

Crops or Cattle? - How different food systems impact the environment

Helene Bang, Erik Fagervik Gaden, Sofie Gjærløw, Cheyenne Hilmer and Stella Langthaler

Agricultural impact:

- Advances in agriculture results in environmental degradation
- Terrestrial ecosystems face challenges: biodiversity loss, deforestation, pollution and freshwater depletion
- Increasing demand for animal products leads to land use change in favour for livestock production
- SDG15: Deforestation to create land for livestock has negative impact on biodiversity, e.g. Amazon
- Grazing livestock also have the ability to provide ecosystem services
- A shift to a sustainable agriculture is needed
- *the rest goes mostly to cattle and waste



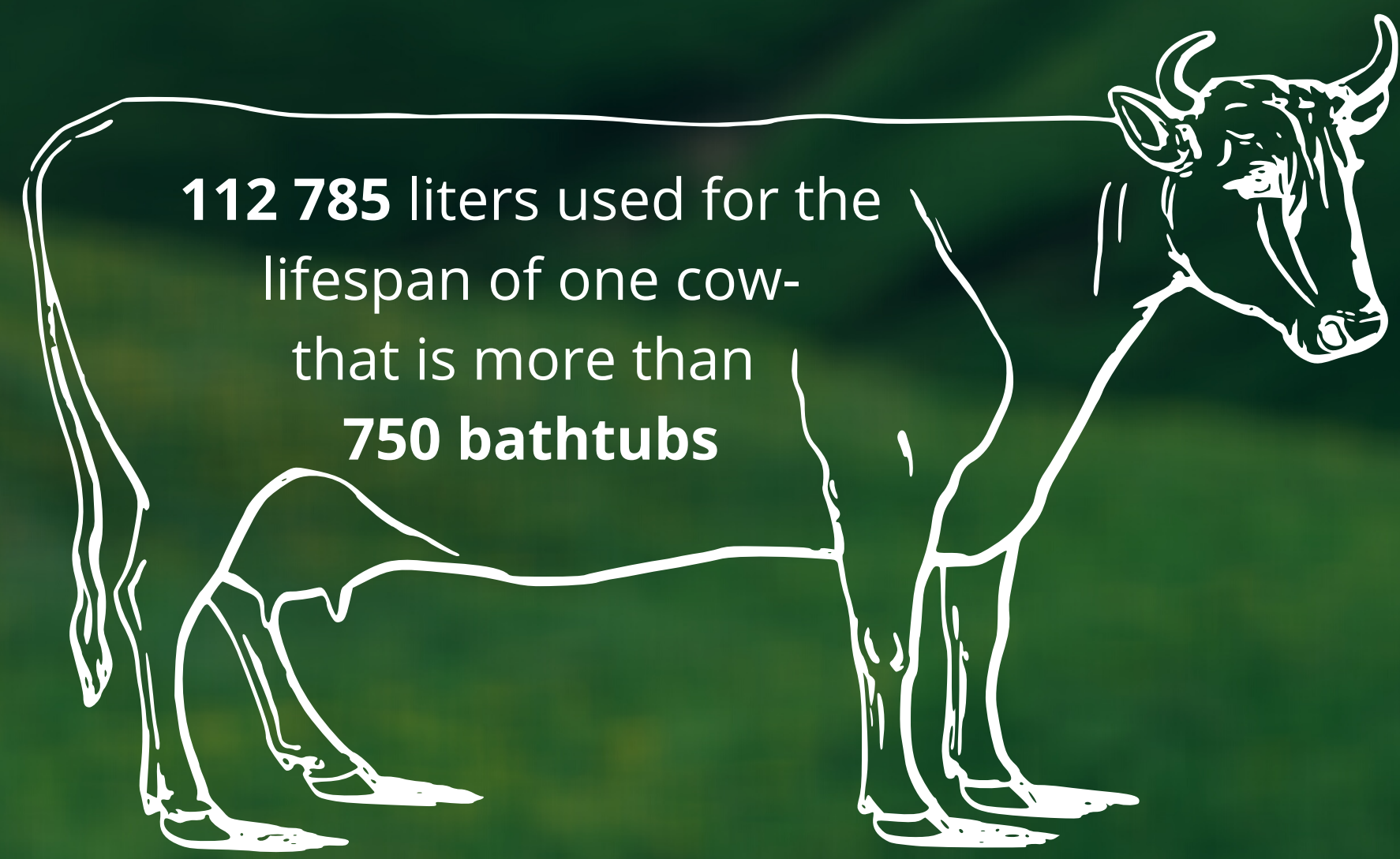
60% of ecosystems degraded

83% of biomass influenced by humans

around **50 %** of habitable land converted to farming land

plant-based diet reduces land use by **76%**

80% of biomass found on land



SDG connections:



References: SDG symbols downloaded from: <https://earthobservatory.nasa.gov/features/CarbonCycle>
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Abstract

The human population is growing rapidly and the demand for food has naturally followed along. Agriculture is the main source of sustaining the human population but have with time grown excessively and caused major negative impacts on the environment. A known example is the deforestation of the Amazon rainforest for the course of sustaining an increased demand for meat and dairy. Resulting in a decrease in biodiversity in and around the affected areas. When comparing livestock and crops it is found that crops require fewer resources than livestock and therefore impact the environment less. For a more sustainable future in land use, a more plant-based diet may be a good solution. The UN's Sustainable Development Goal (SDG) 15: Life on Land which aims to increase sustainable land use, halt deforestation, and increase biodiversity. If this goal is achieved, it may have a positive impact on other SDGs as well.

Introduction

Over the last decades agriculture has seen major improvements in productivity. This increase in production has supported the demand of a growing human population but also resulted in environmental costs. Looking at human activities in general, it is estimated that the human footprint has affected 83% of global terrestrial land and degraded about 60% of the ecosystem services in the past 50 years. This rapid land-use change is the most important reason degradation of land and loss of biodiversity (Nkonya et al., 2012). These alterations affect us as humans because terrestrial ecosystems become prone to negative impacts like scarcity of water resources, eutrophication, greenhouse gas emissions (GHGe), and declining delivery of ecosystem services (FAO, 2018a; Ramankutty et al., 2018).

As agriculture act as one of the primary environmental threats to terrestrial land, working towards a resilient and sustainable food system will be important in our work toward achieving goal 15: Life on Land from UN's Sustainable Development Goals (SDG) 2030 Agenda. The adoption of sustainable agriculture may make us able to feed the future human population without continuing to compromise with environmental health (FAO, 2018a). To do this, managing and communicating the environmental impacts of food production is necessary. One of the major challenges to our food systems is the large amount of land and resources used for livestock production. The need for new land continues to rise as the global demand for animal products increases. Therefore, in this paper we aim to compare livestock with plant-crop systems by highlighting their environmental impacts.

Environmental impact of livestock

The demand for meat and dairy products has rapidly increased during the past 50 years, with the increasing wealth of consumers. Consequently, a dramatic increase in the global number of livestock has arisen, which resulted in large proportions of terrestrial land being cleared for pastureland and animal fodder (Godfray et al., 2010). Land clearing for livestock production have deforested large terrestrial areas supporting biodiversity and valuable ecosystem services. An example of such deforestation is the well-known Amazon in Brazil. To further understand livestock, impact this paper aims to investigate how much resources cattle consume compared to plant crops.

An average cow lives for 3 years before euthanization, whereas pigs live approximately 6 months. On average, cattle drain 103 liter water a day at a temperature of 15 degrees. Surprisingly, pigs, despite their size, devour 142 liters of water including their service expenses. Therefore, on an average lifespan of cattle, 112.785 liters of water are used, whereas pigs consume 25.915 liters. A study by Hoekstra revealed how much water is needed for: one kilogram of beef produced - 16.726 liter of water and 5.469 liters are required for a kilogram of pork (Hoekstra, 2003). Important to mention is green water, which is water that is easily "accessible" for example rainwater. Most of the water used for agriculture is of said source, the percentage fluctuating between regions and studies. Regarding agriculture in Brazil, a study by Spera *et al.* has shown that between 2003 and 2013 the area of cropland, agriculture has more than doubled from 1.2 to 2.5 million hectares. Crops are often used for fodder production and therefore, are widely exploited for cattle (Spera et al., 2016) making livestock an effector on decreasing biodiversity.

Nonetheless, crops may as well consume high amounts of water, depending mostly on the plant. Cotton for example, the largest exporter of Burkina Faso, needs between 9.000 – 11.000 liters of water/kilogram. Cocoa

beans use 20.000 liters of water/kilogram, closely followed by coffee. On the other hand, tomatoes have a water uptake from around 100 liters/kilogram and other vegetables have a range not reaching more than 350 liter/kilogram, such as pumpkin (Uta Steinwehr, 2020). Soy, as a commonly used fodder, requires 2.9 trillion liters of water yearly. On one kilogram of soy, 2.050 liters of water is required, which is especially high compared with the badly rumored avocado which requires up to 1.500 liters/kilogram (Rossa, 2018). Therefore, it is important to think about which type of crops to use, since some are more sustainable than others.

Deforestation and land degradation

The rainforests are being chopped down, destroyed, and degraded and it is happening at an excessive speed, the rainforest in Brazil is no exception. The deforestation area of the Brazilian Amazon rose from 41.5 million hectares in 1990 to 58.7 million hectares in 2000 (Mertens et.al., 2005). When the forests are degraded, a major source of greenhouse gasses such as carbon dioxide, nitrous oxide, and methane may cause an impact on global warming by aggravating the changes (Fearnside, 2000). Exactly how high the tropical emissions from the rainforest truly are, is uncertain and is constantly up for debate. One of the reasons for the uncertainty, is the fluctuation every year, from 0.8 to 2.4 gigatons (Houghton et.al., 2000). Due to the huge differences in these numbers it is difficult to understand how much of the anthropogenic emissions the tropical forests are a part of.

Some reasons for the degradation of the rainforest in Brazil is to market lumber and to make the land for cattle and crops. Once the cattle ranching in Brazil was only for sale within the country, while now the demand for Brazilian beef has moved outside borders. Consequently, the export of beef has escalated the deforestation of the rainforest rapidly (Kaimowitz et.al., 2004). The Legal Amazon houses the world highest terrestrial biodiversities on earth (Kaimowitz et.al., 2004). The loss of biodiversity may affect the dynamic and function of an ecosystem in a way that can be irreversible (Cardinale et.al., 2012). It was found that the efficiency in a whole group of organisms has a reduction in efficiency when it comes to collecting vital biological resources such as water, different nutrients, light, prey, etc.

Connection to SDG15: biodiversity and ecosystem services

The issues of unsustainable food systems, such as what is observed in the Amazon, are directly linked to SDG15. Goal 15 focuses among others on biodiversity and enhancing the delivery of ecosystem services (FAO, 2018b). In both agricultural systems and more pristine systems, biodiversity provides important ecosystem services, which makes it important to assess how livestock food systems impact ecosystems (Nkonya et al., 2012). A misconception is that large-scale industrial production dominates the agriculture, but most of the food consumed is still produced by small-scale farming systems, which may act as a positive factor. In the terms that it is largely the intensity of the production and the farming practices used that determine the impact of livestock (Måren, 2018; FAO, 2018b). The research on livestock's impact on ecosystems is scarce and needs more attention to further assess the impacts, but clearly, the destruction of undisturbed habitat to convert land for livestock has a negative environmental impact. Livestock are also known to pressure ecosystems through water quality (FAO, 2018b). On the other hand, livestock can provide a range of ecosystem services, especially in locations with pasture where biodiversity has slowly adapted to the transforming habitat.

SDG15 in relation to other SDGs

As for many of the goals of the UN's SDG agenda goal 15 is connected to other goals. For example, there exists a strong connection between goal 15 and 12: Responsible consumption and production. It is not only important but essential, that we achieve a more sustainable land use to gain a moderate consumption and to have a production that adjusts to that consumption. Another goal with connections to Life on Land is goal 13: Climate Action. It is important to raise public awareness to improve land use because depending on how the land use is, the impact on climate change will be greater or less (UNCCD, 2017).

When speaking of how we can shift to a sustainable agriculture we already know, agricultural and human activities have been generated in the past and which have affected natural resources, communities, ecosystems, and more. For this reason, it is important to promote sustainable agriculture. (FAO, The good growth plan, 2017).

How can we change the land use?

To achieve a more sustainable way of agriculture, some principles must be followed. It is important to make crops more efficient. Increasing the average productivity of the main crops worldwide by, without using

more land, water, or inputs would be a way towards higher sustainable standards. In 2016, 1.2% of land productivity increased which shows that we are going in the opposite direction of what we should aim for. Recovering more land for crops versus livestock and skip a step in the pathway food reaches humans, may have a significant impact. Improving the fertility of fields on the verge of degradation, help biodiversity grow, improve biodiversity on farmland are ways that may positively affect the environment, and make the land use more sustainable.

Each of these solutions impacts a Sustainable Development Goal. According to the Good Growth Plan, making crops more efficient contributes and is related to SDG 2: Zero Hunger. Also, recovering more land for crop influences contributes to SDG 15: Life on land. Helping biodiversity grow, promotes responsible production and consumption contribute to SDG 12: Responsible consumption and production. Empowering small producers promotes SDG 1: No poverty. Help people stay safe contributes to people's health and well-being or SDG 3. Caring for each worker is related to SDG 8: Decent work and economic growth (UNCCD, 2017).

Conclusion

As agriculture and food systems are connected to several SDGs, we need to emphasize a shift to sustainable agriculture as a necessity to achieve such goals. As crops can feed people more efficiently than livestock, changing the agricultural land use by intensifying crop systems instead of clearing more land for livestock will be important to feed the future human population sustainably.

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