



# THE ENVIRONMENTAL COSTS OF MEAT PRODUCTION

The foods we eat and the methods we use to produce them can often have severe and unintended consequences on the world around us.<sup>1,2</sup> From the pollution of our soils and waterways to the destruction of ecosystems billions of years in the making, the footprint of global agriculture—food animal production, in particular—places a tremendous strain on the natural resources we rely on every day for food, water and habitat (see Figure 1).<sup>1</sup> As we press further into the 21<sup>st</sup> century, our ability to respond to these environmental stressors accordingly will play an important

role in creating a sustainable and equitable future for generations to come.

## Water and Land Use

While it accounts for only 40 percent of the gross domestic product derived from global agriculture, the livestock sector is the largest user of the planet's land and water resources.<sup>1,2,3,4</sup> Combining the areas occupied for pasture and feed-crop cultivation, livestock production commands over 80 percent of the world's farmlands.<sup>1,4,5,6,26</sup> What's more, as the global population continues

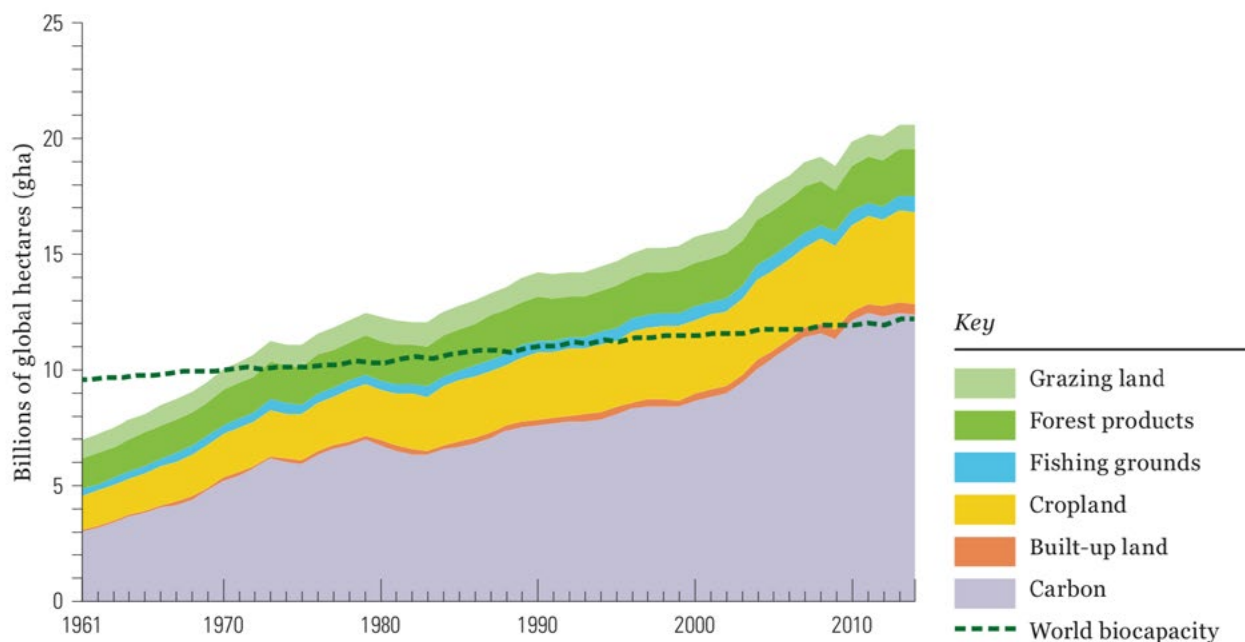


Figure 1. World biocapacity is a measure commonly used to represent the ability of the Earth's ecosystems to replenish themselves, establishing a theoretical ceiling for sustainable human consumption. While technological innovations and improvements to land management practices have led to a near-30 percent increase in world biocapacity over the past half century, the world's ecological footprint, which estimates the natural resource demands of human activities, has concurrently increased by over 190 percent. As we have already begun to see, the consequences of extending beyond these productive boundaries can give rise to land and water scarcity, soil degradation and species and habitat loss—developments that have both immediate and long-term implications for global food security and planetary resilience. Adapted from Grooten & Almond, 2018

to increase in size and affluence, the demand for meat is projected to at least double by the end of the century—a trend that is expected to drive further expansion into indigenous reservations and natural habitats.<sup>6,7,8,9</sup> It is estimated that approximately 13 billion hectares of forest area are cleared for agricultural purposes each year, making the meat industry the most significant agent of land-use change globally.<sup>4,5,10,11</sup>

In addition to the ecological and humanitarian harms associated with largescale deforestation and grassland conversion, the water withdrawals required to accommodate these vast increases in agricultural land usage have also introduced widespread water scarcity issues.<sup>1,4</sup> Currently, animal agriculture is responsible for about 70 percent of the world's freshwater use.<sup>1,5,6,12</sup> In order to meet these resource demands, the amount of water extracted for feed-crop irrigation has doubled over the past 50 years, leading to the rapid and systematic depletion of the Earth's rivers and aquifers.<sup>1,4,5,11,12</sup> By 2050, nearly half of the world's population is expected to live in water-stressed areas as a direct consequence of food animal production.<sup>1,4,5,12</sup>

Promisingly, however, minimizing the consumption of meat by incorporating more plant-based foods into the diet can be an effective means of resource conservation, with the potential to decrease agricultural land and water use by as much as 80 and 50 percent, respectively.<sup>6</sup>

## Soil Health

Over the course of history, human civilizations have depended on their abilities to sustainably manage their soils.<sup>13</sup> In addition to the structural foundations they provide, soils supply the planet with a diverse set of ecosystems, each of which are critical for managing and maintaining the Earth's natural cycles.<sup>14</sup> More than just conduits for plant growth, these elaborate, symbiotic habitats are responsible for carrying out a variety of ecosystem services: from cycling essential ground nutrients to regulating the availability of surface waters and gases.<sup>14</sup> However, the industrialization of animal agriculture—through its intensive land management practices—has placed an immense

strain on both the availability and quality of soil, hampering its ability to perform many of these life-supporting functions.<sup>1,13,15</sup>

In particular, the cultivation of monocultured feed crops—a practice that occupies more than a third of the world's croplands—and the rearing of over 990 million land animals have substantially contributed to the degradation of the Earth's soils, depleting and polluting reserves faster than they can be replenished and remediated.<sup>2,7,16</sup> Currently, 9 million hectares of agricultural land are lost to intensive farming each year, leaving previously fertile regions barren and prone to wildfires, flooding and dust storms.<sup>1</sup> In addition to the negative implications soil degradation has on global food security, the exploitation of this natural resource also diminishes its capacity to filter out harmful environmental contaminants, allowing higher concentrations of industrial pollutants to enter into the planet's air- and waterways.<sup>2,13</sup> For this reason, reducing the amount of land used for pasture- and cropland by curtailing the consumption of meat can be an effective vehicle for protecting and restoring the health and productivity of the Earth's soils.<sup>2,13,17</sup>

## Habitat Loss and Biodiversity

The world is home to a complex assortment of habitats upon which some 8.7 million species are predicted to rely.<sup>18</sup> Billions of years in the making, this species richness forms the biological basis for the ecosystems responsible for providing all life on Earth with water, air, food and habitat.<sup>18,20</sup> However, after centuries of expansion and evolutionary flourishing, biodiversity is being lost at an alarming rate—a phenomenon that has, in large part, been accelerated by the gradual but routine depletion of the world's natural resources.<sup>18,19</sup> Since 1970, human activities have led to the decline of over 60 percent of all species populations, with livestock production superseding all other industries as the primary driver of these ecological losses.<sup>12,19,20</sup>

The proliferation in the global demand for meat has prompted substantial increases in the amount of agricultural wastes produced.<sup>21</sup> These

contaminants, by leeching into open water sources as runoff, can enter into surrounding areas, often creating adverse environments for the lifeforms living within them.<sup>21</sup> In particular, the nitrogen and phosphorus emissions resulting from the use of fertilizers have played major roles in driving eutrophication—a process whereby excessive algal growth depletes the aquatic oxygen supply, creating what are referred to as “dead zones.”<sup>21,22</sup> Today, agricultural activities introduce more nitrogen into the environment than all of the planet’s natural pathways combined, making eutrophication the leading cause of habitat loss globally.<sup>1,21,22</sup>

However, through reductions in meat consumption, dietary shifts can play an important role in species conservation and habitat restoration efforts by minimizing the ecological harms associated with these deleterious industry practices.<sup>1,23</sup>

## The Role of Meatless Monday

Finding sustainable methods of food production that can accommodate a growing global population with an expanding appetite for meat may well be humanity’s greatest challenge yet.<sup>1,4</sup> While livestock products can be an important component of the human diet, especially for low-income populations facing issues of malnutrition, the current scale at which these resource-intensive foods are consumed far exceeds the Earth’s productive capacities—a situation that threatens global food security and the wellbeing of the ecosystems on which we rely.<sup>20,23,24,25</sup> Fortunately, solutions do exist. Transitioning toward more sustainable, plant-forward diets, particularly in settings where meat consumption is disproportionately high, is the single most effective action individuals can take to reduce the world’s ecological footprint.<sup>6,7,8,24</sup> In addition to freeing up the resources to allow the global food system to feed an additional 3.5 billion people, these dietary shifts would also carry tremendous benefits for soil health and biodiversity alike.<sup>6,7,8,24</sup> If 200 million individuals—roughly the population of Nigeria—cut meat from their diets for a single day, over 260 million tons of water and 46,000 hectares of land would be spared—the equivalent of about 104,000 Olympic swimming

pools and the land area of the California Redwood Forests, respectively.<sup>26,27</sup> As more people around the world begin to embrace a Meatless Monday diet, these small, incremental lifestyle changes will continue to play an increasingly profound role in protecting the health of our global environment and securing a livable future for us all.

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