Protein substitutes and the livestock sector

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Background

Livestock products have been, and continue to be important elements of the human diet. At the same time, it is the agricultural sector with the highest negative impact on the environment and human health, particularly in countries where intensive agricultural methods prevail.[1] The sector is associated with nutrient losses, pesticide leakage and utilization of large tracts of agricultural land, water and fossil fuels. These systems contribute to GHG emissions[2] and climate change[3], threatening sustainable development.

Facts and figures - protein substitutes

- The livestock sector is responsible for about 18% of the total worldwide GHG emissions, it uses about 70% of the available agricultural land and represents about 8% of global water usage;[4]
- Feed production is responsible for 50-85% of climate change, 64-97% of eutrophication potential, 70-96% of energy use in the whole animal production system;[5]
- 2 to 15 kg of plant material is needed to produce 1 kg of animal products(low energy conversion);
- 40% to 50% of the global grain harvest is used for feed production; 6
- Regarding land use, eutrophication and acidification, consumption of livestock products is responsible for 43%, 51%, and 60%, respectively, and impacts, the entire food domain.[7]

Source: authors' compilation.

However, in response to a rising demand for livestock products, intensive livestock production has expanded steadily in the last half century, both in developed and developing countries.[8] According to the FAO,[9] the global demand for animal products, and subsequently demand for feed, is expected to double by 2050, due to an increasing world population, rising incomes and further urbanization, but constrained by climate change (this can negatively affect productions). With this, the increased competition for land for other application will result in increased food and feed losses.[10]

Developed countries experience high levels of overconsumption and intensive production of livestock products. However, there is low growth or even stagnation of growth in the sector, while developing countries experience an increase in production and consumption, and the sector is shifting from an extensive pattern towards an intensified one. Increasing numbers of people in developing nations express a desire for a more Western-style diet, and, consequently, the pressure on natural resources accelerates.[11]

In the livestock sector, feed production (cultivation, processing and transport) and livestock consumption represent the main sources of impacts regarding GHG emissions and use of resources such as land, water, energy, nutrients and biodiversity [12] This paper aims to provide mitigation options, represented by sustainable protein substitutes for food and feed related to the livestock sector.

Scientific Debate

The discussion revolves around how to combine reduction in the negative impact of the livestock sector using technological measures, and reduction in livestock production and consumption, without undermining food security.[4] In the entire chain of production and consumption of livestock products, feed production and livestock consumption by humans are by far the most important contributors to environmental impacts in the sector. In this paper attention focusses on one of the new potential mitigation options: novel and/or more sustainably produced protein substitutes for food and feed that are now more widely available, than ever before.,[13, 14]

A human diet based on the exchange of the meat portion in the diet with meat substitutes, has lower climate and land use related impacts, than a diet with food products of animal origin. [15] Substitutes such as legumes, pulses, vegetables and cereals, eggs, or novel protein sources like insects, algae, duckweed, and rapeseed or products based on plant proteins present lower impacts compared to livestock products, and could completely substitute these. [16, 17, 18]

Food for thought - protein substitutes
• "Identification of new feed resources is crucial for sustainable animal production and future viability";[10] • Protein intake in the European Union is 70% higher than the levels recommended by the World Health Organization;[19] • Given the low energy conversion and the high demand for land associated with livestock production, reduction in livestock product consumption could reduce the need for more food;[3] • A global transition towards low-meat diets may reduce the costs of climate change mitigation by as much as 50% in 2050;[20] • The transition towards more sustainable food production and consumption requires cooperation of multiple actors: policymakers, NGOs, traders, farmers, and consumer. This transition will encounter cultural, political, and commercial resistance.[21]

Source: authors' compilation.

It is also important to orient research towards the development of new feed substitutes that can replace cereals as major source of nutrition for pigs, poultry, dairy cows and cattle.[22] Use of agricultural co-products, by-products, insects, duckweed, seaweed or microalgae that have less impact related to emission and resource use (e.g. land) than conventional feed, can be an alternative for importing feed from other countries, and can transform an inedible product into an edible one.[23] V. Smil states that "*assuming that the area now devoted to feed crops were planted to a mixture of food crops, and only their milling residues were used for feeding*"[24], food could be provided for 1 billion people. Some co-products are already being used in diets of livestock. In 2007 in the Netherlands, 22% of livestock diets were composed of co-products (e.g. beet tails).[25] The main barriers in the use of novel sustainable protein substitutes are legislations, technical and processing challenges, and limited knowledge about possible food safety hazards, including a range of contaminants.

New technologies and innovations in food production needs to be combined with a shift in consumption, since technology and society cannot be considered to be independent of one another.[12] Increased awareness of the environmental impact of food, concrete choices in favour of alternative sources of protein and eco-friendly products and a general global consensus on the importance of decreasing food waste and over-consumption, is needed.[4, 26, 27, 28, 29]

Further issues for consideration

The following issues were suggested by the team of young researchers for consideration by policy makers:

- Increase availability and presence in the market of protein substitutes in human food and animal feed through the use of policy instruments, subsidies, research for their development, improvements of legislation and regulation regarding safety and use aspects of new proteins;
- Decrease impact due to feed production and increase awareness of farmers about the impact of different feeds;
- Influence reduction in meat and dairy consumption in western countries and environmental awareness about livestock product consumption both in developed and in developing countries.

Notes

[1] Röös, E., Ekelund, L., & Tjärnemo, H.(2012). Communicating the environmental impact of meat production: challenges in the development of a Swedish meat guide. Journal of Cleaner Production, article in press, 1-11.
[2] GHGs: Green House Gas emissions; any of the gases whose absorption of solar radiation prevent heat from escaping into space, causing the greenhouse effect, including carbon dioxide, methane, ozone, and the fluorocarbons.
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