**Supplementary Table S1** *Scores observed in the 15 farming systems for the 5 primary indicators1 of the theme “Animal welfare”*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Systems | C-1 | C-2 | C-3 | C-4 | C-5 | AC-1 | AC-2 | AC-3 | AC-4 | AC-5 | O-1 | O-2 | T-1 | T-2 | T-3 |
| AW\_HunThi | 0.12 | 0.11 | -0.39 | -0.03 | 0.20 | 0.04 | 0.19 | 0.07 | 0.01 | -0.32 | 0.20 | 0.06 | -0.28 | -0.20 | 0.17 |
| AW\_PaiDis | 0.37 | 0.10 | -0.20 | 0.21 | -0.12 | 0.05 | 0.15 | 0.05 | 0.21 | -0.29 | -0.12 | 0.09 | -0.12 | -0.34 | -0.06 |
| AW\_NatBeh | -0.06 | -0.21 | -0.34 | -0.19 | -0.02 | 0.30 | 0.13 | -0.23 | -0.10 | 0.30 | 0.16 | 0.25 | 0.06 | -0.08 | 0.04 |
| AW\_Discom | 0.22 | -0.39 | -0.39 | -0.09 | 0.01 | -0.09 | 0.22 | -0.12 | -0.09 | 0.06 | 0.12 | 0.12 | 0.01 | 0.12 | 0.29 |
| AW\_FeaDis | 0.22 | 0.05 | -0.05 | -0.07 | 0.05 | -0.11 | 0.37 | -0.11 | -0.05 | -0.16 | 0.05 | 0.24 | 0.10 | -0.49 | -0.05 |
| AW | 1.31 | -0.50 | -2.06 | -0.24 | 0.19 | 0.31 | 1.60 | -0.49 | -0.02 | -0.63 | 0.62 | 1.15 | -0.33 | -1.50 | 0.60 |

1 AW\_HunThi: Freedom from Hunger & Thirst; AW\_PaiDis: Freedom from Pain & Disease; AW\_NatBeh: Freedom to express Natural behaviours; AW\_Discom: Freedom from Discomfort; AW\_FeaDis: Freedom from Fear & Distress; AW = Average score for the theme “Animal welfare”.

**Supplementary Table S2** *Scores observed in the 15 farming systems for the 4 primary indicators1 of the theme “Animal health”*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Systems | C-1 | C-2 | C-3 | C-4 | C-5 | AC-1 | AC-2 | AC-3 | AC-4 | AC-5 | O-1 | O-2 | T-1 | T-2 | T-3 |
| AH\_PreMan | 0.24 | 0.13 | 0.08 | 0.18 | -0.10 | 0.22 | 0.30 | -0.02 | 0.15 | -0.12 | -0.17 | 0.19 | -0.42 | -0.58 | -0.08 |
| AH\_DisSta | -0.24 | 0.01 | 0.01 | 0.07 | -0.19 | 0.43 | 0.12 | 0.09 | 0.12 | 0.08 | -0.03 | -0.37 | -0.55 | 0.31 | 0.14 |
| AH\_Parasi | -0.02 | -0.19 | 0.18 | 0.26 | -0.29 | 0.40 | 0.38 | -0.19 | 0.26 | 0.11 | -0.20 | -0.29 | -0.29 | 0.03 | -0.14 |
| AH\_HeaSta | 0.07 | 0.05 | 0.19 | 0.20 | -0.46 | 0.37 | -0.29 | 0.12 | 0.07 | 0.10 | -0.51 | 0.12 | 0.14 | 0.03 | -0.19 |
| AH | 0.07 | 0.01 | 0.65 | 1.01 | -1.50 | 2.03 | 0.74 | 0.02 | 0.85 | 0.25 | -1.32 | -0.51 | -1.60 | -0.31 | -0.39 |

1 AH\_PreMan: Preventive Health Management; AH\_DisSta: Disease status; AH\_Parasi: Parasite control; AH\_HeaSta: Health status; AH = Average score for the theme “Animal health”.

**Supplementary Table S3** *Scores observed in the 15 farming systems for the 4 primary indicators1 of the theme “Breeding programmes”*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Systems | C-1 | C-2 | C-3 | C-4 | C-5 | AC-1 | AC-2 | AC-3 | AC-4 | AC-5 | O-1 | O-2 | T-1 | T-2 | T-3 |
| BP\_BreGoa | 0.06 | 0.19 | 0.13 | 0.39 | 0.22 | -0.15 | -0.35 | 0.33 | -0.08 | -0.01 | -0.35 | -0.35 | -0.15 | -0.15 | 0.26 |
| BP\_RecSel | 0.13 | 0.33 | 0.02 | 0.23 | 0.23 | -0.08 | -0.19 | 0.44 | -0.08 | 0.13 | -0.19 | -0.19 | -0.40 | -0.40 | 0.02 |
| BP\_GenVar | -0.09 | -0.09 | -0.29 | 0.22 | -0.27 | 0.22 | -0.29 | 0.42 | 0.11 | 0.01 | -0.40 | -0.19 | 0.22 | 0.22 | 0.22 |
| BP\_ManOrg | 0.02 | 0.32 | 0.09 | 0.40 | 0.09 | 0.02 | -0.14 | 0.40 | 0.02 | -0.06 | -0.14 | -0.14 | -0.06 | -0.53 | -0.29 |
| BP | 0.14 | 0.97 | -0.07 | 1.59 | 0.34 | 0.00 | -1.24 | 2.04 | -0.04 | 0.08 | -1.38 | -1.12 | -0.50 | -1.09 | 0.26 |

1 BP\_BreGoa: Breeding Goal & Market; BP\_RecSel: Recording & Selection; BP\_GenVar: Genetic Variation; BP\_ManOrg: Management of Breeding Organisation; BP = Average score for the theme “Breeding programmes”

**Supplementary Table S4** *Scores observed in the 15 farming systems for the 6 primary indicators1 of the theme “Environment”*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Systems | C-1 | C-2 | C-3 | C-4 | C-5 | AC-1 | AC-2 | AC-3 | AC-4 | AC-5 | O-1 | O-2 | T-1 | T-2 | T-3 |
| EN\_CC | 0.14 | 0.07 | 0.10 | 0.16 | 0.09 | 0.07 | 0.13 | -0.33 | 0.20 | -0.13 | 0.08 | 0.03 | -0.49 | -0.22 | 0.09 |
| EN\_APkg | 0.01 | 0.04 | 0.05 | 0.10 | -0.04 | 0.13 | 0.01 | -0.20 | 0.12 | 0.11 | 0.01 | -0.16 | -0.08 | -0.07 | -0.01 |
| EN\_CED | 0.09 | 0.07 | 0.09 | 0.11 | 0.09 | 0.15 | 0.10 | -0.12 | 0.17 | 0.05 | 0.08 | -0.08 | -0.57 | -0.31 | 0.09 |
| EN\_LO | 0.11 | 0.14 | 0.12 | 0.13 | 0.12 | 0.13 | 0.10 | -0.01 | 0.14 | 0.07 | -0.09 | -0.23 | -0.51 | -0.32 | 0.10 |
| EN\_APha | -0.07 | -0.10 | -0.06 | 0.00 | -0.14 | 0.01 | -0.07 | -0.09 | 0.00 | 0.07 | 0.10 | 0.08 | 0.19 | 0.15 | -0.08 |
| EN\_EP | -0.10 | -0.20 | -0.13 | -0.07 | -0.22 | -0.01 | -0.10 | -0.17 | -0.02 | 0.05 | 0.43 | 0.37 | 0.18 | 0.15 | -0.14 |
| EN | 0.40 | 0.09 | 0.34 | 0.72 | -0.05 | 0.78 | 0.39 | -1.48 | 1.04 | 0.26 | 1.04 | 0.11 | -2.53 | -1.26 | 0.16 |

1 EN\_CC: Climate change per kg; EN\_APkg: Acidification per kg; EN\_CED: Energy demand per kg; EN\_LO: Land occupation per kg; EN\_APha: Acidification per ha; EN\_EP: Eutrophication per ha; EN = Average score for the theme “Environment”.

**Supplementary Table S5** *Scores observed in the 15 farming systems for the 6 primary indicators1 of the theme “Meat safety”*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Systems | C-1 | C-2 | C-3 | C-4 | C-5 | AC-1 | AC-2 | AC-3 | AC-4 | AC-5 | O-1 | O-2 | T-1 | T-2 | T-3 |
| MS\_Genera | 0.10 | -0.41 | 0.05 | -0.02 | 0.10 | 0.10 | 0.10 | -0.24 | 0.08 | 0.10 | 0.05 | 0.10 | -0.28 | 0.10 | 0.10 |
| MS\_Contac | 0.22 | 0.03 | -0.18 | 0.14 | -0.05 | 0.01 | 0.22 | 0.03 | 0.13 | -0.19 | -0.05 | 0.22 | -0.23 | -0.26 | -0.06 |
| MS\_PerHyg | 0.23 | 0.04 | -0.02 | 0.11 | -0.07 | 0.05 | 0.23 | -0.03 | 0.11 | -0.11 | -0.11 | 0.22 | -0.21 | -0.35 | -0.09 |
| MS\_CleDis | 0.21 | 0.18 | 0.04 | 0.04 | -0.26 | 0.04 | 0.21 | 0.18 | 0.06 | 0.01 | -0.21 | 0.07 | -0.24 | -0.17 | -0.15 |
| MS\_VacMan | 0.19 | 0.12 | 0.03 | 0.13 | -0.33 | -0.06 | 0.19 | 0.12 | 0.11 | -0.07 | -0.23 | 0.19 | -0.07 | -0.16 | -0.15 |
| MS\_Verifi | 0.12 | 0.12 | 0.06 | -0.10 | -0.33 | 0.12 | 0.12 | 0.04 | -0.05 | 0.12 | -0.28 | 0.12 | 0.12 | 0.06 | -0.27 |
| MS | 1.53 | 0.11 | -0.04 | 0.44 | -1.35 | 0.37 | 1.52 | 0.14 | 0.61 | -0.20 | -1.17 | 1.31 | -1.29 | -1.11 | -0.89 |

1 MS\_Genera: General; MS\_Contac: Contact with outside environment; MS\_PerHyg: Personal Hygiene; MS\_CleDis: Cleaning & Disinfection; MS\_VacMan: Vaccination management; MS\_Verifi: Verification; MS = Average score for the theme “Meat safety”.

**Supplementary Table S6** *Scores observed in the 15 farming systems for the primary indicator of the theme “Market Conformity”*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Systems | C-1 | C-2 | C-3 | C-4 | C-5 | AC-1 | AC-2 | AC-3 | AC-4 | AC-5 | O-1 | O-2 | T-1 | T-2 | T-3 |
| MarkConf-MC | -0.57 | -1.34 | -0.82 | 0.29 | 1.08 | 0.29 | -1.90 | 0.26 | 0.29 | -0.75 | 1.29 | -0.01 | 1.21 | -0.70 | 1.38 |

**Supplementary Table S7** *Scores observed in the 15 farming systems for the 6 primary indicators1 of the theme “Economy”*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Systems | C-1 | C-2 | C-3 | C-4 | C-5 | AC-1 | AC-2 | AC-3 | AC-4 | AC-5 | O-1 | O-2 | T-1 | T-2 | T-3 |
| EC\_Viabil | -0.22 | 0.32 | 0.23 | 0.43 | -0.15 | -0.22 | -0.06 | 0.00 | 0.10 | -0.04 | 0.07 | -0.05 | -0.19 | -0.01 | -0.21 |
| EC\_Specia | -0.01 | -0.15 | 0.00 | -0.06 | -0.02 | -0.06 | 0.04 | -0.06 | -0.06 | 0.09 | -0.01 | 0.02 | -0.02 | 0.31 | -0.02 |
| EC\_FinAut | -0.17 | 0.32 | -0.06 | -0.01 | -0.09 | -0.17 | -0.14 | 0.02 | -0.13 | -0.05 | 0.15 | -0.12 | 0.18 | 0.19 | 0.08 |
| EC\_RelSub | -0.11 | 0.10 | 0.05 | 0.10 | -0.18 | 0.10 | 0.01 | 0.10 | 0.10 | -0.02 | -0.16 | 0.01 | 0.08 | -0.04 | -0.11 |
| EC\_Transf | -0.12 | -0.06 | -0.03 | -0.11 | -0.13 | -0.06 | -0.12 | -0.06 | -0.13 | 0.04 | -0.09 | -0.03 | 0.53 | 0.42 | -0.06 |
| EC\_Effici | -0.23 | 0.23 | 0.45 | -0.04 | -0.27 | -0.17 | 0.32 | -0.33 | -0.03 | 0.08 | -0.17 | -0.18 | 0.14 | 0.38 | -0.17 |
| EC | -1.33 | 1.23 | 1.21 | 0.45 | -1.28 | -0.96 | 0.21 | -0.70 | -0.24 | 0.16 | -0.33 | -0.62 | 1.09 | 1.89 | -0.78 |

1 EC\_Viabil: Economic viability; EC\_Specia: Economic specialisation; EC\_FinAut: Financial autonomy; EC\_RelSub: Reliance on subsidies; EC\_Transf: Transferability; EC\_Effici: Efficiency; EC = Average score for the theme “Economy”.

**Supplementary Table S8** *Scores observed in the 15 farming systems for the 5 primary indicators1 of the theme “Working conditions”*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Systems | C-1 | C-2 | C-3 | C-4 | C-5 | AC-1 | AC-2 | AC-3 | AC-4 | AC-5 | O-1 | O-2 | T-1 | T-2 | T-3 |
| WC\_AutSco | 0.19 | 0.06 | 0.09 | 0.15 | 0.19 | 0.02 | 0.13 | 0.07 | 0.15 | -0.17 | -0.08 | -0.15 | -0.26 | -0.32 | -0.08 |
| WC\_PeLigh | 0.15 | -0.08 | -0.14 | -0.14 | -0.18 | 0.15 | -0.21 | 0.07 | -0.15 | -0.10 | 0.12 | 0.33 | 0.19 | 0.11 | -0.12 |
| WC\_FacPer | -0.06 | 0.11 | 0.04 | -0.04 | 0.11 | 0.11 | 0.11 | -0.06 | 0.11 | -0.24 | 0.11 | 0.06 | -0.48 | -0.01 | 0.11 |
| WC\_PePlea | 0.14 | -0.22 | 0.09 | -0.08 | -0.28 | 0.27 | 0.05 | -0.12 | -0.03 | -0.06 | -0.12 | 0.34 | 0.05 | 0.02 | -0.06 |
| WC\_JobSat | 0.62 | -0.28 | 0.20 | -0.09 | -0.41 | 0.38 | 0.02 | -0.33 | 0.07 | -0.49 | 0.10 | 0.44 | 0.07 | 0.12 | -0.41 |
| WC | 1.75 | -0.73 | 0.52 | -0.30 | -1.03 | 1.39 | 0.14 | -0.74 | 0.23 | -1.66 | 0.24 | 1.55 | -0.38 | 0.04 | -1.02 |

1 WC\_AutSco: Work load: Automation score; WC\_PeLigh: Work load: Perceived lightness; WC\_FacPer: Work environment: Facilities for personnel; WC\_PePlea: Work environment: Perceived pleasantness; WC\_JobSat: Job satisfaction; WC = Average score for the theme “Working conditions”.

**Supplementary Table S9** *Coordinates of the variables (indicators and overall sustainability score) on the first three principal components of the PCA analysis*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| PC1, 31% 1 | | PC2, 17% 1 | | PC3, 16% 1 | |
| Variables | Coord.2 | Variables | Coord.2 | Variables | Coord.2 |
| EC\_Transf | -0.91 | BP\_BreGoa | -0.77 | AW\_HunThi | -0.57 |
| EN\_APha | -0.80 | BP | -0.66 | AW\_Discom | -0.54 |
| EC\_Specia | -0.63 | BP\_RecSel | -0.56 | MS\_Genera | -0.52 |
| EN\_EP | -0.59 | EC\_FinAut | -0.54 | MarkConf-MC | -0.49 |
| EC\_FinAut | -0.49 | BP\_ManOrg | -0.44 | WC\_FacPer | -0.44 |
| EC | -0.48 | EC\_Viabil | -0.42 | AW | -0.41 |
| WC\_PeLigh | -0.48 | EC | -0.31 | EN\_CC | -0.36 |
| MarkConf-MC | -0.31 | BP\_GenVar | -0.29 | EN\_CED | -0.33 |
| AW\_NatBeh | -0.26 | EN\_LO | -0.22 | AW\_NatBeh | -0.31 |
| AW\_Discom | -0.25 | AH\_DisSta | -0.19 | EN | -0.30 |
| EC\_Effici | -0.24 | MarkConf-MC | -0.16 | EN\_LO | -0.17 |
| BP\_GenVar | -0.22 | WC\_AutSco | -0.11 | AW\_FeaDis | -0.10 |
| WC\_PePlea | -0.09 | EC\_Effici | -0.10 | EN\_EP | -0.10 |
| MS\_Verifi | -0.05 | EC\_RelSub | -0.09 | EC\_Specia | -0.09 |
| WC\_JobSat | 0.01 | EN\_APkg | -0.06 | WC\_AutSco | -0.09 |
| AH\_HeaSta | 0.01 | EC\_Transf | -0.04 | AH\_DisSta | -0.01 |
| MS\_Genera | 0.07 | EN\_CED | 0.03 | MS\_Contac | 0.00 |
| EC\_RelSub | 0.16 | WC\_FacPer | 0.06 | EN\_APkg | 0.04 |
| AH\_DisSta | 0.22 | AH\_HeaSta | 0.07 | BP\_RecSel | 0.04 |
| WC | 0.26 | AH | 0.15 | BP\_BreGoa | 0.09 |
| EC\_Viabil | 0.32 | AW\_HunThi | 0.16 | EC\_FinAut | 0.09 |
| AW | 0.35 | EC\_Specia | 0.19 | MS\_PerHyg | 0.13 |
| BP\_BreGoa | 0.35 | AH\_Parasi | 0.20 | WC | 0.14 |
| EN\_APkg | 0.38 | EN\_CC | 0.20 | AH\_PreMan | 0.14 |
| AH\_Parasi | 0.41 | MS\_CleDis | 0.23 | OSS | 0.17 |
| AW\_FeaDis | 0.43 | EN | 0.26 | AW\_PaiDis | 0.18 |
| BP | 0.45 | AW\_PaiDis | 0.34 | WC\_PeLigh | 0.20 |
| AW\_HunThi | 0.49 | EN\_APha | 0.34 | EN\_APha | 0.20 |
| MS\_VacMan | 0.52 | AH\_PreMan | 0.34 | WC\_JobSat | 0.24 |
| AH | 0.56 | MS\_VacMan | 0.36 | AH\_Parasi | 0.28 |
| WC\_FacPer | 0.59 | OSS | 0.37 | BP | 0.29 |
| BP\_ManOrg | 0.61 | MS\_Verifi | 0.37 | EC\_Transf | 0.32 |
| EN | 0.61 | MS\_Contac | 0.49 | WC\_PePlea | 0.36 |
| BP\_RecSel | 0.65 | AW\_FeaDis | 0.50 | EC\_Viabil | 0.36 |
| MS | 0.66 | MS\_Genera | 0.50 | BP\_ManOrg | 0.37 |
| MS\_CleDis | 0.69 | MS\_PerHyg | 0.52 | MS | 0.40 |
| OSS | 0.70 | AW\_Discom | 0.52 | BP\_GenVar | 0.42 |
| AW\_PaiDis | 0.74 | WC\_PeLigh | 0.54 | EC\_Effici | 0.43 |
| MS\_Contac | 0.75 | EN\_EP | 0.54 | AH | 0.46 |
| EN\_CC | 0.76 | MS | 0.58 | EC | 0.54 |
| MS\_PerHyg | 0.81 | AW\_NatBeh | 0.60 | MS\_CleDis | 0.56 |
| EN\_CED | 0.84 | AW | 0.64 | MS\_VacMan | 0.67 |
| EN\_LO | 0.88 | WC | 0.77 | MS\_Verifi | 0.84 |
| AH\_PreMan | 0.91 | WC\_JobSat | 0.77 | AH\_HeaSta | 0.85 |
| WC\_AutSco | 0.91 | WC\_PePlea | 0.83 | EC\_RelSub | 0.88 |

1 Principal component and percentage of the total variance accounted for by the component

2 Coordinate of the variable on the principal component (PC)

**Supplementary Table S10** *Primary indicators contributing to each theme in the three approaches for simplification of the tool for integrated evaluation of sustainability.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Themes | Indicators | Approaches 1 | | |
| Clustering | Addition | Regression |
| Animal Welfare AW | AW\_HunThi |  | X | X |
| AW\_PaiDis |  |  |  |
| AW\_NatBeh |  |  |  |
| AW\_Discom |  | X | X |
| AW\_FeaDis | X | X | X |
| Animal Health AH | AH\_PreMan | X | X | X |
| AH\_DisSta |  | X | X |
| AH\_Parasi | X |  |  |
| AH\_HeaSta | X | X | X |
| Breeding Programmes BP | BP\_BreGoa |  | X | X |
| BP\_RecSel | X |  |  |
| BP\_GenVar |  |  |  |
| BP\_ManOrg | X | X | X |
| Environment EN | EN\_CC | X |  |  |
| EN\_APkg | X |  |  |
| EN\_CED | X | X | X |
| EN\_LO | X |  |  |
| EN\_APha | X | X | X |
| EN\_EP |  |  |  |
| Meat Safety MS | MS\_Genera | X |  |  |
| MS\_Contac | X |  |  |
| MS\_PerHyg | X | X | X |
| MS\_CleDis | X | X | X |
| MS\_VacMan | X |  |  |
| MS\_Verifi | X |  |  |
| Market Conformity-MC | MarkConf-MC | X | X | X |
| Economy EC | EC\_Viabil |  | X | X |
| EC\_Specia | X |  |  |
| EC\_FinAut |  |  |  |
| EC\_RelSub | X |  |  |
| EC\_Transf | X | X | X |
| EC\_Effici |  | X | X |
| Working Conditions WC | WC\_AutSco | X |  |  |
| WC\_PeLigh |  |  |  |
| WC\_FacPer | X | X | X |
| WC\_PePlea | X |  |  |
| WC\_JobSat | X | X | X |
| Total number of primary indicators | | 25 | 18 | 18 |

1 See the Material and Methods section for a description of the approaches.