Food Futures
DRIVING SUSTAINABILITY

Measuring, Reporting, and Verifying Farm Sustainability

A Northern Ireland Case Study

QUEEN'S UNIVERSITY BELFAST | IGFS THE INSTITUTE FOR GLOBAL FOOD SECURITY

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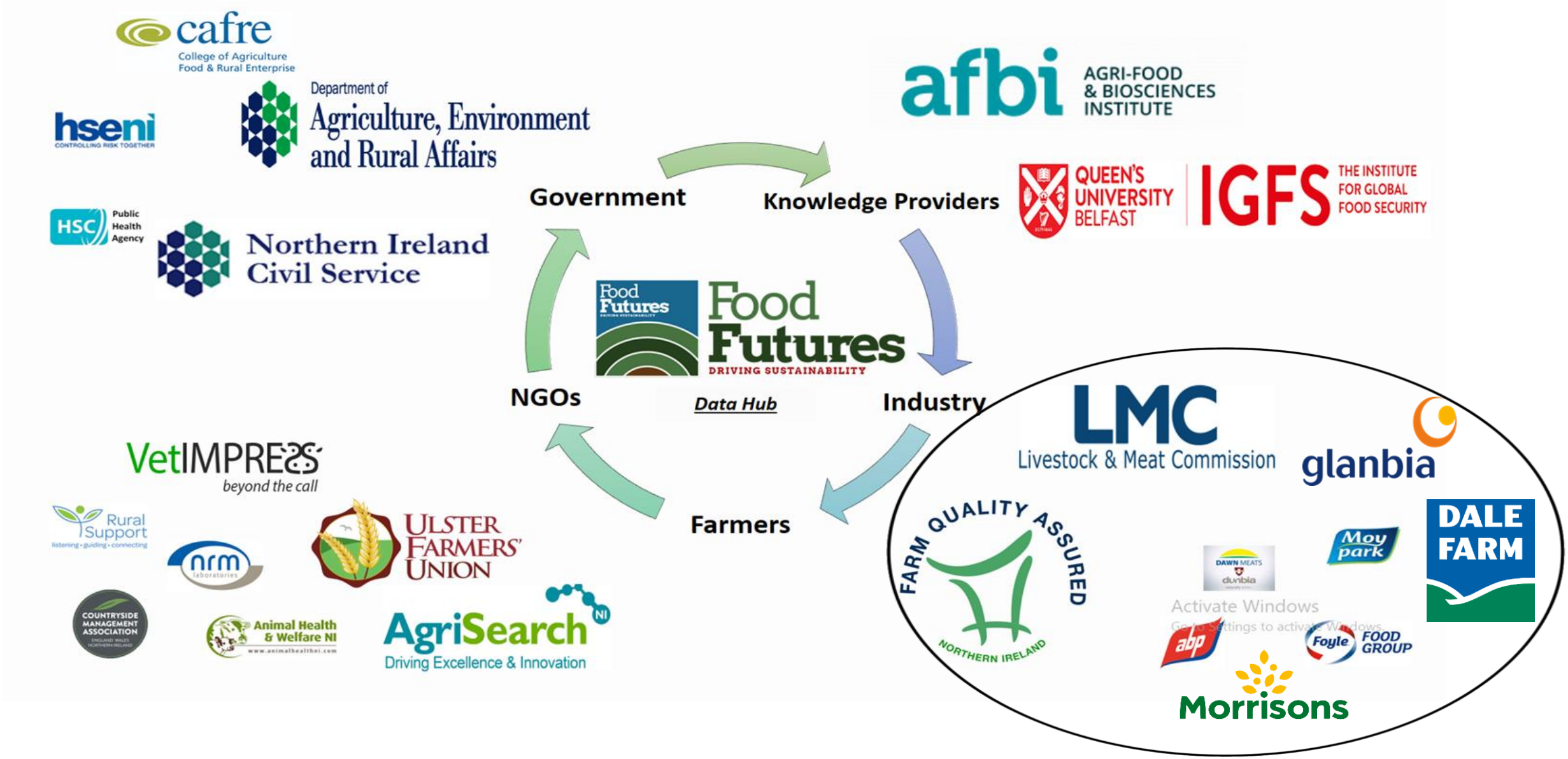
74th

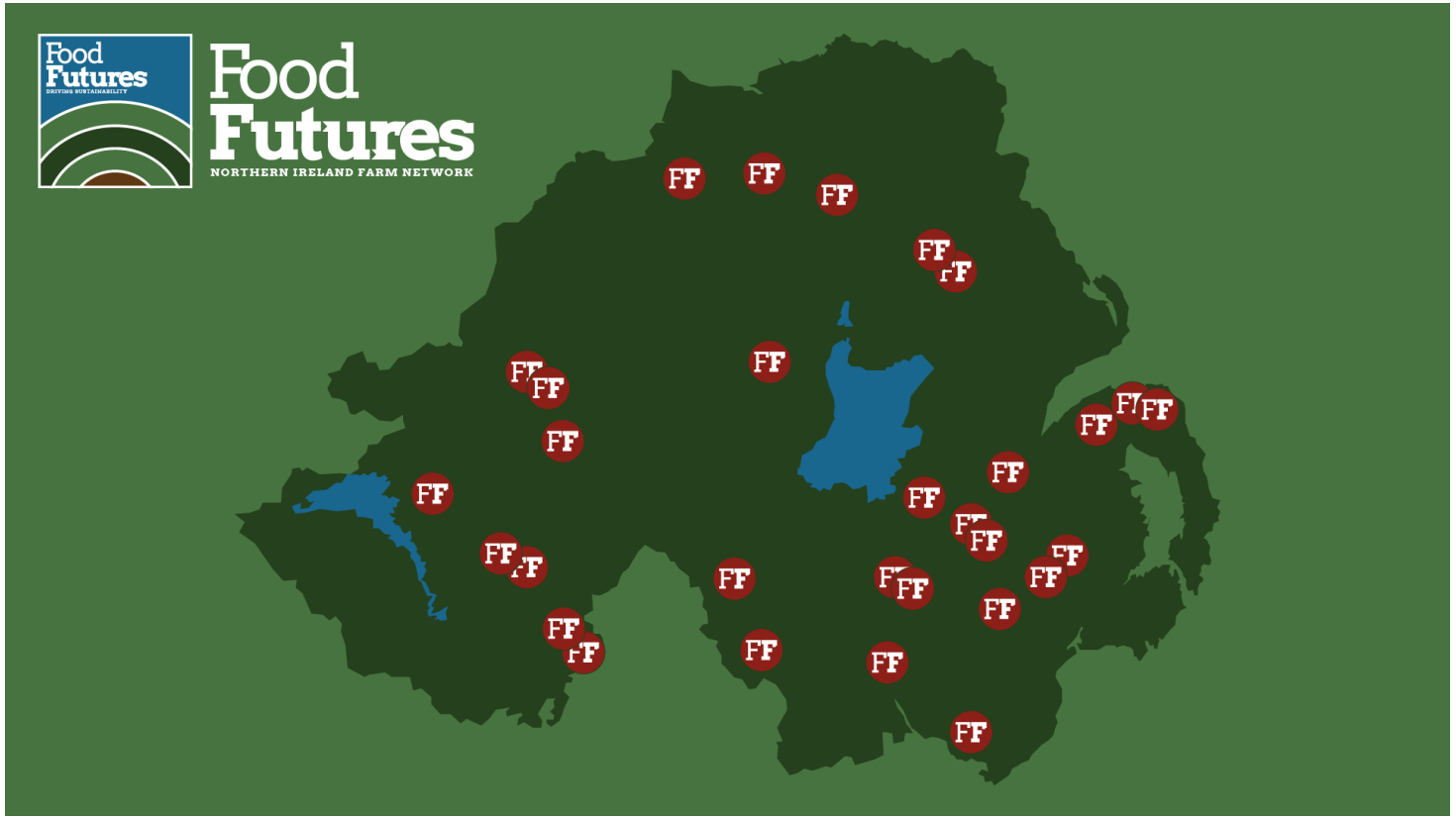
Food Futures

- A **Data**-driven (SMART) tool measuring, reporting and verifying whole-**farm sustainability**.
- This 'nature positive' SMART tool increases NI farm productivity, resource-use efficiency and protects farm-family wellbeing.
    - Scientifically robust;
    - Adapts to and satisfies emerging policy;
    - Enables industry 'buy-in'.

Food Futures Partners



30 Ambassador farms



Location of Food Futures ambassador farms in Northern Ireland

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Indicators and Metrics

8 environmental metrics

6 economic and efficiency metrics

9 Farm family well-being metrics

- ✓ Soil health
- ✓ Carbon footprint
- ✓ Biodiversity
- ✓ Profitability
- ✓ Resilience & viability
- ✓ Livestock welfare
- ✓ Professional development
- ✓ Farm health & safety
- ✓ Labour & working conditions

Scientific Merit

- Based on >150 peer reviewed papers
- Over 20 metrics developed to indicate environmental, social and economic sustainability performance
- 300 indicators/sub indicators
- Wide consultation with scientific community
- Two-way digital dashboard developed and operational
- Minimum Viable Product successfully developed


Climate change: New law in Northern Ireland aims for net zero by 2050

By Jayne McCormack
BBC News NI political correspondent

Metric Matrix (profile of environmental metrics)

Dimension (Pillar)	Metric	Indicator(s)	Criteria/Performance (Sustainability %/Points etc.)					DATA Variable Point(s)	Rationale(s)	Merit (Research/Legislation)
	Soil Biota: chemical health and nutrient availability	Do you carryout soil sampling analysis on your farm?		*No* 0	*Yes* 2				i. Soil acidity as an indicator of chemical soil quality, and nutrient and trace element availability. ii. Ecological & environmental impact of nutrient (N, P & K) run-off. iii. Nutrient inefficiencies – excessive or insufficient (minimal effects/crop penalty). iv. Aggregate stability, improving water infiltration and soil aeration, reducing runoff. Resistance to changes in pH and accelerate decomposition of soil minerals. v. Deterioration in soil physical properties and impairment of soil nutrient cycling mechanisms. vi. Soil compaction results in total porosity: reduces pore spaces, checks the transfusion and transportation of air and water within soil profile and also water retention characteristic.	**Research** (academic papers): - Cassidy et al., (2019). - Jarvie et al., (2013). - Sharpley et al., (2013). - Loveland & Webb (2003). - Dexter AR (2004). - Shah et al. (2017). - Senesi and Loffredo (2018). - Clapp et al. (2005). - Takahashi et al. (2018) - Chavez et al. (2014) - Troeh & Thompson (2005) - Pietri & Brookes (2008) - Bünemann et al. (2006) - Heckrath et al. (2007) - Jarvie et al. (2006). - Barrios (2007). - Des Jardins (2007). - Stockdale et al. (2018). - Bünemann et al. 2018 **Legislation**: - EU Nitrates Directive. - Northern Ireland Nutrient Action Programme Regulation
Environmental Integrity		Soil sampling frequency?	β_{min} 1	β_{med} 2	β_{max} 4			ES1 & ES2 (respectively)		
			All farm soils are analysed ≥ 5 year intervals or in response to need.	All farm soils are analysed every 3 – 4 years.	All farm soils are analysed ≤ 2 year intervals.					
		Method/technology used?	... Using GPS soil sampling 4	... Using GPS soil sampling 4	... Using GPS soil sampling 4			Not available yet		
			Mineral Soils							
	Soil Biota: chemical health and nutrient availability	*Optimum pH*	β_{min}	β_{med}	β_{max}	β_{med}	β_{min}			
			$\beta \leq 5.4$	$5.5 \leq \beta \leq 5.9$	$6.0 \leq \beta \leq 7.0$	$7.1 \leq \beta \leq 7.5$	$\beta \geq 7.6$			
		$\beta \leq 5.4$	β_{min} 0					ES3		
			$\beta = X\%$							

Current Functionality

Data collection: primary & secondary

Data is automatically analysed by the system

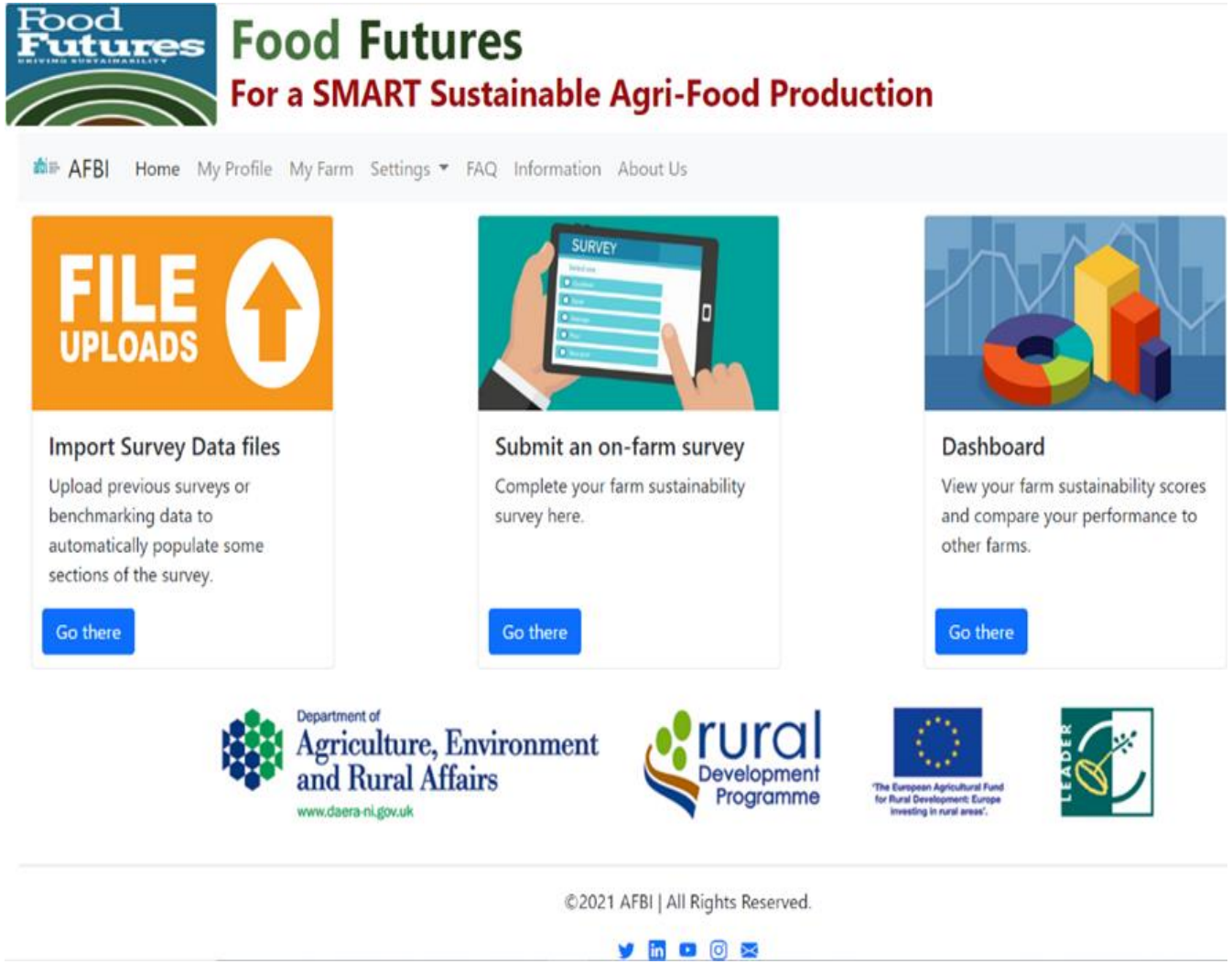
Farm advice is automatically generated

Human checking and issue of report is required

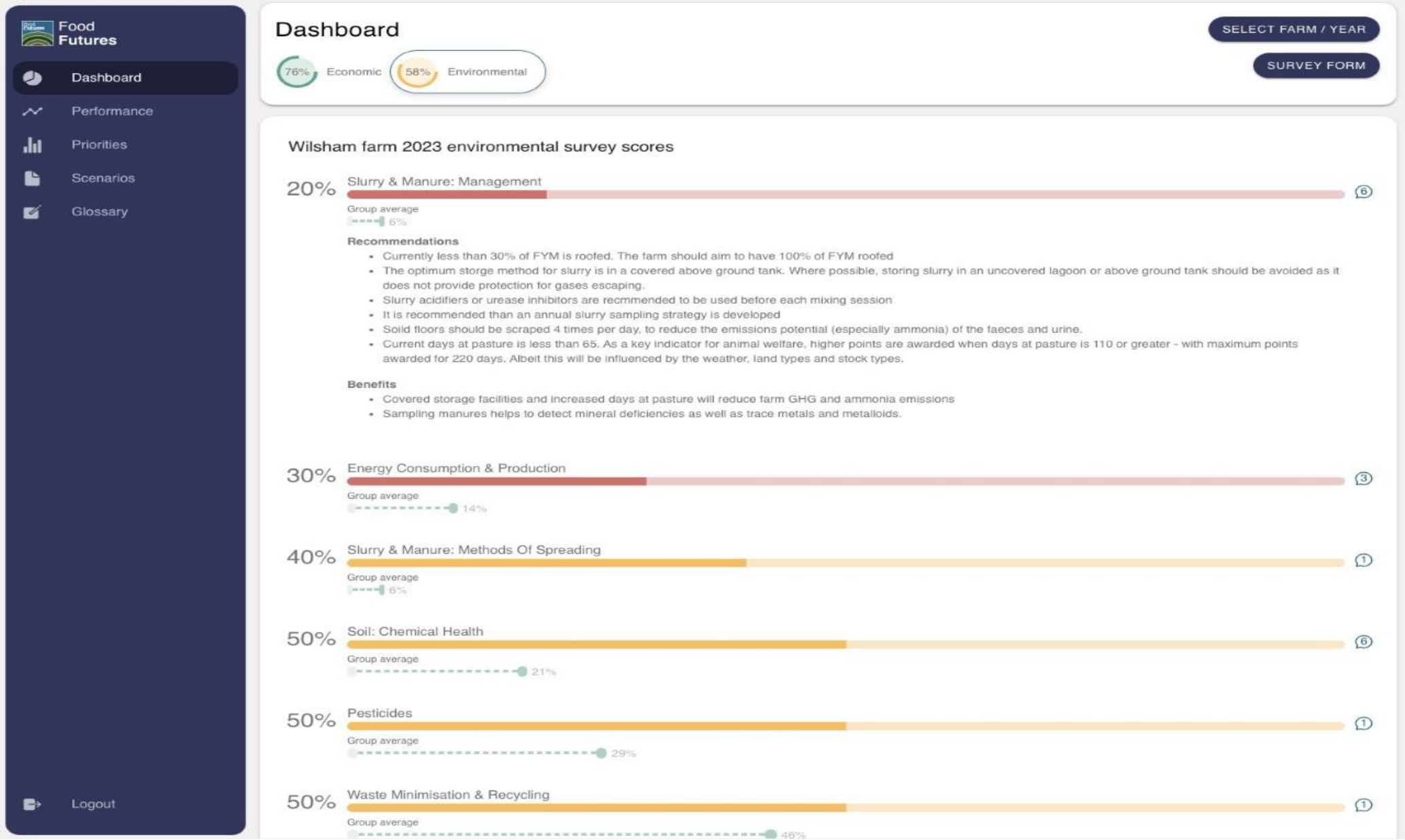
KNOWLEDGE EXCHANGE

How Does it Work?

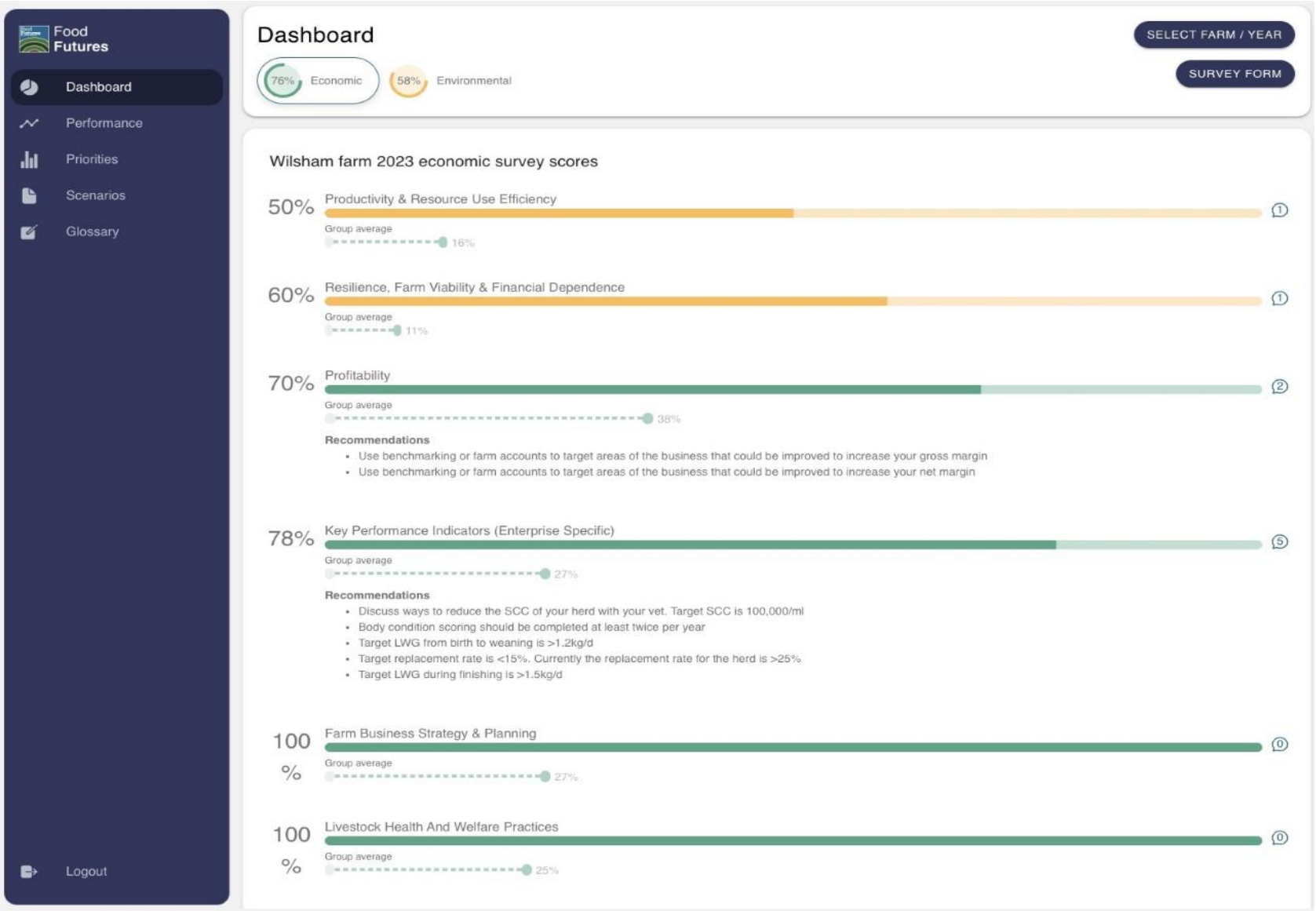
- A digital platform measuring, reporting and verifying the sustainable production of Northern Ireland agri-food:
  - Composed of >20 holistic metrics (carbon, biodiversity, profit, health & safety etc.);
  - Data integration and automation;
  - Digital technologies (LCA, GPS etc.);
  - Measures and reports whole-farm sustainability-wide performance to farmers.

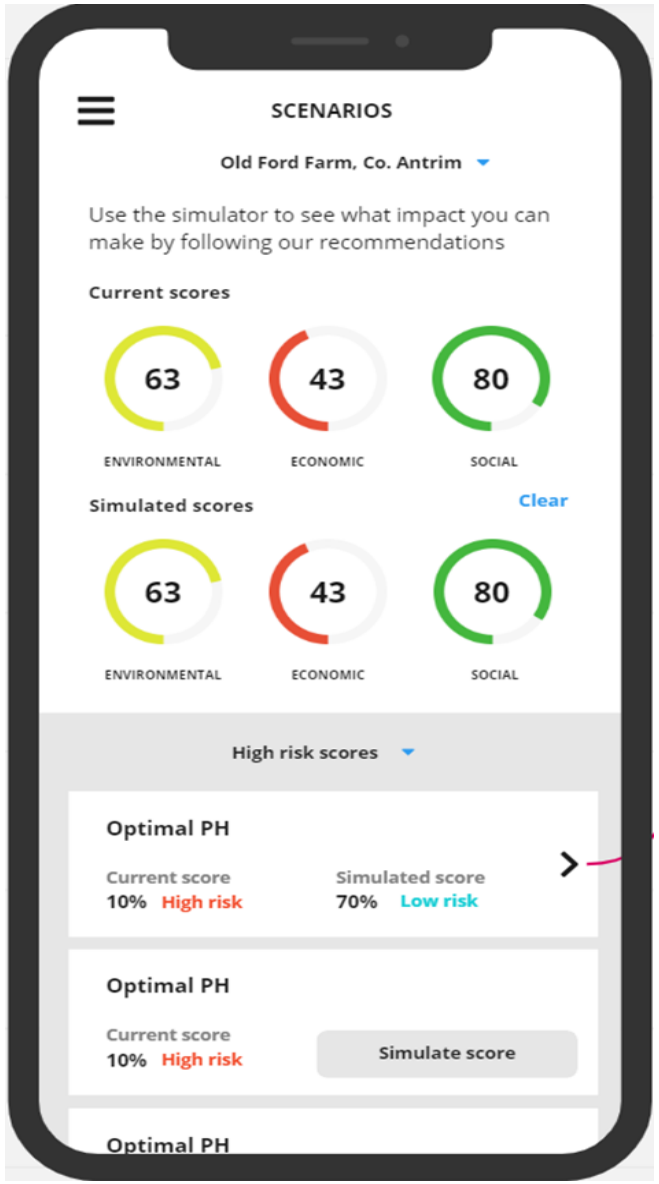


In Development



In Development





Food Futures Progress

- Phase 1:
  - 2018-2023 R&D. Funded through Invest NI, delivered by AFQCC;
  - The SMART Tool measured the sustainability performance of 30 partner farms across NI;
  - Receiving two-way knowledge-exchange outputs (graphics);
  - Tailored recommendations for improvement;
- Phase 2:
  - Food Futures LMC Pilot Study;
  - Measured the sustainability performance of 162 LMC FQA farms across NI;
  - 06/06/22 - 01/09/22;
  - Proof of concept automated process successfully developed

AGRI-FOOD QUEST
Grow through research

LMC Livestock & Meat Commission

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FARM QUALITY ASSURED
NORTHERN IRELAND

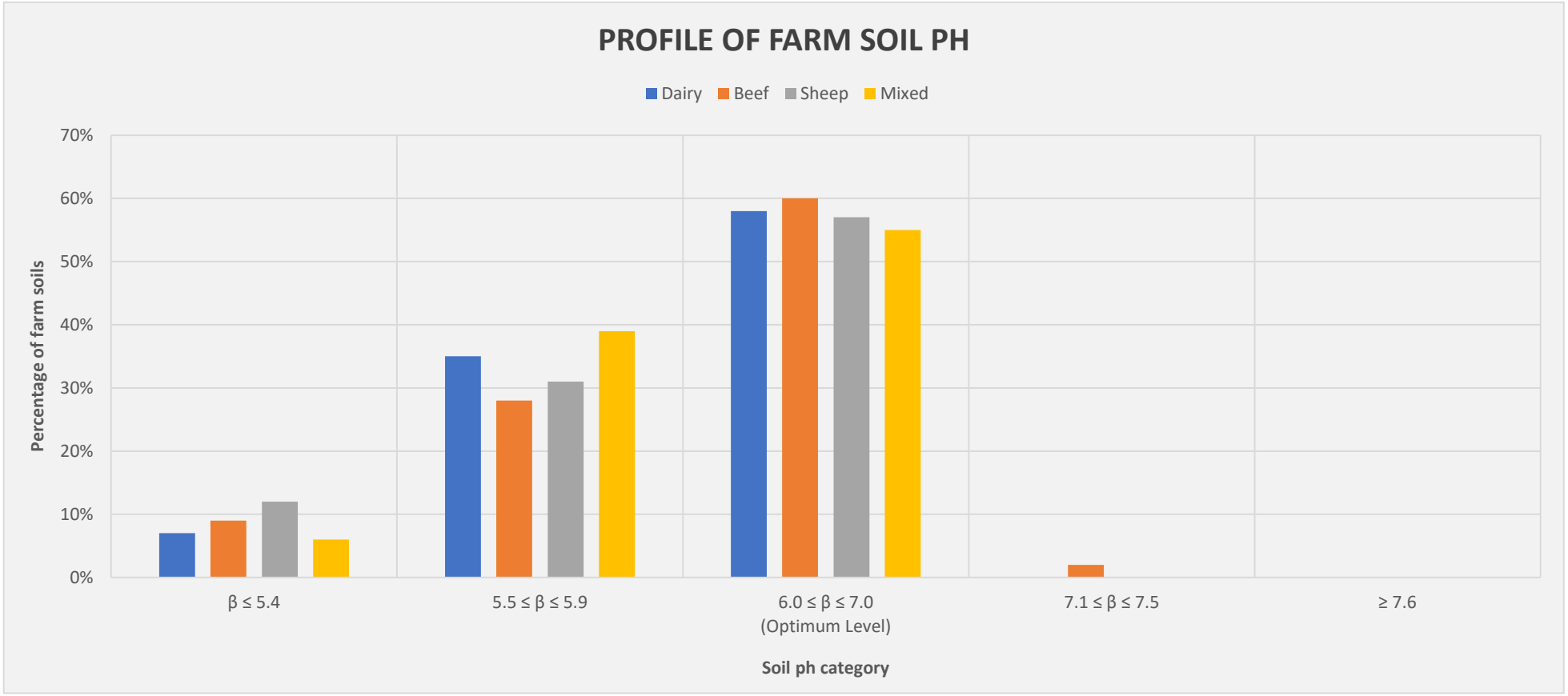
Phase 1 Results (descriptive)

Variable	Mixed	Beef	Dairy
Farm Type	6	11	12
Farm Size(ha)	90	87	78
Renewables	4	2	3
Energy Productivity (Kwh)	15kg (lamb)	15kg	38(l)
Profitable without subsidy (%)	33%	45%	84%
No. of days off in the year	10	13	10
Willing to monitor GHG & NH3 footprint	100%	100%	100%
Willing to farm to reduce GHG & NH3 footprint	100%	100%	100%

Phase 1 Metric Results

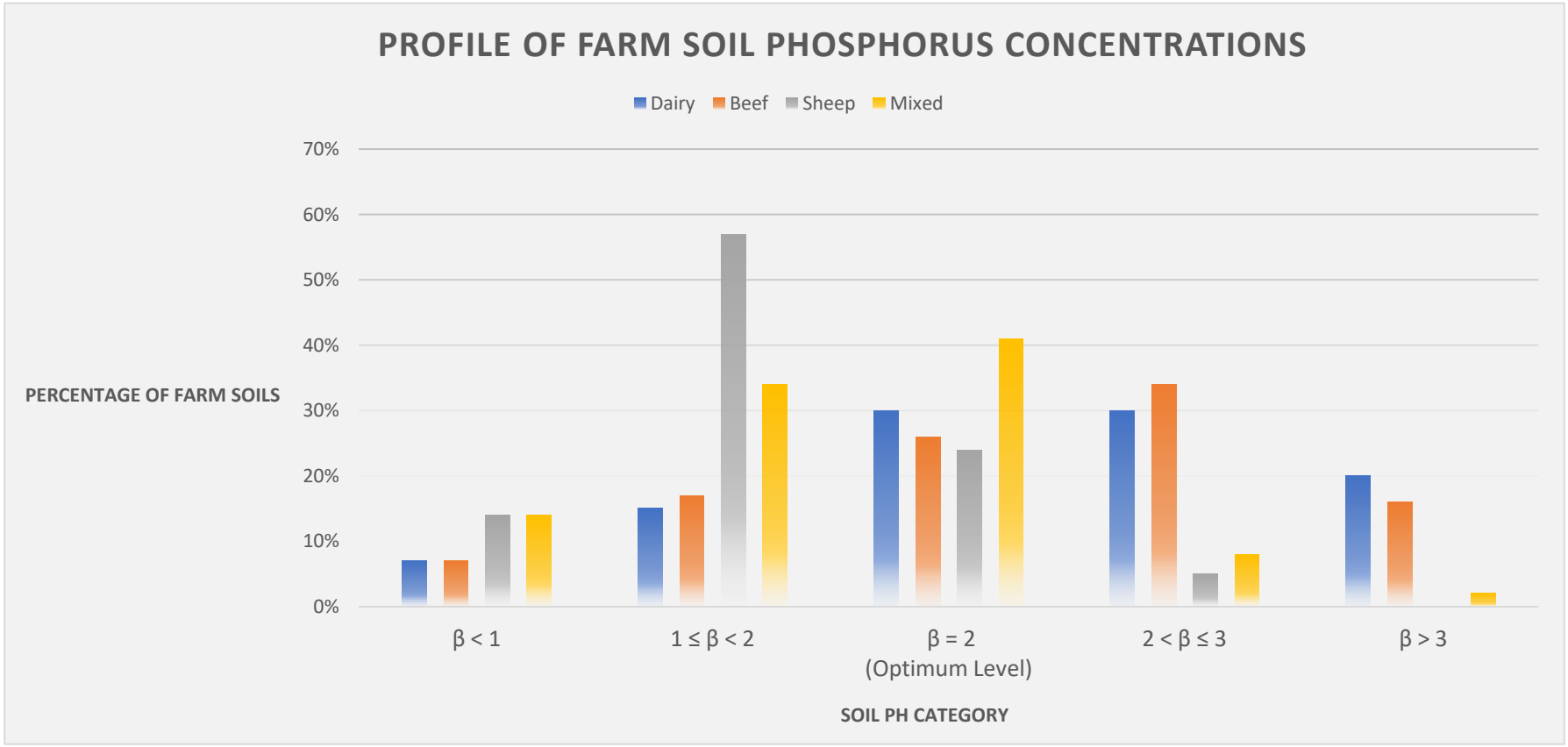
Metric: Soil health
Indicator: Soil pH

Figure 1: Percentage of farm soils (mineral) within respective pH levels (categories)



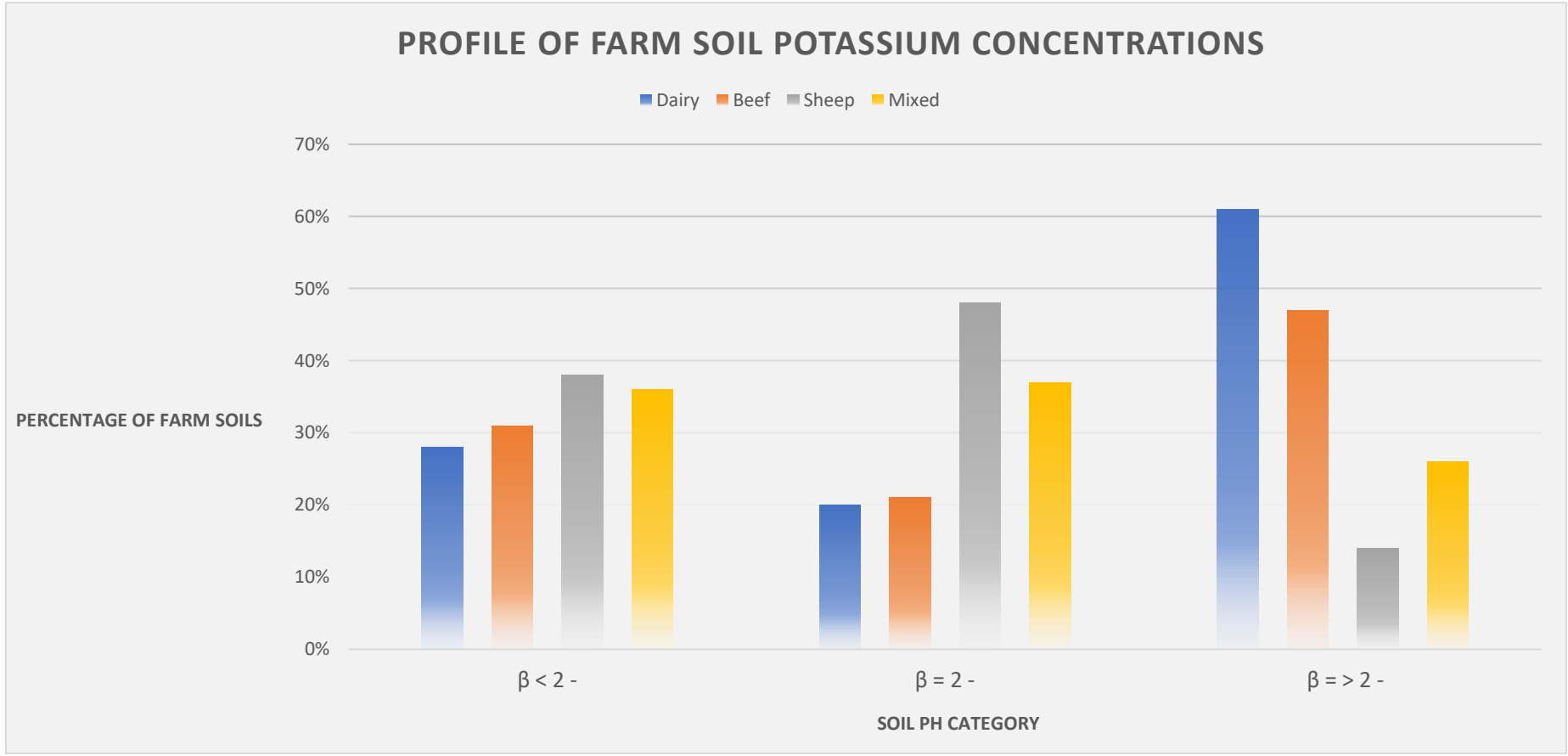
Phase 1 Metric Results

Metric: Soil health
Indicator: Phosphorus concentration



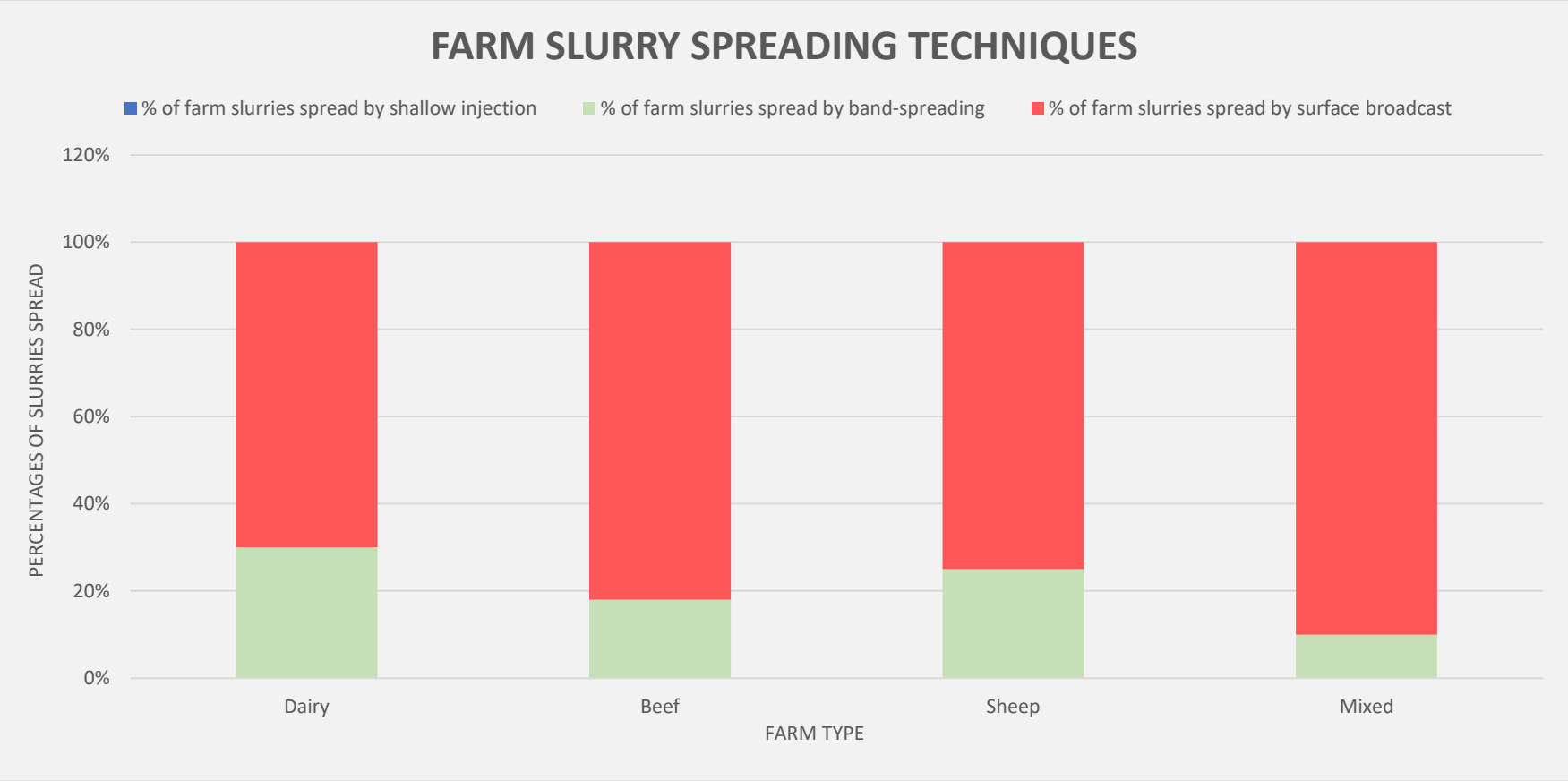
Phase 1 Metric Results

Metric: Soil health
Indicator: Potassium concentration

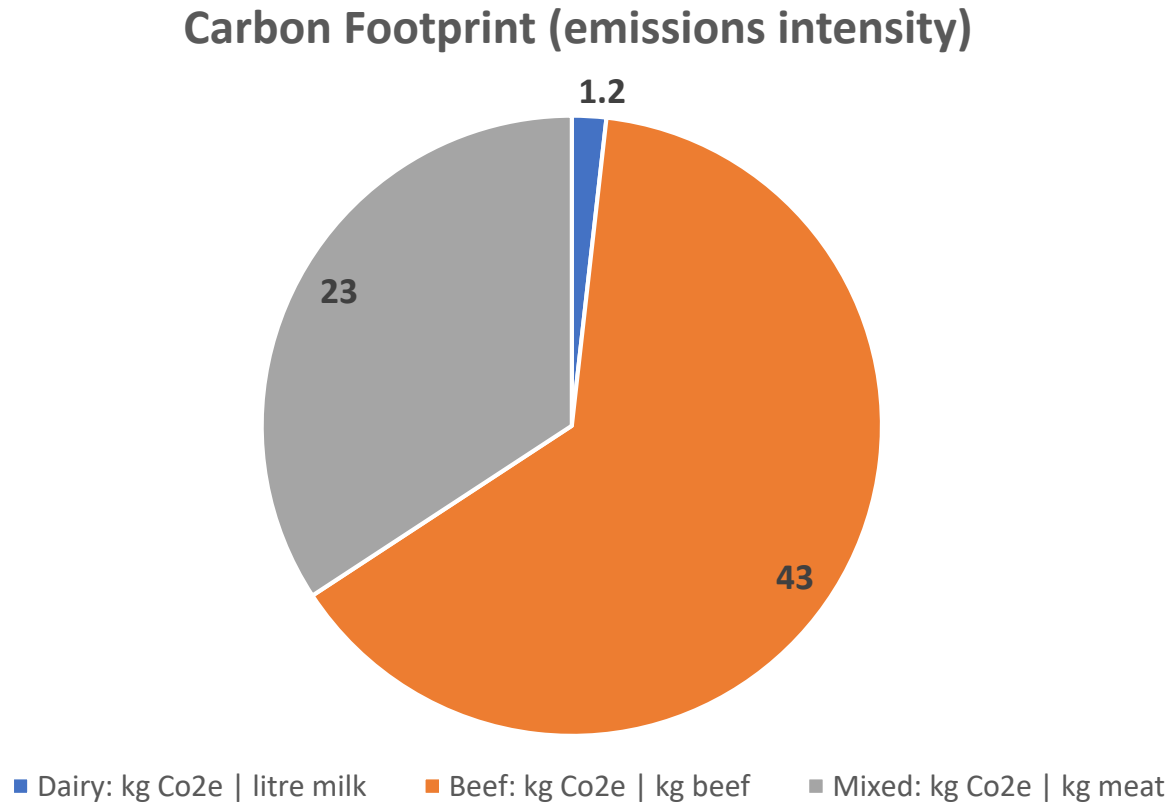


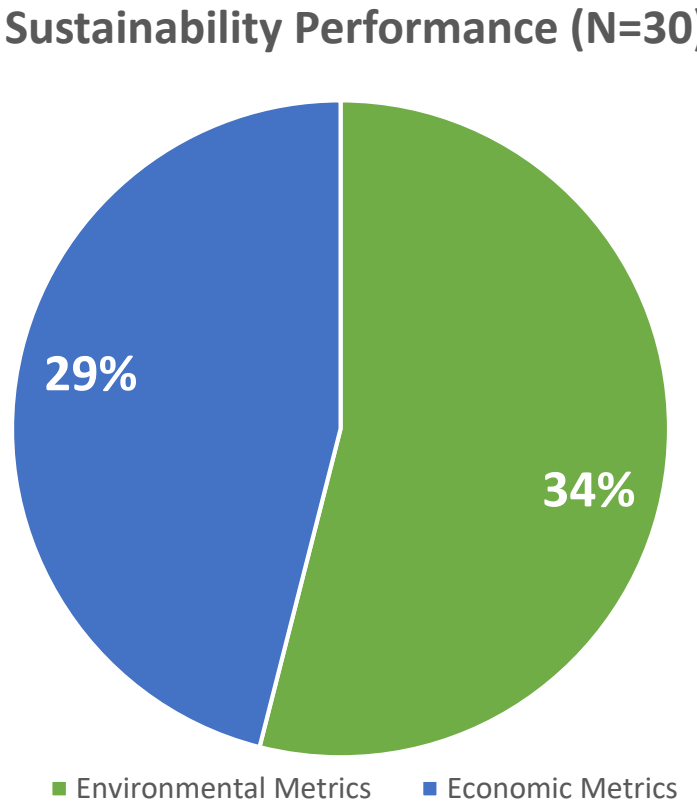
Phase 1 Metric Results

Metric: Slurry & manures: methods of spreading
Indicator: Shallow Injection, Bandspreading and Broadcast



Phase 1 Results: Sustainability Performance





Farm	Environmental	Economic
Dairy	34	28
Beef	33	25
Mixed	36	38

In Summary

- Scientifically informed; serving industry; satisfying policy;
- Provision and automation of data;
- Defend and improve agri-food production;
- Deliver farm profits through environmental regeneration and the protection of farm-family well-being.

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Thank You