IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁜ Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 10, Issue 8, August 2023

DOI: 10.17148/IARJSET.2023.10805

Adverse Effects and Mitigation Measures of Sand Mining on Surface and Underground Water

Sangeeta Choudhary

Associate Professor, Geetanjali Institute of Technical Studies, Udaipur (India)

Abstract: Sand mining can have significant adverse effects on both surface and underground water resources. It can lead to surface water depletion, groundwater depletion, water quality degradation, habitat destruction, increased flood risk, erosion, and other detrimental impacts. To address these issues, various mitigation measures can be employed. Implementing and enforcing regulations, conducting thorough environmental impact assessments, adopting responsible mining practices, promoting sustainable extraction methods, controlling extraction rates, protecting critical habitats, monitoring water quality, restoring mined areas, involving stakeholders, and encouraging research and innovation are some of the key strategies for mitigating the adverse effects of sand mining on water resources. By combining these measures, it is possible to minimize the environmental impacts of sand mining and ensure the long-term sustainability of water ecosystems.

Keyword: Sand mining, Surface water, Underground water, Erosion, Environmental Impact Assessment

I. INTRODUCTION

Sand mining can have several adverse effects on both surface and underground water. Some of the major impacts are as follows:

Surface water depletion: Sand mining can alter the natural flow of rivers, streams, and water bodies, leading to reduced water levels in nearby surface water sources[1, 2]. This depletion can negatively affect aquatic ecosystems and disrupt the balance of natural habitats [3-5].

Groundwater depletion: Excessive sand mining near or in riverbeds can lower the water table, leading to the depletion of groundwater reserves[6, 7]. This can have serious consequences for agricultural irrigation, drinking water supplies, and the overall health of the ecosystem[8, 9].

Water quality degradation: Following are the adverse effects on water quality due to sand mining:

- Sediment release: During the mining process, sand and sediment are stirred up, leading to increased suspended solids in the water. This sediment release can reduce water clarity and light penetration, affecting aquatic plant growth and disrupting the food chain.
- Increased turbidity: The presence of suspended solids from sand mining can increase water turbidity. High turbidity can block sunlight from reaching aquatic plants and negatively impact fish and other aquatic organisms that rely on clear waters for feeding and reproduction[10].
- Nutrient transport: Sand particles can adsorb nutrients like phosphorus and nitrogen. When these nutrients are transported by the flowing water, they can contribute to nutrient loading in downstream areas, leading to eutrophication. Eutrophication causes excessive algae growth, which depletes oxygen levels and harms aquatic life.
- Water temperature changes: The removal of trees and vegetation during sand mining can reduce shading and increase water temperatures in nearby water bodies. Elevated water temperatures can stress aquatic organisms and alter the natural ecosystem dynamics.
- Chemical pollution: Sand mining can introduce contaminants into water bodies, such as fuel and oil spills from mining machinery, or chemicals used in the extraction process. These pollutants can negatively impact water quality and harm aquatic life.
- Groundwater contamination: Sand mining activities can result in the release of pollutants into the groundwater, especially when mining occurs near or in areas with shallow aquifers. This contamination can render groundwater sources unsafe for human consumption and agricultural use[11].

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁜ Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 10, Issue 8, August 2023

DOI: 10.17148/IARJSET.2023.10805

Altered flow patterns: Large-scale sand mining can alter the natural flow patterns of rivers and streams. Changes in flow can disrupt sediment transport, causing erosion or sediment deposition in different areas, affecting aquatic habitats.

Loss of riparian vegetation: Sand mining along riverbanks can lead to the removal of riparian vegetation. The loss of this vegetation can reduce bank stability, increase erosion, and negatively impact the ecological health of the river ecosystem.

Habitat destruction: Sand mining can cause habitat destruction and alteration in aquatic ecosystems, disrupting the natural habitats of fish, invertebrates, and other aquatic organisms. The loss of habitat can lead to a decline in biodiversity and adversely affect the overall ecological balance.

Increased flood risk: Sand mining can change the river's natural morphology, reducing its capacity to hold water during heavy rainfall or floods. This alteration can exacerbate flooding in downstream areas and increase the vulnerability of nearby communities to flood-related damages[12].

Erosion and sedimentation: Removal of sand from riverbeds and coastal areas can accelerate erosion and sedimentation processes. This can result in the loss of fertile soil and pose challenges to agricultural activities[6].

Saltwater intrusion: In coastal areas, excessive sand mining can lead to the intrusion of saltwater into freshwater aquifers. The removal of sand can alter the natural balance between freshwater and saltwater, affecting groundwater quality and availability.

Disruption of aquatic life cycles: The extraction of sand can disrupt the natural migration and breeding patterns of aquatic species, leading to a decline in fish populations and other wildlife that depend on healthy aquatic environments.

Land subsidence: Prolonged and excessive sand mining can lead to land subsidence, especially in areas with loose soil and sediments. This phenomenon can cause structural damage to buildings and infrastructure, and it can also exacerbate flooding problems.

II. MITIGATION MEASURES

To mitigate the adverse effects of sand mining on water resources, sustainable and responsible mining practices should be implemented, and proper regulatory measures must be enforced to protect both surface and underground water sources.

Additionally, alternative materials and construction methods that reduce the demand for natural sand can help alleviate the environmental impacts of sand mining[11, 13].

Implement and enforce regulations: Governments and regulatory bodies should develop and enforce strict regulations on sand mining activities. These regulations should address issues such as permissible extraction rates, mining locations, and environmental protection measures to ensure sustainable mining practices.

Conduct environmental impact assessments (EIAs): Before starting any sand mining project, thorough EIAs should be conducted to assess the potential environmental impacts. This will help identify sensitive areas and design appropriate mitigation measures[14].

Adopt responsible mining practices: Encourage sand miners to use best practices that minimize environmental impacts. These practices may include using advanced equipment that reduces sediment disturbance and employing reclamation strategies to restore mined areas.

Promote sustainable extraction methods: Promote alternatives to traditional sand mining, such as using recycled sand, manufactured sand, or other construction materials that have lower environmental impacts.

Control sand extraction rates: Limit the amount of sand that can be extracted from specific locations and establish sustainable extraction rates that allow natural systems to replenish sand resources over time.

Protect critical habitats: Identify and protect critical habitats for aquatic life, especially breeding and nesting areas, and establish buffer zones around these areas to prevent negative impacts from sand mining activities.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁜ Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 10, Issue 8, August 2023

DOI: 10.17148/IARJSET.2023.10805

Monitor water quality: Regularly monitor water quality in the vicinity of sand mining operations to detect any pollution or contamination. Implement measures to prevent sediment and pollutant runoff into nearby water bodies.

Restore and rehabilitate mined areas: Implement effective reclamation and rehabilitation plans for mined areas to restore them to their original state or to alternative beneficial uses that can support local ecosystems.

Involve stakeholders and local communities: Engage with local communities and stakeholders to raise awareness about the impacts of sand mining and involve them in decision-making processes to find sustainable solutions.

Encourage research and innovation: Invest in research and technology to explore more sustainable materials for construction and improve sand mining techniques to minimize environmental impacts.

By combining these mitigation measures and adopting a holistic approach to sand mining management, it is possible to reduce the adverse effects on water resources and protect the ecological balance of aquatic ecosystems. Sustainable sand mining practices are essential to ensure the long-term availability of this critical natural resource while safeguarding water quality and preserving aquatic habitats. To mitigate water quality degradation caused by sand mining, it is crucial to implement and enforce strict environmental regulations. Regular monitoring of water quality should be conducted, and measures such as sedimentation ponds, silt barriers, and re-vegetation programs should be employed to minimize the impact of sediment release[15].

III. CONCLUSION

It has to be remembered that the sand once removed cannot be replaced in the next generation. It will take centuries for replacement. Sand sustains the rivers and the percolation of water to far off distances both for the growth of trees to sustain drinking water and raise cultivation. It is almost a lifeline to the human existence. The adverse effects of sand mining on surface and underground water systems are well-documented and significant.

The extraction of sand from rivers, beaches, and other aquatic environments can lead to various environmental and hydrological impacts. However, with proper mitigation measures, these impacts can be minimized or even prevented. Without considering the precise gift provided by nature, commercial exploitation for short term gains by pumping out the sand indiscriminately from the rivers, dunes and beaches will destroy whole environment. People employ huge machineries like cranes and other pumping mechanism causing untold natural calamities and loss to the society. In order to maintain the balance between the environment and sand mining, the Governments should regulate the mining.

REFERENCES

[1] Ojha, S. and S. Choudhary, *Environmentally Sustainable Sand Mining Based on GIS based Sediment Yield Estimation.* Engineering and Technology in India, 2017. **8**(1-2): p. 49-57.
[2] Ojha, S. and S. Choudhary, *QUALITATIVE ANALYSIS OF SOCIO-ENVIRONMENTAL FACTORS OF SAND MINING ON MITHRI TRIBUTARY OF LUNI RIVER AT KOSANA, PIPAR JODHPUR DISTRICT OF RAJASTHAN.* International Research Journal of Environmental Sciences, 2017. **6**(10): p. 22-31.
[3] Choudhary, S. and J. Sharma, *Surface Water Quality Trends and Regression Model through SPSS in Udaipur, Rajasthan.* International Advanced Research Journal in Science, Engineering and Technology, 2021. **8**(10): p. 153-160.
[4] Choudhary, S., et al., *Assessment of Drinking Water Quality and Efficiency of Water Treatment Plants in Udaipur, Rajasthan.* European Chemical Bulletin, 2023. **12**(3): p. 1175-1182.
[5] Farahani, H. and S. Bayazidi, *Modeling the assessment of socio-economical and environmental impacts of sand mining on local communities: A case study of Villages Tatao River Bank in North-western part of Iran.* Resources Policy, 2018. **55**: p. 87-95.
[6] Choudhary, S. and P. Choudhary, *Sediment Yield and Sand Erosion Model through Arc SWAT and SPSS-14 Software for Sand Mine Site in Rajasthan.* International Journal of Engineering and Advanced Technology (IJEAT), 2020. **8**(6S): p. 138-141.
[7] Rentier, E. and L. Cammeraat, *The environmental impacts of river sand mining.* Science of The Total Environment, 2022. **838**: p. 155877.
[8] Choudhary, S., et al. *GIS Mapping for Distribution of Ground Water Quality in Udaipur*. in *IOP Conference Series: Earth and Environmental Science*. 2022. IOP Publishing.
[9] Choudhary, S., et al., *Development of Rain Water Harvesting System through National Highway Profiles by Using GIS and Field Survey.* Available at SSRN 3348303, 2019.

DOI: 10.17148/IARJSET.2023.10805

[10] Lodha, R., et al., *Scaling Potential and Corrosion Assessment through Langelier Saturation Index and Ryznar Stability Index of Under Ground Water in Udaipur, Rajasthan.*

[11] Sonak, S., et al., *Impact of sand mining on local ecology.* Multiple dimensions of global environmental change. Teri Press, New Delhi, 2006: p. 101-121.

[12] Choudhary, S., *FACTORS AFFECTING FLOOD MANAGEMENT IN BIHAR, INDIA.* International Journal on Environmental Sciences, 2020. **11**(1): p. 72-76.

[13] Kumar, S., et al., *Scope and Impact of River Sand Mining in Ajmer, Rajasthan.*

[14] Choudhary, S., et al., *Requirements of Solid Waste Management System in Savina Vegetable Market at Smart City Udaipur in Rajasthan.* International Journal of Engineering and Advanced Technology (IJEAT), 2020. **9**(3S): p. 26-29.

[15] Choudhary, S., et al., *Requirements and Planning of Badliya Village for converting it into Smart Village Category in Banswara, Rajasthan.* International Journal of Engineering and Advanced Technology (IJEAT), 2020. **9**(3S): p. 40-44.