The Overlooked Climate Solution

Joint Action by Governments, Industry, and Consumers

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ABSTRACT

Following the failure of the December 2009 climate conference in Copenhagen, there is no clear path for quick worldwide large-scale increases in renewable energy and energy efficiency, though such action is needed to keep greenhouse gas (GHG) emissions down over the long term. In the meantime, better alternatives to livestock products can be scaled up and have a large positive effect on climate quickly and at minimal cost, through joint action by government, industry, and citizens/consumers.

The ability of individuals to make a significant difference in climate change through a single, relatively simple change in their food choices is distinguished from choices in energy—where the same effect entails pushing consumers to make dozens of changes in behaviour. Necessary as those changes will be over time, they will require decades and cost trillions of dollars by governments and industry before the required consumer action can be fully taken.

Keywords: Greenhouse gases, food security, climate change, vegetarianism.

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WHAT COPENHAGEN OVERLOOKED

In 2006, the Food and Agriculture Organization of the United Nations (FAO) published a 388-page report entitled *Livestock's Long Shadow*. That report analyses the climate impacts of livestock—assessing for the first time in a major publication the greenhouse gas (GHG) emissions attributable to livestock's supply chain from forests cleared to supermarkets. According to that report, the only way to increase global supplies of meat and dairy products is through more intensification and more deforestation. That assessment by the FAO was echoed in a recent public statement by the Director-General of the International Livestock Research Institute, Carlos Seré (2009), who wrote that rich countries feed animals grains that 'might instead have fed people'. Perhaps nobody of such stature in the livestock sector has ever made such a statement before.

Livestock's Long Shadow estimates GHG emissions attributable to livestock worldwide. It shows that atmospheric carbon from the respiration of all organisms—along with oxidation and erosion of soil organic matter—already exceeds the capacity of photosynthesis to absorb such carbon (FAO, 2006, Table 3.2). This implies that there are already too many livestock in the world today.

Using our backgrounds in environmental assessment at the World Bank Group, Jeff Anhang and I prepared an article for *World Watch* (Goodland & Anhang, 2009) in which we consider whether any sources of GHG emissions might have been missed in *Livestock's Long Shadow*. The key ones that we found missing are in the land set aside for both livestock and for feed production, along with several other significant sources. So our article suggests that livestock's shadow is not only long but colossal, responsible for at least 51 percent of human-caused GHG emissions.

If livestock are responsible for at least 51 percent of anthropogenic GHG emissions, then mitigation measures no longer suffice, and broadly avoiding emissions attributable to livestock

becomes critical. For example, improvements in the pasture-raising of livestock can somewhat increase carbon stores in soil. However, only about 8 percent of meat is produced from pasture-raised livestock (FAO, 2006), and there is little land available to increase this amount without causing deforestation. Further, when livestock are pasture-raised, they emit as much as three times the amount of methane as do intensively-raised livestock. Moreover, the possibility for mitigation to increase soil carbon is available for only the first part of the lives of most pasture-raised livestock, as most are intensively raised and fed crops for the second part of their lives.

Our *World Watch* article first recognises the importance of broadly avoiding emissions attributable to livestock; then it develops a case for achieving almost as much GHG reduction as was expected to be agreed on in Copenhagen—simply by replacing 25 percent of today's livestock products with better alternatives. According to Chris Mentzel, the CEO of a solar power company, our article shows that a 1 percent reduction in worldwide meat intake would have the same benefit as US$3 trillion in solar energy investments.[1]

Coverage of our article by media outlets and on the Internet has been voluminous. But a good measure of this seems due to unfortunate coincidence. That is, at the time our article was published, reports began to emerge from one country after another regarding harm to crops and livestock as a result of disruptive climate events. In November 2009 alone, livestock in India, Argentina, and the Philippines were among those reportedly harmed significantly by climatic events. Livestock dying from drought in Kenya have been proposed as possibly the first source ever of violent climate conflict (The Guardian, 2009).

These recent reports should be unsurprising, as it had been predicted that the most harm to crops and livestock would occur in countries where people can least afford it. More broadly, it has been forecast that 75 to 80 percent of harm caused by increasing levels of atmospheric carbon will occur in developing countries, although they contribute only about one-third of GHG emissions.

Nevertheless, weak conclusions are often reached when livestock products are assessed through a national or even regional lens. Livestock products and feed are global commodities, so they get flown, shipped and trucked all over the world; and climate change is transboundary. So policymakers must look beyond their own borders in considering the impacts of livestock on climate. In this way it becomes understandable—and even necessary—to imagine a world where not all land today dedicated to livestock and feed would remain so.

While generally overlooked, there is vast carbon absorption foregone today in land set aside for grazing livestock and growing feed. Yet any amount of foregone carbon absorption has exactly the same effect as an increase in emissions of the same magnitude. Moreover, carbon absorption available from land used for livestock and feed production is the only feasible way to absorb a significant amount of today's atmospheric carbon in the near term (Shulze, et al, 2009).

Considering the land used for livestock and feed that could regenerate forest, along with the high levels of relatively short-lived methane attributable to livestock, reducing livestock numbers would be the quickest way to reverse climate change. Yet renewable energy has been the most-discussed option for reversing climate change. This option must be pursued to keep emissions down over the long term. However, consumers will have to wait many years for industry and investors to develop sufficient renewable energy infrastructure across the world to reduce emissions significantly. Conversely, better alternatives to livestock products can be scaled up and have a positive effect on climate quickly—through joint action by citizens/consumers, governments, industry, and investors.

On the other hand, the FAO has publicly disclosed plans to assess GHGs by region and livestock type. However, these plans seem to overlook many reasons why it makes sense to assess GHGs for livestock on a sectoral basis, as the FAO itself did in its 2006 *Livestock's Long Shadow*. Some of the reasons flow from analysis by Alan Calverd, a British physicist. According to Calverd (2005), the specific metabolic rate of large mammals and flightless birds is broadly consistent, with each animal dissipating about 2 Watts/kg to stay alive, regardless of species. To reflect the 2W/kg dissipated by livestock regardless of species, a more or less constant amount of CO_2/kg is emitted from the breath of each type of livestock, regardless of species.

For CO_2 from the breath of each human on earth to be absorbed by trees rather than stay in the atmosphere, seven mature trees need to remain standing. As for each human to maintain a Western diet there must be slightly more livestock mass than human mass alive at any given time, more than seven mature trees are needed to absorb the CO_2 from the breath of livestock for each human eating a Western diet, regardless of the species of livestock consumed (or more than 45 billion trees worldwide). Accordingly, either CO_2 from the breath of livestock should be counted—or absorption by trees of that same amount of CO_2 should be counted, as carbon absorption by trees is foregone for any other purpose if it is set aside for absorbing CO_2 from the breath of livestock.

Transportation fuels accounted for about 6 billion tons of CO_2 in 2009. In comparison, CO_2 from the breath of livestock raised in 2009 accounted for about 10 billion tons of CO_2. Not only are the approximately 10 billion tons of CO_2 from the breath of livestock in 2009 invariable regardless of animal type, but there are also billions more tons of GHGs that are more or less invariable from these aspects of livestock production:

- GHGs from transporting each kg of livestock product;
- GHGs from solid and liquid waste from livestock and their products;
- GHGs attributable to livestock by-products such as leather and feathers;
- GHGs from the substantially higher amount of refrigerating, cooking, and packaging of meat *versus* analogues; and
- GHGs attributable to carbon-intensive medical treatment of millions of cases worldwide each year of zoonotic illnesses (such as swine flu) and chronic degenerative illnesses (such as coronary heart disease, cancers, diabetes, and hypertension leading to strokes) linked to the consumption livestock products—but not to analogues.

Accordingly, close to half the GHGs attributable to the lifecycle and supply chain of livestock products are more or less invariable, regardless of the type of livestock produced. Therefore, while significantly more GHGs are attributable to beef than to other meats because of cattle's grazing, feed, enteric fermentation, and manure management, that significance is much smaller than commonly thought—and no particular meat product is likely to have a GHG footprint more than 25 percent lower than any other. As a result, eating chicken instead of beef (for example) would not result in any appreciable slowing of climate change. Conversely, the GHG footprint of an analogue such as a soy-burger product or whole legume may be as much as 90 percent lower than the livestock product that it can replace.

BEYOND COPENHAGEN

As no new climate treaty was agreed at the December 2009 UN climate conference in Copenhagen, regulation may be left to the local level. This means that where regulation is most needed, it may be least likely to be passed, as the short-term perceived self-interest of constituents may prevent their legislators from effecting what is needed. In some ways, atmospheric carbon can be a useful proxy for broadly measuring adverse impacts on natural capital.

Similarly, opportunities to decrease atmospheric carbon can be a useful proxy for potential benefits in the areas of natural capital. While atmospheric carbon can be used as a proxy for adverse impacts on natural capital, for specialists in forests, fisheries, and agriculture to do their work, they must focus on specific aspects of natural capital.

It can also be useful to focus on adverse impacts on natural capital rather than atmospheric carbon when addressing people who are sceptical that climate change is anthropogenic. The reason for this is that atmospheric carbon is invisible and abstract to most people, whereas most adverse impacts on natural capital are visible and tangible. People sceptical of human-caused climate change may want to consider that most of the points in this paper do not actually require that they believe in human-caused climate change.

Next I will be set out a detailed assessment of issues for government, along with recommendations, followed by briefer assessments and recommendations for industry and consumers.

Government

Hitherto, governments have sought food security in two main ways. The first way to reach food security has been through boosting productivity on existing agricultural lands in a 'green revolution' using inputs such as fertilisers and biocides. Indeed, there is still significant scope to boost productivity by improved agricultural practices. The second way toward food security involves converting more forest to agriculture. However, this undermines the world's priority of reducing carbon by sequestration. In addition, much carbon is released by conversion of forest to food production by burning the cut forest and its subsequent rotting.

There is a third way that most governments have ignored, namely promoting an increase in the nutritional value of agricultural land. This means feeding more people from existing arable lands, while improving human diets. It means phasing down the least efficient land uses (livestock and feed) and focusing instead on the more direct and efficient human nutrition (soy, grains, vegetables). A 25 percent reduction in this least efficient human food would not only achieve the promise of Copenhagen in terms of GHG reduction, but would help governments to achieve their objectives in food security.

To grow better alternatives to meat and dairy products, less than half the acreage is required as that which is needed to produce meat and dairy products themselves. Such alternatives would not only improve the nutritional efficiency of land[2] but also reduce the high wastage in meat and dairy production (Tristram, 2009).

Nearly all (97 percent) of the chronically hungry live in South Asia and Africa, the two regions most at risk from and devastated by climate change. Projected melting of glaciers feeding the major rivers of China and India may be the biggest threat to food security that humanity has ever faced.

A major humanitarian problem for governments will soon be how to feed the projected eight or nine billion people by 2050. Food production must double within 40 years. Yet today, food production is barely keeping up with demand. Climate change will exacerbate

this problematique. If governments, industry, and consumers fail to reverse climate change within five to ten years, what happens in 2050 will become moot. Yet the world should be able to feed these people, because we are already growing enough—but only if it is eaten directly by people. Most grain today is used to feed livestock and to fuel vehicles.

Worldwide, there are now more than one billion hungry, yet more than one billion are overweight or obese. The world wastes enough food to feed three billion. Today's surge in global meat production—70 percent from developing countries, achieved largely through deforestation—is responsible for far more waste than any other aspect of the food chain. The recent meat boom is the result of people in countries such as China abandoning their efficient traditional diets, and adopting western diets richer in meat, poultry, eggs and dairy products. For example, meat consumption per capita in China has jumped to 59.5 kilograms per year, up more than fourfold from 13.7 kg in 1980. In Brazil, it has doubled to 80.8 kg. The world's per capita meat consumption has soared to 41.2 kg per year, up 37 per cent from 30 kg in 1980.[3] Demand has similarly soared for milk and eggs.

The number of land-based livestock now raised annually is approximately 56 billion.[4] While the world focuses on reducing carbon dioxide emissions from fossil fuels, which resides in the atmosphere for 100–1000 years, the transition away from fossil fuels looks unlikely to be fast enough to prevent the critical threshold of 2º C warming. On the other hand, the half-life of methane from livestock is less than 10 years and over a 20-year timeframe methane has a global warming potential over 70 times that of carbon dioxide.[5] Meanwhile, land set aside for livestock and feed production could itself absorb huge amounts of atmospheric carbon. Therefore, reducing livestock production seems the fastest and lowest cost means of preventing climate disruption.

There is consensus among agricultural experts that raising food productivity is essential, possibly by means of another green revolution. Basically, there are only five options to double food production by 2050: 1) Raise agricultural yields; 2) increase production limits; 3) reduce waste; 4) expand agriculture into forest; and 5) improve diets. Only the latter can suffice on its own.

Another way to frame the issue is to ask whether farmland should be expanded into presently uncultivated ecosystems, mainly forest. This would be extremely costly and very difficult. General adoption of Western diets would need 3 million square kilometres of forest to be destroyed by 2050, which means land amounting to two-thirds the size of the Amazon forest. The likelihood of increasing productivity on existing farmland is implausible. Asian fertiliser use soared forty-fold in fifty years, while yields rose only four-fold. India's yields have plateaued, with excessive subsidies offered on water and electricity to pump it, as well as urea-based fertiliser. The water table gets deeper every year.

Deforestation worldwide burgeons according to Global Forest Resources Assessment 2010, now exceeding 3 million hectares annually.[6] Some experts assert that the world needs to convert yet more forest to agriculture for food (for example, Holmgren, 2009). This is actually terrifying, and unnecessary. Halving GHG emissions by 2050 means we have to use all the GHG-sequestration we can possibly muster, and certainly not reduce sequestration capacity. Too much forest has already been destroyed. The world needs more forest than today in order to stabilise climate and sequester carbon.[7] To the extent that further areas might be deforested for food, that would result in less carbon sequestration capacity, along with much more carbon emissions generated from burning and rotting forest being converted to agriculture. There are no clear ideas of how much more forest should be cleared for more food, no agreed-on criteria to select which tracts of forest to remove, and no criteria to know

when enough forest has been converted, hence when to stop and let the forest remnants get on with carbon sequestration.

Recent data on available productive land for all additional agriculture (such as biofuel production, agro-forestry, and tree plantations) is alarming. Energy prices are driving up crop prices, now that the world's financial crisis seems to be subsiding. Subsidies and the concentration of capital in the biofuel business seem excessive, distorting how land is used. Heavy South-South land-buying that results in exporting food to rich buyers appears to be boosting land prices (Grain, 2009).

The 1997 Kyoto Protocol excluded credits from conserving the carbon-sequestration services of forests. Yet preventing deforestation is the most powerful and lowest cost way to reduce climate risks.[8] High-emissions countries can buy up intact forest to be conserved as carbon sinks in perpetuity with monitoring.[9] These need to be ramped up substantially. REDD and the commendable Norway–Brazil forest protection scheme[10] to reduce first Amazonian and then other deforestation hold promise.

Copenhagen failed to agree on a plan to allow countries to claim either cash or GHG-emission credits for changes in managing their forests to sequester carbon. In any event, both REDD and the Norwegian–Brazil schemes are arguably dwarfed by what is needed, and cannot compete with expanding livestock and feed production. IUCN's (2009) *The Financial Costs of REDD* report found that many poor farmers in tropical rainforest zones would stand to benefit from an agreement, due to the low income that they currently receive from 'slash and burn' agricultural production.[11]

The world should in general not convert more forest to food production. Cases for exceptions seem to be few. On the contrary, the emphasis should be on a massive expansion of forest regeneration, reforestation and tree plantations on degraded lands for GHG-sequestration and employment generation. After trees peak in their CO_2 sequestration abilities (after about 50–100 years), they may be selectively logged. However, the survival of much of the world's forests may well depend of the survival of local communities. According to the International Alliance of Indigenous and Tribal Peoples of Tropical Forests, about one billion local people control a quarter of the world's remaining forests.

Following the publication of *Livestock and Climate Change* by Jeff Anhang and me, the FAO graciously invited us to participate in two fora. The first was an FAO expert consultation in Rome, Italy in December 2009 on greenhouse gas emissions and mitigation potentials in the agriculture, forestry and fisheries sectors. The second was an FAO-organised session at the Global Forum for Food and Agriculture during International Green Week in Berlin, Germany in January 2010. For each of those two fora, we prepared presentations that contain many details that interested people may want to read.[12] Rather than repeat all the points in those presentations, following is an updated summary of our policy recommendations.

Priorities for governments everywhere should include a prompt withdrawal of financial and fiscal support wherever it is provided for any large-scale livestock or feed projects. For non-arable land, governments should in most cases support reforestation, or setting aside of land to regenerate forest. Where needed and appropriate, governments should promote the reallocation of arable land for production of the most efficient foods for human nutrition (for example, grains and vegetables). Governments everywhere should introduce GHG emission taxes that would penalise inefficient food production, thus helping to reduce livestock and feed production. This tax should be strictly revenue neutral, through commensurate reductions in income tax. The proceeds from GHG taxes may be fully rebated to each family, or some may be allocated to accelerate the development of renewable energy.

Governments' own procurement policies should promote low-carbon foods, and government functions should offer meat and dairy analogues as a matter of routine (Jowett, 2009). Governments should provide incentives for food retailers to offer meat and dairy analogues—much as they promote fuel-efficient vehicles. Public sector support should be made available for developing labelling of the carbon intensity of foods at the retail level.[13] Governments should work with the health insurance industry to reduce premia for those who consume healthy, low-carbon diets while raising premia for people who choose to do otherwise.

In the US House of Representatives, some significant initiative appears to be underway. House Agriculture Committee Chair Collin Peterson emphasised:

> The livestock industry likes $1.80 corn and they built an industry based on $1.80 corn which was never realistic because it was subsidized and they got cheap feed. And now when they have to pay the actual value, the model doesn't work so well... We need to get to as much of a market-based situation as we can and you need $3.50-4.00 to grow corn. And the more environmental regulations they put on us and all of this other stuff, the more it's going to cost. The livestock people need to get used to it and people are going to have to pay more for meat. That's where this is headed.[14]

Industry

As with all other emissions in the world, the emissions attributable to livestock should be considered as impacts managed or owned by the industry or sector that emits them. But the livestock sector sits within the larger food industry—which in total produces much smaller volumes of livestock products than the volumes it produces of grains, legumes, fruits, and vegetables, all of which are exposed to the impacts of emissions attributable to livestock. Moreover, this exposure is probably greater than the exposure of any other industry to the very same emissions. Therefore, there is a compelling commercial motivation for the food industry to manage the impacts of these emissions, as soon as they are understood.

Interest in managing the risk of livestock should rise even higher when the food industry realises that there are pragmatic business opportunities that would balance the impacts—namely, to produce better alternatives to livestock products. Nobody else owns or can manage the existing impacts and available opportunities as directly as can the food industry. So ideally, the impacts and opportunities will be first understood and then managed directly by the food industry. In fact, all large companies in the food industry already employ their own environmental specialists. However, those specialists have apparently so far overlooked the impacts and opportunities identified in *Livestock's Long Shadow*, *World Watch*, and elsewhere.

Incentives include that meat and dairy prices are set to soar as soon as climate risks are taken seriously. Analogues need less petroleum, create more sustainable jobs, and are more convenient for consumers. If vendors promote analogues, palates will follow.

It seems that industrial livestock production is becoming an obsolescent, sunset industry. Climate and other environmental imperatives, as well as costs, all militate against this industry. Meat and dairy analogues will improve corporate profit margins. They will sell well because of their quality, including ease and speed of preparation and delivery, and good taste. Preferences change readily if price, taste and other benefits are realised. Labelling of carbon intensity will help to improve consumption choices.

Scaling up analogues will insulate food corporations from rising oil prices. 'Peak oil' makes it likely that industry will be forced to produce less meat and dairy products. Analogue

manufacturers might gain carbon credits, as analogues are much less carbon intensive than meat and dairy products.

Food industry leaders such as Cargill[15] and Whole Foods seem to be moving in this direction. Any significant innovation in this area by food industry leaders will tend to lower the costs both of climate disruption and climate adaptation.

Individuals

Many experts have recently targeted the general public with messages about livestock and climate change. For example:

- Andy Thorpe at the University of Portsmouth calculated that 200 cows emit methane each year equivalent to the emissions from a family car driven 111,850 miles (The Independent, 2008).

- Rajendra Pachauri, Chair of the Intergovernmental Panel on Climate Change, emphasised: 'In terms of immediacy of action... reducing meat consumption clearly is the most attractive opportunity' (The Guardian, 2008).

- Paul McCartney is promulgating a worldwide Meat Free Monday campaign for the general public, and spoke in December 2009 to the European Parliament on this topic, along with Rajendra Pachauri and Olivier de Schutter, UN Special Rapporteur on the Right to Food (European Parliament, 2009).

- Lord Stern of Brentford, former World Bank Chief Economist, and lead author of the *Stern Review on the Economics of Climate Change*, has publicly stated: 'Meat is a wasteful use of water and creates a lot of greenhouse gases. It puts enormous pressure on the world's resources. A vegetarian diet is better' (The Sunday Times, (2009).

After some media outlets cited and even exaggerated a claim by Frank Mitloehner in a speech in March 2010, asserting that the climate impact of livestock had been overestimated, numerous independent analyses followed up to show that this claim is false.[16]

The many recent efforts by public figures and media outlets to raise awareness among individuals appear to be creating momentum toward replacing livestock products with better alternatives. However, even more powerful momentum might be developed through collaborative efforts by governments, industry, and the general public. This could be a 'Trifecta' victory—mitigating the challenges of providing sufficient and healthful food for all; alleviating the global water crisis;[17] and reversing climate disruption quickly and inexpensively.

NOTES

1 See http://www.mauiweekly.com/page/content.detail/id/500866/The-Copenhagen-Fools.html.

2 Note that improving human diet efficiency by increasing the plant-based ratios of the human diet is quite different from boosting livestock and dairy 'feed conversion efficiency', which means phasing down pasture-feeding, while ramping up feedlots, stall feeding and factory-farms for meat, egg and dairy production. On the contrary, efficiency should mean reducing the feed and grains allocated to livestock.

3 With big variations, for example: US exceeds 342 g/day, Europe 220 g/day, SubSaharan Africa 36 g/day.

4 CO_2respired from a given weight of livestock is roughly the same, including roughly two billion ruminants (cattle, sheep, goats), plus pigs and poultry. Farmed fish are included, but as they are cold blooded they exhale less CO_2 per kilogram. More than half caught oceanic fish become fishmeal for pond fish, livestock and pets. World meat production is now nearly 300 million tons annually. The average American eats more than 2 kilograms of meat weekly, Europeans about half that.

5 $CO_2$is defined as having a GWP of one. Ammonia from cattle manure oxidizes to N_2O; much also originates from nitrate fertilisers. The Greenhouse Gas Protocol (GHG Protocol.org) is the most widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions.

6 Of course, arid lands sequester much less GHG than forests do, but desertification rages on at nearly 4 million hectares annually, and arable lands lost to soil erosion exceed 5.5 million hectares annually.

7 GHG Sequestration: (a) Johan Eliasch's (2008) report *Climate Change: Financing Global Forests* goal is to halve emissions from deforestation by 2020 and to make global forests carbon neutral by 2030. This seems too modest and incommensurate with the need. It might be politically palatable, but it seems too risky for such a critical goal. (b) James Lovelock (2009) writes, 'There is one way we could save ourselves and that is through the massive burial of charcoal. It would mean farmers turning all their agricultural waste—which contains carbon that the plants have spent the summer sequestering—into non-biodegradable charcoal, and burying it in the soil'.

8 Births outweigh deaths by more than 100,000 per day. Thomas Wire has calculated that providing women choice or family planning is probably the most cost effective measure. US$7 spent on family planning reduces GHG by one ton. $13 spent on reduced deforestation reduces GHG by a ton, $24 for wind energy, $51 for solar power. It matters greatly whether today's 6.8 billion humans grow to 8, 9 or 10 billion by 2050. As overweight/obese/overconsuming people (1.5 billion) now exceed hungry/undernourished/underconsuming people (1.1 billion), overconsumption by the rich is by far a more serious cause of today's environmental problems than overpopulation by the poor.

9 High-emitting nations also must reduce their GHG emissions by 25–40 percent by 2020 compared with 1990 emissions levels.

10 The Norway–Brazil Amazon Funds expect to raise US$21 billion by 2020 from public and private sources: www.amazonfund.gov.br.

11 The process whose acronym is LULUCF acknowledges that forests soak up GHG and sequester them. Countries conserving forests get credit. Logging corporations are pressuring their governments to insert a clause into the rules claiming that by 'Sustainable Forest Management' one could cut most trees without losing credits.

12 See http://awellfedworld.org/sites/awellfedworld.org/files/pdf/FAOConsult12-09.pdf and http://awellfedworld.org/sites/awellfedworld.org/files/pdf/GoodlandFoodIndustryBerlinJan2010.pdf.

13 Monika Pearson of Sweden's National Food Administration in close collaboration with the Environmental Protection Agency is integrating nutritionally-based recommendations with national environmental objectives, especially on GHG emissions. Within each food group, foodstuffs have been judged on their environmental impact on climate, pesticide use, biodiversity and eutrophication.

14 See www.lavidalocavore.org/show Diary.do?diaryId=2932.

15 Cargill, the largest privately held company in the United States (six times the size of McDonald's) recently launched an ingredient for the production of a 100 percent non-dairy cheese analogue for pizza and other prepared food applications that 'replicates the functionality of dairy protein and replaces it fully at an outstanding cost advantage for the manufacturer'. According to Cargill, 'its appearance, taste and texture perfectly match those of processed cheese' (Cargill, 2009).

16 See for example these publications: (1) http://www.theatlantic.com/food/archive/2010/04/the-myth-of-green-beef/38810/; (2) http://www.cjr.org/the_observatory/meat_vs_miles.php, (3) http://blogs.alternet.org/patthomas/2010/03/24/livestock-climate-change-and-a-mediocre-media/, (4) http://environment.change.org/blog/view/meat_is_still_a_climate_villain, (5) http://blog.greenhearted.org/2010/03/when-something-smells-funny-follow.html.

17 1 lb of beef needs 2000 gallons of water. 1 lb of soy needs 200 gallons of water. Corn needs 100 gallons. A plant-based diet requires 300 gallons/week, whereas a typical Western diet today uses 2000 gallons/week.

REFERENCES

Cargill. (2009). *Cargill creates breakthrough for dairy-free analogue cheese production with Lygomme™ ACH Optimum functional system*. Retrieved from http://www.cargill.com/news-center/news-releases/2009/NA3020258.jsp.

Calverd, A. (2005, July). A radical approach to Kyoto. *Physics World*, 56.

Eliasch, J. (2008). *Climate change: Financing global forests*. London: Earthscan.

European Commission. (2009). *The role of European agriculture in climate change mitigation*. Staff Working document, SEC 1093, 23 July.

European Parliament. (2009). *"Less meat = less heat" with Sir Paul McCartney and Dr Rajendra K. Pachauri*. Retrieved from http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+IM-PRESS+20091201IPR65710+0+DOC+XML+V0//EN.

FAO. (2006). *Livestock's long shadow: Environmental issues and options*. Steinfeld, H., Gerber P., Wassenaar, T., Castel, V., Rosales, M. & Haan, C. Rome: UN Food and Agriculture Organization.

Goodland, R. & Anhang, J. (2009). Livestock and climate change: What if the key actors in climate change are cows, pigs and chickens? *World Watch*, *22*(6), 10-19.

Grain. (2009). *Land grabbing and the global food crisis*. Retrieved from http://www.grain.org/o_files/landgrabbing-presentation-11-2009.pdf.

Holmgren, P. (2009, December). *Personal communication*. FAO Director of Environment, Climate Change and Bioenergy, Natural Resources Department, Rome.

ICUN. (2009). *The financial costs of REDD*. Retrieved from http://data.iucn.org/dbtw-wpd/edocs/2009-047.pdf.

Jowett, J. (2009). *Hospitals remove meat from menus in bid to cut carbon*. Retrieved from http://www.guardian.co.uk/society/2009/jan/26/hospitals-NHS-meat-carbon.

Lovelock, J. (2009). One last chance to save mankind. *New Scientist*, *2692*, 30-31.

Nilsson, S. (2009). *Do we have enough forests?* IUFRO Occasional Paper No. 5.

Peskett, L., Huberman, D., Bowen- Jones, E., Edwards, G. & Brown, J. (2008). *Making REDD work for the poor*. Retrieved from http://www.unep-wcmc.org/climate/pdf/Making%20REDD%20work%20for%20the%20poor%20FINAL%20DRAFT%200110.pdf.

REDD Monitor. (2009). *REDD: An introduction*. Retrieved from http://www.redd-monitor.org/redd-an-introduction/.

Schulze, E-D., Luyssaert, S., Ciais, P., Freibauer, A. & Janssens, I. A. (2009). Importance of methane and nitrous oxide for Europe's terrestrial greenhouse-gas balance. *Nature Geoscience*, *2*, 842-850. [CrossRef]

Seré, C. (2009). *Livestock crucial for coping with climate change*. Retrieved from http://cgiarclimatechange.wordpress.com/2009/11/03/livestock-crucial-for-coping-with-climate-change/.

The Guardian. (2009). *UN says eat less meat to curb global warming*. Retrieved from http://www.guardian.co.uk/journalismcompetition/professional-climate-change-conflicts.

The Guardian. (2008). *The first climate change conflicts*. Retrieved from http://www.guardian.co.uk/environment/2008/sep/07/food.foodanddrink

The Independent. (2008). *Emissions from burping cows 'higher than family car'* Retrieved from http://www.independent.co.uk/environment/climate-change/emissions-from-burping-cows-higher-than-family-car-967995.html.

The Sunday Times. (2009). *Climate chief Lord Stern: give up meat to save the planet*. Retrieved from http://www.timesonline.co.uk/tol/news/environment/article6891362.ece.

Tristram, S. (2009). *Waste: Uncovering the global food scandal*. New York: Penguin.

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Robert Goodland is a tropical ecologist specialising in the social and environmental impacts of major projects in developing countries. He drafted and persuaded the World Bank Group to adopt most of its social and environmental policies during his quarter century as Environmental Adviser in Washington, DC. He then served as the technical director of the independent Extractive Industries Review of the World Bank Group's oil, gas and mining strategy. He was elected president of the International Association for Impact Assessment, and Metro Chair of the Ecological Society of America. In 2008, the World Conservation Union (IUCN) awarded him their Coolidge medal for outstanding lifetime achievements in conservation. He is grateful for the work and support of his co-author and colleague Jeff Anhang.

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