

Existential crises of riverine eco-systems: an echoing environmental epidemic in Europe and India

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Context

Sand mining is a problem perpetuated for decades around the world, that presses on riparian ecosystems, but has only recently come to the scientific spotlight.

❑ What types of interventions are more precisely understood by sand mining?

👉 Sand mining refers to the manual/mechanical extraction of sedimentary aggregates (sand and gravel) carried out mainly through open pits in river environments (in-stream, meanders and floodplains) or along beaches and inland dunes. In the most general sense, sand can be also dredged from the beds of lakes, seas and oceans.

❑ Global importance

Sand extraction and dredging are essential for the development of infrastructure projects worldwide, sand being the main aggregate used in construction mortar.

❑ Local, regional and trans-boundary threat

Being pursued actively for its economic significance, sand mining however has the tendency to disrupt the environmental balance and the ecologies gravely.

❑ How is this type of anthropogenic activity on rivers regulated?

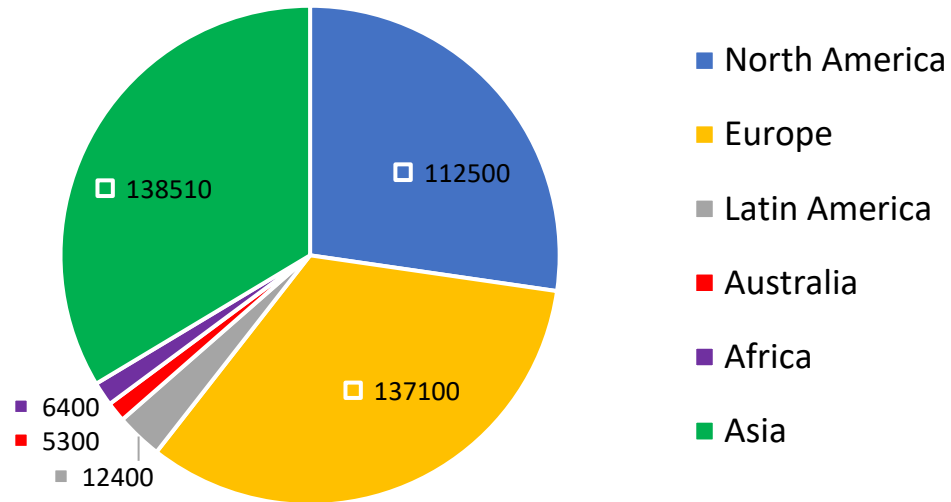
👉 With a few countries having enacted specific binding Rules on Sand Mining and Environment Impact Assessment (EIA) mandates, this age-old practice is still largely covered under the non-specific tutelage of general mining legislations and other soft law instruments like broad environmental guidelines lacking vigorous implementation.

One extractive activity in rivers... multiple impacts

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Each year, almost 50 billion tons of sand and gravel are mined, mostly due to requirements in the construction sector and to help in land reclamation (WWF, 2018).

Industrial sand and gravel production worldwide in 2019 in thousand tons (Statista.com)






i.e., in the fabrication of concrete, for each tone of cement, six to seven times more tons of sand and gravel are required (USGS, 2013).

This growing demand for concrete makes **the sand mining the largest extractive industry on the planet** (WWF, 2018) ... and Asian rivers are on the front cover of this mining activity (mainly due to population growth and increasing need for building material)!

- ❑ Cumulative **impacts** of sand mining → on dams, hydro-sedimentary dynamics, riverine richness loss, etc.
- ❑ Sand mining also raises the question of the **sustainability** of exploiting riverine ecosystems (UNEP, 2019).
- ❑ Across the globe, sand mining is **practiced at an uneven pace**. Is it a question of necessity or of legislation?

There is for sure a need for targeted legislation to ensure compliance with the spatial and volumetric limits imposed for sand mining activities in different countries, to achieve the desired conservation of water and sediment resources and the preservation of the hydro-morphological conditions.

Objectives of Study:

-  Focus on sand mining in rivers/streams including the meanders as distinct to beach sand mining to study the general and specific irreversible damage to the riverine ecologies and ground water conservation using cases studies in India and Europe.
-  Comparison of the green legislative framework like the Impact Assessment Studies, implementation and scope for improvement at the inter-continental level (specifically between EU and India)
-  Suggestion of an integrated model of soft laws and strict mandates with scientific accounting instead of piece meal legislations as a measure to curb the sand mining menace.

Methodology:

- ❖ Legislative review
- ❖ Field observations
- ❖ Cartographical analysis

Data Used:

- ❖ Primary legal sources like International Conventions, National Statutes, EU Directives and Regulations, Indian Constitution, the guidelines issued by respective ministries of environment, etc. Secondary legal sources like reports, articles, case studies, books, legislative reviews, etc.
- ❖ Information achieved from direct field observations conducted in certain quarries used as case studies in India (field visits with local villagers between the years 2016-2017) and Romania (as a case study within European countries).
- ❖ Satellite imageries of river beds over the years from technology like Google Earth, etc.

How the Indian System Functions?

- ❖ India is a 'Union of States' – though the states have autonomy to legislate on the subjects mentioned under List 2 Schedule 7 of the Indian Constitution, they cannot be repugnant to the Union laws as per Art.254.
- ❖ Sand is declared as a minor mineral in India and the State Governments alone have authority to fix royalties and frame rules on sand mining in their regional rivers. Examples are TNMMC Rules, WBMMC Rules, etc.
- ❖ The disadvantage in this system of functioning is that the conditions and pre-requisites for mining in rivers are not the same but are drastically varied. On the one hand, certain states allow 5 year mining leases, mandate approval of gram sabha to operate mines, consult geology and ground water table agencies in the process; on the other hand, there are states that allow leases up to 15 year term period, have no ceiling limit on mining areas, etc.

- ❖ However, despite sand being minor mineral, the Union has the power to legislate on inter-state commerce, inter-state rivers, protection of forests and wildlife, etc. Using this, there is scope for a stricter and uniform mandate.
- ❖ But Multi party system hinders its materialisation; The Union and the states are ruled by different parties and the state themselves are ruled by several regional parties.
- ❖ Even if the Central Govt is willing to take a greener step, the regional parties who are part of its coalition, would rebel such actions and the necessity to maintain its majority trumps the need for environmental protection.
- ❖ As of now, the Central intervention in sand mining is through soft law approaches like the 2016 Sustainable Sand Mining Guidelines and mandatory provisions under Environment Protection Act through EIA Notifications. The States have no exception from the EIA application. This shows the centralised nature of the system.

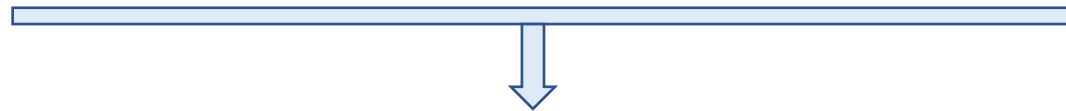
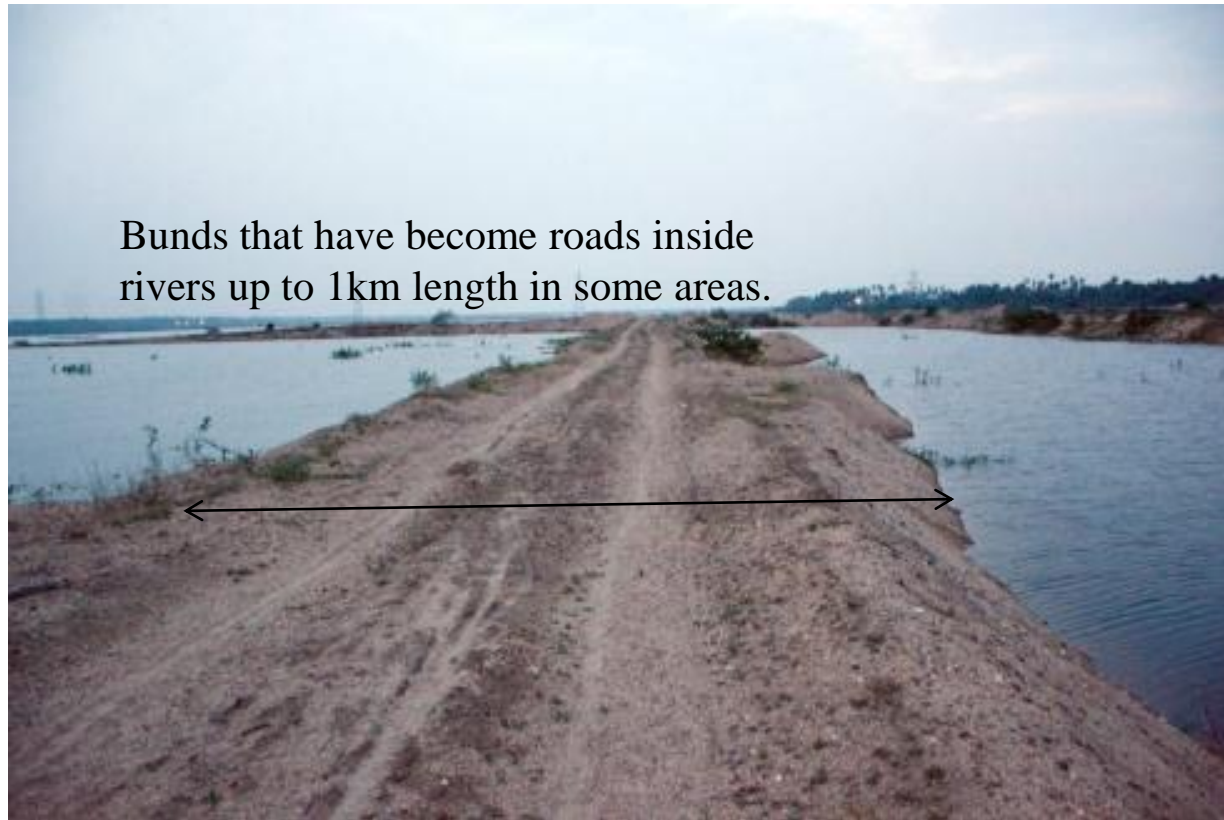
- ❖ ↑ sand mining violations in India despite innumerable legislations is due to lack of regional or international pressure; SAARC does not have a mechanism/authority to actively interfere in this matter nor any external body.
- ❖ Also, since all states are equal in their power and are not sovereign, subject to Central control, they do not intervene/ sanction the acts of one another even if the state actors collude with mafia.
- ❖ Another reason for passive failure of sand mining legislations is the large amount of population; their needs cannot solely be fulfilled by import and the masses are sceptical of the river sand substitutes.
- ❖ On similar lines, the question of affordability of alternatives by the public in this developing country becomes pertinent.

- ❖ Despite India being signatory to several international instruments, the ones operating on riverine environment are limited such as the Bonn Convention, Ramsar Convention, UN Convention on Desertification, 1933 Convention Relative to the Preservation of Fauna and Flora in their Natural Site.
- ❖ Of these, none hinges on river/river sand/geomorphology of river basins or flood plains. Even the definition of ‘desertification’ under the UN Convention is too narrow focusing on arid and semi arid areas and not much on the need to prevent drying up of perennial rivers. Also, if we take UNCLOS regime, inland rivers are not covered.
- ❖ Thus, the lack of effective external mandate is one of the reasons of the environmental sluggishness in India with regard to in-river sand mining.

Case Study (Mohanur, Oruvanthur quarries of Namakkal district, Tamilnadu, India):



Large number of bunds across the river Cauvery in quarry sites affecting free flow of water, forcing the river to change its course to the sides where there are no bund barriers.



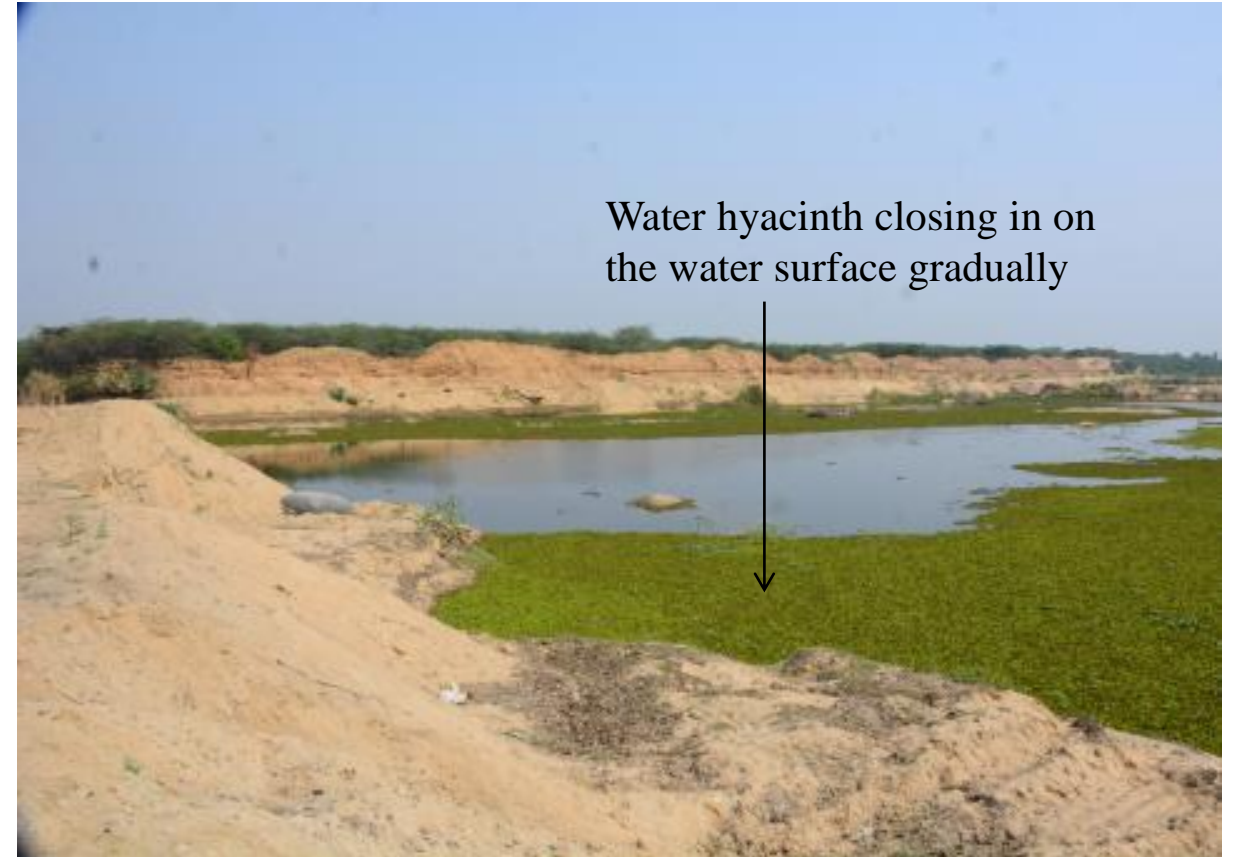
The width and height of the bunds were increased to ease the transportation without any regard for the hydrology and geomorphology of the river.



Due to lack of post-lease monitoring & poor local grievance redressal mechanisms, the mining took place too close to the superstructures like electricity grid, water tanks, etc.



The in-depth mining led to pits of up to 10 to 15 feet and they were not closed or evened out even after the quarries ceased to operate.



Mining only in those portions of the sand carpet deemed desirable for construction (with finer aggregates than the other areas) has led to uneven river bed and water stagnation, weed growth, etc.



Thus, the invasive, extensive and selective mining of river has led to drying off of the distributing water channels and destruction of the riverine ecosystem.

How the EU System Functions?

- ❖ The European Union's authority to legislate has increased with the Maastricht Treaty (1992) and the Lisbon Treaty (2007) by the ↑ conferment of powers on the Union by its members.
- ❖ Unlike India, here the members are sovereign states with authority to legislate in their respective nations. And the centralisation is not as rigid as a federal or quasi-federal state.
- ❖ The EU has 'exclusive competency' in fields like business competition rules where not national governments but only the EU can pass laws; there is 'shared competency' in areas like agriculture, energy, environment, transportation, etc., where the national governments can legislate only if there are no related EU laws.
- ❖ Thus, unlike the Central Government in India, the EU in its regional set up has primary authority to legislate on environmental matters against member states. This paves way for uniformity within the system.

- ❖ Also, unlike an individual country with single ruling party/ coalition, the EU Council and the European Commission have proportionate representation from all member nations so no one State has domination/sway the policy to its ends; the external pressure from other countries within the regional system acts as an incentive to adhere to the established standards.
- ❖ However, so far, mostly directives alone have been enacted by the EU on environmental lines like the Water Framework Directive (WFD - 2000/60/EC), Strategic Environmental Assessment Directive (Directive 2001/42/EC), Environmental Impact Assessment Directive (EIA - 2011/92/EU), Habitats Directive (Council Directive 92/43/EEC), Directive 2008/1/EC concerning integrated pollution prevention and control (the IPPC Directive), Flood Directive D (2007/60/CE) of the European Parliament and Council, etc.
- ❖ These directives though binding on the member states, the choice of means to achieve the results/goals specified therein are at the discretion of the respective member States. This slows down and hinders immediate and effective enforcement.

- ❖ It is pertinent to note that though EIA mandate applies to both public and private projects, the SEA mandates aimed to augment the Espoo Convention are for public plans and programs only; the implementation of EIA mandate shall be 'on the basis of significance of environmental effects from a project'; this phrase is vague and may be subject to misuse as the directive names the States as the deciding authority to distinguish significant and non-significant environmental effect generating projects.
- ❖ Though 'sustainable development' has been formalised as one of EU's fundamental goals post the Amsterdam treaty, so far concrete 'regulations' have not been framed in the environmental field. It is true that the European rivers are nowhere near the Indian scenario in terms of destroyed ecologies from sand mining, but a sound system must focus on prevention than remediation.
- ❖ It is worrisome as the issue of sand mining slips through most of these directives. Even the Habitats Directive focus endangered species but not wildlife in general, which could have meant preserving riverine habitat of the micro & macro fauna and in turn, the entire food chain.

Application on the impact of sand mining on the environment in 3 states with different age and mandate related to EU membership; partially different legislative systems as well: France, the United Kingdom and Romania

1) **French Republic** (*semi—presidential regime*)

- one of the six founding countries of the EU;
- a decentralized unitary state comprising territories with special statutes giving them greater autonomy;
- this longevity of France in the European Union is also reflected in mining, environmental and other policies which have known gradual implementation, together with regulations rising from a national/ sovereign will.

2) **The United Kingdom** (*parliamentary monarchy*)

- EU path (since 1973 to 2018);
- UK helped pass environmental protection laws and helped introduce the concept of "polluter pays" which still manages the environmental impacts of the mining sector;
- Along with respecting EU commitments mostly governed by Directives, UK enforces the protection of riparian areas (i.e. river habitats' protocols). It also has robust minerals regulation and implementation for sand and aggregates extraction

3) **Romania** (*semi—presidential regime*)

- a young member state of the European Union (since 2007);
- pale stipulations on sand mining are provided by the Water Law (107/ 1996, updated in 2020);
- sand mining impact assessment on riparian eco-systems of Romanian rivers not yet included in the national strategy for river basins management (as enforced by WFD - 2000/60/EC).

The case of Ramières sand mine - Drôme with the Rhône confluence (Commune de Rompon, SE France), from the heavily removal of aggregates (until late 90's) to alluvial overburdening of the riverbed (last 20 years)



Sources of photos: Google Earth

- The river management authorities do not know how to proceed, provided that the law prohibited any extraction of gravel which stagnates especially in areas where rivers meet, knowing that the objective of local officials is to extract the gravel for sale and water costs adjustments (JO Sénat, 2016).
- In the event of a fifty-year flood, the water would pass over, with the risk of breaking the dikes (Bravard, 2018).

Granulates extraction in humid zones (alluvial plains), the environmental – legislative – economic deadlock.

Case study from Loire River



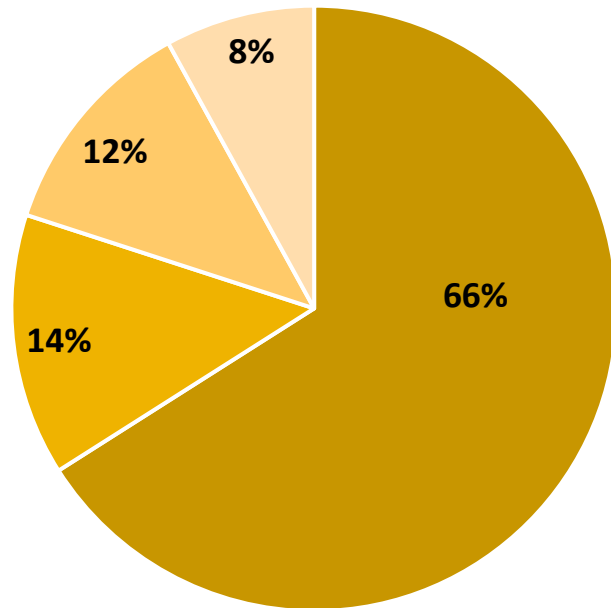
Important alluvial dynamics at the confluence between Loire River and l'Allier (central France). A **tricky reason why not stopping the aggregates extraction**

Source of photos: Google Earth

- On the Loire, until the '70s, the motivation behind alluvial dredging was navigable channel maintenance. Then, sand mining became a venture to the State and private companies' willingness to produce aggregates for public works (Rohaut, 2004).
- With time, instead of stopping the practice, by exceeding quotas and overexploitation, small gravel companies continue to operate by virtue of tacit pact with the Directorate-General for Industry, Research and the Environment. They are also supported by the owners of the lands, who believe in the miraculous intervention in the riverbed mobility by sand mining.

UK turns to offshore mining: a question of depleting rivers' alluvial resources or conserving floodplains?

UK primary aggregates production in 2017
(www.gov.uk)



■ England ■ Scotland
■ Northern Ireland ■ Wales



But only a fifth of the UK aggregates are mined from within the riverine zones → the rest is marine – dredged sand and gravel.

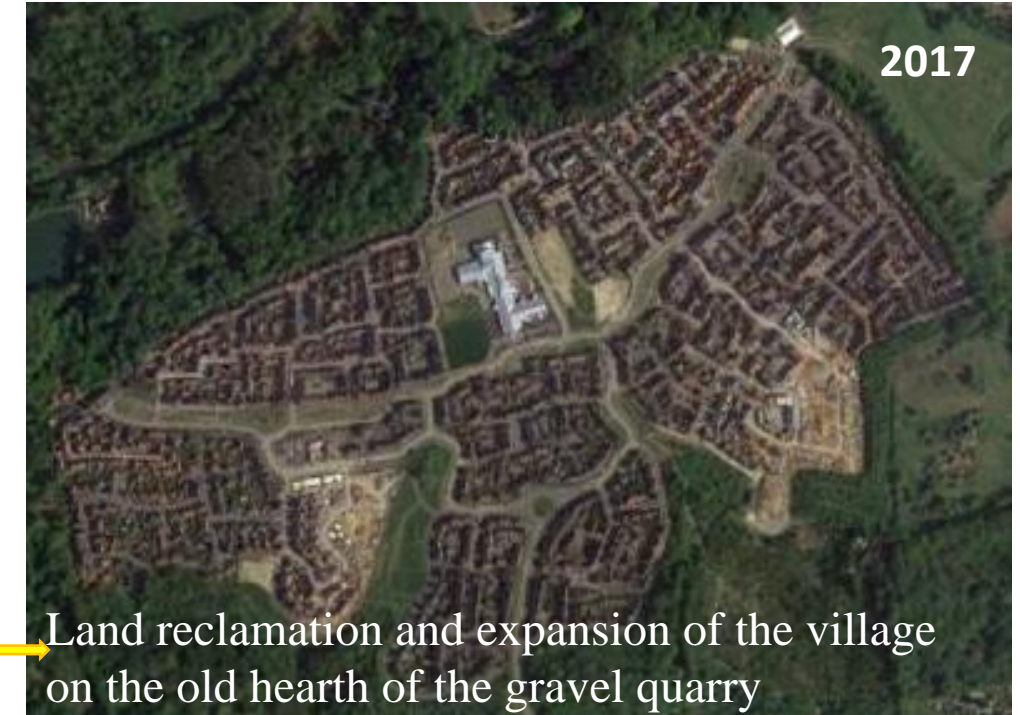
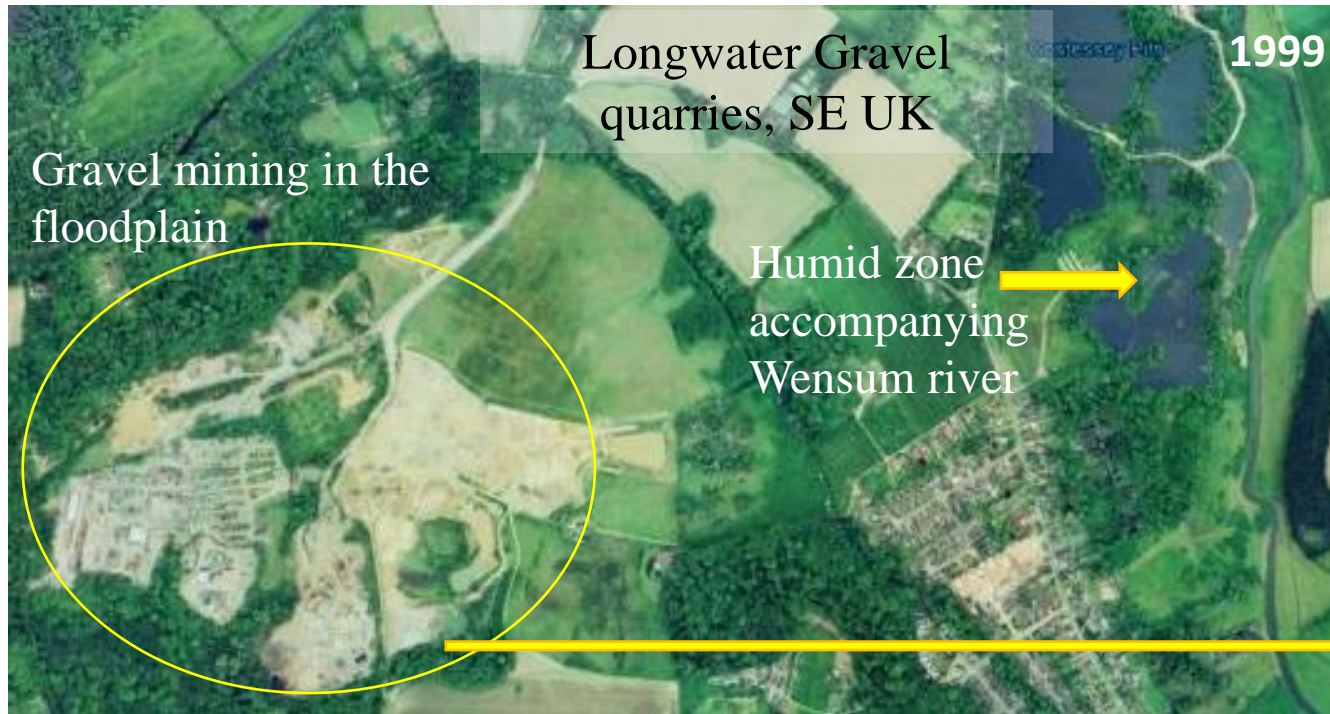
Sand mining effects across the mouth of the River Camel from Padstow
Cornwall, UK



Source of photos: Google Earth

- The River Camel mouth used to be impacted by sand mining.
- Significant changes in sediment supplied to its estuary (always under the risk of tidal erosion) occurred as a result of mining activity.
- **Since the in-river sand mining activity** has diminished, the Camel River has started to regain its so much-needed alluvial transport at its mouth

Between mineral extraction phase and agricultural restoration: liaising with residents and statutory bodies (e.g. Environmental agencies): the case of Longwater Gravel quarries



Source of photos: Google Earth

- In the UK, minerals extraction may only take place if the operator has the agreement of the landowner
- Example of good practices: minerals permissions last for many years, and there may be a need for periodic reviews of the planning conditions attached to that permission.

In times of Covid-19 crisis, another epidemic arises: devastating rivers while staying home. The case of middle sector of Siret River, Eastern Romania



Siret River (Romania) - in-stream sand mining



Lack of concern for practicing sand mining during the season of reproduction for riverine species

Source of photos: AgentGreen (24.April.2020)

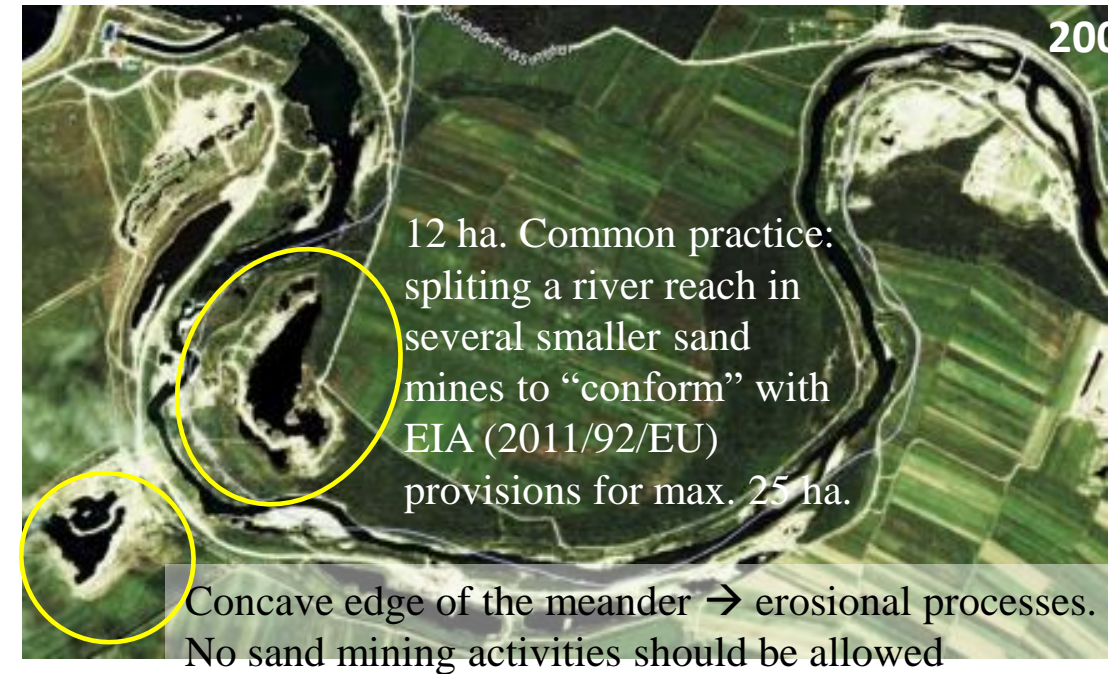
The Siret Culoir in its middle sector is a Natura 2000 ROSCI0434 site :

- Dredging granulates is strictly forbidden in such protected areas
- Yet, not only do authorities close their eyes on such disturbing activities, but they tacitly allow mining sand from in-stream (riverbed) domain, which is no longer permitted in Europe.



Agitated waters and increased turbidity will certainly have an impact on fish breeding and sediment delivery.

Lower Argeş River (SE Bucharest) invaded by sand mines along a meandered sector (*Source of photos: Google Earth*)



Lessons learnt from the Indian and European case studies

Impacts of Sand Mining:

- ❖ Deep pit mining forming pits of varying depths stagnating and curbing the free flow of water.
- ❖ Widening of river triggering sea water intrusion in coastal areas, bank shifts, bank slides, etc.
- ❖ Bed slope changes reducing base flow, \uparrow downward slope = faster drainage + \downarrow ground water recharge.
- ❖ Head cutting with knick points migrating upstream over the period of time.
- ❖ Bunds across the river obstruct water flow, force channel incision, alter the river course.
- ❖ Attempt to the diversity of riparian vegetation species, by removal of the alluvial substrate \rightarrow \downarrow of species' richness in time.

- ❖ Distributing canals stand at higher elevation than main river, thus cutting off their water inflow.
- ❖ ↑ turbidity levels block the gills, ↓ visibility of in fauna species.
- ❖ Fish breeding is affected by loss of ponding substrate, a cumulative effect of ↑ river bed and banks erosion as a consequence of alluvial resource deprivation.
- ❖ Bund obstruction stagnate water that encourages aquatic weed growth, blocking off sunlight, lower oxygenation levels, ↓ spawning in riverine fauna, etc.
- ❖ Mining only on one bank draws the river to that low lying side, changing river flow, affecting the other bank & dependent farm lands.
- ❖ Stability of superstructures like bridges, railways tracks, public water tanks, etc., are affected leading to collapse.
- ❖ ↑ regressive riverbed erosion (with functional risks posed to dams), in river reaches where the minimum distance downstream hydrotechnical facilities was not respected for sans mining operations.

Certain Feasible Solutions to ensure more protective legislations:

- ✓ Renouncing to vague phrases like ‘take necessary precautions to protect environment’ and incorporate legally and scientifically clear limits on the mine area, dredging limits, volumes of sand to be extracted, etc.
- ✓ Fixation of the bund number, height and width; eligibility criteria for mine permits to include non-conviction clauses, etc.
- ✓ Map transportation routes and ensure transport guidelines to prevent ↑ suspended particulate matter in air.
- ✓ Using geo-referencing, optical satellite imagery, etc., as a practical solution to monitor and map active and ex-sand mining areas.
- ✓ Installation of GPS in trucks carrying sand to avoid illegal transport beyond State borders.
- ✓ Installation of CCTVs to avoid unregistered vehicles from entering the mines.
- ✓ Ceiling limit on the number of mining areas held by a person.

- ✓ Regulate more strictly the permits for sand mining operations, which should be offered only upon provision of comprehensive documentation on the hydrological, hydro-morphological and ecological conditions of the river reach to be dredged.
- ✓ Once permits are issued, regular surveys of the said sand mining activity should be planned by expert teams from water and environmental authorities.
- ✓ Avoiding the extension of license beyond 5 years at a time, to allow replenishment and preferring manual than mechanical mining.
- ✓ Minimum distance to be maintained from superstructures and between 2 mines.
- ✓ Royalties to the state per unit load of sand shall be fixed conditional upon the re-sale price of sand; imposing maximum price ceilings on re-sale to avoid hoarding and trafficking.
- ✓ Special portal for the locals to complain about the alleged violations, instilling confidence in the government process & encouraging community participation.
- ✓ Inclusion in the river basins' management plans updated information on sand mining operations and evaluations of the related impacts.

Conclusion:

- ❖ On comparing an innately centralised system in an individual country with complex geography across its states, like India, and a regional system with sovereign member nations, like the European Union, it becomes clear that both systems have advantages and disadvantages; no one system alone is feasible to be environmentally sound.
- ❖ So, an integrated approach of increased regional and, in general, external interventions along with active internal actions by the Countries alone can curb illegal and degrading sand mining practices.
- ❖ Because external expectations act as incentives to adhere to international public morality and the autonomy & self-initiated measures by a State have more chances to be effective & enforceable than soft law measures of outside regimes.
- ❖ However, in both systems, the legislations should avoid vague administrative terms and specifically account for scientific analyses, hydro-geomorphology, river drainage and irrigation patterns, volumetric and base flow, adjoining riverine buffer zones, replenishment & ground water recharge rates, etc.

- ❖ Efforts must be made to subsidize the usage of replacements for natural sand like m-sand, treated fly ash or ash from incinerated solid waste, recycling of used concrete (where technically possible), etc., to reduce the demand volume.
- ❖ Stricter EIA methods have to be put in place irrespective of the area of mine, emphasizing on public consultation and participation processes.
- ❖ Provisions should be put in place to not only penalise the lease holders who violate the Environmental Clearance conditions and deteriorate ecologies, but those polluters shall be compelled to restore the natural balance whether the project proponent is government/private.
- ❖ Coordination should be achieved between national and local authorities in charge with monitoring the water and environment, specifically in relation to the river and river basin management plans, which should have also a focus on the anthropic activities impacting water and sediment dynamics.
- ❖ A stricter survey (based on the community/ civil society complaints, as well as on scientific studies) system should be made in order to monitor in real time the sand mining and illegal granulates transport.
- ❖ **Because it is high time the world realised that the ecology is more important than the economy!**

Feel Free to Ask Questions!

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