Evaluate the land-use efficiency of regional livestock systems from a food systems perspective

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The need for efficient livestock production

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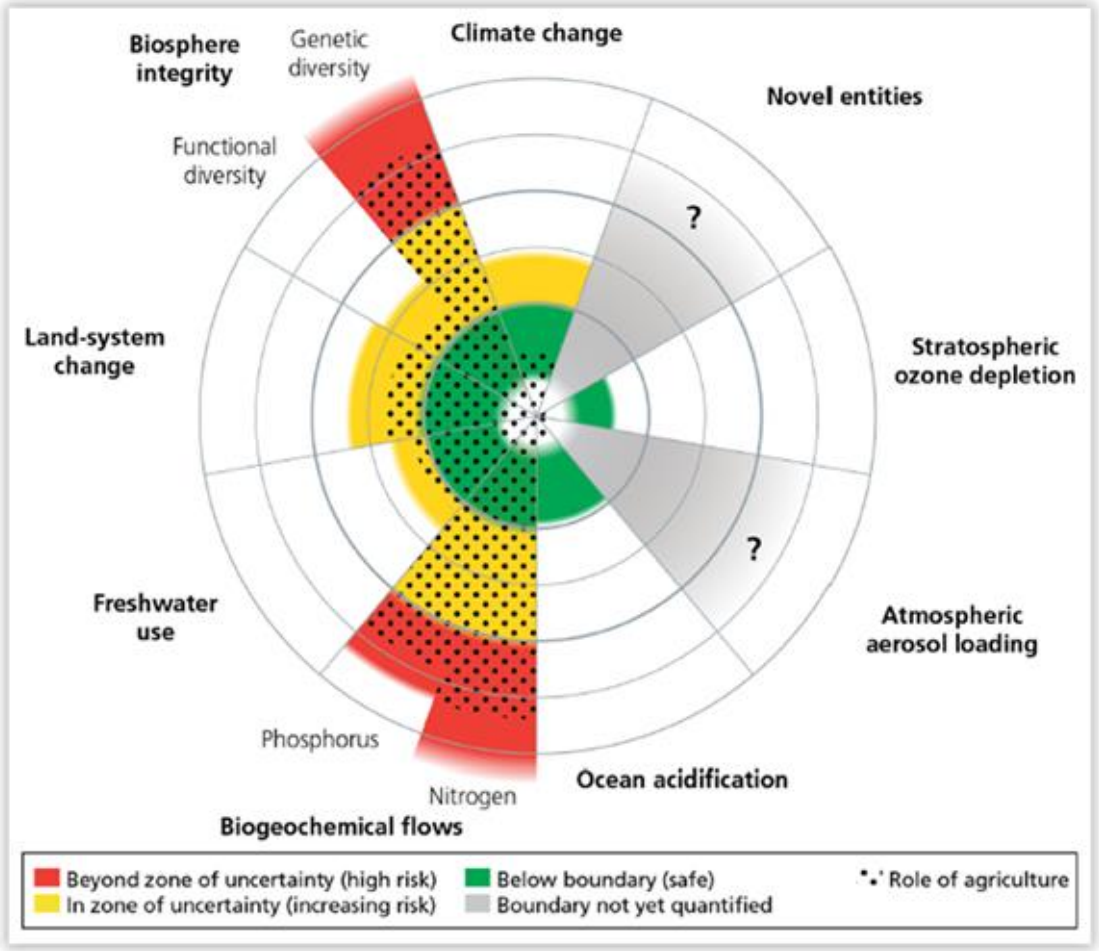

Source: (Miles et al 2020)

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Feed-food competition

- Feed-food competition
  - Land which could produce food is producing feed
  - Potentially less edible food
- Extra land is needed
  - Planetary boundaries
- Eliminating or limiting feed-food competition limits livestock production to the most efficient food producers
  - Livestock in land areas unsuitable for cropping
  - Monogastric Livestock systems designed around by-products
- In order to increase sustainable livestock production
  - Feed-food competition needs to be quantified
  - Feed-food competition needs to be minimised/eliminated
  - Land use Planning needs to form part of the design of the future food systems

Case Study – Feed-Food competition in Ireland

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System Studied in Kgs DM

	Food	Feed			
System Studied	Edible Protein produced	Concentrates	Pasture Grass	Grass Silage	Total
Dairy beef	303	1,681	4,727	1,581	7986
Sheep	11	50	620	297	967
Suckler beef	106	618	5,557	2,624	8800
Pig	20	304	7	3	314

Methods 1: PCR

- Protein Conversion Ratio

- Metric to outline protein use efficiency in livestock systems
  - Feed entering vs food produced

- $\text{PCR} = \frac{Current\ edible\ protein\ used\ as\ feed}{Current\ edible\ livestock\ protein\ produced}$

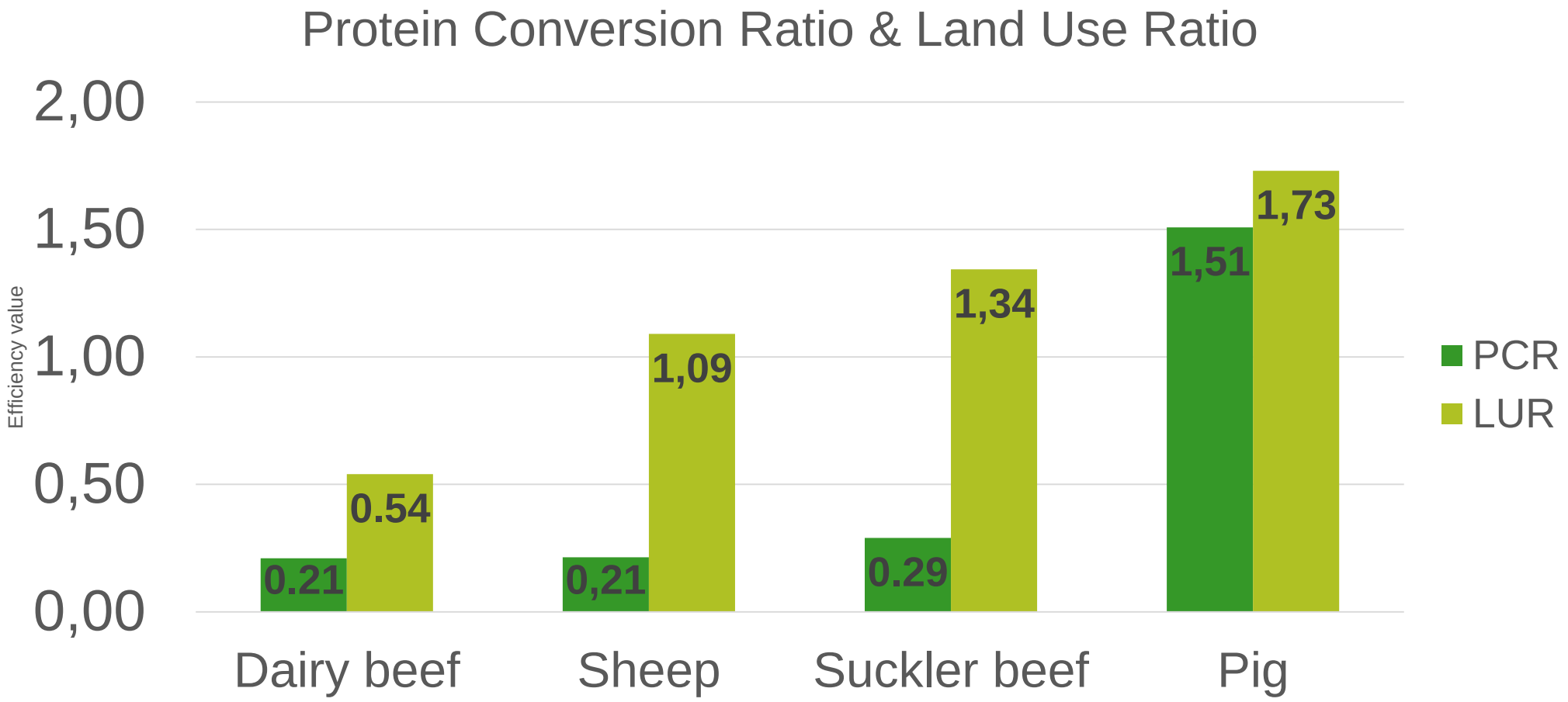
- Can compare livestock systems feed stock and how efficiently it is used to provide edible protein

Methods 2: LUR

- Land Use Ratio
  - Evaluates opportunity cost of livestock production
  - $$\frac{Potential\ edible\ crop\ protein}{Current\ edible\ livestock\ protein\ produced}$$

- Potential alternative crop
  - Proportion of pasture suitable for growing crops
  - Domestic concentrate production
  - International concentrate production

Results of Case Study



(Hennessy et al., 2021)

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Key points 1.

- Feed-food competition is evident for both monogastric and ruminant systems
- Feed-food competition in ruminants should consider the opportunity cost of crop production of land used
- Inefficient LUR in ruminant production
  - Use of arable suitable land for pasture
  - Inefficient systems
  - Land quality and suitability for different systems needs to be considered
- Can the LUR demonstrate **where** to site **which** livestock system?

	Dairy be		Pig
Western	0,34	),69	1,68
Eastern	0,69	864	1,74

15% Pasture suitable for cropping

44% Pasture suitable for cropping

(Hennessy et al., 2021)

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Key points 2.

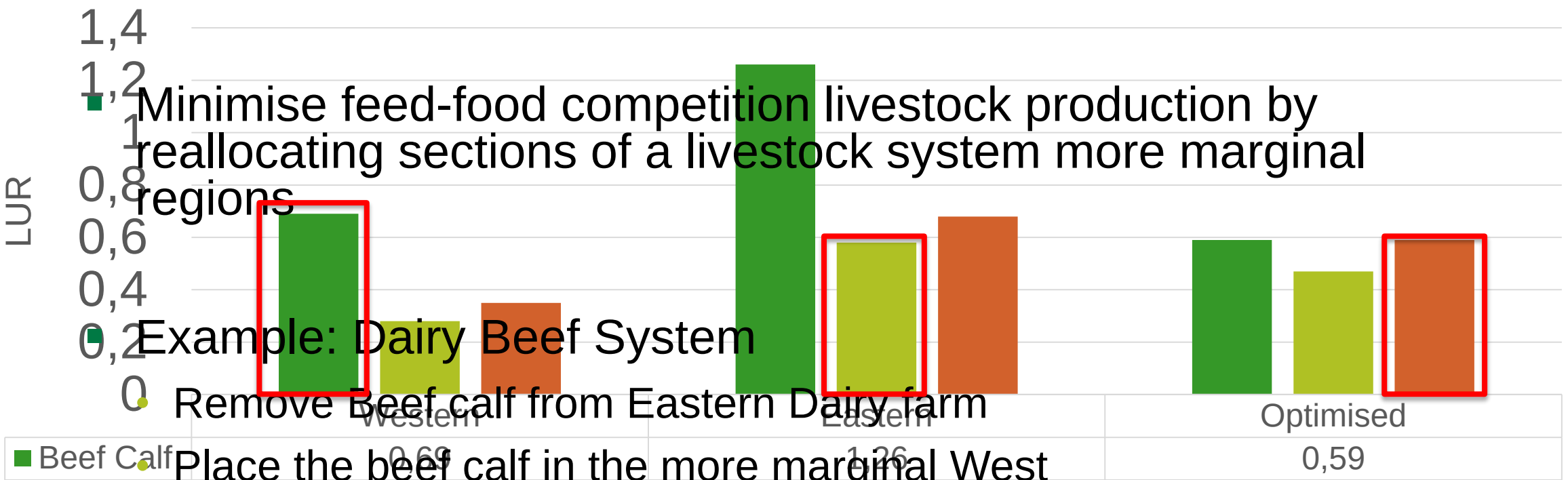
- The same ruminant system placed on lower opportunity pasture has more limited feed-food competition
- Some regions are more suitable for livestock production and contain less opportunity for alternative land-use
- Shifting ruminant numbers to such regions can maximise food production from limited agricultural land-area available
- Part of national and global livestock planning to concentrate livestock for maximal food-production

Global context of the LUR

System	Country	LUR	Source
Dairy beef	Ireland	0.54	(Hennessy et al. 2021)
Sheep	Ireland	1.09	(Hennessy et al. submitted)
Suckler beef	Ireland	1.34	(Hennessy et al. 2021)
Pig	Ireland	1.72	(Hennessy et al. 2021)
Dairy beef	Netherlands	0.67	(Van Zanten et al. 2016)
Dairy beef	Netherlands	2.10	(Van Zanten et al. 2016)
Dairy beef	North-East USA	3.40	(Tichenor et al. 2017)
Beef	North-East USA	9.20	(Tichenor et al. 2017)

Optimising system structure

- There is a finite of area in each region for ruminant production
- Minimise feed-food competition livestock production by reallocating sections of a livestock system more marginal regions
- Example: Dairy Beef System
  - Remove Beef calf from Eastern Dairy farm
  - Place the beef calf in the more marginal West



	Western	Eastern	Optimised
Beef Calf	0,69	1,26	0,59
Dairy	0,28	0,58	0,47
Combined	0,35	0,68	0,59

(Hennessy et al., 2021)

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Key points 3.

- Feed-food competition can direct **how** to structure and **where** to place livestock systems
- There is a role for effective land use planning of ruminant systems to maximise its food producing efficiency
  - Accounting for limited available land
- Combined with other environmental sustainability indicators the LUR can help plan livestock numbers in the regions they are most efficient
- Applying such concepts to a global context can allow us to provide livestock sourced food with minimal feed-food competition – thus increasing food security

Conclusion

- The LUR can quantify feed-food competition in differing livestock systems
- Confining livestock to low opportunity by product and marginal pasture is the best way of reducing feed-food competition
- Tool for land use planning directing systems to different regions
  - Outlining where crop production is the optimal land-use
- Enhancing food security globally
  - Maximising livestock productivity from limited available marginal land

Questions?