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REGENERATIVE AGRICULTURE: NURTURE FOR NATURE

Solutions for a healthy, humane and regenerative food system

"Our inefficient food system is threatening human health and environmental sustainability …

The current agribusiness model benefits the few at the expense of the many: small-scale farmers, the essence of rural livelihoods and backbone of food production for millennia, are under immense stress from land degradation, insecure tenure, and a globalized food system that favors concentrated, large-scale, and highly mechanized farms."

UNCCD, **2017: Global Land Outlook**

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"Agro-industrial systems, consisting of input-intensive monocultures and industrial-scale feedlots currently dominate farming landscapes. The uniformity at the heart of these systems and their reliance on chemical fertilizers, pesticides and preventive use of antibiotics, systematically yields negative outcomes and vulnerabilities. … The environmental impacts, including water, soil and air pollution, of intensive livestock production are significant".

Intergovernmental Platform on Biodiversity and Ecosystem Services [1]

Industrial animal agriculture

Industrial animal agriculture is the main driver of, or a major contributor to, biodiversity loss, deforestation, climate change, soil degradation, and overuse and pollution of water. It contributes to key non-communicable diseases and antimicrobial resistance as well as increasing the risk of future pandemics.

Environment

The European Commission states that nearly two thirds of the EU's cereals are used for animal feed.[i] Globally 40-45% of the world's grain is used to feed animals.[ii] [iii] They convert this very inefficiently into meat and milk.[iv] [v]

Industrial livestock's massive need for grain has fuelled the intensification of crop production. This, with its monocultures and agro-chemicals, has led to biodiversity loss,[vi] [vii] soil degradation[viii] [ix] and overuse and pollution of water.[x]

Forests

USDA data shows that 99% of global soymeal is used as animal feed; 82% is used for industrial pigs and poultry.[xi] Industrial livestock's huge demand for soy, plus a growth in cattle ranching, has led to the expansion of farmland into forests and other key habitats.

Dietary Health

The high levels of consumption of red and processed meat that have been made possible by industrial animal agriculture contribute to heart disease, obesity, diabetes and certain cancers.[xii, xiii, xiv xv]

Anti biotics

Globally, over 70% of all antibiotics are used in farm animals.[xvi] Industrial production depends on the routine use of antibiotics to prevent the diseases that are inevitable when animals are kept in poor conditions. This leads to antibiotic resistance in animals which can then be transferred to people.

Pandemics

The report *Preventing the next pandemic* by UN Environment and the International Livestock Research Institute identifies unsustainable agricultural intensification and increasing demand for animal protein as major drivers of zoonotic disease emergence. A report by the Intergovernmental Platform on Biodiversity and Ecosystem Services states: "The underlying causes of pandemics include … land-use change, agricultural expansion and intensification"[xvii]

Climate change

The global food system generates around 26% of global greenhouse gas (GHG) emissions. Around 75% of agriculture's emissions are produced by livestock, including the production of feed for livestock and the associated land use changes.[xviii] [xix]

Livestock provide an inefficient contribution to food supply. Meat and dairy production uses 83% of the world's farmland and produces 75% of farming's GHG emissions, but provides only 18% of our calories and 37% of our protein. [2] [3] [4]

The need to move to new ways of farming

If we wish to address these problems, we need to move to new ways of farming.

Sustainable livestock production

We need to redefine the role of farmed animals. Animals are only efficient when they are converting materials we cannot consume into food that we can eat.[xx] [xxi] Efficient ways of feeding animals include: raising them extensively on pasture or other grassland, feeding them on crop residues or by-products such as brewers' grains or citrus pulp, or unavoidable food waste such as left-over bakery products or cull fruit and vegetables.
Given the huge environmental harm arising from the production of cereals and soy for animal feed we believe that the use of cereals and soy for feed should be halved by 2030 and reduced by 75% by 2035. Ideally, such use should be ended altogether.

© Rosamund Young, Kite's Nest Farm

Regenerative agriculture

Some argue that we can make the industrial model more efficient, for example by more precise use of pesticides and fertilisers. However, industrial crop production is innately damaging to natural resources. Similarly, with its poor conversion of cereals and soy to meat and milk, industrial animal agriculture is inherently inefficient. Claiming these systems can be made more efficient or sustainable is a verbal sleight of hand; they can simply be made less inefficient and less damaging.

We need instead to move to regenerative, nature-positive forms of agriculture. Regenerative agriculture aims to work with nature, supporting - and harnessing - natural processes. It aims not just to minimise negative impacts but to be a positive force, for example by producing food while at the same time enhancing soil quality and restoring biodiversity.

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[5]

Regenerative agriculture - key characteristics

The key characteristics of regenerative agriculture include:

Minimising the use of external inputs: such as artificial fertilisers and chemical pesticides as these are often environmentally damaging and expensive, so undermining farmers' incomes.

Closed loop fertility: soil fertility is built not by chemical fertilisers but through the use of composts, cover crops, legumes which can 'fix' atmospheric nitrogen into the soil, rotations and manure from animals raised on the farm. Regenerative farming also avoids disturbing the soil through ploughing as much as possible, thereby not upsetting the animals and plants that make up soil ecology and drive fertility.

Integrated pest management: This minimises the use of chemical pesticides, employing them only as a last resort. Instead it uses natural processes to tackle pests and plant diseases.

Water conservation: much more water can be retained in the soil naturally by building abundant organic matter.

Feeding animals only on materials that cannot be eaten by people: Animals only make an efficient contribution to food security when they convert materials we cannot consume into food we can eat. Human-edible cereals and soy should not be used to feed animals as they convert them very inefficiently into meat and milk.

Restoring the link between animals and the land: Good grassland systems for raising cattle and sheep do not feed grain to the animals and minimise the use of chemical fertilisers. By restoring animals to the land, they can play their part in building soil fertility, biodiversity and water conservation. It also means that the animals themselves are kept in more natural environments that provide scope for the highest animal welfare.

Minimising the use of antimicrobials and other pharmaceuticals: Regenerative agriculture uses 'health-oriented systems' for the rearing of animals, systems in which good health is inherent in the farming method rather than being propped up by routine use of antimicrobials.

Diversity of crops and animals: Monocultures of both crops and animals are vulnerable to pests and disease. Nature abhors a monoculture. Crop and animal diversity on rotational farms enhances resilience, soils, biodiversity and water conservation as well as controlling pests and disease more naturally.

Focus on quality, not just on quantity: Industrial agriculture largely focuses on quantity, while regenerative agriculture recognises the value of producing food of high nutritional quality. Studies show that mixed farms, whilst naturally producing less of a single commodity, are nevertheless more productive overall. A mixed portfolio of products also provides greater resilience to farmed incomes as it spreads the risk.

Farmer livelihoods: In developing countries regenerative agriculture increases crop yields. This, together with only minimal use of expensive external inputs, improves the livelihoods of small-scale farmers.

Find local solutions to local problems rather than the one-size-fits-all technofix of industrial agriculture: Soil type and quality, rainfall, biodiversity and disease threats are highly variable and so tailoring the key precepts of regenerative agriculture to local agro-climatic conditions is essential. The leading principle for nature-positive farming is to work in harmony with nature in ways that are context-specific, i.e. right for local conditions.

Agro-forestry is a key element of regenerative agriculture and can produce important environmental benefits.

Examining regenerative agriculture in more detail

Regenerative agriculture can minimise the use of chemical pesticides and fertilisers, while at the same time often enhancing productivity in poor countries. It achieves this by supporting – and harnessing – natural processes.[xxii]

A paper published by *France Stratégie* states: "Agroecology is based on a fundamental principle: making optimal use of the resources provided by nature to develop an agriculture that uses the minimum amount of synthetic inputs (fertilizers, pesticides or antibiotics) and to increase the resilience and autonomy of farms".[xxiii] A detailed French study reports that agroecology could provide a healthy diet for Europeans by 2050 while reducing GHG emissions and restoring soils and biodiversity.[xxiv]

Farmers have to determine how to apply the principles of regenerative agriculture in their own physical context. Soil type and quality, rainfall, biodiversity and disease threats are highly variable and so tailoring the key precepts of regenerative agriculture to local agro-climatic conditions is essential.

Regenerative agriculture nurtures the key factors that are essential for productive agriculture: soils, water and biodiversity. It mimimises the use of external inputs. Diversity is a key feature of regenerative agriculture in contrast to the monocultures of crops and animals that characterise intensive farming.

Soils: Regenerative agriculture can build soil quality and fertility without recourse to chemical fertilisers. It does this by the use of crop residues, animal manure, composts,

cover crops, no-till and rotations that include legumes which can 'fix' atmospheric nitrogen into the soil.[xxv]

Without rich biodiversity soil fertility declines. Soil biodiversity is undermined by the chemical pesticides, herbicides and fertilisers used in industrial crop production. In contrast to this, regenerative agriculture boosts soil biodiversity such as earthworms, spiders, mites, bacteria and fungi. These organisms decompose plant residues, turn them into humus, and distribute this fertility-giving substance throughout the soil.[xxvi] The Dasgupta review states: "These organisms form food webs which drive soil ecosystem processes, including nutrient cycling, carbon sequestration, nitrogen storage and water purification and are important components of global cycling of matter, energy and nutrients".[xxvii]

The importance of soil organic matter is ignored by industrial crop production. Regenerative agriculture, however, aims to increase the quantity of organic matter in soils. Soil organic matter is a key component of good soil; it builds fertility and stores carbon so helping to mitigate climate change. Soil erosion is minimised in soils with abundant organic matter and by the use of cover crops to prevent bare earth being exposed to wind and rain.

Water conservation and prevention of pollution: Soil with plentiful organic matter is able to retain water thereby preventing flooding and lessening the impact of droughts. A cubic metre of soil may contain up to 200 litres of water and so is able to supply water to plants even though it may not have rained for a long time.[xxviii]

Soils with ample organic matter can curtail the pollution that arises from the leaching of nutrients into groundwater and their run-off into rivers. Water can be retained in soils by mulches. Water harvesting can be used to store rainwater so that it can be used in the dry season.

Agroecology can minimise pests and plant diseases by **Integrated Pest Management**.[xxix] This includes, for example, allowing the natural enemies of pests to thrive (while pesticides tend to kill them) and developing healthy soils which can promote strong healthy plants which are better able to resist disease and pest attacks. Moreover, the use of rotations can impede the build-up of pathogens and pests that often occurs when the same plants are continuously cropped.

Biodiversity: Regenerative agriculture can restore biodiversity enabling pollinators, farmland birds, butterflies and mammals to thrive once again. Minimising the use of chemical pesticides allows insects such as pollinators and the predators of crop pests to flourish. Regenerative agriculture can help bees to do well by including wildflowers in fields and grassland as these provide the nectar and pollen on which bees feed. Field margins can provide nesting and hibernation sites for bees.

Because they sit near the top of the food chain, farmland birds are used as an indicator of the quality of the farmed environment. Regenerative agriculture can provide the key nesting and feeding resources that are needed to reverse the decline in farmland birds. Insects are a key food source for birds; a rich mix of plants and minimising the use of pesticides enhance insect populations.

The inclusion of trees, shrubs, hedgerows and ponds within farmed land provides food and habitat for countless wildlife.

Climate change: Regenerative agriculture can help to reduce agriculture's contribution to climate change. Healthy soils in both arable land and grassland can store carbon. By minimising the use of chemical fertilisers, regenerative agriculture can deliver substantial reductions in GHG emissions as:

- the manufacture of fertilisers entails the emission of large amounts of CO_2, and
- the application of these fertilisers to the land involves substantial emissions of nitrous oxide, the most aggressive GHG.

Moreover, agroforestry enables us to simultaneously produce food and store carbon in trees.

Restoring the link between animals and the land is a core principle of regenerative agriculture

We need to restore the link between animals and the land. Good grassland systems for raising cattle and sheep do not feed grain to the animals and minimise the use of chemical fertilisers.[xxx] In such farms the animals are fed on grass, crop residues and root crops grown on the farm. Soil fertility and the nutritional quality of the grass are built through animal manure, the ability of the roots of grasses to collect minerals from deep in the soil and the inclusion in the grass of herbs, wildflowers and protein-rich legumes such as clover.

Some farmers operate rotational integrated crop-livestock systems. One typical system would involve Year One: Wheat, Year Two: Barley, Year Three: Oats, Years Four to Seven: Grazing (the composition of the rotation will vary depending on the climate in the region concerned). In such systems the animals are fed and soil quality is built as described in the previous paragraph. Because good soil fertility has been developed during the grazing phase, the arable stage of the rotation can be undertaken without the use of artificial fertilisers.

Industrial livestock production entails producing just one species on a farm; the farm specialises in pigs or poultry or cattle. Regenerative agriculture often includes cattle, poultry and pigs on the same farm. The poultry follow the cattle. They peck around in the grass, feeding on bugs, seeds and worms, but also scratch in the cow dung to find larvae. This acts to spread the manure onto the soil.

UK farmer Tim May states: "The health of the system is promoted by mixing the class of livestock that run over the ground. The carrying capacity of the land will be increased by following the grazing animals with a mobile pig and poultry unit, a technique called enterprise stacking."[xxxi]

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Regenerative agriculture can deliver substantial and enduring productivity gains in the poorer parts of the world

One study examined the impact of 286 projects in 57 poor countries.[xxxii] The projects included integrated pest and nutrient management, conservation tillage, agro-forestry and rainwater harvesting. These projects increased productivity on 12.6 million farms while improving critical environmental services. The average crop yield increase was 79%, while the African projects showed a 116% increase in crop yields. All crops showed water use efficiency gains. Of projects with pesticide data, 77% resulted in a decline in pesticide use by 71%, while yields grew by 42%.

> The UN Food and Agriculture Organization (FAO) estimates that more than half of the world's rural poor are livestock farmers and pastoralists.[7] In 2018 the then Director-General of the FAO said that small-scale livestock farmers must not be ***"pushed aside by expanding large capital-intensive operations."*** [8]

An analysis of 40 projects in 20 African countries has been carried out.[xxxiii] The projects included crop improvements, agro-forestry and soil conservation, conservation agriculture, integrated pest management, horticulture, livestock and fodder crops. Crop yields more than doubled on average over a period of 3-10 years.

Alliance for Food Sovereignty in Africa: Advocating for Agroecology

The Alliance states: "Industrial agriculture is a dead end. It claims to have raised yields but it has done so at great cost, with extensive soil damage, huge biodiversity loss and negative impacts on nutrition, food sovereignty and natural resources.

In many ways, agroecology is the antithesis of industrial, corporate-driven, monoculture-based agricultural systems. Where industrial agriculture seeks to simplify, agroecology embraces complexity. Where industrial agriculture aims to eliminate biodiversity, agroecology depends on it. Where industrial agriculture is based on one-size-fits-all technofix, agroecology provides local solutions to local problems. Where industrial agriculture pollutes and degrades, agroecology regenerates and restores, working with nature – not against nature.

The strongest resistance to agroecology comes from the vested interests of the industrial food system, who have used their huge economic power to convince African governments that industrial agriculture is the way to go.

Can African policy makers be bold enough to embrace the sustainable solution? Or are they going to wait until it's too late, until the soils are exhausted, biodiversity devastated, nutritional and health problems mounting, and farmers dependent on outside inputs and knowledge? We need a complete transformation of our food systems. Agroecology is a people-centred system of sustainable agriculture, combining indigenous knowledge with cutting edge science, making the best use of nature to create healthy communities and empowering a social movement that resists the corporatization of agriculture.

It's time to let go of tired narratives and failed solutions. It's time to support small-scale food producers to build a sustainable, resilient, diverse, healthy, productive and culturally appropriate food system for Africa."[xxxiv]

Improving the livelihoods of small-scale farmers in the developing world

Some argue that bringing industrial agriculture to the poorest parts of the developing world will enhance farmers' livelihoods. The opposite is likely to be the case.

As long ago as 2000 the World Bank recognised that intensification of livestock production carries "a significant danger that the poor are being crowded out".[xxxv] The FAO points out that industrial livestock production "may occur at the expense of diminishing the market opportunities and competitiveness of small rural producers".[xxxvi]

The High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security states that "the social benefits of agriculture can be eroded as production becomes more concentrated and intensive. Intensive agricultural systems are associated with negative effects on employment, wealth distribution, ancillary economic activity in rural areas [and] service provision in rural areas (such as schools and health facilities)".[xxxvii]

A 2020 report by the Inter-American Development Bank and the International Labour Organisation estimates that moving to plant-based diets with reduced animal-source food would not only provide health and environmental benefits but would create 15 million extra jobs in Latin America and the Caribbean.[xxxviii]

Moving to 'health-oriented' systems for rearing animals

To reduce the risk of future pandemics and minimise the use of antimicrobials on farms, heath-oriented systems should be used in which good health is integral to the farming methods rather than being propped up by routine use of antimicrobials.

This would build good health 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;[xxxix] [xl] [xli]
- ***reducing stress***: stress tends to impair immune competence, making animals more susceptible to disease;[xlii]
- ***enabling animals to perform natural behaviours***: inability to engage in natural behaviours is a major source of stress in intensive systems;[xliii]
- ***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;[xliv]
- ***avoiding excessive group size***: An influential review of the subject found that "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";[xlv]
- ***maintaining good air quality***: poor air quality is a risk factor for respiratory disease;[xlvi]
- ***encouraging a move away from genetic selection for high production levels***: these involve an increased risk of immunological problems and pathologies.[xlvii]

Bringing farming into the circular economy

Our food systems must be part of the circular economy. The livestock sector is an excellent example of how a particular activity can be either linear or circular depending on how it is operated.

Industrial livestock production is inherently linear. Its inputs include huge amounts of cereals and soy used as livestock feed, but most of the calories and protein in this feed do not produce meat or milk. Most are either absorbed by the animals to maintain their bodies' functioning or are excreted in their manure. Its outputs include manure which in

industrial systems is too great to be absorbed by nearby cropland. This excess manure causes water and air pollution as well as GHG emissions.

In contrast, livestock kept on rotational grassland do not need external inputs for feed (many farmers do feed them grain, but this is not necessary). They can be fed on grass, by-products, unavoidable food waste and crop residues. Moreover, the amount of animal manure produced is in proportion to that needed by the farm's pasture and cropland. Rather than being a polluting output, the manure builds soil structure and fertility. Nor are inputs of synthetic fertilisers needed on grassland as, on the best of farms, fertility is built through animal manure and legumes. Such systems are genuinely circular with few external inputs (other than feed that would otherwise have gone to waste) and no polluting outputs.

Sustainable intensification

This has become a divisive concept. It was initially framed to show that yields in the poorest parts of the world could be increased without harming natural resources, for example by the adoption of agroecology.

The term has, however, been hijacked by agri-business to render acceptable further industrialisation even though this cannot be carried out without environmental depredations.

The concept of sustainable intensification assumes that a huge increase in food production is needed. In some regions such as sub-Saharan Africa and South Asia, increased food production is necessary. But there is no overall global need to produce more food. We already produce almost twice as much food as is needed to feed the growing world population, which is expected to reach 9.8 billion by 2050.[xlviii] The problem is that around 60% of this food is lost or wasted in various ways. A Chatham House report states: "Once post-harvest losses, processing, livestock, consumer waste and overeating are included, losses for the global food system exceed 60 per cent of calories produced". [xlix]

Worldwide 25% of food calories are lost or wasted post-harvest or by being discarded by consumers or food businesses.[l] Alexander *et* al (2017) calculate that 2.9 EJ (exajoules) are lost each year through overconsumption i.e. consumption in excess of nutritional requirements.[li] Globally, 9% of crop calories are used for biofuels or other industrial uses.[lii]

Animals convert cereals very inefficiently into meat and milk.[liii] [liv] [lv] [lvi] A cautious calculation indicates that around 27% of global crop calories are lost by being fed to animals; this is due to the low efficiency with which animals convert human-edible crops into meat and milk.

If all the above forms of food loss and waste were halved, an extra 3.55 billion people could be fed; this is more than the anticipated 2.2 billion increase in world population by 2050.[lvii]

Land sharing vs land sparing

Compassion in World Farming fully supports the commitment by many countries to protect 30% of the planet's land and oceans by 2030.

Land sharing involves a non-intensive approach to agriculture that enables biodiversity to be maintained within land that is farmed. This concept argues that regenerative agriculture and biodiversity can be mutually supportive.

Land sparing involves farming some land intensively for high yields to enable other land to be kept completely free of agriculture so enabling nature, including large mammals, to thrive. However, the current industrial farming model is essentially a massive exercise in land-sparing, which proves that the theory does not work in practice. Farm intensification is accompanied by expansion of farmland into remaining wildlands because it requires vast acreages of cropland to be devoted to animal feed. It also causes natural resources such as soils to become depleted, thus meaning new land must inevitably be sought.

The land-sparing approach may be summarised as: if one wishes to preserve some land for nature one must farm other land intensively to produce the high yields that allow other land to be 'spared'. This ignores the following factors:

***The use of monocultures and chemical fertilisers and pesticides to secure high yields leaches the fertility out of soils, leading in time to falling yields*:** The UN Food and Agriculture Organisation (FAO) has said that in its drive for high yields, intensive agriculture can undermine the key factors (e.g. soils, biodiversity and water) on which farming depends and thus "food production is seriously affected, the result being a vicious downward spiral".[lviii] And once intensive agriculture has undermined the viability of a particular area of land, new arable land has to be found by expanding into forests and wildlife habitats.

Restoring degraded land: The UN states that there are around two billion hectares of degraded lands on the planet.[lix] Land degradation has reduced agricultural productivity in 23% of the global terrestrial area.[lx] Restoring degraded land through regenerative agriculture – and in particular restoring soil fertility and structure – could improve productivity on significant amounts of land.

This would substantially reduce the pressure to expand farmland, while at the same time enabling cropland to be farmed without agro-chemicals and monocultures which is essential if long-term sustainability is to be achieved. Progress in restoring degraded land is being made. The Bonn Challenge aims to restore 150 million hectares of the world's degraded and deforested lands by 2020 and 350 million hectares by 2030.[lxi]

Reducing meat and dairy consumption from livestock would free up large amounts of cropland

Schader *et al* (2015) examined a scenario where livestock were only fed on foodstuffs that do not compete with crop production for people e.g grass and by-products.[lxii] They calculated that this would result in 2050 in a 53% reduction in per capita consumption of livestock products compared with consumption in 2005-2009. Moreover, global arable land use in 2050 would decrease by 22% compared with arable land use in 2005-09. This means that 340 million fewer hectares of arable land would be needed in 2050 compared to that used in 2005-09.

Halving food loss and waste: As indicated earlier, worldwide 25% of food calories are lost or wasted.[lxiii] Halving this could release around 187 million hectares of cropland from being used to grow food that is not consumed.[lxiv]

Modern foods: Cultured meat and precision fermentation are poised to replace a high proportion of traditional meat. Cultured meat entails taking cells from an animal and then growing them in a nutrient-rich medium. This process uses very much less land than conventional animal agriculture. A key study states "cultured meat production involves approximately 35-60% lower energy use, 80-95% lower GHG emissions and 98% lower land use compared to conventionally produced meat products in Europe".[lxv]

Precision fermentation entails programming microbes to produce the constituent parts of food. It builds on traditional fermentation which is used to produce foods such as yoghurt. Precision fermentation would save huge areas of farmland.[lxvi]

Embracing the above practices – restoring degraded land, reducing meat consumption from livestock, halving food waste, moving away from intensive farming with its damaging impact on soils, adoption of modern foods – would spare a very substantial amount of cropland. This would:

- reduce pressure for converting natural habitats to agricultural land
- allow cropland to be farmed less intensively so enabling soils and biodiversity to be restored and water pollution to be much reduced.

In short, it is possible through adoption of the above practices, to both spare land allowing nature and wildlife to thrive once again and to share land by using farming methods that enable agriculture and biodiversity to work together in a symbiotic relationship.

The many benefits of reducing global meat consumption

While regenerative agriculture can enhance yields in countries with low productivity, a move to regenerative agriculture in the developed world with its industrial farming systems is likely to lead to a fall in productivity.[lxvii]

To counter this, consumers in the developed world and certain emerging economies will need to move to less resource-intensive diets, and in particular to eating less meat and dairy products from livestock as these require much more land, water and energy than plant-based diets that include only modest amounts of meat. In addition to making it feasible to adopt regenerative agriculture, reduced consumption of livestock products will lower GHG emissions and deliver health benefits in the form of a lower incidence of heart disease, obesity, type 2 diabetes and certain cancers and a decrease in farm use of antibiotics.[lxviii] [lxix]

The World Economic Forum states: "Reducing meat consumption would be good for nature and the climate. In a growing number of countries it would be good for people as well, as overconsumption of meat could be leading to worse health outcomes"[6]

However, in some parts of the world people have very low consumption of animal-derived foods; they should not be expected to reduce their intake. The developing world should aim for a balanced intake of animal-source foods and should not adopt western diets as these have an adverse impact on health.

The Planetary Health Diet proposed by the EAT-Lancet report recommends per capita consumption of no more than an average of 300g of red meat/poultry and 200g of fish per week for a diet that is both healthy and environmentally sustainable.[lxx] In the developed world this will entail a substantial reduction in meat consumption, while in some developing countries it will allow for an increase in meat consumption.

Studies show that reducing global meat consumption would produce multiple benefits in the form of reduced use of resources and a decrease in environmental degradation. In particular, a decrease in the consumption of meat and dairy would lead to reduced use of arable land, freshwater, energy and pesticides as well as reduced nitrogen and phosphorus pollution, deforestation and soil erosion.[lxxi] [lxxii] [lxxiii] In addition, reduced meat consumption would:

- help feed the growing world population as a greater proportion of crops would be used for direct human consumption which is much more resource-efficient
- allow cropland to be farmed less intensively so enabling the environment to be restored and birds, pollinators and insects to prosper once again
- enable us to halt the expansion of cropland (to grow crops for animal feed) and pasture for cattle into forests and other fragile ecosystems
- reduce pressures on wildlife as habitat destruction could be reversed
- make it possible to meet the Paris climate targets

- reduce the risk of future pandemics that could arise due to keeping animals in industrial conditions and to the expansion of pastures and cropland for animal feed into wildlife habitats which increases the risk of pathogen spillover
- reduce the incidence of heart disease and certain cancers (this applies to reduced consumption of red and processed meat)
- help tackle antimicrobial resistance
- enable animals to be farmed extensively to high welfare standards.

Ensuring healthy, nutritious food for all

We have a food system that does the opposite of what it is meant to do: it makes us unhealthy. Poor diets are one of the world's leading causes of disease and mortality.[lxxiv] In many countries the poorer people are, the worse their diet, and the more diet-related diseases they suffer from.[lxxv] Unhealthy diets have large amounts of sugar, salt, ultra-processed food, saturated fat, red and processed meat and empty calories (calories derived from food containing no nutrients) and low quantities of fruit and vegetables. Healthy diets comprise fruit, vegetables, legumes, nuts, seeds, wholegrains and only modest amounts of meat and dairy.

To move to healthy diets and ensure these are available to everyone including the most deprived, a wide range of steps are needed, including the following:

Better information: Governments should develop programmes to increase public awareness of the implications of different dietary choices for health, the environment and climate change. Sustainable Development Goal 12.8 requires governments to ensure that by 2030 "people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature".

Restrict promotion of unhealthy food: Advertising and price promotions of unhealthy food should be restricted, as should the placing of such food in prime supermarket locations such as checkouts and aisle ends.

Education: Schools should help pupils understand the value of healthy diets. They should deliver imaginative food education including growing and cooking food and farm visits. They should provide healthy meals and these should be free for pupils from poor households.

Fostering a healthier food culture: A growing number of initiatives seek to ensure that nutritious food is accessible by the most deprived and that healthy, local, sustainable food that provides decent returns to farmers is more widely available.

The fostering of a healthier food culture is essential, such as schemes that encourage people to learn how to cook and grow food, for example in community gardens and

farms. Not being able to cook from fresh ingredients means people are more likely to turn to unhealthy processed foods. Governments should provide support for *Grow Your Own Activities* in disadvantaged areas as a way of increasing understanding of where our food comes from and supporting healthy eating and exercise.[lxxviii]

Community food outlets take a variety of forms but in essence aim to provide fruit and vegetables, where possible from local farms, and sell them in informal shops, community centres, etc.[lxxix] They are run by volunteers and produce is sold at near-cost price to ensure affordability for customers.

Good Food Hubs should be established where people can learn how to produce healthy, tasty meals composed largely of local, seasonal food.[lxxx] Such hubs aim to provide infrastructure that will enable good, sustainably-produced food to be available to all, regardless of income.[lxxxi] They have short supply chains that support local farmers. Hubs can also provide a number of kitchen units for small businesses, a training kitchen, space for a farmers' market and chefs who can teach people about healthy, varied cooking.

We need to embrace new online business models that link farmers much more directly to consumers allowing farmers to receive a greater share of the income generated by their produce and consumers to buy fresh, local food at lower prices.

Government social policies should ensure that everyone can access nutritious food. No-one should have to 'make do' with unhealthy food. A report by the *International Panel of Experts on Sustainable Food Systems* (iPES Food) stresses that "cheap calories can no longer be a substitute for social policies, which must be rebuilt and redesigned to tackle the root causes of poverty and promote access to healthy food for all".[lxxxii]

Use of fiscal measures to encourage move to regenerative agriculture and healthy, sustainable diets

"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 Organisation[9]

Industrially produced meat and milk are cheap at the supermarket checkout. But the low price 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 the environment and health.

These detrimental impacts are referred to by economists as 'negative externalities'. They represent a market failure as the costs associated with them are not included in the prices paid by farmers for inputs or the prices paid by consumers of livestock products, but instead are borne by third parties or society as a whole. In some cases the costs are borne by no-one and key resources such as soils and biodiversity are allowed to deteriorate so undermining the ability of future generations to feed themselves.

A range of studies have calculated the massive costs that arise from these problems.[lxxxiii] [lxxxiv] [lxxxv] [lxxxvi] [lxxxvii] Olivier de Schutter, former UN Special Rapporteur on the right to food has said "any society where a healthy diet is more expensive than an unhealthy diet is a society that must mend its price system".[lxxxviii] This applies equally to a society where food that respects natural resources and animals' well-being is more expensive than environmentally damaging, low animal welfare food.

So, how can we 'mend our price system'? Many bodies and reports have recommended using taxation to rebalance our food system.[lxxxix] [xc] [xci] [xcii] Regarding consumers, a tax could be placed on industrially produced meat and dairy, unhealthy food and food produced in environmentally damaging ways. All the revenue raised must be used to lower the cost of healthy, sustainable, humane food. There must be no increase in the overall price of food, but simply a re-balancing of the respective prices of good and harmful food. The revenue raised by these taxes could be used to subsidise healthy, sustainable food and to enable such food to be zero-rated for VAT.

Turning to farmers, all subsidies should be redirected on the 'public goods for public money' principle. Taxes should be placed on the inputs of industrial agriculture such as chemical pesticides and fertilisers and the use of soy and human-edible cereals as animal feed. All the revenue arising from such taxes and the redirection of subsidies should be used to support farmers who are switching to regenerative agriculture, building soils, restoring biodiversity and operating to high animal welfare standards.

The repurposing of subsidies is indeed crucial. An OECD report covering 54 countries found that these countries provide support to their agriculture sectors of $619 billion per year. The OECD reports that more than two-thirds of this support tends to have negative effects including harming the environment.[xciii] In a separate report on biodiversity finance the OECD states that "governments spend approximately USD 500 billion per year in support that is potentially harmful to biodiversity i.e. five to six times more than total spending for biodiversity".[xciv]

Big Finance

Commercial banks, international finance institutions (such as the International Finance Corporation), national development backs and export credit agencies pour huge sums into funding industrial animal agriculture even though they have been informed of the harm resulting from such operations to biodiversity, the climate, forests, soils, water and health.[xcv] [xcvi] [xcvii] Financial institutions as well as investors and investment management companies must shift from funding industrial livestock production to supporting regenerative agriculture.

Animal welfare

The link between good animal welfare and human well-being is multi-faceted. Animals whose welfare is good tend to be healthier so reducing the use of antimicrobials and pandemic risks. Healthier animals result in lower veterinary costs and reduced disease and mortality, as well as in some instances better growth rates and feed conversion. With sufficient access to veterinary services and with improved management regarding animal health and animal welfare, global animal production could, according to the OIE (World Organisation for Animal Health), be increased by around 20%.[xcviii]

Achieving good animal welfare standards is an ethical imperative that is recognised by the OIE, the FAO and the UN. The FAO stresses that: "A paradigm shift has become urgent. Animals are to be addressed as living beings to take care of and valorize, not only as a source of commodities to exploit".[xcix]

Scientific research and, in some countries, legislation recognise that animals are 'sentient beings' i.e. creatures that are able to experience both aversive states such as pain, fear and distress and positive states such as pleasure and a sense of well-being.

The OIE's *Guiding principles for animal welfare* state that: "the use of animals carries with it an ethical responsibility to ensure the welfare of such animals to the greatest extent practicable".[c] The UN *2030 Agenda for Sustainable Development* includes in its vision a world "in which wildlife and other living creatures are protected". [ci]

It is over 50 years since Ruth Harrison published *Animal Machines* which first exposed the suffering inherent in industrial animal agriculture. Yet now, more than ever, farm animals are treated as machines. Many endure highly restricted lives in cages or crates or in overcrowded, barren sheds. Genetic selection for extremely fast growth rates or high yields leads to painful lameness, bone fractures, heart disease and premature death.[cii] [ciii] Many are subjected to painful mutilations such as castration, tail docking, teeth clipping, beak trimming and de-horning. Worldwide millions of male chicks born in the egg sector are killed shortly after birth - gassed or macerated.

We have an ethical responsibility to ensure responsible standards of farm animal welfare. Rabobank, a global leader in agriculture financing, highlights the importance of "promotion of positive experiences" and states that this "refers to improving welfare above the survival minimum by providing animals with enriching opportunities to engage

in behaviours that increase their comfort, confidence and capacity to make rewarding choices".[civ]

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.

Public procurement: taking the lead, setting the standard

Public sector bodies must ensure that food produced to high nutritional, environmental and animal welfare standards is the norm in the public sector, for example in schools and hospitals. Public bodies' commitment to quality will help change our attitude to food.

A number of public bodies have achieved high standards in the meals they provide without this leading to increased costs. They have been able to do this by carefully balancing the contents of meals, for example by using less (but better quality) meat and more vegetables.[cv] [cvi] Other key factors in reducing costs while improving quality include buying seasonal and local food, minimising food waste, using tap water and improving energy efficiency.[cvii]

Good quality public sector meals can generate a significant social return in the form of increased revenue for farmers and other local businesses as well as the value arising from improved dietary health, education and environmental sustainability.[cviii]

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