



## Short communication

## Paying the price for the meat we eat

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## ABSTRACT

An increasingly gloomy picture is painted by research focusing on the environmental challenges faced by our planet. Biodiversity loss is ongoing, landscapes continue to transform, and predictions on the effects of climate change worsen. Calls have been made for urgent action to avoid pushing our planet into a new system state. One of the principal threats to biodiversity is intensive agriculture, and in particular the livestock industry, which is an important driver of greenhouse gas emissions, habitat degradation and habitat loss. Ongoing intensification of agricultural practices mean that farmland no longer provides a habitat for many species. We suggest the use of a growing policy tool, biodiversity offsetting, to tackle these challenges. Biodiversity offsetting, or ecological compensation, assesses the impacts of new development projects and seeks to avoid, minimise and otherwise compensate for the ecological impacts of these development projects. By applying biodiversity offsetting to agriculture, the impacts of progressively intensifying farming practices can be compensated to achieve conservation outcomes by using tools like environmental taxes or agri-environment schemes. Low intensity, traditional, farming systems provide a number of benefits to biodiversity and society, and we suggest that the consumer and the agriculture industry compensate for the devastating ecological impacts of intensive farming so that we can once again preserve biodiversity in our landscapes and attempt to limit global temperature rise below 2°C.

## 1. Introduction

Research studies and (inter) governmental reports have highlighted the extreme challenges that our planet faces (Intergovernmental Panel on Climate Change (IPCC, 2014; Newbold et al., 2016; Ripple et al., 2017), amongst others because of the life-style choices that we as humans have made. A sixth mass extinction is well under-way for biodiversity worldwide (Barnosky et al., 2011). The principal drivers of biodiversity loss include habitat loss and degradation, overexploitation, pollution and climate change (Barnosky et al., 2011; Butchart et al., 2010; Vitousek et al., 1997). At present, our day-to-day activities, which can be mapped through human's influence on the environment (Sanderson et al., 2002), alter the movements of wildlife (Tucker et al., 2018), affect their behavioural patterns (Gaynor et al., 2018) and cause species declines (Hallmann et al., 2017; Heldbjerg et al., 2018). As humans, we have brought about a new era called the Anthropocene (Steffen et al., 2007) whereby we now dominate the earth's balance of terrestrial vertebrate biomass. Threats to biodiversity are also emerging due to a rapidly changing climate with uncertain, potentially large consequences for numerous species (Warren et al., 2018). Climate

change has been identified as one of the drivers that may push the Earth system into a new state (Steffen et al., 2015). If we want to avoid this and achieve the 2 °C target set in the Paris agreement, we need to do more than is currently done (Rogelj et al., 2016). The 2 °C limit already accepts that we will face several global challenges, and beyond this the impacts become ever more severe (Warren et al., 2018).

Agriculture is one of the main causes of environmental degradation worldwide (Newbold et al., 2015; Ramankutty et al., 2018) and intensifying agricultural practices have also contributed to widespread declines of biodiversity in recent decades (Donald et al., 2001; Geiger et al., 2010). How to address the negative impacts of the agriculture industry on the natural environment, whilst simultaneously fulfilling the increasing demand of nutrition remains an ongoing challenge. Environmental and agricultural policy changes are thus clearly required to swiftly adapt how we value nature and the functioning of our ecosystems. Several aspects of human's way of life need to change for a future sustainable planet, but in this short communication we focus on the livestock industry given its contribution to climate change (Gerber et al., 2013) and domination of land-use practices of our planet (Ramankutty et al., 2008), both of which have severe consequences for

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biodiversity and the ecosystem services they provide (Foley et al., 2011; Machovina et al., 2015). We briefly outline the impacts of the livestock industry and the agricultural policy platform within Europe, before describing a potential policy tool that we recommend incorporating within agriculture. Our aim is to raise debate about how such policies may be implemented and we briefly describe some examples of how such a policy platform may operate and the subsequent benefits for biodiversity.

## 2. Livestock production impacts on biodiversity

Livestock and humans consist of 59% and 36% respectively of the total biomass of mammals and birds, whilst their wild counterparts make up the remaining 5% (Bar-On et al., 2018). Livestock are kept to provide resources for humans, and the combined impact of growing food for humans, growing food for livestock, and maintaining the land in which livestock are kept means that nearly 40% of the earth's ice-free land surface is dedicated to agricultural practices (Ramankutty et al., 2008), 75% of which is used to either grow livestock feed or to house livestock (Foley et al., 2011). Land-use change is ongoing as forests around the world are being cleared to either plant food crops, bioenergy crops, create pastures, or to grow more livestock feed (Foley, 2005; Steinfeld et al., 2006). Agriculture, and especially livestock farming, thus represent a major threat to biodiversity and ecosystem functioning.

The livestock industry, amongst others, contributes heavily to climate change and estimates of global greenhouse gas emissions from the livestock industry range from 12 to 18% (Bellarby et al., 2013; Garnett, 2009; Gerber et al., 2013; Steinfeld et al., 2006). A recent study has indicated that replacing meat with plant alternatives may reduce emissions of an average Dutch diet by 28%–46% (van de Kamp et al., 2018). Meanwhile, a full life cycle analysis of ruminant meat products indicated that the greenhouse gas footprint was 19–48 times higher than high protein plant-based products (Ripple et al., 2014). Given the impacts of consuming meat, studies have already called for changes in consumption practices (Godfray et al., 2018; Machovina et al., 2015; Ripple et al., 2014). Particularly in more developed countries, consumption rates of meat are high and may constitute up to 40% of diets (Machovina et al., 2015) whereas alternative plant-based diets may still be considered “niche markets” (e.g. Wild et al., 2014). It is uncertain how much longer our planet can support our life choices and drastic lifestyle changes are needed if we are to avert a so-called “Ecological Armageddon” (Leather, 2018).

Livestock farming is not purely detrimental to the environment and biodiversity. In fact, past pastoralism practices were responsible for many of the high value cultural and natural areas we have today because of the grassland ecosystems that grazing creates (Signal and McCracken, 2000). Grazing as opposed to mowing can also be regarded as a preferred management technique for conserving semi-natural grassland and the species that depend on these habitats (Franks et al., 2018; Tälle et al., 2016). The problem is that many ecosystems created by traditional farming practices have all but disappeared because of increasing agricultural intensification, especially in developed countries (Signal and McCracken, 2000), even though greater biodiversity in commercial grasslands could lead to greater economic value (Binder et al., 2018). The large demand for livestock products has resulted in attempts to increase the level of production, where the pattern is to intensify farming practices by moving livestock out of pastures and into barns so that agricultural areas can be harvested more intensively (Garibaldi et al., 2017). Agricultural intensification has been widely regarded as a driving force of biodiversity loss and whereas traditional farms provided important habitats for biodiversity, many of these important habitats are either declining or have been lost already (Signal and McCracken, 2000; Donald et al., 2001; Firkbank et al., 2008).

The challenge is to change human-nature relationships and consumer behaviours. McGregor and Houston, (2018) reviewed four propositions to do just that: promoting intensification, naturalisation,

veganism, and artificial beef and dairy production. They concluded that the most economical and prevailing proposition (promoting intensification of meat and dairy industries) does not provide effective solutions to address global challenges of planetary change and that creative consumption-oriented responses are needed. One such example is the consumption of organic products, including meat, which have been shown to yield benefits to biodiversity (Tuck et al., 2014). However, the rewards for organic farmers are small, no (economic) penalties exist for farms that operate intensively, and organic farming systems alone may not be able to provide enough food to sustain the growing world population (Reganold and Wachter, 2016). Hence, although organic farming clearly provides benefits to biodiversity, it does not appear to be a practice that can yield significant changes to the livestock industry and alternative policy platforms are needed.

## 3. Shifting policy platforms

The Common Agricultural Policy (CAP) is the governing policy for agricultural practices in the European Union. Farmers receive direct payments for conducting farming practices on their land, and the payment may be higher when this is done in an environmentally friendly manner. The challenge is that often the potential benefit from CAP payments does not offset the potential gain from intensifying farming practices, which is why there has been a general trend for larger more intensive farms that are owned by fewer people. For example, in a country like The Netherlands, the number of agricultural and horticultural companies decreased by 43% in the period 2000–2016, but the decrease in area used for agricultural purposes was only 9%; the standard yield per company therefore more than doubled (Central Bureau of Statistics (CBS), 2016). The CAP is currently under review for a new CAP for 2021–2027 with hopes for budgets to be approved by 2019. We believe that now more than ever, an overhaul of the CAP is required so that intensive farming practices are penalised and to provide incentives to reduce the scale of livestock farming.

The CAP could benefit from an emerging policy called biodiversity offsets, which aim to alleviate the environmental impacts of development projects (Bull et al., 2013). Biodiversity offsets aim to govern the ecological impacts of new developments to achieve a no net loss of biodiversity, and in some situations attempt to achieve a net gain (Bull et al., 2013). The general procedure is that a) developers are required to quantify the ecological impacts arising from development, b) ecological impacts should be mitigated by for example avoiding or minimising biodiversity impacts and c) any remaining ecological impacts that are not mitigated should be offset by compensating the biodiversity losses with a biodiversity gain elsewhere (BBOP, 2012; Bull et al., 2013; Maron et al., 2016). The two principal ways to achieve biodiversity offsets are to either enhance a degraded site through for example restoration, or to prevent ongoing or anticipated losses at another site (Maron et al., 2012).

A similar concept that runs parallel to biodiversity offsetting and has been in place in the Netherlands since the 1990s, is called “Ecological Compensation” (Cuperus et al., 2001). Biodiversity offsetting and ecological compensation share similar principles and have become an important platform for minimising and compensating for the ecological impacts of development projects, although whether they achieve no net loss has been a topic of debate (Maron et al., 2016). One of the arguments against biodiversity offsets is that as conservationists and developers squabble over the remaining natural areas of our planet, to either protect or demolish, biodiversity offsets may be seen as a justifying means for developers to construct, meaning that no net loss is never a truly achievable target (Maron et al., 2016). Furthermore, socio-ecological systems are complex that hold ecological values (e.g. biodiversity), instrumental values (e.g. ecosystem services) and non-instrumental values (e.g. cultural) which may be irreplaceable and therefore cannot be compensated (Apostolopoulou and Adams, 2017; Moreno-Mateos et al., 2015). Finally, restoration actions that aim to

compensate biodiversity loss may not succeed due to challenges in measuring biodiversity values, uncertainty of restoration techniques and the long time-lags between the initiation of restoration projects and the realisation of biodiversity gains (Maron et al., 2012). It is however important to highlight that a principle aim of biodiversity offsets is to avoid damaging impacts of development (Bull et al., 2013). We believe that a key limiting factor of both biodiversity offsetting, and ecological compensation, is that their focus is on “new developments”. These policy instruments can be broadened to not only compensate for new projects, but to also assess ongoing impacts within the landscape.

#### 4. Ecological compensation of intensive farming

We highlight that ecological compensation provides a useful policy platform for governing the ecological impacts of the agricultural industry, and in particular the livestock industry. Ecological compensation of intensive agricultural practices has global policy implications and is particularly relevant within the European Union under the CAP. It is also a system whereby the economic costs of environmentally friendly farming practices can be passed onto the consumer without drastically impacting the livelihoods of farmers. Instead of rewarding farmers for implementing environmentally-friendly practices, they should be set as a standard. A tier system may be implemented such that biodiversity offsetting is required for progressively intensifying practices of livestock farming. For example, sustainable stocking densities can be defined where livestock can be kept in pastures and meadows without a heavy reliance on imported feed and a progressive tax is applied as sustainable stocking densities are exceeded. Implementing policies that ensure that farmers compensate for the ecological impacts that intensive livestock farming creates will provide opportunities to restore the ecosystem benefits of low-intensity farming, and also recognise that our current meat consumption habits are not sustainable. Low(er) intensity farming will likely result in higher costs for the consumer, especially if farmers are to maintain similar incomes. Similarly, any tax that is applied to farmers that stock livestock at high densities will also likely be passed on to the consumer. However, higher costs for the consumer may also lead to reduced meat consumption, which ultimately contributes towards biodiversity conservation and climate change mitigation (Binder et al., 2018; Godfray et al., 2018; Machovina et al., 2015; Ripple et al., 2014). Biodiversity benefits include conservation actions that can be achieved on grazed pastures, whilst arable land that was dedicated to growing animal feed can instead be used to grow alternative plant proteins for human consumption.

The income generated through “taxing” intensive agricultural practices can be used to support conservation projects and also encourage low-intensity farming. In addition to direct monetary implications (e.g. taxes) of compensating the ecological damage of intensive farming practices, ecological compensation policies should also require farmers to implement conservation actions to ensure that biodiversity targets are achieved. Conservation actions may include the creation of flower strips or set asides, the size of which could be determined by the number of livestock above a sustainable stocking density. The application of flower strips, set-asides, and other measures that increase naturalness on farmland through practices like agri-environment schemes have generally had positive effects on biodiversity (Haaland et al., 2011). Increasing landscape complexity also increases natural pest control (Rusch et al., 2016) and thus reduces dependences on pesticides, another major threat to biodiversity resulting from agricultural intensification (Geiger et al., 2010). Farmers may also consider alternative farming regimes to improve biodiversity value, for example a compartmental strategy of combining high yield farming, natural areas and low yield farming has been shown to benefit bird populations in lowland areas (Finch et al., 2019). It is thus clear that there are many benefits to implementing agri-environment schemes on agricultural land and the standard way that agricultural landscapes are

designed needs to change (Garibaldi et al., 2017). We feel a policy of ecological compensation within agriculture provides the opportunity to benefit biodiversity as well as farmers and society as a whole.

#### 5. Discussion

We have previously highlighted that the effects of the livestock industry are not only negative, and grazing livestock actually play an important role for grassland ecosystems (Bignal and McCracken, 2000). Our aim is to highlight that the ecological impacts of intensive farming need to be compensated, especially given that intensively farmed livestock no longer provide biodiversity benefits (Bignal and McCracken, 2000; Garibaldi et al., 2017). Similarly, we do not argue for the complete removal of livestock farming. Alternative forms of farming may not be appropriate in some regions (Herrero et al., 2009), whilst the biodiversity value of rangelands, which are maintained through livestock grazing, is being lost due to cropland conversion (Alkemade et al., 2013). Instead, a return to lower intensity practices are needed coupled with a reduction in meat consumption practices (Machovina et al., 2015; Garibaldi et al., 2017). Reducing the intensity of livestock farming may create new challenges for the agricultural industry, for example reducing availability of fertiliser (Cordell et al., 2009), however, sustainable farming systems are aiming to reduce fertiliser input, such as integrated crop-livestock systems and other agroecological approaches (Bonaudo et al., 2014; Garibaldi et al., 2017).

Applying biodiversity offsetting to the livestock industry is not without its challenges. As we highlighted, the true benefits of biodiversity offsetting remains a contested topic (Apostolopoulou and Adam, 2017; Maron et al., 2012; Moreno-Mateos et al., 2015). An important difference between the existing policy structure and our proposal is that it is not focused on potential biodiversity loss from new development projects, but instead on the ongoing ecological impacts of intensive agriculture. Compensating for these ongoing ecological impacts, for example through agri-environment schemes, will improve the biodiversity value of agricultural landscapes (Haaland et al., 2011).

A challenge also concerns how the general public, i.e. consumers, will respond to potential price rises of meat products and the expectation of reduced meat consumption. Studies have shown that the general public may not perceive eating meat as a problem, nor that it is linked to climate change or biodiversity loss (Lentz et al., 2018; Macdiarmid et al., 2016). Consumers may also associate eating meat with social and cultural values and may not only be concerned about the nutrition of meat (Macdiarmid et al., 2016). Reducing meat consumption is thus associated with several challenges and Stoll-Kleemann and Schmidt, (2017) described various factors that create barriers to consumers reducing meat consumption, but also describe opportunities to overcome these barriers. It is therefore important that policy changes are accompanied with broad awareness-raising campaigns of the health, and especially environmental benefits of eating less meat. Increasing the cost of meat would also reduce meat consumption, through for example taxes (Säll and Gren, 2015; Vallgård et al., 2015). Food taxes have already been shown to change consumer behaviours (Säll and Gren, 2015; Vallgård et al., 2015) but taxes will be met with substantial opposition. Solid arguments are needed for the purpose of environmental taxes, and also education to improve consumer’s willingness to pay and to adopt associated dietary changes (Macdiarmid et al., 2016; Stoll-Kleemann and Schmidt, 2017; Vallgård et al., 2015).

#### 6. Conclusion

Policy-makers may feel that our proposition is idealistic and resistance from farmers and consumers is to be expected, yet a change in our farming system is urgently needed (Godfray et al., 2018). Our proposal directly contributes to several of CAP’s future objectives including amongst others fair income to farmers, climate change action, environmental care and to preserve landscapes and biodiversity. A

system of applying carbon taxing to the livestock industry in Denmark (Caro et al., 2017) is a first step in recognising the impacts of intensive agriculture. However, more needs to be done to recognise the full spectrum of ongoing ecological impacts. The immense decline of insect biomass (Hallmann et al., 2017) and apparent decrease of meadow birds (Heldbjerg et al., 2018) may indeed signal an imminent “Ecological Armageddon”. Alternative farming systems like integrated crop-livestock farming have been shown to be able to achieve high crop yields and profits (Garibaldi et al., 2017). To return to these alternative farming systems, our proposition is to implement ecological compensation policies that would remove incentives to farm intensively so that intensive meat production is replaced by increased naturalness of livestock farming. We have focused on livestock farming in this short communication however the principles also extend to intensive crop production, which may be equally devastating to biodiversity (Donald et al., 2001). Our policy recommendations are set-up in a way that farmer’s profits should remain somewhat unchanged since the costs will largely be incurred by the consumer. Currently biodiversity and all mankind are paying the price for the current meat consumption practices and instead it is time that these costs are only paid by the consumers of meat through a system that strengthens the biodiversity value of our landscapes and restores the ecosystem services that it provides.

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