



[MN201 - Exploratory Project]

ANALYSIS OF SAND MINING

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Mining B-Tech– 23155082

ACKNOWLEDGEMENT:

I want to extend my sincere gratitude to my teacher, Dr. Tarun Verma, for giving me the invaluable opportunity to undertake this project on “Analysis of Sand Mining.” This experience allowed me to conduct extensive research and discover many new insights, significantly enhancing my understanding of the subject. His constant support, encouragement, and insightful feedback throughout the project have been a tremendous help in shaping my work. I am truly grateful for his guidance, which has contributed to this project's success and enriched my academic journey. I am deeply thankful for the opportunity to learn from such a knowledgeable mentor.

Last but not least, I would like to thank my family and friends, who have constantly helped me with my mentally throughout my project. Their constant guidance and comfort provided me with strength to complete this project.

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INTRODUCTION

AIM:

The aim of this project is to explore the significance of detecting illegal and extensive sand and morrum mining activities in riverbeds through the use of high-resolution satellite imagery from the Sentinel-2 L1C satellite, with a specific focus on identifying the formation of artificial bunds (dikes or embankments) that often result from such mining practices. The project seeks to understand how satellite-based monitoring can be leveraged to detect illegal mining activities, assess their environmental and socio-economic impact, and ultimately support enforcement and regulatory measures. It also asks for the making of AI-based software to detect the extent of mining.



INTRODUCTION:

Uttar Pradesh, one of India's most populous states, faces significant challenges related to sand production and management. The demand for sand in construction and industrial activities has led to increased extraction, impacting local ecosystems. Recent observations indicate a trend of reverse sand production, where sand accumulates in certain areas, affecting land use and agricultural productivity.

Betwa is among key tributaries of Yamuna river in lower stretch. Like Chambal, Sindh, Ken rivers rising from Vindhya hill ranges, Betwa is also famous for light orange colour sand which is officially and locally known as 'Morrum' or *Morang* in Bundelkhand. Morrum is formed by weathering of granitic rocks. It has coarser and thicker grains than grey colour sand. These properties make Morrum of greater adhesive quality and of high value in construction activities.



OBJECTIVES:

1. Utilising Sentinel-2 L1C Satellite Imagery for Detection
2. Mapping the Formation of Artificial Bunds
3. Environmental Impact Assessment
4. Time-Series Analysis and Monitoring
5. Aim to Develop a Detection Framework
6. Supporting Policy and Enforcement
7. Recommendations for Future Monitoring and Policy

LITERATURE SURVEY

WHAT IS SAND AND MORRUM MINING?

River sand mining and river morrum mining both involve the extraction of materials from riverbeds, but they focus on different types of sediment and serve distinct purposes in construction.

RIVER SAND MINING: is the process of extracting sand from riverbeds or streams, primarily for use in the construction industry, where it is a key component in making concrete, mortar, and other building materials. Sand is prized for its angular grains, which help provide strength and stability in construction projects. However, river sand mining can have significant environmental consequences.

RIVER MORRUM MINING: involves extracting morrum, a mixture of sand, clay, silt, and small stones, from riverbeds and floodplains. Morrum is often used in road construction, for land filling, and sometimes for brick-making due to its compactability and clay content. While morrum mining can be less disruptive than sand mining, it still carries environmental risks. The excavation of morrum can cause erosion along riverbanks, harm habitats for aquatic species, and alter the flow of rivers, leading to changes in water quality and river morphology.

In summary, while both river sand mining and river morrum mining are critical for construction and infrastructure projects, they come with similar environmental concerns. Both activities can lead to erosion, habitat destruction, and water pollution, though the specific impacts vary based on the material being mined. Sand is primarily used in making concrete and other building materials, while morrum is more commonly used in road construction and land filling. Proper regulation and sustainable practices are essential to minimizing the negative effects of these mining activities on river ecosystems and surrounding environments.

WHY RIVER SAND MINING?

The demand for construction-grade sand is growing at a tremendous rate and the world is expected to run out of this resource by 2050. Construction-grade sand, hereafter referred to as 'sand', can be found in (former) aquatic environments, such as rivers and is a provisioning ecosystem service. Even under controlled circumstances, the practice of extracting the sand from the riverbed and -banks impacts the environment.

Sustainable sand mining is one of the main ecological challenges of the 21st century. Sand is a key material for producing concrete, asphalt, and glass. It is the second most exploited resource on the planet after water. In addition to the construction industry, the climate crisis intensifies the demand because sand is used for land reclamation and flood protection. While desert sand is too fine and smooth, sand on riverbeds is suited for many applications. From riverbeds, sand is extracted in huge volumes. This has severe ecological consequences: Extensive sand mining leads to biodiversity loss and damages hydraulic functions. It not only amplifies floodings, but also droughts.



ILLEGAL SAND MINING:

Illegal sand mining refers to the unregulated and often illicit extraction of sand from rivers, lakes, beaches, and other natural sources without proper licenses, oversight, or adherence to environmental regulations. Sand is a crucial resource in construction, manufacturing, and infrastructure development, but its extraction can cause severe environmental and social consequences when done illegally.

The process typically involves the over-exploitation of sand from fragile ecosystems, leading to habitat destruction, water table depletion, soil erosion, and changes to river and coastal dynamics. Illegal mining operations often disregard safety standards and environmental protections, resulting in the loss of biodiversity, the contamination of water sources, and the undermining of local communities that depend on these ecosystems for their livelihoods. Additionally, the lack of regulation in illegal sand mining often fuels corruption and organized crime, as unscrupulous operators evade taxes and bypass permits.

In many regions, particularly in developing countries, illegal sand mining has escalated due to the high demand for construction materials, driven by rapid urbanization and infrastructure projects. Addressing this issue requires a combination of stricter law enforcement, public awareness, and sustainable alternatives to sand extraction.

चांदी पाठी रेत खदान में फिर एसडीएम गौतम ने की छापामार कार्रवाई

अजयगढ़। एसडीएम कुशल सिंह गौतम ने दो दिन पूर्व छापामार कार्रवाई की थी तब रेत माफियाओं को कार्रवाई की भनक लग थी। वाहन और मशीनरी लेकर रेत माफिया छतरपुर जिले व उत्तर प्रदेश में वाहन एवं मशीनरी सुरक्षित कर ली थी परंतु एसडीएम के द्वारा 600 घन मीटर रेत मशीनों एवं वाहनों के उपयोग के लिए रखा ढीजल जस कर लिया था। 1 अप्रैल को एसडीएम कुशल सिंह गौतम ने तहसीलदार सुरेंद्र कुमार नायब तहसीलदार खेमचंद यादव एवं राजस्व अमले के आर आई पटवारी एवं चंदौरा चौकी है पुलिस बल लेकर पुषः

चांदी पाठी रेत खदान में छापामार कार्रवाई की जिसमें 5 टक्के रेत से भरे पकड़ पाए। बीच रास्ते में रेत माफिया ने एक ट्रक को बीच रास्ते में बंद करवाकर डाइवर को भगा दिया जिससे अमला आगे नहीं बढ़ सका नदी में चरवाही मशीने छतरपुर जिले की ओर भाग गई वहां जाकर सुरक्षित हो गई जिससे हाथ मशीने नहीं लायी गौरतलब है कि अभी कुछ ही दिन पूर्व कुशल सिंह गौतम ने अजयगढ़ एसडीएम का पदभार ग्रहण किया है और दो बार रेत माफियाओं पर कार्रवाई की है जिससे रेत माफियाओं में हड्डकंप मचा हुआ है। एसडीएम द्वारा 5 ट्रकों को जब्त कर चंदौरा चौकी में खड़ी खड़ा करवाया गया है।



इनका कहना है

रेत के अधिक उत्खनन व परिवहन पर नियंत्रण कार्रवाहियों की जाति रहेंगी, मेरे कार्य काल में रेत का अधिक करोबार पर वैतानिक कार्रवाहियों जारी रहेंगी अधिक उत्खनन, परिवहन बिल्कुल बद्दोश नहीं किया जाएगा।

■ कुशल सिंह गौतम, एसडीएम अजयगढ़।

NEED FOR TAKING ACTION:

Quarterly Return on Illegal Mining submitted to IBM

Sr. No.	State	Illegal mining cases				Action taken from 2016-17 to 2019-20			
		2016-17	2017-18	2018-19	2019-20	FIR Lodged (Nos.)	Court Cases Filed (Nos.)	Vehicle Seized (No.)	Fine realized by State Govt. (Rs. Lakh)
1	Andhra Pradesh	9703	8128	7644	8354	37	20	1533	64376.031
2	Chhattisgarh	4794	4857	5060	6449	0	21160	0	3552.854
3	Gujarat	8325	7827	7679	7476	471	49	25385	32654.370
4	Haryana	1345	1391	1380	1251	658	0	0	1693.466
5	Himachal Pradesh	783	1753	590	2424	42	704	17	137.605
6	Jammu & Kashmir	n. r.	1485	n.r	n.r	0	0	1485	15.896
7	Jharkhand	838	2772	3132	3269	2686	1070	10031	4183.045
8	Karnataka	5692	4669	4101	4935	4362	1197	3176	9024.074
9	Kerala	4861	8315	7797	8575	0	0	0	17061.620
10	Madhya Pradesh	13880	15205	16405	8223	483	28005	2479	175257.356
11	Maharashtra	31173	26628	13436	10456	6576	0	81693	37868.650
12	Odisha	45	47	29	16	2	0	9	771.055
13	Rajasthan	3945	6632	17118	4027	2873	47	296065	22910.339
14	Tamilnadu	87	132	113	66	30764	470	42936	13320.303
15	Telangana	5839	6143	6553	7039	0	0	2	6132.960
16	Uttar Pradesh	5737	20214	24455	n.r	677	4423	0	13864.060
Grand Total		97047	116198	115492	72560	49631	57145	464811	402823.684

n. r. – quarterly return not received.

This shows that only the government is very slow in taking any action as there is no one to authorize.

Like in UP – only 4423 cases were filed out of 50406 which is about 8.77% only.

EFFECTS OF SAND MINING:

Forcing the river to change its course: Sand and boulders operate as a buffer for the riverbed, preventing it from shifting direction.

Using illegally dug sand is the same as stealing water: Sand contains a lot of water, and when it's mined and loaded onto trucks carelessly, a lot of water is lost in the process.

Depletion of groundwater tables: Sand, which is part of the aquifer, functions as a link between the running river and the water table in a riverbed. Illegal and excessive sand mining in the Papagani catchment area in Karnataka, for example, has resulted in groundwater depletion and environmental degradation in communities along the river's banks in both Andhra Pradesh and Karnataka.

Adverse impact on Microorganisms: There are many microorganisms that are not visible or well-known but are important for soil structure and fertility. Sand dredging physically deprives them of their environment.

Increased river erosion: Rivers are degraded as a result of excessive instream sand and gravel mining. Instream mining lowers the streambed, perhaps causing bank erosion. The loss of sand in streambeds and along coastlines causes rivers and estuaries to deepen, as well as the enlargement of river mouths and coastal inlets.

Damage to Roads And Bridges: At Vishnuprayag, rocks washed down with river water broke a side of the dam, and the water spilled out across the dam, inflicting extensive damage.

Threat to Agriculture: The majority of modern mines in developing countries are found in rural areas where agriculture is the primary source of income. This has the potential to harm farmers by increasing competition for essential resources (such as land and labor) and polluting the environment. For example, despite numerous prohibitions and regulations, sand mining continues apace on the Bharathapuzha riverbed in Kerala. Water tables have plummeted dramatically, and a region once known for its abundant rice harvest now faces water scarcity. Groundwater levels

have dropped dramatically in the villages and towns along the river, and wells are almost always dry.

Damage to Coastal Ecosystem: This harmful unlawful practice causes erosion along the shoreline in beaches and waterways. For example, at Kihim Beach in Alibaug, as the sea level has dropped, communities have been forced to construct sea walls to protect themselves. It devastates the intertidal zone and raises the risk of saline water infiltration into fresh water. Coastal sand mining devastates fisheries, coral reefs, mangroves, and wetlands, and has resulted in the near-extinction of gharials, a type of crocodile found only in India. One of the most serious consequences of beach sand mining is the lack of protection against storm surges caused by tropical storms and tsunamis.

Affects Livelihood: Agriculture and fisheries are important sources of income for people in rural regions across Asia, and a negative impact on either can limit livelihood diversity and raise poverty levels.

Affects Tourism: Sand mining degrades the physical appeal of beaches and riverbanks while also putting these places' biological systems in jeopardy. They would lose their tourism potential if such beaches and riverfront locations become famous tourist sites.

Other: Water is less available for industrial, agricultural, and drinking purposes. Farm workers are losing their jobs.

WHAT CAN BE DONE?

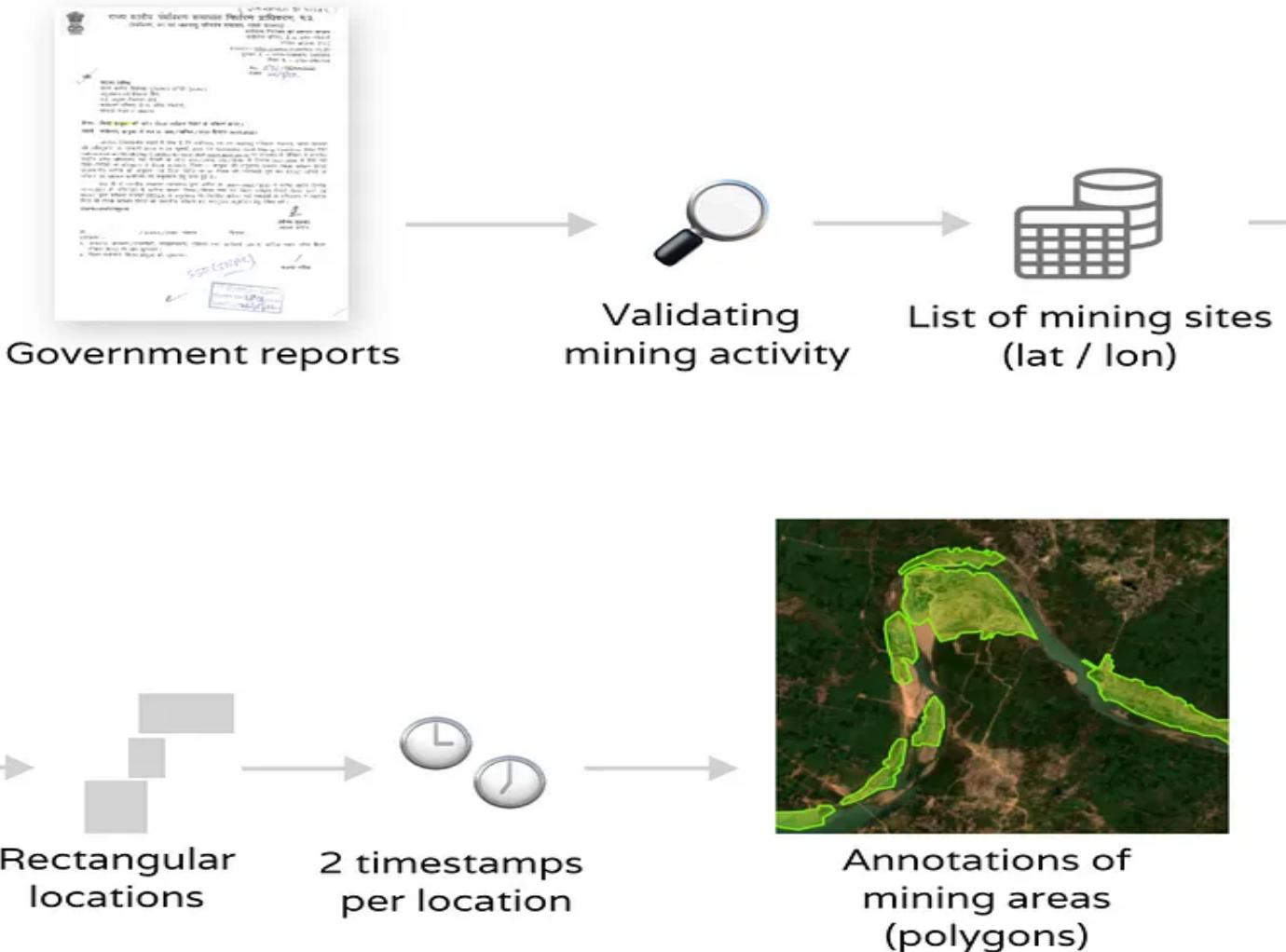
1. Strengthen Legal and Regulatory Frameworks
2. Increase Monitoring and Surveillance
3. Use Technology for Real-Time
4. Enforce Strict Penalties and Deterrents
5. Promote Alternative Materials to Sand
6. Involve Local Communities in Monitoring and Enforcement
7. Raise Awareness and Educate Stakeholders
8. Rehabilitate Degraded Mining Areas
9. Increase Collaboration Among Stakeholders
10. Improve Data Management and Transparency

How exactly can the ML-based sand mining detector help?

- In many places, local populations do not report illegal mining because they fear the sand mafia. The sand mining detector can identify sand mining soon after the beginning of mining activity. It can alarm local authorities to support law enforcement.
1. Real-Time Detection Using Satellite
 2. Drone and UAV-Based Monitoring
 3. Identification of Sand Mining Vehicles and Transport Routes
 4. Predictive Analysis for Preventive Action
 5. Integration with Other Data
 6. Sustainability and Resource Management
 7. Reducing Human Error and Bias
 8. Cost-Effectiveness and Scalability
 9. Improving Regulatory Compliance
 10. Automated Reporting and Auditing

METHODOLOGY

GROUND TRUTH:



STEP 1:

First, we need to identify sand mining locations. This is a joint effort with the Venditum India Foundation and Environment Clearance. We assess government reports with mining concessions. This leads us to locations with potential sand mining activity, for which we validate whether sand mining occurred. After validation, we have a list of point coordinates with mining.


राज्य स्तरीय पर्यावरण समाधार निधीराम प्राधिकरण, म.प्र.
 (पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार)
 पर्यावरण नियंत्रण एवं सम्बन्ध संबंध
 पर्यावरण परिसर, ३-५, अंतर्राष्ट्रीय
 भवान-४८२०१८ (मुख्य)
 वृत्तावाह- <http://www.mpselaa.nic.in>
 फ़ोन नं.- ०७५५-२४६६७९०, २४६६८५९
 फैक्स नं.- ०७५५-२४६२१३६
 No: ५७६ / SEIAA/2022
 Date: २६/५/२२

सदस्य संधिं
 राज्य स्तरीय पर्यावरण मन्त्रालय नियंत्रि (SEAC),
 अनुसंधान एवं विनायक विभाग,
 भूदृष्टि, प्रदूषण नियंत्रण बोर्ड,
 पर्यावरण परिसर, ३-५, अंतर्राष्ट्रीय
 भवान (मुख्य) - ४८२०१८
 नोंदात (मुख्य) - ०७५५-२४६२१३६

विषय: जिला शाकुआ की नवीन जिला संवेदन रिपोर्ट के परिणाम बाबत।
 संदर्भ कलेक्टर, शाकुआ के पत्र क्र. ५०९ / खंडिज / २०२२ दिनांक 24.05.2022।

जारीत विध्यायानीय संदर्भ में लेख है कि पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार की अधिसूचना 15 जारीत 2016 व 25 जुलाई 2018 एवं Sustainable Sand Mining Guidelines 2016 तथा Infoexchange and Monitoring Guideline for Sand 2020 (www.mofc.gov.in पर उपलब्ध) के परिणाम में मानवीय राष्ट्रीय इकाई अधिकारी ने विलो ने ओ.ए. ४५८ / २०१८, ७२८ / २०१८ में दिनांक ०४.११.२०२० में दिये गये दिनांक नियंत्रि के परिवर्तन में दिनांक कलेक्टर, जिला - शाकुआ की अनुसूचि उपलब्ध जिला संबंधित रिपोर्ट उपलब्धान्वयन संभिति की अनुसूचि एवं जिला खंडिज पर २१ दिनों की कागजीय तुर्हि कर SEAC जानिति के परिणाम एवं SEIAA कार्यालय की अनुसूचि द्वारा प्राप्त हुई है।

हाल ही में मानवीय उच्चात्मन चालाक द्वारा अधीक्षत क्र. ३६६१-३६६२ / २०२० में पारित आदेश दिनांक 10.11.2021 के परिणाम में खंडिज संसाधन विभाग/जिला राज्य पर विला संबंधित रिपोर्ट जिला एवं SEAC द्वारा प्रकाशित उपलब्ध SEIAA से अनुसूचि की नियांत्रित प्रीव्या एवं मानदण्डों के परिवर्तन में जारीत नियंत्रि की जिला संबंधित रिपोर्ट का यांत्रिक परिकल्पना कर दिया गया अनुसूचि द्वारा प्राप्त हुई थी।

संलग्न-उपरोक्तानुसार

क्र. /SEIAA/2022 नोंदात दिनांक
 प्रतीक्षिति :-
 1. संघालक, प्रशासन एवं तकनीकी, संघालनालय, भीमियो तथा सामिक्रम- २९-८, खंडिज भाग, अंतर्राष्ट्रीय भवान (मुख्य) की ओर सुनावायें।
 2. जिला कलेक्टर, जिला शाकुआ की सूचनाएं।

SSO (SEAC)
 संदस्य संधिं
 दिनांक १८३
 Date: २६/५/२२

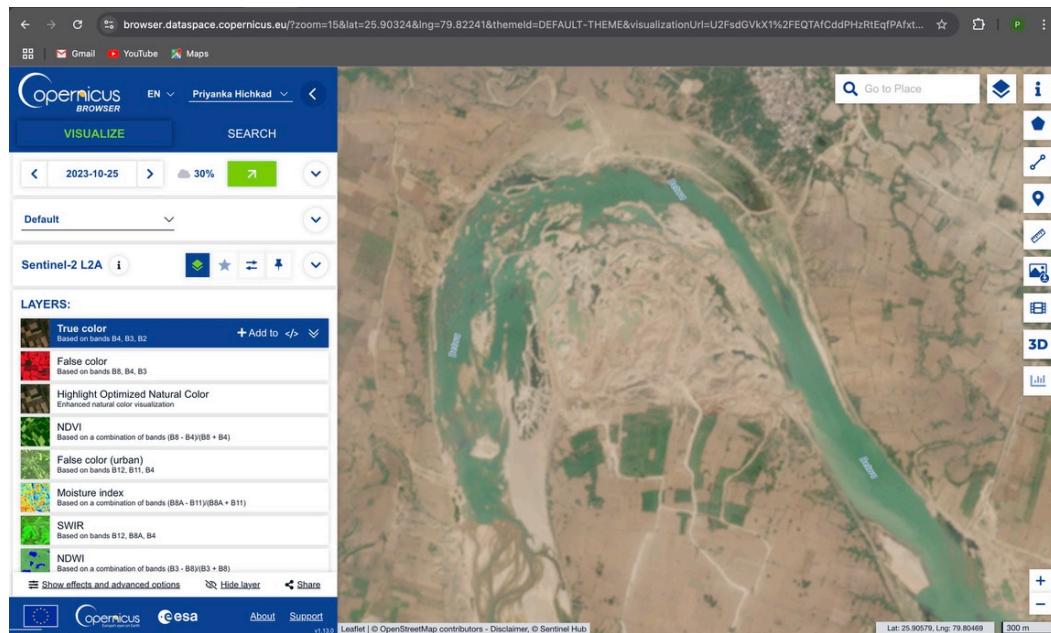
Salient feature		
S.No.	Information	Details
1.	Project name	Bhedi Kharka 23-23 Sand/Morrum Mining Project
2.	Mining Lease Area	12.145 Ha. (Total cluster area- 121.454 ha.)
3	Plot/Survey/Khasra No.	Khand 23-23
4	Location of mine	
	Village	Bhedi Kharka
	Tehsil	Sarila
	District :	Hamirpur
	State :	Uttar Pradesh
5	River/Nalla/Nadi	Betwa River
6	Minerals of mine	Sand/Morrum
7	Proposed Production	194304.00 m ³ or 349747.2 TPA
8	Bulk Density	1.8 t/m ³
9	Method of mining	Open Cast semi-mechanized Method
10	Drilling or Blasting	No
11	No of working days	250 days

PROJECT: BHEDI KHARKA SAND/MORRUM MINE		
APPLICANT: M/s RADHIKA CRUSHER MINES & STONE		
12	Water demand	Domestic Water : 0.53 i.e 0.6 KLD Dust Suppression: 3.0 KLD Plantation= 2.4 KLD Total Water Requirement: 6.0 KLD
13	Man Power	53
14	Nearest railway station	Kalpi Railway Station at a distance of 25 km towards NNW direction from site.
15	Nearest NH/SH	SH-91 is about 9.00km towards North direction.
6	Nearest airport	Kanpur Airport at a distance of 80.00 km in NE direction from site.

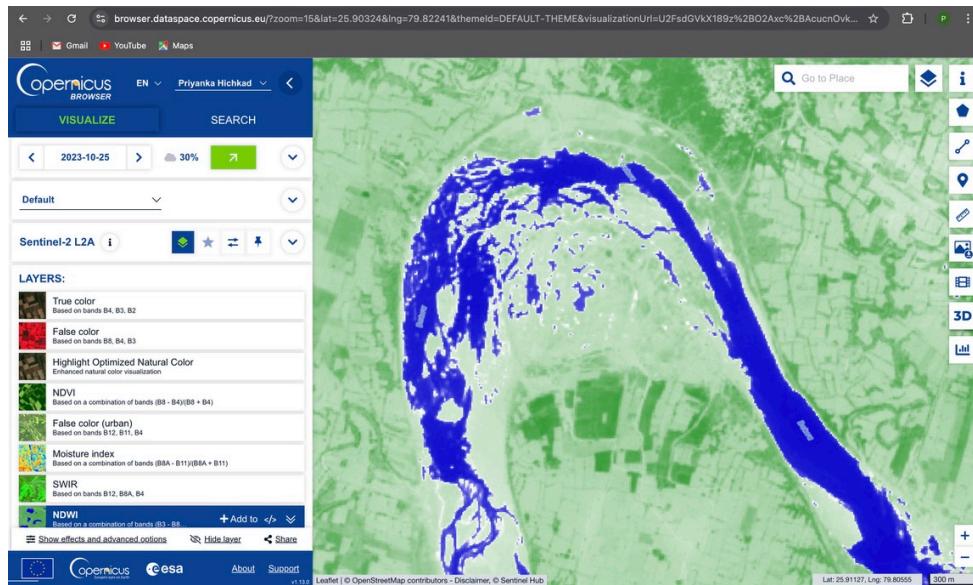
STEP 2:

The sand mining detector is based on satellite images from the *Sentinel-2* mission of the European Space Agency (ESA). Sentinel imagery is freely available.

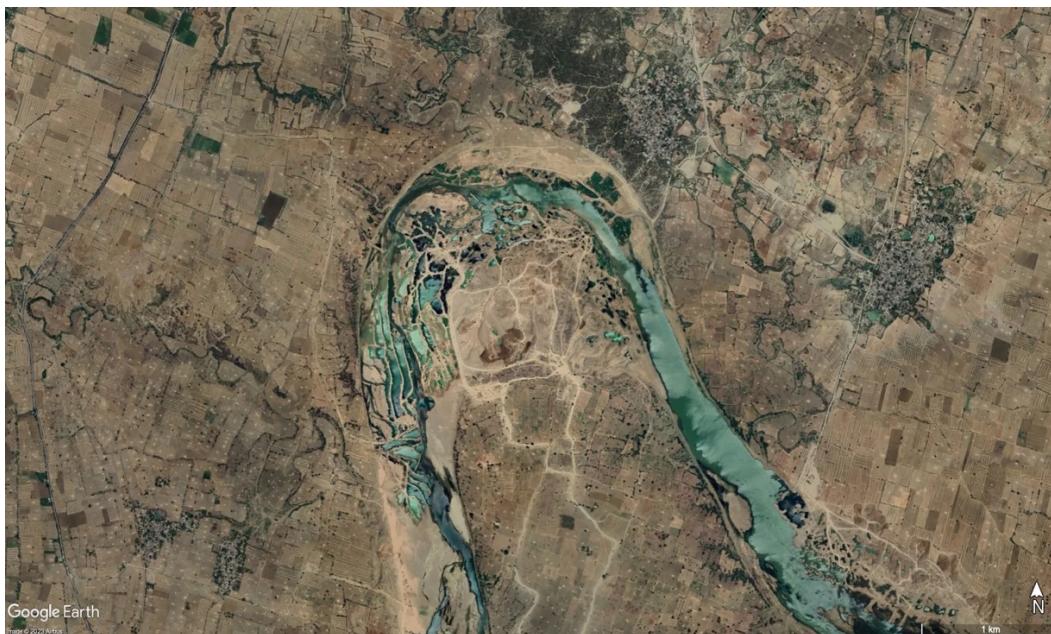
- **Temporal resolution:** Two satellites orbit Earth with revisit times of 10 days each. Jointly, they capture new images every 5 days over every location (except when it's cloudy, then the images are useless).



- **Spectral resolution:** While conventional images (e.g., taken by your smartphone) capture three color bands, red, green, and blue (RGB), Sentinel-2 images consist of 13 color bands. These include RGB and infrared, which is invisible to the human eye. For many earth observation applications, this multi-spectral resolution is valuable. For example, infrared reflectivity is used to assess the photosynthetic activity of forests. We also know that the infrared reflectivity of sand depends on grain size properties (e.g., roughness, shape, grain size). Hence, we hypothesize that the multi-spectral resolution will benefit sand mining detection.



- **Spatial resolution:** One pixel covers 10x10 meters of Earth's surface.
(Depending on the color band, resolution varies between 10x10, 20x20 or 60x60 meters.)



STEP 3:

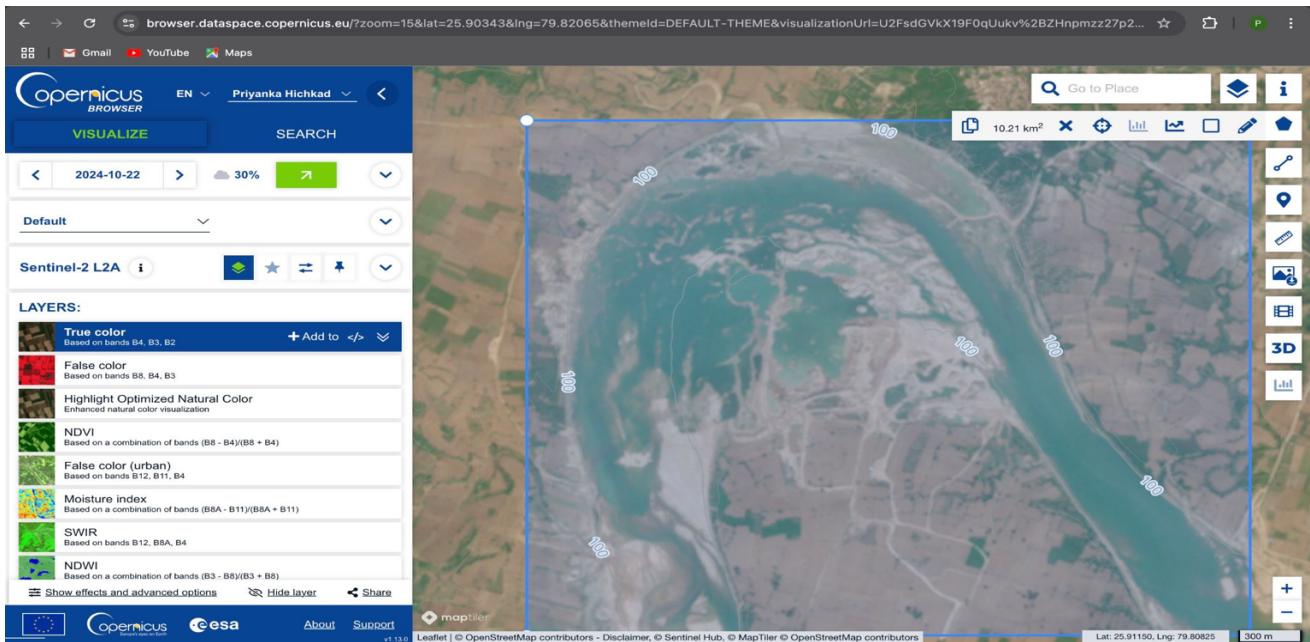
Next, we define our *study areas*. Some of the mining sites are small, covering a few hundred square kilometers. Other mining sites are huge, they follow a river for several dozens of kilometers. Accordingly, we define one or more non-overlapping rectangles around every mining location. These rectangles are arbitrary in size. They become our study area.

3.2 Location

The mining lease area is located in Village Bhedi Kharka, Tehsil- Sarila & District Hamirpur, Uttar Pradesh. The proposed project activity will be carried out in the bed of the River Betwa.

The project site is located at:

Pillar No.	Latitude (N)	Longitude (E)
A	25° 54' 30.31"	79° 49' 26.21"
B	25° 54' 30.97"	79° 49' 35.75"
C	25° 54' 20.87"	79° 49' 40.01"
D	25° 54' 20.57"	79° 49' 21.01"
E	25° 54' 20.77"	79° 49' 33.85"
E	25° 54' 30.38"	79° 49' 27.61"



STEP 4:

Third, we select *timestamps*. Sentinel-2 images are available for every fifth day. For each rectangular area defined above, we chose 2 timestamps, usually several months apart. We aim to maximize the variability of the landscape between these two timestamps.

Monthly data - oct, 2016 to 2024:



Weekly data - oct, 2022-2024



RESULTS

RESULT:



While seeing the timelapse we can see that extensive mining started in November – December of 2018. Still I could not find any report filed against the sand mafia. This is why we need satellite inspections. Officially the mine was handed over to M/s Radhika on 02/01/2020. This means that there was an extensive illegal sand mining for over a year.

Document given by M/s Radhika Crusher Mines & Stones - [Link](#)

The executive summary tell us that the project involves the extraction of sand and morrum from the bed of the Betwa River using an open-cast, semi-mechanized mining method, with an estimated annual production of 349,747.2 tons. The mining operation will be carried out without drilling or blasting, utilizing machines such as light earth-moving equipment and loaders, and the ultimate mining depth will not exceed 3 meters. The project is set to operate for five years, and mining will be suspended during the monsoon season to allow for replenishment of the riverbed materials.

As we see in the document below that owner was prohibited from starting the mine due to it being 60% in the river.

**24. Discussion on Shri S.N. Dubey, M/s Radhika Crusher Mines & Stone letter dated 01/04/2019
(River Bed Sand/Morrum Mining at Bank of Betwa River at Khand No.- 23/23, Village-Bhedi Kharka, Tehsil- Sarila, District- Hamirpur, U.P., over an area 12.145 ha (Total cluster area - 121.454 Ha). File No. 4396/ Proposal No.SIA/UP/MIN/28243/2018)**

The Secretariat informed the committee that the environmental clearance for the above project was issued by SEIAA, U.P. vide letter no. 680/Parya/SEAC/4396/2018 dated 08/02/2019 for the leased area 12.145 ha and production capacity of 194304 m³/year (349742.2 TPA). The project proponent submitted a letter dated 01/04/2019 through which they have informed that approximately 60% of the total mining lease area is in-stream of the river and as per SSMMG rules, 2016, the in-stream mining was prohibited. The project proponent requested to form a subcommittee for spot verification/inspection of the project site.

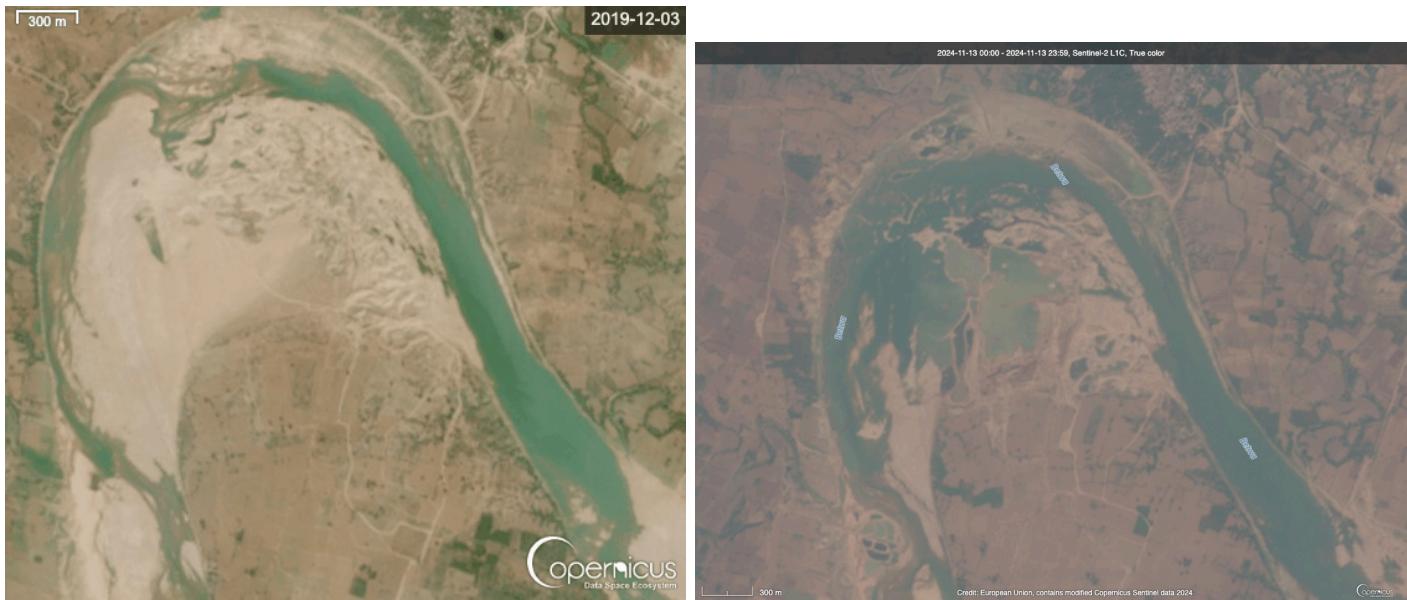
The committee discussed the letter dated 01/04/2019 submitted by the project proponent and decided that a site visit/spot verification shall be undertaken by Shri Meraj Uddin, Member, SEAC and District Mining Officer, Hamirpur within 15 days and the site inspection report shall be submitted to SEAC. The matter shall be discussed after receipt of inspection report.

Murram Mining sites in Hamirpur, Jalaun districts as mentioned on

Directorate of Geology & Mining, Govt. of Uttar Pradesh website on Feb. 16, 2023

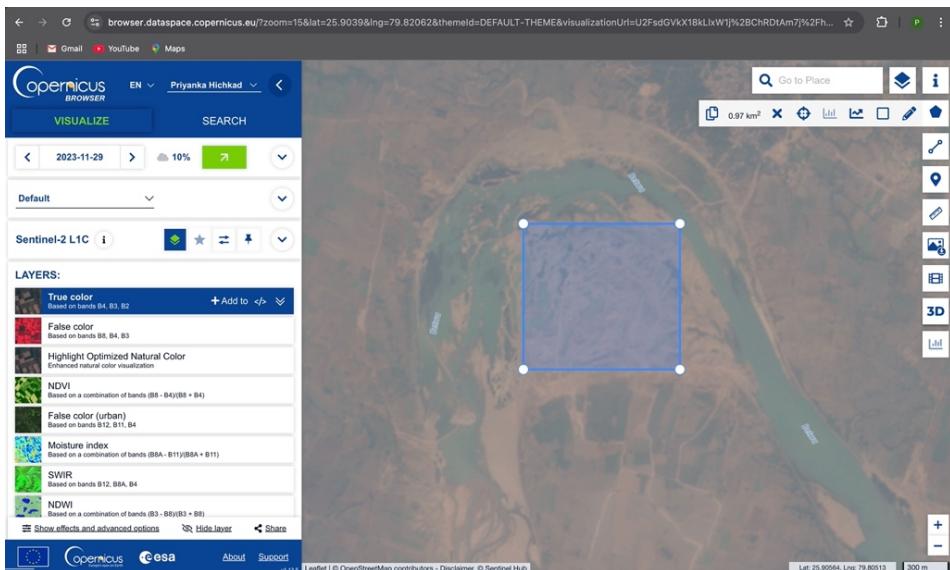
SN	District	Sub Mineral Name	Lease Holder's Name	Lease Holder's Mobile No.	Lease Detail				Lease Period	Dispatched Quantity of Minerals (Cubic Mt.)	Lease Sanctioned	Selling Price of Mineral		Lease Status	Last Updated On
					Gata No.	Village	Area (Acre)	Tehsil		Per Cubic Mt.	Per Cubic Mt.	Per Cubic Ft			
1	Hamirpur	Morrum	m/s Hardik Distributors	9369989121	24/15	chikasi	90.00	sarila	10/12/2019 - 04/12/2024	0.00	728640.00	525.00	15.00	Active	06/09/2021
5	Hamirpur	Morrum	M/s Radhika Crusher	6307921332	23/23	Bhedi Kharka	30.00	Sarila	02/01/2020 - 01/01/2025	0.00	194304.00	0.00	0.00	Active	
6	Hamirpur	Morrum	M/s Unnao	6387043635	10/3	Beri	90.00	Hamirpur	02/01/2020 - 01/01/2025	0.00	582912.00	525.00	18.00	Active	06/09/2021

This is a report is provided by the government. The lease period is of five years but still there is no report of any mining activity officially.



This shows that there has been instream mining and a lot of sand was mined from the site. This shows that the government still has no answers for the public about the quantity of sand that was taken.

Further it states that the official area is 30 - 120 acres while through satellite imagery it states that the mining is happening in over 180 acres.



Recently, the government put the mine for auction for 2023-24 and then again for 2024-25.

Below are the auction sites for the tenders:

The image displays two side-by-side screenshots of the TendersOnTime website. Both screenshots show a search result for a specific tender. The left screenshot is for 'Bhedi Kharka Gata No.23/23 Tender, Uttar Pradesh - 103131439' and the right one is for 'Bhedi Kharka Gata No.23/23 Tender, Uttar Pradesh - 107051552'. Both pages include the TendersOnTime logo, navigation links (Search Tenders, Login, Register, Subscribe), and a 'Download Document' button. The main content area shows the tender summary, which includes the project name, reference number, state, summary, deadline, and other relevant details. A large red 'EXPIRED' stamp is overlaid across both screenshots. The left screenshot also features a 'Tenders By State' dropdown menu.

CHALLENGES:

LABELING CHALLENGE:

Unfortunately, the annotation process is highly ambiguous. Mining locations on riverbeds are exposed to nature, and river water removes signs of mining. Often it is ambiguous whether the remnant of a sand mine should be annotated. Or, it is unclear where to draw boundaries between a mining and a non-mining area. Even with high-resolution images from Google Earth available, expert human labelers disagree on annotations.

Sometimes, researchers spend 30 minutes or more to discuss a single small mining area. In addition to the Sentinel-2 RGB image, high-resolution images are looked from Google Earth Pro (multiple timestamps available), and data from Copernicus. Occasionally, even search for clues on Google Street View from neighboring streets are done. Despite these efforts, the annotation confidence remains unsatisfying.

With sufficient financial resources, a research team could purchase commercial high-resolution satellite imagery. These could make the annotation process easier. Another costly approach involves field visits at the mining sites.

DATA COLLECTION:

It is very difficult to obtain correct data of the amount of material which is mined from the government. Thus the initial input data required for trying out the Algorithm is difficult to get. While visiting the mine is an option but it is very time and labour-consuming, making it infeasible.

CONCLUSION:

A timestamp together with a geographical area yields a unique satellite image. Next, we annotate sand mining areas in these images. We do this by manually drawing polygons over areas where we see signs of sand mining.

There is still an extensive mining happening in the region without any government intervention. This issue should be addressed as illegal sand mining as this can change the course of the river can cause significant harm to the ecology of that area.

The government should keep a proper and updated record of each and every mine. Thus, there is an urgent need for involvement of AI in this field of work.



CASE STUDIES

CASE STUDY - 1:

Mining lease in Khand No. 24/17, Chikassi, District Hamirpur.

Complaint: Grievance in the present application is that illegal sand mining is being carried out by Sushil Tomar, resident of Chandpur, Kanpur Dehatat Khand Sankhya 24/17 in river Betwa at village Mohana, Thana, Dakore, Tehsil Orai, District Jalaun. The illegal mining is also obstructing the main stream of river. Big ditches have been thereby created and a child died by drowning in one of the ditches.

9.8.2) According to information provided by District Mining Officer Hamirpur, the mining was being done 627 days mining between since 24.03.2020 (Commencement of the mining operation) to 30.06.2022. The mining lease holder has obtained CTO from UPPCB vide letter dated 12.11.2020 & the validity of CTO was since 11.11.2020 to 31.12.2021 and letter dated 30.09.2022 & the validity of CTO is since 29.09.2022 to 31.12.2023.

9.8.3) The mining lease holder was being done 326 days mining without valid CTO between since 24.03.2020 to 30.06.2022.

9.8.4) Presently mining operation is being done having valid CTO.

This is a timelapse I took from the coordinates of the mine- 24/17:



It clearly shows the extent of mining done in the river. This is called instream mining which is prohibited in India. It caused the river to change its course during the rainy season causing the nearby village – Mohana to have floods.

The report below shows that the mine was then prohibited. Even the mine nearby was

checked and then closed after seeing that two mines which are both instream and extensive have caused the river to change its course.

4.5 The lease area khand no- 24/17 of Village- Chikasi, Tehsil- Sarila. District- Hamirpur (sanctioned and allotted) is situated throughout the river stream section. The village- Chikasi district- Hamirpur is situated one side of River Retwa and village - Mohana. District-Jalaun is situated other side of River 13etwa. The stream of River betwa is flowing in the area of village- Chikasi, District- Hamirpur presently. The lease area khand no- 24/17 of Village- Chikasi, Tehsil-Sarila. District Hamirpur is situated both side of river stream. During the visit of committee member, it was found that lessee of khand no- 24/17 of Village- Chikasi, Tehsil- Sarila, District - Hamirpur have been diverted the stream flow of River Betwa towards the village- Mohana. Due to water submergence in river stream, it could not be verified that mining work is done in river stream. However river stream flow diversion and mining work in stream is prohibited through the various guidelines.

4.7 Mining work has been done within allotted Co- Ordinate in village- Chikasi but river stream has been diverted towards village-Mohan by lessee of khand no- 24/17 of Village- Chikasi, Tehsil-Sarila, District- Hamirpur. The land area of Village- Mohana in river Betwa was found submerged in river stream flow, hence illegal mining in village- Mohana could not be verified. During the committee visit no mining is being carried out within land area of village-Mohana.

4.8 It was also found that lease area khand no- 24/18 of Village- Chikasi Tehsil- Sarila, District -- Hamirpur (sanctioned and allotted) is situated throughout the river stream section, The village- Chikasi, District- Hamirpur is situated one side of River Betwa and village -- Mohana, District- Jalaun is situated other side of River Betwa. The stream of River Betwa is flowing in the area of village- Chikasi. District- Hamirpur presently. The lease area khand no- 24"18 of Village- Chikasi, Tehsil- Sarila, District -- Hamirpur is situated both side of river stream. Lessee of khand no- 24/18 of Village- Chikasi. Tehsil- Sarila, District -- Hamirpur has been diverted the stream flow of River Betwa towards the village- Mohana. Due to water submergence in river stream, it could not be verified that mining work is being done in river stream. However river stream flow diversion and mining work in stream is prohibited through the various guidelines.

This shows how important it is to maintain proper records of even the sanctioned mines.

CASE STUDY - 2:

BETWA RIVER:

As per Directorate of Geology and Mining (M&G) Department, Uttar Pradesh, there are 238 Murram mining sites in 9 districts of the state of which 80 sites are in **Hamirpur** (52), **Jalaun** (28) districts where Murram mining is taking place on 4036 acres of river land since 2018-19 for a period of 5 years. The website mentions that of the 80 sites 56 are active and 24 closed. Similarly, there are 20 mining sites in Jhansi district of which 14 are mentioned as closed.

Although the five year long mining lease period is coming to an end, information for these sites were last updated in 2018 (4 sites) 2019 (47 sites) 2021 (11 sites) and 2022 (only one site) while 16 sites are without any update. The other information including dispatched and approved quantity of minerals and selling price is mostly incomplete.

**Murram Mining sites in Hamirpur, Jalaun districts as mentioned on
Directorate of Geology & Mining, Govt. of Uttar Pradesh website on Feb. 16, 2023**

SN	District	Sub Mineral Name	Lease Holder's Name	Lease Holder's Mobile No.	Lease Detail				Lease Period	Dispatched Quantity of Minerals (Cubic Mt.)	Lease Sanctioned	Selling Price of Mineral		Lease Status	Last Updated On
					Gata No.	Village	Area (Acre)	Tehsil				Per Cubic Mt.	Per Cubic Mt.	Per Cubic Ft	
1	Hamirpur	Morrum	m/s Hardik Distributors	9369989121	24/15	chikasi	90.00	sarila	10/12/2019 - 09/12/2024	0.00	728640.00	525.00	15.00	Active	06/09/2021
2	Hamirpur	Morrum	M/s Surendra singh Chauhan	9559313131	31/8	pateyora	90.00	Hamirpur	10/12/2019 - 09/12/2024	0.00	728640.00	700.00	20.00	Active	06/09/2021
3	Hamirpur	Morrum	M/s A. J Construction	9580371882	23/14	Bendi kharka	60.00	Sarila	21/12/2019 - 20/12/2024	0.00	388608.00	630.00	18.00	Active	06/09/2021
4	Hamirpur	Morrum	Shri Shrikant gupta	8707456168	24/13	Chikasi	90.00	Sarila	02/01/2020 - 01/01/2025	0.00	728640.00	630.00	18.00	Active	06/09/2021
5	Hamirpur	Morrum	M/s Radhika Crusher	6307921332	23/23	Bhedi Kharka	30.00	Sarila	02/01/2020 - 01/01/2025	0.00	194304.00	0.00	0.00	Active	
6	Hamirpur	Morrum	M/s Unnao Developers	6387043635	10/3	Beri	90.00	Hamirpur	02/01/2020 - 01/01/2025	0.00	582912.00	525.00	18.00	Active	06/09/2021

Moreover, the District Survey Reports (DSR) as recommended by Ministry of Environment, Forest & Climate Change (MoEF&CC) and ordered by National Green Tribunal (NGT) for obtaining Environment Clearance (EC) before approving riverbed mining are not uploaded on the website.

When on February 16, 2023, an inquiry was made regarding the riverbed mining DSRs for Jalaun and Hamirpur districts; Subash Singh, Mines Officer, Hamirpur replied that DSRs are available with Directorate General (DG) and not in public domain. Regarding mineral replenishment study in Betwa river; he claimed that it has been done by Central Mine Planning & Design Institute Limited (CMPDI) but they do not have the report. There is no such report uploaded on CMPDI



CASE STUDY - 3:

KEN RIVER:

The information on Directorate of Mining & Geology shows that there are 50 sand mine sites in **Banda district** of which 36 sites are closed. The complete list of 50 closed and active sand mine sites in Banda can be seen.

Of total 14 active sites 8 are in Banda, 4 in Pailani tehsil and 1 each in Ataraa and Naraini tehsils. These 14 sites cumulatively cover 241.22 acres of riverbed land leased out to mine 5574 cubic metre of morrum for next 3 to 4 years. The website has not been updated since February 2022 and mentioned only 12 cubic meter as dispatched minerals so far from these 14 active mines.

Sr. No.	District	Sub Mineral Name	Lease Holder's Name	Lease Holder's Mobile No.	Lease Detail			Lease Period	Dispatched Quantity of Minerals (Cubic Mt.)	Lease Sanctioned	Selling Price of Mineral	Lease Status	Last Updated On	
					Gata No.	Village	Area (Acre)	Tehsil		Per Cubic Mt.	Per Cubic Mt.	Per Cubic Ft.		
20	Banda	Morrum	Alok Kumar Shukla Ms Falgun Giri	8423123124	2494	Chandaur	19.27	Atarra	01/12/2018 - 30/11/2023	1.00	301.00	600.00	17.00	Active 14/02/2022
24	Banda	Morrum	Renu Gupta Ms Om Prakash Ram Avatar	9369782376	455	KHAPATIHA KALA	23.00	PAILANI	13/02/2019 - 12/02/2024	1.00	251.00	700.00	20.00	Active 14/02/2022
39	Banda	Morrum	K & S Mines, katyana sharma	9953099808	333/3 (Khand no. 3)	Maruli khandar	23.00	Banda	04/12/2020 - 03/12/2025	1.00	375.00	500.00	14.00	Active 14/02/2022
40	Banda	Morrum	Manish Sahu Sahu Electricals Store	9839208192	333/3 (Khand no.2)	Maruli khandar	22.00	Banda	04/12/2020 - 03/12/2025	1.00	461.00	840.00	24.00	Active 14/02/2022
41	Banda	Morrum	Vijay Pal Prajapati Ms VP Construction	9670777727	333/3 (Khand no. 4)	Maruli khandar	23.00	Banda	08/01/2021 - 07/01/2026	1.00	527.00	650.00	19.00	Active 14/02/2022
42	Banda	Morrum	J S Enterprises Vinay Kumar Singh	8303928092	100/3 (khand no. 3)	Khaptiha kala	16.00	Banda	16/04/2021 - 15/04/2026	1.00	251.00	564.00	16.00	Active 14/02/2022
43	Banda	Morrum	Vipul Tyagi	8587026848	176, 172, 182, 187	Amlor khadar	25.29	Pailani	18/05/2021 - 17/05/2026	1.00	586.00	950.00	27.00	Active 14/02/2022
44	Banda	Morrum	Surendra Punya SR Innovation LLP	9651595978	100/1 (khand no. 1)	Khaptiha kala	16.00	Pailani	03/12/2020 - 02/12/2025	1.00	302.00	450.00	13.00	Active 14/02/2022
45	Banda	Morrum	Ram Kumar Shastri	7974808249	05, 09	Bilharka	15.16	naraini	19/01/2021 - 18/01/2026	0.00	501.00	0.00	0.00	Active
46	Banda	Morrum	Durga Prasad Tripathi Ms Thinkhome	7706871102	333/3 (Khand no.6)	Maruli khadar	23.00	Banda	01/03/2021 - 28/02/2026	0.00	626.00	0.00	0.00	Active
47	Banda	Morrum	Pramod Tiwari Jai Maa Siddhidatri	8400357701	khand no. 01	Jauharpur	15.00	Banda	13/01/2020 - 12/01/2025	1.00	251.00	460.00	13.00	Active 14/02/2022
48	Banda	Morrum	Anand Kumar Tripathi Ms Tripathi Construction	8318337279	1130 (khand no. 01)	Achrud	10.70	Banda	01/03/2021 - 28/02/2026	1.00	311.00	500.00	14.00	Active 14/02/2022
49	Banda	Morrum	Narendra kumar Singh	8858588019	5137, 5138, 5139, 5140, 5	Bhawani purwa	4.00	Banda	10/12/2021 - 09/12/2026	1.00	266.00	400.00	11.00	Active 14/02/2022
50	Banda	Morrum	Kailash Singh Yadav	8127101650	2/1, 2/2, 2/4	Khairai	5.80	Pailani	06/01/2022 - 05/01/2027	1.00	565.00	600.00	17.00	Active 14/02/2022

CASE STUDY - 4:

MEANDER AT CHATKAN VILLAGE:

Ken river forms a unique U shaped meander at Chatkan village about 10 km northwards from Banda district. The meander is comprised of an elevated sand island (of about 60 hectare) and sandy floodplain roughly covering over 2 square kilometre area.

Another Google Earth imagery of March 2022 reveals more than 250 heavy trucks making bee line through the floodplain and over 45 giant pochein machines digging out riverbed in unsustainable and illegal manner.

The mining department website mentions the location as Maruli khandar and shows 4 active sand mine leases there with a target to mine 1989 cubic metre of morrum from 91 acres of riverbed. The information on these sites has not been updated since February 2022 and just 3 cubic metre is mentioned as dispatched minerals.

However, approximated measurement from satellite imagery reveals that over 240 acres of floodplain is directly affected by the mining operations and actual mining has taken over 130 acres of riverbed land which is about 39 acres more than permission granted.



CONCLUSION

This project highlights the immense potential of satellite-based monitoring for detecting illegal and extensive sand and morrum mining in riverbeds, particularly focusing on the identification of artificial bunds (embankments) that result from such activities. By leveraging high-resolution satellite imagery, we can monitor vast riverine landscapes and detect environmental degradation that would otherwise go unnoticed. The combination of advanced satellite technology, machine learning, and time-series analysis presents a powerful tool to combat the growing problem of unregulated mining, which is having devastating impacts on local ecosystems, water resources, and communities.

The environmental consequences of illegal sand and morrum mining are severe and far-reaching. As demonstrated in the case studies and the analysis of mining activities along the Betwa River, extensive mining has led to changes in the course of rivers, exacerbated flooding, depleted groundwater levels, and caused widespread erosion. The formation of artificial bunds, often a direct result of excessive and illegal extraction, further alters river morphology, disrupting both aquatic habitats and local agriculture. The challenges this illegal mining poses are compounded by the lack of adequate government regulation, limited monitoring capabilities, and insufficient data on the true scale of mining operations. The slow pace of enforcement, with a significant gap between mining activities and government action, underscores the urgent need for more effective monitoring systems.

The Sentinel-2 satellite imagery is an essential resource in this regard. Its high-resolution multispectral images provide detailed insights into riverbed changes and can be used to accurately track mining activities. This project has shown that using such imagery, coupled with AI-based detection methods, we can identify mining hotspots, track the formation of bunds, and monitor the extent of illegal mining activities over time. Time-series analysis makes it possible to detect the progression of mining activities. Moreover, the real-time detection capability of satellite-based monitoring can help authorities take timely action to prevent further damage, thereby improving regulatory compliance and supporting enforcement efforts.

One of the most significant contributions of this project is its demonstration of how AI can be applied to satellite imagery for the automated detection of sand mining activities. Given the challenges of manual annotation, particularly in regions where mining leaves few visible traces or where natural processes quickly obscure signs of extraction, AI-based detection offers a scalable and cost-effective solution. The ability to integrate satellite data with other sources, such as ground reports or drones, further

enhances the accuracy of detection and enables a more comprehensive monitoring approach.

Despite the promising results, there are challenges that need to be addressed. The labeling process for training AI models is complex and ambiguous, as the signs of mining can be subtle, and interpreting satellite images requires expert knowledge. Additionally, the lack of access to ground-truth data on the amount of material extracted and the specifics of mining operations hinders the development of a robust detection framework. Obtaining accurate and timely data from government sources remains a significant challenge, and field visits, while valuable, are labor-intensive and costly.

In conclusion, this project underscores the critical role of technology in addressing the issue of illegal sand and morrum mining. It not only provides a method for detecting and monitoring mining activities but also contributes to the broader goal of promoting sustainable resource management. The findings of this study call for stronger legal frameworks, better data management, and enhanced public awareness to ensure that river ecosystems and local communities are protected from the adverse impacts of illegal mining. As the demand for construction-grade sand continues to rise, it is imperative that innovative solutions like satellite-based monitoring and AI detection frameworks are integrated into policy and enforcement strategies. Only through such proactive measures can we hope to mitigate the environmental and socio-economic consequences of illegal mining and ensure the long-term sustainability of our river ecosystems.

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