How will the world perceive livestock agriculture in relation to the impacts on, and of, climate change?

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How could this factor develop in the next 10–15 years?
The livestock sector globally constitutes a development conundrum: the benefits and the costs are both multi-faceted and highly context-specific, and their honest appraisal defies simple analysis and easy categorization. In the past, changes in the demand for livestock products have been largely driven by human population growth, income growth and urbanization, and the production response in different livestock systems has been associated with science and technology improvement as well as with increases in animal numbers. In the future, production will increasingly be affected by competition for natural resources (particularly land and water), competition between food and feed, and probably by the need to operate in a carbon-constrained economy. Demand in developed countries is likely to be affected by environmental and animal welfare legislation and by human health concerns and changing socio-cultural values. On the other hand, in many developing countries, particularly in Africa, livestock keeping will continue to be a critical asset to many millions of smallholders and pastoralists: many of these people have few if any other livelihood options.

While the direct impacts of climate change on livestock systems specifically may not be that substantial over the next 10–15 years, ample evidence indicates that impacts on agriculture in the lower latitudes will become much more pronounced in the latter two-thirds of this century if we continue to pursue current greenhouse gas (GHG) emission trajectories. The impacts of public perception, on the other hand, could significantly affect the mitigation debate by 2025 or earlier, with widespread implications for the global livestock industry.

What are the drivers that will influence how this factor develops?
The impacts of unabated anthropogenic GHG emissions on our climate are becoming increasingly difficult to ignore. The consensus of climate science is that the increasingly extreme and erratic weather patterns already being experienced in certain places are due in part to global warming as well as to natural variation. While attribution of specific events to climate change is neither possible nor particularly useful, there is no escaping the conclusion that the climate is changing and becoming increasingly extreme. It is possible that within 10–15 years, key climate feedbacks may come into play and accelerate the rate of change of warming as well as the frequency of climatic extremes. At some stage, either sooner or later, societal willingness finally to take a stand against our current loss of control over GHG emissions will reach a tipping point (surely we can dismiss the alternative, of unconstrained GHG emissions in the face of blindingly obvious evidence of impending catastrophe?). At such a time, society’s attitude will undergo a massive shift, with potentially huge impacts on many areas of mitigation, and the implications could be profound.

What of other societal attitudes and perceptions? Attitudes in the West towards animal welfare have undergone considerable transformation in the last several decades, public concern and research on animal sentience being key drivers of animal welfare legislation in the EU, for example. Changes in societal attitudes could well affect the way in which livestock products are produced, through encouraging technological nudges that lead to more efficient production, as well as leading to reduced meat consumption, primarily as a mitigation and/or health strategy. Those societal changes are quite slow, however; another driver that could change society’s attitude to livestock much more rapidly is technology development: specifically, in-vitro meat. Recent media reports indicate that a breakthrough in the production of ‘lab meat’ may be near. The eating of (probably raw) meat is generally reckoned to have been a critical contributing factor to the evolution of the human brain; if humans’ hunger for meat could be met with something largely indistinguishable from the real thing, the impacts globally—on the
environment, on GHG emissions, on human diets and health—would, quite simply, change the whole
game.

What is the potential impact of this factor on the evolution of smallholder livestock farming (both
crop-livestock and pastoral systems)?
We could consider the following two scenarios as defining the ends of the spectrum of possibilities, in
relation to GHG emissions over the next 10–15 years:

Business As Usual, a world in which control of GHG emissions proceeds at a snail’s pace. We would see
continuation of current trends: livestock production being increasingly characterized by differences
between developed and developing countries, and between highly intensive production systems on the
one hand and smallholder and agropastoral systems on the other. With the exception of peri-urban dairy
systems in some countries, smallholder mixed crop-and-livestock systems as well as the pastoral systems
will likely continue to struggle to become more integrated into national and regional economies. In many
places in developing countries, livestock production will continue to become increasingly intensive and
focused on non-ruminants (e.g., monogastrics such as pigs and poultry). Highly vulnerable populations
of pastoralists will continue to need serious attention from governments, researchers and NGOs, but
these systems tend to be on the political margins and development targeting will become increasingly
difficult because of political and/or resource-based conflicts.

Mitigation World, in which aggressive action is being taken towards a low-carbon global economy as a
matter of extreme urgency. This could result in a very different global livestock sector: rapidly increasing
consumer prices for livestock products (especially beef), as environmental externalities are internalized,
rapid shifts to relatively carbon-efficient monogastric production systems, and some (eventually
considerable) falling-off of previously burgeoning demand as prices soar. Mitigation drives all agendas,
subsuming adaptation, and it is doubtful that smallholder producers in general can benefit from high
consumer prices because of competition and the costs of (some) mitigation technology. There could well
be niche markets for high-value, low-carbon products (‘Maasai beef’) as well as substantial income-
generating opportunities via carbon sequestration schemes, but for smallholders and pastoralists to reap
much benefit, such things would need considerable concerted national and international policy (and
technical) action.

Under either scenario, addressing the livestock and development conundrum remains difficult, but
particularly in a ‘mitigation world’, in which the dichotomy between a developed- and developing-country
outlook is heightened even further: mitigation in direct conflict with adaptive capacity / vulnerability
reduction, a conflict in which the poor and politically excluded will come off worst, if the past is any guide
to the future. The role of livestock research for development may be quite similar in both scenarios: both
need a concentration on technologies that can help smallholders and pastoralists better manage existing
risk and take advantage of local and global markets where they can, and both need careful analyses of
the broad costs and benefits of alternative adaptation and mitigation options, for example. The
differences are more of degree: maintaining thoughtful livestock research for development activities in a
‘mitigation world’ is likely to pose significant challenges in the light of societal attitudes in the developed
world (and even in some middle-income countries) that may increasingly come to see livestock
production in general as carbon prodigal, with impacts on private-sector and donor investment in the
sector, ultimately.

What evidence is available that informs projections in this area?
Impacts of climate change in the coming decades on agricultural systems are summarized in the first-
order draft of the IPCC’s Fifth Assessment Report, due for publication in December 2014. Something
quite similar to a ‘business as usual’ scenario that quantifies agricultural production, consumption and
land-use patterns to the 2050s is described in Rosegrant et al., ‘Looking into the future for agriculture
and AKST (Agricultural Knowledge Science and Technology)’; Chapter 5 in Agriculture at a Crossroads
(eds. McIntyre et al.), Island Press, Washington DC, 2009. There appear to be few if any quantified
projections of extreme mitigation scenarios, and in any case most of the global integrated assessment modelling has little to say about the relative effects of changes on the smallholder versus commercial sectors; there is still a lot of work that needs to be done urgently on multi-level analyses to help elucidate these effects. A recent review of some important societal drivers of change in relation to livestock production globally is Thornton’s ‘Livestock production: Recent trends, future prospects’, in *Phil Trans Roy Soc B* 365: 2853–2867, 2010. The in-vitro meat revolution may be nearer than we think: see Hanlon, ‘Fake meat: is science fiction on the verge of becoming fact’, guardian.co.uk, 22 June 2012. Some of the environmental impacts of switching to in-vitro meat consumption are discussed in Tuomisto & de Mattos, ‘Environmental impacts of cultured meat production’, *Environ Sci Technol* 45: 6117–6123, 2011. Some of the consumption issues are discussed in Schmidinger, ‘Worldwide alternatives to animal derived foods—overview and evaluation models: solutions to global problems caused by livestock’, PhD thesis, Universität für Bodenkultur, Vienna, 2012. Comprehensive integrated assessments of game-changing scenarios on the livestock sector, including widespread in-vitro meat production and consumption, urgently need to be done.