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Important Considerations for Responsible use of Glacial Rock Flour in Agriculture

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Introduction

Glacial rock flour (GRF), a fine sediment produced by the erosion of the bedrock by glaciers, has been identified as a potential candidate for the combined use as a fertiliser and carbon-capture strategy in agricultural soils.

Agricultural soil amendments that support crop production while harnessing land-based carbon storage can help minimise climate change. Though early reports indicate promise for this use-case, implementation and commercialisation of GRF in agriculture risk outpacing evidence and necessary guidelines.

Recommendations

- Fund research on the efficacy and safety of GRF in agriculture and identify material testing requirements
- Fund research on the poorly constrained role of GRF in the local ecosystems to quantify environmental risks associated with collection
- Favour collection strategies that minimise environmental risks
- Require carbon budget analyses based on material origin, carbon sequestration capacity, and transport ahead of use
- Establish feasibility and environmental risk assessments and approval frameworks
- Prioritise involvement of local stakeholders of GRF origin

Summary Statement

Selected glacial rock flours (GRFs) have been found to support crop growth and increase uptake of essential nutrients like magnesium, silicon, phosphorous, and calcium in the short-term. A Greenlandic GRF was reported to enhance CO_2 sequestration through rock weathering. Though other rock flours (e.g. mining byproducts) can serve similar purposes, GRF has the advantage of requiring no additional energy input to achieve a fine particle size, maximizing nutrient availability and carbon sequestration efficiency.

However, scientists have yet to characterise and quantify the impacts of GRF in the marine and mountain ecosystems that it may be intercepted from. That lack of knowledge prevents establishment of reliable guidelines for what could constitute sustainable material collection. Depending on bedrock characteristics, GRFs may contain toxic metals like arsenic which could bio-accumulate in crops, posing a public-health risk. We currently lack sufficient evidence from peer-reviewed reports on the use of GRFs from diverse bedrock origins, in various soil types, at a range of application amounts, and with various crops to establish effective and feasible use-cases or material testing guidelines. Some collection strategies—such as sediment removal at hydroelectric infrastructure—may minimize environmental risks, while others—like mining from natural environments—could threaten fragile ecosystems. These risks must be assessed and quantified. Data on the carbon balance of GRF application, considering collection, transport, and use in agriculture as opposed to alternative soil amendments do not yet exist. Furthermore, the potential socio-economic and political impacts of establishing a supply chain in various global areas also remain to be addressed. Prioritizing funding for necessary research on GRF and establishment of frameworks to identify safe and effective use-cases will be essential to support global sustainable development goals and minimise harm to potentially pristine and fragile environments.

References
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Gunnarsen et al. (2023), "Greenlandic glacial rock flour improves crop yield in organic agricultural production" doi:10.1007/s10705-023-10274-0