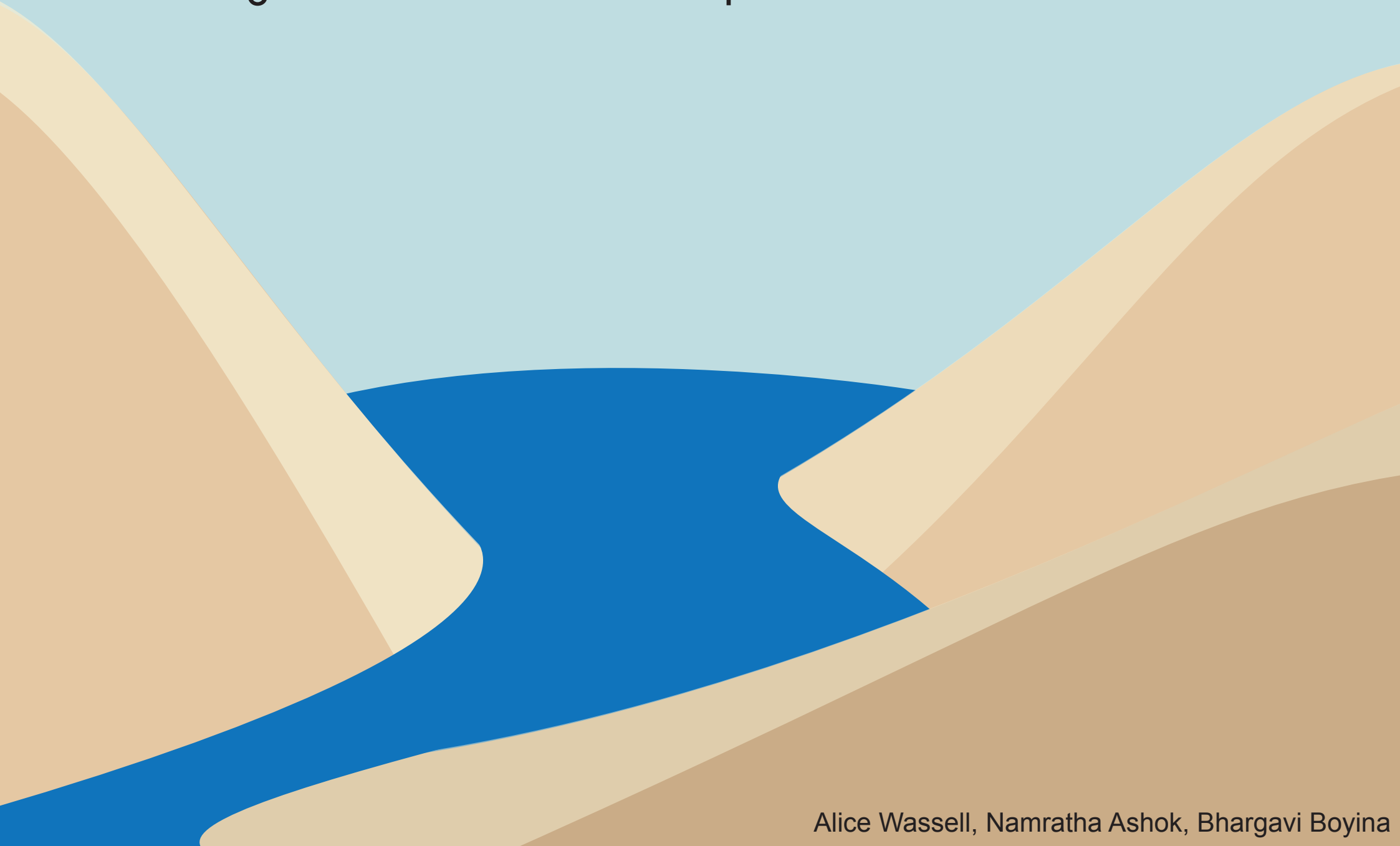


The Sand Crisis:

The Mining of Riverine and Floodplain Sand Within India.



Context

Sand is used in concrete, asphalt, glass, fracking, chemical production, cosmetics, land reclamation, and much more.

An estimated 50 billion tonnes of sand is extracted globally each year.

Sand shaped by wind is too smooth, the angular sand shaped by water is needed.

We are using double the amount of sand than what is estimated to be naturally produced per year

Urbanisation is a main driver of sand mining.

Sand is considered a common-pool resource, meaning in most places it is free for anyone to take.

Focus

We chose India as our country of focus as two of our group members live there. Sand mining, both legal and illegal, is prevalent in India.

We further narrowed our topic by focusing on the effects of riverine and floodplain sand mining, therefore excluding coastal and marine sand mining from our discussion.

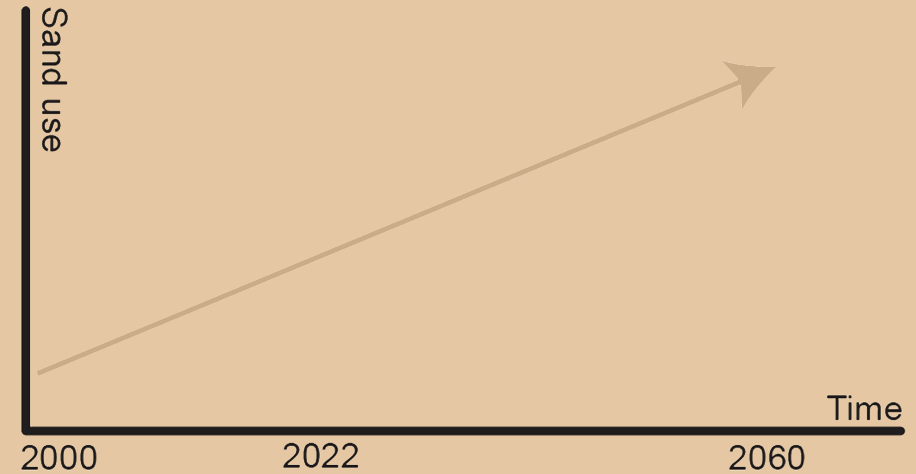
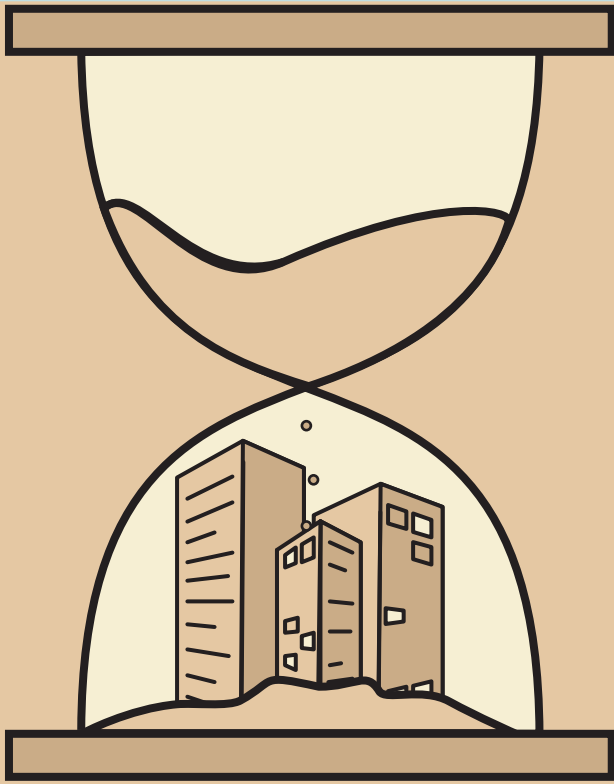


Change Over Time

Globally

Demand for sand worldwide is expected to double by 2060.

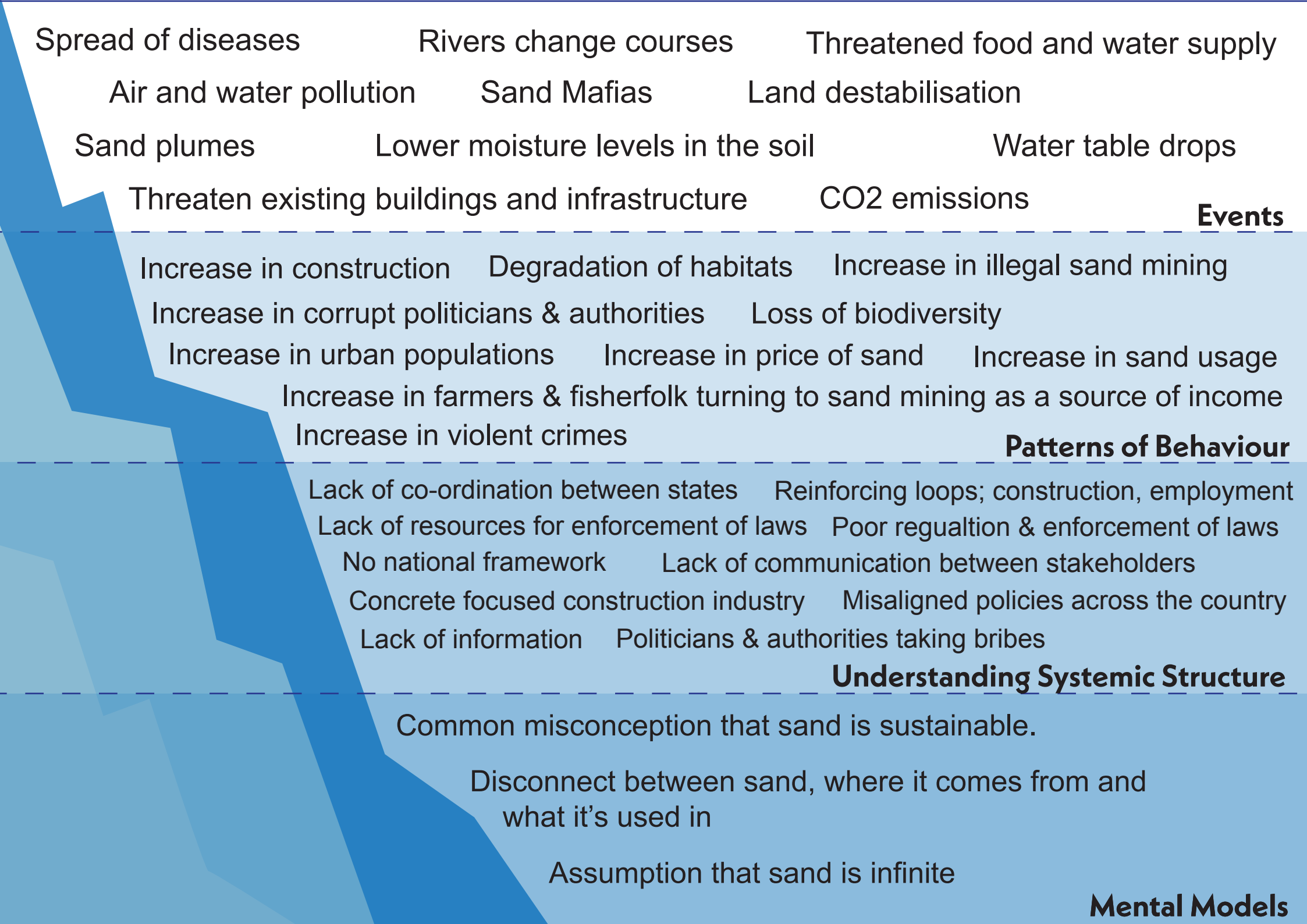
By 2050 it is expected that 68% of the world's population will live in urban areas.



In India

In 2017 the amount of construction sand used in India was estimated to be 700 million tonnes annually, increasing by 6-7% yearly.

Since 2000, the amount of construction sand used in India per year has tripled.



Spread of diseases

Rivers change courses

Threatened food and water supply

Air and water pollution

Sand Mafias

Land destabilisation

Sand plumes

Lower moisture levels in the soil

Water table drops

Threaten existing buildings and infrastructure

CO2 emissions

Events

Increase in construction

Degradation of habitats

Increase in illegal sand mining

Increase in corrupt politicians & authorities

Loss of biodiversity

Increase in urban populations

Increase in price of sand

Increase in sand usage

Increase in farmers & fisherfolk turning to sand mining as a source of income

Increase in violent crimes

Patterns of Behaviour

Lack of co-ordination between states

Reinforcing loops; construction, employment

Lack of resources for enforcement of laws

Poor regulation & enforcement of laws

No national framework

Lack of communication between stakeholders

Concrete focused construction industry

Misaligned policies across the country

Lack of information

Politicians & authorities taking bribes

Understanding Systemic Structure

Common misconception that sand is sustainable.

Disconnect between sand, where it comes from and what it's used in

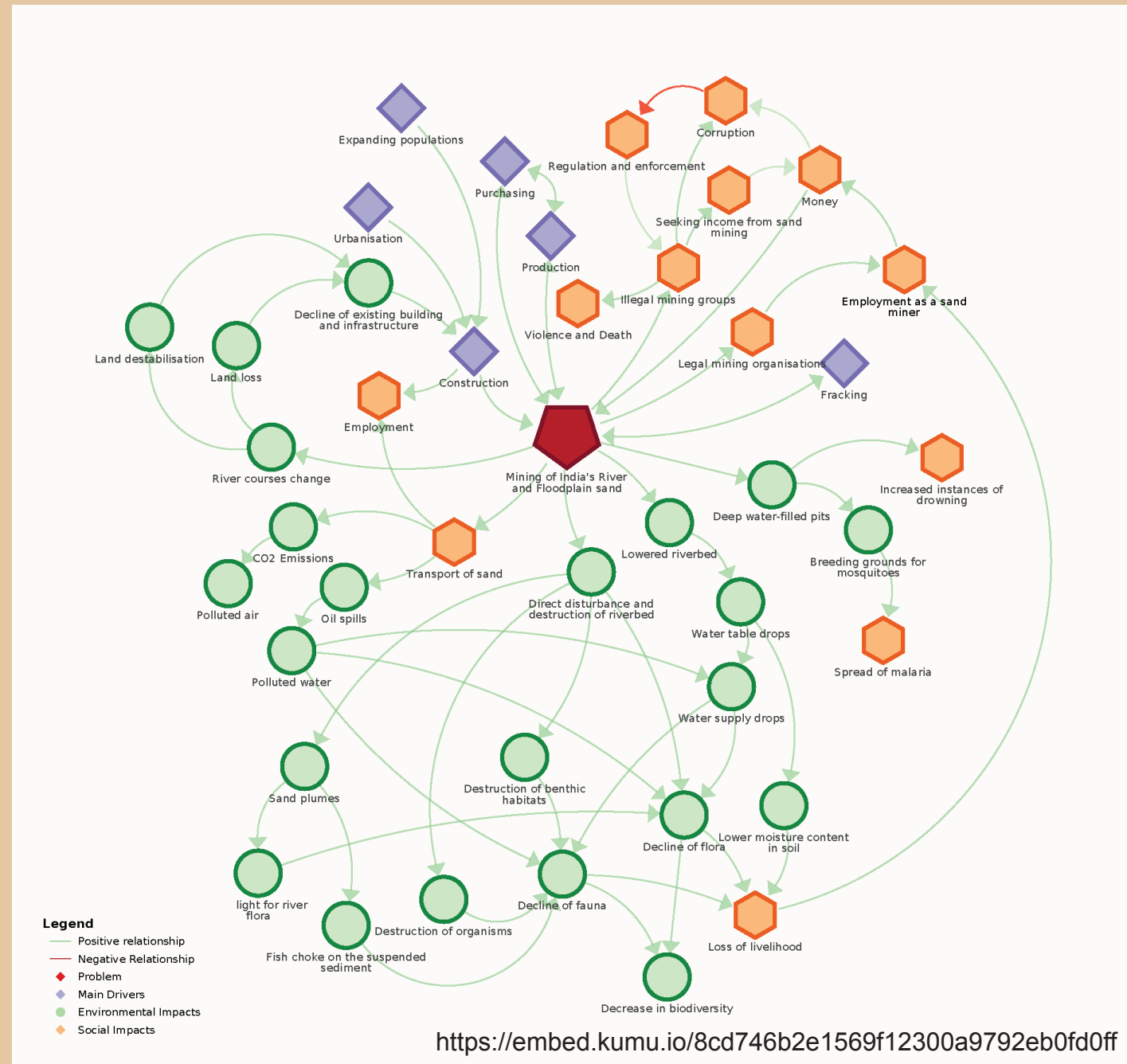
Assumption that sand is infinite

Mental Models

Causal Map

This map is an overview of the system. It includes the main drivers, and impacts of the mining of riverine and floodplain sand within India.

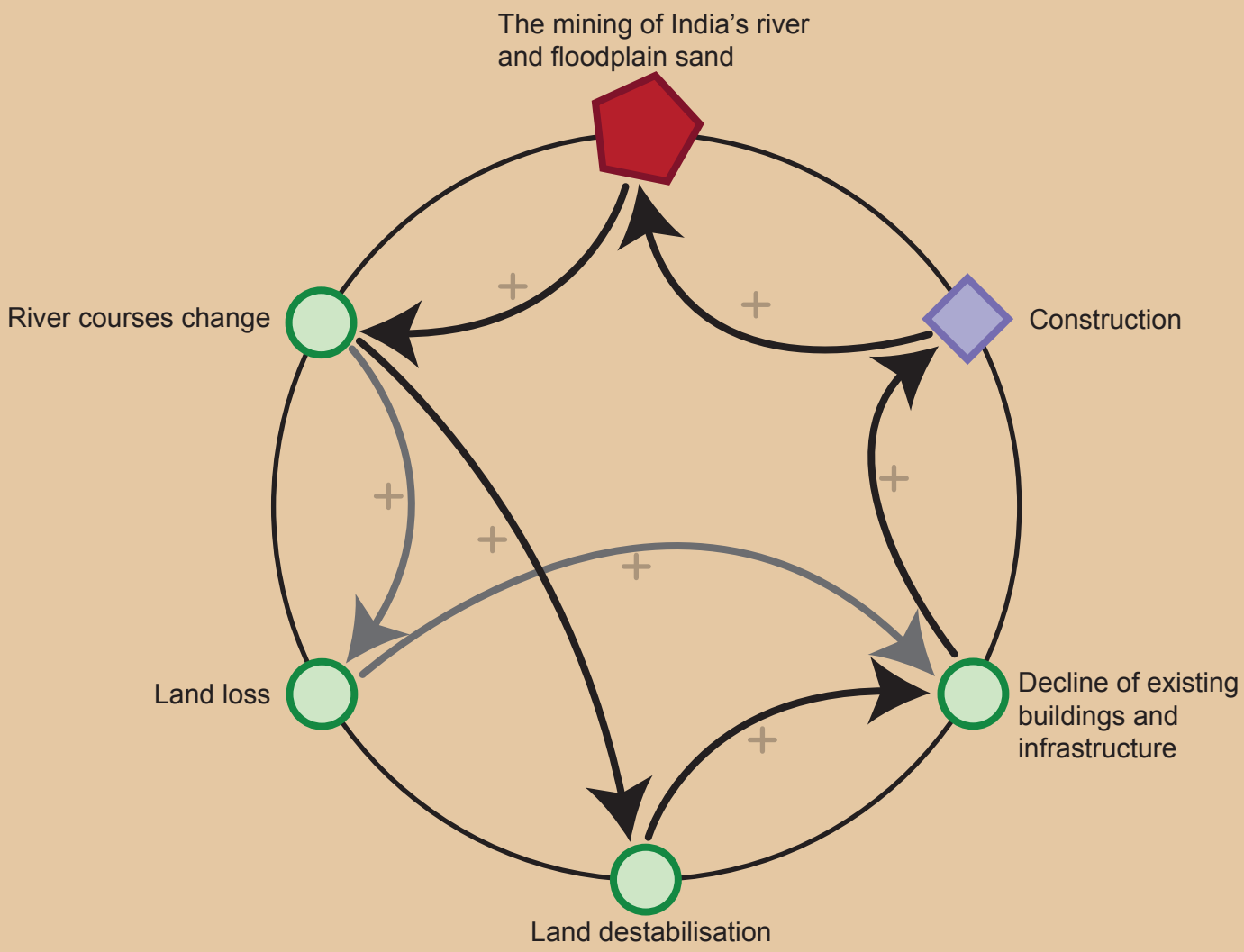
This map helped us identify feedback loops within the system.



Construction Loop

This connection circle shows the vicious cycle of how sand mining causes ecological damage that leads to the destruction of buildings and infrastructure that then requires rebuilding, thus completing the cycle.

This would be a good place to intervene within the system to reduce the need for sand for construction and rebuilding.



Livelihood Loop #1

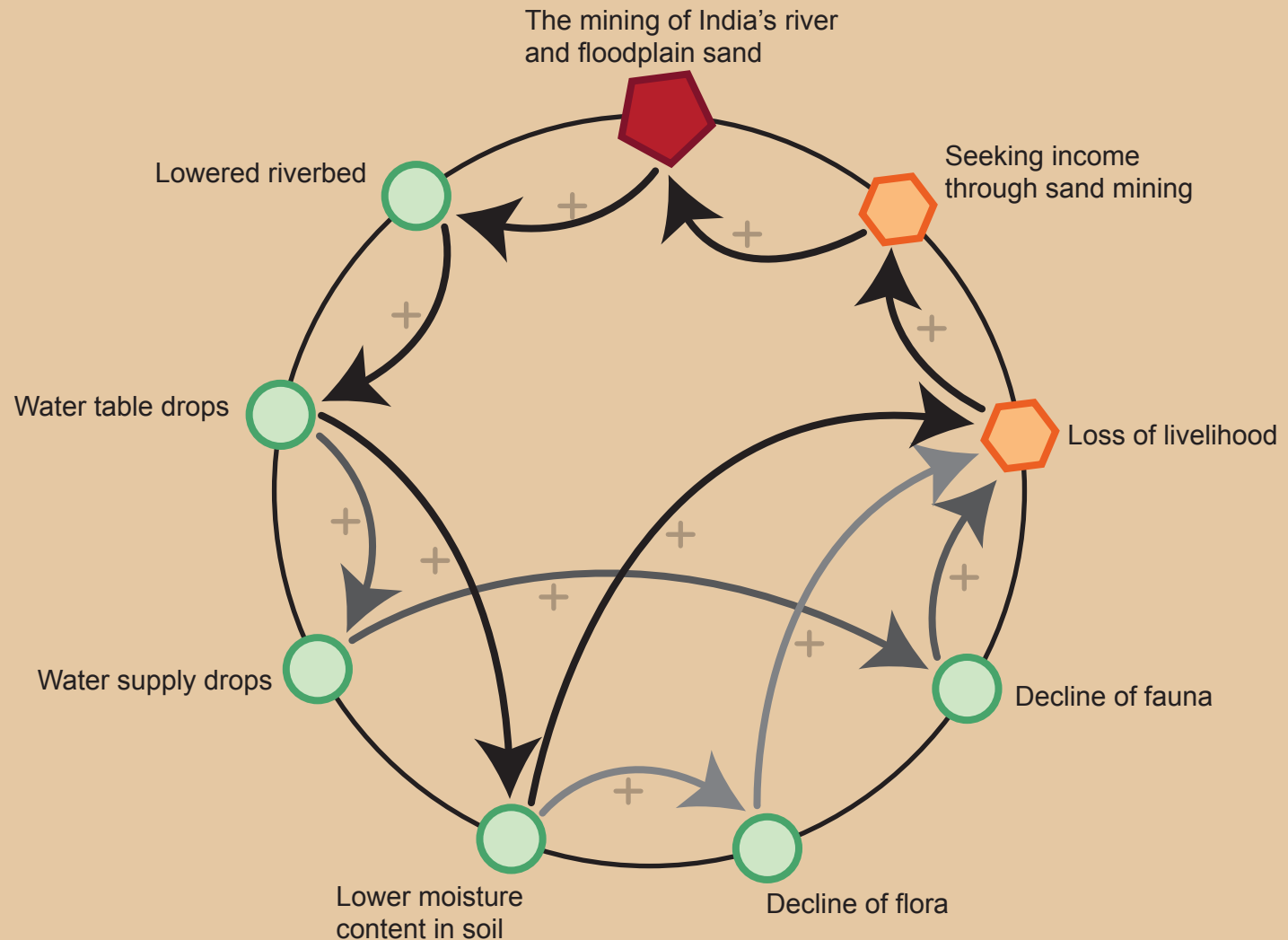
This connection circle illustrates the reinforcing loop that causes farmers to lose their livelihoods.

The environmental effects of sand mining cause the soil to become dry and harder to grow crops in, and water supply decreases meaning plant and animal life decline.

These farmers often turn to sand mining as their new source of income, thus increasing the rate of mining in the area and increasing the rate at which the land is made unsuitable for agriculture.

This not only affects the farmers themselves but also the people relying on the produce from the farm.

Intervening within this feedback loop would slow the growth of the sand mining industry within India.



Livelihood Loop #2

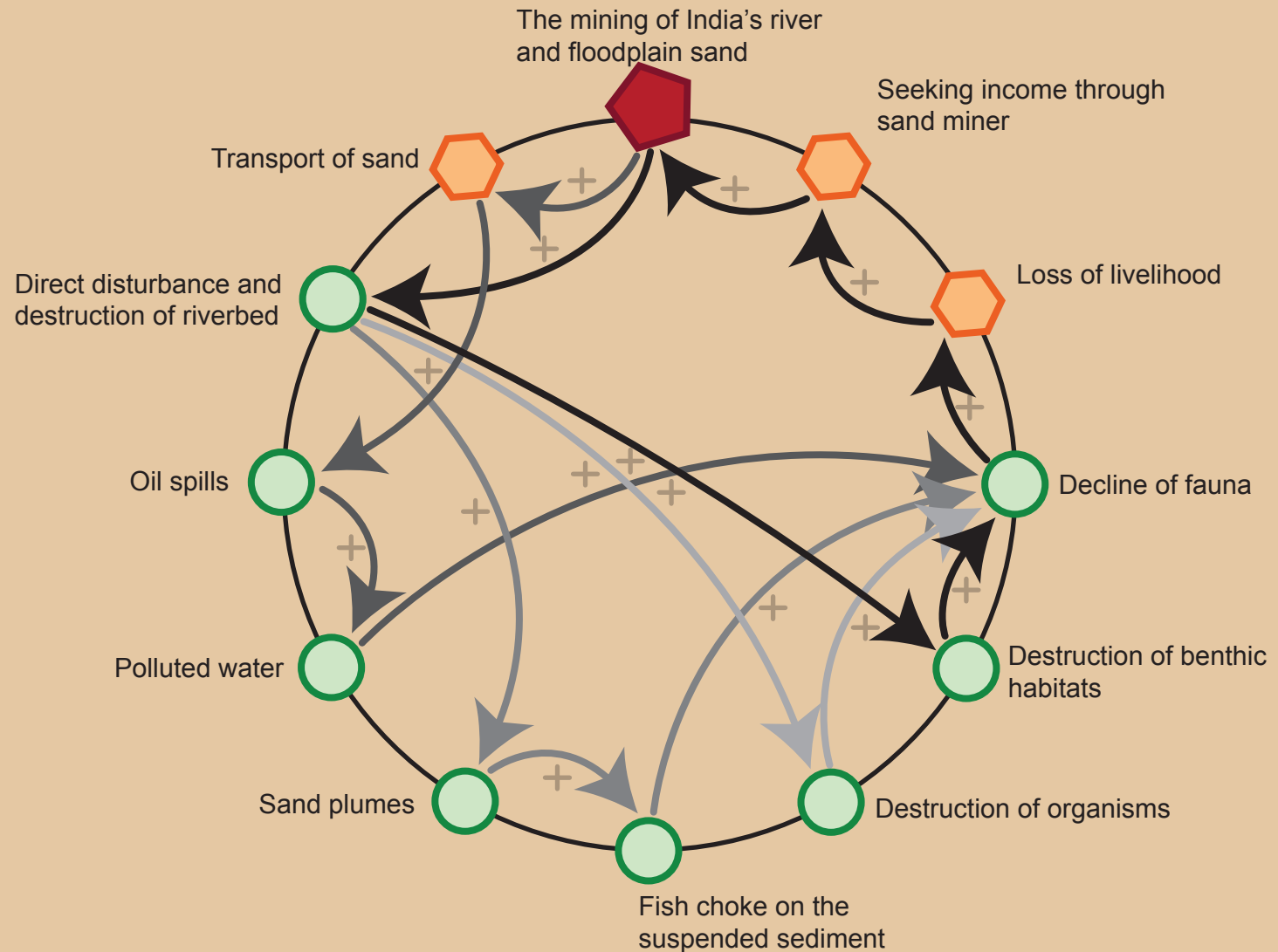
This connection circle illustrates the events that cause fisherfolk to lose their livelihoods.

The environmental effects of sand mining cause the number of fish in the rivers to decline, therefore causing the decline of the profession.

These fisherfolk often turn to sand mining as their new source of income, thus increasing the rate of mining in the area and increasing the rate at which the life in the river decreases.

This not only affects the fisherfolk themselves but also the people relying on the food they supply.

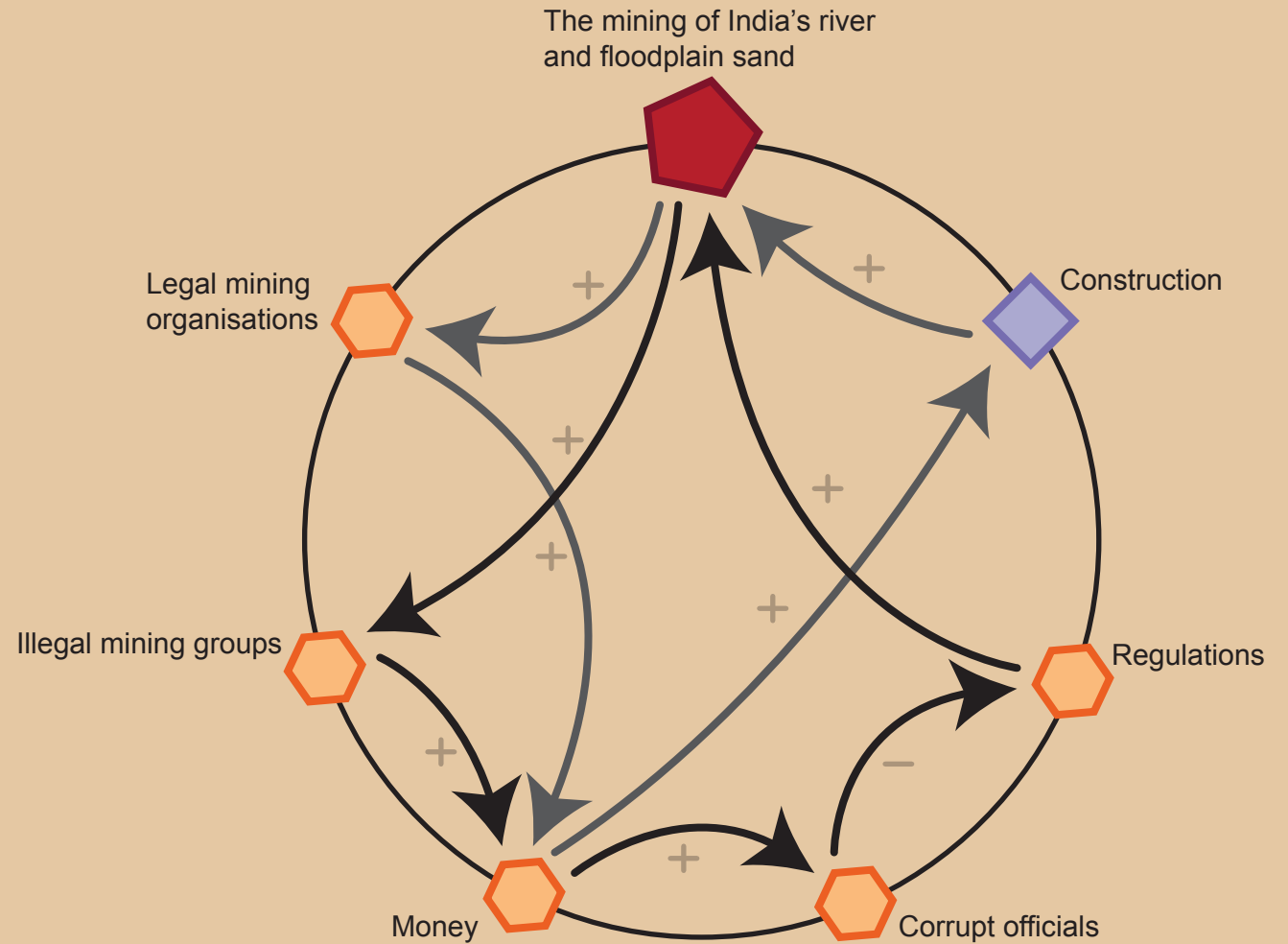
Intervening within this reinforcing feedback loop would slow the growth of the sand mining industry within India.



Corruption Loop

This reinforcing feedback loop shows how both legal and illegal sand mining operations crop up due to the high profits of the trade. It also shows how the high profits of illegal mining cause officials to turn a blind eye.

This would be a good place to intervene within the system. If sand mining were to become less profitable, possibly by introducing a tax on sand, then the number of sand mining groups would decrease and therefore the amount of sand mined would also decrease.

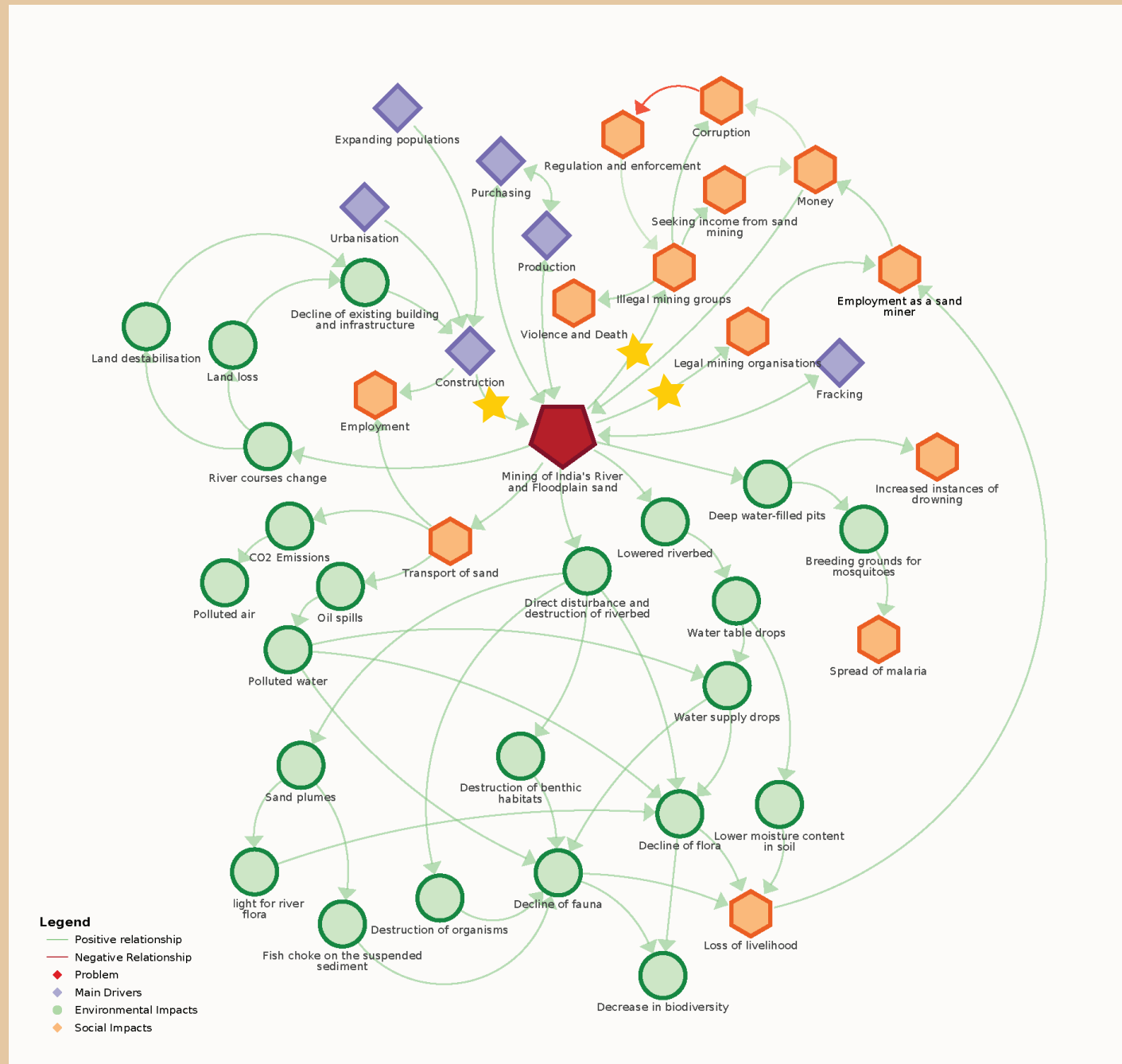


Solution Efforts

Currently there are two types of solutions being tried; those that limit the mining of sand and those that reduce the use of sand.

Within India the limiting method has been attempted by implementing new laws and regulations around sand mining. This hasn't reduced the amount of sand mining occurring due to the lack of resources to properly enforce these laws and also corruption within their police and politicians.

Outside of India there are attempts being made at reducing the use of sand. Zurich and Amsterdam have made goals to use less sand and be more circular in their resource use. Scientists are working on substitutes for sand within concrete, and more effective ways to recycle sand based materials.



Impact Gaps

Awareness

Lack of education about the crisis
Lack of awareness of alternative materials

Communication

Lack of communication between key stakeholders within the system
More communication could help reduce the amount of illegal sand mining by merely knowing where the sand we are using is coming from

Information

More research is needed so that we can fully understand the challenge
The more we understand about the system the more effective our solution efforts will be
Information about the effects of specific types of mining
Information about the amount extracted and amount replenished

Regulation

Regulation has been attempted
The real impact gap is resources for enforcement of regulations
The main reason law changes have failed is poor enforcement due to lack of resources

Restoration

Attempts to reverse environmental impacts are missing from the solution landscape
This wouldn't be a permanent solution but a way to subdue the impacts while action is taken in a more permanent way.

Levers of Change

Restoration

Events

Use less sand. Shift away from concrete use in construction or use a sand-substitute concrete.

Patterns of Behaviour

Increased communication and transparency

Global sand regulation entity

Understanding Systemic Structure

Education and awareness

Further research

Mental Models