Chapter 10
An Introduction to Ecomodernism

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Abstract Land use change has detrimental impacts on the planet. It is not only a major cause of biodiversity loss, through habitat destruction and fragmentation, but also an important driver for climate change, through deforestation and peat oxidation. Land use change is mainly driven by food production, of which meat production comprises the major share. Ecomodernists therefore feel reduction of the impact of meat production is paramount for a sustainable future. To achieve this, ecomodernists focus on intensification of the production process to produce more on less land, both through the closing of global yield gaps and through the development of integrated indoor systems like agroparks. On the demand side, ecomodernists feel a diverse strategy is needed, from the development of meat substitutes and lab meat, to the persuasion of consumers to move from beef to monogastrics like pork or chicken.

10.1 Introduction

With the 2005 essay *The Death of Environmentalism* Ted Nordhaus and Michael Shellenberger introduced the world to Ecomodernism, and with that the start of a new green movement. The first 10 years they build their organization and philosophy, culminating in 2015 in *The Ecomodernist Manifesto*, a document, written by experts from different backgrounds, where the basic principles of the new movement where laid down. The writers felt the classic Green environmentalists lost sight of saving the planet, amidst political interests. Ecomodernists generally agree they owe a great deal to the environmental movement from the 1960s and 1970s, but felt increasingly frustrated by the lack of results of the last decades of the twentieth century. It was time for the old movement to die, for a new one to thrive.

Ecomodernists, as a principle, strive to reduce mankind's impact on the planet by concentrating its activity on as little land as possible. The more humans intensify their activities, the more space there is for nature to thrive. At this moment, humans

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use more than 70% of the ice-free land for the build environment, infrastructure, energy, but mainly for agriculture (IPCC 2019). And although the earth's population grows from 7,5 billion to 10 billion in 2100 and at the same time will get more prosperous, ecomodernists feel it is possible to reduce our need for land to a maximum of approximately 30% of the total ice-free land.

As a consequence of this principle, ecomodernists favor nuclear energy as an energy source for combating climate change, over renewables like wind and sun, as nuclear reactors provide the most dense form of energy, and thus save space for nature. Ecomodernists also support the ongoing urbanization trend. Currently, half of the population, 3,5 billion people, live in cities thereby occupying only 3% of the globe. Estimations are that in 2100 more than 70% of the people will live in cities (UN DESA 2018). Finally, on agriculture, ecomodernists believe intensive agriculture is the most sustainable way of combining a well fed and green planet in 2050.

As to the stance on agriculture, the focus point of this essay, ecomodernists owe a big deal to the work of Ben Phalan and Andrew Balmford, both from the University of Cambridge, UK, and their work on the land sharing versus land sparing debate. In a nutshell, this debate revolves around the question whether for biodiversity it is better to combine high yielding agriculture with setting away large swaths of the planet for nature, or go for wildlife-friendly farming, with lower yields and thus requiring more land, but with more biodiversity on the farm. The results of Phalan and Balmford, but also of others, unequivocally show that land sparing in most cases saves more biodiversity than land sharing, currently, but also in scenarios where in 2050 70% more calories need to be produced (Phalan et al. 2011; Balmford et al. 2015; Hodgson et al. 2010; Egan 2012). This is true for birds, mammals, trees, plants and insects, and can simply be explained by the fact that animals or plants don't like agricultural fields, no matter if they are extensively or intensively managed. Especially rare organisms need 'wild' nature to thrive.

The aim to reduce land use, fits with another core principle of ecomodernism: saving nature by not needing it. In stark contrast with the classic green motto of wanting to live more in harmony with nature as a way to save the planet, ecomodernists feel that dependency on nature for one's survival leads to its detriment. There are some striking historical examples where nature was saved by not needing it anymore. The population of whales, whose oil was used for lighting, was saved by the discovery of fossil oil, and the same accounted for forest all around the world: by switching from wood to oil and coal many forests around the world were saved from the axe. Moreover, the rise of synthetic rubber, saved forests from turning into rubber plantations, and, more recently, wild fish stocks are being saved by the development of fish farms (Asafu-Adjaye et al. 2015). The less we need nature for its ecosystem services, its resources or its land, the more it can follow its own dynamic, and the more wild nature there is for us to enjoy. Nature should be saved for its intrinsic value, not for its use for humankind, as then it is bound to lose.

So how do animals fit in this picture? Most ecomodernists don't oppose eating animals from a moral point of view, but naturally feel those animals should be treated well. They however also realize that it is often hard to exactly pinpoint what exactly comprises a good life for animals and how to measure it, without falling in the trap

of anthropomorphizing. Ecomodernists often question our meat consumption from an efficiency point of view: how much land can we save if we eat less meat, and how do we produce meat in the least harmful way for the planet, with the lowest possible greenhouse gas emissions and eutrophication potential.

10.2 The Optimal Role of Animals in Our Food System

From an environmental point of view, eating meat generally is a very inefficient and wasteful way of producing food. Life Cycle Analyses (LCAs) show that meat production over the whole range uses more land and comes with more greenhouse gas emissions per kilo protein then a plant-based diet (FAO 2006). There is however a large difference between the various meat sources regarding their environmental impact, mainly through their different feed conversion ratios. While cows on average need around 6 kilo feed to produce 1 kilo of meat, chicken need less than 2 kilo.

This means that to produce a kilo of beef, 100 m^2 of land is necessary while greenhouse gas (ghg) emissions reach 300 kilo CO_2-equivalent for that same kilo. A kilo of pork is produced on 13 m^2, poultry on 8 m^2. Similar calculations can be made for milk and eggs, using respectively 4 and 5 m^2 per kilo protein. For comparison: the production of 1 kilo of proteins from pulses costs on average 1 m^2 (Nijdam et al. 2012).

This seems like a clear call for eating less meat, but it is not as simple as that. Animals serve an important role in the feed system, as they are able to feed on feed not suitable for human consumption, like leaves and stems from crops, co-products of the production system like spent grain of breweries and even food waste. Furthermore cows feed on grass, non-digestible for humans, which often grows on soils not suitable for crops. Historically, it is in this function animals roamed on the premises of the small scale Dutch farms of the nineteenth century and before: by upcycling waste, the system, which was characterized more by scarcity then by the current abundance, was made more circular and less nutrients were wasted (Bieleman 2010).

During the twentieth century, agriculture professionalized, leading to specialization of the various tasks. Farmers specialized in crops or cattle, specialized butcheries were erected. But animals still somewhat serve the same functions as before: more than half of the feed of Dutch pigs consists of residual feed, for instance from the starch industry. Over the years however, several residual feeds, like swill and animal meal have become off-limits, because of disease risks. This made circular agriculture harder, and sentenced a lot of food waste to the incinerator.

Recently, Dutch researchers from Wageningen University calculated the optimal amount of animal protein consumed per day per capita for a system with as few food waste as possible, to be between 9 and 23 grams (Van Zanten 2019). The large range can be explained by legislation, which allows for residual streams, and by the types of animals used for upcycling. As humans need approximately 60 grams of protein per day, only a third of it should be of animal origin, the rest should come

from either plants or seafood. Currently Dutch consumers consume 104 grams of protein on average, of which 74 are of animal origin, on a daily basis, which implies a drastic reduction of meat consumption is crucial for an optimal and sustainable future agricultural system (Dagevos et al. 2019).

It is important to notice that this analysis largely applies to rich countries in North America and Europa, as this is where most meat is consumed. Where American citizens consume 120 kilo meat per year, which translates into more than 400 kilocalories per day, Indians only devour 4 kilo and China around 60. In many developing countries increasing meat consuming improves overall health, as meat is an easy and dense source of nutrients, much more than vegetables. Ecomodernists therefore accept UN predictions that global meat consumption will continue to rise, which begs the question what the most sustainable way is to raise animals.

10.3 The Case for Intensification

Under pressure of population growth, technological progress, globalization and scarcer land, meat production in the Netherlands, but also in other western countries changed during the twentieth century from extensive grazing or roaming, to intensive production systems. This was especially true for pork and poultry, as they cannot live on grass and became more and more 'land independent', fed by feed sometimes from far away. As a result of this intensification process, during the twentieth century the number of pigs in the Netherlands grew from 3 million in 1960 to 12,5 million in 2018, while the numbers of broiler chickens grew from 2,4 to 48 billion. Cows showed a far more modest growth (CBS). Similar intensification trends are currently underway in China and other countries like Brazil, where the economy and the population are growing (FAO 2006).

The process of intensification has increased food security but led to a series of environmental problems, ranging from eutrophication of streams and waters due to overuse of fertilizer, to land degradation and deforestation through the increasing need for land for grazing and for the production of soy and maize for feed (ibid.). It furthermore led to rising greenhouse gas emissions, raised concerns about animal welfare and made people question the impact on the landscape.

Lately, this has led to an increasing interest in meat raised in extensive systems. In the US sales of grass-fed beef is on the rise, as opposed to feedlot-finished beef (Hayek and Garrett 2018). Similarly, sales of organic produce is growing in the Netherlands, often motivated by both environmental and animal welfare concerns (Bionext Trendrapport 2018). Environmental organizations like Friends of the Earth (2017) call for buying locally and organically produced meat, next to reducing consumption in general.

Ecomodernists very much question whether a move to a more extensive meat production system is the right direction. As Marian Swain (2017), fellow by the American thinktank the Breakthrough Institute notices in her essay on The Future of Meat, intensive livestock farming produces more meat, more quickly, with fewer

animals. The controlled environment and formulated feed promote optimized growth and reduce losses. As most of the greenhouse gas emissions come from the need for land for feed production, and, in the case of ruminants, the production of methane through burping, it are these characteristics which make intensive cattle farming more environmentally friendly. The direct use of fossil fuels in those intensive system is small, usually less than 20% of the total greenhouse gas emissions of agriculture.

Several studies endorse the notion that intensification is more sustainable: Pelletier et al. (2010) for instance find that in the US pasture beef almost takes 20 kilo of CO_2-equivalents per kilo to produce, while the more intensive feedlot-finished beef costs a little more than 15 kilo. Dutch intensive agriculture is even more efficient, with 10,9 kilo of CO_2-eq emissions per kilo beef. In poultry, it takes 39,2 kilo CO_2-eq emissions to create a per kilo protein in intensive production systems, compared to 48,7 in extensive systems. Only for pork, extensive systems have lower greenhouse gas emissions: 47,6 over 52,0. With total combined yearly greenhouse gas emissions of 1609 million ton the production of chicken and pork is dwarfed by the 5024 million ton which is yearly emitted by the production of beef (FAO 2017).

Similar calculations can be made for land use, where in the US feedlot-finished beef needs only half of the land compared to its grass-fed equivalent. In 2016, the American agronomist Jason Lusk from Oklahoma University calculated that if there had been no intensification and technological progress since the 1950s, 15,3 million more beef cows would be needed to produce the amount of meat we produce now. Also, 228 million more acres of corn would be needed, as well as 101 million more acres of soybeans (Lusk 2016). Thus, intensification saves nature from being ploughed under, a phenomenon also known as the Borlaug hypothesis, named after Norman Borlaug, the famous plant breeder and Nobel Peace prize laureate, also known as the father of the Green Revolution.

Recently, a team of scientists endorsed the importance of sparing land by introducing the concept of carbon benefit. Currently, life cycle analyses of food production often do not take into account the carbon storage opportunity of fields taken out of production, but the concept of carbon opportunity costs in this study solves this lacuna. The consortium of scientists shows that intensification of production, and thereby freeing land for forest is a powerful and efficient climate change mitigation strategy (Searchinger et al. 2018a). In a similar vein, Lamb et al. (2016) two years earlier calculated that by intensifying agriculture in the UK on the best suitable places, and returning marginal land to nature, the UK would be able to produce the same amount of food, whilst at the same time achieving the goals of the 2015 Paris Agreement, without changing its energy portfolio.

The Dutch Scientific Council for Government Policy (WRR) was an early advocate of intensification. Already in 1992 the council calculated that for the European Union it is possible to produce a similar amount of food on a quarter of the current area, by concentration and optimizing production in the most fertile places. In this way, 75% of all European fields, could utopically be rewilded, used for climate change mitigation or have any other beneficial function.

Similar calculations can be made for the Netherlands, where at the moment already 80% of economic value in agriculture is made on 20% of the land (Van de Klundert

2012). By intensifying these areas further, it is possible to put marginal lands like the poor sandy soils in the northern province of Drenthe out of production. Those areas can be turned into reserves for meadow and farmland birds, which are an important part of the identity of the Dutch landscape and people. It also opens up the opportunity to stop oxidation of peatlands in the west of the country by flooding these areas and turning them into biodiverse wetlands, instead of using them for milk cows to graze upon.

Opponents of such land sparing strategies often point to the so called rebound effect, also known as Jevons Paradox. Historically, gains in efficiency often do not lead to environmental wins but ramp up consumption by lowering prices, thereby increasing the pressure on earth and its resources. William Jevons already in 1865 showed that improved technology in the coal industry led to more, not less fuel consumption. Applied to agriculture, it means that a farmer who intensifies his production most often will not spare land, but expands his business either because technology allows him, or because low prices force him.

Ecomodernists agree this is a serious problem. Especially in the age of rapid economic growth, combined with a rising population, intensification and agricultural expansion often go hand in hand. Ecomodernists therefore believe that intensification only works when accompanied by strict zoning policies from the government, which allow for the setting aside of large swaths of nature (Boersma et al. 2018). Ecomodernists even consider the erection of an IPCC-like body for global land use (Ellis and Mehrabi 2019). Without strict land use policies, it will be very hard to save biodiversity and stabilize the climate, whatever the agricultural system in place.

10.4 How History Shapes the Way We Think About Animal Farming

Making the case for intensification isn't popular. This stems not only from misconceptions about what sustainability actually compromises or from sincere concerns about animal welfare, but also has historical and sociological components. What scientifically counts as sustainable, often isn't considered beautiful or culturally correct, and this makes for a murky debate. People often make inconsistent, and sometimes even contradictory demands.

Such contradictions is what the German philosopher Jürgen Habermas (1985) calls the conflict between the worlds of subjectivity, objectivity, and intersubjectivity, or, more simply put, the worlds of facts, social norms and individual experiences. As an example, in animal agriculture this means that from a scientific, rational point of view it is best to keep cows indoors, with high productivity and low emissions under tightly controlled circumstances. But from a normative point of view, those animals belong in the meadow, as this is how it should be, this is what we see on paintings of famous Dutch artists of the seventeenth to nineteenth century like Paulus Potter and Willem Maris. Grazing cows are part of the Dutch identity. Finally, from

an individual point of view, the sight of a cow slogging in a field at 35 °C, might make an onlooker think it is better to take the animal inside. Such conflicting views slow down transitions, as they lead to contradicting views and thus conflicting policy recommendations. Transitions often only come to fruition when the three worlds come together.

In the discussion about the future of animal agriculture, environmental organizations have a peculiar position. Environmentalists generally are highly educated, live in urban environments and live a cosmopolitan lifestyle. They optimally benefit from the globalized, industrialized and interconnected world and live a wealthy life, mostly shielded from the hardship of the normal world, in what the German philosopher Peter Sloterdijk (2005) calls a Crystal Palace.

But when it comes to the landscape in their direct surroundings, they expect the exact opposite. They don't like the globalized and highly connected, technological food chain, and what it has done to the landscape. For them, farmers should move to a way of farming resembling the past: more extensive and in harmony with nature. The conflicts between peoples own lifestyles, in this case cosmopolitanism, and preferences on how others should live their lives, show how hard it is to align the world of subjectivity, objectivity, and intersubjectivity.

To whether animals are better off outside, the evidence is mixed. In intensive systems, disease rates are often lower, as are animal losses, but in extensive systems animals are able to display more natural behavior. For cows, living outside in hot summers can be stressful. With their sophisticated metabolism of grass, their bodies generate a lot of heath, and cows therefore dislike temperature above 16 °C. Recently, Von Keyserlingk et al. (2009) from the University of British Columbia showed that cows in temperate climates like their pastures, but only at night when it is cooler. In more tropical regions, like India and Brazil, from a welfare stance, it might be better for cows to always stay inside. For pigs, Hötzel et al. (2004) showed that indoor pigs displayed more aggressive and unnatural behavior then their outdoor living equivalents. If held indoors, efforts should be taken to mimic outside circumstances. Finally, chicken by nature are forest animals, and refrain from going far in open fields.

As for global human health, indoor systems are preferred. Diseases like the various versions of the avian flu, which can also infect humans, are more easily spread in open, outdoor systems, sometimes through contact with wild relatives like ducks. Similarly, wild boars more easily spread swine fever to pigs roaming outside, then to those living in closed systems (Brown and Bevins 2018).

10.5 The Future of Animal Farming

How do ecomodernists feel animal farming should develop the coming decades? First of all, efforts should focus on making best practices common practice. In crop agriculture, closing the yield gap between maximum and actual yields, is a major strategy in solving hunger and malnutrition while saving nature (Floey et al. 2011),

and a similar effort should be made in animal agriculture. Research shows there are large gaps in efficiency and productivity between countries, but also between farms within countries. Especially in beef production the gap between the best and the worst performing farms is large. Nijdam et al. (2012) show that greenhouse gas emissions vary from 9 kilo per kilo beef for the most efficient intensive system, to 129 kilo for the worst performing pastoral system. Land use varies from 7 m^2 per kilo for the best to 420 m^2 per kilo for the worst performer. For pigs and chickens the gaps are smaller, but the best performing systems still use half the land of the more unproductive ones.

The country of Brazil serves as an example where closing the gap can make a difference. Although soy plantations get the most attention as a driver of deforestation of the Amazon and the Cerrado (a vast tropical savanna), 80% of the fields which used to be pristine forest are used for grazing, in a very extensive way, often with only one cow per hectare (Pendrill et al. 2019). The introduction of feedlot-finishing alone will already drastically lower land demand.

For the places where intensification already is in place, ecomodernists feel that environmental gains can be made by transforming farms into so-called agroparks. Agroparks are integrated, concentrated facilities where multiple actors in the food chain come together, from breeding to processing, and where residual flows can be re-used on site. Agroparks aim to make as efficient as possible use of space, scale, distance and waste (Smeets 2011).

Agroparks come from the field of industrial ecology and were first mentioned at the turn of the century. They were born out of the idea that a strict separation of functions would increase livability of the countryside: agroparks for agriculture, the landscape for nature. Agroparks are inspired by the mixed farms which were common in the Netherlands in 1900, especially on the poorer, sandy soils of the east and south of the country. Those farms kept a couple of animals, mainly for the manure, grew the feed themselves and even slaughtered the animal on site. The discovery of artificial fertilizer, the growing global market and better infrastructure made mixed farms to inefficient and led to specialization. This went so far that whole regions began to focus on the production of one type of product, like vegetables under glass in the area around the cities of Rotterdam and The Hague, and pigs in the province of Noord-Brabant.

However, technological progress has made it possible to operate mixed farms that are actually competitive enough in the global market. Mixed farms are more sustainable as they are easier to make circular by re-using residual streams on site. They furthermore avoid transporting animals, and thus lowering stress levels, as an agroparks can have their own butcher. Key to making this work is scaling up: butcheries are only profitable on farms with more than 200.000 animals, and agroparks make this possible, in an animal-friendly way.

Agroparks build on the success of the famous greenhouses in the Netherlands. By controlling all circumstances in a closed circuit, Dutch horticulturists are able to make products with minimal input. Where a kilo of tomatoes in an open field in Spain need 60 L of water to grow, Dutch growers work with only 8. Furthermore, yields per hectare are significantly higher than elsewhere in the world, which means

the Dutch are making efficient use of space. The advantages of indoor systems are reflected in the price. The costs of a kilo chicken in a closed system add up to 2,30 euro, in an open system to 3,70 (ibid.).

Size and proximity in agroparks also make horizontal integration possible. This means for instance that slaughter waste can be processed into useful resources, which can be used to grow crops. The energy and heat of this process can be used on site, or returned to the net as green energy. Wastewater from the greenhouses can serve as feed for algae, fish or mollusks. As animals live in a closed off area, it is easier to separate feces and urine, and reuse nutrients as phosphate and nitrogen. Technical improvements to make such things work, are often expensive, and are only cost-effective in large systems.

In 2018, Peter Smeets, researcher at Wageningen University and Research, retired geographer Steeph Buijs and me developed a redesign of the Dutch landscape, based on increasing urbanization and the use of agroparks for the production of food (ibid.). We were inspired by the plan of the Chinese government to create so-called metropolitan regions, like the greater-Beijing area, which will grow to 130 million people (Johnson 2015). To house them, the government allocated an area as big as 200.000 km^2, which means every inhabitant has on average 1500 m^2 at her disposal, 1,5 times as much as people living in the Randstad, the urbanized area in the west of the Netherlands. The Chinese plan to make this area self-sufficient for fruit, vegetables, meat, eggs and dairy. Staple crops and feed will be imported from the hinterland of from other countries.

The Netherlands should also be developed like a metropolitan region. For that, it is essential to think across borders. City planners already for a long time call the Netherlands, and more specifically the Randstad, an empty city, and the same counts for surrounding areas like the Ruhr in Germany, the Brussels-Antwerp axis in Belgium and the area around Lille in France. This whole area houses 35 million people, and Dutch agriculture at the moment produces mainly for this region: 70% of all products are sold here, which makes the area largely self-sufficient. This forms the perfect basis for the development of a metropolitan region.

With the clustering of agricultural activities there is finally room to really improve nature and biodiversity in the Netherlands. The last couple of decades the Dutch landscape has become cluttered, and it has proven hard to create large areas for nature and recreation (PBL 2017). In the 1990s the Dutch government planned the Ecological Main Structure, in an effort to connect Dutch nature areas, but it largely failed to materialize due to political inertness in the following decades (LNV 2018). To improve biodiversity, interconnected reserves are crucial, as many scientists have shown in different parts of the world (Kuussaari et al. 2009).

In our plan, agroparks are built or expanded in areas which are already leading the way. This means more greenhouses around Rotterdam and The Hague, and more in the north of the province of Noord-Holland, where Seed valley is located. Poultry agroparks will be built around the Veluwe, in the middle of the country, while de Peel in the province of Noord-Brabant is perfectly suited for agroparks for pigs. We furthermore anticipate a continuing urbanization, and thus expanded housing areas around cities. Through this concentrating of housing and food production, large

swaths of land can be returned to nature, most notably the peatlands of the 'Green Heart', the area in between the cities of Utrecht, Rotterdam and Amsterdam, which will be completely turned into wetlands, both for nature purposes and to increase water storage potential, in the wake of climate change.

10.6 The Future of Animal Eating

Clearly, the production side isn't the only lever to pull when it comes to making animal agriculture more sustainable; there is also the demand side. As stated above, from an environmental point of view, reduction of meat consumption is paramount. Although a full plant-based lifestyle isn't necessarily the best, as long as many people eat more than their fair share of meat, every extra vegetarian should be welcomed.

Like every major behavioral change, getting people to eat less meat is hard. Notwithstanding years of promotion of ideas like meatless Monday, average meat consumption in the Netherlands has stagnated at 77 kilo per year, down from a peak of 79 kilo in 2010. The last two years no change in consumption has been detected. Similarly, the percentage of vegetarians is relatively stable at approximately 4% (Dagevos et al. 2019). To lower the impact of the consumption of meat, several strategies have to be set in motion simultaneously. People have different values when it comes to diet and eating meat in particular, and to get people to change their diet, means catering to those different values.

As full vegetarianism is hard to adhere to, one important strategy might be to get people to swap their beef for chicken or pork. The World Resource Institute in December 2018 calculated that swapping one third of ones beef for pork or poultry already reduces ones greenhouse gas emissions by 14% and land use by 13% (Searchinger et al. 2018b). The transition from beef to chicken is already in place in most western countries, as Linus Blomqvist (2019) notices in his essay *Eat Meat, Not Too Much, Mostly Monogastrics*: "In the US, beef consumption declined from 169 kcal/capita/day at its peak in 1976 to just 100 kcal/capita/day in 2013, a drop of over 40 percent."

Another strategy is the development of meat substitutes. The last couple of years there have been many improvements and new introductions, and substitutes now resemble real meat in taste, structure and look. A prominent example is the Impossible Burger, which uses a plant heme, produced by modified yeast, to let its burger 'bleed' like a really burger, thereby mimicking its mouthfeel. The pea-based Beyond Burger uses beet juice, to do the same. Both are available in restaurants and shops around the world.

A third important strategy is the development of lab meat.[1] In 2013 Dutch pharmacologist Mark Post from Maastricht University presented the first burger created from stem cells in a petri dish (Jha 2013). Back then, it costed 250.000 euro to create, but since then various companies have optimized and standardized the process and got

[1] See also the chapter by Cor van der Weele in this Volume.

the price down to 1000 euro per kilo. In a few years lab meat will probably be affordable for the masses. Lab meat presumably will have the biggest impact replacing bulk meat like nuggets, minced meat and shawarma, as these are the simplest form of meat, containing only muscle tissue. As these meat products constitute a major chunk of total consumption, lab meat might make a big difference. Several studies already show lab meat being superior from an environmental point of view, especially with regard to land use (Tuomisto and Teixeira de Mattos 2011; Smetana et al. 2015).

Ecomodernists recognize that in the end, a sizeable part of the people still prefer the real deal over meat substitutes. To tackle this, in the Netherlands, food writer Joel Broekaert (in Hertzberger et al. 2018) introduced the concept 'eating less meat by eating more meat', in which he advocates for eating the whole animal instead of only parts. For him, there are four major upsides, namely (1) people will get more knowledgeable about the food chain and eat their animal with more respect; (2) farmers will be able to capitalize on the whole animal, instead of having to sell leftover parts for lower prices to the processing industry; (3) people's quality of life will rise, as the parts we seldom eat actually are the most tasteful; and lastly (4) when people recognize what good meat really tastes like, it makes it easier to swap tasteless chicken in other dishes for substitutes like tofu.

10.7 Conclusion

For a sustainable future, ecomodernists aim to minimize humanity's footprint primarily by shrinking the area humans use to live and produce. Where humans now use more than 70% of the ice-free land, ecomodernists aim to reduce that to around 30%. As cattle, pigs and chickens tread heavily on the earth, our meat consumption and production serve as an important lever. Ecomodernists believe that a pragmatic combination of intensification and demand reduction are the most important ways to lower impact. The former consists of a combination of closing the yield gap between the best and the worst performers, along with the development of innovative concepts like agroparks; the latter needs a combination of the (further) development of meat substitutes and lab meat, combined with a move away from beef to pork or chicken, and an increased use of the whole animal instead of only a few parts.

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