

ECOLOGICAL EFFECTS OF AQUATIC SEDIMENTATION ON FRESHWATER ECOSYSTEMS

Bonika Pant, Vibha Lohani, Rajinder Kaur and Tarang Kumar Shah

College of Fisheries, GBPUA & T Pantnagar, U.S. Nagar, Uttarakhand

Email: hereami09@gmail.com

Introduction

Sediments are vital to the health of ecosystems as they make up an important compartment in the energy flow. The particles which settle or deposit on the sides and bottom of water bodies are referred as sediments and the species that dwell in the sediments play important functional roles in freshwater ecosystems (Covich *et al.*, 1999). Sediments not only mediate biogeochemical transformations of global significance but are quite necessary for the maintaining clean water, decomposing organic material, transportation of materials and primary production (Freckman *et al.*, 1997). The organisms living in the deep floor of an aquatic ecosystem recycle organic matter, influence remineralization rates and nutrient availability to flora and fauna. The sediments of many rivers, lakes and streams have been contaminated by inorganic and organic materials over the past decades.

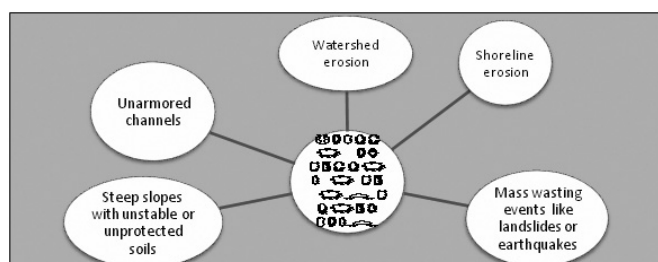
Also called one of the most critical habitats- sediments in aquatic environments have been an issue of concern of scientists and stakeholders. For the search of best and most effective treatments for ecosystem management, the study of sediment deposition, erosion and transport has increased exponentially across the globe. Although, establishing a systematic approach towards enriching trophic level leading to eutrophication is a challenging but substantive endeavour.

What brings changes in sediment load ?

From an ecosystem perspective we deal with the long-term problem of excess sediments in aquatic ecosystems having dire effects on aquatic habitat. Sedimentation does not usually spontaneously start increasing in a system. Sudden mass movements like occasions of **natural system changes** such as volcanic eruptions, landslides or earthquakes cause debris flows, mud flows or human activities.

Most sediment increases that not sudden are termed as **gradual** like changes such as land management, urbanisation, industrialization, stream alterations, or short-term climatic events. Environmental changes and other factors such as precipitation, discharge, shear stress or a change in topography or geometry may also accompany the sedimentation changes. Recent findings about fish eDNA suggest that settling of extra-membranous DNA is usually more concentrated in aquatic sediment than in water. Turner *et al.* (2015) studied carp eDNA and reported

Figure- The key sources from where sediment load comes



SRR Aqua Suppliers.. ❖ HDPE Float ❖ HDPE Motor Cover ❖ Impeller ❖ Bush & Bush Stand ❖ Gear Box & Motor ❖ SS Frames ❖ SS Shaft ❖ Worm Gear ❖ Worm Shaft ❖ Flower Shaft www.srraqua.com info@srraqua.com	ಲಲಿತಾ ಸೇವಾ ಉದ್ಯಮಗಳು LALITHA ENTERPRISES <i>Aquaculture Products</i> V.SUBBA RAJU, 76600 92645. 76600 72645 Dealers for : SRR Aqua Suppliers (I). Manufacturers of Paddle Wheel Aerators & Spares	SRR AQUA Shop Address : 1-3-32/3, KNF Road, Opp : Vinayaka Temple, Black Bridge, Main Road, AMALAPURAM-533 201. A.P. E.G.D.t., web : www.srraqua.com ☎ : 08856-235645
--	--	--

that it was 8–1800 times more concentrated per gram of sediment than per millilitre of water and was detected in sediments up to 132 days after carp removal as well as five times longer than any previous reports of microbial eDNA persistence in water.

Transport patterns of sediment and organic material in water

Sedimentologists describe that transportation of sediment particles in a water body occurs after separation into three categories- suspended material, bedload and the saltation load. **Suspended load** comprises of particles that are held in suspension like sand, silt and clay-sized. “Fine-grained sediment is often referred $< 62 \mu\text{m}$ in particle diameter.

Bedload is the coarser, relatively inactive, stony material, such as gravel and cobbles, which move by rolling because it is too heavy to be lifted into suspension by the current. **Saltation load** transitional between bedload and suspended load and refers to particles that are light enough to be picked off by turbulence but heavy to remain in suspension (Ongley, 1996).

History

The very first article on sediment intrusion into streambeds was published by M.M. Ellis in 1936 and covered many aspects of the effects of silt in aquatic systems, including light intensity, temperature, bottom conditions, electrolytes and organic matter retention.

Ellis (1936) observed very high mortality rates for freshwater mussels living in gravel-bedded or sand-bedded channels. After this many reports have been published on the same.

Aquatic sediments as system function

Opinions on sediments being complex interactive systems report that an increase in fine sediment or the upper limit of the fines is interpreted to have an adverse effect on fisheries by ichthyologists. Sediment is connected with degradation often assumed that “less is better,” but many aquatic systems may function with high background levels of fine sediment. The aggrading or degrading of sediment due to the natural or human-induced change at an accelerated rate is generally a problem.

The aquatic sediments are habitats of rich biodiversity and these biota are often extremely sensitive to hydrologic alterations; changes in water levels bringing changes in species and functional group composition and richness, flow rate, flood frequency, and quality of groundwater (Gibert *et al.*, 1997; Lake 1998; McCabe and Gotelli, 2000).

There are many problems associated with sediment in the aquatic environment and many studies are being conducted in laboratories, but questions can be raised as to their applicability to natural systems. Sediments are the sink in aquatic systems and can serve

Effects of irrational sediment load in water bodies

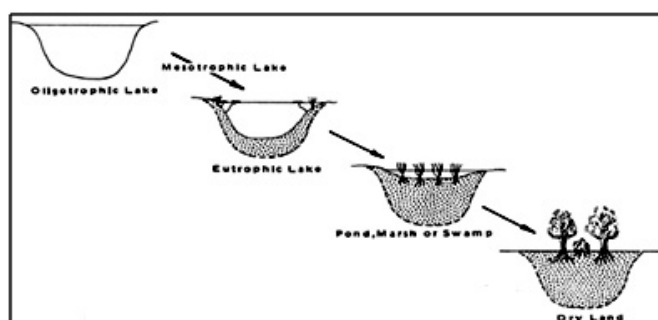


Fig - Conservation of fresh water source due to sedimentation (Source - USDA)

SRR Aqua Suppliers.. ❖ HDPE Float ❖ HDPE Motor Cover ❖ Impeller ❖ Bush & Bush Stand ❖ Gear Box & Motor ❖ SS Frames ❖ SS Shaft ❖ Worm Gear ❖ Worm Shaft ❖ Flower Shaft www.srraqua.com info@srraqua.com	ಲಲಿತಾ ಸಂಸ್ಥೆಗಳು - ಕುಶಲವಸ್ತು LALITHA ENTERPRISES <i>Aquaculture Products</i> V.SUBBA RAJU, 76600 92645. 76600 72645 Dealers for : SRR Aqua Suppliers (I). Manufacturers of Paddle Wheel Aerators & Spares	SRR AQUA Shop Address : 1-3-32/3, KNF Road, Opp : Vinayaka Temple, Black Bridge, Main Road, AMALAPURAM-533 201. A.P. E.G.D.t., web : www.srraqua.com ☎ : 08856-235645
---	--	--

as a reservoir of toxic contaminants that continually threaten the health and viability of aquatic systems and its biota. The Salmonella mutagenicity test is the most frequently used assay for toxic analysis and accounts for 41.1% of the available data to study contaminant interference in sediments and Chen and White (2004) concluded that analyses of the Salmonella data showed significant differences between rural, urban/industrial and heavily contaminated sites.

➤ Decrease in **water storage capacity** of water body.

➤ Concomitant changes in the quality of water overlying aquatic sediments due to increased turbidity results in **loss of sediment-dwelling species** in freshwater ecosystems due to land-use alterations and increasing sedimentation.

➤ Gill clogging, asphyxiation, excessive slime secretion, reduced growth, increased pathogen attack and abnormal swimming are some of the **physical, physiological and behavioural changes** occur in aquatic beings due to siltation and turbid water.

➤ **Aquatic plants are affected** by both sediment



Best wishes to our Aqua Farmers

SHARAT INDUSTRIES LIMITED

No. 17, (Old No.30) LUZ Avenue, Myloapore, Chennai-600004. India

Phone : 044-24994663, 24997867/88, Fax : 044-24995893.

e-mail : sharatpremium@dataone.in



: NELLORE OFFICE :

16/375-A-2, Ramalingapuram, Nellore-524003 (A.P.) Phone : 0861-2344857/2344859, 2331727/2329831, Fax : 0861-2325583. email : saratnlr@hotmail.com

Farm, Hatchery & Feed Mill :

Venkannapalem Village,

Thotapalli, Gudur Mandal, Nellore - 524 002, ☎ : 0861-2387633, 2387733

Processing Plant :

Mahalakshmiipuram Village,

T.P.Gudur Mandalam, Nellore Dist. ☎ : 0861-24994663 / 24997867

Corp. Off: Flat No.4, III Floor, Pallavi Apartments, No.57/11 HDFC Bank Compound, First Main Road, RA Puram, Chennai - 600 028. ☎ : 044-24994663 / 24997867

SRR Aqua Suppliers..

- ❖ HDPE Float ❖ HDPE Motor Cover
 - ❖ Impeller ❖ Bush & Bush Stand
 - ❖ Gear Box & Motor ❖ SS Frames
 - ❖ SS Shaft ❖ Worm Gear
 - ❖ Worm Shaft ❖ Flower Shaft
- www.srraqua.com
info@srraqua.com

ಲಲಿತಾ ಸಂಸ್ಥೆಗಳು - ಕುಶಲವಸ್ತು

LALITHA ENTERPRISES *Aquaculture Products*

V.SUBBA RAJU, 76600 92645. 76600 72645

Dealers for : SRR Aqua Suppliers (I). Manufacturers of Paddle Wheel Aerators & Spares



Shop Address : 1-3-32/3, KNF Road, Opp : Vinayaka Temple, Black Bridge, Main Road, AMALAPURAM-533 201. A.P. E.G.D.t., web : www.srraqua.com ☎ : 08856-235645

load as it may bury an area in which a plant species is growing because primary plant production is reduced with increase in turbidity.

➤ Results in a **decrease in diversity and density of benthic organisms** because of a limited food supply. This leads to the reduction in the benthic population and reduced food supply for fish and the fishes migrate due to limited food supply.

➤ Fishes prefer relatively more stable substrate environment as **spawning habitats** like Lake trout do not generally use coarse sands or gravels to spawn. Changes in sediment concentration and amount put deleterious effects on these breeding grounds and sometimes destroy them completely.

➤ The **diversity of above-sediment primary producers** is usually linked to the diversity of detritivorous sediment biota as the later ones influence nutrient regeneration and there are numerous direct and indirect linkages between the biota and the physical processes (Palmer *et al.*, 2000).

Changes in sediment quality are harmful for overall diversity of an ecosystem.

➤ Artificial dumping or accelerated sedimentation **introduces sediment too quickly** for benthic invertebrate organisms to avoid (Herdendorf, 1992). Benthic invertebrates can move quickly enough to keep ahead of fluctuations, under normal environmental conditions.

➤ Even sound sampling and monitoring methods for determination and identification of suitable habitats for feeding or spawning are insufficient because of **seasonal variability and the complex interactions** between the physical and biologic environments.

➤ **Riparian plant communities decline** leading to dramatic effects on nearby water bodies and their bottom sediments zones.

What can be done?

❖ **Sampling of aquatic sediments** using grab samplers (instantaneous grab samplers/ pump samplers/ integrated samplers) corers that use lines and cables according to water depth or sedimentation traps can be performed to get an idea about the scenario of a particular system. Use of **remote sensing and GIS** technologies can also be done.

❖ Working on **sediment quantity and quality problems** like recognizing the erosion source and rates for each type of erosion of sediment. Study of an undisturbed system, can become the target goal for restoration success.

❖ Gore (1978) gave a concept that can easily be applied to sediment yield by using benthic macroinvertebrates as **bioindicators**. Using the same techniques, proper indicator species can be identified to determine appropriate sediment levels.

❖ Landscape adjacent to water bodies may need **regulation** and any anthropogenic activity that increases the transfer of material from terrestrial areas to fresh waters needs proper monitoring. **Land-use and management practices** may need to be revised to focus on the Land use change is expected to have a dramatic global impact on biodiversity over the next 100 years (Sala *et al.*, 2000).

❖ **Siltation rate** control in reservoirs requires adequate data and demands an understanding of sediment transport and appropriate methods for measuring sediment load and movement.

SRR Aqua Suppliers.. ❖ HDPE Float ❖ HDPE Motor Cover ❖ Impeller ❖ Bush & Bush Stand ❖ Gear Box & Motor ❖ SS Frames ❖ SS Shaft ❖ Worm Gear ❖ Worm Shaft ❖ Flower Shaft www.srraqua.com info@srraqua.com	ಲಲಿತಾ ಸೇವೆಗಳು ಕುಶಲವಾರ್ಡ್ LALITHA ENTERPRISES <i>Aquaculture Products</i> V.SUBBA RAJU, 76600 92645. 76600 72645 Dealers for : SRR Aqua Suppliers (I). Manufacturers of Paddle Wheel Aerators & Spares	  Shop Address : 1-3-32/3, KNF Road, Opp : Vinayaka Temple, Black Bridge, Main Road, AMALAPURAM-533 201. A.P. E.G.D.t., web : www.srraqua.com ☎ : 08856-235645
---	---	--

❖ For sediment biota, sophistication of **species-specific information** collection techniques can be beneficial but is quite challenging as numerous taxa in aquatic sediments live deep and are microscopic. (Palmer *et al.*, 2000).

❖ Decline in **road density** near aquatic sediment can be good because impervious surfaces like roadways interfere with groundwater movement.

❖ Changes in sedimentation rates can be associated with an increase in the introduction of **invasive plant and animal species** (Palmer *et al.*, 2000) in ecosystems, thus certification and full knowledge about

exotic species is crucial before introducing them in a vacant niche area.

Conclusive remarks : Streams, lakes, and all freshwater ecosystems are susceptible to sedimentation and erosion problems. Since each system responds in a different way to accelerated sedimentation thus each system should be evaluated independently of the others although these systems may be closely connected. To protect freshwater resources, maintain their biodiversity and optimise their use sedimentation and siltation must be controlled and minimised by effective management as well as spreading awareness among locals.

Best Compliments to Aquafarmers...



Coastal Scientific Agencies

P.C.R.Lab Equipment, Glassware & All Lab Equipment available

1-1, Rajiv Nagar, PERUMALLAPURAM - 533 449

Thondangi Mandal. E.G.Dt., A.P.

S.Kasim 915444 9999

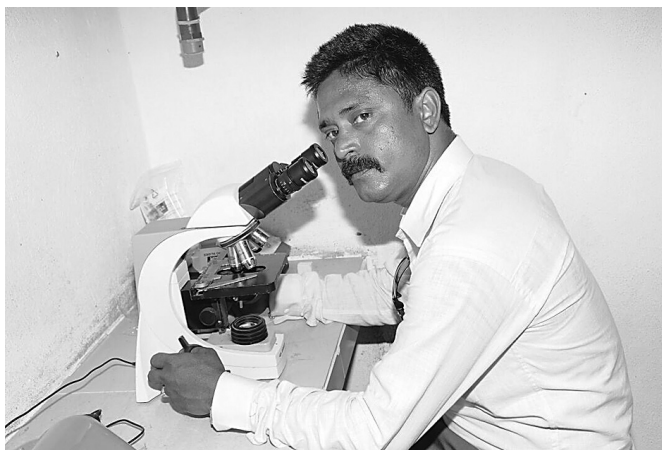
94921 41888

kasim.moanaindia@gmail.com

B.Srinivas

94926 43215

srinivas.baddi007@gmail.com



SRR Aqua Suppliers..

- ❖ HDPE Float ❖ HDPE Motor Cover
 - ❖ Impeller ❖ Bush & Bush Stand
 - ❖ Gear Box & Motor ❖ SS Frames
 - ❖ SS Shaft ❖ Worm Gear
 - ❖ Worm Shaft ❖ Flower Shaft
- www.srraqua.com
info@srraqua.com

ಲಲಿತಾ ಸೊಲರ್‌ಲಕ್ಸ್‌ ಕುಶಲವಾರ್ಡ್

LALITHA ENTERPRISES
Aquaculture Products

V.SUBBA RAJU, 76600 92645. 76600 72645

Dealers for : SRR Aqua Suppliers (I). Manufacturers
of Paddle Wheel Aerators & Spares



Shop Address : 1-3-32/3, KNF Road,
Opp : Vinayaka Temple, Black Bridge,
Main Road, AMALAPURAM-533 201.
A.P. E.G.Dt., web : www.srraqua.com
☎ : 08856-235645