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All Hat and No Cattle

27–34 minutes

The spectacular implosion of a popular delusion about livestock farming.

By George Monbiot, published on monbiot.com, 2nd August 2023

Every industry has its apparatus of justification. The more damaging the industry, the greater the effort spent constructing it. Few if any industries are as damaging as meat production, especially meat production from ruminant animals, such as cattle and sheep.

The principal reason is their vast hunger for land. Every hectare of land used for an extractive industry is a hectare than cannot be occupied by wild ecosystems. Cattle and sheep ranching has destroyed more habitat and seized more indigenous people's land than any other enterprise – and continues to do so. Rainforests, dry forests, wetlands, natural grasslands and savannahs have all been converted on a massive scale to ranchland.

Allied to this is the sector's massive contribution to global heating. This has two main components: the opportunity cost of replacing carbon-rich habitats with carbon-poor ones and the daily emissions of methane, nitrous oxide and carbon dioxide from the animals and the business of keeping, feeding, transporting,

slaughtering and processing them.

If we were to ensure that our food system was compatible with a habitable and thriving planet, the first sector we would phase out would be cattle and sheep ranching. Forget the excitable claims of celebrity chefs and food writers: the most damaging of all farm products is pasture-fed meat.

As centuries of history show, no industry voluntarily throws in the towel. No industry weighs the damage it causes against any benefits it delivers and decides that, on balance, the world would be a better place if it didn't exist. To sustain themselves in the face of the evidence, damaging industries must use public relations. The more damaging they are, the more misleading the public relations must be.

So where does the ranching lobby turn? To a series of claims that, far from being one of the most destructive of all industries, ranching is in fact the planet's saviour. That, done the right way, ranching can contribute to global cooling and the mass restoration of ecosystems. The best-known exponent of these claims is a Zimbabwean rancher called Allan Savory. His Ted talk, asserting that if we follow his prescription, "we can take enough carbon out of the atmosphere" to "take us back to pre-industrial levels" has been viewed millions of times. It's clearly a story people want to believe, and the ranching and meat industries have pushed and promoted it at every turn. In their hands, it has a similar intent and impact to a theme trumpeted by the fossil fuel industry: "CO2 is plant food".

I took it seriously and, drawing on all the available scientific literature, throughly investigated Allan's claims. I found that they

were comprehensively and unquivocally false. I wrote up these findings in my book *Regenesis*, an extract from which I published on my website.

The response, unsurprisingly, was a pile-on by the ranching industry. Allan challenged me to a debate, and large numbers of cattle and sheep farmers on social media noisily insisted I accept. I did so with some reluctance: partly because such questions are best resolved in the scientific literature, and partly because we should be cautious about giving false claims more weight than they deserve. Oxford University's Museum of Natural History kindly agreed to host us.

Popcorn emojis abounded, and the general tenor of the response from the ranching industry was "fight, fight, fight!". They were convinced, as several maintained, that Allan would "wipe the floor" with me.

Well, to put it mildly, it didn't work out that way. You can watch the debate here.

Allan chose the title of the debate (it was then tweaked very slightly by the moderator): "Is livestock grazing essential to mitigating climate change?"

But on the night, he flatly refused to discuss or even address the motion. He rambled about military strategy, history, art, music and his own career, and repeated one word over and over: "oxidation". He insisted that "oxidation" occurs in dry places but not wet ones. Sorry, what??? And that somehow this made all discussions of climate impacts irrelevant. He offered no explanation, let alone evidence for this remarkable proposition.

In fact, he was unable even to say what he meant by oxidation in

this context. Did he mean decomposition? If so, why use "oxidation" instead? I can find no scientific justification for the use of the word in this context. But he used it so often that I started thinking about General Jack D. Ripper in *Dr Strangelove*, endlessly raging about "bodily fluids".

In any case, it took us not one inch towards resolving the motion of the debate. But as a tactic, it was pretty effective. After all, you can't argue with mystical obscurantism. And I must admit that it threw me. By the time I got up to speak, I was so spun out by his tidal wave of non-sequiters and meaningless woo that 30 seconds into my response I lost my train of thought. This doesn't happen very often.

Anyway, I recovered sufficiently to make my points. I argued that if you are to show that livestock grazing *could* mitigate climate change, let alone is "essential" to it, you would need to demonstrate that the following conditions are met:

1. Carbon must be stored in the soil (not just sequestered). You need to show, meeting tests of statistical significance, that storage is sustained across meaningful time periods[1]. Any demonstrated carbon storage must be additional, verifiable, and attributable to the presence of livestock.

2. Any carbon storage has to outweigh the current-account emissions of the livestock operation: enteric methane, nitrous oxide, the carbon dioxide produced by machinery, feed, transport, slaughter, packing ….

3. Any carbon storage in the soil must also outweigh the capital account greenhouse gas losses: in other words the carbon opportunity costs of not having the wild ecosystem (including wild

herbivores) that could otherwise have occupied the same land, minus the carbon costs of producing protein by alternative means. This carbon opportunity cost consists of a combination of below-ground and above-ground carbon, both of which should be accounted.

I argued that, after an exhaustive search, I could not find a study anywhere in the scientific literature which shows these conditions being met. On the contrary, I found an abundance of evidence showing that these conditions are highly unlikely to be met under any circumstances, and that livestock grazing – whether of Allan's variety or any other – contributes significantly to global heating.

How did Allan respond? He didn't. He simply repeated what he said in his presentation. He didn't even attempt to explain how it related to the matter in hand. I kept trying to pull the discussion back to the motion we were supposed to be debating, to no avail. Instead, he airly dismissed the importance of carbon dioxide and methane. It was a weird and meandering form of climate science denial. So why did he insist on the title?

I can't deny that I feel pretty angry about it. I took the debate seriously and spent a long time preparing, ensuring I was completely up to date with the scientific literature. But he showed no sign of having thought about it, let alone of ensuring he was capable of addressing his own motion. It was giant exercise in trolling – wasting everybody's time. I felt conned. But I felt worse for his fans, some of whom had travelled to Oxford from Scotland and Wales to hear him.

The debate was a powerful vindication of the Bullshit Asymmetry Principle, otherwise known as Brandolini's Law:

The amount of energy needed to refute bullshit is an order of magnitude bigger than that needed to produce it.

Except in this case, given the time I put into preparing for the debate and the complete absence of apparent research, thought or preparation on Allan's side, I would say it was more like two or three orders of magnitude.

Anyway, I've seldom seen such a spectacular implosion. The livestock farmers who were crowing and strutting before the debate in the certainty that I would be routed either fell uncharacteristically silent or frantically sought excuses for Allan's bizarre and self-destructive performance. Some of them claimed it was the wrong debate: we should have been discussing a different motion, or that I should have had it with someone else, some mysterious personage whom, despite repeated requests, they were unable to name.

Some of them resorted to the same kind of obscurantist waffle that Allan deployed. They claimed I didn't understand the "deep meaning" of the things he said. It's true: not only did I not understand it, I was unable to detect it. But they have been unable to explain it either. Nor, it seems, can Allan. If someone can't make themselves clear, it's a strong indication that they don't know what they're talking about.

Several of them, including members of the Savory Network, tried to explain the debate as a clash between "holism" (Allan) and "reductionism" (me). Reductionism is a term often used by people who are freaked out by empirical evidence. In reality, this was a clash between handwaving and scientific evidence. And sorry, but mystifying waffle is the exact opposite of holistic.

These desperate excuses merely highlight the blow that this variety of greenwash suffered on that day in Oxford. Of course, the apologists for this devastating industry will not give up. They never do. They will find another story, another way of duping people who don't have the time or resources to investigate their claims. So this is no kind of victory. But at least it will now be harder for Allan Savory and his network to keep spraying the particular variety of bullshit with which they have splattered this issue, for so long and to such great effect.

I promised a list of references, with key quotes, for the statements I made in the talk. Because I've already spent so long on this debate, and have, as a result, a major backlog of work, I've focused here on the two most important and contentious issues: A. does the Savory method or any other kind of ranching cause net soil carbon storage, and B. is significant carbon storage in agricultural soils a viable proposition?

A. Is there evidence of net soil organic carbon storage caused by cattle or sheep ranching, "holistic" or otherwise?

i. H.-J. Hawkins, Z.-S. Venter, M.D. Cramer, A holistic view of Holistic Management: What do farm-scale, carbon, and social studies tell us?, Agriculture, Ecosystems & Environment, Volume 323,2022, 107702, ISSN 0167-8809, https://doi.org/10.1016/j.agee.2021.107702.

"Carbon sequestration rates with HM [Holistic Management] are unsubstantiated and likely overestimated by an order of magnitude. …. Here we summarize the conclusions from 22 peer-reviewed studies, focusing on farm-scale studies, and the few social and soil carbon studies from across the globe. …. This

synthesis confirms that HM's intensive grazing approach either has no effect or reduces production, as evidenced by farm-scale studies in United States of America, Argentina and South Africa, thus negating the claim by HM proponents that there is a difference between 'the science and the practice'."

"Interestingly, changing from livestock to wildlife (notably megaherbivores such as elephants that knock over, consume and damage large trees and shrubs) increased soil carbon over decadal timescales in Kenya (Sitters et al., 2020)."

"Also HM estimates of SOC do not account for increases in other greenhouse gases with increased livestock numbers (Soussana et al., 2007)."

ii. Beillouin, D., Corbeels, M., Demenois, J. *et al.* A global meta-analysis of soil organic carbon in the Anthropocene. *Nat Commun* 14, 3700 (2023). https://doi.org/10.1038/s41467-023-39338-z

"In grasslands, increased intensity of grazing (–9.9%, CI [–18, –0.5]) and the presence of grazing compared to no grazing (–7.1%, CI [–31, –3.9]) had negative impacts on SOC."

iii. Schlesinger, W.H. Biogeochemical constraints on climate change mitigation through regenerative farming. *Biogeochemistry* 161, 9–17 (2022). https://doi.org/10.1007/s10533-022-00942-8

"The attribution of carbon credits must be based on reality. The increments of carbon stored in soils must be additional, permanent, verifiable, and derived from a full life cycle analysis that shows the marginal gain in soil carbon associated with a marginal increase in effort. The net increments must be calculated in the context of the emissions of greenhouse gases associated with their creation, for example the carbon dioxide emitted by

producing fertilizer and the nitrous oxide (N_2O) released when using it."

"Soil organic matter is rich in nitrogen content, with C/N ratios typically ranging from 12 to 15 (Post et al. 1985). This basic stoichiometry limits what we can expect from increasing fertilizer applications to increase soil organic matter (van Groenigen et al. 2017). To store 5% of current fossil fuel emissions of CO_2 in the United States in soil organic matter would require 6×10^6 mt/year of new nitrogen inputs to cropland soils—roughly half again as much N as in current fertilizer usage—at a time of increasing recognition and concern about excess nitrogen as an environmental pollutant. One cannot postulate that this nitrogen can be supplied by more efficient cycling in the soil; soil organic matter is a stock and to increase it requires a permanent storage of the other constituent elements in that stock in their stoichiometric ratio to C."

"Low inputs of exogenous nitrogen explain the low rates of accumulation of soil organic carbon in virgin soils (Schlesinger 1990) and in soils abandoned from agriculture (Post and Kwon 2000; Table 1)."

"Reinhart et al. (2021) discuss the problems with managing livestock grazing to increase the storge of carbon in soils, citing problems with experimental design in nearly all studies to date. Simple mass balance considerations alone should dismiss manure as a source of incremental net carbon storage in the soil"

"Typically, in these experiments cattle are grazed over a large area of pasture or rangeland, and their manure is applied to a smaller area of cropland that is monitored for changes in soil organic

carbon. The grazed lands are deprived of the natural input of plant residues, and cattle typically respire 50% of their dietary intake of organic C as C O_2 and 5% as methane (Charmley et al. 2016).

Thus, the small area that receives manure application has increased organic inputs, but these are derived at the expense of plant residues that would otherwise have been left on the larger area of grazed land. There is only a finite amount of plant production to go around, and as long as cows are heterotrophic, it seems unlikely that their manure can increase soil carbon stocks if one considers the entire landscape."

iv. Chang, J., Ciais, P., Gasser, T. *et al.* Climate warming from managed grasslands cancels the cooling effect of carbon sinks in sparsely grazed and natural grasslands. *Nat Commun* 12, 118 (2021). https://doi.org/10.1038/s41467-020-20406-7

"Direct human management activities are simulated to have caused grasslands to switch from a sink to a source of greenhouse gas, because of increased livestock numbers and accelerated conversion of natural lands to pasture."

"Here, we show that the net global climate warming caused by managed grassland cancels the net climate cooling from carbon sinks in sparsely grazed and natural grasslands."

"The net carbon sink in grasslands worldwide intensified over the last century (Fig. 2), mainly driven by North America, Europe and Russia (Supplementary Figs. 1 and 4). These increasing soil carbon sinks were due to the interaction between indirect human activities, like rising CO_2 concentration, climate change (e.g., warming at high latitudes leading to higher LAI[43] and grassland productivity[44]), atmospheric nitrogen deposition, and direct human

activities like recent decreases of livestock numbers and pasture abandonment in Europe and Russia. Sparsely grazed and natural grasslands account for 80% of the total cumulative carbon sink of the world's grasslands, and explain most of the current global sink"

"In spite of this, the historical increase in livestock alone caused a substantial warming ($147 \pm 27\,mW\,m^{-2}$ by CH_4 and N_2O emissions) partly balanced by a cooling from the reduced number of wild grazers $-47 \pm 11\,mW\,m^{-2}$ (CH_4 and N_2O; Supplementary Table 3)."

"We show below that anthropogenic carbon sinks are mainly located in sparsely grazed and natural grasslands, whereas CO_2 and non-CO_2 sources prevail in managed grasslands."

"The results indicate that management intensification caused 9% less soil carbon storage since the pre-industrial period (set to before 1750), because grazing and mowing reduced the carbon input to soils (i.e., overall carbon outputs from grassland ecosystem increased) more than they increased input via the stimulation of plant productivity through the generation of new leaves (Supplementary Figs. 7 and 8)."

v. Su, J. and Xu, F. Root, not aboveground litter, controls soil carbon storage under grazing exclusion across grasslands worldwide. Land Degradation and Development 2021, Volume3 2, Issue 11, Pages 3326-3337. https://doi.org/10.1002/ldr.4008

"Generally, grazing exclusion enhanced plant production and soil C storage across grassland worldwide. Exclusion of medium and small herbivores had stronger effects on aboveground litter production and soil C storage than exclusion of large herbivores,

and grazing exclusion's enhancement on litter production and soil C storage tended to increase as grazing exclusion proceeded."

vi. Hawkins, H.-J. A Global Assessment of Holistic Planned GrazingTM Compared with Season Long, Continuous Grazing: Meta-Analysis Findings. African Journal of Range & Forage Science 2017, 34 (2), 65–75. https://doi.org/10.2989/10220119.2017.1358213

"A review done the year after the 2012 Savory TEDTalk stated "could find no peer-reviewed studies that show that this management approach is superior to conventional grazing systems in outcomes."

"The majority of experimental evidence indicates that grazing strategy has a minimal effect on carbon sequestration,especially in arid and semiarid rangelands where rainfall is a major driver of sequestration, and rangelands act as weak carbon sinks in wet years and weak carbon sources in dry years"

vii. Godde, Cécile M., et al. "Soil carbon sequestration in grazing systems: managing expectations." *Climatic Change* 161.3 (2020): 385-391.

"Any soil carbon sequestration that may arise under specific conditions is time-limited and reversible. Several decades after introducing an improved practice, sequestration rates diminish to zero as soils approach new carbon equilibria"

"The overall contribution of grazing systems to climate change depends on the net balance of all GHG emissions and removals. Methane (CH_4) emissions from ruminants should not be ignored, nor should potential nitrogen losses from grazing systems, which

may be higher under improved pasture (Appendix). Efforts to sequester carbon and reduce CH_4, CO_2, and nitrous oxide (N_2O) emissions may not always align (van Groenigen et al. 2017)."

viii. Hayek, Matthew N., et al. "The carbon opportunity cost of animal-sourced food production on land." *Nature Sustainability* 4.1 (2021): 21-24.

"Extensive land uses to meet dietary preferences incur a 'carbon opportunity cost' given the potential for carbon sequestration through ecosystem restoration. Here we map the magnitude of this opportunity, finding that shifts in global food production to plant-based diets by 2050 could lead to sequestration of 332–547 $GtCO_2$, equivalent to 99–163% of the CO_2 emissions budget consistent with a 66% chance of limiting warming to 1.5 °C."

ix: The Climate Change Committee, UK Government, 2020. Land use: Policies for a Net Zero UK.

"According to the current UK land-use GHG inventory, transitioning from grassland to forestland would increase the soil carbon stock by 25 tonnes of carbon per hectare (on average across England) once long-term equilibrium is established, although this may take many decades to be reached.96 This is additional to the large amounts of carbon that would be stored in the biomass of the trees themselves."

B. Is long-term carbon storage/sequestration in aerated soils a realistic proposition, even in theory?

Note: There is tremendous confusion, even in the scientific literature, between the terms storage and sequestration. Sometimes they are used interchangeably. Sometimes

sequestration is used to mean the uptake of carbon into the soil, without any guarantee that it will stay there, while storage means the long-term deposition of carbon in the soil. In other words, sequestration is the process, storage is the outcome. These are the definitions I used in the debate. And in most other contexts (ie other than soil), carbon storage is used to mean long-term deposition. But sometimes in soil papers the terms are used exactly the other way round! Collectively, we need to sort this out.

The question this section addresses is whether a significant long-term deposition of additional carbon in agricultural (ie aerated) soils is possible even in principle.

i. Berthelin, Jacques, et al. “Soil carbon sequestration for climate change mitigation: Mineralization kinetics of organic inputs as an overlooked limitation.” *European Journal of Soil Science* 73.1 (2022): e13221.

“All of these debates so far appear to have entirely overlooked a crucial aspect of the question. It concerns the short-term mineralization kinetics of fresh organic matter added to soils, which is occasionally alluded to in the literature, but is almost always subsumed in a broader modelling context.”

“in the short run, this microbially-mediated process has important practical consequences that cannot be ignored. Specifically, since at least 90% of plant residues added to soils to increase their carbon content over the long term are mineralized relatively rapidly and are released as CO2 to the atmosphere, farmers would have to apply to their fields 10 times more organic carbon annually than what they would eventually expect to sequester. Over time, because of a well-known sink saturation effect, the multiplier may

even rise significantly above 10, up to a point when no net carbon sequestration takes place any longer. The requirement to add many times more carbon than what one aims to sequester makes it practically impossible to add sufficient amounts of crop residues to soils to have a lasting, nonnegligible effect on climate change."

ii. Schlesinger, William H., and Ronald Amundson. "Managing for soil carbon sequestration: Let's get realistic." *Global Change Biology* 25.2 (2019): 386-389.

"Here, we argue that the potential mitigation of climate warming by improved soil management, while laudable, is likely to be very limited"

"While the technical potential of various forms of C sequestration in soil is attractive, the political reality of massive soil C sequestration is far less certain or even unlikely (Poulton, Johnston, Macdonald, White, & Powlson, 2018). Presently, no coherent economic strategy has been offered that will induce millions of individual farmers to adopt and maintain prescribed practices on multidecadal time scales. When C sequestration emerges in the popular press (Barker & Pollen, 2015; Leslie, 2017; Velasquez-Manoff, 2018), it creates the dangerous impression that we can easily sequester a significant fraction of CO_2 from continuing fossil fuel emissions through better soil management. This illusion contributes to continuing political inertia, and it needs to be balanced by realistic experimental field research that is seldom part of technical soil C sequestration analyses."

"In sum, while it is likely that better management of agricultural soils may enhance food production and stem the expected losses of soil organic matter under intensive agriculture, it is extremely

unlikely that with better management soils can store carbon at a rate that is at all comparable to the current emissions from fossil fuel combustion."

iii. Baveye, Philippe C., and Robert E. White. "The "4p1000" initiative: A new name should be adopted." *Ambio* 49.1 (2020): 361-362.

"Since its launch in 2015, the "4 per 1000" (4p1000) Initiative has been the object of sustained criticism from a variety of sources, and for a sizeable number of different reasons (e.g., Baveye et al. 2018; de Vries 2018; White et al. 2018). Whereas there is universal agreement on the many benefits resulting from storing more carbon in soils, considerable uncertainty surrounds the amount of CO_2 released by consumption of fossil fuel that carbon sequestration in soils could realistically compensate. Even supporters of the initiative cannot come up with overall figures that amount to more than about 10% of the target, under the best of conditions."

"On YouTube, the website (www.youtube.com/watch?v=pvCCaTv_3LE) dedicated to the "4p1000" initiative by Regeneration International indicates that "the 4p1000 Initiative is the ONLY climate agreement that puts AGRICULTURE at the center of how we deal with climate change." Given how plausible these statements implicitly make an increase of soil carbon stock by 0.4%, there seems to be little chance that policy-makers reading them would realize that they all refer to a thought experiment, nothing more, and certainly not to something that is achievable in the foreseeable future."

"In this general context of inaction, any suggestion that agriculture,

via the increase of soil carbon stocks, can compensate, if not for the totality, at least for a substantial part of the CO_2 released by the consumption of fossil fuels, is likely to be music to the ears of policy-makers, since it means clearly that they can largely or even entirely sidestep the transition to renewable forms of energy, thereby placating the powerful lobbies of the petroleum and gas industry and pleasing farmers by acknowledging a key role for them in saving the planet"

iv. Derrien, Delphine, et al. "Current controversies on mechanisms controlling soil carbon storage: implications for interactions with practitioners and policy-makers. A review." *Agronomy for Sustainable Development* 43.1 (2023): 21.

"Additional C storage in agricultural and forest soil results either from additional C inputs or from increased preservation of soil organic carbon (SOC), which reduces C loss from soil. Both types of processes have a positive effect on climate change by alleviating the amount of C transferred from the soil to the atmosphere as CO_2 or CH_4 and should therefore be favored by soil management practices. However, there is a lack of consensus in the scientific community on the mechanisms leading to C storage."

"The generally short residence time of C in POM is a strong limitation to its utility for additional C storage over the long term. The sensitivity of POM to environmental changes that affect plant inputs or decomposer activity also carries a risk of C storage reversibility by the effects of climate change (Hagedorn et al. 2019; Rocci et al. 2021). This is the reason why some calculation methods of C sequestration potential at regional and national

scales (e.g., Alvarez and Berhongaray 2021; Chen et al. 2018) do not consider the accumulation of C in POM but rely only on the finite capacity of the fine soil fraction to sequester SOC in the long term, as first conceptualized by Hassink (1997)."

"When advising on beneficial practices, though, the scientific community must make it clear that there is no such thing as the absolute, definitive storage of C in soil (Dynarski et al. 2020). A given practice may lead to C storage for a certain period of time only."

"When choosing a practice, practitioners must be aware of the need to pursue it over the long term. The minimum storage timeframe considered in public policies, such as the Green Deal and C neutrality, is on the order of 20–30 years."

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[1] "The minimum storage timeframe considered in public policies, such as the Green Deal and C neutrality, is on the order of 20–30 years."

Delphine Derrien et al, 2023. Current controversies on mechanisms controlling soil carbon storage: implications for interactions with practitioners and policy-makers. A review. Agronomy for Sustainable Development, vol 43, Article number: 21.