

Meat and Global Warming:

Impact Models, Mitigation Approaches and Ethical Aspects

Humans contribute substantially to the global warming (IPCC, 2007; Oreskes, 2004). The main cause is fossil fuel use (IPCC, 2007), but animal production is also significant (Steinfeld et al., 2006). In this paper, I give an overview of various views of the nature and scale of the impact of animal production on climate change and of various approaches to mitigation of climate change to the extent it is caused by animal production. On the basis of these analyses, I also carry out a preliminary investigation of ethical aspects of the mitigation approaches and sketch a policy proposal.

The ethical problem

Animal production contributes to climate change, but there are different views on how much. The estimates of the global greenhouse gas (GHG) emissions from the livestock sector vary from 10% to 51% (Herrero et al., 2010). The Intergovernmental Panel on Climate Change (IPCC) estimates that agriculture as a whole contributes with 13.5% of the global GHG emissions but provides no specific estimation for the livestock sector (IPCC, 2007: 4). This suggests, however, a figure around 10% for this sector (given the estimate that it causes 80% of the total emissions from agriculture (Steinfeld et al., 2006: 112)). According to the report *Livestock's Long Shadow* from the UN Food and Agriculture Organization (FAO), the global emissions from the livestock sector constitute 18% (Steinfeld et al., 2006: xxi). A much higher estimate is made by Goodland and Anhang, 51% (Goodland and Anhang, 2009).

The FAO report has been at the centre of the debate. It has been criticized for providing a too high estimate as well as a too low. Before presenting some of this criticism, let me briefly summarize the key points of the report.

In its estimations, FAO uses a method (life cycle analysis (LCA)) that focuses on the whole production chain from feedcrop to product, transport not included. 9% of the global emissions of carbon dioxide are related to changes in land use, especially deforestation. When forests are harvested or burned in order to give way for graze land and feedcrop production—this is mainly the case in Latin America—large amounts of carbon dioxide are emitted into the atmosphere from vegetation and soil. 37% of the emissions of methane derive from enteric fermentation in ruminants (cattle, sheep). 65% of the emissions of nitrous oxide come from the livestock sector, mainly from manure. Methane and nitrous oxide are much more powerful greenhouse gases than carbon dioxide. Methane has 23 times higher global warming potential (GWP), nitrous oxide 296 times higher (Steinfeld et al., 2006: xxi). The FAO estimates that globally intensive livestock production contributes with 5% of the global GHG emissions and extensive production with 13% (Steinfeld et al., 2006: 113). Together this comprises 18% of the global emissions, and this is more than the emissions from the transport sector, including aviation (Steinfeld et al., 2006: xxi).

This last statement—that the GHG emissions from the livestock sector are larger than those from the transport sector—has recently been criticized by Pitesky et al. (2009). The comparison is flawed, since the report uses one method for the assessment of the livestock sector (LCA) and quite a different one for the transport sector (without LCA). For this reason, the estimate that the global emissions from the livestock sector constitutes 18% cannot be trusted. Moreover, Pitesky et al. point out that the FAO statement that globally livestock produces more greenhouse gases than transport cannot be applied regionally, as has often been made in the media (but not by the FAO). They argue that the contribution of animal production in most developed countries is relatively small compared to the transport and energy sectors, while it can be much higher in developing countries, due to their much smaller transport and energy sectors. In the US, the livestock sector contributes only 3% (as estimated

by Pitesky et al. without using LCA) and the transport sector 26%. However, in countries like Paraguay, livestock production may contribute more than 50% because of Paraguay's much smaller transport and energy sectors (Pitesky et al., 2009). In addition to the estimate by Pitesky et al. regarding the US emissions, one can mention that the relative emissions from the livestock sectors in other developed countries are also lower than the global estimate by the FAO. For example, the emissions in the UK have been estimated to be 7-8% (Garnett, 2009) and in my own country, Sweden, to be 5-6% (The Swedish Board of Agriculture, 2010). It should also be noted that these estimates are in line with FAO's estimates that globally intensive livestock production contributes with 5% and extensive production with 13% (comprising together 18% of the global GHG emissions, as mentioned above), since we find intensive production primarily in developed countries and extensive in developing countries. However, even if these rather low estimates of the relative emissions in developed countries are correct, the emissions are in absolute terms substantial. The severity of the situation is further indicated by the fact that meat consumption per capita in developed countries is much higher than in developing countries. The US consumption of meat—which is the highest in the world—is on average 127 kg per person and year, while the average consumption in the world is 41 kg. As a comparison Bangladesh has the lowest consumption with 3 kg (FAO, 2009: 135-139 (these figures concern the year 2005)).

However, the FAO report has not only been criticized for overestimating the global GHG emissions from the livestock sector. It has also been criticized for underestimating them. Goodland and Anhang at the World Watch Institute state that the global emissions are as high as 51%. For example, they argue that livestock respiration should be included (Goodland and Anhang, 2009). I will analyse their arguments in more detail later on.

With all this in mind, the key question is this: To the extent climate change is caused by animal production (and consumption), what should we do to mitigate it? This question has of course technological and policy aspects, but it is also—and basically—an ethical question. It is a question about how we *should* act when facing the fact that the global warming in part is caused by production—and corresponding consumption—of meat, eggs and dairy products.

The answers to this ethical question depend partly on how we conceive of the nature and scale of the impact of animal agriculture on climate change. There are at least three different views in this regard, below called “models”. As we will see later on, these models may function as starting-points for different—technological, political and ethical—approaches to climate change mitigation.

Models of the impact of animal production on climate change

The three models are:

- (1) the life cycle model,
- (2) the complex impact model, and
- (3) the additional emissions model.

Let me briefly explain the key ideas of each model.

The life cycle model

The first impact model is “the life cycle model”. It provides a picture of the nature and scale of the impact of animal agriculture on climate change that is based on results of life cycle analysis (LCA). With the method of LCA one can measure the GHG emissions at different stages of the production chain of various food products, animal and non-animal. The results of LCA show that food products may differ substantially in GHG intensity or “carbon footprint”

(commonly measured in terms of carbon dioxide equivalents per kilogram (CO₂e/kg) commodity). During the last few years a number of reports have been published on GHG emissions in animal agriculture using LCA. Apart from the FAO report and the report by Pitesky et al. mentioned above, an early and very important one is the 2006 UK Defra (Department for Environment, Food and Rural Affairs) report (Williams et al., 2006; also called “The Cranfield Study”). Other examples are reports by Fiala (2008) and Cederberg et al. (2009).

A very informative and recent one is the UK report from World Wildlife Fund (WWF) and Food Climate Research Network (FCRN) (Audsley et al., 2009). Here follows a few results from this report. The emissions from beef are 12.14 kg CO₂e/kg, from sheep and goat meat 14.61, from pork 4.45, from chicken 2.84 and from eggs 2.94. Milk (whole, fresh) emits 1.19. The report also includes fish and gives a simplified composite figure covering both fishing and fish farming: 5.4 kg CO₂e/kg (see comment on pp. 17-18 in Audsley et al., 2009). This is slightly higher than the figure for pork. Let me also mention a few figures for non-animal food products: potatoes 0.26 kg CO₂e/kg, tomatoes 3.79 (a relatively high figure due to production in greenhouses (cf. Williams et al., 2006)), apples 0.32, and wheat (milling) 0.52 (Audsley et al., 2009: 37-39).

Regardless of the exact figures, we see a similar pattern in all these reports: the emissions from beef production are much higher than those from pork production, which are higher than those from production of chicken and eggs. In addition, the emissions from animal products are generally much higher than those from non-animal products.

It should be noted, however, that the life cycle model, as here understood, is not the same as LCA. It is a model of reality based on a method (LCA). One may accept the method but argue that a good model of the impact of animal production on climate change should not be based solely on LCA, because it gives a too simplified picture. This is

emphasised by, for example, the cited UK report from WWF and FCRN (Audsley et al., 2009: 36).

The method of life cycle analysis and the life cycle model can be referred to for quite different policy purposes, i.e., different views on how to mitigate climate change to the extent it is caused by animal production. As I will show later, the FAO report and Pitesky et al. argue for intensified animal production as a mitigation approach, while some other participants in the debate argue for a reduced production and consumption of animal products (a “less beef” approach and a “less meat” approach).

The complex impact model

The next model—“the complex impact model”—accepts LCA but stresses its limitations. It does not provide the full picture of the impact of animal production on climate change. This view is elaborated by, for example, Tara Garnett. She argues that the conclusions from LCA should be considered within a broader framework that encompasses also indirect impacts and opportunity costs (Garnett, 2009).

Garnett argues that cattle and sheep can actually help to prevent emissions of carbon dioxide by grazing on non-arable land. If we did not rear them on this poorer land, we would have to plough alternative land for other food production. The grasslands act as carbon sinks. Garnett refers to Allard et al. who argue that on unfertilised grasslands where cattle are reared without concentrated feed or fertilisers, their carbon sequestering role outweighs their emissions of methane and nitrous oxide (Allard et al., 2007). However, if only reared on non-arable land a much lower number of cattle would be allowed than is currently the case (Garnett, 2009).

Moreover, Garnett finds the replacement of ruminants (beef and sheep meat) with pork and poultry meat questionable, because pigs and poultry are much more dependent

on cereal and oilseed. Humans could eat the cereals, which would be much more resource efficient, and oilseed production (soy) is associated with high emissions of carbon dioxide from land use change (deforestation) (Garnett, 2009).

Finally, Garnett stresses that the climate impact of livestock manure is complex. On the one hand, it provides important nutrients to the soil. On the other hand, it emits nitrous oxide and to a lesser extent methane when it breaks down in the soil (Garnett, 2009).

On the basis of this complex impact model, Garnett proposes a policy that allows livestock production but at reduced numbers (see below).

The additional emissions model

A much more radical view of the nature and scale of the impact of animal agriculture on climate change has recently been presented by Robert Goodland and Jeff Anhang (Goodland and Anhang, 2009). They advocate what I call an “additional emissions” model. As mentioned above, they maintain that the estimate by the FAO that the contribution of animal agriculture of 18% of the global anthropogenic GHG emissions is much too low. An adequate estimate of the contribution of the life cycle and supply chain of livestock products is rather 51%. In addition to the emissions included by the FAO, Goodland and Anhang include also other emissions that are overlooked or underestimated (Goodland and Anhang, 2009).

According to Goodland and Anhang, a major overlooked source of GHG emissions is livestock breathing. This should be included, since livestock like cars are human inventions and the carbon dioxide exhaled by livestock therefore is no less unnatural than the carbon dioxide emitted from cars (Goodland and Anhang, 2009). Goodland and Anhang refer to the physicist Alan Calverd who has estimated that livestock respiration is responsible for 21% (Calverd, 2005).

Another overlooked source is land use. The FAO report only includes the changes in land use each year due to introduction of livestock, not the much larger reductions in GHG emissions that are foregone by using it for grazing and feed production rather than regenerating forests. Such forest regeneration would have the potential of mitigating half or even more of all human-caused GHG emissions. Alternatively the land could be used for growing crops for human consumption and biofuels (Goodland and Anhang, 2009).

Moreover, Goodland and Anhang maintain that the methane emissions from animal agriculture are underestimated. In its calculations regarding methane emissions, the FAO assumes that the global warming potential (GWP) of methane is 23 times the warming potential of carbon dioxide using a 100-year timeframe (although this figure is actually somewhat outdated; the now widely accepted figure is 25). However, according to Goodland and Anhang, a more appropriate figure is 72 using a 20-year timeframe. This figure is also supported by the IPCC (Goodland and Anhang, 2009).

Goodland and Anhang also point out that the FAO report seems to underestimate the number of livestock and overlook emissions that are higher from animal products than from non-animal alternatives, for example, emissions from cooling, cooking, waste, byproducts, and packaging (Goodland and Anhang, 2009).

The estimates by Goodland and Anhang have recently been criticized by Herrero et al. (2010). Among the co-authors we find authors cited above: Steinfeld (FAO) and Garnett. As an example of their criticism, livestock respiration should not be considered a net source of carbon dioxide, because the amount of carbon in feed consumed and carbon dioxide emitted by livestock are roughly equivalent, and if respiration is included, then the carbon dioxide absorption related to the growth of forage and feed should also be included (Herrero et al., 2010).

Referring to the extremely high GHG emissions from livestock production and consumption, Goodland and Anhang suggest a mitigation approach according to which meat should be replaced with other products (see below).

Mitigation: technological solutions

Now, how can we mitigate climate change to the extent it is caused by animal agriculture?

Several approaches have been proposed. One type is technological. By improving the methods of animal production the GHG emissions will be reduced. Mainly, there are three approaches:

- (1) improving productivity,
- (2) changing management, and
- (3) managing outputs.

Let me briefly present some options within each of these categories (in this overview I rely to a large extent on Garnett, 2007).

Improving productivity

The general idea of increased productivity in livestock production is to make the animals grow faster and thereby emit less greenhouse gases over their lifetime. One main option is to *change the feed* in terms of a diet higher in lower-fibre concentrates including cereals and oilseeds. This leads to higher outputs of meat or milk and relatively less methane emissions. One may also breed new strains of grasses and cereals with better nutritional properties or add various nutritional supplements (Garnett, 2007: 130-135).

Another option is to *change the genetic make up* of the animals. In this way higher quantities of meat or milk may be produced per animal or lower levels of methane be emitted during digestion. One may also breed cattle for multifunctionality, i.e., for both milk

and beef production. This is preferable to slaughtering unwanted calves at birth (Garnett, 2007: 136-137).

Moreover, there is the option of *changing the lifespan*. One may increase the fertility or longevity of the animals or shorten the fattening period (Garnett, 2007: 137-139).

Changing management

Another approach is to change the management system. One option is to *manage the soil inputs*, for example by improving soil drainage or optimising nitrogen fertiliser applications. One may also *restrict the time cattle spend outdoors* grazing. This may reduce the emissions of nitrous oxide from manure. The manure could then be used for biogas (Garnett, 2007: 139-143).

Other options have been much debated in terms of the pros and cons of organic versus conventional production, and the pros and cons of intensive versus extensive production. Here a conceptual clarification is required regarding the relation between organic and extensive production. Organic production is generally carried out on an extensive basis, however extensive production may not be based on organic principles, because it may use synthetic fertilisers. Extensive production is characterised by lower stocking densities and, in the case of cattle, uses less concentrated feed than intensive production (Garnett, 2007: 147).

Many studies have tried to compare the impacts of *conventional* and *organic* animal production, including their GHG emissions. The results vary substantially. Some conclude in favour of conventional systems, others of organic (Garnett, 2007: 143; see also McMichael et al., 2007).

The Defra report found that for dairy and beef cattle, organic systems are more GHG intensive per unit of milk or meat than conventional systems, while beef suckler systems are the most GHG intensive of all. The higher GHG intensity of organic production

depends on higher methane emissions. Even if the nitrous oxide emissions are lower, they do not compensate for the extra methane. Regarding chicken and egg production, the Defra report found organic systems to be more GHG intensive than their conventional counterparts. Regarding pork and sheep meat production, it found organic systems to be somewhat less GHG intensive than conventional ones (Williams et al., 2006).

Garnett concludes tentatively that conventional production seems very slightly less GHG intensive than organic. However, she admits that several studies point in the opposite direction, “so it is not really possible to come to any clear conclusion” (Garnett, 2007: 147). She maintains that “it is quite probable that the differences in the greenhouse gas intensity of organic and conventional systems are not very significant at all, particularly since often the differences between individual farm practices (and emissions) can be greater than those between systems” (Garnett, 2007: 147).

Also with regard to the relative merits of *intensive* and *extensive* animal production different views exist. Let me give a couple of examples.

Against the background that extensive livestock production contributes 13% of the global GHG emissions while intensive production contributes only 5% (Steinfeld et al., 2006: 113), the FAO states that intensification is necessary. “By far the largest share of emissions come from more extensive systems, where poor livestock holders often extract marginal livelihoods from dwindling resources” (Steinfeld et al., 2006: 114). However, intensification “is only achieved at the cost of pushing numerous small- and middle-scale producers and other agents out of business” (Steinfeld et al., 2006: 279). The FAO goes as far as to predict that “intensification and perhaps industrialization of farming is the inevitable long-term outcome” (Steinfeld et al., 2006: 283). Intensified livestock production as mitigation approach is also supported by Pitesky et al. (2009).

Casey and Holden, on the other hand, find that a more extensive system which

uses more high-yielding cows—in distinction to the low-yielding cows presupposed by the FAO—could reduce emissions by 14-18%. While the cattle are grazing at low stocking rates, the feed is nevertheless supplemented with substantial amounts of concentrates. In this way the emissions both per kg of output and emissions per hectare are minimised (Casey and Holden, 2005). Their results “suggest that, in general, extensifying beef production will result in lower GHG emissions per unit produced and per unit area” (Casey and Holden, 2006: 236). But this comes at the price that “live weight production per hectare would be reduced” (Casey and Holden, 2006: 231). They maintain: “A shift toward more extensive beef production is occurring in Europe in line with European agricultural policy, and therefore a reduction in GHG emissions from the sector should follow” (Casey and Holden, 2006: 238).

Managing outputs

Another type of mitigation approach focuses on manure storage and handling. For dairy cattle enteric fermentation is responsible for 80% of methane and manure for 20%. For pigs it is the other way around, with manure responsible for 70%. However, the total methane emissions from cattle are much higher than from pigs. Moreover, where manure is anaerobically digested, the methane can be used for biogas. The manure can also be used as a nitrogen fertiliser for plants. A potential problem is, however, that these options might lead to keeping the animals indoors for longer periods of time in order to collect more manure. This may affect animal welfare negatively (Garnett, 2007: 149-152).

Mitigation: reduction of livestock numbers

A more radical mitigation approach is to reduce livestock numbers over and beyond the outcome of increased productivity. Technological solutions are considered insufficient.

Garnett maintains:

Ultimately the most straightforward way to reduce greenhouse gas emissions from the livestock sector is to reduce significantly and absolutely the number of animals farmed. This is especially true from a global perspective: the many finely balanced technological and managerial approaches to mitigation identified in this paper may be simply too costly or difficult to scale up to the global level (Garnett, 2007: 152).

Up to a point, the number of animals can be reduced without decreasing the quantity of meat or milk produced, provided that the productivity increases. However, there is a limit to the increase in productivity. Beyond that limit, there will be serious consequences for animal welfare (Garnett, 2009). This means that if truly substantial reductions of GHG emissions are to be achieved, the livestock numbers have to be reduced to produce reductions in GHGs beyond those mitigation levels that are possible through the technological approaches presented above.

LCA shows that meat is much more GHG intensive than other food products (see above). A mitigation option would therefore be to produce and consume less meat. However, it is stressed within this approach that production and consumption strategies need to be integrated. If—within a particular country—animal production were to fall while the consumption levels remained the same, the country would simply import more. The effect might even be an increase in emissions, if the imported products were produced with less climate-friendly methods. Conversely, if consumption of animal products were to decline, but production stayed the same, this would lead to increased exports to other countries, and this would certainly not solve the global climate change problems. Changes in production and consumption strategies would have to go hand in hand (Garnett, 2009).

Within the general approach of reduction of livestock numbers there are at least three different options that need to be explored further. Interestingly, these three options are closely linked to the three models of the impact of animal agriculture on climate change presented above. I will investigate:

- (1) a “less beef” approach based on the life cycle model,
- (2) a “less meat” approach based on the complex impact model, and
- (3) a “no meat” approach based on the additional emissions model.

It should be noted, however, that there are no strict implications between impact model and mitigation approach. If you accept a particular model of the impact, it is by no means logically necessary to accept the mitigation approach suggested by the proponents analysed here. However, a particular model of impact may provide a good basis for a particular mitigation approach. Conversely, if you are in favour of a particular mitigation approach, this may be supported by reference to different models of impact.

A “less beef” approach based on the life cycle model

The first approach takes as its starting point the differences in GHG intensity of different food products as shown by the life cycle model and uses this as a basis for a policy of change away from beef and sheep meat. This policy can be seen in the following proposal from the FAO:

Shifting consumption from animal products with high associated GHG emissions (beef and sheep meat) to products with lower emissions (poultry, vegetable protein) can reduce total global GHG emissions (FAO, 2009: 74).

We see here that the emphasis is on reducing beef (and sheep meat) consumption, not on reducing meat consumption in general. Certainly, people are encouraged to eat more

vegetables (“vegetable protein”), but it seems equally acceptable to consume meat products with a lower carbon footprint than beef (for example, “poultry”).

A similar pattern we see in Weber and Matthews. The emphasis is on reducing beef consumption in more or less radical ways by shifting to less GHG intensive animal products or to vegetable-based diets (Weber and Mathews, 2008). It is not quite clear whether the proposal implies reduced meat consumption in general.

However, in an article by McMichael et al. we find a proposal that more clearly combines a reduction in absolute terms of meat consumption with a relatively bigger reduction of beef consumption and a relatively smaller reduction of consumption of less GHG intensive animal products such as pork, chicken and fish. McMichael et al. state:

The main options for reducing greenhouse-gas emissions per unit of animal production include ... increasing the proportion of chickens, monogastric mammals, and vegetarian fish in the flow of animals grown for human consumption ... An effective ... policy would therefore seek to ... reduce consumption of meat (especially ruminant red meat) and milk from the current high levels in high-income countries, with predicted health benefits (McMichael et al., 2007: 1260).

A “less meat” approach based on the complex impact model

The next approach focuses on reduction of meat consumption in general and downplays the differences in GHG intensity between different types of animal products. It should be noted that this approach can be based on any of the three impact models, however I will here analyse proposals based on the complex impact model.

A proponent of this approach is Garnett. As we saw above, she takes seriously the results of LCA but defends a complex impact model that stresses indirect impacts and opportunity costs. She does not stress the differences in GHG intensity between different animal products but stresses rather the differences in GHG intensity between animal products and non-animal products. We should reduce meat production/consumption and eat more non-animal food. However, we should not eliminate meat production/consumption entirely. Meat production is acceptable to some extent. Garnett even finds a positive role for livestock in climate change mitigation, provided that their numbers are much lower than they presently are. This is what she argues:

A certain level of livestock production can actively help tackle climate change, by contributing to soil carbon sequestration and by making use of otherwise unproductive land, so avoiding the need to plough alternative land. The ability of livestock to consume crop residues and byproducts that are inedible to humans is resource efficient and leads to GHG avoidance, provided the advantages of substitute uses (such as biogas production) do not outweigh their benefits as an animal feed. Manure can improve soil quality.

Nevertheless at *current* levels of production and consumption – and even more so at projected future levels – the disbenefits of livestock with respect to GHG emissions far outweigh the benefits (Garnett, 2009: 497).

Another statement in line with this approach—with a special focus on reduced consumption—can be found in the recent UK report by WWF and FCRN:

Diet provides single measures with big effects. In addition, these measures are technically feasible now. The most effective single measure (meat-free diet) gives a 20% reduction. The benefit of a vegetarian diet increases to about 38% when our estimates of LUC [land use change] emissions are included, but this excludes the loss of soil carbon if UK grassland was converted to arable cropping. Our analysis of the effects of the production of substitutes leads to the conclusion that a broad reduction in livestock product consumption balanced by broad-based increases in crop product intake is a more feasible measure which avoids the land use burden associated with soy based livestock product analogues (Audsley et al., 2009: 68).

In the last sentence, we find a critique against Goodland's and Anhang's version of the next approach ("no meat"). They suggest precisely a reorientation of production to soy based livestock product analogues.

A "no meat" approach based on the additional emissions model

The third proposal is based on the additional emissions model, i.e., the view that the total emissions from the livestock sector are much higher than the FAO states, and it takes this as a reason to adopt an approach of replacing livestock products with other products. It should be noted, however, that this approach—as the others—can be based on different impact models, in this case also on the life cycle model and the complex impact model.

Goodland and Anhang stress that the problem is extremely urgent and that this requires extreme measures. They recommend that meat should be replaced with alternative products, as is evident from this statement:

An effective strategy must involve replacing livestock products with better alternatives, rather than substituting one meat product with another that has a somewhat lower carbon footprint (Goodland and Anhang, 2009: 15).

We see here that Goodland and Anhang accept the view of the life cycle model about the differences between different animal products but argue that they are negligible given the dimensions of the problem. As an alternative, Goodland and Anhang suggest production of livestock product analogues such as tofu and quorn. In particular, they highlight the opportunities in this regard for the food industry. Actually, they stress that private sector initiatives should take the lead over policy measures (Goodland and Anhang, 2009).

Regarding marketing, they recommend the following:

A successful campaign would avoid negative themes and stress positive ones. For instance, recommending that meat not be eaten one day per week suggests deprivation. Instead, the campaign should pitch the theme of eating all week long a line of food products that is tasty, easy to prepare, and includes a “superfood,” such as soy, that will enrich their lives ... By replacing livestock products with analogs, consumers can take a single powerful action collectively to mitigate most GHGs worldwide (Goodland and Anhang, 2009: 17).

Ethical aspects

We now turn to the ethical aspects of the mitigation approaches. The research papers and reports on mitigation approaches investigated here seldom explicitly discuss ethical aspects (an exception is Garnett, 2009). I will try to fill this gap by highlighting some ethical aspects that need to be taken into account (however, due to limited space a detailed analysis of ethical

arguments will not be carried out). I start with some general ethical considerations. Then I sketch a policy proposal based on these considerations.

General ethical considerations

It seems to be taken for granted in the above-cited articles and reports that climate change mitigation is ethically justified. An ethical principle that could reasonably be thought to justify this assumption is *intergenerational justice*:

(1) We should strive for a just distribution of goods and burdens between the present generation and future generations.

Each generation should have its fair share of natural resources, but each generation also has a responsibility to see to it that future generations get their fair shares (cf. Page, 2006; Gardiner, 2006; Caney 2009). Thus the principle of intergenerational justice might be used to support sustainable development, which—understood in terms of the classical statement by the Brundtland Commission—is to meet the “needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987: 85). Among the goods that should be justly distributed between generations is a good climate or rather—to put it the other way around—avoidance of bad effects of climate change such as extreme weather, sea level rise, destruction of ecosystems, extinction of species, adverse impacts on indigenous populations, environmental refugees, socio-economic tensions, and the spreading of diseases.

So, the goal is to mitigate climate change for reasons of intergenerational justice. Are there any ethical restrictions on the means for reaching this goal?

One ethical restriction—and one that is referred to in some mitigation proposals—is *intragenerational justice*:

(2) We should strive for a just distribution of goods and burdens among countries and individuals within each generation.

One policy observing this restriction is the “contraction and convergence” approach. This approach is supported by a range of non-governmental organisations, e.g. the Global Commons Institute (2011), as well as a number of developed and developing countries, e.g. Switzerland and Mexico. According to this approach, the global GHG emissions are to be reduced below a certain safe level (contraction) and, in the longer term, the per capita emissions in developed and developing countries are to converge on an equal level (Page 2007: 177). This approach is also applicable to GHG emissions caused by animal production.

Central to this approach are the special responsibilities that lie with the developed countries. This is in line with the view on responsibilities stated in the UN Framework Convention on Climate Change: “common but differentiated responsibilities”. According to this view, “the developed country Parties should take the lead in combating climate change and the adverse effects thereof” (UN Framework Convention on Climate Change, 1992, Article 3:1).

The next ethical restriction is *animal welfare*. We saw above that Garnett argues that there is a limit to the increase of productivity that is set by animal welfare considerations (Garnett, 2009). There is some dispute about what animal welfare consists in (Appleby and Hughes, 1997). However, regardless of which conception we embrace more precisely, the restriction can be articulated as follows:

(3) We should avoid unnecessarily compromising animal welfare in animal production.

This restriction can be interpreted more or less radically, but it is beyond the purpose of this paper to determine exactly how.

Animal welfare is an important ethical aspect in the controversy over conventional versus organic production (Garnett, 2007: 156-158; Gjerris et al., 2010). If Garnett is right in stating that “it is quite probable that the differences in the greenhouse gas intensity of organic and conventional systems are not very significant at all” (Garnett, 2007: 147), then the choice between the two types of system would depend more on animal welfare reasons—and other types of reason—than on reasons of climate change mitigation. If, on the other hand, there are significant differences in GHG intensity between organic and conventional production, it is easy to see that conflicts might arise between animal welfare concerns and climate mitigation concerns. According to the Defra report, for example, organic production of dairy and beef cattle is more GHG intensive than conventional production (Williams et al., 2006). To some this might suggest that we should support conventional production rather than organic in order to reduce GHG emissions and thereby compromise animal welfare (presupposing that organic production is more animal-friendly than conventional production). A possible response could be to propose organic production for animal welfare reasons but compensate for the higher GHG intensity by the production of fewer animals.

In addition to the ethical principles above ((1)-(3)), I propose two further restrictions of a pragmatic character ((4)-(5)). The first concerns the *potential to mitigate* of a mitigation approach. In this regard, I suggest the following formulation:

(4) We should choose a mitigation approach with a sufficient potential to mitigate climate change rather than an approach with an insufficient potential to do so.

Elimination of meat production has a higher potential to mitigate climate change than mere reduction of meat production does, and radical reduction has a higher potential than modest reduction. Technological solutions—such as those mentioned above—probably have a lower potential to mitigate than elimination or radical reduction, but may have lower or higher potential than modest reduction depending on the impact of animal agriculture on climate change. If the impact is only rather limited, technological solutions might be sufficient, i.e., have potential enough to mitigate climate change. If, however, the impact is more substantial, technological solutions may not have potential enough and a more radical reduction of livestock numbers becomes necessary. This means that which approach we ought to choose depends on which view we accept about how much animal production contributes to climate change.

We also need to consider the *feasibility* of the mitigation approaches. A restriction regarding feasibility can be formulated like this:

(5) We should choose a mitigation approach that is more feasible rather than one that is less feasible.

However, the question of feasibility has no simple answers. Judgements of feasibility depend on one's views about the impact models, technology, human nature, the economic situation and the political situation, nationally and globally.

If the impact of animal agriculture on climate change is only limited, technological solutions might be sufficient, and on this basis one might expect that mitigation approaches focusing on such solutions are quite feasible. For example, they do not require radical changes in consumption behaviours.

If, however, technological solutions are not sufficient and reduction of livestock numbers are necessary, this would require behavioural changes to some degree, and the key question is this: are people willing to make these changes and able to keep to their new consumption patterns for the rest of their lives?

Reduction of livestock numbers also faces economic problems. We have seen that a reduction of production and consumption within a country must go hand in hand, otherwise they will be compensated by import or export changes that would not solve the mitigation problem globally.

Finally, there are several political problems. Would politicians within a particular developed country be prepared to argue in favour of reduced meat production/consumption? Would they gain enough votes on such a policy to survive in politics? And what about the global aspects: can a sufficient number of states agree on such a policy? We also have the delicate problem of what kind of political steering is feasible. Climate labelling of food products and meat taxes are possible options but perhaps difficult to implement, partly due to opposition from meat producers.

Policy proposal: a sketch

On the basis of these general ethical considerations, I will now put forward a few policy suggestions. Let me first clarify my background assumptions.

Background assumptions

More empirical research is needed to settle the issue of the exact amount of GHG emissions from the livestock sector. I tentatively assume, however, that a moderate estimate is adequate, i.e., around 10 to 18% of the global GHG emissions (see above). The much higher estimate by Goodland and Anhang (51%) is too controversial and unconfirmed to be a reasonable starting

point for a policy, and even a moderate estimate suggests that the global emissions from the livestock sector are substantial enough to justify mitigation. The problem of global warming is so big and so urgent that emissions from every sector in society should be the focus of attention, including the livestock sector. If it turns out that the global GHG emissions from the livestock sector are higher, I am certainly prepared to revise my assumption.

I also assume that a complex impact model is adequate (cf. Garnett above). Life cycle analysis is important but does not give the full picture of the scale and nature of the impact of animal production. As Garnett points out, there is a role for livestock in climate change mitigation. They can contribute to soil carbon sequestration and make use of otherwise unproductive land. This presupposes, however, that their numbers are much lower than at present. Moreover, the differences in GHG intensity between animal products and non-animal products are more significant than those between different animal products.

A “less meat” approach in developed countries

I agree with Garnett that mitigation approaches that focus on technological solutions alone are probably not sufficient. Reduction of livestock numbers seems necessary and has a higher potential to mitigate climate change. The problem is how far we need to go in reduction. I have analysed three more or less radical approaches in this regard. With Garnett I propose a “less meat” approach. However, should this approach be production-focused or consumption-focused? For reasons of feasibility, I suggest that we start with a consumption-focused approach rather than a production-focused one. As McMichael et al. point out, the feasibility of this approach is indicated by the fact that people in the developed part of the world have already shown that they are prepared to reduce their meat consumption for health reasons (2007). We must start somewhere and—as the UK report from WWF and FCRN states—“diet provides single measures with big effects. In addition, these measures are technically feasible

now” (Audsley et al., 2009: 68; cf. Stehfest et al., 2009). Another UK report by the WWF and the Food Ethics Council, *Livestock Consumption and Climate Change: A Framework for Dialogue*, illustrates how in practice we can go about working with stakeholders—such as industry and government—in this regard (MacMillan and Durrant, 2009). How far we need to go in reduction is a problem that we can try to solve along the way.

However, despite the fact that I support a “less meat” approach rather than a “less beef” approach I do not agree with those who argue that the differences in GHG intensity between different animal products—as shown by LCA studies—are insignificant. To start changing one’s consumption patterns by eating more chicken and less beef could work as an incentive to make even more radical changes. The next step could be to eat non-animal food a day a week and then two days a week.

Reduced production/consumption allows for relatively more organic production compared to conventional production. There don’t seem to be any significant differences in GHG emissions between conventional and organic production, but if there are differences these are smaller than those between animal and non-animal products and between different kinds of animal products (see above). Therefore the issue of organic versus conventional production is not of vital significance from the point of view of climate change mitigation. What is important is the reduction of consumption and production. However, the issue of organic versus conventional production is significant from an animal welfare perspective. To the extent that organic production is more animal-friendly than conventional production, and we have some reasons to believe it is (cf. Gjerris et al., 2010), we may produce relatively more organic animal products provided that the overall production of livestock is reduced.

Contraction and convergence

The FAO predicts that global meat consumption will double until the year 2050, mainly due to increasing consumption by the growing middle class in developing countries (Steinfeld et al., 2006: 4, 33, 276), and we have seen above that in addition to technological solutions there are good reasons to believe that a reduction of global animal production and consumption is necessary in order to successfully mitigate climate change. In the light of this, how should the increasing demand for meat in developing countries be handled? Among the proposals analysed above we find an explicit emphasis on a differentiation of responsibilities in McMichael et al. They support a kind of “contraction and convergence” approach (see above): a reduction of meat consumption to a certain level in developed countries and an increase of meat consumption up to this level in developing countries (McMichael et al., 2007).

The proposal by McMichael et al. seems reasonable. A measure to facilitate its implementation is to try to limit the population growth in developing countries by promoting the use of contraceptives and respect for women’s rights (Cafaro, 2010). Another measure is to provide technological support to developing countries in order to improve productivity. Traditional production systems are extensive and use low-yielding cows, leading to very high emissions (cf. Steinfeld et al., 2006: 114).

Political steering, social pressure, and individual responsibility

In order to implement the policy proposed above, neither a bottom-up model—stressing individual responsibility and formation of social norms—nor a top-down model—stressing political steering—seems appropriate. What is needed is probably a mixed model, in which political steering is the most important component but in which individual responsibility and formation of social norms are important in order to put social pressure on politicians. The reason political steering is necessary is that action is urgent and many people might not be

willing to change their lifestyle and diet for the good of future generations. We need mutually agreed-upon mutual coercion in a similar way as we as citizens already force ourselves to pay income taxes, go to school and respect public smoking bans (Alcott, 2008). The reason social pressure on politicians is necessary is that their previous value commitments regarding animal production may make it difficult for them to change direction.

An important part of political steering would be to initiate measures to reduce meat consumption in developed countries. How far and how fast this reduction would need to go is still unclear. However, this approach urges politicians to rethink the goals for the livestock sector and start considering seriously what sustainable development and human (and animal) flourishing require in the long run (cf. Cafaro, 2010).

Conclusions

I have shown that the ethical problem of mitigation of climate change, to the extent it is caused by animal production, is an extremely complex and difficult issue. There are different views on the nature and scale of impact and different mitigation approaches. I have also highlighted some ethical aspects of the mitigation approaches. In particular, I have suggested a kind of “contraction and convergence” policy, i.e., a policy of reducing meat consumption to a certain level in developed countries while allowing people in developing countries to increase their consumption up to this level.

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