Livestock, feed and food security

FCRN briefing paper, January 2010
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This short paper explores some of the arguments surrounding the relationship between what we feed and how we rear farm animals, and the availability and accessibility of food for human consumption. Does livestock production foster or hinder food security? In what ways are the contributions of intensive and extensive systems to food security different?

Extensive small scale systems have traditionally made a very important contribution to food security. In parts of the world where crop production is limited, the grazing of animals that can convert grass, crop residues and household waste into food (meat, milk, blood or eggs), draught power, soil fertliser and resilient materials (hides and wool) has been critical. In these contexts, livestock farming contributes to more than food security– it sustains livelihoods.

Intensive systems make a different contribution to food security. From a simple point of view, intensive landless livestock systems contribute to nearly half (45%) of the world's meat supply[1] and in particular provide a relatively cheap source of protein for the world's growing urban populations.

It has been argued, however,[2] that at a deeper level, intensive livestock production actually undermines food security since it uses so much of the world's grains – around a third. For simple biological reasons, feeding grain to an animal and then consuming the animal's flesh or milk is always going to be less efficient than consuming the grain directly, whether efficiency is measured in terms of energy (calories), or protein, or land use. Of course, animal-source foods provide more than just energy or protein – they are excellent sources of essential micronutrients in highly bioavailable form, such as calcium, iron, vitamin B12 and so forth. While animal products are not biologically necessary for humans provided a well range of plant based foods is available and consumed (the exception being in the case of vitamin B12 which can nevertheless be manufactured from yeast), for many people in many parts of the world consuming very limited diets, the inclusion of some animal source foods in their diets can make a very valuable difference.[3] On the other hand iron, meat and dairy consumption at levels seen in the developed world are not only excessive in relation to our requirements but can be damaging in so far as they oversupply people with calories and fat.

[1] FAO, *Livestock's Long Shadow*, Rome, 2006
[2] *Beyond factory farming: Sustainable solutions for animals, people and the planet,* A Report by Compassion in World Farming, UK, 2009

[3] Neumann, C., Harris, D.M., Rogers, L.M., 2002. Contribution of animal source foods in improving diet quality and function in children in the developing world. *Nutrition Research* 22 (1–2), 193–220.

In view of the 'inefficiency' of feeding grains to livestock before these livestock are then consumed by humans, UNEP has calculated that the feed grown worldwide for livestock, if released for human consumption, would be sufficient to feed 3.5 billion people.[4]

However, it has also been argued[5] [6] that the production of dedicated crops for livestock has a 'buffering' effect. Since growers produce grains for animal feed as well as the food markets, more grain is therefore produced than needed to feed humans efficiently. In a good harvest year this grain is fed to livestock but in poor harvest years this additional planned production has can compensate for the shortfall in yields, and the crops can be fed directly to humans. The argument for ensuring adequate 'buffers' against shocks is important, since the absence of sufficient grain stocks was one of the contributing factors to the food price rises of the last few years, and the subsequent increase in the number of hungry people world wide.[7] One estimate suggests that nations should aim to ensure they have access to supplies 30% greater than what is strictly needed to ensure adequate nutrition.[8]

The food versus feed question is based on a complex set of interacting issues. Any analysis of whether feed production hinders or improves food security needs to be based on further exploration of the following key questions:

a. What feed crops are at issue here? Is the focus on prime cereals, spoiled crops, or poor quality grains?
b. Which livestock systems are consuming which products? Is the focus on intensive systems predicated on a constant supply of soy and wheat or extensive systems bolstered by occasional localised surpluses?
c. Who is eating what? Who eats grain-fed animals - rich people or poor people, people in cities or in rural areas?
d. What prices? How do the elasticities of demand affect the picture?

We investigate each of these issues in turn as follows:

a. Which grains?

What crops are fed to livestock? Generally speaking livestock are fed one, or a combination, of the following, (in addition to the grass that grazing animals consume):

- Human grade wheat, barley and so forth.
- Feed grade grain crops
- Less palatable crops (sorghum, millet)
- Residues, byproducts, spoiled crops, food waste

Human grade wheat and other grains are generally grown where the climate is favourable. Human grade wheat, for example, is generally grown for breadmaking and commands a

[4] UNEP, *The environmental food crisis: The environment's role in averting future food crises*, Nairobi, 2009
[5] Rosegrant M W, Leach N, Gerpacio R V. (1999). Plenary Lecture: Alternative futures for world cereal and meat consumption in Meat or wheat for the next millennium?' *Proceedings of the Nutrition Society*, 58, 219–234
[6] Speedy, A W. (2003).Global Production and Consumption of Animal Source Foods, J. Nutr. 133: 4048S-4053
[7] Evans A (2008). Rising Food Prices: Drivers and Implications for Development Chatham House Food Supply Project, Chatham House, London
[8] Stuart T. (2009). *Waste: Uncovering the global food scandal*, Penguin, London

higher price than feed grade wheat. However, prices also dictate whether, in any particular year, it is only used for human consumption. For example, in the case of the UK, in a good harvest year when supply is plentiful and prices are low, then it may be cheaper for a farmer to sell the crop at lower prices for feed than to store it until the following year.[9]

Feed grade wheat and other grains: Taking UK wheat production as an example, feed wheat tends to be grown in colder and damper regions. This makes the formation of high gluten levels not possible, and so the wheat does not meet *current* bread making specifications, although it was used to make bread in the past, before we developed high gluten varieties of our own and before we imported 'harder' wheat from North America. This lower gluten wheat is also used to make biscuits and for the production of alcohol. The key point to emphasise here is that the wheat is perfectly edible – the constraints here are consumer and industry perceptions of 'quality.' Feed wheat is cheaper than the higher quality bread making wheat.

Less palatable crops: Some crops are less generally less favoured than the prime grains (wheat, maize, rice). These include cassava, millet and sorghum in tropical regions and oats and barley in temperate climates. Although these grains are eaten, particularly (in the case of developing countries) by poor people because they cannot afford to eat anything else, they are considered less palatable and so when people can afford to do so, instead of being consumed directly, they are fed to animals which people then eat. Sorghum and millet have relatively good nutritional profile (measured in terms of protein and micronutrients); cassava, on the other hand has relatively few nutrients (other than carbohydrate) and is poisonous unless treated before cooking.

Byproducts, crop residues, spoiled crops and so forth: these include a huge diversity of products from citrus pulp, to rice husks, to substandard vegetables. These foods generally (and with a few exceptions) cannot be consumed by humans and therefore feeding them to animals can be seen as a resource efficient strategy. In essence, by feeding to livestock what would otherwise be waste, one is getting 'something for nothing.' Of course that waste could also be anaerobically digested to produce energy rather than food; a decision as to the merits of one approach over another is likely to be highly context specific.

In most intensive pig and poultry systems, the dominant feed mix comprises grains such as wheat, barley or maize, in combination with soy. It has been estimated that 90% of the soy imported into the EU goes to feed pigs and poultry.[10] Together, cereals and soy make up around 80% of diets of pigs and poultry, with other crops constituting the remainder. Figure 1 shows the typical feed make up for chicken rations in a selection of countries.

These intensive pig and poultry systems rely on the production of these grains in order to produce the volumes of meat and eggs that they do. Ruminant feed contains a higher proportion of byproduct material although the soy content in intensively reared dairy cow rations can still be substantial. Such systems are, in effect, dependent on the production of dedicated feedstuffs, and not on occasional surpluses. These production of these feedstuffs may themselves raise environmental concerns, as in the case of the association between soy production and deforestation in the Amazonian region.

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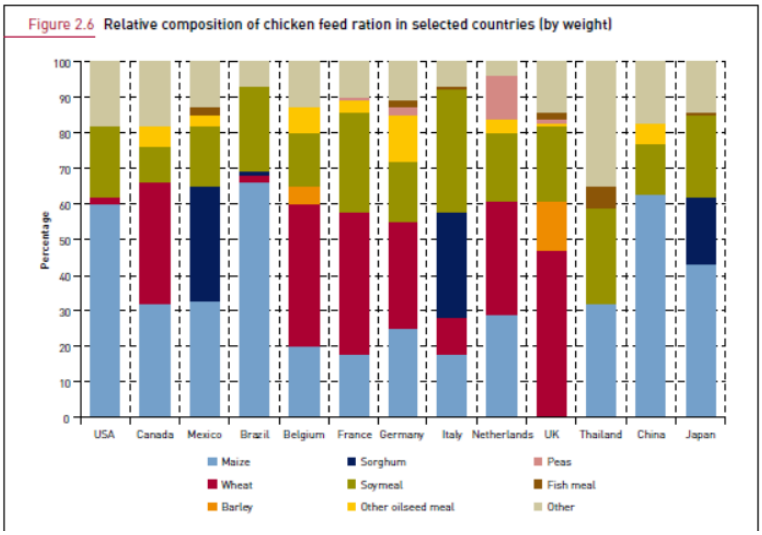
[9] *Meat and dairy production & consumption: Exploring the livestock sector's contribution to the UK's greenhouse gas emissions and assessing what less greenhouse gas intensive systems of production and consumption might look like (2007)*. Working paper produced a part of the work of the Food Climate Research Network, Centre for Environmental Strategy, University of Surrey

[10] Friends of the Earth Netherlands, 2008. *Soy consumption for feed and fuel in the European Union*. A research paper prepared for Milieudefensie (Friends of the Earth Netherlands) by Profundo Economic Research, The Netherlands.

Figure 1



As regards feed grade wheat and the less palatable crops, it could be argued that these do have a buffering role at a local level although it should be remembered that how one defines food and feed grade quality has more to do with culture and economics than with nutrition. As an alternative to using livestock as a repository for surplus harvests, it is also possible to envisage a situation where this buffering role is replaced by more consistent prices for farmers, adequate storage, and policies specifically developed to promote food security through the maintenance of adequate grain stocks. This system would also reduce the demand for animal feeds in years when yields are lower.

Biofuel residues (such as distillers grains) are increasingly coming onto the market and these could potentially serve as a substitute for soy in animal feed. One could argue that this replacement of soy, if it leads to less Amazonian deforestation, could be seen as beneficial. On the other hand, if the production of biofuel crops on land currently used to produce grains for export means that less grain is exported then this could still have an indirect land use change effect since the market demand for these grains will have to be met from production elsewhere – which could lead to land use change. In other words, in a world where markets are global, changes in the production or use of one product can have indirect knock on effects on land use elsewhere.

Use of other residues (eg. wheatfeed (husks and germ of wheat), rice husks and so forth can be seen as highly resource efficient, but these feedstuffs are more likely to be fed to ruminants - the feature less in intensive pig and poultry systems.

Moreover it is worth drawing attention to anticipated trends in feed production. According to the FAO[11] demand for feed will increase by 1 billion tonnes by 2030 from a 1997/9 baseline.

[11] FAO, *Livestock's Long Shadow*, Rome, 2006

Keyzer *et al*. estimate a higher figure still at 1.9 billion tonnes.[12] For reference, the global grain harvest in 2007 was around 2.2 billion tonnes.[13] Even if there have been situations in the past where the use of harvest surpluses to feed livestock has enhanced food security, in a situation where the global population is expected to rise by a further 2.3 billion people, and where land pressures are become more acute, the feeding of dedicated feedcrops to livestock is almost certain to undermine, not improve food security.

b. Which livestock systems?

As emphasised in previous paragraphs, the feeding of occasional surpluses to livestock is very different from the systematic production of grains specifically for feeding animals. We have also pointed out intensive pig and poultry production is predicated on this systematic production, although significant quantities of grains and soy are also fed to intensively reared beef and dairy cattle in the developed world.

The argument with respect to buffering, in short, has some validity in the case of extensive ruminant systems, that are more flexible in their diets, but does not hold in the case of intensive pig and poultry production, or intensively reared beef and dairy cattle. As such issues relating to feed, feed quality, and quality of land use, needs to be set against, and complicate the findings of life cycle analysis (see *Intensive versus extensive livestock systems and greenhouse gas emissions*, FCRN briefing paper, January 2010).

c. Which people?

Who eats grain fed meat? In poor harvest years, when grain prices go up, do they stop eating it? We are now at a point where, for the first time in history, overall production of meat (of all kinds) is higher in the developing than in the developed world, although this is not the case for milk where overall production in the developing world is only 27% of production in the developed world.[14] This is the overall figure – it is important to emphasise that *per capita* intakes are still much lower in the developing than in the developed world.

On the other hand, the use of feed grains for livestock production is still much higher in the developed than the developing world, since at present most feed production takes place in OECD countries.[15] This means that grains reared for livestock go to feed animals that, for the most part, are eaten by rich (mainly urban) rather than poor (rural) people. This is changing, however, and feed production has increased dramatically in many parts of the developing world, notably China.

The fact that rich people are more likely to eat grain fed meat than poor people, is significant to the food versus feed debate when the issue of prices, and demand elasticities are factored into the discussion.

d. What prices?

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[12] Keyzer M A, Merbis M D, Pavel I F P W, van Wesenbeeck C F A. (2005). Diet shifts towards meat and the effects on cereal use: can we feed the animals in 2030? *Ecological Economics* Volume 55, Issue 2, Pp 187-202

[13] FAO, Crop prospects and food situation,November 2009 http://www.fao.org/docrep/012/ak340e/ak340e04.htm

[14] *Food Outlook Preview: Global Market Analysis*, FAO, June 2009 http://www.fao.org/docrep/011/ai482e/ai482e13.htm

[15] *Managing Livestock - Environment Interactions, Item 4 of the Provisional Agenda*, FAO, Committee on Agriculture, Twentieth Session, Rome, 25-28 April 2007

The elasticity of demand for meat products can be visualised as an S shaped curve. As incomes rise above a certain level, demand for meat rises rapidly. Beyond a certain point, however, there is only so much meat that they can eat, and the rise in consumption tails off.[16] This means that wealthy people consume more meat, but it also means that their demand for meat is relatively inelastic. Once incomes rise above a certain point, consumption does not continue rising to any significant degree – but it also means that when prices go up, demand for meat *per se* remains high because there is enough 'slack' in people's incomes to afford it. Hence, instead of abandoning their consumption of meat, (leading to the release of grains onto the world market that in theory could be bought by poor people), at times when prices are high, rich world consumers simply switch to eating cheaper meat. In practice this means eating more pig and poultry meat – exactly those meats that are more cereal and oilseed dependent. These grains are therefore not released onto the market for consumption by poor people.

It is also important to note that food security is about much more than the physical supply of food.[17] It is also a problem of distribution – a word that encompasses the concepts of access, affordability and availability. In theory, feed crops could be fed in poor harvest years to hungry poor people where they are produced. However, in order for feed crops to act effectively as a buffer against food insecurity, there has to be a mechanism for ensuring that in times of need, the fodder crops do actually get consumed by the people who need it – that the wealthy forgo the meat and dairy foods, so releasing grains onto the market for poor people to eat This does not happen. At present there is no world authority that takes grains in a poor year away from livestock feeding operations and gives it to poor and hungry people. Price mechanisms (ie. the market) do not effectively do that either.

In conclusion, the 'buffering' argument might only hold for some crops, fed to some animals, in some years and in some contexts. It is probably the case that in order to ensure a certain level of food security, we need to plan for a certain over production of grains. In good harvest years, when production exceeds the safe 'buffer' limit, these grains, in combination with crop residues, byproducts and so forth, can be fed to livestock, and this will help improve, rather than undermine food security in some regions. Ruminant livestock, who can cope with varied and variable diets, have a particular role to play here, as does cottage pig and poultry keeping, where livestock tend to be fed on household scraps and byproducts. However, seeking to create farming systems which deliberately build in a little production 'slack' so as to develop reserves is very different from the dedicated and systematic production of grains and protein crops specifically to feed livestock. The system of intensive pig, poultry and cattle production would not exist if it were not for this planned production. Hence such systems perform no buffering function at all.

It is also important to emphasise that everything depends on the policy context - on the extent to which this is part of a systematic approach to building adequate stocks or whether this is simply a feature of price fluctuations.

Acknowledgements
Thanks to many FCRN members for their very helpful thoughts and inputs to this paper.
Thanks to Emily Lewis-Brown for editing and comments

[16] Keyzer M A, Merbis M D, Pavel I F P W, van Wesenbeeck C F A. (2005). Diet shifts towards meat and the effects on cereal use: can we feed the animals in 2030? *Ecological Economics* Volume 55, Issue 2, Pp 187-202
[17] FAO, World Food Summit, 1996