CLIMATE ENGINEERING AND AGRICULTURE:

BRIDGING THE CONCEPTUAL BINARY

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Geoengineering vs. Agriculture

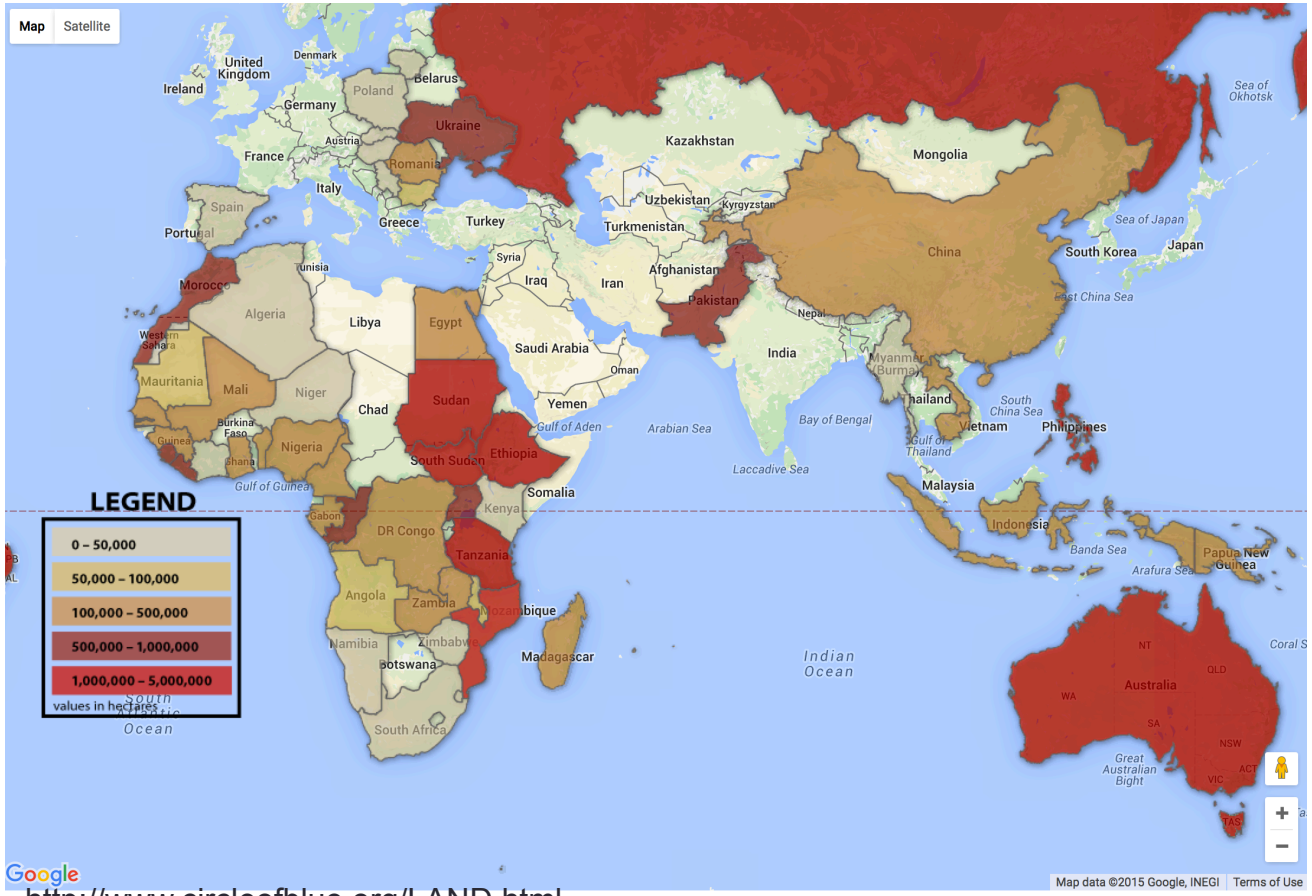
Guardian sustainable business
Rethinking prosperity

We need regenerative farming, not geoengineering
Charles Eisenstein

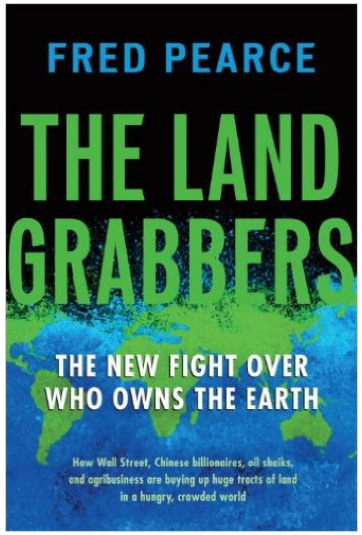
The quick fix mindset behind geoengineering must be transformed to one that seeks a humble partnership with nature if we are to address climate change

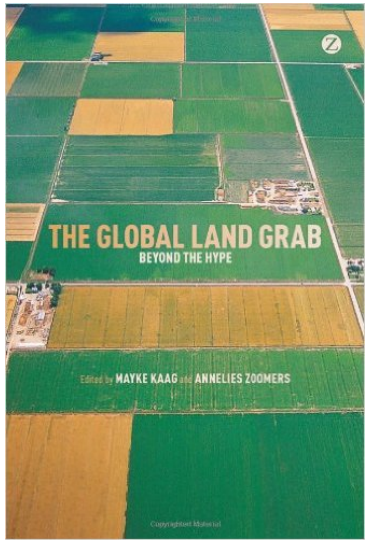
"We oppose geoengineering and other false solutions to climate change (e.g., proprietary, genetically-engineered 'climate-ready' crops)" and support "peasant-led agroecological responses to the climate crisis" — ETC Group

"The global land grab"



http://www.circleofblue.org/LAND.html





1. Agriculture as the original geoengineering

- intentional, ongoing, planetary-scale intervention in N cycle

- Ag proves it is possible for humans to deploy global-scale technology in response to a problem – it also cautions that "the scope of such an intervention can greatly outstrip its progenitors plans, and perhaps their imaginations" (Oliver Morton, 2013)

Agriculture is the most familiar, most widely implemented model for manipulating terrestrial ecosystems

2. Food systems' contribution to GHG emissions

- Food systems contribute 19%–29% of GHG emissions

- Agricultural production, including indirect emissions associated with land-cover change, contributes 80%–86% of that (Vermuelen et al, 2012)

3. Contemporary geoengineering *through* agriculture: some climate interventions involve cultivation

Techniques can blur lines between climate-change adaptation, climate engineering, and more familiar forms of agriculture.

- Soil carbon sequestration
- Climate-smart agriculture
- Enhanced mineral weathering

4. Food crisis as reason to do CE

- Growing demand, yet already heat events have reduced yield growth rate by about 10% from 1980 onwards (Lobell et al., 2011)]

- **Threats to agricultural systems are probably the most compelling reason to see climate engineering as an option**

- Economic rationale: agriculture projected to bear ½ the global economic damages from climate change by 2035, and 2/3 by 2060 (Braconier et al, 2014)
- Humanitarian rationale
- Geopolitical rationale: food insecurity and weak states

5. Impacts of CE on food systems - SRM

- Pongratz et al (2012): **SRM in a high-CO2 climate causes increase yields in global rice, maize, wheat - temperature stresses are diminished while benefits of CO2 fertilization are retained**

Table 1 | Global changes in yields and crop production.

	$2 \times CO_2$ minus control		SRM minus control		SRM minus $2 \times CO_2$	
	Yield	Production	Yield	Production	Yield	Production
Maize	−3	−29	11	57	14	86
Wheat	6	46	26	145	21	99
Rice	19	122	28	147	8	25

Differences in global mean yield (percentage) and global production (million tons) between $2 \times CO_2$ and control climate, between SRM and control climate and between SRM and $2 \times CO_2$ climate.

- Xia et al (2014):Geoengineering causes little impact to Chinese rice production, and maize production to rise, though there are unknowns - an increase in incident ultraviolet light might harm agriculture

5. Impacts on food systems – CDR

- Competition for land (land prices, food prices)
- Competition for inputs (N, P, water, petroleum)
- Effects of land tenure changes on society (income inequality, gender, rural-urban migration, indigenous peoples)

(The short list)

BECCS (Bioenergy with carbon capture & sequestration)

- Most but not all IPCC WG3 emission scenarios stabilising climate at low levels, such as 2°C, require large scale deployment of BECCS.
- IAMs suggest that negative emissions from BECCS could accumulate to more than 270 PgC, essentially doubling the available emission budget (Fuss et al., 2014; Creutzig, 2014)
- Miscanthus for BECCS would imply a 77% increase in fertilizer application in 2100 (5.2 Pg C cumulative penalty). (Kato & Yamagata 2014; Creutzig 2014)
- Contribution of negative emissions from BECCS is unlikely to exceed cooling of 0.7°C by 2100 – deforestation dominates the cooling from negative emissions. More realistic values are around 0.25°C from redeploying agricultural land to bioenergy (Wiltshire & Davies-Barnard, 2015)

Afforestation

- Edmonds et al. (2013): net terrestrial carbon sequestration of 55–190 PgC between 2020 and 2095, resulting from afforestation as a response to a carbon price, but do not specify the land, soil, water, and other resource requirements.
- Smith & Torn (2013): afforestation of 74 PgC over the same time frame would already require 200–1000 Mha of additional land (with higher probability on the higher end)
- Fertilizer input would increase fertilizer consumption by 20–75% above today's level
- Water demand

Biochar

- Woolf (2010): "Annual net emissions of carbon dioxide (CO2), methane and nitrous oxide could be reduced by a maximum of 1.8 Pg CO2-C equivalent (CO2-Ce) per year (12% of current anthropogenic CO2-Ce emissions; 1Pg=1Gt), and total net emissions over the course of a century by 130 Pg CO2-Ce, without endangering food security, habitat or soil conservation"

- "The promise of biochar in the market is running far ahead of relevant agronomic, soil and ecological science, but it is also shaping that science." (Leach et al, 2012)

- Investigation of biochar as a soil amendment

Enhanced weathering

- natural chemical weathering enhanced by applying finely ground silicate rocks to agricultural areas or forests
- Hartmann and Kempe (2008): theoretical global maximum potential of 65 106 t sequestered C02, if EW would be applied homogenously on all agricultural and forested areas of the world.
- equivalent to 0.9% of anthropogenic CO2 emissions (reference period 2000–2005).
- not economically feasible because of logistic issues
- net-CO2 sequestration is expected to amount to only a fraction of consumed CO2 due to the energy demand of the application itself (currently ~11%).
- could possibly be cost effective in case of crop production, specifically rice.

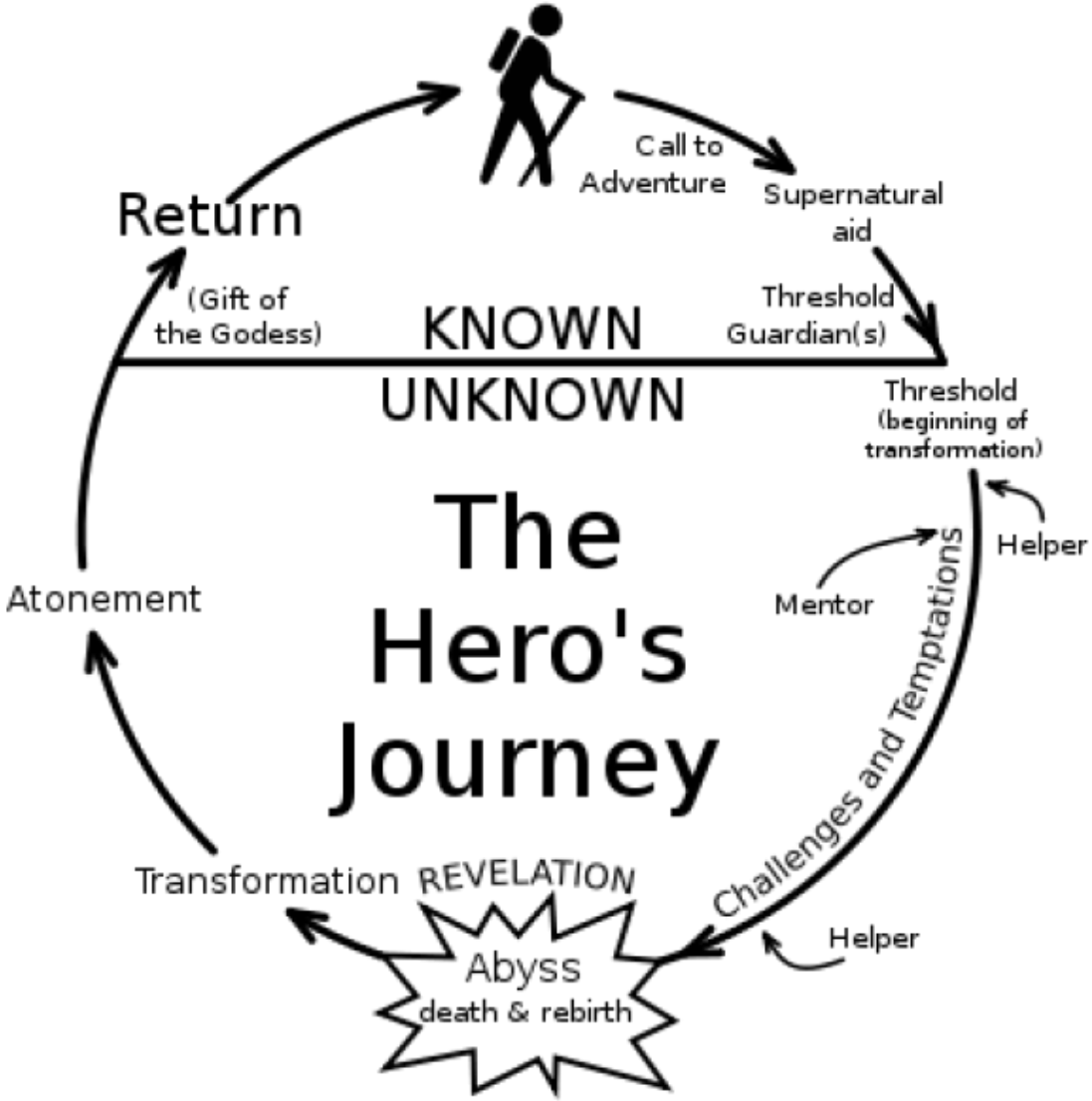
Limitations of a modeling-only approach

Going beyond caveats…

"Potential future scarcities of water and nutrients, policy-induced restrictions on agricultural land expansion, as well as potential welfare losses have not been specifically looked at in this exercise."

(Lotze-Campen et al 2014, study on second-gen biofuel impact on global food prices)

The Binary's Thousand Faces



Agroecology vs. industrial agriculture: a clash of models

Monoculture	Diversity
Western, homogenous models	Non-western, pluriethnic models
The New & modernity	History & tradition
Rigid	Resilient
Genetic engineering	Agroecological design

Historical formulations of the binary: from the Enlightenment to neoliberalism

Reductionism	Holism
Treating symptoms	Treating cause
Quick technofix	Long-term, systemic change
Command and control / domination	Mimicking nature
Linear thinking & control of variables	Complex nonlinear systems

Contemporary moment: “green grabbing”

"Green grabbing builds on well-known histories of colonial and neocolonial resource alienation in the name of the environment - whether for parks, forest reserves or to halt assumed destructive local practices”

Processes:

- Alienation
- Appropriation
- Financialization

(Leach, Fairhead, & Scoones 2012)

What's new about green grabbing?

- The "novel forms of valuation, commodification and markets for pieces and aspects of nature, and an extraordinary new range of actors and alliances, as pension funds and venture capitalists, commodity traders and consultants, GIS service providers and business entrepreneurs, ecotourism companies and the military, green activists and anxious consumers among others find once-unlikely common interests (Leach, Fairhead, Scoones 2012)

- Implications for how CE is both viewed and done

Social relations of large-scale CDR

"Just how much of the money due to the capture of a ton of carbon in a REDD+ scheme, for instance, goes to the communities responsible for looking after the trees? How much, by contrast, is captured by those who prospect for, evaluate and assess or trade the commodity?" (Leach, Fairhead, Scoones, 2012)

- This is important not just out of concern of justice and wellbeing for those "impacted"- Relates to a redistribution of wealth and changes in a larger social order.

- Makes you wonder if SRM actually looks better when it comes to these social issues: if we had the institutional and political capacity to do these CDR techniques right, we would probably be mitigating emissions by now

Moving Beyond the Binary

- The implementation doesn't inhere in the technology, or does so to varying degrees.
- CE technologies are not objects — attention paid assessing "the technologies" as objects and their feasibility— but little paid to assessing various means or contexts for implementing them.
- When we take into account the techniques or contexts, we can better assess both the realism of these techniques and their potential effects on food systems.

1. Dialogue

Currently, there are separate conversations (between agriculture and geoengineering)

- because of how the academy is structured
- because geoengineering isn't that much of a policy topic

Conferences, roundtables, and cross-sector informal discussions which focus on the intersection of climate engineering and agriculture are necessary.

2. Transdisciplinarity

More interdisciplinary work:

- better models informed by social data (needs increased funding to really quantify who lives where, and how)
- Integrating empirical case study work on forest carbon & bioenergy
- Hard when competing epistemologies – "simplifying complexity" versus "complicating"…
- But doing so would produce more reality-relevant / policy-relevant science

3. Media Production

Challenges:

- Agroecology or sustainable agriculture isn't always as interesting / mediagenic as "geoengineering"
- binaries are interesting in terms of storytelling
- media focused on events, not processes
- scholars writing on this not necessarily writing for the public

4. Reckon with History

- Climate engineering as "new" often puts it into an ahistorical void
- novelty good for news stories and grants, bad for intelligent and compassionate CE
- has to be viewed in the context of colonialism, uneven development processes, and more recent era of marketization & financialization to (a) understand the worst-case mechanisms for advancing carbon management and (b) take care to invent alternative ones

Ideas?

- Deconstruction of binaries: taking down old buildings for a firmer foundation
- can there be a “third term”?

- Can there be a better climate intervention / adaptation / mitigation / social structure?

- What does it look like— small-scale farming, climate intervention as development?