

# Some Environmental Impacts of Animal Agriculture

## Part 2

### Updated December 2010

#### Introduction

As stated in Part 1 of this series, the United Nations Food & Agriculture Organization has said that urgent action is required to deal with the detrimental environmental impacts of livestock.<sup>1</sup>

They have also said:

"Perhaps even among the majority of environmentalists and environmental policy makers, the truly enormous impact of the livestock sector on climate, biodiversity and water is not fully appreciated."<sup>2</sup>

Similarly, the chairman of the Intergovernmental Panel on Climate Change (IPCC), Dr Rajendra Pachauri, has said:

"Please eat less meat - meat is a very carbon intensive commodity." He went on to say, "This is something that the IPCC was afraid to say earlier, but now we have said it."<sup>3</sup>

In this instalment, we compare the "per hectare" performance of an animal-based food product (beef) with four plant-based products (soy, wheat, rice and potatoes) in terms of: (a) nutrition levels; (b) greenhouse gas emissions; and (c) water usage.



A comparison on a "per hectare" basis is necessary if we are to consider the amount of land used to produce different food products, with impacts on the natural environment, including forests.

#### The findings

Some key observations are:

- The greenhouse gas emissions and water usage of beef are extremely high relative to its nutritional value per hectare, particularly in the context of results for plant-based food products.
- All the plant-based foods included in the report provide more protein, energy, iron, zinc, omega-3 and calcium per hectare than beef.

The findings reflect a key problem in using animal products to satisfy humankind's nutritional requirements, which is the inherently inefficient nature of the process. It takes many kilograms of plant-based food to produce one kilogram of animal-based food with comparable nutritional value, with significant impacts on energy inputs, greenhouse gas (GHG) emissions, water usage and land usage.

The initial response to the findings may be that the nutritional figures for beef are understated. For example, most people may consider beef to be a high protein food. While that is correct in terms of protein per kilogram, it is not true in terms of protein per hectare. That is because of beef's low yield (kilograms per hectare) relative to other food products. On a per hectare basis, even potatoes have considerably more protein than beef.

Even on a per kilogram basis, a product such as soy beans compares favourably to beef. For example, dry roasted soy beans (soy nuts) have around 150% of the protein content of beef, while tofu (soy curd) has around 67%. Soy beans, like potatoes, contain all the essential amino acids.

The main findings are outlined in the charts on the following page. In order to broaden the range of products included within the report, the charts are based on various information sources in relation to product yields, nutrition levels, GHG emissions and water usage, as outlined below.

**Figures 1–6:** The calculations for determining the level of nutrition per hectare have utilised information from the United States Department of Agriculture's (USDA) National Nutrient Database for Standard Reference.<sup>4</sup> The assumed per hectare yield of **beef** (343 kg) has been determined by utilising the gross energy output per hectare as reported by Spedding<sup>5</sup> and the USDA energy value figures. The assumed per hectare **soybean** yield (2,804 kg) has been derived from the U.S. bushels per acre as reported by Nabors<sup>6</sup>, and the USDA's bushel weight for soybeans of 60 pounds.<sup>7</sup> The figures for **wheat, rice** and **potato** have been obtained from the Australian Bureau of Statistics Year Book 2008.<sup>8</sup> Please refer to further comments on product yields below.

**Figure 7:** GHG emissions of **beef, wheat and rice** are from The Australian Greenhouse Office (now forming part of the Department of Climate Change).<sup>9</sup>

GHG emissions of **soy and potato** are from Annika Carlsson-Kanyama and Alejandro Gonzalez, as published in The American Journal of Clinical Nutrition.<sup>10</sup>

**Figure 8:** Water usage of **beef, soy, wheat and rice** is from CSIRO.<sup>11</sup>

Water usage of **potato** is from Hoekstra and Chapagain, whose figures are utilised by UNESCO.<sup>12</sup>

**Figure 9:** GHG emissions of **all products** are from Annika Carlsson-Kanyama and Alejandro Gonzalez, as referred to above.

**Figure 10:** Water usage of **all products** is from Hoekstra and Chapagain (refer above).

**Figure 11:** Water usage of **all products** is from David Pimentel of Cornell University, USA and research colleagues.<sup>13</sup>

Regardless of the information source utilised, the results show low per hectare nutrition levels and high GHG emissions and water usage for beef, relative to plant-based food sources.

Wide variations in product yield can apply, depending on the location and conditions in which products are grown, and some of the yields used for this report may be high for Australian conditions.

For example, while the yield figure for beef (refer above) may be achievable in the more intensive cattle farming regions of Australia, the enormously widespread range of cattle grazing (including grazing in marginal areas) causes our average yield to be a small fraction of the figure assumed in the charts.

In regard to soy beans, the Primary Industry Bank has reported an average yield for Australian production of 1,880 kg per hectare between 1993/94 and 1999/00.<sup>14</sup> Accordingly, as for beef, the yields for soy may be at the upper end of the expected range.

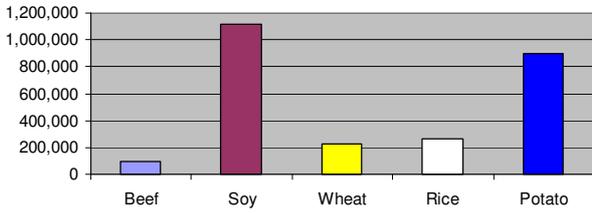
If lower yields were assumed for any product, the GHG emissions and water usage figures would be lower, but so would the nutritional value.

With the exception of vitamin B12, the comparisons on the following page include all the nutrients highlighted in Meat & Livestock Australia's "five essential nutrients one amazing food" advertising campaign featuring the actor Sam Neill and an orang-utan.<sup>15</sup> Vitamin B12 is perhaps the only nutrient that is significantly more difficult to obtain directly from plants than from animals. However, it is easily produced from bacteria and supplemented in other food products, which is a far more natural approach than: (a) destroying rainforests and other natural environs; and (b) operating industrial farming systems; purely for animal food products.

**Producing this much nutrition per hectare ...**

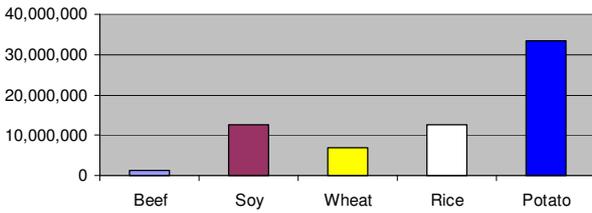
**Figure 1**

Protein per hectare (g)



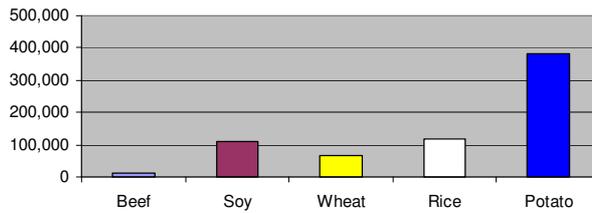
**Figure 2**

Energy per hectare (kcal)



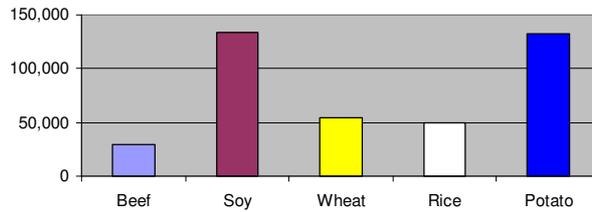
**Figure 3**

Iron per hectare (mg)



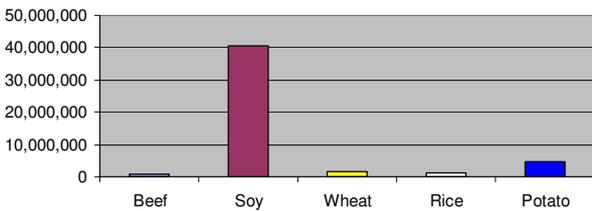
**Figure 4**

Zinc per hectare (mg)



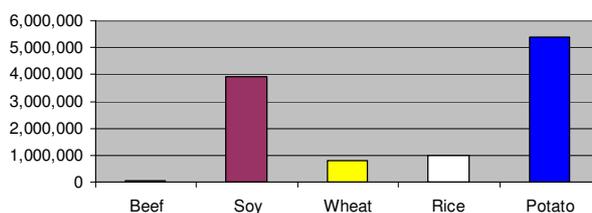
**Figure 5**

Omega 3 (ALA) per hectare (mg)



**Figure 6**

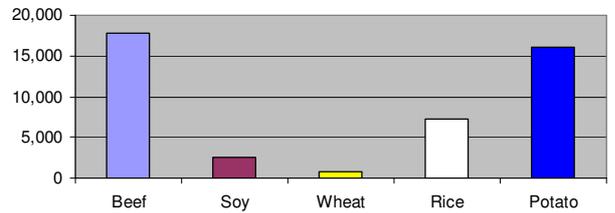
Calcium per hectare (mg)



**... causes us to emit this much greenhouse gas (incl. Australian Greenhouse Office figures) ...**

**Figure 7**

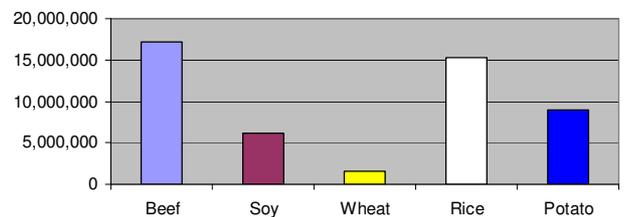
Greenhouse gas emissions per hectare (kg)



**... and use this much water (incl. CSIRO figures):**

**Figure 8**

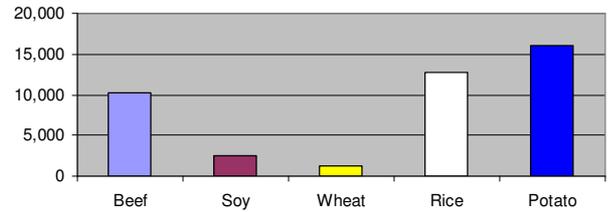
Water usage per hectare (litres)



**Some alternative figures (solely using international research findings):**

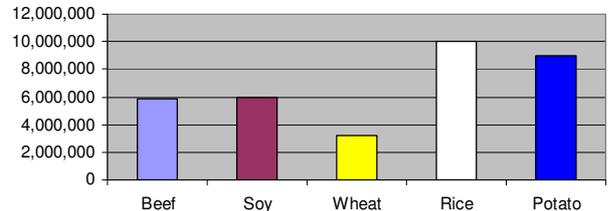
**Figure 9**

Greenhouse gas emissions per hectare (kg)



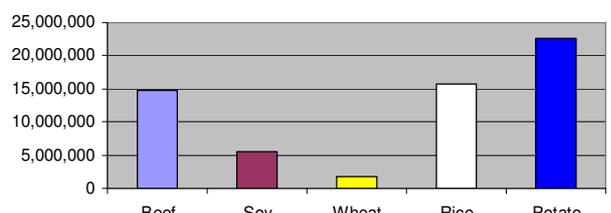
**Figure 10**

Water usage per hectare (litres)



**Figure 11**

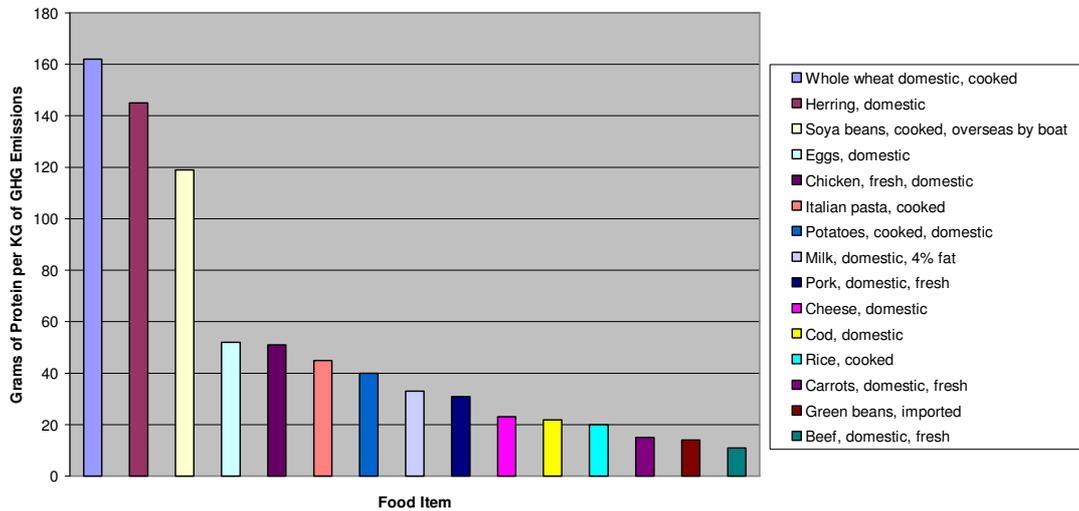
Water usage per hectare (litres)



### Some further comments on GHG emissions

According to Carlsson-Kanyama and Gonzalez (as referred to on page 2), per kilogram of GHG emissions produced, even carrots and green beans have more protein than beef. Wheat has around thirteen times more and soy beans around ten times more, as demonstrated by the following chart:

**Figure 12**



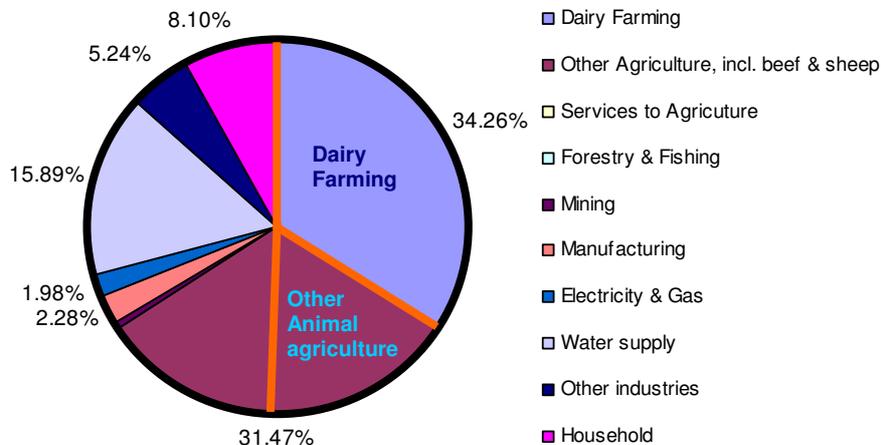
### Some further comments on water consumption

According to a study by Melbourne University researchers (based partly on findings of the CSIRO), 90% of most people's water is consumed in the food they eat, with most of that being in animal-based products.<sup>16</sup>

Based on their findings, a person can save over **900,000 litres** of water per annum on a plant-based diet (helping to save some of Australia's great rivers, their associated wetlands and the Murray-Darling "food bowl"), compared to the **20,000 litres** that can be saved by taking 4 minute showers with a 3-star shower head.<sup>17</sup>

Figures from the Australian Bureau of Statistics confirm that direct household consumption accounts for only 8% of Victoria's water use, while dairy farming alone (largely through the flood irrigation of pasture for cattle) accounts for 34% and animal agriculture as a whole 51%.<sup>18 & 19</sup>

**Figure 13**



## General comments:

As indicated earlier in this report, information on the nutritional value of the various food types has been obtained from the USDA National Nutrient Database for Standard Reference. None of that information, or any other information contained in this report, is intended to represent dietary advice.

The relevant product descriptions from the USDA database are as follows:

- Beef, chuck, blade roast, separable lean and fat, trimmed to 0" fat, choice, cooked, braised [Top Blade Steak, URMIS #1879]
- Soybeans, mature seeds, dry roasted [Soy nuts]
- Cereals, whole wheat hot natural cereal, dry
- Rice, white, long-grain, regular, cooked
- Potato, baked, flesh and skin, without salt

## Conclusion

The world's population is running out of time to avoid the catastrophic effects of runaway climate change.

Subjects such as diet must not be regarded as taboo, and must feature heavily in the choices that we make in order to save our planet for all species and future generations. We can no longer regard food choices as being personal when the impacts of those choices have far reaching consequences for our natural resources and climate change.

### What you can do

#### Individuals:

- Consume fewer livestock products, particularly beef, lamb, dairy and wool.
- Inform others.

#### Environmental Groups:

- Include animal agriculture as a high priority in campaigning efforts directed at the community and governments.

#### Governments:

- In regard to those factors within their control, ensure that all relevant costs (including environmental costs) are incorporated in the price of agricultural products.
- Inform the community, so that consumers can make purchasing decisions based on adequate knowledge.

The above governmental measures would assist markets to operate efficiently, which is often the professed, though often not the practiced, aim of governments.

Prepared by Paul Mahony, 13 September 2010 and last updated on 5 December 2010

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