**Table S1.** Measures of centrality, in-degree and out-degree of the 33 components in the pasture-fed beef production system as defined by the Pasture For Life research group. Terms in bold are those used as shorthand for these concepts in Figures 1 and 2.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sustainability pillar** | **Components** | **Centrality** | **Out-degree** | **In-degree** |
| Environmental | **Vegetation quality**  | 10.80 | 7.10 | 3.70 |
| **Vegetation quantity** | 8.60 | 4.00 | 4.60 |
| **Water quality** | 4.20 | 0.80 | 3.40 |
| **Water quantity** | 3.60 | 1.10 | 2.50 |
| **Soil health** | 8.50 | 4.00 | 4.50 |
| Proportion **(%)** of **non cropped** habitat | 6.30 | 5.20 | 1.10 |
| **Connectivity** of **non cropped** habitat | 1.60 | 0.00 | 1.60 |
| **Renewable energy** use | 1.10 | 0.40 | 0.70 |
| **Fossil fuel** usage | 6.20 | 2.00 | 4.20 |
| **Preventive** stock **health** | 3.10 | 0.00 | 3.10 |
| **Fertiliser usage** | 6.80 | 3.30 | 3.50 |
| **Paddock size** | 2.00 | 1.50 | 0.50 |
| Economic | **Net margin** | 2.80 | 0.20 | 2.60 |
| Farm **capital assets** | 1.30 | 0.00 | 1.30 |
| **Owned:rented land** | 0.90 | 0.90 | 0.00 |
| **Farm size** | 1.20 | 1.20 | 0.00 |
| Number of **(No) farm enterprises** | 1.50 | 1.10 | 0.40 |
| Number of **(No) farm products** | 1.60 | 0.00 | 1.60 |
| Length of **supply chain** | 2.20 | 1.80 | 0.40 |
| Amount of on **farm processing** | 1.30 | 0.40 | 0.90 |
| Social | Number of on-**farm events** | 1.30 | 1.10 | 0.20 |
| Number of **public footpaths** | 0.50 | 0.50 | 0.00 |
| Amount of **links** to local **infrastructure** | 1.30 | 0.20 | 1.10 |
| **Willingness to** try and **learn** new things | 3.30 | 2.20 | 1.10 |
| Amount of **training/knowledge exchange** | 2.40 | 1.20 | 1.20 |
| **Nutritional density** of food produced | 1.60 | 0.90 | 0.70 |
| Number of **(No) native breeds** | 2.20 | 2.20 | 0.00 |
| Governance | Length of **grazing period** | 3.40 | 0.60 | 2.80 |
| **Muck application** rates | 4.30 | 3.60 | 0.70 |
| Amount of **government** support **payments** | 1.70 | 0.00 | 1.70 |
| **Grass use efficiency** (sustainable grazing practices) | 8.70 | 4.80 | 3.90 |
| External **monitoring** e.g. of animal **welfare** | 0.20 | 0.20 | 0.00 |
|  | **Farmer monitoring** of outcomes | 2.70 | 2.10 | 0.60 |

**Table S2.** Measures of centrality, In-degree, and Out-degree of the 38 components in the conventional beef production system as defined by 15 stakeholders from across the beef production sector. Terms in bold are used as shorthand for these concepts in Figures 3 and 4.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sustainability pillar** | **Concepts** | **Centrality** | **Outdegree** | **Indegree** |
| Environmental | **Soil health** | 6.50 | 3.10 | 3.40 |
| **Seasonal productivity** | 5.00 | 2.10 | 2.90 |
| **National herd size** | 6.50 | 2.20 | 4.30 |
| Ability to meet **climate change targets** | 8.60 | 2.00 | 6.60 |
| **Production efficiency** | 7.40 | 2.40 | 5.00 |
| Amount of **imported feed** | 8.10 | 3.50 | 4.60 |
| Occurrence of **extreme weather** | 3.50 | 3.50 | 0.00 |
| **Biodiversity of sward** | 1.40 | 0.70 | 0.70 |
| Extent of **environmental regulations** | 9.10 | 7.70 | 1.40 |
| Ratio of land use for farming versus other uses (**Farming land use ratio**) | 7.10 | 2.70 | 4.40 |
| Proportion of **feed from** agricultural **by-products** | 4.40 | 3.20 | 1.20 |
| Economic | **Income** from **subsidies**  | 2.00 | 0.50 | 1.50 |
| Retailer/food services **food demand** | 4.80 | 3.10 | 1.70 |
| **Exchange rate** (value of pound) | 1.40 | 1.40 | 0.00 |
| **Price per kg** | 7.80 | 3.90 | 3.90 |
| **Feed costs** | 6.00 | 1.10 | 4.90 |
| Number of **farms** participating in farm records/**benchmarking** | 4.90 | 3.60 | 1.30 |
| **Import tariffs**  | 2.50 | 2.50 | 0.00 |
| **Ability to export** produce | 6.90 | 2.40 | 4.50 |
| **Relative affordability** | 2.80 | 0.50 | 2.30 |
| Social | Number of on **farm events** | 1.90 | 1.70 | 0.20 |
| Success of **vegan messaging** | 4.40 | 2.30 | 2.10 |
| Amount of **positive messaging** for meat | 5.30 | 2.00 | 3.30 |
| **Consumer demand** for meat | 5.10 | 3.70 | 1.40 |
| **Employment** | 1.60 | 0.20 | 1.40 |
| **Training / skill level** (individual) | 4.00 | 2.60 | 1.40 |
| **Demand for local** food | 5.40 | 3.20 | 2.20 |
| Consumer **demand for** increased **environmental** **management** | 4.10 | 3.20 | 0.90 |
| Governance | Number of **members of assurance schemes** and standards | 6.30 | 2.60 | 3.70 |
| Proportion of **animals from dairy** sector | 1.70 | 0.20 | 1.50 |
| Amount of **feed and straw** available | 3.60 | 1.40 | 2.20 |
| Extent of resources / **farm infrastructure** available | 5.50 | 4.10 | 1.40 |
| **Earned recognition** - amount and opportunity | 4.30 | 1.20 | 3.10 |
| **Confidence** level of producers towards industry (**in**) **leadership** | 2.20 | 0.50 | 1.70 |
| Level of health and **welfare compliance** | 4.10 | 1.40 | 2.70 |
| **Renewable energy** targets | 0.70 | 0.50 | 0.20 |
| Scope of **C footprint** measurement | 2.20 | 1.20 | 1.00 |
| **Miles travelled** by livestock | 2.70 | 1.80 | 0.90 |

**Figure S1.** Results of the FCM scenario analysis. Relative change (%) in the values of components in the conventional beef production system based on a decrease in production efficiency, and an increase in price per kilo, training/skill level, and farm infrastructure/resources. This illustrates the effect predicted by participants on the main components of UK beef production if it were switched to an entirely pasture-fed system. Percent change is relative to the value of components in the conventional beef production system FCM (Figure 2). Changes to “Amount of imported feed” (shaded grey) is an artefact of the modelling approach (see Discussion section below).