

*Chomping Climate Change*

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**Response to “Livestock and greenhouse gas emissions: The importance of getting the numbers right,” by Herrero et al. [Anim. Feed Sci. Technol. 166-167: 779-782]**

Herrero et al. (2011) wrote a commentary in this journal entitled “Livestock and greenhouse gas emissions: The importance of getting the numbers right,” and indicated that the commentary’s objective was to improve “understanding of livestock’s contribution to GHG [greenhouse gas] emissions” and “to design better climate change mitigation and adaptation strategies.” Thus, readers were led to believe that what followed would clarify the amount of GHG emissions attributable to livestock, and the best available strategies for reducing those emissions.

However, the commentary by Herrero et al. (2011) actually consisted mainly of a review of an article that we co-authored in *World Watch* (Goodland and Anhang, 2009). We believe that their commentary misstates some important facts, and in some areas risks misleading readers. For each such case, we will summarize the relevant statement by Herrero et al. (2011) and provide our response. For the convenience of readers, this commentary uses the same headings as used by Herrero et al. (2011).

## **1. Introduction**

Herrero et al. (2011) began their commentary by stating: “Livestock farming plays a critical role in food production across the globe, and has formed part of local landscapes and ecosystems for millennia.” This risks misleading readers to believe that livestock farming has been a relatively static activity for millennia – when at its start it was a relatively insignificant activity, while today livestock systems are said to occupy 45% of earth’s land surface area (Thornton et al., 2011).

Next, the commentary by Herrero et al. (2011) stated: “The importance of livestock in providing human societies with food, incomes, employment, nutrients and risk insurance is widely recognized.” Again, this risks misleading readers to overlook important changes in the livestock sector in recent years. Today, livestock do not uniformly provide risk insurance. In fact, the World Bank and others are

providing assistance to livestock herders in the form of insurance schemes to absorb risk to livestock as a result of climate change (New Agriculturalist, 2010), although, as will be discussed, livestock themselves actually are responsible for a significant amount of the risk.

Moreover, any assurance that livestock would provide benefits of any type has been reduced as a result of climate change. In recent years, there have been unprecedented levels of livestock die-offs due to disruptive climate events. For example, in 2009, major livestock die-offs due to climate disruption occurred in the Philippines, India, Argentina, Kenya, and the U.S. (World Food Programme, 2009; The Hindu, 2009; Demos, 2009; ILRI News, 2009; Stoddard, 2009).

Readers may want to assess the importance of livestock in providing food, incomes, employment and nutrients to humans relative to the importance of other agricultural products in providing such benefits. In this regard, a report commissioned by the World Bank's Agriculture and Rural Development Department from the Harvard School of Public Health (Hu and Willett, 1998) states: "In many situations, the partial displacement of the carbohydrate staple source of energy with animal products may have neutral or beneficial health effect. However, the use of plant source of protein and fat, such as soy products, nuts, and vegetable oils, may provide even greater health benefits and should therefore be considered simultaneously when considering investments in development."

Where livestock-raising is now imperiled by climate change, alternative livelihoods are now much more widely available than previously as a result of the dramatic growth in use of computers, mobile communications, mobile banking, microfinance and off-grid electricity (Sullivan, 2007). Various reports also suggest a number of pastoralists are turning to raising crops instead of livestock (Omula, 2010; Smith, 2011; Njeru, 2011). Even so, our *World Watch* article recommended a 25% reduction in the number of livestock worldwide – and this can be made to happen in select locations so that livestock populations in poor rural communities would remain entirely intact.

Next, Herero et al. wrote that *Livestock's Long Shadow* (FAO, 2006) uses well documented and rigorous life cycle analysis. This is not so. *Livestock's Long Shadow* counts only GHG emissions which, according to the GHG Protocol (<http://www.ghgprotocol.org/>) – the most widely-used protocol for

counting GHG emissions in the world – are considered to come under Scope 1 and Scope 2 (that is, GHG emissions from elements owned or purchased by a livestock producer). However, our *World Watch* article included an assessment that *Livestock's Long Shadow* dramatically undercounts Scope 1 GHG emissions attributable to livestock, and omits to count any GHG emissions considered by the GHG Protocol to come under Scope 3 – that is, GHG emissions from parts of the livestock supply chain not owned or purchased by livestock producers (Goodland and Anhang, 2009).

The commentary by Herrero et al. (2011) promoted *Livestock's Long Shadow* as containing the single authoritative assessment of GHG emissions attributable to livestock. They did so without making an explicit disclosure that one of them was the lead author – and another of them a co-author – of *Livestock's Long Shadow*.

Herrero et al. (2011) rounded out their introduction section by starting to critique our analysis. They claimed that our *World Watch* article was not peer reviewed; but that is not so. When our *World Watch* article was published, one of us (Jeff Anhang) was an active staff member (and still is) of the International Finance Corporation, part of the World Bank Group. World Bank Group rules require prior management approval of any article published by a staff member. For our *World Watch* article, World Bank Group management required thorough and expert peer review by numerous environmental, and other, specialists. As is commonly written by authors of reports published by the World Bank Group itself, we disclaim that our views are necessarily those of the World Bank Group. However, our analysis has been cited on the World Bank's official external website (World Bank, 2011).

The World Bank and International Finance Corporation each have the same status within the United Nations (UN) system as does FAO, publisher of *Livestock's Long Shadow*; that is, each is a specialized agency of the UN.

According to our *World Watch* article, the lifecycle and supply chain of livestock products account for at least 51% of annual worldwide GHG emissions (Goodland and Anhang, 2009). That article stated that we believed we were making a strong claim that required strong evidence. We endeavored to provide such evidence, and our *World Watch* article became widely cited.

Since publication of our *World Watch* article, many experts in environment, industry and international development have expressed support for our analysis of livestock and climate change. For example, UNESCO (2010), another specialized agency of the UN, reported: "Goodland and Anhang explained... what may be a large-scale paradigm shift in the approaches to mitigating climate change." Our *World Watch* article has been included in numerous university reading lists, such as the one for a 2011 environmental studies course at the University of California at Santa Barbara (UCSB, 2011). Although our *World Watch* article critiqued *Livestock's Long Shadow*, the FAO invited us to deliver presentations on our *World Watch* article at meetings in Rome and Berlin (Goodland, 2009 and Goodland, 2010).

We are both longstanding environmental assessment (EA) specialists. Conversely, not a single author of *Livestock's Long Shadow* is an EA specialist. International good practice in EA is to have any project with major environmental impacts – such as global livestock and feed production – be assessed by EA specialists (Kiene, 2010).

It appears that evidence arose of the need for EA specialists to be involved in assessing livestock and climate change when the authors of *Livestock's Long Shadow* were forced to retract their comparison of livestock related GHG emissions to transport related GHG emissions, after it was revealed that their estimate of livestock related GHGs involves some lifecycle analysis, but their estimate of transport-related GHGs involved none, only CO<sub>2</sub> from the tailpipes of all types of transportation vehicles (The Atlantic, 2010). We propose that such an elementary error would have been less likely to occur if an EA specialist had been involved in the writing of *Livestock's Long Shadow*.

## **2. Exclusion of carbon dioxide emissions from livestock respiration**

According to Herrero et al. (2011), under the Kyoto protocol CO<sub>2</sub> from livestock respiration is not considered a net source of CO<sub>2</sub>. This is factually incorrect. According to the Kyoto Protocol's Annex A, all CO<sub>2</sub> should be counted without exception. Yet according to Herrero et al. (2011), no CO<sub>2</sub> from livestock respiration should be counted in analysis of GHG emissions attributable to livestock.

In our assessment, either CO<sub>2</sub> in livestock respiration or carbon absorption foregone because of land set aside for livestock and feed production must be counted as emissions. That is because reality no longer reflects the old model of the Carbon Cycle, in which photosynthesis balanced respiration. That model made sense when there were roughly constant levels of respiration and photosynthesis on Earth. However, respiration has increased exponentially with livestock production (now more than sixty billion land animals per year) – while increased livestock and feed production accompanied by large scale deforestation and forest-burning have caused a dramatic decline in the earth’s photosynthetic capacity, along with large and accelerating increases in volatilization of carbon in soil. This seems evident in a table published in *Livestock’s Long Shadow* itself, showing that today’s atmospheric carbon from the respiration of all organisms – along with oxidation and erosion of soil organic matter – exceeds the capacity of photosynthesis to absorb such carbon (FAO, 2006, Table 3.2).

We would propose that those who consider counting CO<sub>2</sub> from livestock respiration to be overly controversial can consider it to be a proxy for carbon absorption foregone in land set aside for livestock and feed production. This perspective is supported by a source (Searchinger et al., 2009) cited by Herrero et al. (2011) themselves. According to this source: “If... crops displace forest or grassland, the carbon released from soils and vegetation, plus lost future sequestration, generates carbon debt, which counts against the carbon the crops absorb.”

### **3. Emissions from land use and land use change**

According to Herrero et al. (2011), FAO’s analysis of actual land use trends is preferable to our *World Watch* article’s use of a ‘what-if scenario’ in estimating emissions attributable to land use. In fact, the Kyoto Protocol, cited by Herrero et al. (2011) as a relevant reference, relies in all its parts on ‘what-if’ scenarios; that is, measurements of theoretical prospective carbon emissions and absorptions. Similarly, a ‘what-if’ scenario is entirely properly applied to measurements of livestock and climate change.

According to Herrero et al. (2011), our *World Watch* article did not quantify the lost opportunity for carbon sequestration that results from other forms of land use, such as urban development. In fact, our *World Watch* article used a minimal figure for foregone carbon absorption in land set aside for livestock and feed production (Goodland and Anhang, 2009) when the true figure would be much higher.

According to Herrero et al. (2011), the “proposed biofuel option” in our *World Watch* article was “misleading.” Actually, our *World Watch* article did not propose biofuel as an option, but rather assessed it as a possible – yet undesirable – scenario.

According to Herrero et al, most livestock occupy large areas of the world where other forms of agriculture are not possible. Livestock do sometimes occupy land where no other productive use is possible, such as desert areas too dry for woody growth. However, they much more often occupy reforestable land, or arable land where non-livestock agriculture is possible (World Resources Institute, 2011). In addition, one of the world’s key frontiers for expanding livestock and feed production in recent years has been the Amazon rainforest. Either non-livestock agriculture or regeneration of forest would provide for much more sequestration of carbon than does livestock raising.

The commentary by Herrero et al. (2011) expressed concern that if domesticated ruminants are removed from an area, implications would arise there for populations of wild ungulates and mixes of species. In fact, the adverse impacts of livestock raising are much greater than the adverse implications of any other scenario, as studies have consistently shown that GHG emissions attributable to wild animals are minimal relative to those of livestock (*e.g.*, Subak, 1994).

According to Herrero et al. (2011), our *World Watch* article failed to provide detailed analysis of which alternative protein sources would replace animal protein in human diets and implications in terms of land use, land use intensity, food security, human nutrition and livelihoods. In fact, our *World Watch* article discussed at length the alternative protein sources that would replace animal protein in human diets, and briefly discussed their implications in terms of land use, food security, human nutrition and livelihoods.

*Livestock's Long Shadow* actually discussed the many adverse impacts of livestock, and their inefficiency compared with alternative protein sources. The insistence by Herrero et al. (2011) that our analysis was insufficiently detailed was recently undermined by the chief executive of his own organization. That is, Dr. Carlos Seré, then Director-General of the International Livestock Research Institute, wrote that livestock eat grain that "might instead have fed people" (CGIAR, 2009), and apparently considered it appropriate to provide no further details.

#### **4. Global warming potential of methane**

According to Herrero et al. (2011), at the writing of *Livestock's Long Shadow*, a global warming potential (GWP) of 23 for methane over a 100 year time horizon was considered valid and acceptable. We have not suggested otherwise. However, the International Panel on Climate Change (1995) has long supported the use of a 20 year timeframe for methane.

Our *World Watch* article explained that a 20 year time horizon, and a GWP of 72, are more valid and acceptable to use in relation to livestock related methane emissions than a 100 year time horizon and GWP of 23. Our explanation is supported by an article (Dyer et al., 2011) co-authored by four scientists employed by Agriculture and Agri-Food Canada, a Canadian Government department, which states: "The 20-year accounting period may be a better reflection of the time scale for the GWP of CH<sub>4</sub> because of the growing urgency of global warming (Goodland and Anhang, 2009)."

#### **5. Attribution of greenhouse gases to livestock**

According to Herrero et al. (2011), our *World Watch* article confounded "poultry biomass" with production of poultry meat. However, in developing analysis for our *World Watch* article, wherever we thought that we might not have been able to interpret correctly FAO numbers (FAO, 2006; FAO, 2007a; FAO, 2007b), we built in an allowance for the lowest possible numbers to apply.

According to Herrero et al. (2011), estimating GHG emissions attributable to livestock is very complex, and must be analyzed with solid conceptual models and methodologies that are still under



development and have not yet been vetted by the international scientific community. This is true. However, disappointingly, they do not propose any solid conceptual models, nor is any such model used in *Livestock's Long Shadow*.

## **6. Conclusions**

According to Herrero et al. (2011), relevant environmental assessment concepts suggest it is clear that effective GHG emission mitigation options should be designed to reduce emissions and improve sustainability of the livestock sector. However, they assert that livestock are needed to provide livelihoods and food for people; they project continued growth in the livestock sector and recommend no measure to restrict its growth; and they propose no strategy to achieve a net reduction in GHG emissions attributable to the livestock sector worldwide. They continuously fail to consider concepts considered essential in professional environmental assessment – notably the avoidance of impacts and analysis of alternatives, which would examine more environmentally sustainable pathways than livestock to provide livelihoods and food for humans.

Today's worldwide concentration of atmospheric carbon is the highest in recorded history, and is considered by experts to be unsafe, yet it is rising steadily (International Energy Agency, 2011). To reduce the concentration of atmospheric carbon, long-term potential reductions in projected GHG emissions are being examined in virtually every sector of human activity.

As long as today's broad international disagreement continues on the required large scale steps for reducing usage of fossil fuels, it seems clear that substantial reductions in GHG emissions in most sectors will be difficult to achieve (International Energy Agency, 2011). At the same time, the livestock sector is unique in being responsible for a significant amount of GHG emissions not attributable to usage of fossil fuels. This suggests that it may be particularly important to estimate GHG emissions attributable to livestock accurately, and to recommend measures to reduce GHG emissions attributable to the livestock sector.

In our *World Watch* article, we proposed that almost the entire goal of recent climate treaty negotiations could be achieved by replacing one quarter of today's human food products deriving from livestock raising with alternatives. This would allow forest to regenerate on the vast areas of land now set aside for cattle grazing and feed production for livestock. Regeneration of forest is the only known way to create new large scale capacity to sequester today's atmospheric carbon. Otherwise, atmospheric carbon normally takes at least a century to dissipate. As a result, our case may be the only pragmatic one available to address climate change in a significant way within the few years that remain before climate disruption is projected to become irreversibly catastrophic (International Energy Agency, 2011). According to the International Energy Agency (2011), the next five years are likely to be the world's last real chance to combat climate change.

While governments continue to struggle to agree on measures that would increase renewable energy infrastructure significantly, we propose that alternatives to livestock products could be scaled up quickly to reduce today's grave risk of climate change significantly. Indeed, reducing animal feed production and replacing at least one quarter of today's livestock products with substitutes could be the only way for governments, industry, and the general public collaboratively to take to take a single, powerful action to reduce climate change quickly.

### **Conflict of interest**

None

### **References**

CGIAR, 2009. Livestock Crucial for Coping with Climate Change.

[ [zerocarbonfarm.com/community/node/61](http://zerocarbonfarm.com/community/node/61) ]

Demos, T., 2009. Argentina's Cattle Crisis. *Fortune Magazine*, 8/11/09.

[ [http://money.cnn.com/2009/08/10/news/international/argentina\\_beef.fortune/index.htm](http://money.cnn.com/2009/08/10/news/international/argentina_beef.fortune/index.htm) ]

Dyer, J.A., Vergé, X.P.C., Desjardins, R.L., Worth, D.E., 2010. The Protein-based GHG Emission Intensity for Livestock Products in Canada. *J. Sust. Agric.*, 34: 618-629.

FAO, 2006. Livestock's Long Shadow. Environmental Issues and Options. Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO, 2007a. The State of the World's Animal Genetic Resources for Food and Agricultural. Rome, Italy.

FAO, 2007b. FAOSTAT Statistical Database updated 30 June 2007. [ [apps.fao.org](http://apps.fao.org) ]

Goodland, R., Anhang, J., 2009. Livestock and Climate Change. What if the key actors in climate change were pigs, chickens and cows? *World Watch*, November/December 2009. Worldwatch Institute, Washington, DC, USA. Pp. 10–19.

Goodland, R., 2009. Forests, Fisheries, Agriculture. A Vision for Sustainability. By invitation of the FAO for its expert consultation in Rome, Italy, 2-4 December 2009.

Goodland, R., 2010. How the Food Industry Can Reverse Climate Change Quickly and Profitably. By invitation of the FAO for the Global Forum for Food and Agriculture, International Green Week, Berlin, 14-16 January 2010.

Herrero, M., Gerber, P., Vellinga, T., Garnett, T., Leip, A., Opio, C., Westhoek, H.J. Thornton, P.K., Olesen, J., Hutchings, N., Montgomery, H., Soussana, J.-F., Steinfeld, H., McAllister, T.A. 2011. Livestock and greenhouse gas emissions: The importance of getting the numbers right. *Anim. Feed Sci. Technol.* 166-167: 779-782.

Hu, F. B., Willett, W.C., 1998. The Relationship between Consumption of Animal Products (Beef, Pork, Poultry, Eggs, Fish and Dairy Products) and Risk of Chronic Diseases: A Critical Review.

[<http://www->

[wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2004/09/17/000090341\\_20040917140312/Rendered/PDF/296130Consumption0of0animals01public1.pdf](http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2004/09/17/000090341_20040917140312/Rendered/PDF/296130Consumption0of0animals01public1.pdf) ]

ILRI News, 2009. Drought Hits Kenya's Livestock Herders Hard.

[ <http://www.ilri.org/ilrinews/index.php/archives/101> ]

Intergovernmental Panel on Climate Change, 1995. Climate Change 1994: Radiative Forcing of Climate Change and an Evaluation of the IPCC IS92 Emission Scenarios, Ed. J.T. Houghton, Cambridge University Press, Cambridge, U.K.

International Energy Agency, 2011. World Energy Outlook 2011. International Energy Agency, Paris, France. [ <http://www.worldenergyoutlook.org> ]

Kiene, W. Enforcing Industry Codes of Conduct: Challenges and Lessons from Other Sectors. 4/20/10. [ <http://siteresources.worldbank.org/EXTARD/Resources/336681-1236436879081/5893311-1271205116054/Kiene.pdf> ]

New Agriculturalist, 2010. Livestock Insurance: Reducing Vulnerability. July. [ <http://www.new-ag.info/en/focus/focusItem.php?a=1668> ]

Njeru, G. Kenyan herders switch to farming as droughts worsen. Alertnet, 7/7/11.

[ [www.trust.org/alertnet/news/kenyan-herders-switch-to-farming-as-droughts-worsen](http://www.trust.org/alertnet/news/kenyan-herders-switch-to-farming-as-droughts-worsen) ]

Omulo, D. Kenyan herders farm aloe as climate hits traditional income. Alertnet, 12/13/10.

[ [www.trust.org/alertnet/news/kenyan-herders-farm-aloe-as-climate-hits-traditional-income](http://www.trust.org/alertnet/news/kenyan-herders-farm-aloe-as-climate-hits-traditional-income) ]

Searchinger, T., Heimlich, R., Houghton, R.A., Dong, F., Elobeid, A., Fabiosa, J., Tokgoz, S., Hayes, D., Yu, T.-H., 2008. Greenhouse gases through emissions from use of U.S. croplands for biofuels increases land-use change. Science 319: 1238-1240.

Smith, G. Zambian poachers convert to climate-smart organic farming. Alertnet, 4/11/11.

[ [www.trust.org/alertnet/news/zambian-poachers-convert-to-climate-smart-organic-farming](http://www.trust.org/alertnet/news/zambian-poachers-convert-to-climate-smart-organic-farming) ]

Stoddard, E., 2009. Cattle, Crop Losses Mount in Texas Drought. Reuters, 8/20/09.

[ <http://thearansasproject.org/basin-management/cattle-crop-losses-mount-in-texas-drought/> ]

Subak, S., 1994. Methane from the House of Tudor and the Ming Dynasty: Anthropogenic Emissions in the Sixteenth Century. [ [www.uea.ac.uk/env/cserge/pub/wp/gec/gec\\_1994\\_06.Pdf](http://www.uea.ac.uk/env/cserge/pub/wp/gec/gec_1994_06.Pdf) ]

Sullivan, N., 2007. You Can Hear Me Now: How Microloans and Cell Phones are Connecting the World's Poor to the Global Economy. Jossey-Bass, San Francisco, CA, USA.

The Atlantic, 2010. Carnivorous Climate Skeptics in the Media. 4/22/10.

[ <http://www.theatlantic.com/food/archive/2010/04/carnivorous-climate-skeptics-in-the-media/39177/> ]

The Hindu, 2009. Drought and Crisis Management. 8/18/09.

[ <http://www.thehindu.com/opinion/editorial/article4637.ece> ]

Thornton, P., Herrero, M., Erickson, P., 2011. Livestock and Climate Change. ILRI Issue Brief.

[ <http://mahider.ilri.org/bitstream/handle/10568/10601/IssueBrief3.pdf> ]

UCSB, 2011. The Santa Barbara County Agrifood system, 2011 Winter Quarter.

[ [es.ucsb.edu/sites/es.ucsb.edu/files/content/syllabi/ES157\\_W11.pdf](http://es.ucsb.edu/sites/es.ucsb.edu/files/content/syllabi/ES157_W11.pdf) ]

UNESCO, 2010. Energy Flow, Environment and Ethical Implications for Meat Production.

[ [unesdoc.unesco.org/images/0018/001897/189774e.pdf](http://unesdoc.unesco.org/images/0018/001897/189774e.pdf) ]

World Bank, 2011. Diet for a low-carbon planet. [ [climatechange.worldbank.org/blogs/diet-low-carbon-planet](http://climatechange.worldbank.org/blogs/diet-low-carbon-planet) ]

World Food Programme, 2009. Philippines luzon typhoons and floods: Emergency food security assessment. [ <http://home.wfp.org/stellent/groups/public/documents/newsroom/wfp229085.pdf> ]

World Resources Institute, 2011. A World of Opportunity.

[ [http://pdf.wri.org/world\\_of\\_opportunity\\_brochure\\_2011-09.pdf](http://pdf.wri.org/world_of_opportunity_brochure_2011-09.pdf) ]

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