Is Grass-Fed Guilt-Free?

Are pasture-fed cows methane villains or carbon saviours?
Simon Fairlie sifts through evidence supplied in a new report by Tara Garnett.

Dairy and beef farmers and consumers of their products are under attack from scientists and environmentalists who hold cattle responsible for high emissions of greenhouse gases, notably methane and nitrous oxide. Many graziers have resorted to one main line of defence: soil carbon sequestration.

"Cattle eating and digesting on pasture where the consumption and regrowth of grass naturally captures carbon from the environment and returns it to the soil, produces guilt-free beef," writes one UK producer,and it is a view shared by many in the "pasture-fed" beef and dairy movement.[1] Particularly high levels of carbon sequestration are attributed to the currently fashionable practice of "mob grazing", which involves rotating livestock around different paddocks for short periods at very high stocking rates (see previous page).

Olivia Keith

Nobody denies that pasture can, under certain circumstances, absorb some carbon from the atmosphere. But the claim that the carbon sequestrated in the soil through the actions of grazing animals is more than enough to compensate for their greenhouse gas emissions, loudly championed by the likes of Alan Savory and Graham Harvey, is equally vigorously contested by many scientists, not to mention George Monbiot.[2]

Grazed and Confused, a report published by the Food and Climate Research Network is a welcome attempt to get to the bottom of this dispute. FCRN, which is an arm of the Environmental Change Institute at Oxford University, is the leading on-line depository of information about agricultural sustainability, highly respected for its objectivity and expertise. Tara Garnett, the principal author, has enlisted the support of a number of academics, including Pete Smith of Aberdeen University, author of dozens of papers about soil sequestration.

Climate Solution Hedged with Caveats

Chapter Three of this report provides an explanation of how soil sequestration works which is probably as lucid and helpful as any that can be found. There are, the authors explain, instances and circumstances where significant amounts of carbon can be sequestrated through improvements in grazing regimes and pasture management. On the other hand there are caveats:

• Increases in soil carbon occur when there is a change in land management, especially when cropland is turned over to pasture; but the increase does not last forever; it is likely to tail off after about 40 years.

• If the change in land management is reversed – for instance if pasture is ploughed up – then the gains in soil carbon will be lost. Carbon can be lost from soils more quickly than it can be gained.

• An increase in soil carbon on a given site can be achieved by adding manure or other organic matter to the soil; but this means that organic matter has been removed from somewhere else, implying a corresponding loss of soil carbon elsewhere.

• Increases in soil carbon can be achieved by improving fertility, but this may also result in increased emissions of nitrous oxide which negate the benefit.

• Improvements attributed to changes in grazing regime, for example a switch to mob grazing practices, may in fact be the legacy of an earlier change in regime, typically replacing arable cropping with pasture.

• A change from arable cropping to pasture may not sequester as much carbon as a change from arable to woodland.

The conclusion that the reader is led to is that the surest way of sequestrating soil carbon is to take land out of crop production and convert it to pasture or some other regime such as forestry or rewilding. Since we have to continue to feed people, the only way that this can be achieved is by removing from arable production some of the land dedicated to growing feed grains and pulses to be fed inefficiently to pigs and poultry.[3]

Grazed and Confused skirts around this line of reasoning, and settles for the conclusion that "global assessments of the sequestration potential through grassland management range from about 0.3 to 0.8 gigatonnes of CO_2 a year, with the higher end estimate assuming a strong level of ambition." This is not a negligible amount, but it is not going to save the planet either. The authors maintain that it will potentially offset between 20 and 60 per cent of the emissions from the livestock grazing on

that land. In other words, soil carbon sequestration notwithstanding, cattle and other ruminants are still forceful agents of global warming

Flagship Figure

This figure of 20 to 60 percent depends, of course, upon what emissions are attributed to livestock. *Grazed and Confused* uses the standard Food and Agriculture Organization calculation that livestock are responsible for 14.5 per cent of anthropogenic greenhouse gas emissions. Eighty per cent of these emissions are caused by ruminants, of which about half consists of methane emissions, and a quarter of nitrous oxide emissions. Forty per cent of all livestock emissions are caused by cows, sheep and goats belching.[4]

Many a farmer has glanced at the endless stream of cars on the motorway spewing gas from their exhausts and planes blazing trails across the sky, then turned towards his cows peacefully grazing, letting out the odd burp and depositing all that useful manure, much as they have done for thousands of years, and thought "that can't be right".

A farmer's intuition doesn't carry much weight in the face of scientific evidence these days. But it would be wrong to assume that the FAO figure is totally scientific. Not only does it rely on evidence which is acknowledged to be uncertain. It is also based on a unit, known as the "CO_2 equivalent", which assumes that the emission of one tonne of methane is equivalent to the emission from 25 tonnes of CO_2. This is not a natural mathematical constant – the accepted figure was once 20, then 23 and has recently been raised to 28 – but an assessment based on the global warming effects of each gas averaged out over an arbitrarily selected period of 100 years through a methodology known as Global Warming Potential (GWP). Since methane has a short life of about 12 years before it degrades, while CO_2 accumulates in the atmosphere and remains there almost indefinitely, this considerably overstates the impacts of methane in the longer term. Choosing a different time horizon would yield a quite different figure from that promoted by the FAO.

The two graphs below which were devised by Tara Garnett for the FCRN's report show that since methane degrades quickly, stable emissions of methane lead to a stable level of methane in the atmosphere and no increase in global temperature. On the other hand, stable emissions of CO_2 cause an inexorable increase in global warming.

This in turn means it would only take a relatively small drop in the volume of methane emissions to bring about a decline in the amount of methane in the atmosphere. In 2006, Oxford University's Environmental Change Institute, who published *Grazed and Confused*, estimated that a 6.1 per cent reduction in anthropogenic methane emissions would be sufficient to stabilise methane levels in the atmosphere.[8] The IPCC more cautiously calculate that a "less than 30 per cent" drop in anthropogenic methane emissions would stabilise methane within 20 years. By contrast, a 30 percent drop in CO_2 emissions would still see carbon accumulating rapidly in the atmosphere. It requires at least an 80 percent drop in CO_2 emissions to stabilise carbon in the atmosphere.[9]

There is something deeply untrustworthy about a metric which views methane as being many times more harmful than CO_2, when only a small reduction in methane emissions is required to stabilise its presence in the atmosphere, whereas a massive reduction in CO_2 emissions is required to achieve the same.

Other methodologies which attempt to address these difficulties have been devised, but none will be "accurate" – and hence there is no truly accurate way of measuring soil carbon storage against livestock methane emissions.[5] FCRN examines this matter in some detail, but since there is no convincing alternative metric, the FAO's flagship figure of 14.5 percent remains unscathed at the end of the report.

Fossil Fuel Methane

Grazed and Confused notes that methane emissions from ruminants constitute "about a third" of all anthropogenic methane emissions. It omits to mention that another third of anthropogenic methane emissions results from fossil fuel extraction (see fig p55) and what's worse this is fresh carbon which is leaking from the bowels of the earth, rather than carbon recycled around the biosphere. Whereas methane emissions from livestock, if eliminated, could rebound in some other form (see box), any fossil fuel methane which is not extracted remains securely inert within the earth's crust. Preventing fossil fuel methane emissions is therefore a safer bet than reducing livestock emissions.

As we have already noted, if we are going to stabilise global warming gases in the atmosphere – at say a rise in temperature of no more than two degrees over pre-industrial levels – we have to stop using fossil fuels, or at least drastically reduce their use. With the falling price of renewables, improvements in

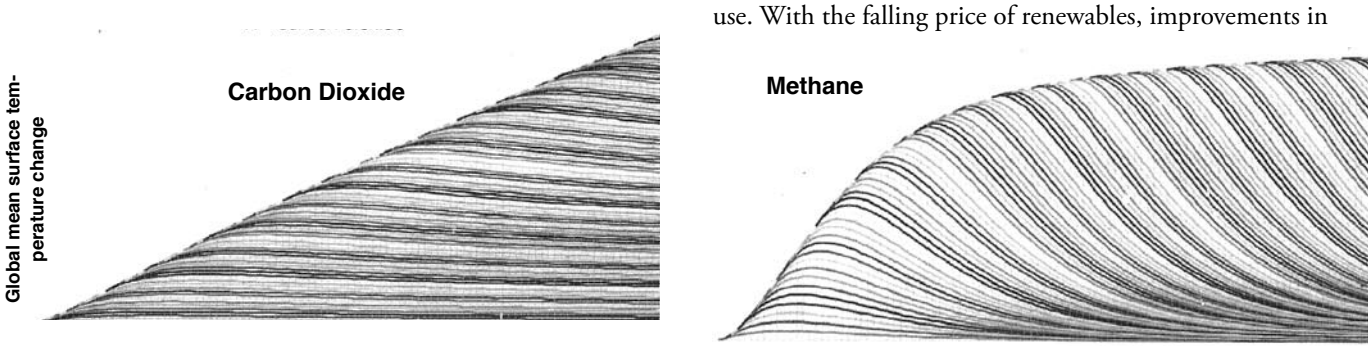
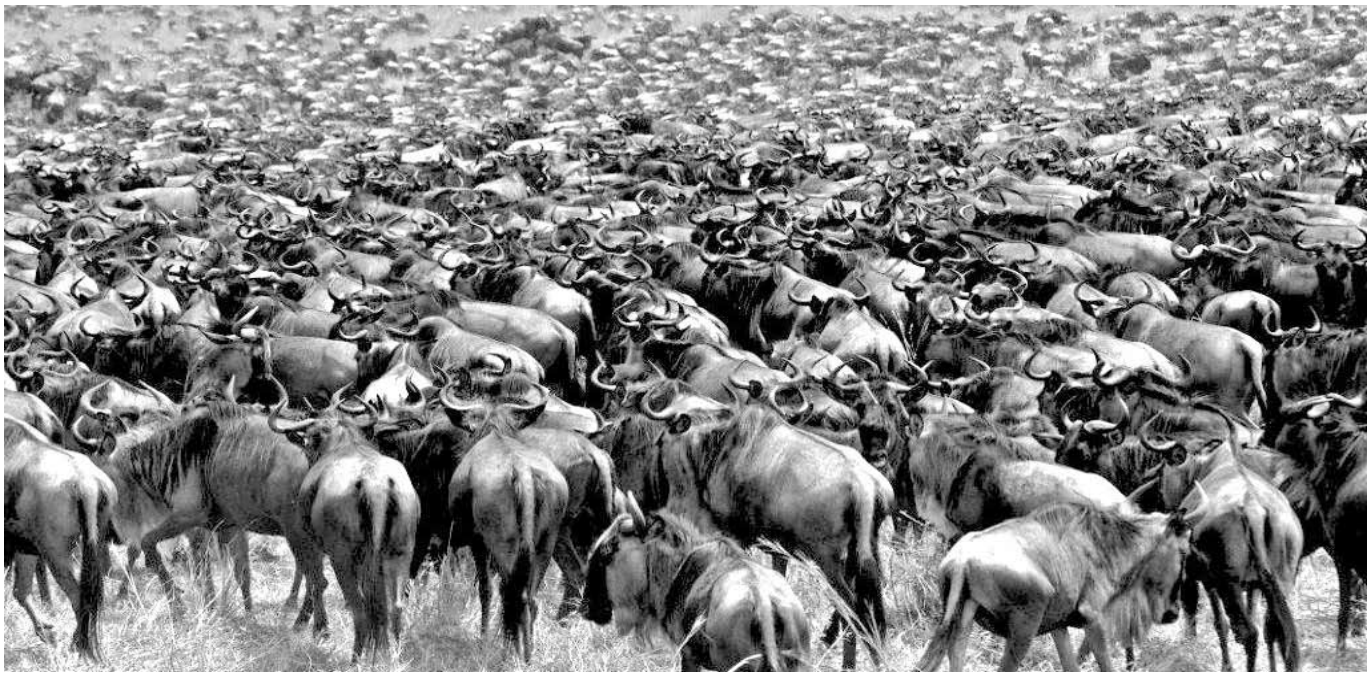


Fig 1. These graphs show the increase in global warming caused by constant annual emissions of carbon dioxide on the left, and methane on the right, over a period of 100 years, at any scale. Each line represents an annual emission of equal volume adding to the warming caused by previous emissions, starting from zero in year one. Whereas warming caused by constant emissions of carbon dioxide increases in an almost straight line, warming caused by constant methane emissions tails off and is almost stable by the end of the century. The graphs also show that if annual emissions cease then the warming caused by methane tails off rapidly, unlike that caused by CO_2.



Mob grazing on the Serengeti

Methane on the Rebound?

If methane emissions are reduced by cutting back on livestock, is it possible that a corresponding volume of fresh methane might be emitted through different pathways? This is a question that has so far been little studied.

FCRN allow that if ruminant livestock were eliminated, their methane emissions would partly be replaced by emissions from wild animals. According to the Carbon Project, wild animals produce only 1.3 per cent of all methane emissions (or 2.6 per cent if you include termites). Wild species can expand rapidly when there is a vacant niche. When cattle were expelled from Tanzania's Serengeti Wildlife Park, herds of wildebeest grew from 250,000 in the early 1960s to 720,000 in 1979, and 1.5 million by 2004.[6]

Wild ruminant populations would never reach the levels of current domestic livestock, but one may also wonder what increased emissions there might be from other sources such as rice cultivation, wetland expansion, bush-fires, termites and so on. If grass is not eaten by ruminants or other animals something else has to happen to it, often decomposition into a soggy mass or bursting into flames – and both these processes release methane. Natural wetlands are currently responsible for a quarter of all methane emissions and wildfires and biomass burning for 4.5 percent (see fig 2 p 56) Until all these "opportunity costs" are fully estimated it is impossible to arrive at a true assessment of the additional methane burden imposed by livestock.

The feedstock for methane is CO_2, and thanks to fossil fuel extraction there is much more of it in the biosphere now than there was in pre-industrial times; there is therefore reason to suspect that even if the numbers of ruminants had remained at pre-industrial levels, some of the methane emissions that they are now held responsible for might have occurred anyway through other pathways.[7]

energy storage and so on, this is beginning to look feasible. When we stop using them that will reduce anthropogenic methane emissions by up to a third which will, at the very least, stabilise methane levels in the atmosphere, even if the number of cattle remain the same as they are now.

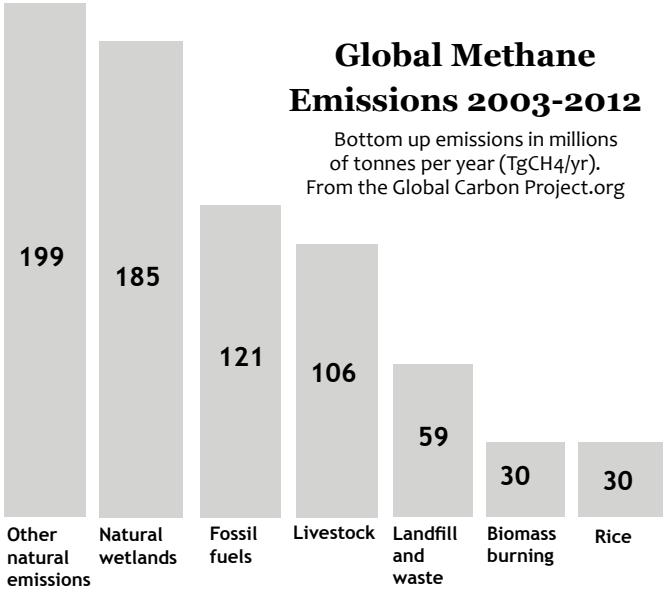
Moreover, if we stop using fossil fuels, livestock numbers are almost certain to drop of their own accord. The report's concluding chapter observes that "almost all livestock systems rely on fossil fuels, including grazing systems". Currently that is true, but once there are no more fossil fuels being extracted, livestock farmers will not be able to rely on them. The result will almost certainly be a reduction in livestock production, and its associated methane emissions, because artificial fertilisers will be more expensive, and biomass production will outbid grazing for some of the marginal land.[10]

Low Hanging Red Herrings

Although the imperative is to reduce CO_2 emissions, methane and other short-lived climate pollutants (SLCPs) such as black carbon (soot) are viewed as a "low hanging fruit" by some climate policy makers, for two reasons. Firstly, reductions in SLCP and especially methane emissions offer more immediate mitigation of global warming than reductions in CO_2 emissions. And secondly, reductions in methane emissions are often considered to be cheaper and easier to implement. So, for example, Stefan Wirsenius and colleagues at Chalmers University in Gothenburg, argue that reducing methane and nitrous oxide emissions by eliminating beef and dairy from people's diets will make:

> "more 'room' for CO_2 emissions. This in turn implies that the energy transition away from fossil fuel technologies with high CO_2 emissions can be delayed, with corresponding higher annual CO_2 emissions during the transition period."[11]

Myles Allen and Raymond Pierrehumbert at Oxford University have contested this line of argument, pointing out that CO_2 accumulates in the atmosphere while methane and other SLCP gases do not, so while the proposed delay is taking place, the bank of accumulated CO_2 mounts up making the task of limiting warming to a peak of two degrees above pre-industrial levels more difficult to achieve. Allen writes:



> "If the main objective of climate policy is to limit peak warming then SLCP mitigation could be delayed until after global CO2 emissions have started to decline. It is quite wrong to suggest that bringing forward SLCP emission reductions can 'buy time' to procrastinate over CO_2 – quite the reverse. Early SLCP measures only have an impact on peak warming if ambitious CO_2 mitigation measures are already under way. Unless CO_2 emissions are being reduced at the same time, it makes almost no difference to peak warming whether SLCP emissions are reduced now, or reduced at some later date." [12]

The matter becomes doubly problematic if nations or businesses are allowed to use reductions in their methane emissions to offset CO_2 emissions, using as a unit of exchange, the CO_2 equivalent valuing one tonne of methane the same as 28 tonnes of CO_2. Allen writes:

> "Such large-scale offsetting, were it to occur, would wipe out the impact of methane reductions in the short term, while in the longer term it would result in substantially more warming because of the additional CO_2."

In practice such off-setting might involve reducing herds of grass-fed ruminants and replacing them with chickens and pigs more dependent upon fossil fuels, artificial fertilisers and arable cropping – the scenario that is often promoted under the title "sustainable intensification".

There is an inherent injustice in making the ruminant sector, which has been around for some 10,000 years, pay disproportionately for damage caused by an industrial system that has been with us just two centuries. One may feel little sympathy for US feedlot owners or Brazilian beef barons – but that injustice will be felt keenly by livestock farmers in some developing countries, notably India, for whom a cow or a few goats may represent nearly all of their greenhouse gas emissions.

A Sideshow

Aside from global warming there are other good reasons for reducing the numbers of domestic animals. Livestock require lots of land, are inefficient converters of human edible grains and pulses, and they can overgraze, undermine biodiversity, or compete with trees for space.

But the root cause of the current excessive number of livestock is the economic and ecological distortion caused by the extraction of millions of years of carbon deposits within a time span of two centuries. As we stop mining them, and become more dependent on land-based forms of energy, animal husbandry will be forced to stabilise at a level that balances our need for meat, dairy, leather and, crucially, manure, against our need for renewable energy, biodiversity and other benefits that land offers. We will favour livestock that contribute to agro-ecological systems rather than draining them, for example by consuming waste products, harnessing fertility or promoting biodiversity – what *The Land* has referred to as "default livestock" and FCRN call "ecological leftovers". We will also be ridding the atmosphere of the methane emissions caused by fossil fuel extraction. Raymond Pierrehumbert has remarked that "methane is a sideshow"; livestock methane is a sideshow to that sideshow.[13]

The undue weight currently given to methane emissions provides ammunition for extremists at both ends of the ideological spectrum – vegans who view livestock husbandry as a "Cowspiracy", and corporate pig and poultry producers whose factory farms are a travesty of the age-old contract between humanity and domestic livestock.

The main lesson for grass farmers to take from *Grazed and Confused* is that soil carbon sequestration is not on its own sufficient to defend ruminants against the charge of climate villain. What is also required is a robust critique of the GWP methodology and its CO_2 equivalent; and clear explanation to policy makers why "methane is a sideshow".

Grazed and Confused, by Tara Garnett et al. is available online at www.fcrn.org.uk

NOTES AND REFERENCES

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2. A Savory, *How to Fight Desertification and Reverse Climate Change*, www.ted.com; G Harvey, *The Carbon Fields*, Grassroots, 2008; G Monbiot, *Eat More Meat and Save the World*, Guardian, 4 Aug 2014.
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7. The same rebound arguments applies to many of the nitrous oxide emissions currently emitted by ruminants through their manure, and through the legumes that they are fed. Most manure and many leguminous pastures are used to fertilise arable crops, and in the absence of ruminants, other sources, such as artificial fertilisers or green manures would have to be used, emitting similar amounts of nitrous oxide. Moreover, arable cropping would have to increase to make up for the loss of meat and dairy.
8. Christine Jardine et al, *Methane UK*, Environmental Change Institute, 2006, www.eci.ox.ac.uk In fact levels of methane did remain stable in the atmosphere between 1997 and 2007, but have since increased again. The chief causes of this increase are believed to be natural wetland emissions, possibly due to increased temperatures and fossil fuel emissions.
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10. This reduction may be tempered by a need to use livestock to harvest fertility from grazing lands for use on arable land.
11.David Bryngelsson et al , "How Do Dietary Choices Influence the Energy-System Cost of Stabilising the Climate, *Energies*, 10, 182 2017.
12 Myles Allen, *Short Lived Promise*, Oxford Martin Policy Paper, 2015. There is one exception to this – if the earth's climate entered into a "tipping point" scenario where global warming triggered the release of additional volumes of natural methane.
13 Quoted in Bobby Magill, "US 'Likely Culprit' of Global Spike in Methane over the Last Decade", *Guardian*, 17 Feb 2016.