FOOD SECURITY AND FARM ANIMAL WELFARE

COMPASSION in world farming

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CONTENTS

SUMMARY

Livestock plays a central role in food security by providing food, employment and income. But livestock can also negatively affect food security, in consuming a growing proportion of the world's crops that could otherwise be used for direct human nutrition.

Grain-based intensification of livestock has allowed vast increases in production and consumption in recent decades. However, it has also resulted in negative impacts on smallholders, food security and animal welfare. Continuing along the path of livestock intensification and the westernisation of human diets will have dramatic consequences on land use globally. It could also make food security more challenging in areas which are already food insecure, including parts of Africa, Asia and Latin America. Additionally, international trade in animal feedstuffs can increase the vulnerability of these regions to world market-price shocks.

However, future paths for livestock development do not have to follow full-scale intensification. This study indicates that it is possible to feed the world with extensive farming, while avoiding the risks associated with livestock intensification, and achieve healthy balanced diets for all in 2050.

We urge governments, intergovernmental organisations, the donor community and the food industry to take action:

- Develop humane-sustainable food security strategies and include farm animal welfare in future agriculture and food security assessments and policies.
- Question the intensification of livestock farming. More research and data are needed in order to manage contradictions between the projected intensification of livestock farming, global and regional food security, and impacts on animal welfare, that this report indicates.
- Reduce the quantity of arable crops – especially cereals – fed to livestock, and increase the research and knowledge transfer on novel feeding strategies, including the use of agro-industrial by-products.
- Develop specific food and livestock policies for vulnerable sectors of the population, with targeted programmes and policies to ensure that these groups are not excluded from the food security-related benefits of livestock.
- Promote sustainable diets, address food losses and waste in the supply chain and devise measures to challenge increasing meat consumption in high-consumption countries.

THE CHALLENGE

Feeding the growing global population is one of the key challenges facing the world today. There are clear signs that so far, we are failing to address this. The inequalities in terms of food distribution are staggering: nearly one billion people experience hunger and one billion lack important micronutrients in their diets. Meanwhile, a further one billion are over-consuming food, spawning a new public health epidemic involving chronic conditions such as type-2 diabetes and cardiovascular disease[1]. Overall, there are nearly three billion people with inadequate diets.

Livestock play a central role in food security – but livestock production requires considerable resources. Around one-quarter of all global freshwater use and three-quarters of all agricultural land relates to livestock production[2,3]. The pressure to deliver ever-increasing quantities of cheap meat, eggs and dairy products is causing major animal production and welfare challenges while still failing to address the vast inequalities in human diets.

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Hens eating grain, which is a valuable resource

Further pressure to increase production to feed the world's growing population must not follow this spiral of unsustainable production and consumption. It is time to question the direction of livestock production and invest in solutions that feed the planet while being economically viable, environmentally resilient and respectful of animal welfare.

THE STUDY

Designing solutions to feed the planet requires robust information about the role of livestock in food security, with analysis of production and consumption scenarios that take into consideration total land availability. Compassion in World Farming, with support from The Tubney Charitable Trust and the World Society for the Protection of Animals, commissioned a research study[4]. Its aims were:

- To analyse the role of livestock in food security
- To quantify and analyse feed demand and the global feed trade
- To analyse how changes in the livestock sector impact on food security
- To model future livestock production and consumption options at the global and regional levels.

This briefing summarises the main findings from the research study, sets out the implications for farm animal welfare, explores solutions and makes recommendations for the development of humane sustainable livestock production.

METHODOLOGY

The authors used a literature review to provide insights into the complex interrelations between livestock, changing market patterns and food security. To quantify and analyse feed demand and global trade, they used the international statistics of the Food and Agriculture Organization of the United Nations (the FAO). They also used a biomass balance model, developed in 2009 by Erb *et al.*[5], as the basis for exploring changes in livestock and impacts on food security, and to model future options at the global and regional levels.

RESULTS AND DISCUSSION

Understanding the environmental impacts of livestock production systems

Food security encompasses four dimensions:

- Food availability,
- Access,
- Utilisation, and
- Stability.

The aspect of food security most commonly studied is that of food availability (supply). However, increased food supply alone does not guarantee food security. The concept of food security builds strongly on central aspects of sustainability, such as equity, but often excludes issues such as human livelihoods or animal welfare.

Livestock play a central role in food security – both directly and indirectly. Farm animals provide food, as well as employment, income, draft power and manure for arable crops. However, they can also negatively affect food security – in particular, by consuming feed that could be used to feed humans directly *(see the box below)*. Despite the central role of livestock in food security, the authors found only a limited number of scientific studies that addressed the links between the two.

Livestock play a central role in human diets. Globally, livestock contribute an average of 16% of food energy (kcal) – much less than the contribution of cereals (50%) or other crops (34%). However, regional differences are massive: livestock products provide 37–38% of dietary energy in North America and Western Europe but only 5–7% in sub-Saharan Africa and South Asia.

In contrast with this relatively small contribution to global diets, livestock dominate global land use. Grazing lands occupy 36% of the global ice-free area and span a huge range of ecosystems and management. Around 75% of the world's agricultural land area is used for livestock grazing. More than a third of the global cropland area is used to produce livestock feed[6].

The roles of livestock in food security

	DIRECT	INDIRECT
POSITIVE	• Source of food (energy, protein and nutrients)	• Source of energy (draft power, manure for fuel and biogas)
	• Source of income and employment	• Source of fertiliser or soil conditioner
	• Status for the farmer	• Means of weed control
	• Store of wealth and a buffer against crop failure	• Increasing animal production saves foreign exchange
	• Broadened resource base (recycling household or industrial wastes and utilisation of marginal lands and crop residues)	• Provide investment and savings
		• Manure, leather, bones and other by-products for building, clothes and tools
		• Social and cultural significance
NEGATIVE	• Competition with humans for crops and agricultural land	• Associated with animal welfare issues
	• Use of fish that could feed humans directly	• High environmental impact
	• Higher resource use compared to crops	• May displace the consumption of balanced, healthy plant-based foods
	• Increased risk of certain diseases due to high consumption of livestock products	• Measures to reduce disease spread from intensive farming may disproportionally impact on small-scale farmers
	• Human health threats from zoonotic diseases, food safety and incorrect use of antibiotics	• Intensification may displace small-scale farmers from the market

Grass-fed cattle

Grain-fed beef cattle

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Livestock feed demand and global trade

Feed supply for livestock consists of market feed (including primary crops such as cereals, and secondary products such as oil cakes) and non-market feed (fodder crops such as leguminous crops, silage, cropland residues and grass). Non-market feed is usually not traded or transported long distances, and is usually not included in statistical databases.

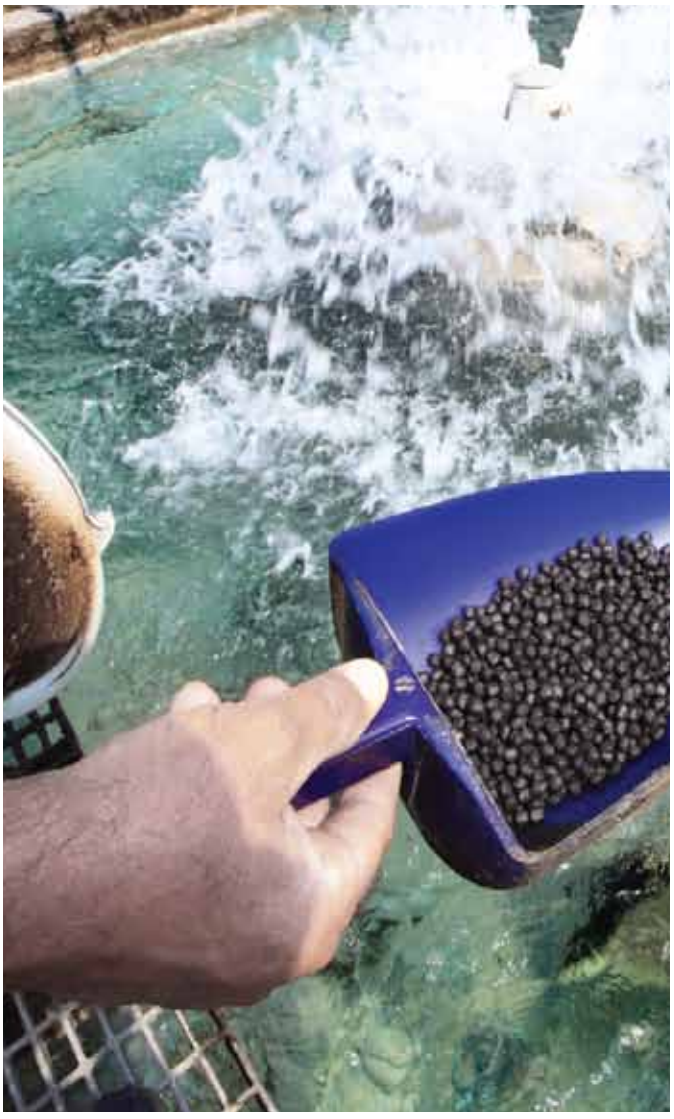
In the year 2000, global total feed demand was seven times as high for ruminants (such as cattle) compared to monogastrics (such as poultry and pigs). However, for ruminants, feed demand consists mainly of roughage, whereas for monogastrics market feed is considered essential. Even though monogastrics grow faster, and are more efficient in converting feed into livestock products, they require a larger portion of the world's arable crops compared to ruminants.

Overall, major losses relate to livestock production. Based on the global average, it takes 25 dry matter units of feedstuff per year to produce one unit of livestock output.

Globally, 53% of all oil crops (soybeans, palm oil and rapeseed) and 38% of all cereals (mainly wheat, maize and some rice) are used for livestock feed. While oil cakes used for livestock feed are not fit for human consumption, the authors included oil crops in the same category as other crops used for direct food consumption, since they could often be consumed as food in other forms. In addition, the land needed for cultivation of oil crops could otherwise be planted with food crops.

Table 1. Share of crops, dairy and fish used for livestock feed (% of total regional supply in year 2000).

	Middle East and North Africa	Sub-Saharan Africa	Southern Asia	South-Eastern Asia	Eastern Asia	Central Asia and Russian Federation	Latin America	North America	Western Europe	Eastern and South-Eastern Europe	Oceania and Australia	World
Cereals	33	15	11	20	30	46	44	78	67	62	67	38
Roots	2	16	0	11	41	14	29	2	35	38	5	25
Sugar crops	7	10	4	7	13	4	9	7	13	12	16	8
Pulses	16	9	8	13	41	68	1	27	72	57	84	24
Oil crops	49	24	38	32	49	51	53	67	72	62	44	53
Dairy	10	3	14	2	9	26	6	1	15	26	14	12
Fish	28	10	11	14	18	27	36	15	33	28	20	20



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Fish are also used to feed terrestrial livestock

Fish are also used to feed terrestrial livestock. In 2007, approximately 25% of the total world fish production (from fishing and aquaculture), was used for purposes other than to feed people directly – this included feeding poultry and pigs. Milk is also used for rearing calves. The share of crops, dairy and fish used for livestock feed is larger in developed regions than in developing regions (see Table 1).

Trade allows regions to gain access to resources or to dislocate production. In recent decades there have been steep increases in international trade, leading to greater interdependency between importing and exporting nations. Higher import dependency lowers self-sufficiency and increases dependency on markets. In regions with lower economic performance, or failing institutions, this can result in increased vulnerability to commodity price fluctuations.

Africa and the Middle East are considerably dependent on imports of crop products. The regions with the highest degree of self-sufficiency, which therefore export to the world market, are North America and Oceania – although not for all categories. Western Europe is self-sufficient in cereals and livestock products but heavily dependent on imports of oil crops for livestock feed (see Table 2).

Table 2. Regional self-sufficiency ratios of consumption and production for crops and livestock products (year 2000). *Values lower than 1 denote that regions are net importers, while values above 1 denote that regions are net exporters.*

	Middle East and North Africa	Sub-Saharan Africa	Southern Asia	South-Eastern Asia	Eastern Asia	Central Asia and Russian Federation	Latin America	North America	Western Europe	Eastern and South-Eastern Europe	Oceania and Australia
Cereals	0.54	0.75	0.96	0.93	0.82	1.00	0.86	1.51	1.07	1.01	2.76
Roots	0.98	1.02	1.00	1.56	0.99	1.01	1.00	1.01	0.77	1.00	1.04
Sugar crops	0.53	0.94	1.09	1.24	0.72	0.34	1.87	0.34	0.84	0.76	2.68
Pulses	0.77	0.97	0.91	1.34	1.04	0.98	0.89	2.16	0.71	1.06	1.69
Oil crops	0.42	0.99	0.89	1.01	0.70	1.00	2.17	1.61	0.33	0.96	1.99
Meat (ruminants)	0.86	0.99	1.04	0.85	0.88	0.86	1.05	0.99	1.01	1.09	2.53
Pigs, poultry, eggs	0.88	0.90	1.00	1.04	0.96	0.74	1.02	1.13	1.10	1.00	0.98
Dairy	0.82	0.91	0.99	0.27	0.86	0.99	0.93	0.98	1.10	1.08	3.05

Cereals are crucial for human food as well as for livestock feed. The world's top users of cereals for feed are the USA and China, which together are responsible for 38% of the global cereal use for feed. A small number of countries – 25 in total – are responsible for over 80% of global cereal use for feed.

Japan, Spain and Mexico are the largest cereal importers for feed, and several European countries are among the top 25 largest importers of cereals for feed. A number of African nations are importers of cereals, but they are used primarily for direct human consumption.

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Cereals are crucial for human food as well as for livestock feed

Changes in livestock production and impact on food security

The food system is undergoing a drastic transformation that is changing all stages of the food system: food production, utilisation and access. With the growth in incomes and urbanisation, and the spread of global food businesses, demand for livestock products has increased much faster than that for crops. This places additional pressure on land resources, through demand for pastures and arable land for market feed. These dietary shifts show large regional disparities, but overall are fundamentally increasing the food-related health and environmental challenges facing the world today.

In order to understand in detail the interrelation between livestock production and food security, the study analysed changes in the relationship between land uses, livestock, processing, consumption, trade and waste. There are ten 'hot spots' associated with changes in livestock production that have implications for food security. The model does not highlight distributional issues related to food access. However, it is mainly the poor that are vulnerable, as they have limited access to resources and factors that are key to food security, such as land, income and economic opportunities.

TEN HOT SPOTS DESCRIBING RELATIONS BETWEEN LIVESTOCK PRODUCTION AND FOOD SECURITY

1. Competing land uses. Industrial livestock systems, which have a high proportion of monogastric production and a high amount of cropland products fed to ruminants, require more arable land. This can increase the demand for high-quality land, resulting in competition with food production or cropland expansion at the expense of grazing lands and forests. This can push pastoralists or subsistence farmers onto less fertile land, making their existences even harder.

2. Breeding and input-output ratios. Through breeding strategies, livestock now require less feed input per unit of product output. Nevertheless, these gains in efficiency (through use of high-yielding breeds) have been marginal, with the exception of poultry meat. This is because lean meat – preferred by producers and consumers – requires more high-quality feed to produce. For smallholders, the benefits of improved breeds are limited because they are less likely to use market feeds.

3. Change in livestock mix. Monogastrics, such as pigs and chicken, are more efficient at converting input into output, but require high-quality feed – especially in industrial systems. Industrial livestock production requires considerable capital, which may be difficult for smallholders to access.

4. Animal disease and welfare. If large populations of animals in industrial systems are affected by disease, this can affect regional supply of animal products and food security. The change to industrial livestock production is typically accompanied by a decline in animal welfare.

5. Loss of multifunctionality. In many rural societies, the change towards industrial, grain-fed systems leads to a decline in the multifunctional role of livestock – for example, for energy provision, draft power, manure or risk reduction – and the switch to a single food-production role. This switch results in a decline in employment and income, and can trigger urbanisation.

Sheep can utilise marginal and otherwise unproductive lands, adding to food security

6. Resource-use conflicts. With industrialisation and specialisation in livestock production, the focus on meat production impacts on other functions of livestock. Surges in grain-fed livestock systems put pressure on land availability, and thus on people who depend on cheap world-market supply of cereals and other crops for feed and food.

7. Livestock products and human health. Availability and affordability of livestock products has led to patterns of over consumption, causing health risks such as obesity and coronary diseases. Over-consumption and malnutrition occur simultaneously.

8. Residues, wastes and manure. With industrialisation, the re-use of waste and residues typically declines, reducing the overall efficiency of the system. Nutrient flows that are closely managed in mixed systems are often broken up, and manure that can be used to replenish soil fertility in mixed systems becomes spatially separated from cropland.

9. Lower regional self-sufficiency. Increased dependency on markets can make importing regions with lower economic performance more vulnerable to price fluctuations and price shocks. Price surges can particularly affect the food security of the urban poor in regions that are heavily dependent on trade for livestock production.

10. Marginalisation of smallholders and pastoralists. The trend towards industrial livestock systems may occur at the expense of diminishing market opportunities and competitiveness of small rural producers who may not be able to compete with the low prices of large-scale industrial production. Strict food regulations constitute barriers that often prevent poor farmers from entering formal markets because of the costs involved in certification. Pastoralists may also be pushed on to less fertile lands, endangering their way of life and requiring alternative employment and income.

Surges in grain-fed livestock systems put pressure on land availability

Increases in production have been brought on by intensification and, to a lesser extent, by crop land expansion. For livestock production, the vast majority of the recent growth comes from intensive industrial systems. Globally, intensification involves raising stocking densities and using measures to increase yield per animal, such as indoor or feedlot housing, concentrated feeding and switching to high-input breeds. This intensification and industrialisation of livestock poses several challenges to animal welfare.

The globalisation of food systems has triggered a large growth in the international trade of food and feed. Far more agricultural produce is traded today than 30 years ago, with the result their commodity markets and food security outcomes are connected across space and time. This means that food-price shocks have become a global problem; what happens in one country or region has ripple effects elsewhere.

The growth in the demand for animal products is predicted to continue for decades. This poses a different set of challenges in terms of food security for urban populations than for rural populations.

It is predicted that food insecurity will increasingly become an urban problem. By 2030, more than 57% of people in developing countries are expected to live in cities. However, at present, 70–75% of the poor and food insecure are living in rural areas in developing countries. For the rural poor, two decisive factors play an important role in food security: i) the ability to produce food for subsistence and ii) access to markets. Pressure to modernise small-scale agriculture can lead to rising food insecurity on a local scale. Poverty and lack of infrastructure often prevent the rural poor from buying food, despite rising meat production in industrial livestock systems.

LIVESTOCK PRODUCTION AND CONSUMPTION OPTIONS FOR 2050

The study used a biomass balance model to explore changes in livestock production, and to develop consumption scenarios and their potential impacts on food security at the global and regional levels in 2050.

What is the biomass balance model?

This model operates at the level of 11 world regions, and studies different trajectories in human diets, livestock developments, feed type and agricultural yields. The model has been presented in the literature[7, 8].

The model draws on detailed databases for the year 2000 to match the global land demand for the production of biomass products (such as food, feed or fibres) with agricultural production and land use. The model then calculates scenarios for demand and supply of cropland and grazing land in 2050, at the global and regional scales.

The model identifies global scenarios as 'feasible' or 'unfeasible' if global cropland area demand and grazing intensity fall within certain thresholds, taking grazing land quality into account (see Erb *et al.*)[9]. Regional scenarios are presented in terms of self-sufficiency rate – in other words, whether the regions produce enough biomass to meet their consumption needs or if they need to import.

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Many factors may limit cereal supplies, including soil degradation, climate change, water and fuel

Limitations

The model focuses on the planet's biophysical capacity to produce biomass. Economic and distributional issues are crucial for food security, but are outside the scope of this model.

When interpreting results of the model, one needs to consider that global scenarios may be unfeasible or undesirable for reasons other than insufficient cropland or excessive grazing intensity. It might be impossible to actually achieve the livestock efficiencies, as assumed here, or the yield levels as projected by the FAO for the year 2050. This may be, for example, due to economic factors (a lack of investment) or biophysical reasons (soil degradation, climate change or a lack of resources such as water or nitrogen).

What is more, poor management or inappropriate agricultural technologies can result in occurrences such as pest outbreaks or salinisation resulting from poor irrigation techniques. Similarly, regions with low purchasing power or failing institutions may not be in the position to import the required food or distribute it fairly. So, in some regions, it is sensible to interpret decreased self-sufficiency as increased vulnerability to food insecurity.

The four dimensions and variations in the model

Four different dimensions are studied in the model:

- Human diet,
- Mix of animal products in the human diet,
- Livestock diets, and
- Agricultural yields.

For each dimension, the authors established a baseline scenario based on the literature, and added two or three variations to the model to explore options in the year 2050.

The four variations of human diet, each with three variations of the mix of animal products, results in 12 scenarios. This, combined with four livestock diet variations, each with three variations of agricultural yields, results in a total of 144 future scenarios.

The four dimensions and variations studied in the biomass model

HUMAN DIETS	MIX OF ANIMAL PRODUCTS IN THE HUMAN DIET
Baseline diet: By 2050, every region attains the diet of the country with the richest diet in that region.	**Baseline business as usual:** By 2050, the same proportion of animal products from monogastrics versus ruminants is consumed as in 2000.
Western diet: By 2050, global adoption of a rich western-style diet with relatively high meat and dairy consumption.	**Monogastric:** Increase in the proportion of products from monogastrics such as pigs and chicken.
Constant diet: In 2050, regions will maintain the same diet as in 2000.	**Ruminant:** Increase in the proportion of products from ruminants such as cattle and sheep.
Less meat diet: Same level of dietary energy as the baseline diet. The proportion of animal products decreases in wealthy regions such as Western Europe, North America or Oceania, and increases in other regions such as sub-Saharan Africa and Southern Asia.	
LIVESTOCK DIETS AND EFFICIENCIES	**AGRICULTURAL YIELDS**
Baseline trend: Assumes that livestock diets and efficiencies in 2050 are to progress according to projections in the literature.	**Baseline conventional yields:** Based on the FAO's optimistic assumptions of rapid agricultural intensification. Production increases by 68% in 2050, mainly due to increased yields and, to a lesser extent, by expansion of area under cultivation.
Intensive path: Assumes that more crop products such as cereals (and less roughage) will be fed to animals.	**Lower yields:** Levels at 60% of baseline yields and in line with assumptions of yields obtained through organic farming.
Intensive path with roaming space: Same type of baseline livestock diet but with higher feed demand and space allowance, to reflect free-range conditions.	**High yields:** By 2050, very optimistic yields are assumed at 109% of the baseline, reflecting high levels of external inputs. It may not be possible to achieve these yields in practice.
Extensive path: Assumes more roughage-based diets and animals kept in free-range conditions, resulting in poorer feed conversion rates.	

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A healthy diet with a lower share of animal products provides better food security options

Food security options

The model analysed a total of 144 scenarios. Of these, 53 were found to be feasible, 33 probably feasible, and 58 unfeasible due to lack of cropland, prohibitive by grazing intensity, or both.

The authors found that future scenarios that involved feeding more grains to livestock (the common path of livestock intensification) will have major effects on cropland demand, with the potential to trigger competition between cropland for food and cropland for animal feed.

The quantity and quality of the human diets is a decisive factor in future scenarios. Rich (western-style) diets hit the margins of feasibility, due to the limited amount of cropland, grazing land (limits of grazing intensity) or both. Diets with a lower share of animal products tend to keep the option space open in terms of land use for both grazing and cropland.

The authors also found that additional space for roaming does not alter the feasibility of grain-based livestock production. This indicates that it is possible to allow more space, to improve animal welfare, without leading directly to land use conflicts or competing land uses.

Increases in cropland area cannot be ruled out in the future – especially if western-style diets are adopted. Cropland expansion, however, will increase pressure on other ecosystems – either by increased grazing intensity on the remainder areas or by pushing agriculture further into ecosystems such as forests. Industrial livestock systems are already associated with environmental impacts such as the disruption of local nutrient cycles, biodiversity loss, and local pollution of soils, water and air.

The regional analysis revealed different patterns of cropland and grazing land resources. Extensive farming of livestock would be beneficial in Sub-Saharan Africa, in those areas where the amount and quality of grazing land are not limiting factors. Intensification of livestock production could result in diminishing self-sufficiency in this region, which is already dependent on imports to feed its human population.

In East and Southern Asia, much tighter limits exist in relation to grazing land availability, and integrated approaches to production and consumption would be more favourable. In these regions, intensification of livestock production could reverse the net trade flow and result in the regions becoming dependent on imports in 2050.

OUR VIEW - IMPLICATIONS FOR FARM ANIMAL WELFARE

The ways in which we secure food for future generations will have wide-ranging implications for farm animal welfare. Despite the evident links between livestock and food security, the research study found only a few dedicated studies on this issue, and even fewer mentioning animal welfare. Given the trends towards increasing production and consumption of animal products, this is of concern. Projections indicate that by 2050, the global population will consume 1.7 times more meat and 1.6 times more milk than in 2010[10]. Developments in the livestock sector in recent decades have been dominated by industrialisation and rapid growth, especially in the pig and chicken agriculture sectors. Unless challenged, this trend is likely to continue[11].

A path of intensification could result in negative impacts on animal welfare – and animal welfare should be a vital consideration in sustainable farming. The research study found that a path towards intensification is not inevitable, and identified more moderate developments that seem possible, particularly if they optimise production and consumption in an integrated manner.

INTENSIFICATION AND KEY ANIMAL WELFARE ISSUES

Chicken and pig meat production has grown rapidly in recent decades, and now accounts for nearly 30% and 40% of all meat produced respectively[12]. Around two-thirds of all chicken meat and eggs, and more than half of all pork, come from industrial farms[13]. Many industrial farms use production methods that severely restrict basic animal behaviours, such as free movement (in the case of pregnant sows, kept in sow stalls), or stretching wings (in the case of hens reared in battery cages). Practices such as tail docking of pigs and beak trimming of laying hens are also widely used.

Increasingly, ruminants are kept without access to grazing land (for example, finishing beef cattle in feedlots). Keeping beef cattle or dairy cows in zero-grazing systems is not only a key resource-management issue; it can also result in severe animal welfare problems. Grazing is an important species-specific behaviour for cattle and brings overall benefits to health and welfare. Dairy cows in zero-grazing systems have an increased risk of lameness, hoof problems and a variety of infections[14]. The risk of dairy cow mortality decreases in line with the increasing number of hours spent grazing during the season[15].

Higher animal welfare is possible in outdoor systems

Intensively farmed pigs experience considerable suffering

Contrary to popular perception, the research study also found that a path towards extensification of the livestock sector can feed the world's population a varied diet in an equitable way. Furthermore, providing animals with more space – enabling them to perform natural behaviours appropriate for their species – does not have to lead to land competition and can improve animal welfare. Feed-conversion efficiency may be lower in slower growing and more active animals, but the extra feed or space necessary are small in comparison with the total feed requirements in more intensive grain-based systems.

The research study shows that the human diet is an extremely important variable in the analysis. With the current projections of agricultural yields, a 'less meat' diet can feed the world more equitably in 2050. This scenario is based on a decreased consumption of animal products in some regions and an increase in others, achieving a more equal world distribution of consumption of animal products. Various positive methods for achieving dietary change are identified in the literature, and include economic interventions such as taxation, purchasing guidelines by retailers and food services, campaigns and labelling. Reducing losses and waste in the supply chain would also lower the amount of livestock products needed to feed the world, as an estimated one-third of all food produced for human consumption is currently lost or wasted[17].

Reducing the amount of arable crops diverted to animal feed would be a positive contribution to global food security. This can be achieved through production of an increasing share of animal products from extensive grazing and mixed systems, leaving more cropland available to produce food for people. Extensive systems also have a higher potential for safeguarding animal welfare.

Livestock feeding strategies should also increase the use of agro-industrial by-products. Limiting the amount of consumption of animal products, however, is essential for such strategies, in order to avoid the detrimental effects resulting from an increased area requirement per product.

There has been a rapid growth in the livestock sector, but many rural as well as urban poor are currently unable to benefit from it. Future developments need to consider direct and indirect food security impacts in relation to the needs of different societies.

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Supporting small-scale family farming can improve food security and incomes as well as animal welfare outcomes

CONCLUSIONS

Livestock play a central role in food security

Livestock contribute directly to food security, through proving food, employment and income, and indirectly, for example through provision of manure for crop production. Livestock can also negatively affect food security, particularly in cases when livestock feed consists of products that can be used for direct human nutrition.

A large proportion of crops is used for livestock feed and traded internationally. In developed nations, up to two-thirds of total cereal production is used as animal feed. At a global level, more than a third of all cereals and more than half of all oil crops are used for animal feed. The rise in international feed trade increases inter-regional dependencies, and may increase the vulnerability of many regions to world market-price shocks.

Intensification of livestock production can reduce food security

Grain-based livestock intensification will have major effects on cropland demand, with the potential to trigger competition between cropland for food and cropland for animal feed.

This study finds that food import dependent, developing regions are particularly likely to be negatively affected by livestock intensification, including in Southern Asia and Sub-Saharan Africa, where food security is already problematic.
The modelling of options for 2050 indicates that future paths do not inevitably have to follow full-scale intensification strategies. More moderate pathways are possible if these are accompanied with strategies aimed at optimising both production and consumption.

Space for animals to roam does not reduce food security

The additional feed required for livestock to be more active and the space needed for them to roam and perform natural behaviours is relatively small and does not affect the food security option space. The study authors concluded that extra feed and area requirements to allow farm animals to roam are not an argument against providing animals with more space, even in intensive livestock systems.

EXTENSIVE FARMING CAN FEED THE WORLD HUMANELY

Global food security for all in 2050 is not feasible with a scenario of livestock intensification and a Western-style diet for all, even with unrealistically high yield scenarios.

The research study found that a path towards extensification of the livestock sector can feed the world a varied diet, in an equitable way.

The human diet is an extremely important variable. A diet which is consistent with today's diet is achievable in 2050, but this would fail to address malnutrition.

With the current projections of agricultural yields, a 'less meat' diet can feed the world equitably in 2050. This scenario is based on a decreased consumption of animal products in some regions and an increase in others, achieving a more equitable world distribution of consumption of animal products.

POLICY RECOMMENDATIONS

We urge governments, intergovernmental organisations, and the food industry to take action:

1. Develop humane-sustainable food security strategies and include farm animal welfare in future food security assessments and policies.

Livestock play a central role and contribute both directly and indirectly to food security. It is essential that future agriculture and food security assessments and policies include farm-animal welfare and move away from industrial farming systems.

2. Question the intensification of livestock farming.

Intensification of livestock has resulted in an increasing share of the world's cereals and other crops being used for livestock feed rather than directly for human food. This can compromise food security. More research and data are needed in order to manage the contradictions between the projected intensification of livestock farming, global and regional food security, and impacts on animal welfare, that this report reveals.

3. Reduce the quantity of arable crops – especially cereals – fed to livestock.

The current dependency of livestock on market feed needs to be reduced and reversed to avoid competition with food production. Research and knowledge transfer on novel feeding strategies, including the increase in the use of agro-industrial by-products, are essential.

4. Develop specific food and livestock policies to assist vulnerable sectors of the population.

Recent intensification and increases in production have failed to improve food security for many groups of the world population, including rural and urban poor. Targeted programmes and policies are needed to make sure these groups are not excluded from the food security-related benefits of livestock.

5. Promote sustainable diets and address food losses and waste.

Human diets play a major role in any future food security scenario, and will determine land-use options for food and energy production and environmental preservation. Decision-makers need to challenge increasing meat consumption and promote sustainable diets, adapted to different regional and cultural contexts. In parallel, it is essential to tackle current levels of losses and waste in the supply chain.

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Space for animals to roam does not reduce food security

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[1] World Society for the Protection of Animals
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ciwf.org

River Court, Mill Lane,
Godalming, Surrey, GU7 1EZ, UK
Email: research@ciwf.org
Tel: +44 (0) 1483 521 950
Web: ciwf.org

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WSPA World Society for the Protection of Animals

5th floor, 222 Grays Inn Road,
London WC1X 8HB, UK
Email: wspa@wspa-international.org
Tel: +44 (0) 207 239 0500
Web: wspa-international.org

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