WPF
World Preservation Foundation

Reducing Shorter-Lived Climate Forcers through Dietary Change:

Our best chance for preserving global food security and protecting nations vulnerable to climate change




The debate over setting a limit of global average temperature increase to 2C has been a contentious one. Nations most vulnerable to climate change, including most of Africa, low lying islands and those dependent upon rapidly-melting glaciers for irrigation and drinking water have been calling for a climate change agreement limiting temperature increase to no more than 1.5C or even 1C in order to protect their people and livelihoods, as well as food security. [1] [2] On the other side of the debate, mainstream climate scientists claim such a low temperature limit is technically unfeasible because it would require commercially-viable negative emissions technology, which currently does not exist, to extract carbon dioxide (CO_2) from the air.[3]

How Urgent is Urgent?

Recognition of the need to find rapid emission-reduction solutions has magnified in the last year. Witnessing Russia lose a quarter of her grain crop[4] due to a "once-in-5,000-year" drought[5] and fires[6] at the same time as a fifth of Pakistan was flooding[7] highlighted global vulnerabilities to both social stability and food security present already, when average temperature increases have only reached 0.8C.[8] [9]

Furthermore, a recent report from the WWF has estimated that by 2020,

there will be 30 percent more emissions in the atmosphere than the levels estimated to keep global average temperature increases to 2C or under.[10]

To put this into perspective, researchers at University of Arizona calculated that between 129,000 and 116,000 years ago, when global average temperatures were 3C to 5C higher than they are today, the melting of the Greenland and Antarctic ice sheets led to sea levels up to six metres (20 feet) higher than they are now.[11]

How Low should We Go?

These recent events call into question the wisdom of policies putting off achieving deep emission reductions for 40 years. Earth Policy Institute founder Lester Brown states

> "*When political leaders look at the need to cut carbon dioxide emissions to curb global warming, they ask the question: How much of a cut is politically feasible? At the Earth Policy Institute we ask a different question: How much of a cut is necessary to avoid the most dangerous effects of climate change?"* [12]

While the G8 nations have agreed to reduce emissions 80 percent by 2050[13], the Earth Policy Institute estimates that to protect food security and to preserve lives and livelihoods, emissions need to be reduced 80 percent by 2020.[14] Their estimates are similar to those made by Nobel Prize-winning chemist Dr. Paul Crutzen, who estimates emissions should be reduced 70 percent by 2015.[15]

Why CO_2 Reductions won't Act Fast

In the beginning of the climate change debate, CO_2 was singled out as the single greatest cause of climate change. However, more recent research indicates CO_2 reductions will not create cooling in the relevant time frame. In

fact, CO_2 released today will still be in the atmosphere after thousands of years. Dr. David Archer at University of Chicago states

"The idea that anthropogenic CO_2 release may affect the climate for hundreds of thousands of years has not reached general public awareness."[16]

This means that although CO_2 reductions in the long run are imperative, and in the short run will avert increased warming, no amount of investment in green energy, electric cars, etc. will actually begin to create cooling in this generation. Therefore, other solutions are essential if short-term emission reduction is important.

Rapid Solutions Unveiled by Recent Climate Science Studies

Fortunately, the understanding of climate science has advanced significantly in the past few years to present a fast acting solution: reduction of non-CO_2 climate forcers which are not only more potent than CO_2, but dissipate out of the atmosphere much more quickly.

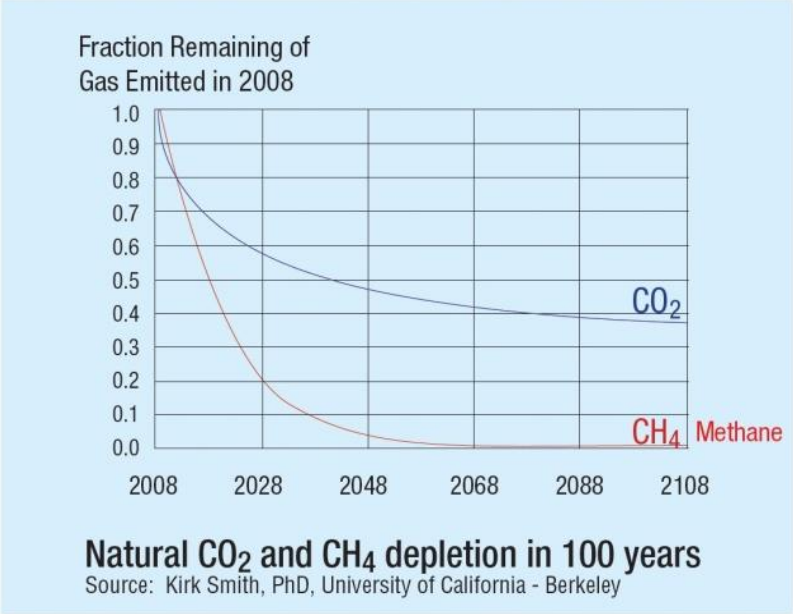
In *Short-lived pollutants in the Arctic: their climate impact and possible mitigation strategies* led by Dr. Patricia Quinn of the US National Oceanic and Atmospheric Administration (NOAA), the authors recommended reducing methane, ground level ozone and black carbon to bring about immediate benefits, stating:

"Reducing emissions of CO_2 globally will reduce the rate of surface warming and snow/ice melt in the Arctic. However, targeting emissions of short-lived pollutants along with CO_2 has the advantage of impacting Arctic climate on a more immediate timescale." [17]

Commercially viable solutions to reduce these shorter-lived causes of climate change exist today, with a dietary change away from animal proteins, towards plant proteins, being the most attractive for its ability to reduce emissions quickly and inexpensively, as well as for the additional benefits of contributing significantly to reversing biodiversity loss, ensuring water and food security, substantially reducing tropical deforestation, and reducing healthcare costs.

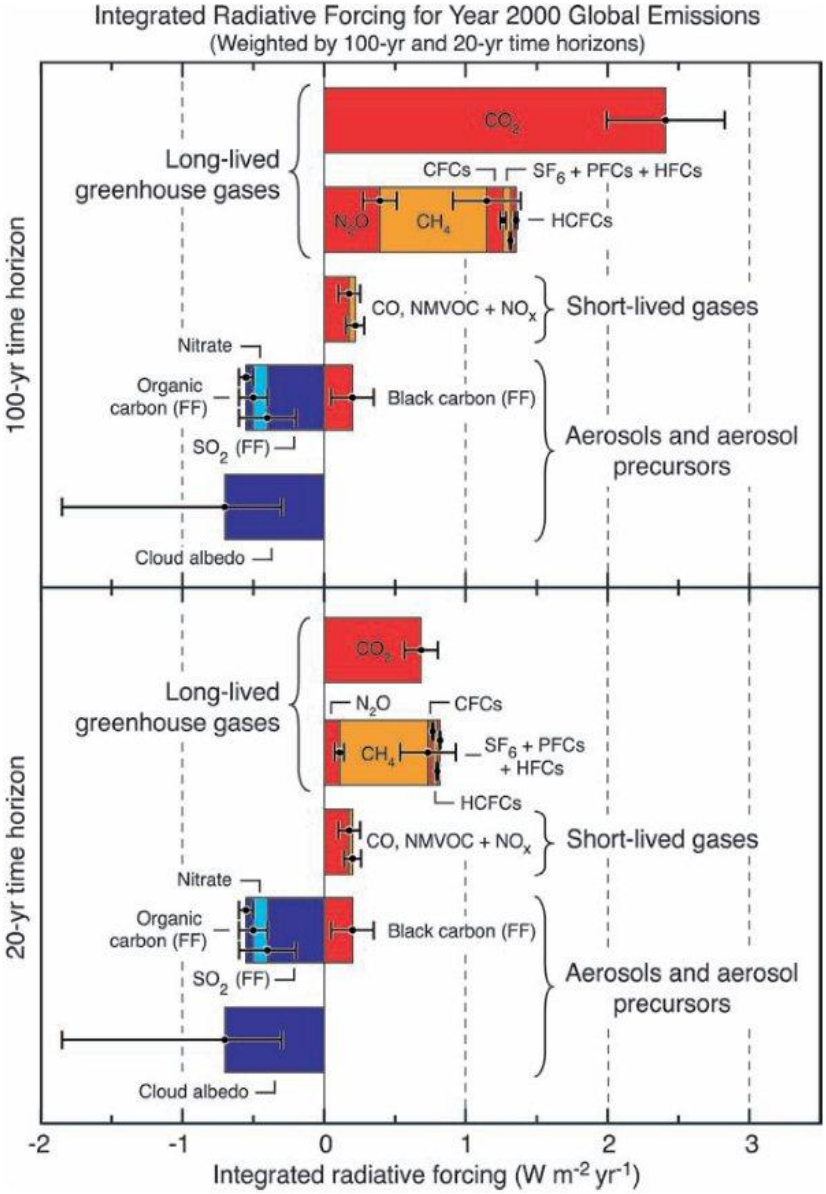
Methane: Carbon Dioxide on Steroids

Methane has been identified as one of the most important emissions to reduce quickly because it is more potent than CO_2 and dissipates out of the atmosphere much more quickly (see figure 1). Methane's atmospheric lifetime, the time taken for a given amount of methane released into the atmosphere to reduce by a specific value (approximately two-thirds) is only 12 years. In other words, after just 12 years, most of the methane is gone, with the remainder gradually dissipating over a longer time period. Recent research led by Dr. Drew Shindell at

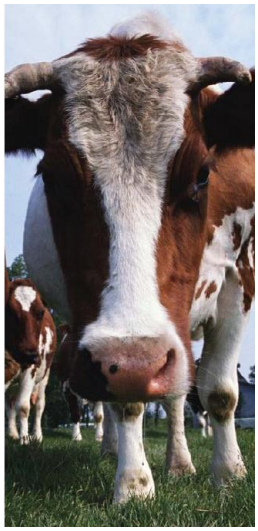


NASA's Goddard Institute for Space Studies concluded that methane's role in climate change is much greater than previous estimates. Dr. Shindell and his colleagues estimate that 20 years after methane is emitted, that which has not been absorbed or dissipated is still 100 times more potent than CO_2 at trapping heat in the atmosphere. Even 100 years after the methane is emitted, it is 33 times more potent than CO_2.[18] [19]

<Figure 1>
Methane dissipates out of than atmosphere more quickly that Carbon Dioxide
Source: Dr. Kirk Smith, University of California - Berkeley



<Figure 2>
Although carbon dioxide (CO2) appears to be the greatest source of climate change when evaluated 100 years after the emissions occur, shorter-lived climate forcers, including methane (CH_4), black carbon and ozone precursors contribute much more to warming in the near term.
Source: UNIPCC Fourth Assessment Report 2007



Ozone Reduction: a Side Benefit of Methane Reduction

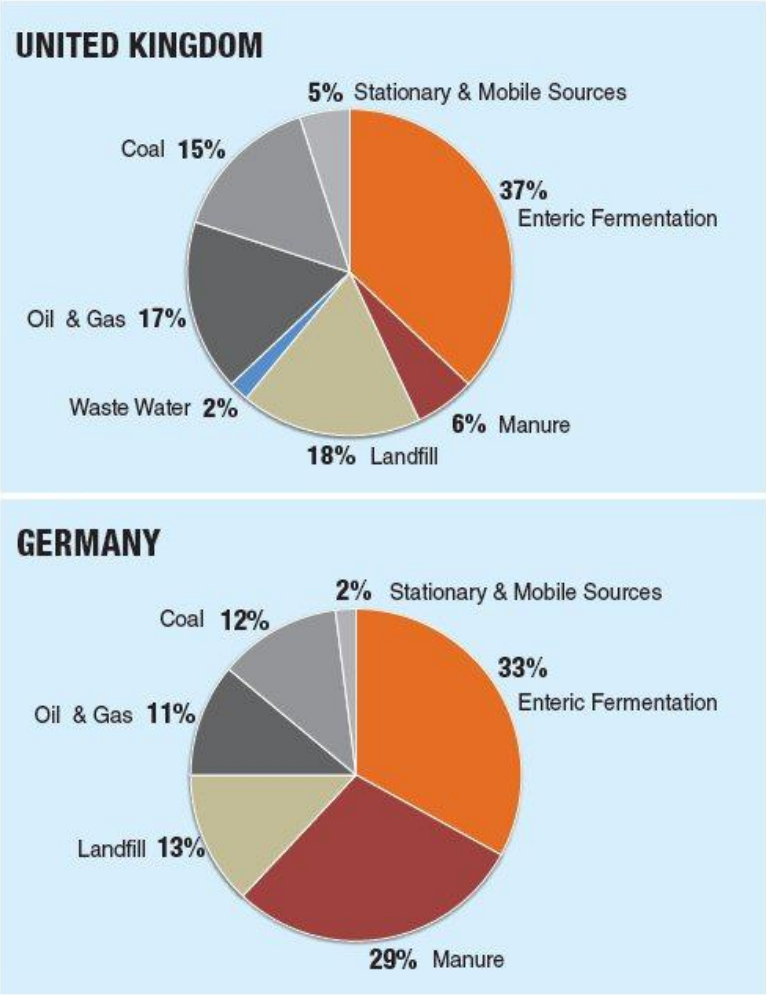
Tropospheric, or ground level, ozone is the third most prevalent greenhouse gas after carbon dioxide and methane. Ozone dissipates out of the atmosphere in about 22 days,[20] and has a global warming potential of about half that of CO_2.[21] Best known as a component of smog, it is created through a series of chemical reactions involving nitrogen oxide, methane, carbon monoxide and other non-methane volatile organic compounds.[22] The cooling effects of methane reduction will be magnified as a result of correspondingly reduced ozone levels.

Structural Causes and Mitigation Strategies for Methane Reduction

On a global basis, livestock accounts for 37 percent of human-caused methane, from both enteric emissions and waste.[23] Other sources include landfill, oil and gas operations and coal. In the United Kingdom, 43 percent of methane comes from livestock, 18 percent comes from landfill and 17 percent comes from oil and gas.

The Methane to Markets initiative seeks to reduce anthropogenic emissions by capturing the methane and turning it into energy. In agriculture, a main focus is capturing methane from manure.[24] Unfortunately this approach is only really applicable to 'factory farm' settings where it is easier to consolidate the waste.

Factory farms present their own host of environmental concerns, including threats to local public health, water and air pollution, as well as the potential to breed pandemic diseases, such as swine flu and bird flu.[25] [26] Longer term efforts are being made to create new feeds which would reduce methane from enteric emissions, and inoculations which would



Anthropogenic Sources of Methane

UNITED KINGDOM

- No.1 - Livestock (43%)
- No.2 - Landfill (18%)
- No.3 - Oil & Gas (17%)

GERMANY

- No.1 - Livestock (62%)
- No.2 - Landfill (13%)
- No.3 - Oil & Gas (11%)

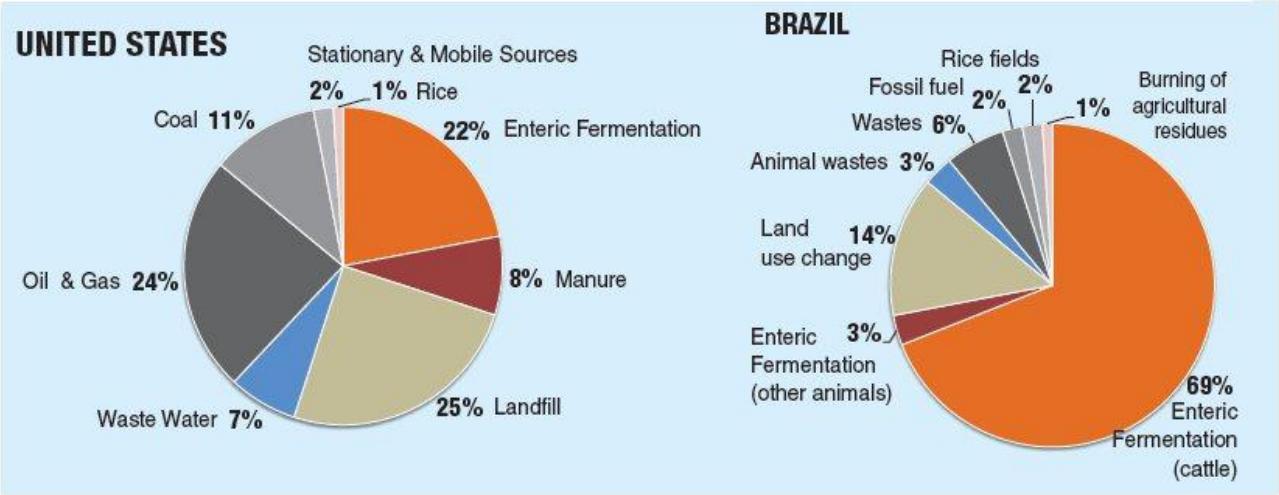
UNITED STATES

- No.1 - Livestock (30%)
- No.2 - Landfill (25%)
- No.3 - Oil & Gas (24%)

BRAZIL

- No.1 - Livestock (75%)
- No.2 - Land use change (14%)
- No.3 - Wastes (6%)

<Figure 3>
Source: Methane to Markets



change the animals' actual digestive processes, both giving rise to concerns about the safety of consuming livestock whose natural alimentation and digestion had been thus altered.

Researchers from both Dalhousie University[27] and the London School of Hygiene and Tropical Medicine[28] have also highlighted that

technological solutions are not sufficient to reduce livestock emissions,

further stating that changes in dietary patterns to reduce consumption of animal proteins will be necessary.
Given the short time period needed to bring about reductions in emissions, as per Dr. Crutzen and the Earth Policy Institute mentioned above, the fastest and least expensive way to begin reducing methane and ozone is to eat as close to a purely plant-based diet as possible.

Black Carbon: 4,470 Times More Potent than CO_2

Black carbon, also known as soot, is 4,470 times more potent than CO_2 at warming the atmosphere over a 20 year time frame, and 1,055- 2,240 times more potent over 100 years. It also dissipates out of the atmosphere in a few weeks or months, although longer if it lands on snow. [29]

Black carbon is a microscopic particulate that gets into the atmosphere when forests,

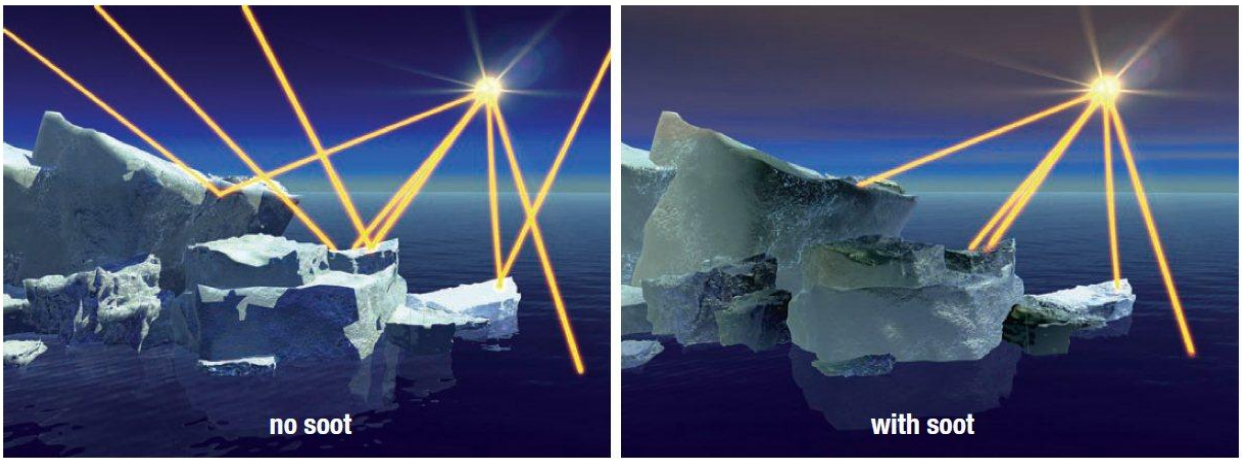
<Figure 4>
Biomass burning in the Amazon. Source: NASA

savannahs, biomass and fossil fuels are burned. The particles create heat by absorbing the sun's radiation much like a road on a hot day. The single greatest sources of black carbon, estimated at 42 percent are savanna and forest fires, 90 percent of which are anthropogenic.

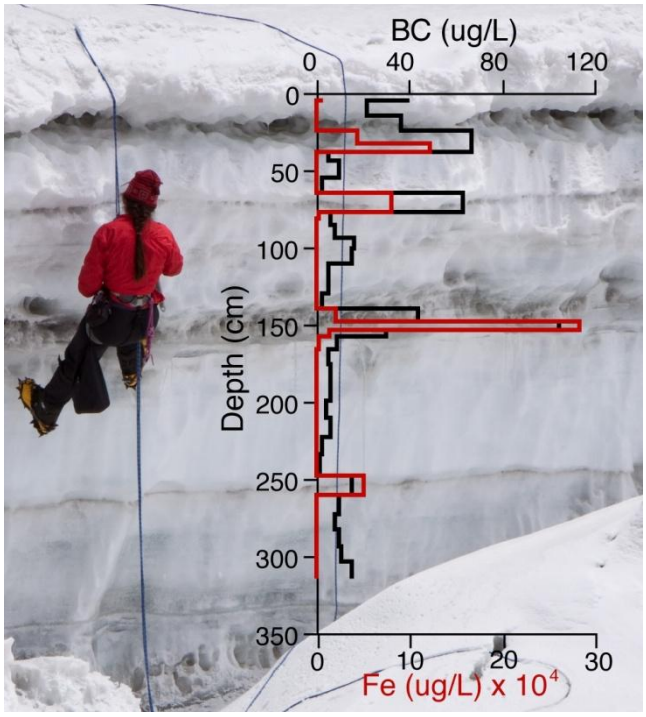
Black carbon can blow thousands of kilometres to land on glaciers and polar ice caps, where, due to its dark color, it absorbs the sun's rays and thus speeds melting. Dr. Drew Shindell estimates that

black carbon is responsible for 45 percent of the Arctic warming[30] and 50 percent of Himalayan[31] melting.

Less well known is black carbon's effect in the Andes and Antarctica. The NASA models never accounted for much black carbon in Antarctica because of the relative lack of



<Figure 5> Once black carbon (soot) lands on ice, it absorbs heat and accelerates melting. Source: NASA



<Figure 6> Measuring black carbon, Mera Glacier, Nepal. Source: NASA

industry in the southern hemisphere. However, Brazilian researchers led by Dr. Heitor Evanglista of Rio de Janeiro State University found black carbon in concentrations higher than those in the NASA models. [32]

Structural Causes of Black Carbon from Diet

Dr. Evangelista and his colleagues estimated that around 50 percent of the black carbon in Antarctica was from biomass burning in central South America; industry's contribution was 20 percent, and 30 percent was coming from Africa. The black carbon is most concentrated in the Antarctic Peninsula and Western Antarctica, both of which are warming at rates far exceeding the global average.[33] These are also the regions closest to South America. By contrast, eastern Antarctica, which is closer to New Zealand and Australia, is actually cooling and growing due to the stratospheric ozone hole.[34]

The biomass burning in central South America relates primarily to slash and burn agriculture, 70 to 80 percent[35] [36] of which is associated with cattle grazing in the Amazon, with much of the rest coming from the growing of soya crops which are exported for animal feed in Europe and elsewhere.[37] [38] This suggests that at least 35 to 40 percent of the black carbon in Antarctica is connected or attributable to livestock raising. It is possible that use of fire to clear forest for pastureland in Africa contributes more to the black carbon there, but no figures are available to date.

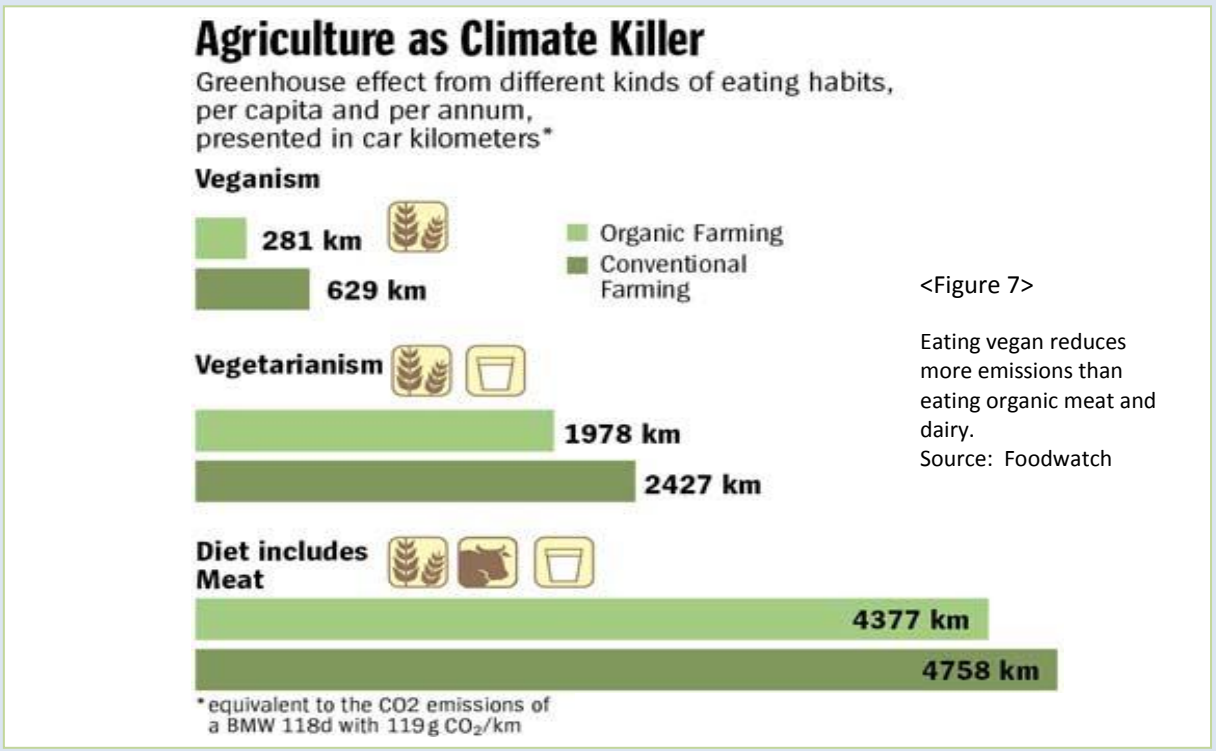
It is presently not known to what degree, if any, the black carbon in Antarctica is contributing to the melting, but the proximity of the biomass burning to the regions where the highest concentrations of black carbon were found, and the fact that these areas are warming quickly relative to other areas of Antarctica suggests there is a correlation. Furthermore, it is possible

that the slash and burn agriculture is likewise contributing to the rapid melting of Andean glaciers.

Other Climate Change Benefits of a Plant Based Diet

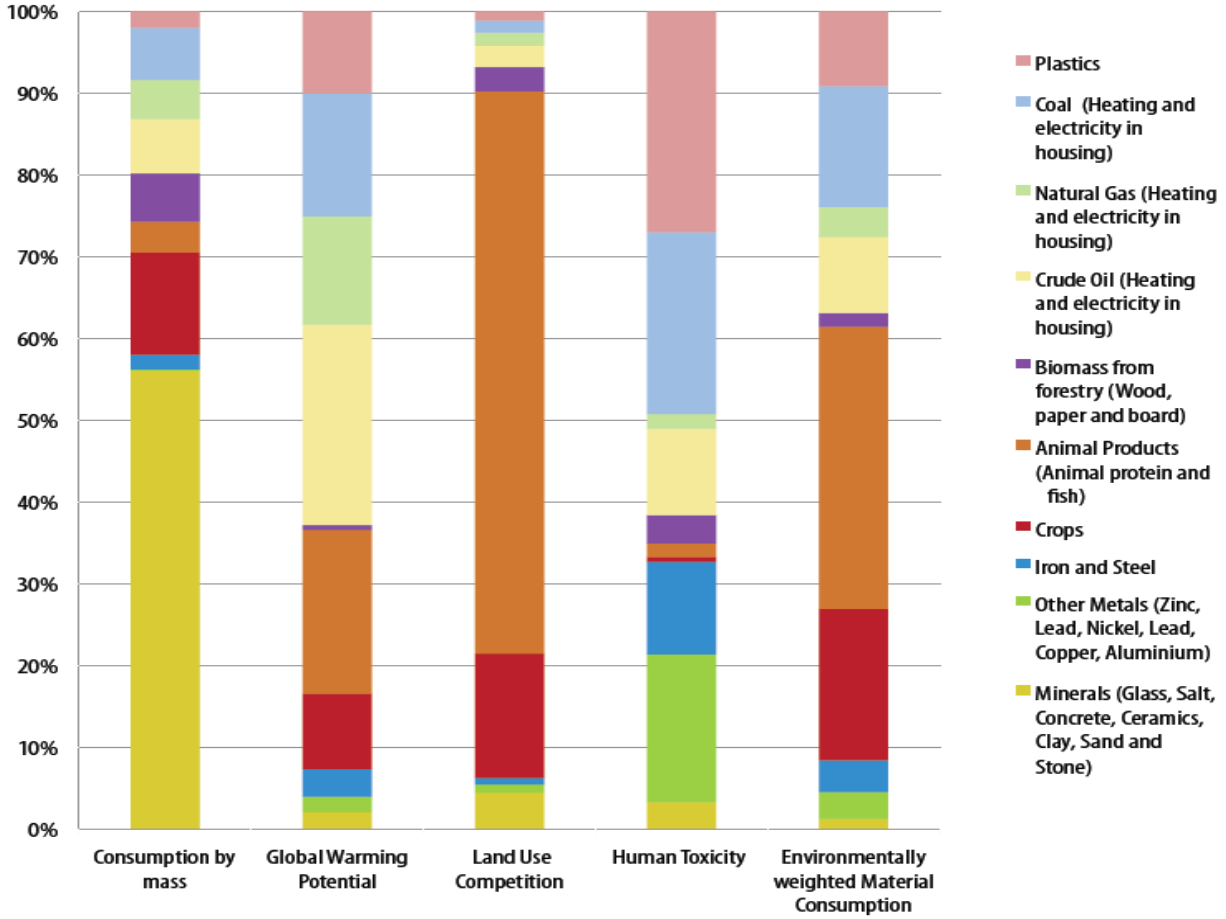
Although the greenhouse gas theory began decades ago by identifying fossil fuels as the single leading cause of climate change, the magnitude and weight of reports singling out agriculture, specifically to derive animal-based proteins, as nearly as great or a greater threat to environmental health has grown. A summary of the more notable is below:

- **Eating vegan more beneficial than driving a hybrid.**
  In 2006, a University of Chicago, US, report concluded a person adopting a vegetarian diet for a year would reduce more emissions than someone swapping their regular car for a Toyota Prius.[39]
- **Livestock emissions higher than transport emissions.** In 2006, the Livestock group within the UN's Food and Agriculture Organization released *Livestock's Long Shadow*, estimating livestock to be responsible for 18 percent of global emissions:
  more than all transportation combined. [40]
- **A vegan diet reduces emissions 7 times more than local eating.**
  In 2008, Carnegie Mellon University compared the emissions from consuming a diet of 100% locally grown food to one of 100% plant-foods, concluding a vegan diet led to a reduction of seven times the emissions of a locally-grown diet because most dietary emissions are in operations, not transportation.[41]
- **An organic vegan diet reduces 94% of dietary emissions vs. 8% for sustainable meat & dairy.** In 2008, Germany's Foodwatch Institute estimated shifting from a conventional diet, including meat and dairy, to a conventionally-raised vegan diet would reduce emissions by 87 percent, while shifting to an organic diet including meat and dairy would only reduce emissions by 8 percent. By contrast, a 100% organic vegan diet would reduce emissions by 94 percent.[42]



<Figure 7>

Eating vegan reduces more emissions than eating organic meat and dairy.
Source: Foodwatch



< Figure 8> The UN Environment Programme recommends replacing animal proteins with plant-proteins after estimating the environmental impact of animal proteins is greater than all fossil fuel sources combined. Source*: "Assessing the Impacts of Consumption and Production,"* UNEP 2010

- **Livestock emissions estimated at over half of global emissions**. In 2009, World Bank analysts writing in the WorldWatch Magazine re-evaluated *Livestock's Long Shadow* in their article *Livestock and Climate Change*, estimating that livestock accounts for 51 percent or more of greenhouse gas emissions. [43]

- **Livestock's environmental impact greater than that of fossil fuel.** In 2010, the United Nations Environment Programme called for the adoption of plant-based eating with the report *Assessing the Environmental Impacts of Consumption and Production*, in which they identified the overall environmental, including climate change, effects of livestock, including global warming potential and land use change, as being greater than fossil fuels from coal, natural gas and crude oil. [44]

- **Livestock growth imperils the planet.** In 2010, Dalhousie University in Canada warned that the projected doubling of meat and dairy consumption by 2050 would imperil the planet due to increased emissions related to livestock, increased consumption of the earth's CO_2-absorbing biomass, and reactive nitrogen. They also compared substituting chicken for beef, finding that the net reduction in environmental impact would be only 5 to 13 percent. However, a diet of 100% protein from meat sources ranked on a scale from one to 100 as 100, compared to only 1 for a diet where 100% of the protein came from plant-sources. [45]

Vegan Diets Reduce Climate Change Mitigation Costs 80 Percent

Perhaps one of the most under-reported climate change studies is the Netherlands Environmental Assessment Agency's *Climate Benefits of Changing Diet* (2009) which evaluated how dietary changes could reduce the costs of addressing climate change. It showed that a diet without ruminant animals, which produce the most methane, would reduce the cost of climate change 50 percent. However, switching to a diet of no animal products, including no eggs or milk, would reduce the costs of mitigating climate change by more than 80 percent.[46]

Organic Plant Based Eating: a Carbon-Capturing Solution

The need to develop technologies to pull CO_2 out from the atmosphere is an important objective in climate science, because even if carbon neutral technology existed that could completely replace all fossil fuels today, the CO_2 already emitted into the atmosphere would still need to be dealt with. Viable solutions will need to be inexpensive enough to deploy globally, and scalable also to work locally.

With organic, plant based nutrition available to the global human population, more CO_2-sequesterable biomass would become available to absorb atmospheric carbon, in part through associated land use changes. The net effective carbon capture through biomass and soil sequestration available as a result of reforestation, the reinstatement of natural habitats and more sustainable soil management provided by a shift from meat and dairy to plant based foods represents an important and comparatively near-term carbon scrub.

Plants, and especially trees, are one of the oldest carbon dioxide scrubbing technologies on the planet. In their report *Climate Benefits of Changing Diet*, the Netherlands Environmental Assessment Agency estimated that a global shift to a "no animal products" diet would result in much land being freed up for replanting as forests.[47] In addition to places like the Amazon and the Congo, forests have been taken down to create room for livestock for thousands of years, from the Isle of Skye in Scotland to Western Australia. Because it takes less land to grow a whole foods plant-based diet than one that includes animal proteins, land freed up could be returned to CO_2-absorbing forests and meadows, which by 2030 the authors estimate would be capable of sequestering significant amounts of CO_2. [48]

This would also end much of global deforestation, which is estimated to be the cause of between 15 to 25 percent of climate change. *Livestock's Long Shadow* estimated the release of CO_2 from deforestation due to livestock agriculture in the Brazilian Amazon alone to be eight percent of total CO_2 emissions. Other areas where deforestation is being driven by livestock include Southeast Asia where tropical rainforests are being deforested to create palm oil plantations. Greenpeace states that palm

kernel expeller, one of the three main palm oil products, is actually fed to livestock as food.[49] Organic farming methods can also accelerate the rate at which CO_2 is pulled out of the atmosphere, while offering many other environmental benefits. For example, the Rodale Institute in the US, which has been researching organic farming techniques since the 1940s, has developed a system which they estimate could absorb 40 percent of CO_2 emissions from the atmosphere annually,[50] further contributing to cooling. In light of the above scientific findings and increasing insights into organic farming and related agricultural developments,

organically farmed plant-based diets represent an environmentally optimal, carbon minimal source of nutrition.

Nutritionists Conclude Vegan Diets are Nutritionally Sound

In 2009, the American Dietetic Association, the largest body of nutritional professionals in the world, concluded that well planned full vegetarian or "vegan" (meaning no animal products) diets are nutritionally sound and adequate for all stage of the human lifecycle from gestation (in the womb) through to old age. They also found them to be effective in reducing the incidence of common non-communicable diseases, including cardiovascular disease and diabetes, as well as reducing the incidence of obesity and certain cancers. [51] Several studies, including one by the London School of Hygiene and Tropical Medicine,[52] have concluded that reduction in meat consumption would bring about a double benefit of also reducing health care costs.

Other Considerations: Biodiversity, water and Food

Climate change is not the only serious challenge facing society, humanity. Plants and

animals provide valuable ecosystem services which are being destroyed by human actions, causing biodiversity extinction rates of 100 to

1000 times those of any other time in historical records. [53]

Experts are now indicating that biodiversity loss will cost as much as US$14 billion, or 7 percent of the global economy. [54] Although most efforts to protect biodiversity center around setting aside conservation areas, 30 percent of the earth's landmass is occupied by livestock or food being grown for livestock,[55] making it one of the largest contributors to biodiversity loss on the planet. [56] Given that less land would be needed to grow food for a plant-based diet, the simple act of eating from sources of nutrition not derived from animals allows land to be returned to more natural and subsequently biodiversity-friendly settings.

In the report *Rethinking Global Biodiversity Strategies* (2010), the Netherlands Environmental Assessment Agency evaluated the effectiveness of policy options for reversing the trend of biodiversity loss, finding a no-meat diet would preserve over 60% of mean species abundance.[57]

Water and food security, also key issues, would also be mitigated in part because plant based diets use less water and allow more food to be grown with fewer land and water resources. [58] [59]

Honouring the Farmer

It is a given that farmers must be allowed to make a living and support their families. In the past western model, this has been done with the assistance of subsidies overly focused on the production of animal proteins and livestock feed. With more recent understanding that plant based nutrition offers health as well as environmental advantages over diets reliant on animal foods, a timely shift in subsidies towards plant foods and related sustainable, for example organic, growing practices is now a highly-regarded, natural and profitable step for governments to take both upon their own volition and as part of multilateral frameworks (for example a modernization of the EU's ever more outdated CAP).

Furthermore, farmers who return some of their land to its original state, including forests and meadows, could receive carbon credits for creating a carbon sink.

Will farmers agree to change?

After publishing an article about the role livestock raising has played in climate change, physicist Alan Calverd, PhD was invited onto a radio show with a group of farmers who were asked what they thought of his findings.[60] The farmers responded that they would raise whatever food they had subsidies to raise. Similarly, in another example taken from the USA, the movie *Food, Inc*.[61] investigated how the farming and food industries were

contributing to unhealthy eating in America; one farmer interviewed therein stated if people demanded healthier food, farmers would grow it for them.[62]

Summary

In conclusion, based upon the summation of research into the impact of livestock and dietary patterns on the planet, the livestock industry and public demand for animal-based foods are some of the most significant common denominators driving biodiversity loss, climate change, deforestation, food and water security and oceanic ecosystems collapse. Through fast-acting, forward thinking measures, such as legislation, public education and information initiatives and other socio-economic influencers, the shift towards more plant-based nutrition can be encouraged as an empowering and planet-protective choice on an individual and community level, and a substantial environmental and economic benefit on a much wider scale; mitigating climate change and improving food and water security among others. Some personal incentives of a plant-based diet include the likelihood of greater health and confidence that one's dietary choice is nutritionally optimal, together with the proud assurance that it helps promote the sustenance of life and the abundance of biodiversity planet-wide for current and future generations.

For further information please see:

www.WorldPreservationFoundation.org

[1] http://www.guardian.co.uk/environment/2009/dec/10/copenhagen-climate-change
[2] http://www.guardian.co.uk/environment/2009/dec/16/evo-morales-hugo-chavez
[3] http://news.bbc.co.uk/1/hi/8405025.stm
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