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# A balanced perspective on the importance of extensive ruminant production for human nutrition and livelihoods and its contribution to greenhouse gas emissions

There is a general perception that ruminants produce large quantities of greenhouse gases which contribute to global warming. Sometimes percentages are quoted out of context. For example, the percentage quoted for developed countries indicates the greenhouse gas contribution from livestock is less than 6%, while that for developing countries is 40–50%. However, the reason for this relatively low contribution from developed countries is because of very high contributions from other sectors. Ruminant production also is in the spotlight as it is the world’s largest user of land and South Africa is no exception. Only ruminants can utilise areas of non-arable land where the vegetation is rich in fibre and convert this fibre into high-quality nutrients for human consumption. Foods from animal sources (including ruminants) are essential for the human diet, as they support early childhood and cognitive development. Many rural households depend on ruminants and these animals are central to the livelihoods and well-being of these communities. The negative effects of red meat on human health and the negative environmental impact of livestock production are overemphasised, while the higher bioavailability of nutrients from livestock source foods, which stimulates mental and cognitive development compared to vegetarian or grain based foods, is ignored. Here we estimate that livestock are responsible for only 4% of the world’s greenhouse gases through methane production. We also highlight that if the high fibre vegetation is not utilised by livestock, it will still produce greenhouse gases through burning or rotting, without any benefit to humans. Livestock source foods are important if global nutritional, educational and economic needs are to be met; and this message should be conveyed to the public.

**Significance:**

- We propose that a balanced message should be conveyed to the broader scientific community and the public on the role of livestock in meeting global nutritional needs and contributing to global warming.
- Livestock source foods are important if the global nutritional, educational and economic needs are to be met and can be used to feed developing countries out of poverty.

Livestock is often blamed for producing large quantities of greenhouse gases (GHG) and thus contributing to global warming. This general perception, that livestock makes a huge contribution to global warming, follows on the Food and Agriculture Organization’s publication of *Livestock’s Long Shadow*<sup>1</sup>, in which it is reported that livestock is responsible for 18% of the total greenhouse gas (GHG) emissions, although it was later scaled down to 14.5% of the total anthropogenic GHG emissions<sup>2</sup>. Furthermore, these percentages are at times irresponsibly quoted out of context. For example, the percentages quoted for developed countries indicate that the GHG contribution from agriculture is less than 6%. However, the reason for this low contribution is a result of the very high contributions from the energy, manufacturing, mining and other sectors. Developing countries have lower energy consumption and smaller manufacturing and mining sectors. Thus, although the relative contribution from agriculture ranges between 40% and 50%, the actual contribution is still lower than 6%.<sup>3</sup>

Livestock are characterised into ruminants (cattle, sheep, goats and water buffalo) and monogastric animals (pigs, poultry, donkeys and horses). Ruminants generate a large amount of GHGs, mainly in the form of methane (CH<sub>4</sub>), through enteric fermentation, which is a natural by-product of anaerobic microbial fermentation and manure storage. The methane produced in the rumen is emitted by belching. It is estimated that about 80% of the GHG from livestock comes from ruminants and that they are responsible for more than 90% of the total CH<sub>4</sub> emissions from livestock.<sup>4</sup> Thus, while ruminants play an important role in providing high-quality protein essential for human diets, they are also an important source of animal GHG emissions.

That ruminant production is in the spotlight is understandable, as it is the world’s largest individually identifiable producer of GHGs and user of land, and South Africa is a clear example of the latter. About 84% of South Africa’s land is available for agriculture, but most of this land cannot be used for crop production. Only 13% of South Africa’s land area is arable, with the greater part (71%) only suitable for extensive ruminant production.<sup>3</sup>

Ruminants are often the scapegoat for GHG emissions, with their strategic value in the supply of human nutrition often disregarded. In many parts of sub-Saharan Africa ruminants play an important role in human diets. Most of the fibre rich vegetation on land can only be utilised by ruminants which convert it into high-quality protein and other nutrients for human consumption.<sup>3</sup>

The importance of animal source foods should be recognised, because any reduction in the consumption of ruminant source foods (meat and dairy products) will compromise the intake of the nutrients that are supplied in relatively large proportions in meat and dairy products. In cases where there is evidence of low nutritional

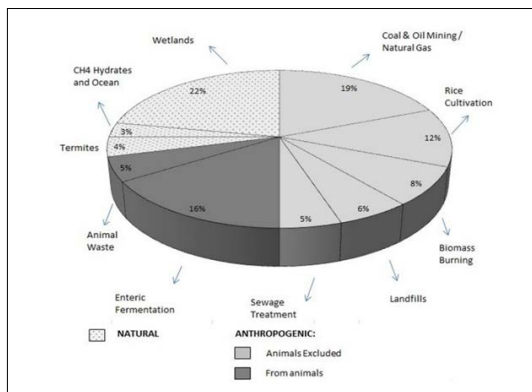
status, the risk will be bigger.<sup>5</sup> Millions of children in developing countries already suffer from impaired cognitive development as a result of poor nutrition due to the insufficient consumption of livestock source foods.<sup>6</sup> A relationship between early and even later cognitive development and the consumption of livestock source foods by pregnant and lactating women, and children, has been established.<sup>7</sup> The reason for this is that livestock source foods supply nutrients with a higher bioavailability that stimulates mental and cognitive development, compared to vegetarian- or grain-based foods.<sup>6</sup> It should also be noted that immunoglobulin, which is present in cow's milk, assists the human body in its fight against bacteria, viruses and allergens.<sup>8</sup> Cow's milk may therefore influence the development of the immune system in the upper respiratory tract<sup>9</sup>, which may play a role in the body's defence against the novel coronavirus disease (COVID-19).

It should also be noted that small-scale and subsistence farmers keep ruminants for a variety of purposes. Many rural households are dependent on ruminants for milk, meat, hides, horns, fertiliser, draught and income.<sup>10,11</sup> Ruminants are therefore central to the livelihoods and well-being of these households.

In spite of the importance of livestock production, the recently published report by the EAT-Lancet Commission<sup>12</sup> downplays the significant role of livestock in providing the valued nutritional elements. Instead the report focuses on the negative effects of red meat source foods (from ruminants) on human health and overestimates the negative environmental impact of livestock production. It is not only the EAT-Lancet Commission that is overplaying the effect of methane emissions from ruminant livestock on global warming. This is also done by many other groups with their own agenda, such as the Meat-Free Monday campaign. Capper<sup>13</sup> indicates that if all the USA's 313 million inhabitants adopted meat-free Mondays, the annual reduction in GHG emissions is estimated to be only 0.3%. The information used by these advocacy groups is often overly simplistic, and based on misconceptions, a lack of knowledge and incorrect calculations.<sup>13-15</sup>

Climate change – the increase in average temperature and an associated increase in the frequency of extreme weather events – and global warming are consequences of an increased production of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride (SF<sub>6</sub>), collectively referred to as GHG.<sup>16,17</sup>

Of these six GHGs, the most important are CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O because they are closely associated with human activities.<sup>18</sup> Carbon dioxide is produced through burning fossil fuels and other biological material (e.g. solid waste and trees), as well as from certain chemical reactions, whereas the CO<sub>2</sub> from livestock originates from the aerobic digestion of manure and other waste. It is important to note that CO<sub>2</sub> is removed from the atmosphere through the process of sequestration, in which plants absorb CO<sub>2</sub> as part of the biological carbon cycle, whereas nitrous oxide is emitted through the combustion of fossil fuels and other waste products, agricultural and industrial activities and during the treatment of waste water.<sup>3,17</sup> The natural and anthropogenic sources of CH<sub>4</sub> production are illustrated in Figure 1.



Source: Adapted from Augenbraun et al.<sup>22</sup>

Figure 1: Natural and anthropogenic sources of methane

The major GHGs related to livestock production are CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O. Their characteristics in terms of atmospheric concentration, atmospheric lifetime and heating potential are summarised in Table 1.

Table 1: Major greenhouse gases (GHG) related to lifestyle production and their characteristics

GHG	Carbon dioxide	Methane	Nitrous oxide
Atmospheric concentration (%)	49	18	6
Atmospheric lifetime (years)	100–200	12	114
Heating potential (CO <sub>2</sub> -eq)	1	23	296

Sources: Adapted from Clark et al.<sup>18</sup>, IPCC<sup>21</sup> and Biotech<sup>23</sup>

Most of the CH<sub>4</sub> produced by livestock originates from enteric fermentation by ruminants. It is therefore important to identify the sources of CH<sub>4</sub> production as indicated in Figure 1. Livestock and rice are the two most important single food sources for the developing world. However, these two food sources are also responsible for the production of large quantities of anthropogenic CH<sub>4</sub>. Livestock are responsible for 21% (16% from enteric fermentation and 5% from animal waste, including manure) and rice cultivation for 12% of anthropogenic CH<sub>4</sub> (Figure 1).

A simple calculation can be made using the information from Table 1 and Figure 1. Livestock contributes 21% of anthropogenic CH<sub>4</sub> production and the atmospheric concentration of CH<sub>4</sub> forms only 18% of the GHG emissions. Thus 0.21 x 0.18 = 0.04. This implies that livestock is responsible for only 4% of the world's GHG emissions through CH<sub>4</sub> production.

It should be noted that the global warming potential of CH<sub>4</sub> is approximately 23 times more than that of CO<sub>2</sub>, but its atmospheric lifetime is 12 years compared to 100–200 years for CO<sub>2</sub> (Table 1). Although CH<sub>4</sub> has a larger effect, the duration of the effect is much shorter. This is one of the aspects that is frequently ignored. In addition, a large percentage of ruminant production is in developing countries, and supports rural livelihoods<sup>3,19</sup>, and, in many cases, is a more environmentally friendly method of producing ruminant source foods<sup>20</sup>.

An important question to ask is: What will happen with the vegetation if it is not consumed by product-producing (meat, milk and fibre) ruminants? There are three possible consequences for the vegetation: (1) it can be consumed by wild animals that will also emit CH<sub>4</sub>; (2) it can burn during veldfires/wildfires, which will produce CO<sub>2</sub> that is released into the atmosphere with an atmospheric lifetime of 100–200 years, or (3) it can rot and produce N<sub>2</sub>O with a global warming potential of almost 300 times more than that of CO<sub>2</sub>. It is also important to note that the domesticated ruminants to a large extent replaced wildlife on the same land and the wildlife inhabiting the area before also produced CH<sub>4</sub>. The net effect may thus be more or less the same. During the regrowth of the vegetation grazed by ruminants, CO<sub>2</sub> is absorbed from the atmosphere. This carbon sequestration that occurs naturally has been neglected and therefore the quantitative effect thereof is not known.

It should also be noted that differences in livestock production systems between countries can influence the carbon footprint of livestock products. This is especially the case between developed countries in Europe and the Americas versus developing countries. Some of these differences relate to production systems (intensive versus extensive), manure storage and the application thereof, as well as feed production, transport and processing.<sup>21</sup> Many of the current methods used to estimate carbon footprints are based on generic assumptions that do not take into account the different production systems. The principle of carbon sequestration during the regrowth of the vegetation is sometimes also ignored.

The bottom line is that livestock is important for human sustainability, as it plays a critical role in increasing food security, improving nutrition, reducing poverty, and improving human health.<sup>6</sup> This important contribution of livestock source foods to humans should be considered in all sustainability and climate change debates. It is therefore crucial that a balanced message be conveyed to the broader scientific community as well as the public on the role of livestock in meeting global nutritional needs and in contributing to global warming. Livestock source foods are important for global nutritional, educational and economic needs to be met and can feed developing countries out of poverty.

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## Competing interests

We declare that there are no competing interests.

## Authors' contributions

M.M.S. conceived and conceptualised the Research Letter and also wrote the initial manuscript. Both F.W.C.N. and M.L.M. made valuable proposals on improving the manuscript. All authors participated in writing the final manuscript and approved it.

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