Pollution: Industrial Agriculture Examined

Background Research

Pollution Defined:

Pollution is the presence of or introduction into the environment of a substance which has harmful or poisonous effects.

Introduction

Agriculture is a leading cause of pollution in many countries[i], particularly industrial animal agriculture[ii]. In 2006, the United Nations Food and Agriculture Organisation (FAO) described livestock farming as "one of the most significant contributors to today's most serious environmental problems"[iii]. Yet despite the magnitude of the problem, which is fuelled by high levels of consumption of meat and dairy products, relatively few global and national policies address the environmental effects of animal agriculture, and those that do are grossly inadequate.[iv]

Industrial agriculture damages the soil, water, and even the climate on an unprecedented scale. Intensive monocultures deplete the soil and leaves it vulnerable to erosion. Chemical fertilizer runoff and intensive animal agriculture wastes add to global warming emissions and create oxygen-deprived "dead zones" at the mouths of major waterways. Herbicides and insecticides harm wildlife and can pose human health risks as well. Biodiversity in and near monoculture fields is impacted too, as populations of birds and beneficial insects decline[v].

In 2000, there were an estimated 15 billion livestock in the world, according to the Worldwatch Institute. By 2016, that had risen to about 24 billion, with the majority of eggs, chicken meat and pork produced on intensive farms.[vi]

The U.S. has led the world in large-scale farming, pioneering the use of intensive livestock rearing in pig farms, cattle sheds and sheep pens. There are now more than 50,000 facilities in the U.S. classified as concentrated animal feeding operations (CAFOs[vii]), with another quarter of a million industrial-scale facilities below that threshold. Around the world, developing countries in particular were quick to follow suit to take advantage of economies of scale and more competitive food prices. Globally, CAFOs account for 72% of poultry, 42% of egg, and 55% of pork production according to the UN.[viii]

Traditional farming and agroecological methods can be relatively efficient at converting grass and other waste products into useful food[ix], and farm waste can be a soil enriching nutrient when applied in the correct amount and with the right method. But the "fast-growth, high-yield" intensive farming model is far less efficient, using substantial amounts of grain and protein-rich soya as feed. These crops often receive large quantities of pesticides and nitrogen-and-phosphorus-rich fertilizer to boost plant growth, and a large amount of these are not assimilated by the crops, resulting in runoff and pollution.

In intensive animal production, animals and their wastes are concentrated and usually exceed the capacity of the land to absorb the waste. Undesirable components of animal waste from farms and slaughterhouses include pathogens (such as

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E-coli), antibiotic-resistant bacteria, hormones, veterinary pharmaceuticals, excess nutrients, viruses, industrial chemicals, and heavy metals which can pollute land and water; and can release ammonia, hydrogen sulfide, volatile organic compounds, bioaerosols, and particulate matter into the air[x]. Consequently, the rapid growth of intensive animal production has produced an expanding array of deleterious environmental effects on local and regional water, air, and soil[xi].

Although waste production varies according to species, diet, and age, the United States Environmental Protection Agency (EPA) has estimated that for each animal unit (1000 pounds of animal), 50-60 pounds of manure are created each day and that a single facility housing 2,500 dairy cows can produce as much waste as a city exceeding 400,000 people[xii].

The creation of such enormous quantities of waste has a devastating effect on the air, water and soil surrounding intensive animal production facilities. Unlike human waste, livestock manure is not processed for sanitation. At these facilities, this waste is commonly mixed with water and held in pits (called "lagoons"), and then spread or sprayed on cropland. However, the system often suffers from an excess of manure, and the lagoons can leak or spill. Alternatively, if the manure is over-applied to fields it can run off into surface waters. Nutrients and heavy metals present in animal feed are also excreted by livestock, and so end up being applied to cropland. These include zinc, copper, chromium, arsenic, cadmium and even lead.[xiii]

The agri-food processing industry is also a significant source of organic pollution in most countries[xiv].

Aquaculture production is rapidly expanding around the world, in some places and for certain species, at the expense of natural environment[xv]. Intensive fish production facilities also crowd fish (and their waste) together (in nets, cages, or ponds) and use large amounts of antibiotics, pesticides and other chemicals to keep disease at bay. The risk of contamination is high, both to the surrounding water and within the enclosures themselves[xvi]. When these facilities are close to the sea, uneaten fish feed, fish waste, chemicals and antibiotics can flow through the cages directly into the ocean, polluting the water and harming the ocean environment. There are also concerns that diseases and parasites—common occurrences in crowded pens—are spread to wild fish[xvii].

Food Waste

We are killing the environment for food that is not even being eaten[xviii].

According to the FAO a third of global food production is lost or wasted annually[xix]. This adds substantial pollution to our environment, simply for food that is being thrown into landfills to pollute our environment even further.

Air Pollution and Greenhouse Gases

When food waste breaks down in landfills it emits greenhouse gases, including carbon dioxide and methane, which is 25 times more potent than carbon dioxide. It is also necessary to factor in the amount of greenhouse gases that are emitted during production of that wasted food and transport emissions to market and landfills. As an example of the severity of the problem, the yearly pollution from food waste in Finland is the equivalent of what 100,000 cars produce in the same year[xx].

Food is the primary source of landfill gas and the largest component of materials sent to landfills. In the USA, landfill gas is responsible for 17 percent of USA methane emissions. If integrated into a country ranking of top Greenhouse Gas emitters, food wastage would appear third, after the U.S. and China. Furthermore, the problem keeps growing. Over the past 50 years, greenhouse gas emissions from food waste have increased more than 300 percent, and are projected to increase another 400 percent by mid-century if current dietary and waste trends continue[xxi]

Land Pollution

Landfills, where our food waste ends up, are taking up large amounts of land and polluting soil in the area. The UK estimates that it will run out of landfill sites by 2019, and will then have to search for even more land that it will eventually destroy[xxii].

Water Pollution

The waste we throw in landfills and the fertilizers we use for crops are polluting underground water in these areas, as well as the water bodies that this water streams to. The common and widespread overuse of fertilizers releases excessive amounts of nitrogen and phosphorus into the environment, poisoning drinking water and aquatic ecosystems.

Resource Burdens of Plant and Meat-based Diets

An assessment of the inputs required for both industrialized meat and plant-based diets shows that diets that are primarily meat-based require up to 25 percent more land, nearly twice as much energy, and 100 times more water more water than diets that are primarily plant-based[xxiii]. Because of this, production of animal products that end up in landfills is a particularly egregious burden on our food production systems, ecosystems, and planet. Wasting roughly one-third of the food produced globally means that pollution is created and resources used to create products that become waste and pollutants themselves.[xxiv] Further, the loss of this food production adds further pressure to increase crop yields and intensify production of animals—a circular problem.

Marine Pollution

Eighty percent of marine pollution comes from land-based sources. We will not be able to protect marine ecosystems without accepting planetary boundaries and a comprehensive circular economy. As stated in the NGO Major Group position paper for the High Level Political Forum, to reduce negative impacts and stem the tide of climate change, nutrient contamination, plastic and microplastic waste and the discharge of toxins, environmental policy must focus on precautionary solutions, effective regulation and taxation of unsustainable practices[xxv].

Industrial agriculture is a key source of damage to seas and oceans. Studies using satellite imagery have shown direct evidence that large-scale coastal farming is linked to massive algal blooms in the ocean, with scientists concluding that key regions of the ocean are much more vulnerable to agricultural runoff than was previously assumed. They stated, "Inarguably, the effects of marine nitrogen pollution are becoming extremely widespread and severe as a consequence of the global expansion of industrialized agriculture and the intensification of certain practices"[xxvi].

The introduction of excess nitrogen, phosphorous and other nutrients into waterways (including streams, rivers and oceans) causes eutrophication. Eutrophication encourages algal growth and results in algal blooms. Algal blooms can be dangerous to humans and marine life depending on the species. Species that produce toxins can sicken and kill shellfish, fish, turtles, birds, marine mammals and other animals in the region. They can also harm people who come into contact with the bloom or an affected drinking supply. As the algae dies, bacterial decomposition uses the water's oxygen, leading to hypoxic and "dead zones." Dead zones can move with the tides and fluctuate in size seasonally, but their presence is common in areas where excess nutrients from conventional agricultural operations enter waterways[xxvii].

The largest recorded dead zone is in the Gulf of Mexico and, as of July 2017, spanned over 8,200 square miles—roughly the size of New Jersey. The dead zone is fed by the Mississippi River, which transports pollution from agricultural operations in the Midwestern U.S. to the Gulf of Mexico. Much of the nitrogen and phosphorous causing this dead zone comes from soy and corn production—not for direct human consumption, but rather to feed livestock.[xxviii]

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Pollution from Aquaculture

An additional burden on marine resources comes from industrial aquaculture. The Food and Agriculture Organization of the United Nations (FAO) projects that by 2030, aquaculture, one of the fastest growing methods of food production globally, will be responsible for almost two-thirds of the fish we eat.

Aquaculture has significant detrimental impacts on oceans and marine environments. The most common method of aquaculture uses net pens or cages anchored to the sea floor in the ocean near the coast. Alternative methods use closed systems of tanks or ponds that float on water. Fish waste and left-over food spill out from nets and tanks into the ocean, causing nutrient pollution, eutrophication and hypoxia which can stress or kill aquatic creatures.

Antibiotics or pesticides used on farmed fish can affect other marine life or human health. These nutrients and chemicals impact the biodiversity on the ocean floor when they sink, have led to increased occurrences of algal blooms and have made potentially toxic algae even more poisonous[xxix].

When fish are crowded together in nets or pens they are susceptible to stress, fostering disease and parasites that are then spread to wild species. Sometimes farmed fish also escape into the ocean, breeding with wild species and affecting the population's overall genetic diversity.

Importance of Marine Protected Areas

Studies have shown that the establishment of Marine Protected Areas (MPAs) has a strong positive effect. However, a very small proportion of the world's seas are protected, when compared to the area of land protected[xxx]. The IUCN stated that just under 3% of oceans were protected in 2013[xxxi], whereas Target 11 of the Convention on Biological Diversity states:

> "By 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape."

A 2016 IUCN report on marine protected areas (MPAs) and climate change[xxxii] stated that MPAs remain one of our most effective tools in the fight against climate change. When properly managed, those areas can help conserve rich marine biodiversity and the life-supporting services that the ocean provides us with. They absorb large amounts of global carbon emissions, strengthen the ocean's resilience and are critical in supporting our ability to mitigate and adapt to climate change. However, the report also concluded that the ocean—and its capacity to support life on earth—is increasingly threatened by the scale of human induced greenhouse gas emissions.

The ocean is a major asset in the fight against climate change, but only if it is duly protected—a "catch-22." It is therefore necessary to fight climate change at its root and no longer ignore the cascading effects on oceans caused by animal agriculture.

Fresh Water Pollution

Agriculture is the single largest user of freshwater on a global basis and a major cause of degradation of surface and groundwater resources through erosion and chemical runoff[xxxiii].

Agriculture uses a global average of 70% of all surface water supplies. While livestock directly use only 1.3% of total water used in agriculture, water for livestock feed requires a significant amount of water.[xxxiv] Comparing the water requirements per calorie of different foods, beef requires 20 times more water than cereals and starchy roots. If comparing the water footprint per gram of protein, milk, eggs and chicken meat require about 1.5 times more than pulses, while beef requires six times more.[xxxv]

In addition to water use, the most common cause of water pollution in the U.S. is excess levels of nitrogen and phosphorous, the main source of which is fertilizer runoff that occurs when rain carries fertilizer into waterways[xxxvi]. Other

water quality issues generated by intensive agriculture include the release of various wastes, such as sediments, pesticides, animal manures, fertilizers and other sources of inorganic and organic matter.

Many of these pollutants reach surface and groundwater resources through over-application of manure to available land resulting in nutrient run-off, overflow or leakage of manure storage tanks and lagoons, and aerosolized pollutants which condense into waterways. These are therefore called "non-point" sources of pollution. Identification, quantification and control of non-point pollution remain relatively difficult tasks as compared to those of "point" sources of pollution[xxxvii].

According to the U.S. Environment Protection Agency, the agricultural sector is "the leading contributor to identified water quality impairments in the nation's rivers and streams, lakes, ponds, and reservoirs." In particular, the agency has noted that water quality concerns are most pronounced in areas "where crops are intensively cultivated and where livestock operations are concentrated."[xxxviii]

Additionally, because agricultural water is recycled back to surface water and/or groundwater, the use of these polluted waters in agriculture contaminate crops and transmit disease to consumers and farm workers[xxxix].

Experts predict that, because pollution can no longer be remedied by dilution in many countries, freshwater quality will become the principal limitation for sustainable development in these countries early in the next century[xl].

Aquaculture in Fresh Water

Aquaculture is now recognised as a major problem in freshwater, as well as estuarine and coastal environments, leading to eutrophication and ecosystem damage[xli]. Aquaculture is increasing worldwide in order to satisfy the increasing demand for animal protein, due to the limitations of capture fisheries production. However, it has been found to have significant impacts on the environment and natural resources, with water pollution being cited as of most concern. Discharges from flow-through aquaculture systems such as raceways and tanks contain organic matter, nutrients, and suspended solids and directly impact oxygen depletion, eutrophication, and turbidity in receiving waters[xlii].

Land & Soil Pollution

Soil pollution due to human activities took center stage at the 5th Global Soil Partnership Plenary Assembly held at the FAO's headquarters in Rome in June 2017. The FAO stated that nitrogen and metals can strain farmable land by polluting soil, damaging plants, and, ultimately, posing risks to food security. They called for global collaboration and reliable scientific evidence to reduce knowledge gaps and promote sustainable soil management[xliii].

Agricultural Sources of Soil Pollution

Industrial animal agriculture is a significant contributor to soil and land pollution. Most food produced for animals is grown using a combination of untreated animal waste and synthetic fertilizers, both of which contain excessive amounts of nitrogen, phosphorus and heavy metals (such as zinc, copper, chromium, arsenic, cadmium, and lead). Farmers may overuse these inputs to increase crop yields, and the remainder that cannot be absorbed by the soil degrades the soil's water retention ability and fertility[xliv] and may also contribute to pollution of surrounding waterways.

Contribution of Monoculture Agriculture

Monoculture agriculture has significant negative impacts, and is at the heart of land pollution. As animal production intensifies, it is uncoupled from crop production, with the result that standard nutrient cycles between plants, soil, and animals are severely altered[xlv], resulting in the use of large quantities of synthetic herbicides, insecticides, bactericides and fertilizers which contribute to pollution of soil and water.

Besides the negative impact the overuse of chemical fertilizers has on the soil, monocultures are detrimental to soil health in other ways. Ground cover crops are eliminated, meaning there is no natural protection for the soil from erosion by wind and rain. Without plants to provide leaf litter mulch, topsoils are not replenished. These factors combine to continually

degrade the soil, and in some cases the soil becomes unusable for agriculture. In some countries, this means that forests are then cleared to provide new agricultural land, starting the damaging cycle all over again.

Because of market forces, monocultures have allowed a small group of crops to take over the majority of the agricultural land across the globe. While this results in the production of large amounts of corn, soy and other livestock feed, this is an inefficient way to feed the world's population and does not facilitate agro-ecological solutions. These impacts must be alleviated if the ecological systems of the earth are not to be irreversibly damaged.[xlvi]

Air Pollution & Greenhouse Gases

According to the U.S. Department of Agriculture (USDA), global agriculture, including livestock production and the grains required for this sector, accounts for 30% of greenhouse gas emissions. The USDA also indicates that management of nitrous oxide and methane emissions from animal production and nutrient management "is of particular importance given their potential for contributing to global warming"[xlvii]. A 2006 study by the FAO found that 18% of global greenhouse gas emissions is directly attributable to livestock production, more than the emissions attributable to the entire transportation sector[xlviii].

Greenhouse gases, primarily methane, carbon dioxide, and nitrous oxide are produced by animals during the digestion process. Additional emissions result from degradation processes occurring in uncovered waste lagoons and digesters[xlix]. When emissions from land use and land use change are included, the livestock sector accounts for nine percent of CO_2 deriving from human-related activities. However, the sector produces an even larger share of more powerful greenhouse gases, generating 65 percent of human-related nitrous oxide, (which has 296 times the Global Warming Potential of CO_2), 37 percent of all human-induced methane (23 times the potential as CO_2), and 64 percent of ammonia (which contributes significantly to acid rain)[l].

Air quality degradation is another problem in and around intensive animal production facilities, due to localised releases of toxic gases, odorous substances, particulates, and bioaerosols containing a variety of microorganisms and human pathogens[li]. These emissions can have moderate to severe health implications for surrounding communities and for farm workers, which disproportionately affects low-income areas where industrialized animal production facilities are typically located.[lii]

Despite these already dire implications, agricultural emissions are only going to increase as rising incomes and urbanisation drive a global dietary transition towards increased consumption of meat and dairy products[liii]. The growing demand for animal products is expected to be a major contributor to a roughly 80% increase in global greenhouse gas emissions from the agricultural sector alone[liv].

Chemicals

A wide variety of chemical products are used in agriculture (agricultural chemicals), such as pesticides (including insecticides, herbicides and fungicides), as well as synthetic fertilizers, hormones and antibiotics. Farmers spray agricultural chemicals onto food grown for animals in order to kill bugs, rodents, weeds, and other organisms that would otherwise eat the grain grown for livestock feed. They also apply these substances directly to animals' skin, fur or feathers to combat parasite infestations. Many approved agricultural chemicals contain carcinogens, while others cause severe allergies, birth defects and various health problems. In addition, those who grow food for animals rely heavily on synthetic petroleum-based fertilizers, and animal waste itself contains residues from the massive doses of non-therapeutic antibiotics and artificial growth hormones that are routinely given to animals to prevent illness and accelerate weight gain. Ultimately, the dangerous compounds found in agrichemicals end up as pollutants when wind and rain disperse them into the environment[lv].

Systemic Problems

Pollution is not a natural disaster we have to deal with. It is man-made and a consequence of the current materialistic, consumerist, throw-away lifestyle and lack of effective regulation and enforcement. We can only battle pollution by changing our consumption and production patterns, designing and implementing sustainable lifestyles, re-thinking and replacing our growth-fuelled economic system; and establishing effective regulatory systems which prevent and disincentivise pollution, and instead incentivise environmentally-friendly alternatives. We will only solve the overall pollution problem by focusing on system change and a phase out the consumerism society.

Numerous environmental problems are linked specifically to industrial agriculture—the input-intensive crop monocultures and industrial-scale feedlots that now dominate farming landscapes. The uniformity at the heart of these systems, and their reliance on chemical fertilizers, pesticides and preventative use of antibiotics, leads systematically to negative outcomes and vulnerabilities[lvi].

However, the current neoliberal climate does not hold businesses responsible for the full economic costs of their production. This allows businesses to take full advantage of the "economies of scale" of large monoculture farming without paying a penny for the detrimental environmental impacts this is wreaking. These businesses then go on to make large profits while destroying our land, water, air and biodiversity.

The OECD has carried out studies on the monetary costs of agriculture on water quality. In their report[lvii], they mention the need to account for external costs. They recognise that as an economic activity agriculture generates a number of marketed goods such as grain, milk and meat. However, the process of agricultural production also generates a number of external effects felt to wider society. Some of these, such as attractive landscapes, are beneficial to society. Others, such as pollution, are costly to society. In either case, failing to account for such non-market goods and services means that the allocation of resources to and within agriculture is sub-optimal from society's perspective.

Although the detrimental impacts of industrial agriculture are well documented (including by UN agencies), there has been a singular lack of effective action to address this massive problem. There is a lack of:

- Effective regulation and enforcement
- Education/awareness
- Food policy favoring more sustainable and environmentally-friendly diets
- Meaningful disincentives to pollution, and
- Incentives to produce in more environmentally-friendly ways.

Furthermore, we are not only destroying our own countries, we are also exporting this environment-wrecking model to developing countries through development policies, practices and lending, and foreign direct investment—and giving profits for this to business.

The economic growth paradigm causes countries to produce in quantity for export, as opposed to focusing on food sovereignty. However, local production-consumption models are far more sustainable for the planet and contribute to food security on a local level.

The UN's own Harmony with Nature initiative promotes Environmental Justice and the Rights of Nature[lviii]. Yet for as long as economic growth remains the predominant development paradigm, nature will continue to be despoiled, polluted and pillaged by industries engaged in the existential pursuit of profit.

Recommendations

Systemic Changes

- There is an urgent need to re-examine and replace the use of economic growth as the primary development paradigm, in view of the resource and environmental pressures this is placing on our planet. This should take into account the need to prioritise the wellbeing of humans, nature and animals[lix].
- The UN's Harmony with Nature initiative needs to be further developed and mainstreamed in UN policy and practice, with themes such as Environmental Justice and the Rights of Nature being given the priority they deserve.
- A new vision is needed which recognises earth/nature as a self-regulating system which humans need to respect and safeguard. A new mind set needs to be created where precautionary and preventative measures are taken against pollution and environmental degradation, rather than reactionary measures and remediation.
- Tough regulatory systems are needed which are underpinned by the precautionary principle and make provisions for effective regulation and taxation of unsustainable agricultural practices. Corporations must be held responsible for their actions. Action must be taken to ensure that products reflect the full costs of production, including fees for any allowable resource usage and wastes (plus disincentives/penalties for deleterious actions). All damaging subsidies should be removed.
- Support, training, extension and incentives should be provided to more environmentally-friendly forms of agriculture. These should also be supported and promoted in development work, as opposed to polluting industrial agriculture.
- Food policy needs to focus on sustainable and environmentally-friendly solutions. The need to refocus our eating habits towards healthier and environmentally aligned products should be supported by education/awareness campaigns and taxes on livestock products.
- Fiscal incentives are needed to stimulate systemic and behavioral changes. This includes redirecting investments from the short-term profits of polluting activities to the more sustainable profits of greener alternatives.
- Food waste must be tackled decisively. This would include setting binding food wastage reduction goals, discouraging the sending of food waste to landfill, and enabling growers to harvest all they grow. There should be regulation to require companies to donate any unwanted edible food. This will need to be supported by education/awareness to change our consumerist, throw-away society.
- Trying to fix these problems with bioengineering or technological solutions is not the answer, as this perpetuates the human dominion framework and risks untold unintended consequences, as history has repeatedly shown. The solutions are at our fingertips—we just need the systems and self-control to finally implement these.

Specific recommendations for the regulation of agricultural operations include:

- Control of and public input on the siting of new animal production facilities, as well as access to redress for neighbors when these operations fail to comply with standards.
- Stricter approval criteria for agricultural chemicals.
- Regulation and enforcement to prevent/reduce agricultural chemical leaching; including regulatory limits, financial disincentives (more than just "polluter pays" as must both internalize costs and work towards prevention).
- Minimisation of adverse effects from agricultural chemicals by use of integrated and humane "pest" management.
- Requirement for large agricultural operations to file an annual nutrient and pollution management plan.
- Establishment of biological, physical and chemical water quality criteria for agricultural water users and for marine and riverine ecosystems.
- Establishment and operation of water quality monitoring systems for agricultural water uses.
- Prevention of soil runoff and sedimentation.
- Proper and regulated disposal of manure produced by intensive livestock farming.
- Prevention of adverse effects of agricultural activities on water quality for other social and economic activities and on wetlands, inter alia through optimal use of on-farm inputs and the minimization of the use of external inputs in agricultural activities.
- Cessation of sub-therapeutic use of antibiotics in animal production and a transition to production systems which do not require such use.
- Effluent regulation and enforcement for slaughterhouses and agro-food processing businesses.

- Education of communities about the pollution impacts of the use of fertilizers and chemicals on water quality and food safety.

Specific recommendations for the regulation of marine pollution include:

- Reduction of negative impacts of nutrient contamination, plastic and microplastic waste and the discharge of toxins. Environmental policy must focus on precautionary solutions, effective regulation and taxation of unsustainable practices (See: NGO Major Group Position Paper for the 2017 HLPF. Downloadable from: http://www.ngomg.org/).
- The phase-out of synthetic fishing nets and replacement with biodegradable fishing nets that decompose naturally underwater.
- Establishment of Marine Protected Areas to at least the targets established in the Convention on Biological Diversity.

References

[i] WWF. Farming: Pollution.
http://wwf.panda.org/what_we_do/footprint/agriculture/impacts/pollution/
[ii] Henning Steinfeld et al., FAO, Livestock's Long Shadow: Environmental Issues and Options (2006).
http://www.fao.org/docrep/010/a0701e/a0701e00.htm
[iii] Henning Steinfeld et al., FAO, Livestock's Long Shadow: Environmental Issues and Options (2006).
http://www.fao.org/docrep/010/a0701e/a0701e00.htm
[iv] Hyner, Christopher. Managing Editor–Georgetown Environmental Law Review. A Leading Cause of Everything: One Industry That Is Destroying Our Planet and Our Ability to Thrive on It. October 23, 2015. https://gelr.org/2015/10/23/a-leading-cause-of-everything-one-industry-that-is-destroying-our-planet-and-our-ability-to-thrive-on-it-georgetown-environmental-law-review/
[v] Union of Concerned Scientists: Science for a Healthy Planet and Safer World. Industrial Agriculture. http://www.ucsusa.org/our-work/food-agriculture/our-failing-food-system/industrial-agriculture#.WaQ60CiGM2w
[vi] Levitt, Tom. Factory farming divestment: what you need to know. *The Guardian.* March 3, 2016. https://www.theguardian.com/sustainable-business/2016/mar/03/factory-farming-divestment-explain
[vii] The United States Department of Agriculture (USDA) defines a concentrated animal feeding operation (CAFO) as a farm in which animals are raised in confinement that has over 1000 "animal units" confined for over 45 days a year.
[viii] Harvey, Fiona, Wasley, Andrew, Davies, Madlen and Child, David. The Guardian. Rise of mega farms: how the US model of intensive farming is invading the world. 18 July 2017.
https://www.theguardian.com/environment/2017/jul/18/rise-of-mega-farms-how-the-us-model-of-intensive-farming-is-invading-the-world
[ix] Compassion in World Farming. Factory farming pollutes environments, contaminating the natural world with a range of potentially lethal toxins.
https://www.ciwf.org.uk/factory-farming/environmental-damage/#pollution
[x] Humane Society International (HSI). An HSI Report: The Public Health Implications of Intensive Farm Animal Production in South Asia. July 2013.
http://www.hsi.org/assets/pdfs/hsi-fa-white-papers/public_health_impacts_of.pdf
[xi] Pew Commission. Putting Meat on the Table. 2008. https://www.ncifap.org/reports/
[xii] United States Environmental Protection Agency. Risk Management Evaluation for Concentrated Animal Feeding Operations, pp. 7. 2004. http://nepis.epa.gov/Adobe/PDF/901V0100.PDF
[xiii] GRACE Communications. *Food Program: Environment.* Accessed September 26, 2017. http://www.sustainabletable.org/265/environment
[xiv] Ongley, Edwin D. Control of water pollution from agriculture - FAO irrigation and drainage paper 55 (1996). Chapter 1: Introduction to agricultural water pollution. http://www.fao.org/docrep/w2598e/w2598e04.htm
[xv] World Bank. FISH TO 2030 Prospects for Fisheries and Aquaculture WORLD BANK REPORT NUMBER 83177-GLB. December 2013.
http://www.fao.org/docrep/019/i3640e/i3640e.pdf
[xvi] Food and Water Watch. Factory Fish Farming. January 2, 2013. https://www.foodandwaterwatch.org/insight/factory-fish-farming
[xvii] Seafood Watch Website. Aquaculture. Problems with Condensed Space and Waste
https://www.seafoodwatch.org/ocean-issues/aquaculture/pollution-and-disease
[xviii]Froodly. 3 Sources of Pollution from our Food Waste. June 26, 2015. https://froodly.wordpress.com/2015/06/26/3-sources-of-pollution-from-our-food-waste/
[xix] FAO. Food Loss and Food Waste. http://www.fao.org/food-loss-and-food-waste/en/
[xx] Froodly. 3 Sources of Pollution from our Food Waste. June 26, 2015. https://froodly.wordpress.com/2015/06/26/3-sources-of-pollution-from-our-food-waste/
[xxi] FAO. Food Waste Footprints. http://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Factsheet_FOOD-WASTAGE.pdf
[xxii]Froodly. 3 Sources of Pollution from our Food Waste. June 26, 2015. https://froodly.wordpress.com/2015/06/26/3-sources-of-pollution-from-our-food-waste/
[xxiii] Pimentel and Pimentel, Sustainability of meat-based and plant-based diets and the environment. *The American Journal of Clinical Nutrition.* 2003. http://ajcn.nutrition.org/content/78/3/660S.full
[xxiv] FAO. Food Waste Footprints. http://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Factsheet_FOOD-WASTAGE.pdf
[xxv] NGO Major Group Position Paper for the 2017 HLPF. Downloadable from: http://www.ngomg.org/
[xxvi] Mark Shwartz. Stanford Report, March 10, 2005. Ocean ecosystems plagued by agricultural runoff.
http://news.stanford.edu/news/2005/march16/gulf-030905.html. Accessed 11 April 2017.
[xxvii] Scientific American. What Causes Ocean "Dead Zones"?. https://www.scientificamerican.com/article/ocean-dead-zones/
[xxviii] Milman Oliver, the Guardian. Meat industry blamed for largest-ever 'dead zone' in Gulf of Mexico (August 1, 2017). A new report shows toxins from suppliers to companies like Tyson Foods are pouring into waterways, causing marine life to leave or die.
https://www.theguardian.com/environment/2017/aug/01/meat-industry-dead-zone-gulf-of-mexico-environment-pollution
[xxix] Scottish Government. Review and Synthesis of the Environmental Impacts of Aquaculture 2002).
http://www.gov.scot/Publications/2002/08/15170/9406
[xxx] Bruce Barcott. Yale Environment. 16 June 2011. The Unfulfilled Promise of the World's Marine Protected Areas.
http://e360.yale.edu/features/fulfilling_the_great_promise_of_worlds_marine_protected_areas
[xxxi] IUCN website. 24 Oct 2013. World nearing 3% of ocean protection https://www.iucn.org/content/world-nearing-3-ocean-protection
[xxxii] Simard, F., Laffoley, D. and J.M. Baxter (editors). Marine Protected Areas and climate change: Adaptation and mitigation synergies, opportunities and challenges. 2016. https://portals.iucn.org/library/sites/library/files/documents/2016-067.pdf
[xxxiii] Ongley, Edwin D. Control of water pollution from agriculture - FAO irrigation and drainage paper 55 (1996). Chapter 1: Introduction to agricultural water pollution. http://www.fao.org/docrep/w2598e/w2598e04.htm
[xxxiv] Pimentel and Pimentel, Sustainability of meat-based and plant-based diets and the environment. *The American Journal of Clinical Nutrition.* 2003. http://ajcn.nutrition.org/content/78/3/660S.full

[xxxv] Water footprint of crop and animal products: a comparison. Water Footprint Network. http://waterfootprint.org/en/water-footprint/product-water-footprint/water-footprint-crop-and-animal-products/
[xxxvii] Ongley, Edwin D. Control of water pollution from agriculture - FAO irrigation and drainage paper 55 (1996). Chapter 1: Introduction to agricultural water pollution. http://www.fao.org/docrep/w2598e/w2598e04.htm.
[xxxviii] An HSUS Report: The Impact of Industrialized Animal Agriculture on the Environment http://www.humanesociety.org/assets/pdfs/farm/hsus-the-impact-of-industrialized-animal-agriculture-on-the-environment.pdf
[xxxix] Ongley, Edwin D. Control of water pollution from agriculture - FAO irrigation and drainage paper 55 (1996). Chapter 1: Introduction to agricultural water pollution. http://www.fao.org/docrep/w2598e/w2598e04.htm.
[xl] Ongley, Edwin D. Control of water pollution from agriculture - FAO irrigation and drainage paper 55 (1996). Chapter 1: Introduction to agricultural water pollution. http://www.fao.org/docrep/w2598e/w2598e04.htm.
[xli] Ongley, Edwin D. Control of water pollution from agriculture - FAO irrigation and drainage paper 55 (1996). Chapter 1: Introduction to agricultural water pollution. http://www.fao.org/docrep/w2598e/w2598e04.htm
[xlii] Saremi et al., Iranian Journal of Fisheries Sciences. The effect of aquaculture effluents on water quality parameters of Haraz River (2012). https://jifro.ir/article-1-1001-en.pdf
[xliii] UN News Centre. Country-level action 'new frontier' for tackling soil pollution – UN agriculture agency. June 23, 2017. http://www.un.org/apps/news/story.asp?NewsID=57055#.WahF3siGM2w
[xliv] Food Empowerment Project. Pollution (Water, Air, Chemicals). http://www.foodispower.org/pollution-water-air-chemicals/.
[xlv] Humane Society International (HSI). An HSI Report: The Public Health Implications of Intensive Farm Animal Production in South Asia. July 2013. http://www.hsi.org/assets/pdfs/hsi-fa-white-papers/public_health_impacts_of.pdf
[xlvi] GRACE Communications Foundation. *Industrial Crop Production,* Accessed September 26, 2017. http://www.sustainabletable.org/804/industrial-crop-production.
[xlvii] USDA. USDA Climate Change Science Plan 4 (2010), available at http://www.usda.gov/oce/climate_change/science_plan2010/USDA_CCSPlan_120810.pdf. These figures include contributions from land use change and deforestation for the purpose of agriculture—primarily to make land available for grazing.
[xlviii] Henning Steinfeld et al., FAO, Livestock's Long Shadow: Environmental Issues and Options (2006). http://www.fao.org/docrep/010/a0701e/a0701e00.htm. A more recent and comprehensive study published by Worldwatch Institute, however, finds that livestock and their by-products actually account for 51% of worldwide human-related greenhouse gas emissions annually. Robert Goodland & Jeff Anhang, Livestock and Climate Change, World Watch Magazine, November/December 2009, at 11.
[xlix] Pew Commission. Putting Meat on the Table. 2008. https://www.ncifap.org/reports/
[l] Henning Steinfeld et al., FAO, Livestock's Long Shadow: Environmental Issues and Options (2006). http://www.fao.org/docrep/010/a0701e/a0701e00.htm.
[li] Pew Commission. Putting Meat on the Table. 2008. https://www.ncifap.org/reports/
[lii] Humane Society International (HSI). An HSI Report: The Public Health Implications of Intensive Farm Animal Production in South Asia. July 2013. http://www.hsi.org/assets/pdfs/hsi-fa-white-papers/public_health_impacts_of.pdf
[liii] David Tilman & Michael Clark, Global Diets Link Environmental Sustainability and Human Health, 515 Nature 518, 520 (2014). http://www.nature.com/nature/journal/v515/n7528/abs/nature13959.html?foxtrotcallback=true.
[liv] David Tilman & Michael Clark, Global Diets Link Environmental Sustainability and Human Health, 515 Nature 518, 520 (2014). http://www.nature.com/nature/journal/v515/n7528/abs/nature13959.html?foxtrotcallback=true.
[lv] Food Empowerment Project. Pollution (Water, Air, Chemicals). Chemicals. http://www.foodispower.org/pollution-water-air-chemicals/
[lvii] Moxey, Andrew. OECD. Agriculture and Water Quality: Monetary Costs and Benefits across OECD Countries (2012). https://www.oecd.org/tad/sustainable-agriculture/49841343.pdf
[lviii] UN. Harmony with Nature. Rights of Nature Law and Policy. http://www.harmonywithnatureun.org/rightsofnature.html
[lix] NGO Major Group. Official Position Paper for the 2017 High-Level Political Forum. http://nebula.wsimg.com/47b20fccb88656e5a802c7936cc567cd?AccessKeyId=E3A2183630CD52C7534E&disposition=0&alloworigin=1