Extended Abstract
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Paper/Poster Title	Evaluating Irish farms' contribution to protein security nationally and globally

Abstract prepared for presentation at the 98th Annual Conference of The Agricultural Economics Society will be held at The University of Edinburgh, UK, 18th - 20th March 2024.

Abstract	***200 words max***

Amongst the various debates surrounding livestock production is the feed-food debate, questioning the use of human edible input as animal feed that could directly be used as food. In this debate, the Republic of Ireland is an interesting case study due to the prevalence of livestock production in its agricultural sector, its status as a net exporter of livestock products, and its ambitious target when it comes to reducing agricultural GHG emissions.

This paper aims at evaluating the net contribution, i.e., subtracting human-edible input to human edible output, of the four main Irish farm systems (cattle, dairy, sheep and tillage) to protein security. We examine first the net protein and essential amino acid production across farm system. We then look at how each system meets the population's protein and essential amino acid requirements.

While tillage farms produce more net protein than all other systems, both in total and per hectare, dairy farms produce the most lysine in net terms. On aggregate, the Irish dairy sector is able to meet the protein requirements of more than 15 million individuals, against less than 8.1 million for all other systems. Dairy and cattle sectors are the most efficient at meeting the population's amino acid requirements.

Keywords	Food security; food policy; protein
JEL Code	Q180 Agricultural Policy; Food Policy; Animal Welfare Policy

Introduction	***100 – 250 words***

Global food demand is expected to grow by 35% to 56% between 2010 and 2050, with population growth being the main driver (Van Dijk et al., 2021). Proteins require particular attention due to their importance to human nutrition. Moreover, protein production has been a point of concerns due to environmental and nutritional considerations. Amongst the criticism directed towards livestock production is the feed-food debate, defined as the "*tensions and*

trade-offs between using edible crops and other resources to either feed people directly or feed livestock" (Breewood and Garnett, 2020).

This issue is particularly relevant in Ireland, where the livestock sector is predominant in the agricultural sector. Indeed, 75% of the Irish utilized agricultural area is outdoor permanent grassland, against only 30% for the European Union (Eurostat, 2023). Most of the barley, oats and beans produced or imported in the country is used for feed (FAO, 2023). Ireland also established some ambitious climate targets, aiming at a 25% reduction in agricultural GHG emissions by 2030 compared to 2018 levels (EPA, 2023). The Irish agricultural and livestock sectors then need to improve efficiency if the target is to be met.

This paper evaluates the contribution of the four main Irish farm systems (cattle, dairy, sheep and tillage) to protein security in Ireland and globally. We first look at the net production (i.e., subtracting human-edible input to human edible output) of protein and essential amino acids across farm system. We then evaluate how each system contributes to national and global protein security.

Methodology

100 – 250 words

Farm level data were taken from Teagasc's National Farm Survey (NFS) 2016-2021. To evaluate the net contribution of Irish farms to protein production, we separate all crops produced in Ireland into two categories: human edible and non-human edible. We then calculate total protein and essential amino acid yields by farm. We account for protein quality by considering total amino acids as well as amino acids taking into account ileal digestion. This allows a distinction between the total amino acid content of the protein sources considered as well as the amino acid remaining available to the body after the digestion process. The net contribution is obtained by subtracting all human edible inputs to human edible output.

To evaluate how many people can effectively be fed by Irish farms, we distribute the net human-edible output of farms to a representative individual with 2 250 kcal and 0.66 g of protein per kg of bodyweight required per day (HSE, 2023; FAO, 2013). We first establish how many people can one average farm feed by dividing the net human edible yield by the yearly protein and amino acid requirements of the representative individual. To evaluate the overall contribution of the Irish agricultural sector to food security, we then aggregate the results using the number of farms in Ireland (CSO, 2020).

Results

100 – 250 words

Between 2016 and 2021, dairy and sheep farms used respectively 1.2 and 1.3 times more human-edible protein per livestock unit compared to cattle farms. Tillage farms produced the most protein per hectare in net terms, with 459 kgs against less than 400 kgs for livestock systems. Tillage farms also produce more essential amino acids per hectare in net terms than all other systems except for lysine. Dairy farms produce the most lysine per hectare. The results remain when accounting for ileal digestibility of the amino acids considered.

However, the aggregate dairy and cattle sectors contributed the most to protein security. Annually, the Irish dairy sector was able to meet the protein requirements of 15.6 million individuals between 2016 and 2021, against 8 million for tillage farms, 7.8 million for cattle farms and 1.7 million for sheep farms. Dairy and cattle farms were also able to meet the essential amino acid requirements of the largest number of individuals.
Finally, the Irish agricultural sector, without discriminating for farm system, met the protein requirements of 44 146 080 individuals, and the amino acid requirements of between 31 102 920 and 74 134 200 individuals depending on the amino acid considered.
On average between 2016 and 2022[1], Ireland counted 4 955 502 people (CSO, 2023a), which means that the main four Irish farm systems can contribute to protein security nationally and globally.

Discussion and Conclusion

100 – 250 words

The feed-food debate questions the efficiency of livestock farm systems to convert human-edible input into human edible output. This debate is particularly relevant in Ireland, where the agricultural sector is dominated by livestock production and where most of the protein-rich crops produced or imported are used as animal feed. Livestock systems are also protein producers and converters and contribute to protein security both in Ireland and globally. Ireland is a net exporter of several livestock commodities such as beef and sheep meat (CSO, 2023b). This paper looks at the efficiency of Irish livestock farm systems to produce human edible protein, accounting for the human edible protein they consume, as well as their contribution to national and global protein security.

While the average tillage farm produces more net protein and amino acids than the average livestock farms, the livestock sector contributes more to protein security due to its predominance in Ireland.

The Irish agricultural sector should decrease its GHG emissions by 25% by 2030 compared to 2018 to meet the governmental target. The agricultural sector and in particular the livestock sector will then have to adapt rapidly. However, this will need to be done while accounting for the contribution of the sector to protein security in Ireland and beyond. Policies aimed at making the agricultural sector in Ireland more environmentally sustainable will also have to ensure that protein security is not threatened in the process. In particular, dairy and cattle systems, the most GHG intensive farm systems (Bukley and Donnellan, 2023), are also the biggest contributors to protein security in Ireland, which will have to be accounted for in policy design.

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