# Supplementary Materials 1

Table SM1.1. Stakeholder workshop timing and number of participants.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CS | Date | Total | Farmer | Govern-ment | Industry | NGO | Agricultural advice | Research | Finance | Other |
| BE-Dairy | Desk study | - |  |  |  |  |  |  |  |  |
| BG-Arable | 16/01/2020 | 19 | 8 | 5 | 1 | 2 | 3 |  |  |  |
| DE-Arable&Mixed | 06/02/2020 | 15 | 5 | 4 | 1 | 1 | 1 | 1 |  |  |
| ES-Sheep | 14/02/2020 | 18 | 7 | 4 | 1 |  | 3 | 3 |  |  |
| FR-Beef | Desk study | - |  |  |  |  |  |  |  |  |
| PL-Horticulture | 29/11/2019 | 12 | 7 | 1 |  | 1 | 3 |  |  |  |
| IT-Hazelnut | 21/01/2020 | 14 | 5 | 2 | 1 | 2 | 3 | 1 |  |  |
| NL-Arable | 10/12/2019 | 22 | 8 | 3 | 2 | 2 |  | 3 | 2 | 2 |
| RO-Mixed | 12/03/2020 | 16 | 6 | 2 | 3 |  |  | 5 |  |  |
| SE-Poultry (eggs) | 31/01/2020 | 7 | 5 |  | 1 |  |  |  |  | 1 |
| SE-Poultry (broilers) | 03/02/2020 | 2 |  |  | 2 |  |  |  |  |  |
| UK-Arable | 15/01/2020 | 5 |  | 1 |  | 2 | 2 |  |  |  |

Table SM1.2. Closeness to critical thresholds of the main challenges per farming system in case thresholds were discussed and defined.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Challenges** | **Domain** | **BG-Arable** | **NL-Arable** | **UK-Arable** | **DE-Arable&**  **Mixed** | **RO-Mixed** | **ES-Sheep** | **SE-Poultry** | **IT-Hazelnut** | **PL-Horti-culture** | **Total1** |
| Change in technology | Agronomic |  |  |  |  |  |  | Close |  |  | 1 |
| Low prices and price fluctuations | Economic | Close |  | Close | At or beyond | Not close |  |  | Somewhat close | Somewhat close | 6 |
| High production costs | Economic |  | Close | Close |  |  | At or beyond |  |  |  | 3 |
| Extreme weather | Environmental | Close | Somewhat close |  | Close | At or beyond |  |  | Not close | Somewhat close | 6 |
| Pests & diseases | Environmental |  | Close |  |  |  |  |  | Somewhat close |  | 2 |
| Wildlife attacks | Environmental |  |  |  |  |  | Not close |  |  |  | 1 |
| Continuous change of laws and regulations | Institutional | Somewhat close | Close |  | Somewhat close | Somewhat close |  |  |  | Close | 5 |
| Economic laws & regulations | Institutional |  |  | At or beyond |  | Somewhat close |  | At or beyond | Not close (1x); Somewhat close (1x) |  | 4 |
| Environmental laws & regulations | Institutional |  |  | Somewhat close |  |  |  | At or beyond | Close |  | 3 |
| Lack of infrastructure | Social |  |  |  | At or beyond |  |  |  |  |  | 1 |
| Low attractiveness | Social |  |  |  | At or beyond |  |  |  |  |  | 1 |
| Low labor availability | Social | Close |  |  |  |  | At or beyond |  |  | Somewhat close | 3 |
| Changes in consumer preferences | Social |  |  |  |  |  | At or beyond | Not discussed |  |  | 2 |
| **Total** |  | **4** | **4** | **4** | **5** | **4** | **4** | **4** | **6** | **4** | **38** |

1For BE-Dairy and FR-Beef, desk studies were conducted instead of workshops and results from these case studies have hence not been included in this table.

Table SM1.3. Closeness to critical thresholds of indicators discussed per system function per farming system in case thresholds were discussed and defined.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **System functions** | **BG-Arable** | **NL-Arable** | **UK-Arable** | **DE-Arable&**  **Mixed** | **RO-Mixed** | **ES-Sheep** | **SE-Poultry** | **IT-Hazelnut** | **PL-Horticulture** | **Total1** |
| Food production | Close (1x); At or beyond (1x) | Close | Not discussed | Somewhat close | Close | At or beyond | At or beyond |  | Close | 9 |
| Bio-based resources |  |  |  |  | At or beyond |  |  |  |  | 1 |
| Economic Viability | Somewhat close | Close | Not discussed | Close | Somewhat close | Somewhat close | Close | Close (2x) | Close (2x); At or beyond (1x) | 12 |
| Quality of life |  |  | Not close |  |  | At or beyond |  |  |  | 2 |
| Natural Resources |  | At or beyond (1x); Somewhat close (1x) | At or beyond | Somewhat close (2x); Close (1x) |  |  | Not discussed | Somewhat close |  | 8 |
| Biodiversity & habitat | Not defined (2x) |  | Close |  | Not close |  |  |  |  | 4 |
| Attractiveness of the area | Not defined |  |  | Somewhat close (2x) |  |  |  | Somewhat close |  | 4 |
| Animal health & welfare |  |  | Close |  |  |  | Not discussed |  |  | 2 |
| **Total** | **6** | **4** | **6** | **7** | **4** | **3** | **4** | **4** | **4** | **42** |

1For BE-Dairy and FR-Beef, desk studies were conducted instead of workshops and results from these case studies are hence not included in this table.

Table SM1.4. Closeness to critical thresholds of resilience attributes discussed per farming system in case discussed and defined.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Resilience attributes** | **BG-Arable** | **NL-Arable** | **UK-Arable** | **DE-Arable&**  **Mixed** | **RO-Mixed** | **ES-Sheep** | **SE-Poultry** | **IT-Hazelnut** | **PL-**  **Horti-culture** | **Total1** |
| Reasonably profitable |  | Close | Not discussed |  |  |  | Close |  | Close | 4 |
| Production coupled with local and natural capital | Not defined | Not defined | Not discussed |  |  | Somewhat close |  | Close | Somewhat close | 6 |
| Functional diversity |  |  |  |  |  |  | Not discussed |  | Not defined | 2 |
| Response diversity |  |  |  | Somewhat close |  |  | Not discussed |  | Not defined | 3 |
| Exposed to disturbances | Close |  |  |  |  |  | Not discussed |  |  | 2 |
| Heterogeneity of farm types |  |  | Not defined |  | Close |  |  |  |  | 2 |
| Support rural life |  |  |  | Somewhat close | Close |  |  | Somewhat close |  | 3 |
| Socially self-organized | Close | Somewhat close | Somewhat close |  |  |  |  | Not close |  | 4 |
| Appropriately connected with actors outside the farming system |  |  | Not defined |  | Not close |  |  |  |  | 2 |
| Legislation coupled with local and natural capital |  |  |  |  | Somewhat close |  |  |  |  | 1 |
| Infrastructure for innovation | At or beyond | Not defined | Not defined | Close |  |  | Not defined | Close |  | 6 |
| Diverse policies |  |  |  |  |  | At or beyond |  | At or beyond |  | 2 |
| **Total** | **4** | **4** | **6** | **3** | **4** | **2** | **5** | **5** | **4** | **37** |

1For BE-Dairy and FR-Beef, desk studies were conducted instead of workshops and results from these case studies are hence not included in this table.

Table SM1.5. Indicators and resilience attributes per case study and their current perceived performance and developments and average developments expected after exceedance of critical thresholds of challenges. Developments are represented by arrows where ↓: strong negative, ↘: moderate negative, →: no developments, ↗: moderate positive and ↑: strong positive developments. The table continues over multiple pages.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  | **Expected developments** | |
| **CS** | **Specific challenge** | **Ind./Attr.** | **Indicator** | **Function / Resilience attribute** | **Current level** | **Current system** | **Exceeding critical thresholds of challenges** |
| BG-Arable |  | Indicator | Productivity (t/ha) | Food production | Moderate to high | ↗ | ↗|↓ |
| BG-Arable |  | Indicator | Net farm income | Economic viability | Low to moderate | ↘ | ↓ |
| BG-Arable |  | Indicator | Nutrient balance | Natural resources | Low | ↘ | ↓ |
| BG-Arable |  | Indicator | Diversity of production | Biodiversity & habitat | Low | *→* | ↗ |
| BG-Arable |  | Indicator | Level of services in rural areas | Attractiveness of the area | Low | *→* | ↓ |
| BG-Arable |  | Resilience attributes |  | Production coupled with local and natural capital | Moderate | *→* | ↓ |
| BG-Arable |  | Resilience attributes |  | Exposed to disturbance | Moderate | *→* | ↗ |
| BG-Arable |  | Resilience attributes |  | Socially self-organized | Low | *→* | ↗ |
| BG-Arable |  | Resilience attributes |  | Infrastructure for innovation | Low | *→* | ↑ |
| DE-Arable&Mixed |  | Indicator | Cereal production (t/ha) | Food production | Moderate | →|↘ | ↘|↓ |
| aDE-Arable&Mixed |  | Indicator | Profitability (Euro/ha) | Economic viability | Moderate | →|↘ | ↘|↓ |
| DE-Arable&Mixed |  | Indicator | Availability of successors | Attractiveness of the area | Low | ↘ | ↘|↓ |
| DE-Arable&Mixed |  | Indicator | Availability of workers | Economic viability | Low | ↘ | ↘|↓ |
| DE-Arable&Mixed |  | Indicator | Soil quality | Natural Resources | Good | → | → |
| DE-Arable&Mixed |  | Indicator | Production of biogas | Bio-based resources | Good | → | ↘|↓ |
| DE-Arable&Mixed |  | Indicator | Water availability | Natural Resources | Good | ↘ | ↘|↓ |
| DE-Arable&Mixed |  | Resilience attributes |  | Response diversity | Moderate | → | ↘|↓ |
|  |  |  |  |  |  | **Expected developments** | |
| **CS** | **Specific challenge** | **Ind./Attr.** | **Indicator** | **Function / Resilience attribute** | **Current level** | **Current system** | **Exceeding critical thresholds of challenges** |
| DE-Arable&Mixed |  | Resilience attributes |  | Infrastructure for innovation | Low | → | ↘|↓ |
| DE-Arable&Mixed |  | Resilience attributes |  | Support rural life | Low | → | ↘|↓ |
| ES-Livestock |  | Indicator | Gross margin | Economic viability | Low | → | ↘|↓ |
| ES-Livestock |  | Indicator | Sheep census | Food production | Low | ↓ | ↓ |
| ES-Livestock |  | Indicator | Number of farms | Attractiveness of the area | Low | ↓ | ↓ |
| ES-Livestock |  | Resilience attributes | Access to pastures | Production coupled with local and natural capital | Low | ↘ | ↘|↓ |
| ES-Livestock |  | Resilience attributes | Subsidies | Diverse policies | Low | → | ↘|↓ |
| ES-Livestock |  | Resilience attributes |  | Socially self-organised | Low | → | ↘|↓ |
| ES-Livestock |  | Resilience attributes |  | Support rural life | Low | ↘ | ↘|↓ |
| ES-Livestock |  | Resilience attributes |  | Infrastructure for innovation | Low | ↘ | ↘|↓ |
| ES-Livestock |  | Resilience attributes |  | Reasonable profitable | Low | ↘ | ↘|↓ |
| IT-Hazelnut | Hazelnut prices decline | Indicator | Gross Saleable Production | Food production | High | ↗ | ↘ |
| IT-Hazelnut | Hazelnut prices decline | Indicator | Gross Margin | Economic viability | High | → | ↘ |
| IT-Hazelnut | Hazelnut prices decline | Indicator | Organic farming (Ha) | Biodiversity & habitat | Low | ↗ | → |
| IT-Hazelnut | Hazelnut prices decline | Indicator | Retention of young people | Attractiveness of the area | Moderate | ↗ | → |
| IT-Hazelnut | Hazelnut prices decline | Resilience attributes |  | Socially self-organised | Moderate | → | → |
| IT-Hazelnut | Hazelnut prices decline | Resilience attributes |  | Production coupled with local and natural capital | Low | ↗ | ↘ |
| IT-Hazelnut | Hazelnut prices decline | Resilience attributes |  | Support rural life | Moderate | ↗ | →|↘ |
| IT-Hazelnut | Hazelnut prices decline | Resilience attributes |  | Infrastructure for innovation | Moderate | ↗ | → |
| IT-Hazelnut | Hazelnut prices decline | Resilience attributes |  | Diverse policies | Low | → | → |
|  |  |  |  |  |  | **Expected developments** | |
| **CS** | **Specific challenge** | **Ind./Attr.** | **Indicator** | **Function / Resilience attribute** | **Current level** | **Current system** | **Exceeding critical thresholds of challenges** |
| IT-Hazelnut | Extreme weather events: droughts | Indicator | Gross Saleable Production | Food production | High | ↗ | ↘ |
| IT-Hazelnut | Extreme weather events: droughts | Indicator | Gross Margin | Economic viability | High | → | ↘ |
| IT-Hazelnut | Extreme weather events: droughts | Indicator | Organic farming (Ha) | Biodiversity & habitat | Low | ↗ | ↘ |
| IT-Hazelnut | Extreme weather events: droughts | Indicator | Retention of young people | Attractiveness of the area | Moderate | ↗ | ↘ |
| IT-Hazelnut | Extreme weather events: droughts | Resilience attributes |  | Socially self-organised | Moderate | → | ↘ |
| IT-Hazelnut | Extreme weather events: droughts | Resilience attributes |  | Production coupled with local and natural capital | Low | ↗ | ↘ |
| IT-Hazelnut | Extreme weather events: droughts | Resilience attributes |  | Support rural life | Moderate | ↗ | ↘ |
| IT-Hazelnut | Extreme weather events: droughts | Resilience attributes |  | Infrastructure for innovation | Moderate | ↗ | ↘ |
| IT-Hazelnut | Extreme weather events: droughts | Resilience attributes |  | Diverse policies | Low | → | ↘ |
| IT-Hazelnut | Greater eco-friendly requirements | Indicator | Gross Saleable Production | Food production | High | ↗ | ↘|→ |
| IT-Hazelnut | Greater eco-friendly requirements | Indicator | Gross Margin | Economic viability | High | → | ↘|→ |
|  |  |  |  |  |  | **Expected developments** | |
| **CS** | **Specific challenge** | **Ind./Attr.** | **Indicator** | **Function / Resilience attribute** | **Current level** | **Current system** | **Exceeding critical thresholds of challenges** |
| IT-Hazelnut | Greater eco-friendly requirements | Indicator | Organic farming (Ha) | Biodiversity & habitat | Low | ↗ | ↗ |
| IT-Hazelnut | Greater eco-friendly requirements | Indicator | Retention of young people | Attractiveness of the area | Moderate | ↗ | ↗ |
| IT-Hazelnut | Greater eco-friendly requirements | Resilience attributes |  | Socially self-organized | Moderate | → | → |
| IT-Hazelnut | Greater eco-friendly requirements | Resilience attributes |  | Production coupled with local and natural capital | Low | ↗ | ↗ |
| IT-Hazelnut | Greater eco-friendly requirements | Resilience attributes |  | Support rural life | Moderate | ↗ | → |
| IT-Hazelnut | Greater eco-friendly requirements | Resilience attributes |  | Infrastructure for innovation | Moderate | ↗ | ↗ |
| IT-Hazelnut | Greater eco-friendly requirements | Resilience attributes |  | Diverse policies | Low | → | ↗ |
| IT-Hazelnut | Bargaining power of the confectionary industry | Indicator | Gross Saleable Production | Food production | High | ↗ | ↘ |
| IT-Hazelnut | Bargaining power of the confectionary industry | Indicator | Gross Margin | Economic viability | High | → | ↘ |
| IT-Hazelnut | Bargaining power of the confectionary industry | Indicator | Organic farming (Ha) | Biodiversity & habitat | Low | ↗ | → |
|  |  |  |  |  |  | **Expected developments** | |
| **CS** | **Specific challenge** | **Ind./Attr.** | **Indicator** | **Function / Resilience attribute** | **Current level** | **Current system** | **Exceeding critical thresholds of challenges** |
| IT-Hazelnut | Bargaining power of the confectionary industry | Indicator | Retention of young people | Attractiveness of the area | Moderate | ↗ | → |
| IT-Hazelnut | Bargaining power of the confectionary industry | Resilience attributes |  | Socially self-organized | Moderate | → | ↗ |
| IT-Hazelnut | Bargaining power of the confectionary industry | Resilience attributes |  | Production coupled with local and natural capital | Low | ↗ | ↓ |
| IT-Hazelnut | Bargaining power of the confectionary industry | Resilience attributes |  | Support rural life | Moderate | ↗ | → |
| IT-Hazelnut | Bargaining power of the confectionary industry | Resilience attributes |  | Infrastructure for innovation | Moderate | ↗ | ↗ |
| IT-Hazelnut | Bargaining power of the confectionary industry | Resilience attributes |  | Diverse policies | Low | → | → |
| NL-Arable |  | Indicator | Starch potato production | Food production | Moderate | → | ↘|↓ |
| NL-Arable |  | Indicator | Profitability | Economic viability | Moderate | ↗ | ↘|↓ |
| NL-Arable |  | Indicator | Soil quality | Natural Resources | Low | ↗ | ↘|↓ |
| NL-Arable |  | Indicator | Water availability | Natural Resources | Moderate | ↗ | ↘|↓ |
| NL-Arable |  | Resilience attributes |  | Reasonable profitable | Low | → | ↘|↓ |
| NL-Arable |  | Resilience attributes |  | Socially self-organised | Moderate | → | ↘|↓ |
| NL-Arable |  | Resilience attributes |  | Infrastructure for innovation | Moderate | → | ↘|↓ |
| NL-Arable |  | Resilience attributes |  | Production coupled with local and natural capital | Moderate | → | ↘|↓ |
|  |  |  |  |  |  | **Expected developments** | |
| **CS** | **Specific challenge** | **Ind./Attr.** | **Indicator** | **Function / Resilience attribute** | **Current level** | **Current system** | **Exceeding critical thresholds of challenges** |
| PL-Horticulture |  | Indicator | Utilized agricultural area | Food production | Moderate | → | ↘|↓ |
| PL-Horticulture |  | Indicator | Purchase prices for agricultural products | Economic viability | Low | ↘ | ↘|↓ |
| PL-Horticulture |  | Indicator | Income dynamics | Economic viability | Moderate | ↘ | ↘|↓ |
| PL-Horticulture |  | Indicator | Labor costs | Economic viability | Low | ↘ | ↘|↓ |
| PL-Horticulture |  | Resilience attributes |  | Production coupled with local and natural capital | Moderate | ↘ | ↘|↓ |
| PL-Horticulture |  | Resilience attributes |  | Functional diversity | Low | → | ↘|↓ |
| PL-Horticulture |  | Resilience attributes |  | Response diversity | Low | → | ↘|↓ |
| PL-Horticulture |  | Resilience attributes |  | Reasonable profitable | Low | ↘ | ↘|↓ |
| RO-Mixed |  | Indicator | Agricultural production | Food production | Moderate | *→* | ↘ |
| RO-Mixed |  | Indicator | Sales of agricultural products | Bio-based resources | Low | *→* | *→* |
| RO-Mixed |  | Indicator | Subsidies | Economic viability | Moderate | *→* | ↘ |
| RO-Mixed |  | Indicator | Awareness of biodiversity importance | Biodiversity & habitat | Moderate to low | ↗ | ↘ |
| RO-Mixed |  | Resilience attributes |  | Spatial and temporal heterogeneity (farm types) | Good | ↗ | → |
| RO-Mixed |  | Resilience attributes |  | Support rural life | Good | ↗ | → |
| RO-Mixed |  | Resilience attributes |  | Appropriately connected with actors outside the farming system | Low | *→* | ↘ |
| RO-Mixed |  | Resilience attributes |  | Coupled with local and natural capital (legislation) | Low | *→* | ↘ |
| SE-Poultry |  | Indicator | Viable income | Economic viability | Low/Moderate | → | ↘|↓|↑ |
| SE-Poultry |  | Indicator | Healthy and affordable products | Food production | Moderate/High | ↗ | ↗|↘ |
| SE-Poultry |  | Indicator | Maintain natural resources in good conditions | Natural Resources | High | ↗ | ↘|↗ |
| SE-Poultry |  | Indicator | Animal health and welfare | Animal health & welfare | Moderate | ↗ |  |
| SE-Poultry |  | Resilience attributes |  | Response diversity | Low | → |  |
| SE-Poultry |  | Resilience attributes |  | Reasonable profitable | Low | → | ↘|↓|↑ |
|  |  |  |  |  |  | **Expected developments** | |
| **CS** | **Specific challenge** | **Ind./Attr.** | **Indicator** | **Function / Resilience attribute** | **Current level** | **Current system** | **Exceeding critical thresholds of challenges** |
| SE-Poultry |  | Resilience attributes |  | Functional diversity | High | → |  |
| SE-Poultry |  | Resilience attributes |  | Exposed to disturbance | High | ↗ | ↗|↑ |
| SE-Poultry |  | Resilience attributes | Infrastructure for innovation | Infrastructure for innovation | Moderate | ↗ | ↗|↑ |
| UK-Arable |  | Indicator | Soil health | Natural Resources | Low | ↘ | ↓ |
| UK-Arable |  | Indicator | Biodiversity | Biodiversity & habitat | Low | ↘ | ↓ |
| UK-Arable |  | Indicator | Happiness index of farmers | Quality of life | Low | ↘ | ↓ |
| UK-Arable |  | Indicator | Percent of products certified higher welfare standards | Animal health & welfare | Moderate | → | → |
| UK-Arable |  | Resilience attributes |  | Spatial and temporal heterogeneity (farm types) | Low | → | → |
| UK-Arable |  | Resilience attributes |  | Socially self-organised | Moderate | → | ↓ |
| UK-Arable |  | Resilience attributes |  | Appropriately connected with actors outside the farming system | Moderate - low | ↘ | ↓ |
| UK-Arable |  | Resilience attributes |  | Infrastructure for innovation | Low | ↘ | ↓ |

Table SM1.6. Median of developments of system indicators and resilience attributes per farming system for the current system and for when critical thresholds of challenges are exceeded. With strong negative (↓), moderate negative (↘), no trend (→), moderate positive (↗) and strong positive trends (↑).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  | **Expected developments** | |
| **Indicator / resilience attribute** | **Case study1** | **Indicators/**  **resilience attributes [#]** | **Current system** | **Critical thresholds of challenges exceeded** |
| Indicators | BG-Arable | 5 | *→* | ↓ |
|  | NL-Arable | 4 | ↗ | ↘|↓ |
|  | UK-Arable | 4 | ↘ | ↓ |
|  | DE-Arable&Mixed | 7 | →|↘ | ↘|↓ |
|  | RO-Mixed | 4 | *→* | →|↗ |
|  | ES-Sheep | 3 | ↓ | ↓ |
|  | SE-Poultry | 4 | ↗ | *→* |
|  | IT-Hazelnut | 4 | ↗ | →|↘ |
|  | PL-Horticulture | 4 | ↘ | ↘|↓ |
|  | **Median farming systems** |  | *→* | →|↘ |
| Resilience attributes | BG-Arable | 4 | *→* | ↗ |
|  | NL-Arable | 6 | *→* | ↘|↓ |
|  | UK-Arable | 4 | →|↘ | ↓ |
|  | DE-Arable&Mixed | 3 | *→* | ↘|↓ |
|  | RO-Mixed | 4 | →|↗ | →|↗ |
|  | ES-Sheep | 6 | ↘ | ↘|↓ |
|  | SE-Poultry | 3 | ↗ | ↗|↑ |
|  | IT-Hazelnut | 5 | ↗ | →|↘ |
|  | PL-Horticulture | 4 | →|↘ | ↘|↓ |
|  | **Median farming systems** |  | *→* | ↘ |

1For BE-Dairy and FR-Beef, desk studies were conducted instead of workshops and results from these case studies are hence not included in this table.