Preliminary Summary of Scientific Review (v 0.9) for
"Greenwashing Counterinsurgency: How 'Regenerative' Cowboys are Rebranding the Frontier of Settler Colonialism and Climate Denial"
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1) Methane and Nitrous Oxide

The Savory Institute denies a correlation between increased concentrations of atmospheric methane and livestock. Yet agriculture, predominantly cattle livestock, accounts for 37% of global anthropogenic methane emissions and 65% of anthropogenic nitrous oxide emissions. On a 100-year time scale, Methane is 25 times more potent than carbon dioxide at trapping radiative heat, while nitrous oxide is nearly 300 times more potent than CO2.

Proponents of the Savory Method argue that methane emissions are not as relevant as carbon dioxide emissions, due to the relatively short atmospheric lifespan of methane compared to the long legacy of carbon dioxide. But if increasing livestock rates persist across the planet, as Savory advocates, then a new continuous source of methane emissions will be added to the atmosphere at increasingly more dangerous levels.

In fact, the importance of rapidly eliminating methane and nitrous oxide emissions cannot be overstated, due to their potency and the large benefits to be derived from eliminating their short-term warming potential now. This is why the newest IPCC report in 2023 called reducing Methane emissions "the single fastest way to tackle climate change." Furthermore, the potent nature of methane and nitrous oxide emissions has the potential to trigger global warming feed-back loops, as discussed below.

A solely grass diet in cattle produces more methane than a grain fed diet. Grass fed beef produces 30 percent more methane emissions than feedlot-finished beef in the United States. Grass contains less caloric energy per pound, therefore requiring the cow's rumen bacteria to work longer to break down and digest the grass. The microorganisms generate methane as they work, thus creating more emissions. This increase of methane emissions further exacerbates the dangerous situation of short term emissions cascading into rising global temperatures and feedback loops.

Reducing methane emissions is absolutely essential to slowing down runaway global heating. Methane emissions must be reduced by 45% over the next decade to limit warming to 1.5 degree Celsius. Drastically increasing the number of livestock grazing on a grass diet would increase methane emissions into the atmosphere during a time when decreasing methane is key to reversing global warming and avoiding feedback loops.

2) **Carbon Sequestration**

Holistic Management claims to sequester enough carbon to reverse climate collapse by improving the health of soils resulting in increased carbon storage. The Savory Institute claims up to 500 billion tons of carbon will be sequestered over 40 years if his technique is applied across 5 billion hectares of land. This estimate is far higher than what land is actually available for grazing. According to a 2000 IPCC report there is an estimated 3.5 billion hectares of grazable land, substantially less than the amount of land needed for the alleged sequestration benefits to occur.

Many environments with unhealthy soils will require external inputs of nutrients to improve productivity and facilitate carbon sequestration. The addition of external inputs requires a source of those nutrients, in return limiting carbon and organic matter sequestration in that system and canceling out claimed net benefits of Holistic Management.

Carbon loss occurs via livestock respiration, manure oxidation, enteric methane and in the form of animal products. Furthermore, manure not converted into stable forms of carbon can lead to further carbon leaching. Crucially, studies have shown that any carbon sequestered by the Savory Method does not outweigh the increase of methane and nitrous oxide emissions from cattle, let alone the opportunity cost of forgoing other methods of building soil carbon which don't emit these potent gasses.

Allan Savory's Holistic Management, expanded across the globe, would lead to increased methane and nitrous oxide emissions causing rapid heating in the short term, because of the potent nature of these emissions. This increased warming risks feeding into a soil-carbon feedback loop. The general consensus among researchers is that as warming increases, carbon persistence in the soil decreases, meaning that more soil carbon is released into the atmosphere. This feedback loop, which the Savory Method

perpetuates, would increasingly counteract any marginal benefits of carbon sequestration claimed by the Savory Institute.

Beyond methane and nitrous oxide feedback loops, the potential carbon sequestration of non-forested lands is only 1-2 billion metric tons/year, a small fraction of global carbon emissions of 50 billion metric tons/year. These ecosystems would have to produce much larger vegetative biomass than they are capable of to achieve the Savory Institute's promised results.

Furthermore, the rate of topsoil carbon sequestration decreases over time as soils reach equilibrium, where carbon flow in equals carbon flow out. Equilibrium is typically reached in anywhere from 30-70 years, depending on the health of the soils and the specific ecosystem at the beginning of land-use change or disturbances. When equilibrium has been achieved, the rate of sequestration dramatically declines or halts all together. This means any benefit of topsoil sequestration is diminished to zero, and its ability to partially offset methane and nitrous oxide emissions also diminish to zero.

At the same time, carbon stocks can be reversed over the course of one growing season due to a multitude of factors, including changes of land ownership and climatic fluctuations such as drought. This danger shows why a soil-carbon feedback loop triggered by methane and nitrous oxide emissions is a further risk that must be weighed against marginal benefits of short-term carbon sequestration from intensive grazing practices.

In highly arid landscapes, Savory insists his method of grazing will transform those unproductive, dry systems into flourishing grasslands. To do so, external food sources will need to be imported to feed livestock. Arid landscapes mean there is already limited precipitation resulting in less forage for large numbers of livestock to eat. Emissions from the imported food must be accounted for in addition to any potential land-use change emissions from the feed's land source, which could include artificial fertilizers, deforestation, pesticide, insecticide spraying and so on.

Another consideration is nitrogen limitation in soils. Plants require biologically fixed nitrogen by soil microbes for growth and varying cellular functions. In many areas of the world nitrogen is not abundantly available and therefore would hinder the ability of plants to take up carbon. This can be potentially offset by importing nitrogen as in chemical fertilizers

however there are other trade-offs with doing so such as eutrophication and harmful algal blooms. Ecosystem responses must be considered surrounding the production and transfer of nitrogen. Additionally, grazing has been shown to decrease microbial nitrogen fixing capabilities.

It is possible for overly optimistic estimates to fail to consider the legacy of past land-use changes. These changes could still be influencing the rate of carbon sequestration in the status quo, which would be occurring regardless of the land management techniques currently employed. Therefore, it is a very real possibility that credit is given to the latest land management technique i.e., the Savory Method, when it is the legacy of a previous land management technique resulting in carbon sequestration.

3) **Grassland-Grazer Relationship**

Allan Savory's theory of Holistic Management is based upon the premise that plant communities and soils of arid, semiarid, and grassland systems across the globe evolved alongside herds of hoofed ungulates. Large herds of herbivores migrate to access new food sources and they will form packs to avoid predators which encourages even more migration. The movement of tightly grouped hoofed ungulates have substantial impacts on the ecosystems they roam, both physical and chemical. However many of the above ecosystems did not historically support herds of large-hoofed ungulates. The International Journal of Biodiversity explains, in an article:

"*... Lands west of the Continental Divide of the USA, including the Great Basin, Sonoran, Mojave, and Colorado Plateau deserts, along with the Palouse Prairie grasslands of eastern Washington, western Montana, and northern Idaho, did not evolve with significant grazing pressure from bison...*"

Pronghorn Antelopes can be found west of the Rocky Mountains, but due to small stature and feeding habits their presence does not play a similar ecological role as bison. East of the mountain range within the plains of the present day United States supported significant populations of migratory bison. While west of the Rockies the presence of bison was quite rare. Supporting evidence to further illustrate the absence of bison in this region was the lack of native Dung beetles in comparison to thirty-four native species found east of the Rockies where bison were numerous. These

beetles are important in moving carbon and nitrogen from dung into the soil for microbes to make available for plant consumption.

A more relevant theory describing plant and animal symbiotic relationships is termed 'Animating the Carbon Cycle' (ACC). ACC is the concept that populations of terrestrial and marine animals play a major role in carbon cycling between terrestrial and aquatic ecosystems and the atmosphere. This is possible by the consumption and storage of carbon in animals and the respiration of carbon dioxide as waste. Preservation and protection of nature across the planet is paramount to the effectiveness of ACC.

The ACC method encourages native species of plants and animals to coexist undisturbed to facilitate natural cycles and flows of carbon, nitrogen and other elements. ACC agrees with the philosophical foundation of the Savory Method in regard to apex predators forcing herds to migrate throughout landscapes which, in turn, prevent overgrazing. The pivotal point of departure between the two theories is Savory's over-emphasis on the role of large-hoofed ungulates while ignoring other plants and animals that play critical roles in carbon cycling and sequestration within many diverse ecosystems across the planet. Intensifying stocking rates of cattle and installing fences is not a replication of natural ecosystems. This is especially true in ecosystems in which large-hoofed ungulates were sparse or non-existent.

4) **Grassland Deterioration**

According to Holistic Management,livestock grazing is necessary to prevent the degradation of lands and reverse desertification around the world. According to Allan Savory, this is happening in large part because of biological crusts being allowed to form, which intensive grazing will trample and destroy.

In reality, biological crusts are a vital component of stabilizing soils and protecting them from wind erosion and carbon loss, especially in drylands. Intensive livestock grazing negatively impacts biocrusts both directly and indirectly, at the cost of these and other benefits.

A journal article published in 'Ecological society of America' explains how biological crusts are keystone components of dryland ecosystems, and play

disproportionately important roles in their functioning, with roles including:

"(1) stabilizing soils, thus protecting them from erosion; (2) contributing nitrogen and carbon to soils otherwise impoverished by these elements; (3) heavily influencing local to regional hydrological processes; (4) notably participating in ecosystem biogeochemistry; and (5) by providing suitable habitat for a diverse and abundant soil microfauna."

Biocrusts may not be of similar importance in other ecosystems, but they do not lead to desertification, as Allan Savory claims. Conversely, long-term studies have shown that reductions in intensive grazing have improved forage production and range conditions. Relict sites throughout the western USA, meaning they have never been grazed by ungulates, retain thriving bunchgrass communities and support thick cover of grasses and forbs.

It is true that the trampling of hooves across soil can help break down organic matter and feces, and thereby incorporate nitrogen into soils. Yet in the process livestock are not adding new nitrogen to the soil, but simply redistributing and recycling nitrogen already present in that ecosystem acquired through eating vegetation growing there. Unless feed is being imported from somewhere else, nitrogen will be limited in one source just to redistribute in another, therefore canceling out any potential benefits.

The contrary is true for soil health: livestock grazing variably compacts soil, especially in high moisture environments, reduces infiltration and aeration, and increases runoff, erosion, and sediment yield. Allan Savory's assertions that cattle grazing is necessary to break down organic matter into soils and help plant seeds ignores already occurring biological processes resulting in the same alleged benefits of Holistic Management.

Already occurring biological processes include mycelium. A study showed that as grazing intensity increases, it destroys mycorrhizal fungi at the microbial level. Additionally, the study showed that ground cover, plant litter, and soil organic carbon and nitrogen decreased. Mycelium is a vital symbiotic support for all life on land, and expanding the Savory method risks destroying mycelial structures en masse.