3.06
Organic carbon (%)	0.15	3.23

current velocity areas).

It is also suggested that remedial measures should be undertaken to restore the Doodhganga Stream in the affected area. Some of the remedial measures suggested are.

(i) Smoothening of Stream bed and giving a forward slant to the Stream bed.
(ii) The barrier at Baghi-i-Mehtab should be lowered in height so that the current velocity is increased.

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