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Press note - for information

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Reversing the claim that grazing cattle and sheep release carbon into the atmosphere.

The extent to which ruminant animals, by eating grass, sequester atmospheric carbon, both in themselves (and then in us), and enable a huge amount to be captured by the turf they graze, is, now, slowly, being better understood by Universities, the furthest forward apparently being Sydney. It is just possible that the very latest thinking stems from within the NBA – linking the work at Sydney with that of Darwin (see page 2) to show how the accumulation of 8.7 (CO_2 equivalent) tonnes of methane (CH_4 i.e. carbon-hydrogen) per hectare per year deepens the soil by forming organic carbon compounds Darwin called worm mould.

We already know that the world's soils hold three times as much carbon as the atmosphere and over four times as much carbon as the vegetation. With 82% of terrestrial carbon in soil (compared to only 18% in vegetation), soil represents the largest carbon sink over which we have control.[i] Even better is the news from Australia that this store of carbon is being and can be increased further.

A study published in December by Mark Adams, the Dean of Agriculture at the University of Sydney has found that while cows might emit 54 kg[ii] of methane per head per year, oxidising bacteria in high country soils (old turf) can oxidise methane at the rate of 8,760 kg for every hectare each year. It has long been known that farm animals, fossil fuels and vegetation decay in bogs and rice paddies produced methane, but now it can be shown by the Sydney University work that grazed pasture absorbs much more than any release of carbon by the rotting vegetation or the bacteria digesting grass within ruminants. Those taking part were Miko Kirschbaum, a researcher with Australia's Co-operative Research Centre for Greenhouse Accounting, researchers from the co-operative research centre, CSIRO Plant Industry, the Australian National University and the University of NSW. Their study on gases emitted by and absorbed by vegetation has been published in the scientific journal *Functional Plant Biology*. The work at Sydney confirm the extent to which methane is released by plants (mainly in the tropics) and the absorption of carbon in other climates by pasture and grassland.

Good news also comes from the USA Agricultural Research Service (ARS) soil scientists:-
Sara F. Wright, a soil scientist with the ARS Sustainable Agricultural Systems Laboratory in Beltsville, Maryland, discovered glomalin in 1996 and named the substance after Glomeraceae, the taxonomic order of the symbiotic fungi that produce the sticky protein on the roots of vegetation. Recently, she used a nuclear magnetic resonance imager to show that glomalin is structurally different from any other organic matter component, proving it is a distinct entity.

The fungi live on most plant roots and use the plants' carbon to produce glomalin. Glomalin is thought to seal and solidify the outside of the fungi's pipe-like filaments that transport water and nutrients to plants. As the roots grow, glomalin sloughs off into the soil where it acts as super-glue, helping sand, silt and clay particles stick to each other and to the organic matter that brings soil to life. It is glomalin that helps give soil the feel of the glued-together particles and organic matter. The deeper the turf the better it hangs together and can be thrown into the air and caught again. Sand and soil bereft of organic matter and glomalin blow away in a strong wind. The conversion of the Great Plains grasslands of America into dust bowls in some areas demonstrates this.

Glomalin is a component of the more commonly understood humus, the organic matter that is sometimes called black gold. When it first turned up in humus measurements, it was thought to be a contaminant. Glomalin is not just the glue that holds humus to soil particles; it actually does much of what humus has been credited with. Because there is so much more glomalin in the soil than humic acid, an extractable fraction of humus, glomalin stores 27 percent of total soil carbon, compared to humic acid's eight percent. It also provides nitrogen to soil and gives it the structure needed to hold water and for proper aeration, movement of plant roots and stability to resist erosion.

Soil before extraction

Glomalin

Soil after extraction

The new link, which may be credited to the NBA, is in relating the work by Sydney University with Darwin's development of the idea of soil under pasture increasing in depth – except that he credited the increase in depth of soil under pasture solely to earthworm casts. Darwin worked out in 1837 that the soil increased in depth by 13 inches in 30 years (0.43 inches / year). Others concluded later that, on average, after 10 years an object in the soil will go down two inches, and after 1,000 years it will be 200 inches below the surface, with the amounts ranging from 0.2 to 0.8 of an inch per year.

Darwin recalled how his children called the 13 ½ acre Great Pucklands field, *'Stony Field*', and how, when they ran down the slope into the valley, the flints clattered under their feet. Darwin, while staying in Staffordshire with his maternal uncle and father-in-law, Josiah Wedgwood, developed the idea that soil increased in depth, and material (in that case, burnt marl and cinders) in it lay deeper every year. Darwin explained how over the years the flints on the surface of his *'Stony Field*' had become buried by soil, due, in his opinion, to the action of earthworms, so that by 1871, ***"a horse could gallop over the compact turf from one end of the field to the other, and not strike a single stone with his shoes."*** Darwin's book "***Earthworms***", published in 1881, was his last major contribution to science. He died the following year.

In 2005, his work was repeated by scientists from the Natural History Museum in London in the same fields. They found a similar annual increase in soil depth. However, they continued to accept that this was solely because of the cumulative effect of millions of worms in a field chewing their way through the soil and depositing it on the surface so that they actually raise the surface of the soil. Darwin and they observed that the result on the ground is that things disappear and gently sink into the soil.

In the light of the findings by Sydney University that huge amounts of carbon are absorbed by pasture from the atmosphere, I offer an alternative hypothesis. Most living objects incorporate organic carbon compounds. It has been accepted for some time that after arable soils are converted to pasture turf, the process stores carbon for up to 50 years. However, now that we know from Sydney about the continuing accumulation of carbon in old turf, it can surely be concluded that the very large increase in the depth of a soil under pasture is because of the accumulation of carbon material in and below the turf itself as the glomalin and humus increase. Earthworms thus only make a contribution to this process by processing upwards the solid organic matter which is converted from atmospheric carbon dioxide and methane. This hypothesis is further backed by the realisation that earthworms can improve the structure of a soil by moving through it, by worm casts and by consuming dead leaves, but they cannot increase the soil volume itself by as much as previously thought, the additional organic carbon matter from the atmosphere makes the difference. Another relevant point is that such increases in the depth of turf do not occur to the same extent under arable crops – hence the many discoveries of ancient artefacts by ploughing, or shallow digging where a metal detector indicates a metallic item.

The greatest and fastest accumulation of organic matter within turf is where it is grazed and farmed to best effect, keeping up the lime and plant food content by dung, and by controlled grazing to develop the deeper rooting clovers as a component of the pasture. One can therefore emphasise the huge value of pasture (grazed by cattle and sheep) in capturing carbon from the air and storing it for as long as the ever-deepening pasture remains.

In the UK there are 7.3 million ha of grass and 5.3 m ha of rough grazing (12.6 m ha total) out of 18.4 m ha of total agricultural area, and only 170,100 ha of horticultural land (only 27 sq m per person). Thus the area that can be utilized only via ruminants for red meat is 74% of the UK. Across the world the FAO say that 70% has to be grazed to be usable.

POSTSCRIPT

To deal with comments that not all cattle and sheep graze grass, one can sensibly say that very nearly 100% of all cows, dairy and beef, and sheep eat grass when it is growing in the summer. Some dairy sheep and cows are housed in very hot conditions in France and grass hauled to them, and this also happens in a few other counties - including even a very few dairy farms in England, in some cases to keep them in biosecurity from contact with TB-infected badgers.

In winter many suckler cows are still kept on rough grazing, as was traditional in many areas. Most suckler cows and nearly all dairy cows are fed grass silage or haylage in winter as the basis of their ration. The few exceptions are fed a ration based on straw and by-products such as molasses.
There is no farmer known to the NBA who would think of giving human quality feed grain (i.e. bread-making wheat or malting barley) to their ruminants, adult or young.

In the case of the young stock reared for beef, these are often fed by-products such as molasses, potatoes or carrots etc which are blemished or are not round nor straight enough for supermarket or EU rules. (Allocate the carbon content of the feed to the supermarket buyers for rejecting the vegetables, not to the cattle for utilising them – instead of landfill.) Grain fed to cattle is often barley (non-malting quality) grown after two years of wheat crops. Some farmers are reverting to the old practice of following three cereal crops with a 2 or 3 year ley to be grazed so that the fertility (including organic carbon matter) builds up and provides plant food for the following human-edible wheat crops. (The cows eat the grass, the young stock are finished on the barley and we humans eat a balanced died. The longer the ley is left the more carbon is captured. (The modern technique of min-till reduces the large carbon release caused by ploughing and cultivation.) Bear in mind that only 4.7 m ha out of 18.4 m ha farm land grows non-grass crops.

The NBA acknowledges that beef production can be made even more Green-House-Gas (GHG) efficient than it is already. Quick finishing significantly reduces GHG emissions per animal. The Agri-Food and Biosciences Institute in Northern Ireland points out that the carbon footprint of a 16 month old young bull is 43 per cent less than a 25 month old steer because the shorter production cycle results in 52 per cent less methane output.

The NBA considers that the feed additive Rumensin should be allowed to be used by farmers. Last year, in a report to the Government by Lord Turner on agriculture's contribution to global warming, it was claimed that ionophores (the group of chemicals, including Rumensin) were the single most effective way to reduce the carbon footprint of livestock production. The report claimed that their use could reduce methane by 25% at the same time as improving feed efficiency by the same incredible figure of 25%. Its use in dairy and beef diets was estimated to have the potential to reduce CO_2 (equivalent) emissions by over 700,000 tonnes in the first year – the most significant methane reduction agent identified in the EU so far. At the moment Rumensin is banned, caught up in the rush to ban antibiotic growth promoters. It has enabled cattle to obtain more energy from every ration for 30 years, is cheap and very effective, and is still widely used throughout the world. Rumensin has increased liveweight gain by up to 42% yet reduces total feed intake by 16%. It works in the rumen to increase the utilisation and absorption of volatile fatty acids and at the same time reduces the ruminal breakdown of protein to ammonia; a benefit in both protein utilisation efficiency and reduced ammonia (NH_3) and carbon emissions.

The end notes below are recommended reading rather than mere references.

In summary, British family farmers need politicians and the public to realize that grazing pasture is one of the very best ways to capture and store carbon, and need reasonable prices to stay in business. At present UK beef production is on a family farm scale with very high welfare standards which are natural to the vast majority of farmers' families. This is vulnerable to price domination by the current short-term view of supermarket buyers, ready to import beef produced elsewhere to far lower welfare standards.

Be aware that in America that "*Less than 1% of the animals killed for meat come from family farms*"[iii]

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[i] Christine Jones, http://www.amazingcarbon.com/PDF/JONES-OurSoilsOurFuture%288July08%29.pdf.

[ii] http://www.abc.net.au/rural/nsw/content/2009/08/s2649416.htm. and
http://www.grist.org/article/the-climate-solution-got-cows/
A European study calculated the methane emission from a cow to be 73 kg / year.
http://www.newscientist.com/article/mg12216635.100-methane--the-hidden-greenhouse-gas-methane-from-cowsrubbish-tips-and-rice-fields-is-warming-the-earth-car-exhausts-may-helptheprocess-but-methane-from-the-arctic-tundra-could-be-most-damaging-of-all.html. – Grasslands have vast untapped potential to mitigate climate change by absorbing and storing CO_2, according to a new report by FAO. "Pastures and rangelands represent a carbon sink that could be greater than forests if properly managed." 13 January 2010, Rome. http://www.fao.org/news/story/en/item/38916/icode/

[iii] Eating Animals by Jonathan Safran Foer – published by Hamish Hamilton ISBN: 978-0-241-14393-3 4th March 2010