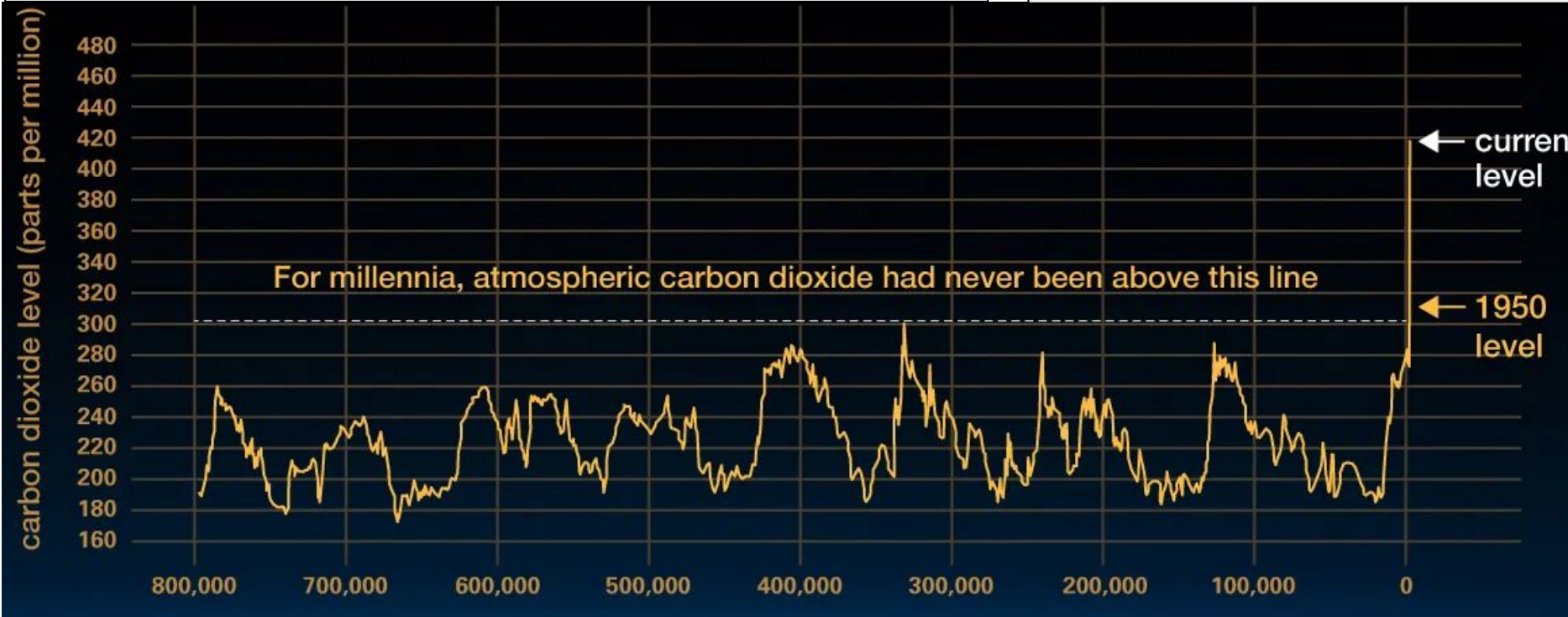
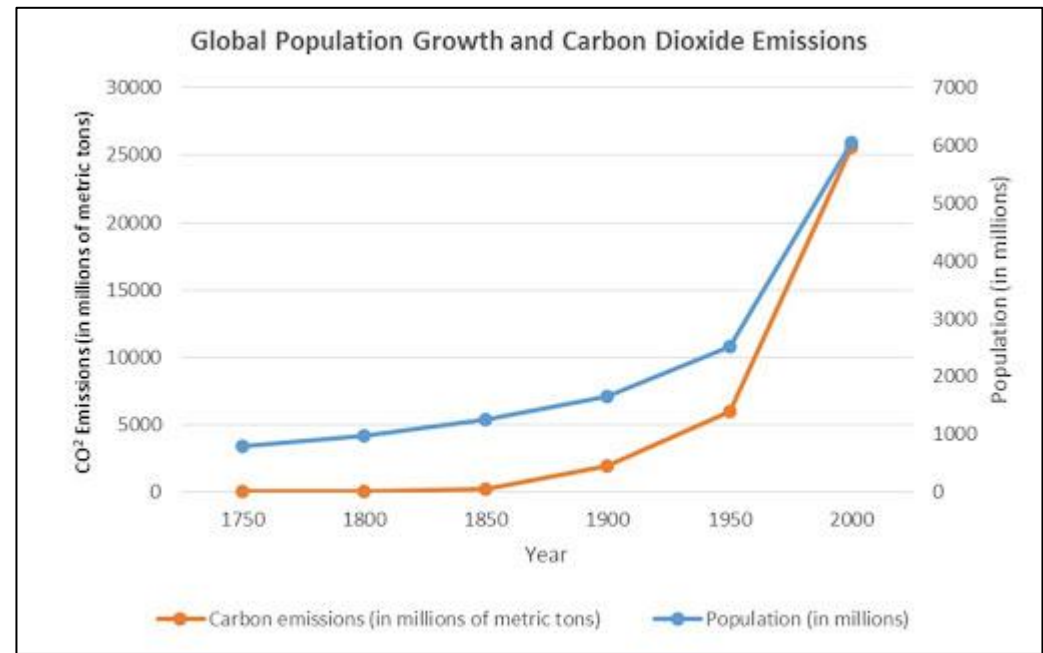
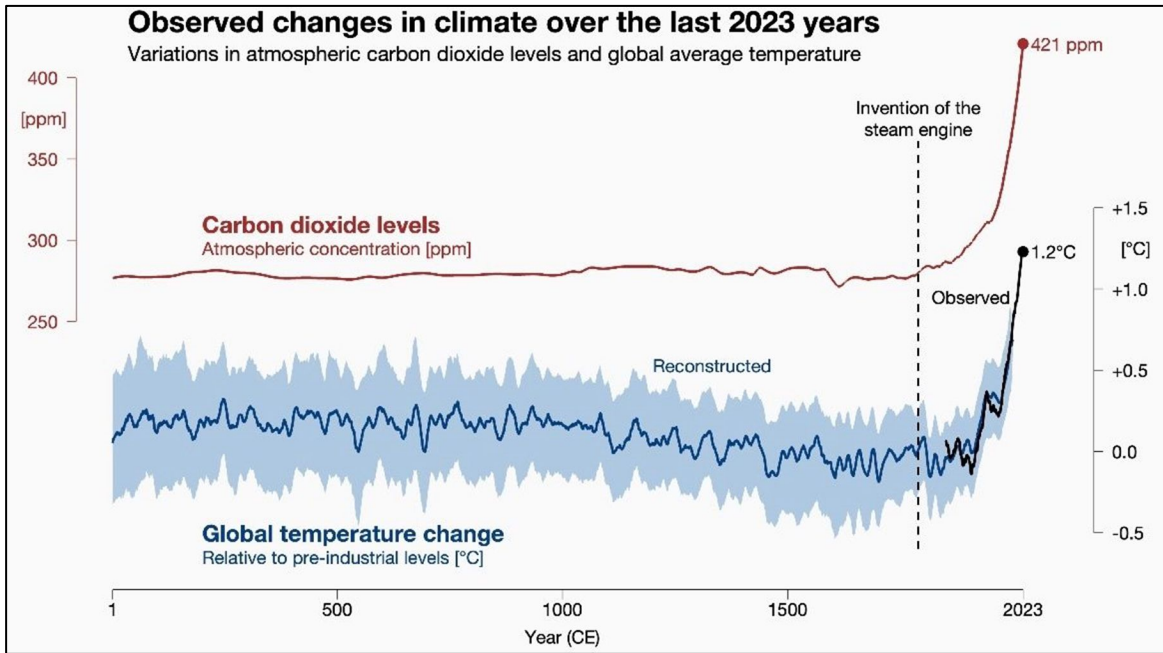
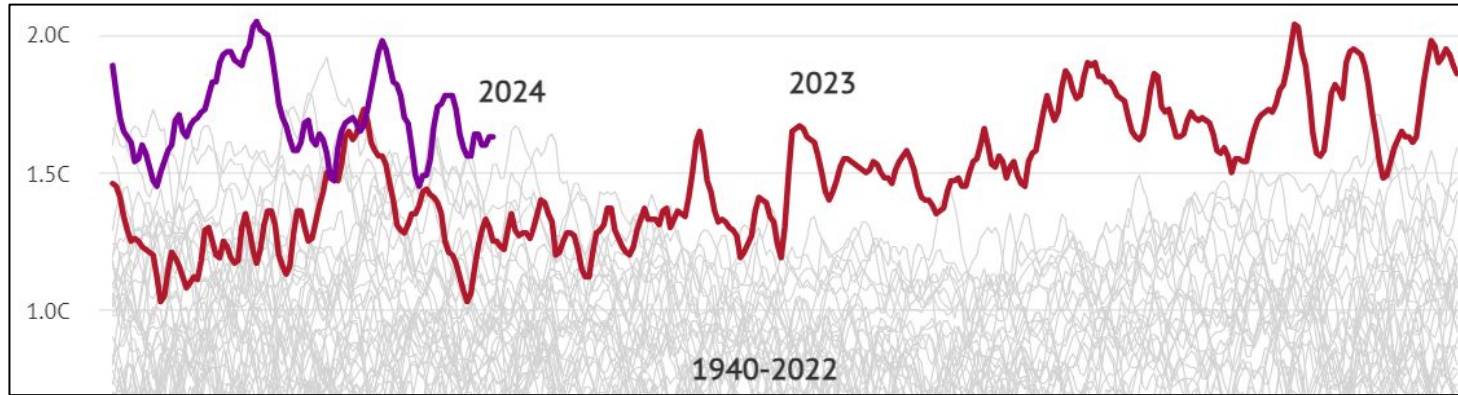


India's biogeochemical potential to feed the country and stabilize the climate

Dr. Ishfaq Ahmad Mir
Senior Geologist
Geological Survey of India
State Unit Karnataka and Goa
Bengaluru





Causes

- Rapid industrialization
- Energy use
- Agricultural practices
- Deforestation
- Consumer practices
- Livestock
- Transport
- Resource extraction
- Pollution



Effects

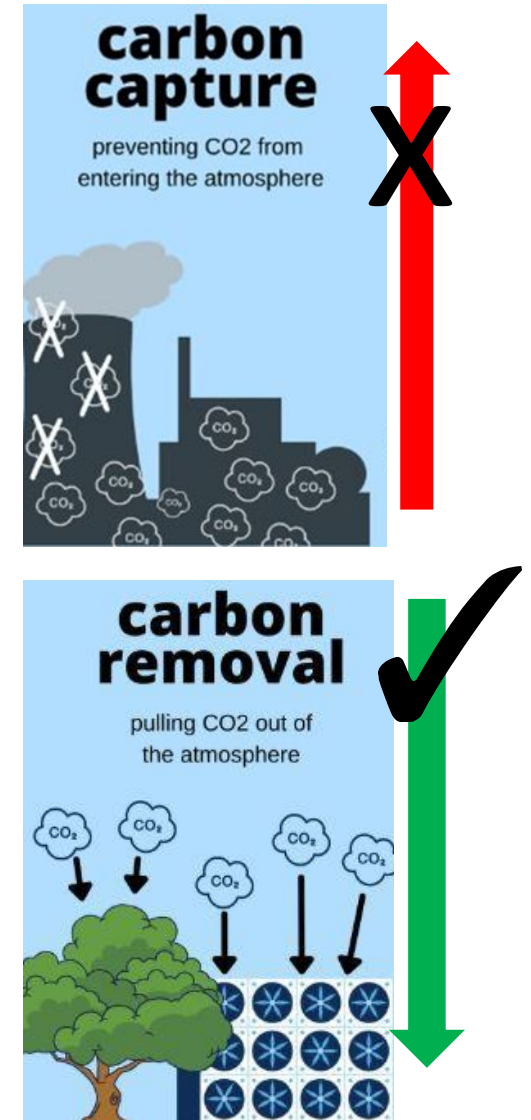
- Rising temperatures
- Rising sea levels
- Unpredictable weather patterns
- Increase in extreme weather events
- Land degradation
- Loss of wildlife and biodiversity

What are the social impacts of climate change?

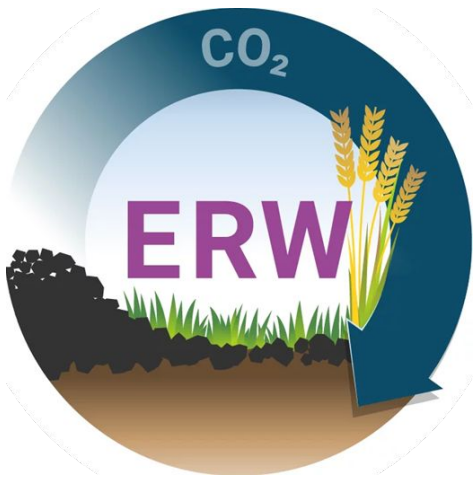
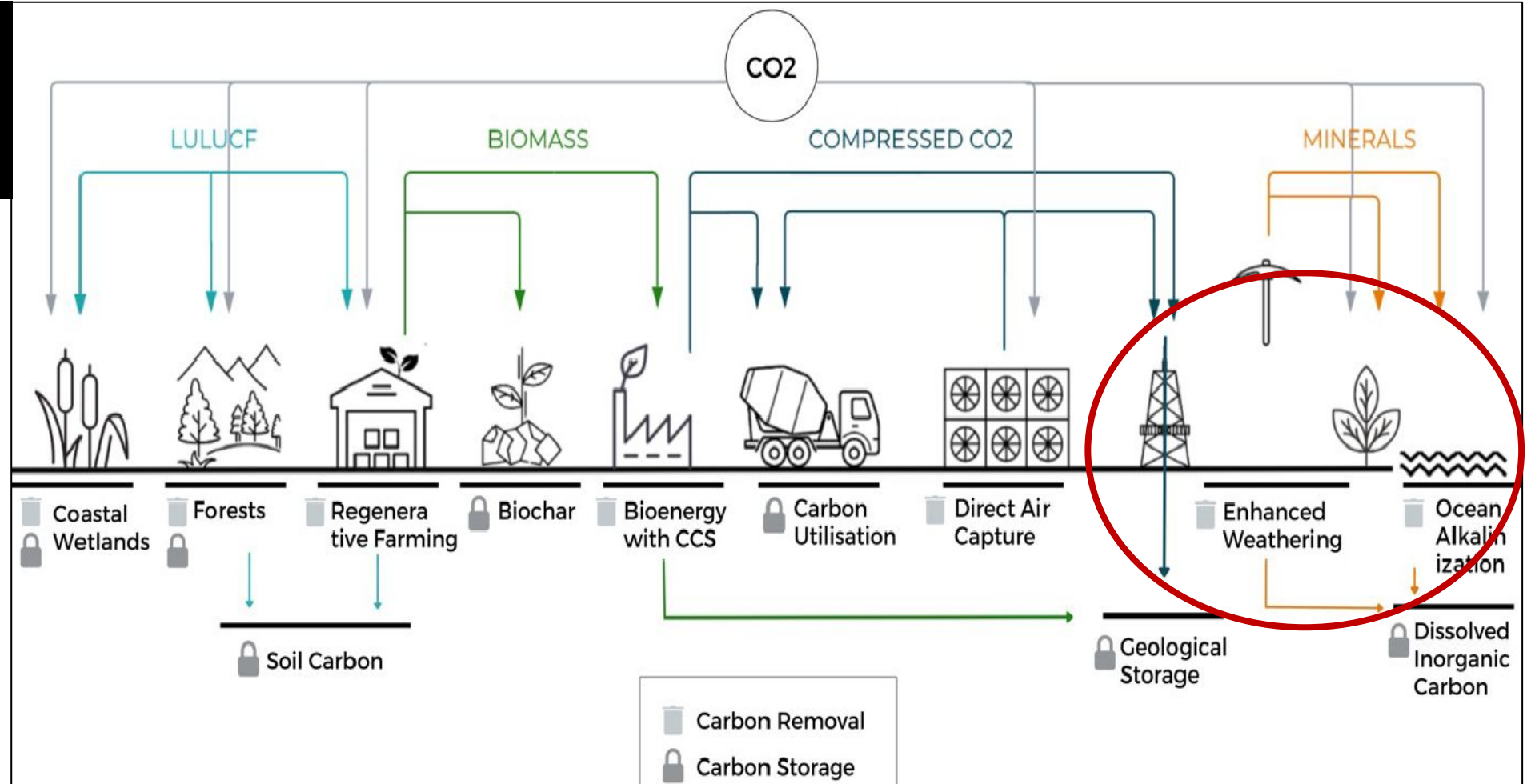
Displaced people. Poverty. Loss of livelihood. Hunger. Malnutrition. Increased risk of diseases. Global food and water shortages.

Is there any hope for better climate?

- In addition to reduction of emissions, CO₂ removal (CDR) is required at multi-gigatonne (Gt) annual scale by mid-century to meet the goals of the Paris Agreement and limit warming to 1.5 or even 2°C.
- Methods of CDR that offer meaningful co-benefits, and that can be delivered at significant scale in the coming years, with the potential for low cost, are of particular interest.



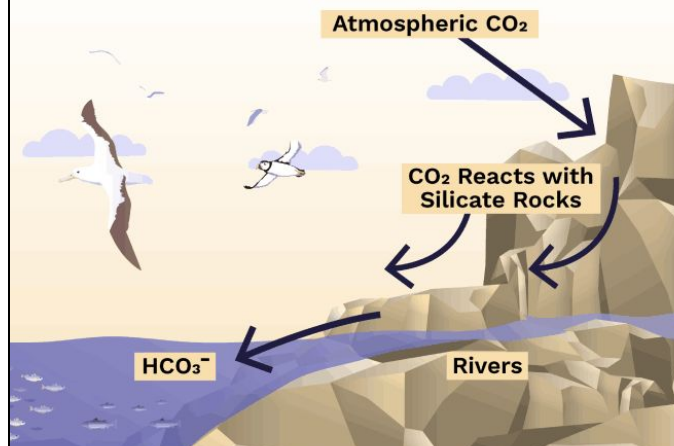
- CDR methods sequester CO₂ already in the air.
- CDR tech. removes 2 BT of CO₂ every year, it needs to rise to 8 BT if temperature rises are to be kept below the key threshold of 1.5°C



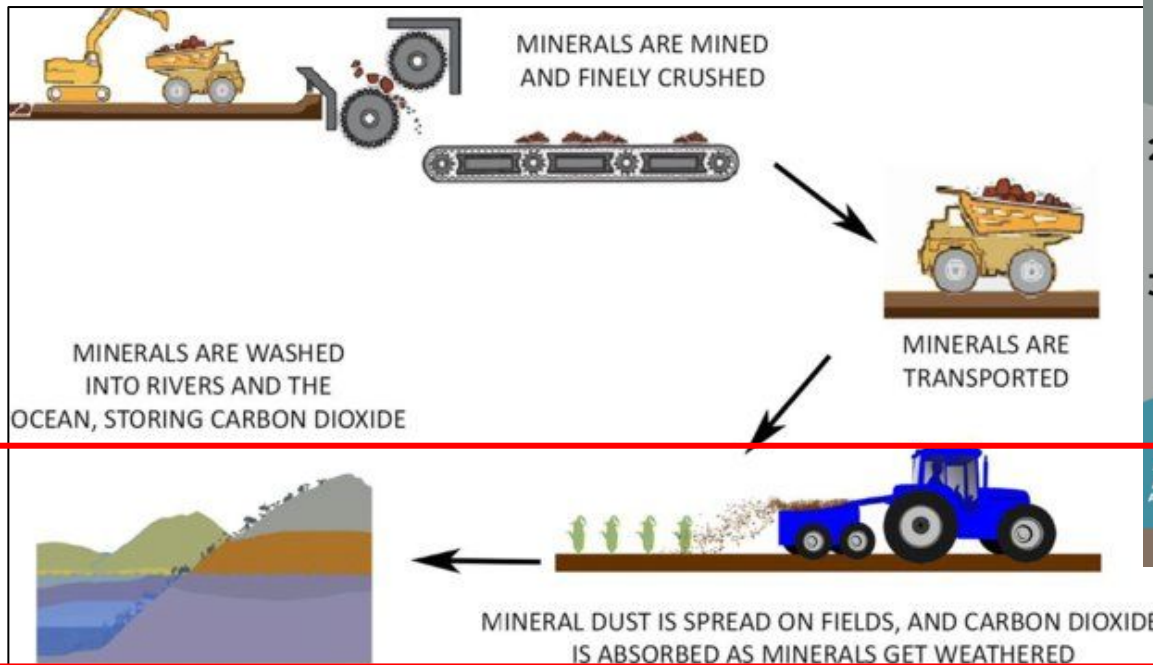
Durable Carbon Dioxide Removal in India: The Opportunity to Lead the World While Improving Agricultural Systems, Increasing Export Revenue and Generating Jobs, A White Paper for Indian Policy Makers December 2023

Geology can play a key role in addressing the climate emergency

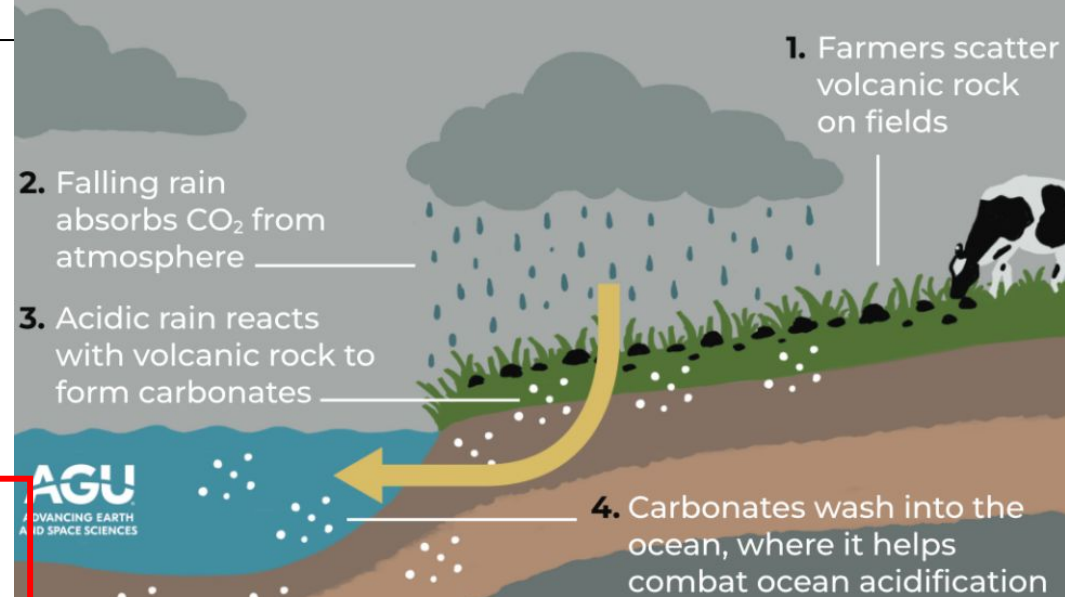
How weathering rocks capture CO₂ from the atmosphere

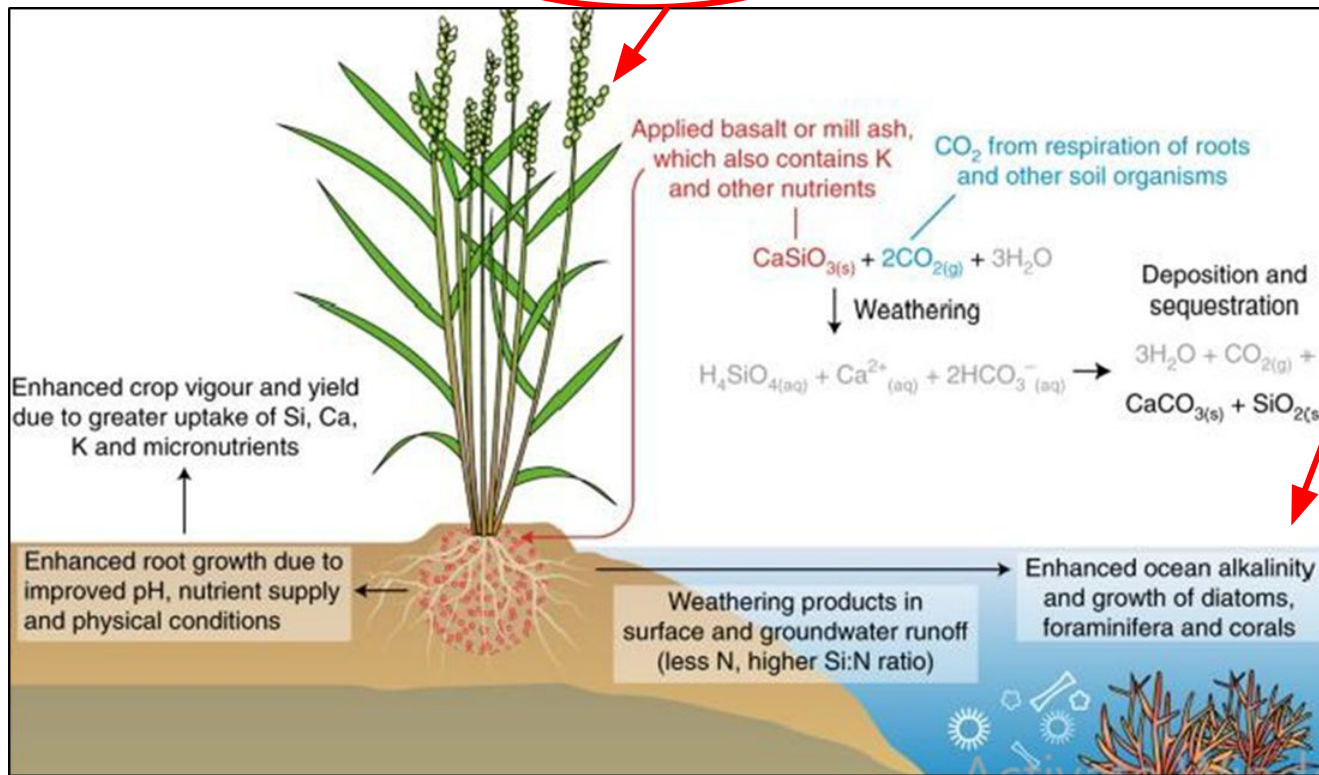
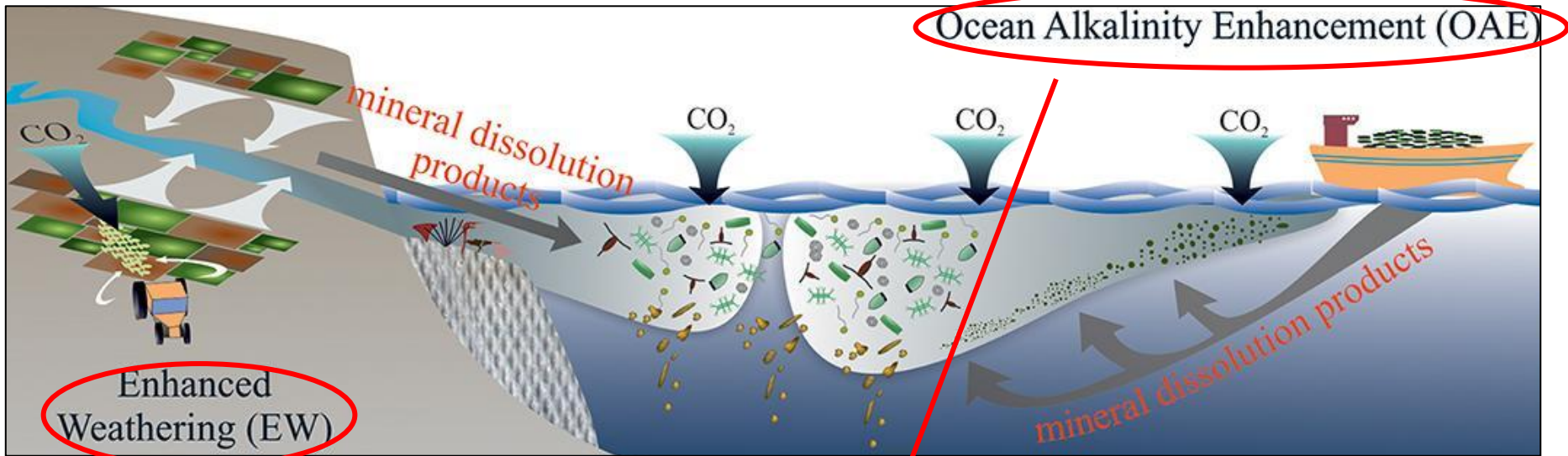


- For millions of years, CO₂ has combined with rain to form dilute acid - when this falls on lithosphere, CO₂ interacts with the rocks, mineralizes and is safely stored as carbonates.
- **Is it possible to accelerate weathering to remove CO₂ from air?**
- Yes.....Enhanced Rock Weathering
- Speed this process up so that, CO₂ can be locked away swiftly and at scale.



How enhanced rock weathering works





Benefits of remineralization in agro systems

- Slow release of nutrients, reduces fertilizers use
- Improves nutrient intake by plants, high yields
- Rebalances soil pH, builds humus, prevents soil erosion
- Increases resistance to disease, reduces pesticide use
- Scalability at low cost
- New income to farmers and miners
- Nutrition dense food, reduces medical expenses

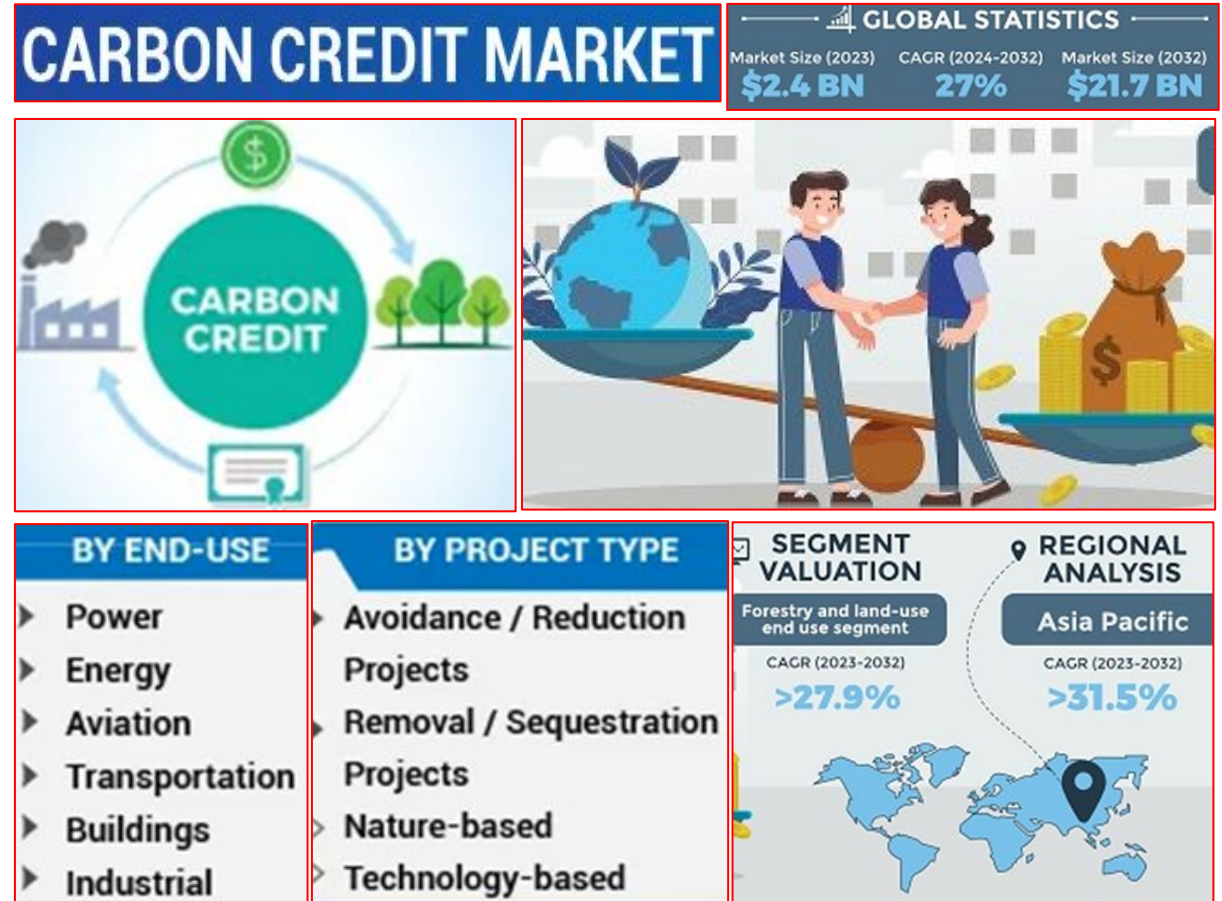
Benefits of remineralization in marine system

- Neutralizes ocean acidification
- Less fertilizer use at land prevents eutrophication
- Prevents thinning of marine organism shells
- Thriving coastal fishing zones
- Improves fisherman economy

Which type of rock dust is best?

Silicate rocks contain nutrients necessary for fertile soils.

CARBON REMOVAL

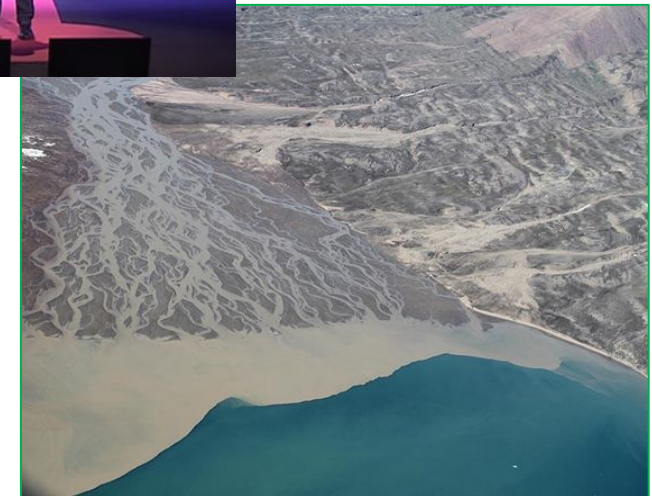
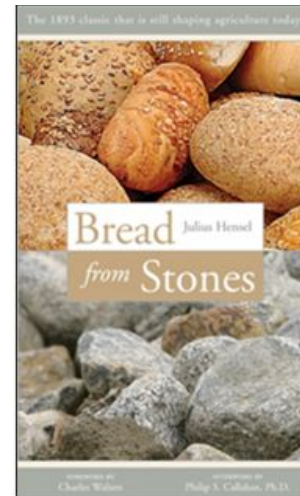
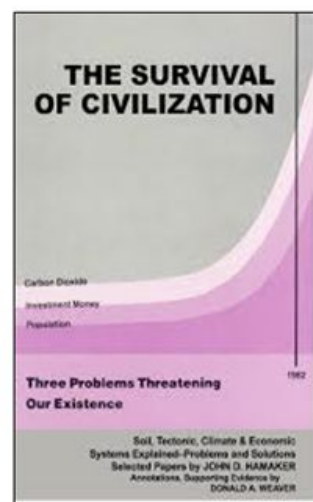
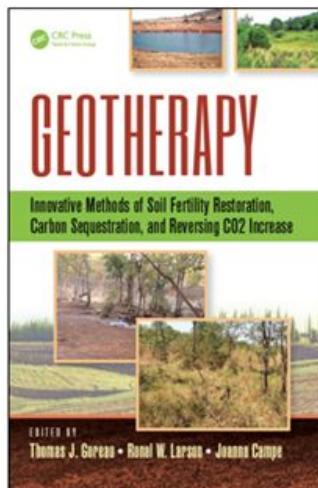
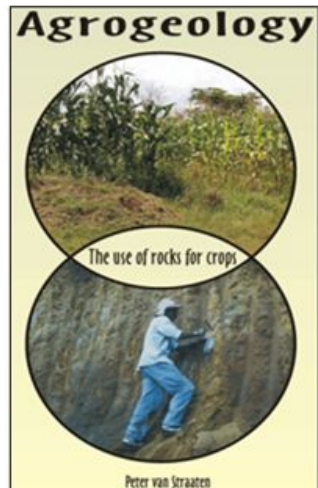


BACKED BY SCIENCE ?


Greenland's Glacial Mud Could Remineralize the Tropics

- Lal, R. 2004. Soil carbon sequestration impacts on global climate change and food security. *Science*, 304(5677), 1623–1627.
- Beerling et al., 2018. Farming with crops and rocks to address global climate, food and soil security. *Nature Plants*, doi.org/10.1038/s41477-018-0108-y
- Kantzas et al., 2021. Substantial carbon drawdown potential from ERW in the United Kingdom. *Nature Geoscience*, doi.org/10.1038/s41561-022-00925-2
- Goll et al., 2021. Potential CO2 removal from ERW by ecosystem responses to powdered rock. *Nature Geoscience*, 14(8), 545–549.
- We need to remineralize on a vast scale
- Remineralize the Deltas – De-acidify the Oceans
- Greenland's Perspective Initiative Partnership to create food security in the tropics

Professor Minik Rosing
University of Copenhagen
TEDX Cannes 09/11/16

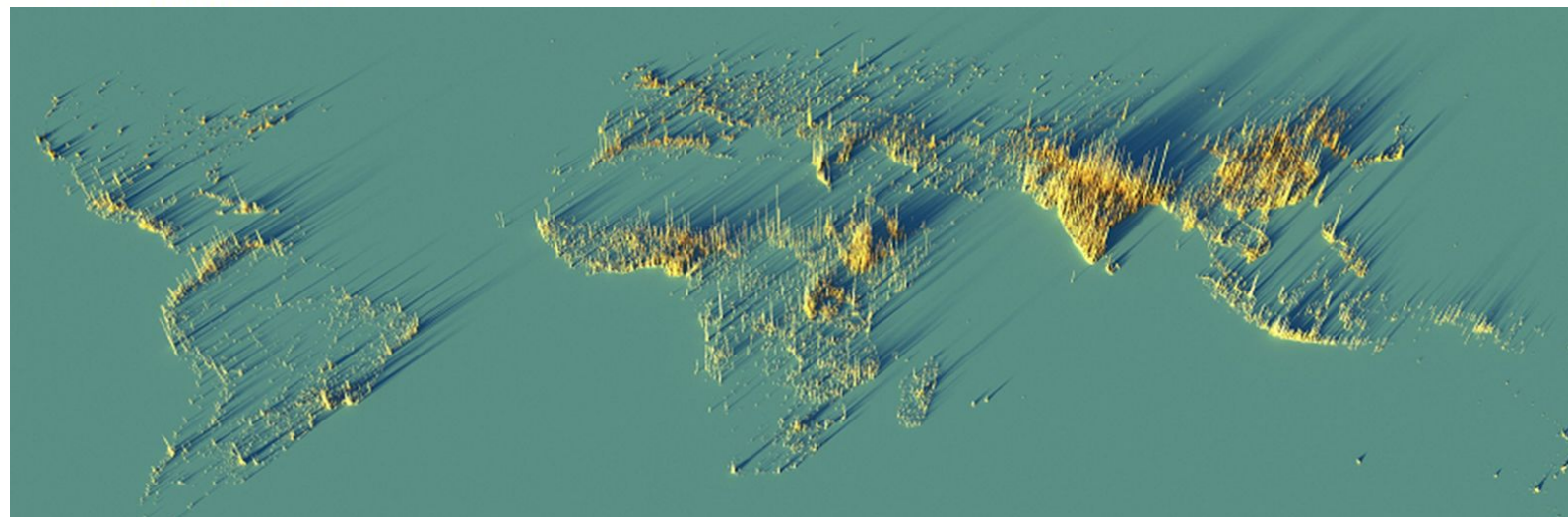
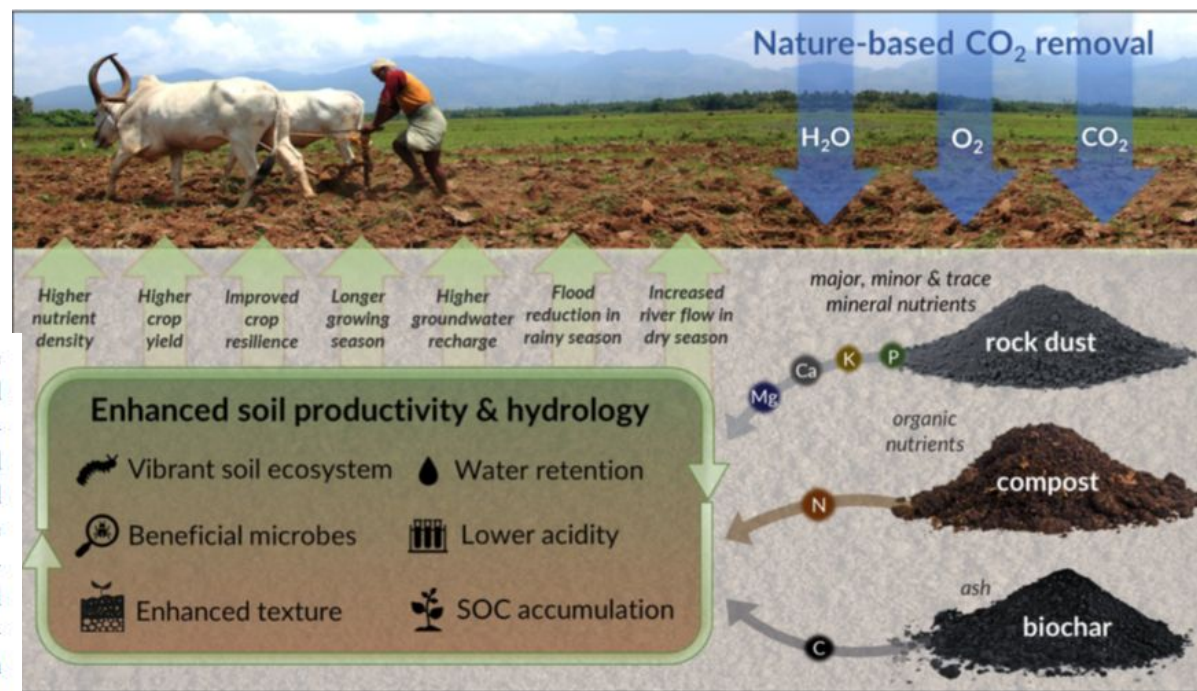


India's biogeochemical capacity to attain food security and remediate climate

Ishfaq Ahmad Mir , Thomas J. F. Goreau, Joanna Campe & James Jerden

Abstract In order to supply wholesome food and slow down climate change, this paper covers India's agrogeological resources. The soils are the result of the weathering of rocks with ages ranging from more than a billion years to the most recent Holocene. Because they are severely deficient in vital minerals, many soils have low agricultural production. In addition to helping to fertilise soils, reduce atmospheric carbon dioxide levels, and stop the acidification of the Indian Ocean, rock powder weathering and biochar have significant positive effects on the productivity of Indian soils. The nutrient density of food is also increased which improves health and lowers the demand for and cost of medical treatment. Remineralization may help to solve Indian soil issues including soil infertility and texture. To improve soil and plant nutrition, dusts of carbonate, basic, and ultrabasic rocks are readily available at mining sites in India combined with biochar. Adding different grain sizes to the soil helps improve the texture of the soil. Silicate

and carbonate rock powders enhance soil structure by promoting the creation of soil organic matter and fostering the growth of advantageous microbial communities. These processes offer a low-cost method of remineralizing soils with important macro- and micronutrients. For each significant soil/crop/climate system, an optimised application of India's rock powder resources must be determined through a national research and development programme. India's capacity to adapt to the mounting challenges of population expansion and climate change would be significantly improved by the findings of this study programme.

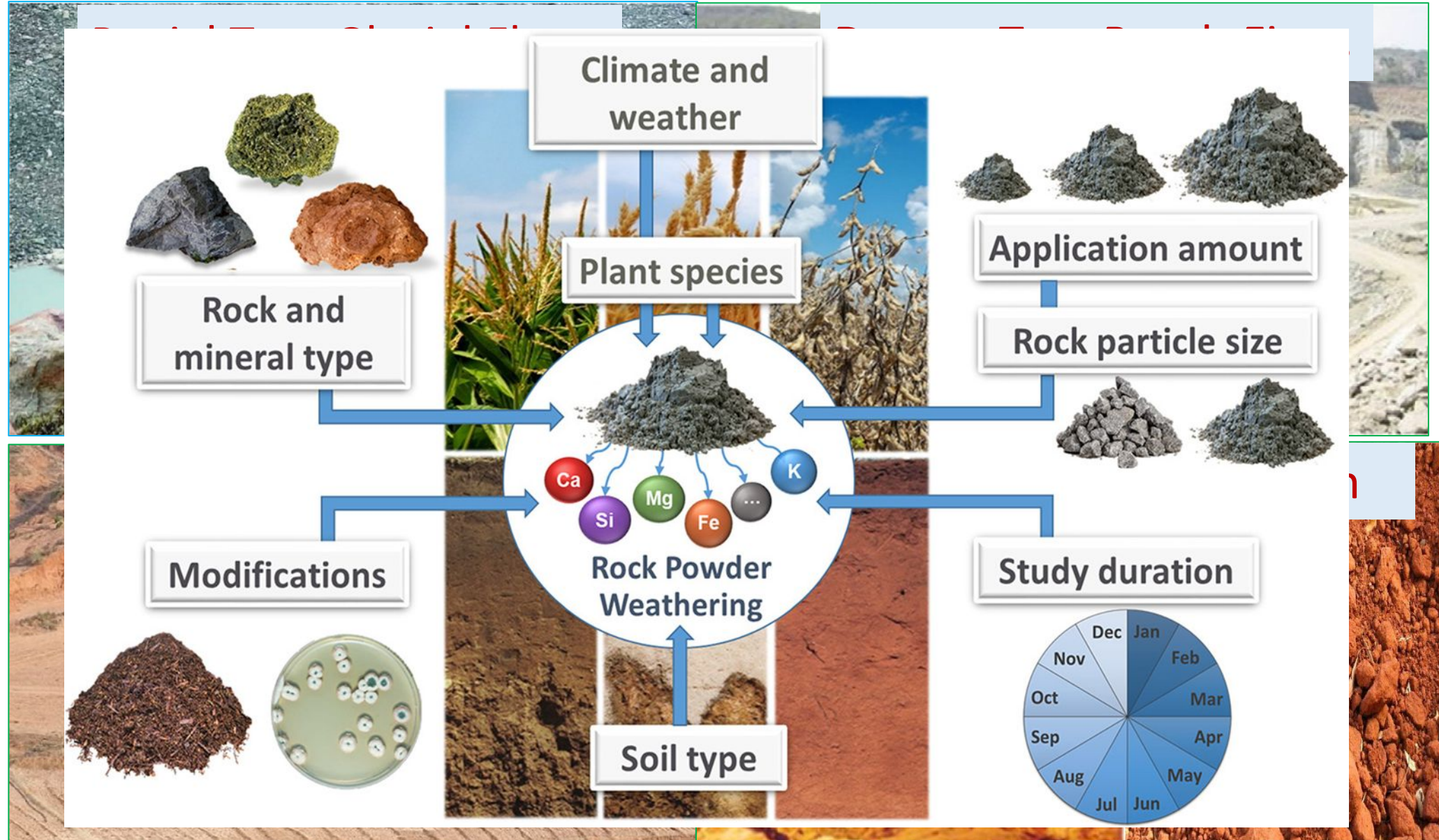




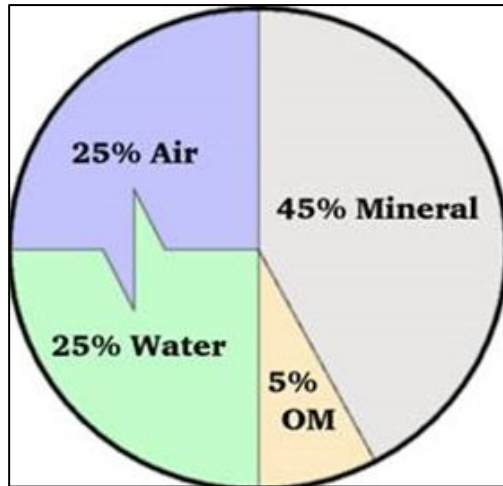
and Area

soil:
High Temp &
High in Iron
but low in
(, and Lime)

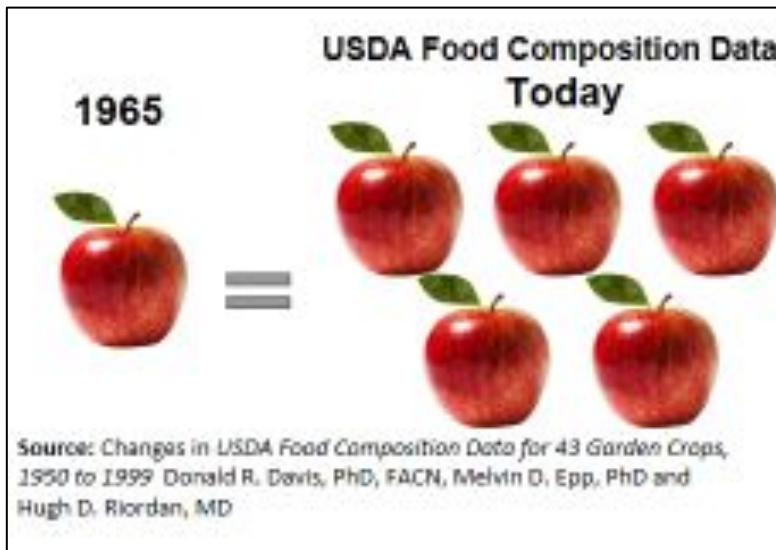
(mus, and Potash)



SOIL

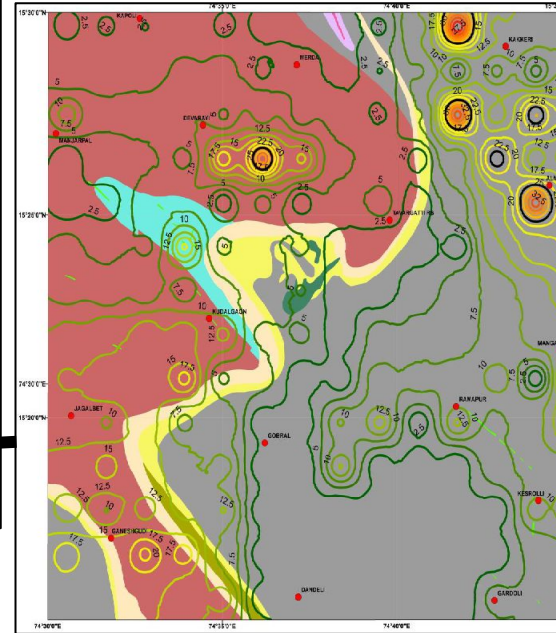
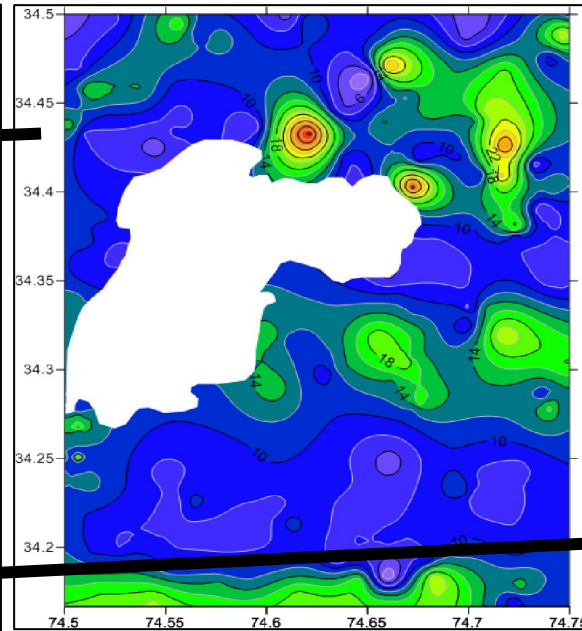
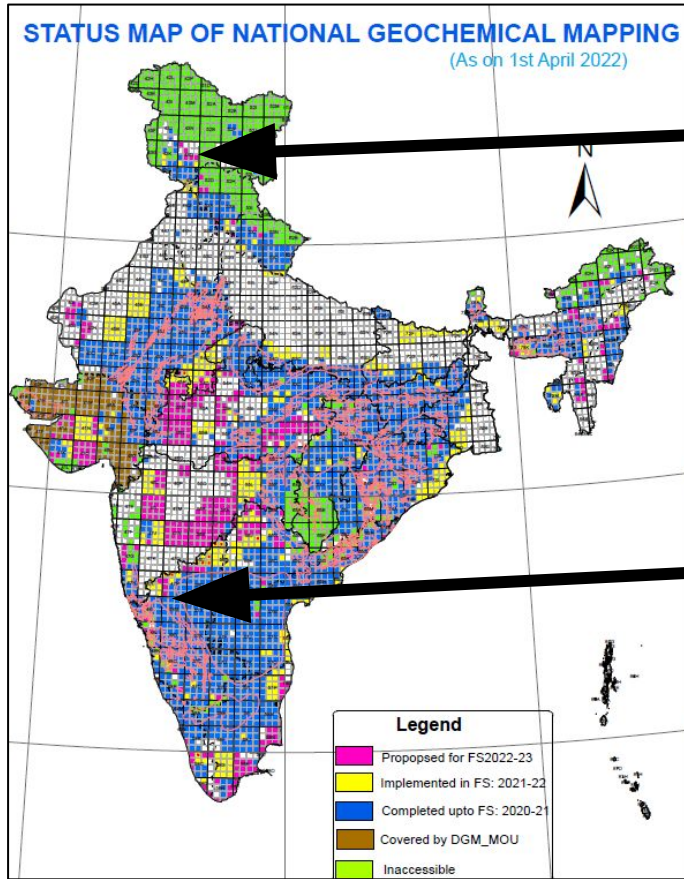


- Rock weathering produces soils. For corrective measures, documenting the element concentration and their variance is required.
- N, P, K very well studied, Ca, Mg, S, O, C, H; B, Cl, Cu, Fe, Mn, Mo, Ni, Zn and toxic elements from fertilizers and pesticides poorly studied.
- Many soils have significant levels of toxicity or deficiency, which results in low agricultural productivity.



- Healthy soils aid in the growth of healthy plants, reduce atmospheric CO₂ levels, and stabilize climate change. Food's nutritional value improves health and lowers the need for and cost of medical treatment.
- The mapping of nutrient-rich and nutrient-deficient soils, soil pH, and other soil parameters, as well as the identification of agro-mineral provinces that can be mined for enhancing the health of poor soils, particularly in tropical India, are all possible with the help of geochemical surveys.

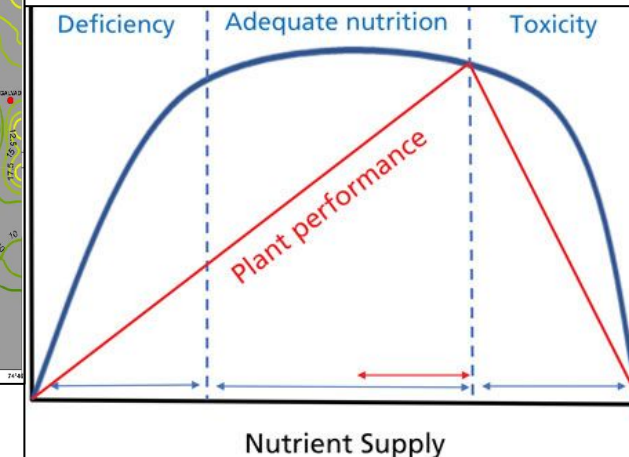
National Geochemical Mapping(NGCM) GSI, toposheet wise (64 elements)



NGCM in final stage,
What next?

PAN India elemental maps:

- Mineral Exploration
- Agriculture
- Environment
- Health
- Sustainability



Article

<https://doi.org/>
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Geosciences Journal

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scientific reports

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Distribution, sources and toxicity
of heavy metals in surface
sediments of north western
Karnataka, south India

Ishfaq Ahmad Mir^{1,2}, M. SreePrabash¹, V. Sridhar¹ & K. V. Maruthi²

J. Earth Syst. Sci. (2019)128 223
<https://doi.org/10.1007/s12040-019-1248-9>

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Geochemistry of surface sediments in parts
of Bandipora–Ganderbal areas, Kashmir valley, western
Himalaya: Implications for provenance and weathering

ISHFAQ AHMAD MIR^{1,*} and RIYAZ AHMAD MIR²

¹State Unit: Karnataka and Goa, Southern Region, Geological Survey of India, Bengaluru 560 111, India.

²State Unit: Jammu and Kashmir, Northern Region, Geological Survey of India, Srinagar 190 008, India.

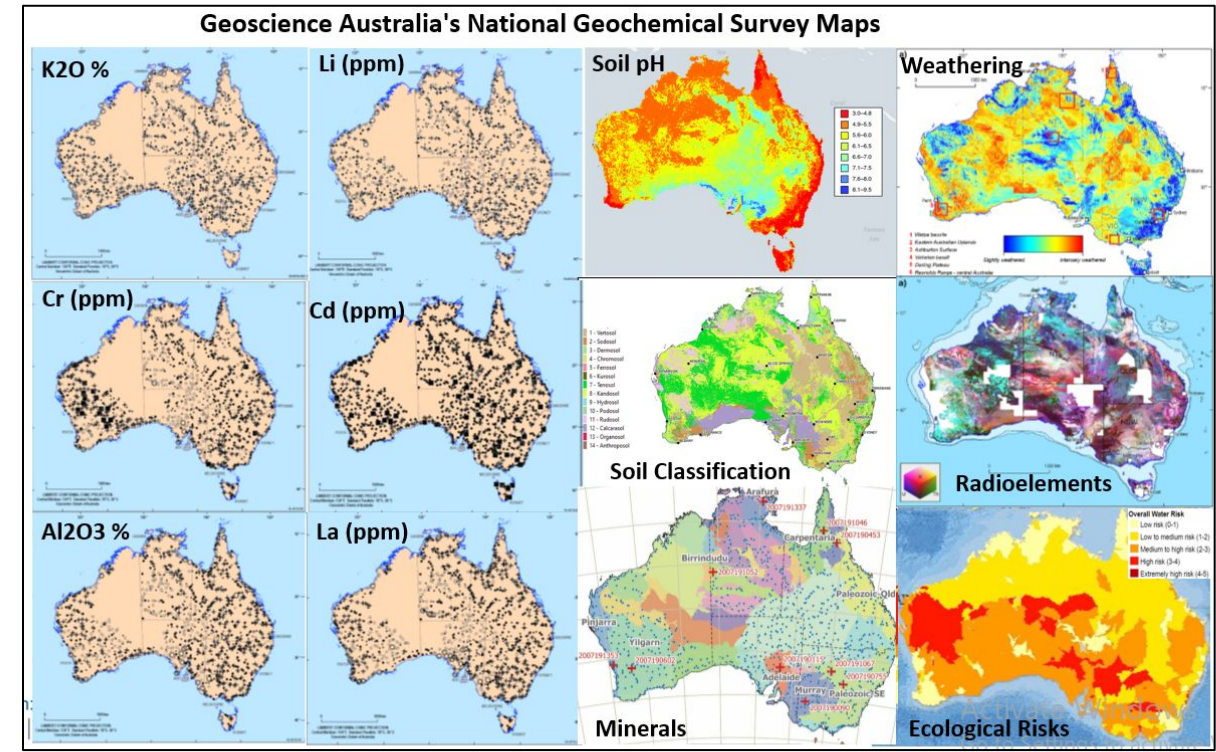
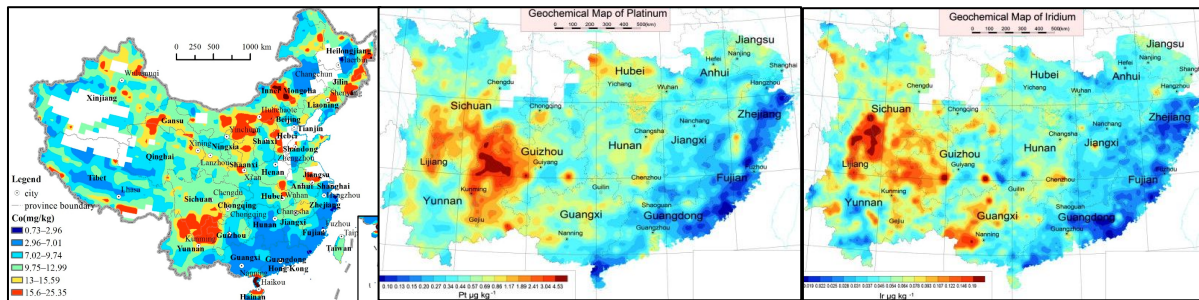
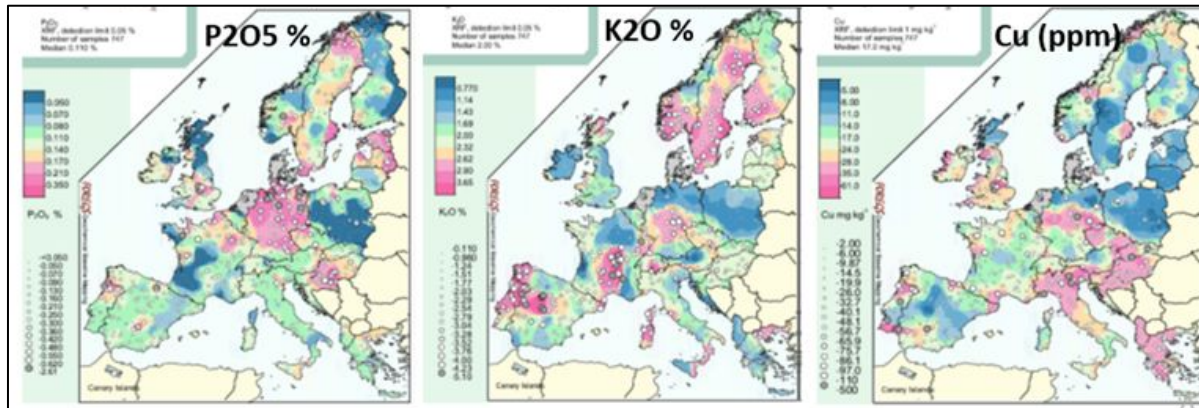
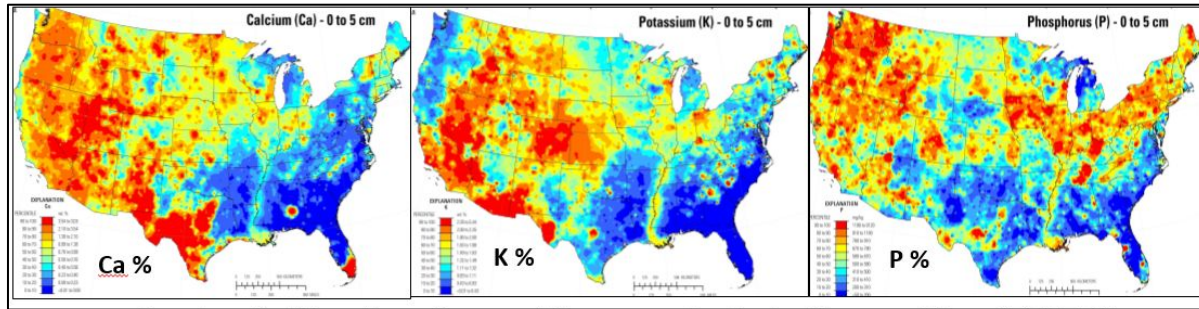
*Corresponding author. e-mail: geoishfaq@gmail.com

Surface sediment geochemistry for understanding the
recent sedimentary environment in northwestern Kar-
nataka, south India

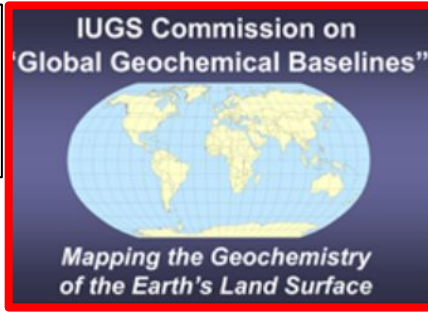
Ishfaq A. Mir^{1*}, Aijaz A. Bhat¹, M. Sreeprabash¹, V. Sridhar¹, and K.V. Maruthi²

PAN India maps shearing:

- Various Ministries
- State Govt's.
- Research Institutes/Universities
- NGOs working for health, environment, food, soils, water, sanitation.



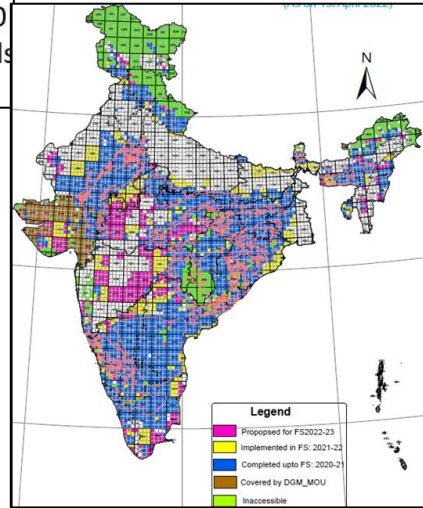
Chemical Earth like Google Earth



ONE EARTH • ONE FAMILY • ONE FUTURE

<https://www.globalgeochemicalbaselines.eu/>

- Global Terrestrial Network (GTN) Grid Cells of 160x160 km will cover the land part of Earth with 5700 grid cells
- NGCM is high resolution data (1x1/ 2x2)



PAN India maps benefit at global level

- UNDP/UNEP
- WHO/UNICEF
- WFP/FAO/IFAD
- UNESCO/UNIDO
- NGO's

- Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
- Sustainability goals, such as the 17 United Nations Sustainable Development Goals (SDGs), address key global challenges, and call for action by all countries.

- **Basalt:** Spreading 4 T of basalt sequester 1 T of CO₂.

We have Panjal, Deccan and Rajmahal Traps and Metabasalts.

- **Wollastonite:** Spreading 1.6 T of Wollastonite has the potential to sequester 1 T of CO₂.

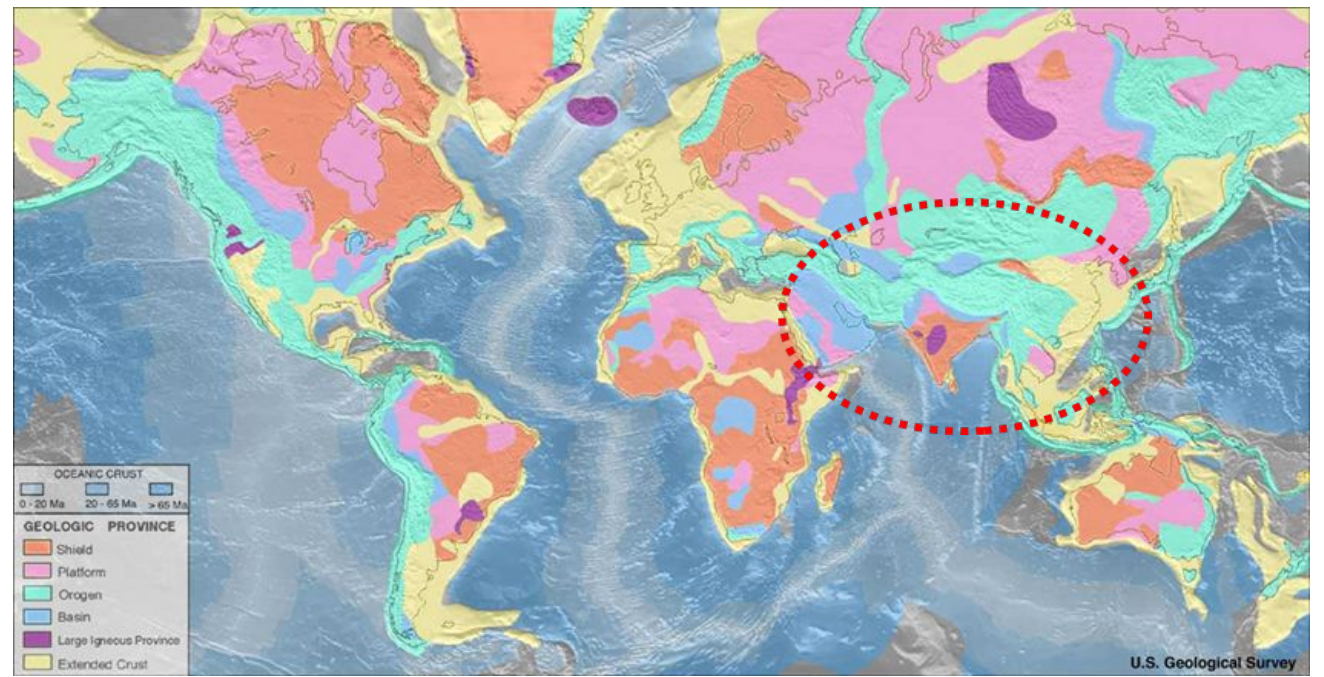
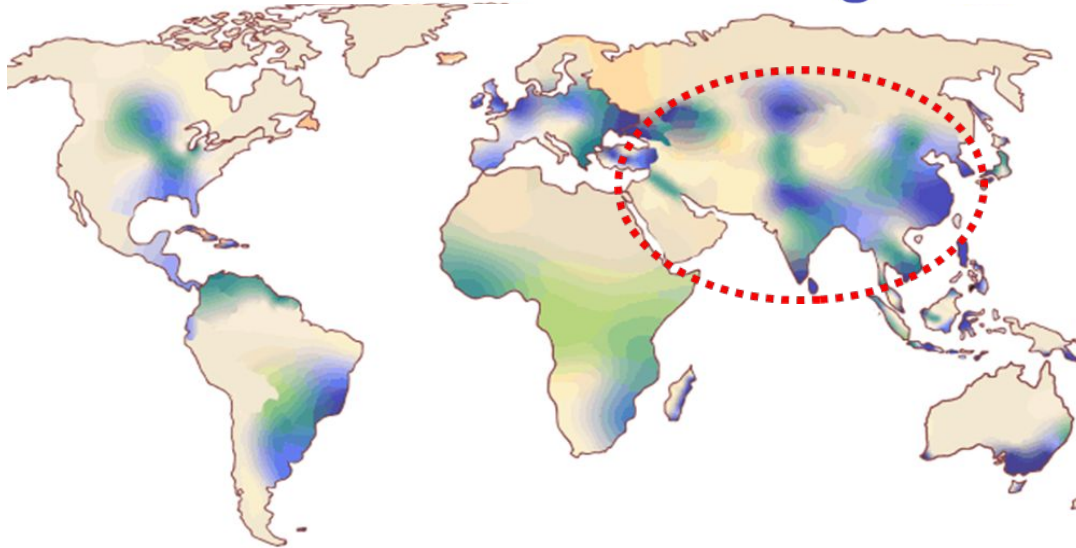
We have Wollastonite in Rajasthan, Gujarat and Tamil Nadu.

- **Carbonatite:** applied as fertilizer due to its high content of carbonate minerals and silicates. Good source for P, Ca, Mg.

We have Carbonatite in Gujarat, Karnataka and Meghalaya.

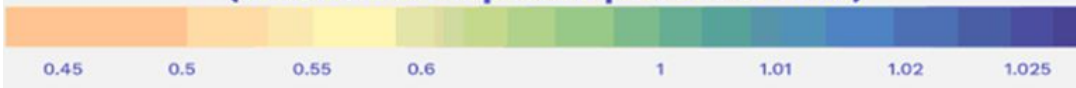
- For potassium **S type Granites**; silicates rich in K-feldspar, mica; illite.
- **Lake and river mud** especially in alkaline terrains are source for organic and inorganic nutrients
- Mine waste and selected mineral-based industrial waste.
- Use of enhanced rock weathering to remove CO₂ and naturally enhance soil health represents a potential win-win for farmers and climate.....Professor Yit Arn The, Newcastle University.
- ERW is a CO₂ removal technology attracting investment from Microsoft, Google, USAID, Oak Foundation, Pelorus Foundation .

Where can we carry out enhanced weathering?



U.S. Geological Survey

Effectiveness of enhanced weathering (tons of CO2 captured per ton of rock)

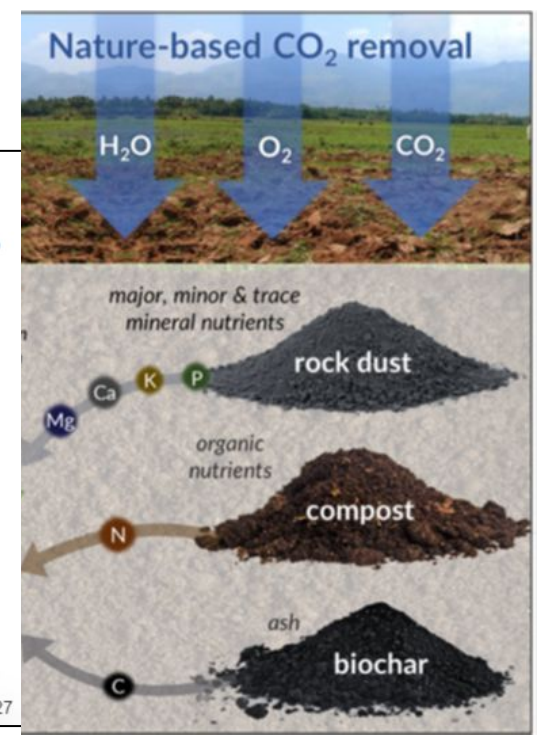
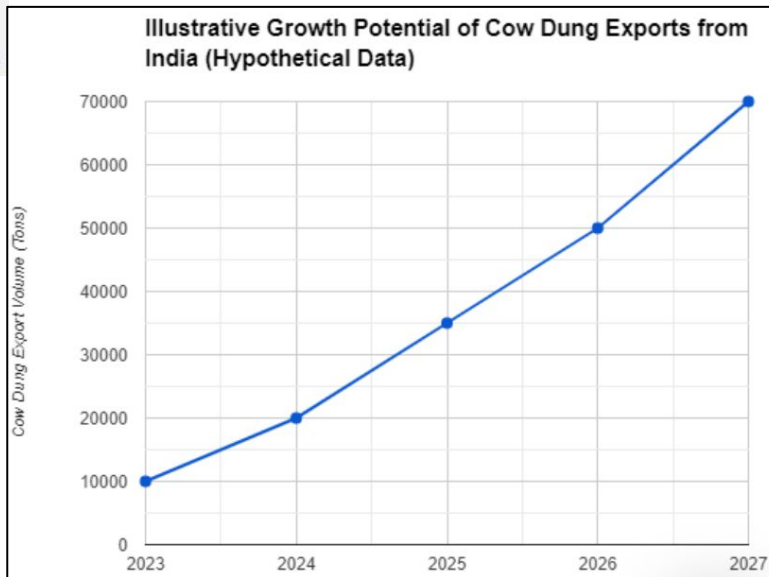


*Taking into account rock availability, processing facilities, transportation and climate conditions.

India set to export 192 metric tonnes of cow dung to Kuwait

Published on : 10:19 PM Jun 11, 2022

National President Organic Farmer Producer Association of India, Dr Atul Gupta told ETV Bharat that they have received an order of 192 metric tonnes of cow dung from Kuwait.



Is Brazilian model ideal for us?

- Brazil is the emerging leader for remineralization in the research and public policy arena.
- Brazil mentained fertilizer crisis due to Ukraine-Russia war with local rock powders.
- Laws Enacted in Congress

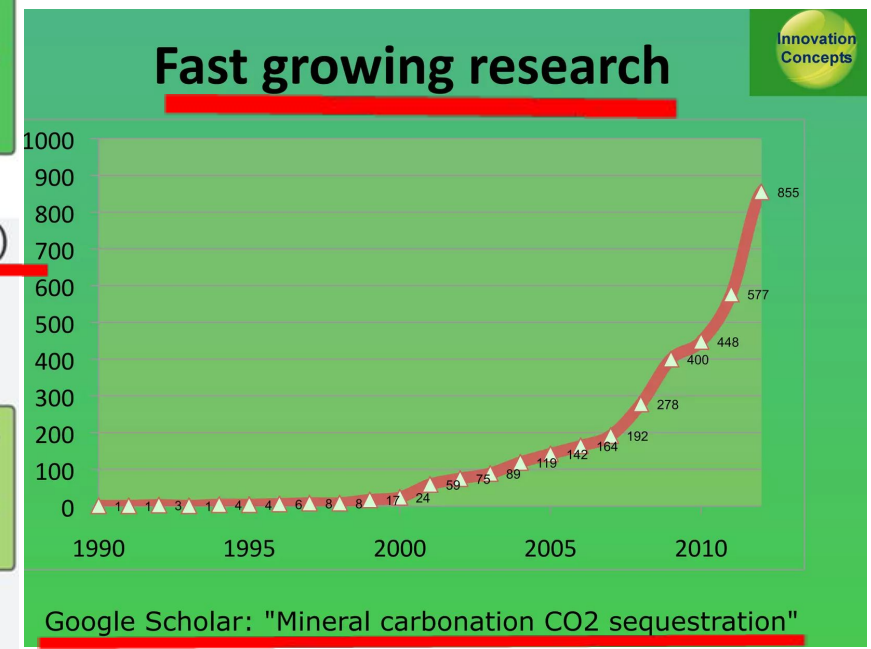
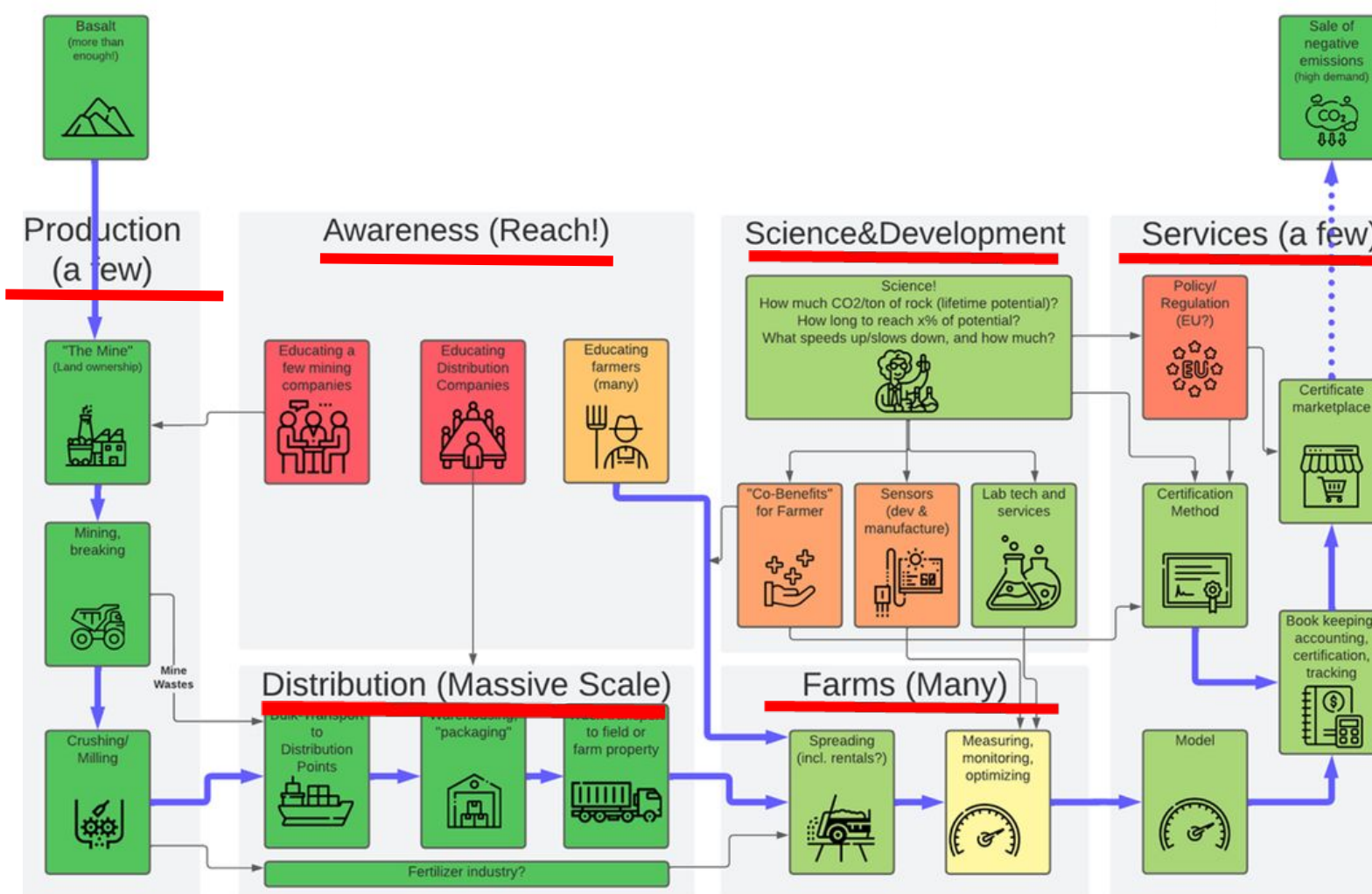
1) Rock dust as a fertilizer (Law 12.890/2013)

2) Certification for rock dust products (Decree 8.384/2014)

Brazil and India both have tropical climate, some of the finest basic rocks and vast agriclutural fields.



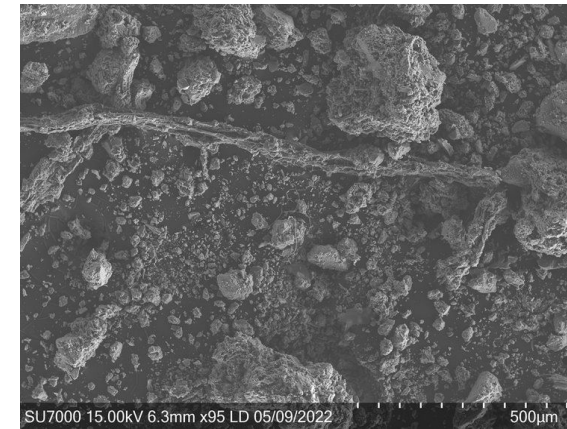
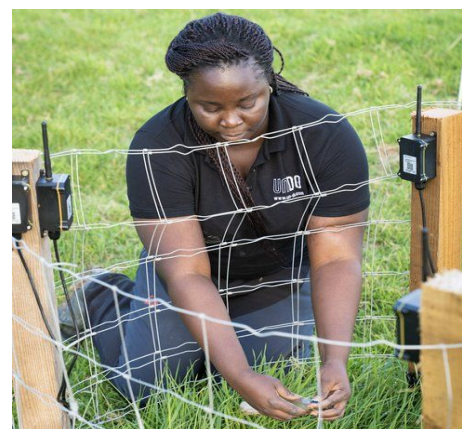
Team from Brazilian Agricultural Research Corp and Geological[®] Survey of Brazil with co-researchers from Cameroon and Uganda



ENHANCED WEATHERING RESEARCH IN INDIA



- For each significant rock/soil/crop/climate system, an optimized application of National rock powder resources must be determined through a national R&D programme.
- Nations capacity to adapt to the mounting challenges of population expansion and climate change would be significantly improved by the R&D programme.



mati.earth/our-work/

Mati

Our Work Impact Science Team Contact News

Mati Carbon is responsible for the first ever delivery of engineered carbon dioxide removal credits in the Global South.

India Operations:

Mati Carbon is the first group to push Enhanced Rock Weathering (ERW) to an industrial scale in India. Moreover, at Mati's initial Indian deployments the first ever engineered carbon dioxide removal credits were delivered. Mati has fully operationalized its model in two states (Madhya Pradesh, Chhattisgarh) and is currently working on expansion in to three other states within next twelve months.



Farmers Name: Rose [redacted]
 Field ID: KW32
 Location: Kisumu, Kenya
 Crop: Maize (Beans intercropped)
 Photo Taken: 7 weeks after planting
 Avg Height Control: 84cm
 Avg Height Treatment: 133cm
 Avg Height Increase: 57.57%

Treatment: Rock dust @ 20t/hectare

Control: Normal Farming Practices

FLUX

un-do.com/our-partners/farmers-landowners/

UNDO

For Businesses For Individuals Enhanced Weathering Our Partners Resources

Our Field Trials

From small plot field trials to expansive research at Newcastle University's Nafferton Farm, we're building a robust dataset to quantify the agronomic benefits of enhanced rock weathering.

We're studying eight different crops, from cereals and oilseeds to potatoes and grassland, across hundreds of plots as we gather thousands of soil and tissue samples.

inplanet.earth/science/

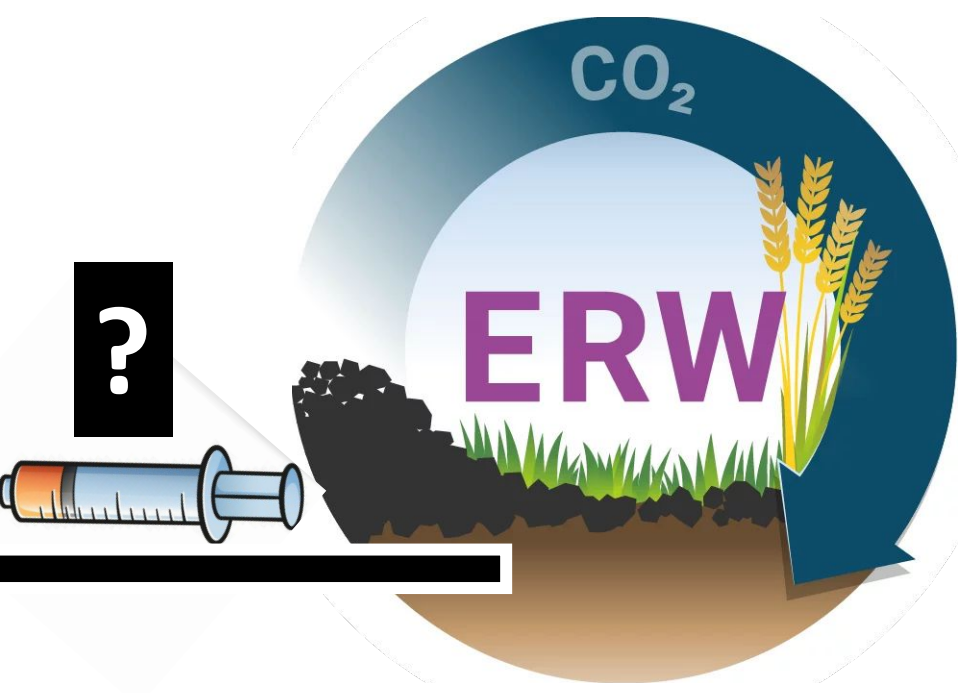
InPlanet

Science About Careers Updates Buy carbon credits

Why Enhanced Rock Weathering is a Crucial Carbon Removal Method

THERE IS **NO** VACCINE FOR CLIMATE CHANGE

Dr. Tedros Adhanom Ghebreyefus
Director-General,
World Health Organization



THANK YOU