COMPASSION in world farming

TOWARDS A FLOURISHING FOOD SYSTEM

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"HIGH-INPUT, RESOURCE-INTENSIVE FARMING SYSTEMS, WHICH HAVE CAUSED MASSIVE DEFORESTATION, WATER SCARCITIES, SOIL DEPLETION AND HIGH LEVELS OF GREENHOUSE GAS EMISSIONS, CANNOT DELIVER SUSTAINABLE FOOD AND AGRICULTURAL PRODUCTION. [WE NEED] INNOVATIVE SYSTEMS THAT PROTECT AND ENHANCE THE NATURAL RESOURCE BASE, WHILE INCREASING PRODUCTIVITY. [WE NEED] A TRANSFORMATIVE PROCESS TOWARDS 'HOLISTIC' APPROACHES, SUCH AS AGROECOLOGY, AGRO-FORESTRY... AND CONSERVATION AGRICULTURE, WHICH ALSO BUILD UPON INDIGENOUS AND TRADITIONAL KNOWLEDGE."

UN FOOD AND AGRICULTURE ORGANIZATION, 2017 [1]

FOREWORD

It has long been recognised that high-input, resource-intensive farming systems are harmful and unsustainable;[2] [3] yet there has been considerable intertia around action to deliver healthy and sustainable food systems.

This report accompanies the Compassion in World Farming and WWF's seminal 2017 conference: *Extinction & Livestock: Moving to a flourishing food system for wildlife, farm animals and us* where the biggest cause of the negative effects of the current food system is identified as the intensive production of animal-sourced foods. The UN in 2016 shows intensive animal production as having a negative effect in a number of significant ways: emerging diseases; foodborne disease; contribution to antimicrobial resistance and non-communicable diseases; poor conditions for workers; poor animal welfare; air, land and water pollution; contribution to climate change, high water use; and, vulnerable to price squeeze from input suppliers, processors and retailers.[4]

A recently published book *Deadzone: Where the wild things were*[3] extends the story to the impact intensively produced livestock has on biodiversity and conservation of wild animal species, for example how the developed world's dependence on cheap chicken is killing the jaguar in Brazil. Not directly, but by habitat-destruction as forests are cleared to grow soy to feed to chickens reared in intensive systems. It's bad for human food security too, it's an inefficient utilisation of resources and contributes to food waste. UNEP calculates an extra 3.5 billion people could be fed by the grain that will be fed to animals by 2050.[23]

The solution is simple. Reforming the food system from industrial agriculture to diversified agroecological systems, combined with:

- a predominantly plant-based human diet, and,
- a significant contraction in dietary animal sourced foods in high-consumption countries and convergence to a healthy, low-level elsewhere.

How to get there is less straightforward but this conference and other key initiatives such as the EAT-Lancet Foundation, Chatham House and the United Nations are all working hard to make it happen. Join us in that journey.

Dr Angela Wright
Chief Scientific Advisor

INTRODUCTION

> ***Globally, it is estimated that transitioning to more plant-based diets, in line with WHO recommendations on healthy eating (WHO 2015) and guidelines on human energy requirements (WHO 2004) and recommendations by the World Cancer Research Fund (WCRF/AICR, 2007), could reduce global mortality by 6-10% and food-related greenhouse gas emissions by 29-70% compared with a reference scenario for 2050.***
> *UNSCN, 2017* [5]

In 2016 the International Panel of Experts on Sustainable Food Systems (IPES) report calls for a necessary shift from 'industrial agriculture' to diversified agro-ecological systems.

Industrial - or intensive - agriculture is identified as problematic in relation to both food security and nutrition (FSN) and climate change by the United Nations Food and Agriculture Organisation's High Level Panel of Experts report on the role of livestock in sustainable agricultural development. The report identifies priority challenges to attaining sustainable agricultural development for Food and Nutrition Security (FNS) in different livestock systems with Intensive systems causing concern across all identified categories of challenge, including: emerging diseases; foodborne disease; contribution to antimicrobial resistance and non-communicable diseases; poor conditions for workers; poor animal welfare; air, land and water pollution; contribution to climate change, high water use; and, vulnerable to price squeeze from input suppliers, processors and retailers.

Globally we need a far-reaching rethink of our food and farming systems. Without this it will not be possible to meet the 2030 Sustainable Development Goals (SDGs) and the Paris Climate Agreement's targets. Nor will it be possible to achieve healthy dietary patterns and we will not be able to halt the devastating impact of food production on wildlife.

Industrial agriculture is incompatible with the following SDGs:

Achieving food security (Goal 2):
The UN Food and Agriculture Organisation (FAO) warns that further use of cereals as animal feed could threaten food security by reducing the grain available for human consumption.[6]

Reducing water use and pollution (6.3 & 6.4):
Industrial livestock production generally uses and pollutes more surface- and ground- water than grazing systems.[7] This is due to industrial systems' dependence on grain-based feed.[7] Further intensification of animal production systems will result in increasing use and pollution of water per unit of animal product.[7]

Reversing land degradation and improving soil quality (2.4 & 15):
Modern agriculture, in seeking to maximize yields, has degraded soils to the point where poor soil quality is thought to be constraining productivity.[8]

Ensuring healthy lives (3.4 & 3.9):
Current high levels of red and processed meat will make it very difficult to reduce non-communicable diseases.[9] Industrial agriculture is a major cause of air pollution.

Halting biodiversity loss (15):
UNEP states that modern agricultural practices have been "responsible for considerable damage to biodiversity, primarily through land-use conversion but also through overexploitation, intensification of agricultural production systems, excessive chemical and water use, nutrient loading, pollution".[10]

Halting deforestation (15.2):
The use of soy as animal feed is an important driver of deforestation.

The OECD stresses the need to break out of policy silos.[11] We need instead to develop cohesive food and farming policies that seek to fulfil a range of objectives relating to farming livelihoods, food security, natural resources, dietary health, climate change and animal welfare. These policies need to be properly integrated so that one objective is not achieved at the expense of another.

We need to move away from industrial agriculture. Industrial livestock production is responsible for a substantial proportion of the harm arising from today's food and farming systems.

PEOPLE

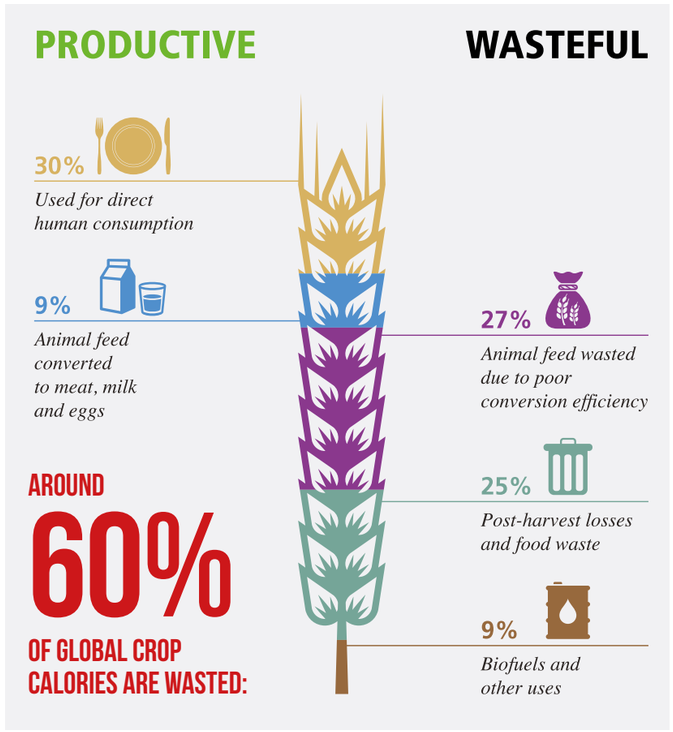
> ***Overconsumption of meat is bad for our health and for the health of our planet... we need to decide whether to act now to reduce human meat consumption or wait until the decay of sufficient parts of the global system tip us into much poorer planetary, societal, and human health***
>
> *John Potter, Professor of Epidemiology, British Medical Journal 2017* [12]

Human food security: Rebutting the 70% myth. A flaw in our current food policy is the assumption that by 2050 we need to produce 70% more food to feed the growing world population. However, a number of sources, including Olivier De Schutter, a former UN Rapporteur on the Right to Food, show that we provide sufficient food to feed not only the current world population but the projected 2050 population (estimates of the number of people that could be fed from current food production vary from 11.5 billion to nearly 16 billion.[13 14 15]).

The problems are inequitable distribution and that over half of all food produced globally is wasted in various ways:

- **Post-harvest losses and food waste** (by consumers and food businesses worldwide) of a quarter of food calories produced. ***If such loss and waste could be halved an extra 1.4 billion people could be fed.***[16]
- **Feeding human-edible grain to animals.** The UN Environment Programme calculates that over 3.5 billion people could be fed by the grain that will be fed to animals by 2050 in the business-as-usual model. ***If a target were adopted of halving the use of cereals for feed an extra 1.75 billion people could be fed.***
- **Overconsumption.** Alexander *et al.* (2017) calculate that 2.9 EJ (exajoules) are lost each year through overconsumption i.e. consumption in excess of nutritional requirements.[17] ***An extra 400 million people could be fed if such overconsumption was halved.***

USE AND WASTE OF CALORIES PRODUCED BY WORLD'S CROPS



If these conservative targets for reduction of food waste were successful, an extra 3.55 billion people could be fed: more than the anticipated 2.2 billion increase in world population by 2050.[18] While we do not need to produce large amounts of extra food we must utilise it more wisely.

A caveat to this is a need for regional increases in production through the closing of yield gaps in such places such as sub-Saharan Africa and South Asia but this must be achieved in a genuinely sustainable manner, rather than by unsustainable high-input intensive methods.

Intensive livestock production undermines human food security[6]: it's an inherently inefficient use of resources. Intensive livestock production is dependent on feeding human-edible cereals to livestock who convert them very inefficiently into meat and milk: experts variously describe the use of cereals to feed animals as "staggeringly inefficient",[19] "colossally inefficient"[20] and "a very inefficient use of land to produce food".[21]

Why is this? For every 100 calories fed to animals as cereals, just 17-30 calories enter the human food chain as meat.[22 23] Some studies indicate that the conversion rates may be even lower[24] with Cassidy *et al.* (2013) reporting that for every 100 grams of grain protein fed to animals, we get only about 43 new grams of protein in milk, 35 in eggs, 40 in chicken, 10 in pork, or 5 in beef.[24]

To put this into context:

- 98% of global soybean meal is used as animal feed[25]
- 56% of EU cereals are used as animal feed.[26]
- 67% of US crop calories are used to feed animals[24]

These inefficiencies are significant: globally, the quantity of crops used as animal feed is 36-40%.[24 27]

> ***States [should] ensure the political and financial commitments needed to shift from current industrial agricultural systems to nutrition-sensitive agroecology that is healthy for people and sustainable for the planet.***
>
> *Hilal Elver, UN Special Rapporteur on the right to food: 2016* [28]

Industrial livestock production has detrimental impacts on human health:

- **Non-communicable diseases** The high levels of consumption of red and processed meat that have been made possible by industrial livestock production contribute to heart disease, obesity, diabetes and certain cancers.[29 30 31] The World Health Organization (WHO) has classified red and processed meat as 'probably carcinogenic' and 'carcinogenic' respectively.[32]
- **Generating disease** Industrial livestock production plays an important part in the emergence, spread and amplification of pathogens, some of which are zoonotic.[33 34]
- **Antimicrobial resistance** Antimicrobials are regularly used in industrial livestock systems[35 36] to prevent the diseases that would otherwise be inevitable where animals are confined in crowded, stressful conditions and are bred and managed for maximum yield. These conditions compromise their health and immune responses, and encourage disease to develop and spread. To prevent this, antimicrobials are routinely given to whole herds or flocks of healthy animals via their feed and water. The WHO stresses that the high use of antimicrobials in farming contributes to the transfer of resistant bacteria to people thereby undermining the treatment of serious human disease.[37]
- **Nutritional quality** Free-range animals - who consume fresh forage and have higher activity levels - often provide meat of higher nutritional quality than animals that are reared industrially. Pasture-fed beef has less fat and higher proportions of omega-3 fatty acids than grain-fed beef.[38]

  Meat from free-range chickens contains substantially less fat and generally a higher proportion of the beneficial omega-3 fatty acids than meat from chickens reared industrially. Moreover, the fast growth rates of today's chickens are having a detrimental impact on the nutritional quality of chicken breast meat with increased fat content and less and lower quality protein.[39] This suggests that the claim that chicken meat is healthy is questionable. A paper published in the *Journal of the American College of Cardiology* challenges the health status of chicken stating that "much chicken is transformed into fast food and other calorie-rich, ultra-processed" products.[40]

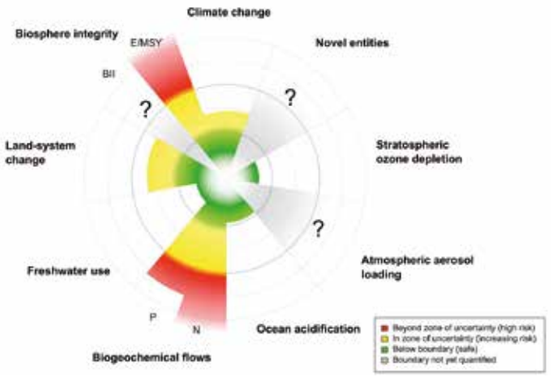
PLANET

Much food production is now divorced from its primary purpose of providing the nutrients that sustain human life in good health

World Health Organisation, 2017 [78]

Intensive livestock's huge demand for feed has fuelled the intensification of crop production which, with its use of monocultures and agro-chemicals, has led to overuse and pollution of ground- and surface-water,[41] soil degradation,[42 43] biodiversity loss,[44] and air pollution.[45] The demand for soy as animal feed is a key driver of deforestation.

Planetary boundaries: In two cases, we have entered the high-risk zone.



From Steffen and others, 15 January 2015, Science.
Reprinted with permission from AAAS

Research has established nine planetary boundaries which, if crossed, could generate irreversible environmental changes and drive the planet into a much less hospitable state.[46] In two cases – (i) biodiversity loss and (ii) nitrogen and phosphorus flows – we have crossed the boundary and entered a high-risk zone. Intensive livestock production has played a major part in the crossing of both these boundaries. Nitrogen and phosphorus are primarily used in fertilisers much of which are used to grow crops for animal feed.[47 48 49] The demand for huge quantities of feed crops has led to biodiversity loss through both the intensification and the expansion of arable production.[50] Studies show that population and species extinctions are proceeding rapidly and a sixth mass extinction may already be underway.[51] Human pressures including agriculture are an important factor in this. Ever more forests and savannahs are being destroyed to grow soy and cereals for industrially farmed animals. This is eating into wildlife habitats driving many species - including elephants and jaguars - towards extinction.[52]

Moreover, the chemical soaked monocultures that have arisen in part to satisfy the industrial sector's growing demand for feed crops have devastated birds, butterflies and pollinators.[53] Both the numbers and diversity of earthworms are being reduced by intensive agriculture;[54] earthworms are essential to human life as they play a key part in maintaining soil health and fertility.

If we are to avoid dangerous levels of climate change all sectors must reduce their greenhouse gas (GHG) emissions. However, on a business-as-usual basis the emissions from agriculture are likely to substantially increase by 2050.[55] Animal products generally generate substantially higher GHG emissions per unit of nutrition produced than plant foods.[56 57] Research shows that our diets - with their high proportion of meat and dairy - will make it very difficult to respect the Paris targets.[58] A significant reduction in meat and dairy consumption is essential if food-related emissions are to decrease and if we are to meet the Paris targets.[59 60]

The UN states that "Intensive livestock production is probably the largest sector-specific source of water pollution"; [61] it is also a major source of three important air pollutants: ammonia, particulate matter and nitrous oxide. The latter is a serious problem for human health as it contributes to conditions such as bronchitis, asthma, lung cancer and congestive heart failure. Studies show that in some countries - including Demark and the UK - agriculture is responsible for a larger proportion of the health problems arising from air pollution than transport or energy generation. [62 63] Agriculture's emissions largely result from livestock and fertilisers; a substantial proportion of these are used to grow crops for animal feed.

ANIMALS

INDUSTRIAL LIVESTOCK PRODUCTION'S DETRIMENTAL IMPACT ON ANIMAL WELFARE

Even with good stockmanship industrial livestock production has no potential for providing satisfactory welfare. Animals are confined in cages or narrow crates or in barren, overcrowded units which make it impossible for them to carry out their natural behaviours. Many are pushed to such high yields or fast growth that they suffer from painful health problems including lameness, bone deformities and bone fractures.[64 65 66]

Concepts of animal welfare are evolving. Increasingly it is being recognised that animal welfare does not just entail preventing suffering but that animals must be able to have positive experiences. Mellor writes that such experiences include "comfort, pleasure, interest, confidence and a sense of control".[67] Industrial livestock production flies in the face of the growing recognition that animals are sentient beings and that each is an individual with their own distinct characteristics. Animals have been placed in this world for their own sakes, to live their own lives not just to act as our handmaids, as servants to our needs and wants. Industrial production takes a mechanistic view of animals as tools that can be made ever more efficient. This is unworthy of our finer, more generous instincts as humans. Let us recognise that animals are not pieces of machinery; they are our fellow creatures entitled, like us, to experience the joy of living.

Animal welfare should not be regarded as a peripheral consideration in the formulation of food and farming policy. Instead it should be accepted - together with food security, public health, the environment, climate change and farmers' livelihoods - as one of the core criteria that must be satisfied by our food and farming systems.

COMPASSION in world farming

ARE INTENSIVE LIVESTOCK SYSTEMS THE NEW CLIMATE CHANGE?

Intensive livestock systems[1] are at the heart of – or contribute to – many problems affecting health, food security, the environment and animal welfare

[1] FAO GLEAM model, underpinning the system categorisation in HLPE Report, 2016, 'Sustainable agricultural development for food security and nutrition: What roles for livestock?'

ANTIBIOTICS

Resistance to antibiotics used in human medicine

Regular preventive antibiotic use

HEALTH

Heart disease, certain cancers, obesity

Enables – and needs – excessive meat and dairy consumption

WILDLIFE

Need for cereals and soy as feed has led to deforestation and erosion of wildlife habitats threatening animals with extinction

INDUSTRIAL LIVESTOCK PRODUCTION

CLIMATE CHANGE

GHG emissions – impossible to reach Paris climate targets

Need for cereals as feed has fuelled intensification of crop production

Animals in cages and barren overcrowded sheds and selection for fast growth

Soil degradation, biodiversity loss, water and air pollution

NATURAL RESOURCES

Animals convert cereals very inefficiently into meat and milk. This undermines food security by reducing cereals available for people

FOOD SECURITY

Very poor animal welfare; animals treated as machines

ANIMAL WELFARE

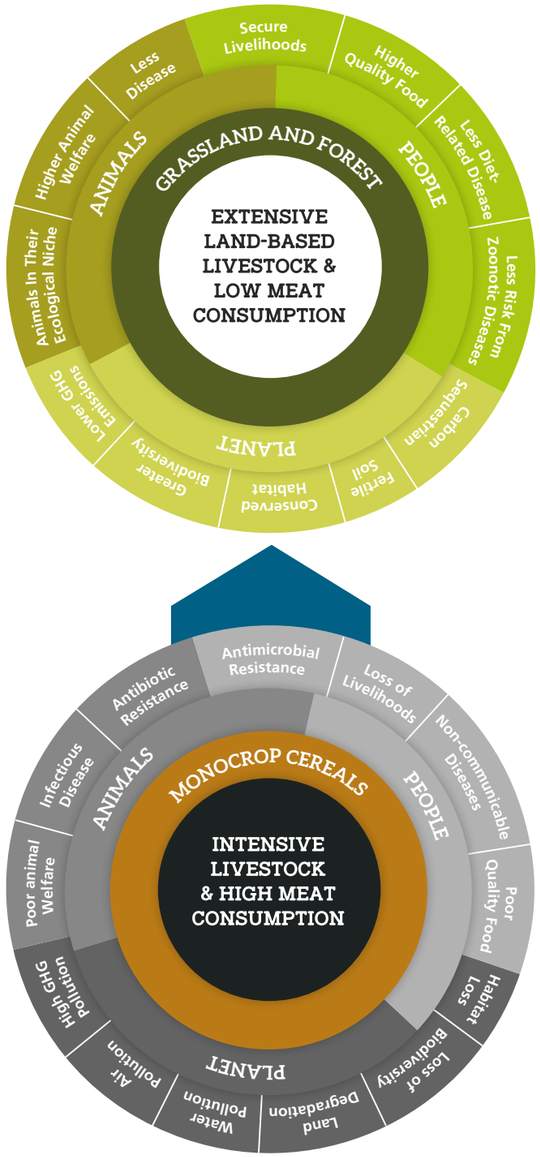
For more information visit **www.ciwf.org** or email **engagement@ciwf.org**

Registered charity number 1095050

SOLUTIONS

"The International Panel of Experts on Sustainable Food Systems highlights the need to transition to agroecological systems. They stress: "This transition is viable and necessary whether the starting point is highly specialized industrial agriculture or forms of subsistence farming in poor developing countries".

IPES Food, 2016 [68]



WHAT DO WE NEED TO TRANSFORM TO A FLOURISHING FOOD SYSTEM?

As a broad principle, intensive livestock systems should be replaced with pasture- and land-based farming of animals to high animal welfare and environmental standards producing 'better' animal-sourced food. Animals reared in land-based farming systems such as pastoralism, silvopastoralism, mixed rotational farming and pasture-fed free-range provide more nutritious food in ways that are better for the environment and animal welfare whilst safe-guarding human food security.

Consumption patterns need to change with those in countries with high meat consumption moving to a plant-based diet; small amounts of meat and dairy and eggs added to grain-based human diets have beneficial nutritional effects. In general, consumption levels of some animal-sourced foods needs to contract in some places and among some populations, while increasing in others. Such a shift would allow for greater convergence of consumption at the global level.

As this report shows, simply increasing food production will not of itself be sufficient to combat hunger.[69] It must be combined with improved livelihoods for the poorest, particularly small-scale farmers in the developing world. Smallholder farmers must be empowered to increase their productivity by closing yield-gaps without resorting to input-based farming models. This should be accompanied with improved healthcare and nutrition for their animals through better disease prevention and management, the expansion of veterinary services and the cultivation of fodder crops such as legumes. Better animal health and nutrition result in increased livestock productivity and longevity. This will improve smallholders' purchasing power, making them better able to buy the food that they do not produce themselves and to have money available for other essentials such as education and health care. Analyses of some 300 projects in the developing world show substantial benefits in the form of increased crop yields, improved water efficiency and reduced pesticide use arising from techniques such as integrated pest and nutrient management, agro-forestry and conservation agriculture.[70] [71]

These requirements underpinning a shift to a flourishing food system are explored in greater depth in following sections.

1. REPLACING DISTORTING ECONOMICS WITH TRUE COST ACCOUNTING

"In many countries there is a worrying disconnect between the retail price of food and the true cost of its production. As a consequence, food produced at great environmental cost in the form of greenhouse gas emissions, water pollution, air pollution, and habitat destruction, can appear to be cheaper than more sustainably produced alternatives.

UN Food and Agriculture Organization, 2015 [72]

Industrially produced meat and milk are cheap at the supermarket checkout. However, the low cost of these products is achieved only by an economic sleight of hand. We have devised a distorting economics which takes account of some costs such as housing and feeding animals but ignores others including the detrimental impact of industrial agriculture on human health and natural resources.

These "negative externalities" represent a market failure in that the costs associated with them are borne by third parties or society as a whole and are not included in the costs paid by farmers or the prices paid by consumers of livestock products. In some cases the costs are borne by no-one and key resources such as soil and biodiversity are allowed to deteriorate, undermining the ability of future generations to feed themselves.

Need to internalise negative externalities

The UK Foresight report on the future of food and farming said: "There needs to be much greater realisation that market failures exist in the food system that, if not corrected, will lead to irreversible environmental damage and long term threats to the viability of the food system. Moves to internalise the costs of these negative environmental externalities are critical to provide incentives for their reduction."[73]

We need to develop ways of internalising these negative externalities so that the costs and losses they engender are properly reflected in the price of food. If this were done, industrial meat and milk would be more expensive than their more nutritious, extensively produced counterparts.

Mending our price system

Olivier De Schutter, former UN Special Rapporteur on the right to food, stresses that "any society where a healthy diet is more expensive than an unhealthy diet is a society that must mend its price system."[74] This applies equally to a society where environmentally damaging, low animal welfare food is cheaper than food that respects natural resources and animals' well-being.

Fiscal measures should be used to lower the cost of quality food for both farmers and consumers. Farmers producing to high environmental and animal welfare standards could be compensated for the extra costs involved by subsidies and, in their tax affairs, by generous capital allowances and an extra tranche of tax-free income. This could be paid for by placing taxes on the inputs of industrial agriculture such as chemical fertilisers and pesticides.

Taxes should be placed on unhealthy, inhumanely produced food with the revenue raised being used to subsidise the price of healthy food produced to high standards of animal welfare. In countries which charge VAT on food, the price paid by consumers for quality food could be reduced by placing a lower or nil VAT rate on such food.

2. PRODUCING FOOD WITHIN PLANETARY BOUNDARIES USING AGROECOLOGICAL PRINCIPLES AND METHODS

"Today, the number one economic threat to humanity is our inability to value nature. This is not only about monetization… valuing nature also means that we have to accept leaving the realm of economics. We enter the realm of ethics, inclusiveness and justice."

Johan Rockström, 2017 [75]

At present consumption is presumed to be unchangeable and that, whatever the planetary consequences, demand must be met. Policies about production and consumption need to be interwoven. Healthy eating patterns must be encouraged that enable food to be produced without causing irreparable harm to natural resources and the climate.

Production: Redefining the role of livestock

Studies show that livestock are only efficient when they are converting materials that people cannot consume - grass, by-products, crop residues, unavoidable food waste – into food that we can eat.[21] [76] The role of livestock should be transformed so that they are primarily seen as converters of inedible materials into meat and milk.

The use of human-edible crops as animal feed should be reduced with the main emphasis being on:

- **raising animals on extensive pastures and rangeland:** Extensively reared ruminants convert grass and other vegetation into food that we can eat and are able to use land that is generally not suitable for other forms of food production. Well-managed grasslands support biodiversity and store large carbon stocks
- **integrated crop/livestock production:** The link between animals and the land should be restored through mixed rotational farming where animals are fed on crop residues and pasture and their manure, rather than being a pollutant, fertilises the land
- **raising pigs and poultry outdoors:** Pigs and poultry are nature's great foragers and recyclers. They should be kept outdoors where some of their diet can come from foraging, pasture, cull vegetables from local farms and food waste. This could replace part of the cereal, soy, palm and fish-based feed currently used
- **agro-forestry:** This can be more productive, profitable and sustainable than forestry alone or agricultural monocultures. In Galicia in Spain, pigs are farmed in forest areas[77] while in Denmark pig rearing is combined with fruit and vegetable production.[78] In Italy some farmers integrate pig rearing with trees which provide shade for the pigs in the hot summer months.[78]

3. CONSUMPTION: EATING LESS AND BETTER MEAT AND DAIRY PRODUCTS

> ***WHO and other health agencies are advising populations to reduce meat consumption as part of an overall healthy diet***
>
> *World Health Organization, 2017* [79]

A reduction in meat and dairy consumption would deliver multiple co-benefits. It would:

- reduce the incidence of heart disease and certain cancers (this applies to reduced consumption of red and processed meat)
- make it possible to meet the Paris climate targets
- allow cropland to be farmed less intensively so enabling biodiversity, soils and water quality to be restored
- help feed the growing world population as a much greater proportion of crops would be used for direct human consumption
- reduce pressures on wildlife as habitat destruction could be reversed
- enable animals to be farmed extensively to high welfare standards.

Reducing meat production and consumption: should the focus be on ruminants or monogastrics?

Some argue that the reduction should be made in ruminants as they have higher GHG emissions than monogastrics. It is also argued that ruminants need more land than monogastrics. However, this point does not distinguish between (i) intensively and extensively raised ruminants and (ii) arable land and grassland. Extensive ruminants utilise land very efficiently when they graze grassland which cannot be used for others forms of food production. In contrast, monogastrics and intensive ruminants need arable land for feed which could be used more efficiently to grow crops for direct human consumption.

In several respects extensive ruminants make a much better contribution to sustainable food production than monogastrics (most pig and poultry production is in the industrial sector). Extensive ruminants augment food security by converting inedible materials into food we can eat. Monogastrics, however, undermine food security as they consume much more nutrition when eating human-edible crops than they deliver as meat.

Any expansion of the monogastrics sector would fuel increased demand for cereals and soy as animal feed. This would lead to expansion of cropland into forests and grasslands and/or intensification of crop production through the use of monocultures and agro-chemicals.

Animals raised in industrial systems are vulnerable to disease. As a result antibiotics use is much higher in such systems than in extensive ruminants. Animal welfare is poor in industrial pig and poultry operations while well-managed extensive ruminant production has the potential to deliver high welfare standards.

In summary, the fact that ruminants produce more GHG emissions per unit of meat produced than pigs and poultry is crucial. However, it does not follow that meat production should switch from ruminants to monogastrics as this would result in detrimental impacts on food security, biodiversity, use of arable land, deforestation, antibiotic resistance, animal welfare and the quality of soil, water and air. The best response to ruminant GHG emissions - while at the same time ensuring that other key factors are not undermined - is to substantially reduce meat consumption but for the bulk of meat production to be extensive ruminants as industrial pig and poultry production is responsible for a very wide range of harms.

4. REDUCING RELIANCE ON ROUTINE USE OF ANTIMICROBIALS WITH HEALTH-ORIENTATED SYSTEMS FOR REARING ANIMALS

> ***A Joint Scientific Opinion by the European Medicines Agency and the European Food Safety Authority highlights the "need to rethink those particular farming systems which place much reliance on antimicrobial use ... The stress associated with intensive, indoor, large scale production may lead to an increased risk of livestock contracting disease.***[80]

Heath-orientated systems should be used in which good health is integral to the system rather than being propped up by routine use of antimicrobials. This approach would build good health and strong immunity by:

- **avoiding overcrowding:** high densities are a risk factor for the spread and development of infectious disease; such densities can allow rapid selection and amplification of pathogens [33 34 81]
- **reducing stress:** stress tends to impair immune competence, making animals more susceptible to disease [82]
- **enabling animals to perform natural behaviours:** inability to engage in natural behaviours is a major source of stress in intensive systems [83]
- **ending the early weaning of pigs:** this is stressful due to premature removal from the sow, change in diets, mixing with unfamiliar pigs and being moved to a new environment.[84]
- **avoiding excessive group size:** The O'Neill Review states: "large numbers of animals living in close proximity ... can act as a reservoir of resistance and accelerate its spread. There are often many opportunities in intensive farming environments for drug-resistant bacteria to be transferred between, for example, thousands of chickens being reared in the same indoor enclosure" [85]
- **maintaining good air quality:** poor air quality and inadequate ventilation are risk factors for respiratory disease [86]
- **encouraging a move away from genetic selection for high production levels:** these appear to involve an increased risk of immunological problems and pathologies.[87]

5. EMPOWERING CONSUMERS

> ***SDG 12.8 requires people "to have the relevant information and awareness for sustainable development and lifestyles in harmony with nature".***

Governments should develop programmes to increase public awareness of the implications of different livestock farming methods and consumption levels for human health, the environment, food security, climate change and animal welfare.

Consumers should be empowered to play a greater part in driving improvements in animal welfare. Mandatory labelling of meat, dairy products and eggs as to farming method would enable consumers to make informed choices when buying food.

6. DIVERSIFYING OUR SOURCES OF PROTEIN: MEAT ANALOGUES AND ARTIFICIAL MEAT

> ***I believe that in 30 years or so we will no longer need to kill any animals and that all meat will either be clean or plant-based, taste the same and also be much healthier for everyone.***
>
> *Richard Branson, 2017* [88]

Meat analogues and artificial meat are being developed. These will facilitate reduced consumption of real meat with concomitant benefits for health, the environment, climate change and animal welfare.[17 89] Meat analogues (imitation meat), based on plant sources of protein such as soy and wheat gluten, resemble meat in flavour, texture and appearance. The market for meat analogues is expected to grow strongly.[90]

Artificial meat ('lab-grown' meat) could make a major contribution to meeting the growing demand for meat while at the same time reducing the global population of farm animals. Moreover, its production would not entail the routine use of antimicrobials which is endemic in industrial livestock production or carry the risk of zoonosis outbreaks. Artificial meat would have much lower environmental impacts and GHG emissions and would need less land and water than real meat.[91]

Artificial meat is made from cells collected from an animal which are then grown in a culture medium. Lab-grown burgers and meatballs as well as chicken meat have already been produced.[92 93 94 95] A number of start-ups are working in this field.[96] Costs are coming down.[97] Governments should adopt policy positions that strongly support the development of artificial meat.

BARRIERS

"Political will is needed to re-evaluate and challenge the vested interests, incentives and power relations that keep industrial agrochemical-dependent farming in place".

Hilal Elver, 2017 [98]

Challenging vested interests

The WHO points out that a handful of large multinational corporations now control the food chain.[79] They stress the need for governments "to make bold political choices that take on powerful economic operators, like the food and soda industries. If governments understand this duty, the fight against obesity and diabetes can be won. The interests of the public must be prioritized over those of corporations".[79]

Multi-national companies that provide agricultural inputs such as livestock feed, genetics and pharmaceuticals; fertilisers, pesticides and commercial seeds; and farm equipment have a vested interest in promoting industrial agriculture, including industrial livestock production.

These providers of inputs are dependent on agriculture being industrial. If farming were to become extensive, demand for their products would fall very substantially. Accordingly, they endeavour to protect industrial agriculture from criticism. Such companies wish not just to protect their markets but to keep on growing; hence their desire to see further expansion of the industrial model in the developing world. Indeed, the global South is the prime growth region for industrial agribusiness.[99]

Even those input providers with no apparent connection to industrial livestock - such as manufacturers of pesticides and fertilisers - are in fact dependent on it, as 36% of global cereals[24] and 98% of the world's soybean meal are used as animal feed.[25]

The major international grain traders also have a strong interest in the continued expansion of industrial livestock production as it is their products that are used by manufacturers of the concentrate animal feed that is the norm in the industrial sector.

These companies have immense political influence which they use to influence policymakers and regulators and to obstruct reforms. They are able to shape the narratives that entrench the *status quo* e.g. industrial agriculture gives us cheap food and is vital to feed the world.

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