Technical Sheet for Solution Implementation

Multi-species Grasslands for Climate Change Adaptation

Thematic area:
Environmental Sustainability.

Priority: How to manage grassland in the face of the future challenges?

Need: Forage production: how to limit the effects of climate change on the quality and quantity of forage?

Solution EU number:
GM-03.

Content of the solution: Multi-species grasslands are promoted as a climate-resilient strategy to secure and optimise forage production under increasing climatic variability. By combining diverse grasses and legumes adapted to soil, climate, and management practices, these grasslands improve yield stability, forage quality, ecosystem services, and the long-term sustainability of equine farms.

Key Contacts:
- For France: IFCE – Pauline Doligez pauline.doligez@ifce.fr

Reasons for Implementing the Solution

Climate change increasingly affects forage production through droughts, heat waves, irregular rainfall, and other climatic hazards, which can threaten forage self-sufficiency and long-term grassland productivity. Multi-species grasslands improve the resilience, flexibility, and stability of forage systems by combining plant species with complementary agronomic characteristics and different tolerances to environmental conditions.

Description of Solution Strategies

In this challenging context caused by climate change, actions have been identified in all herbivore sectors to secure and optimise forage production. Among the adaptation strategies that could enhance the role of grasslands in forage systems, multi-species grasslands comprising a blend of grasses and legumes intended for mowing and/or grazing offer a promising solution from agronomic, zootechnical, and environmental perspectives.

When choosing a species mix to produce a multi-species grassland for horses, the preferences of the horses should not be the only consideration. The type of soil, climate, and farming practices used to maintain the vegetation cover in the long term must also be considered. In addition, management intensity and expected longevity of the sward should guide species selection, as plant communities evolve significantly over time under grazing or mowing pressure.

Grasslands with diverse flora provide multiple ecosystem services at agronomic, environmental, ecological, and societal levels. Their flexibility of use allows regular and sustained forage production for both grazing and mowing, while different rooting depths and growth patterns improve adaptation to drought, frost, or flooding. Diverse grasslands also contribute to atmospheric carbon sequestration, soil fertility, biodiversity conservation, pollinator support, and the maintenance of open landscapes appreciated by local communities.

Initially, multi-species grasslands are generally established as temporary grasslands composed of grasses and legumes adapted to local conditions and intended use. The aim is to maintain a dense, productive, and resilient vegetation cover capable of

producing forage of suitable nutritional quality while remaining resistant to climatic hazards. Species selection at establishment stage therefore strongly influences long-term botanical development and system stability.

A multi-species meadow ensures that grass grows throughout the plot, even in the most disadvantaged areas. The presence of different species provides high-quality forage over a longer period, and resilient legumes (40 – 50 % in summer) can maintain forage production during summer conditions. Such mixtures are particularly suitable for temporary grasslands managed for approximately four to five years. However, studies show that the botanical composition of the sown mixture evolves over time depending on environmental and climatic conditions. More competitive species may progressively dominate, while others disappear, eventually stabilising at a smaller number of dominant species. This process is driven by interspecific competition, soil nutrient availability, and species-specific persistence characteristics.

The flexibility of multi-species grasslands is characterised by sufficient productivity throughout the year depending on whether the grassland is mainly used for grazing, mowing, or both. In addition, these systems improve soil fertility through nitrogen fixation by legumes, increase organic matter content, stimulate soil biological activity, and reduce the need for external fertilisers or plant protection products within crop rotations.

The grassland seed mixture combines different species and varieties of grasses and legumes selected according to:

- the nutritional requirements and intended use for the equines present,
- the method of utilisation (grazing, mowing, or mixed use),
- and local soil and climatic conditions.

Additional criteria include resistance to climatic stress (e.g. drought tolerance), persistence under grazing pressure, and compatibility between fast- and slow-establishing species.

Grasses mainly provide sugars, energy, and fibre, while legumes contribute protein and calcium and improve soil fertility through atmospheric nitrogen fixation. Different species also vary in productivity, aggressiveness, precocity, perenniality, drought tolerance, and resistance to trampling. They also differ in seasonal growth patterns, which allows forage availability to be extended across the grazing season.

The number and diversity of species contribute to flexibility of use, nutritional quality, and resilience to climatic hazards. High-quality permanent grasslands may contain between 40 and 60 species per 100 m², whereas degraded grasslands often contain only around 10 species. Higher species richness is generally associated with greater ecosystem stability and resilience to climatic variability.

The flora of multi-species grasslands evolves continuously over time. Some aggressive species may progressively dominate due to competitive advantages, while less competitive species disappear. Additional non-sown species may also colonise the grassland naturally depending on environmental conditions and management practices. This dynamic succession is a normal ecological process in managed grassland systems.

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When mixing species, it is beneficial to combine plants with different growth habits, flowering periods, rooting depths, and climatic adaptations. Species selection must also consider equine-specific grazing behaviour and nutritional requirements.

For grazing systems, species should ideally tolerate trampling, remain perennial, mature slowly, and resist overgrazing. Horses generally prefer mixed-species swards and young vegetation rather than single-species stands or grasses that become stemmy rapidly. Grass species with excessively high soluble sugar concentrations may not be suitable for insulin-resistant horses with low nutritional requirements, whereas highly productive and nutritious species are more suitable for broodmares, foals, or horses with high nutritional demands.

For mowing systems, mixtures may contain a higher proportion of legumes to compensate for reduced protein content in later-harvested forage. Certain species such as alfalfa or sainfoin may also offer additional nutritional or potential antiparasitic benefits, although further research is still needed in some areas.

Implementation Steps

1. Define the role of grassland within the farm system
- Identify the objectives of the grassland (grazing, mowing, mixed use, forage autonomy, biodiversity, soil improvement, etc.)
- Assess local climatic risks and expected forage needs.
- Consider the role of grasslands within crop rotations and long-term farm sustainability.

2. Assess local environmental conditions
- Evaluate soil type, fertility, drainage, and load-bearing capacity.
- Identify climatic constraints such as drought, flooding, or frost.
- Analyse current vegetation and existing grassland condition.

3. Choose the type of grassland system
- Decide between permanent or temporary grassland systems.
- Determine expected duration and management strategy.
- Define intended utilisation method (grazing, mowing, or mixed management).

4. Select appropriate plant species and mixtures
- Choose grasses and legumes adapted to:
  - equine nutritional requirements,
  - grazing or mowing management,
  - soil and climate conditions.
- Combine species with complementary characteristics (growth habit, maturity date, rooting depth, drought tolerance, perenniality).
- Limit species that may become excessively dominant or unsuitable for equine feeding.

- Example of species selection (based on Pierre P., La Prairie multi-espèces, 2007):

PLANT FAMILIES	MAIN GRASSLAND SPECIES ADAPTED TO THE ENVIRONMENT	SUITABLE FOR GRAZING	HIGH NUTRITIONAL VALUE
Grasses	Festuca arundinacea, Festuca pratensis, Lolium × boucheanum Kunth, Lolium perenne, Lolium multiflorum, Dactylis glomerata, Phléum pratense, Poa pratensis	Festuca arundinacea, Lolium × boucheanum Kunth, Lolium perenne, Lolium multiflorum, Poa pratensis	Festuca arundinacea, Lolium perenne, Poa pratensis
Legumes	Alfalfa, Trifolium pratense, Trifolium repens, Trifolium hybridum, Medicago lupulina, Lotus, sainfoin	Trifolium pratense, Trifolium hybridum, Lotus	Trifolium repens, Trifolium hybridum, Lotus, alfalfa

- Causes of species elimination (based on Pierre P., La Prairie multi-espèces, 2007):

NOT SUITED FOR WET SOIL	NOT SUITED FOR DRYING SOIL	NOT SUITED TO GRAZING
Dactylis glomerata, Phléum pratense, Bromus, alfalfa, sainfoin, Trifolium pratense, Festuca rubra	Festuca pratensis	Lolium × boucheanum Kunth, Lolium multiflorum, Trifolium pratense, alfalfa

5. Establish and manage the grassland

- Prepare soil and sow the selected mixture.
- Implement appropriate grazing and/or mowing management.
- Monitor vegetation cover, species balance, and productivity over time.
- Adapt management practices according to climatic conditions and botanical evolution of the grassland.

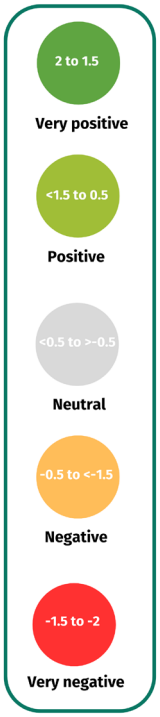
6. Monitor long-term evolution and adapt management

- Observe changes in flora composition over the years.
- Identify disappearance or dominance of species.
- Adjust grazing intensity, mowing frequency, or reseeding practices when necessary.
- Maintain dense and productive vegetation cover adapted to farm objectives and climatic conditions.

Multi-species Grasslands for Climate Change Adaptation

How Will this Solution Impact the Performance of your Farm?

TOPIC	SCORE
Social	0
Economics	0.50
Welfare	1.00
Health	1.00
Environmental	1.00
Pasture access and management	0
Global	0.67



Traffic light explanation

Socioeconomics: This solution will not affect the social performance of the farm because it primarily concerns technical and agronomic choices relating to pasture composition and forage production. Although biodiverse grasslands are receiving increasing attention for their environmental benefits, implementing them does not substantially modify working conditions, social interactions or stakeholder engagement at farm level.

This solution will support the farm's economic performance because it can improve the resilience and productivity of forage systems in variable climatic conditions. This reduces the need for purchased fertilisers by including legumes and helps to maintain forage availability during droughts or other extreme weather events. Although outcomes depend on species selection, pasture management, and local conditions, diverse species mixtures can enhance long-term pasture performance, support horse health, and contribute to more stable forage production.

Health & Welfare: This solution will support the farm's day-to-day health performance by helping to maintain low levels of pain, mortality, and drug use. A more diverse feed composition naturally contributes to better health by providing a broader range of nutrients, trace elements, and vitamins than a less diverse diet. However, the sward quality should be monitored to avoid over- and under-nutrition due to the natural seasonal changes in nutrients in plants.

This solution will also support equine welfare by promoting positive emotional states and providing feeding conditions that more closely resemble those found in a natural environment. By encouraging feed-searching and locomotor activities, horses can express species-specific behaviours. Opportunities for choice, agency, and control over aspects of their environment contribute to positive welfare outcomes and support optimal mental well-being.

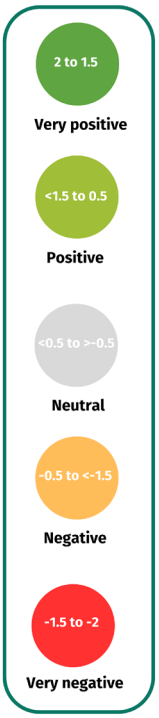
Environmental sustainability: This solution will support on the environmental performance of the farm because reduced input use of clover lowers fertilizer needs, which reduces CO2 emissions. Diverse pasture mixtures contribute to higher plant diversity and ecosystem health. Focus should be on functional diversity (e.g. including deep-rooted species) rather than just species number. In practice, 5–6 species mixtures can be efficient. Biodiverse pastures support grazing, resilience, and ecosystem services simultaneously. This solution also supports water management as deep-rooted species access water from deeper soil layers, improving drought resistance. Better soil structure: diverse root systems enhance soil infiltration and water retention. Mixed pastures reduce the risk of failure during both drought and excessive rainfall periods.

This solution will not have an effect on the land access or management performance of the farm because effects are two folded and depend on the farm systems and regional differences. For instance, in Nordic conditions (e.g., Finland): pastures are frequently renewed, whilst in Southern-European conditions (e.g., Portugal): long-term biodiverse permanent pastures are common. Balancing species composition can be difficult. Weed control and mowing require careful timing. Success on the farm level depends heavily on clear objectives, appropriate species selection, and skilled management.

Multi-species Grasslands for Climate Change Adaptation

How Will this Solution Impact the Resilience of your Farm?

TOPIC	SCORE
Social	0
Economics	0.08
Welfare	0
Health	0
Environmental	0.06
Pasture access and management	0
Global	0.03



Socioeconomics: This solution will not impact social performance of the farm facing external challenges assessed because multi-species grasslands mainly improve ecological and agronomic resilience rather than directly affecting social organisation or working conditions. The solution remains largely neutral in the event of inflation, pandemics, welfare regulations, disease outbreaks, or limited grassland access. However, more biodiverse and climate-adapted grasslands may indirectly support long-term farm stability and a positive environmental image. Proper pasture management is essential, particularly for controlling invasive or alien plant species that can spread through grazing horses.

This solution will not impact the economic performance of the farm facing external challenges, as the system generally has low implementation costs and can improve resilience to extreme weather events, particularly drought, by maintaining stable forage production through species diversity and complementary climatic adaptations. More biodiverse grasslands may also improve the long-term persistence of pasture and reduce vulnerability to climate variability. However, the solution has limited direct effect on economic resilience in situations such as pandemics, inflation, disease outbreaks or restricted land access. Its effectiveness also depends strongly on the appropriate management of grasslands and grazing.

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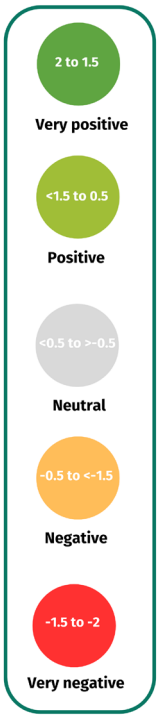
Health & Welfare: This solution does not directly support the farm's health performance, as pasture composition does not directly reduce pain, mortality, or the need for medication when the farm is exposed to external pressures such as staff shortages, reduced farm income, or water shortage. Nevertheless, prolonged access to high-quality pasture may help maintain horses in good health and body condition, thereby supporting their ability to cope with external challenges. When the farm is subjected to socio-economic or environmental pressures, such as staff shortages, reduced farm income, water scarcity, or limited access to maintenance and technical services, the effectiveness of this solution may be compromised. As a result, the solution has a neutral effect on farm welfare performance, since the access to pastures may be restricted or sward composition may be changed if not monitored in such conditions.

Environmental sustainability: This solution will not impact environmental sustainability because even though it has a positive effect on environmental sustainability when farm faces extreme weather events, it does not have an effect when farm faces the other assessed challenges. This solution will not impact on land access or management performance of the farm facing external challenges assessed because the solution does not have it does not have direct effect on land access and management in a situation when farm faces inflation, pandemics, high welfare standards, infectious equine disease or lost or limited access to agricultural land.

How can this solution help your farm to face specific external challenges to be more resilient?

CHALLENGES	SCORE
Inflation	0
Pandemic	0
High welfare standard	0
High infectious diseases	0
Extreme weather event	0.17
Loss/limited access to grassland	0



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Inflation & Social Crises: Social challenge: This solution will not affect the overall performance of farms in the event of a pandemic because multi-species grasslands primarily enhance long-term pasture resilience and forage stability, and pandemics have minimal direct impact on grassland composition or management. The solution will not significantly change labour organisation, nor will it directly affect social interactions or operational continuity during sanitary restrictions.

Economic challenge: This solution will not significantly impact the global performance of the farm facing inflation because its costs of establishment and management remain relatively low. The main benefits are long-term forage resilience and adaptation to climatic variability, rather than direct protection against rising input prices. While diversified grasslands may slightly improve forage stability under difficult conditions, their immediate effect on inflation-related economic pressures remains limited.

Welfare & Diseases: Health challenge: This solution has a neutral effect on the global performance of the farm across the three sustainability dimensions when facing an infectious disease challenge. Socioeconomic, environmental, and animal health and welfare objectives may be difficult to achieve if the farm experiences a sudden outbreak of infectious disease. Although multi-species pastures can support good nutritional status and general health, they are unlikely to be sufficient to mitigate the consequences of an infectious disease outbreak.

Welfare challenge: Similarly, this solution does not significantly affect the global performance of the farm when facing the implementation of high-standard animal welfare legislation. Access to pasture is a fundamental requirement from an equine welfare perspective, and the duration of pasture access is often more important than pasture quality alone. However, if extended pasture access can be combined with the provision of high-quality, well-maintained multi-species pasture, this solution may contribute to greater farm resilience and facilitate compliance with higher welfare standards.

Climate Change & Access to Land: Environmental challenge: this solution will support the global performance of the farm facing abnormally high temperatures and/or drought because this solution enhances the overall resilience and performance of the farm under conditions of abnormally high temperatures and/or drought stress. Increased plant biodiversity within the system improves ecosystem stability and functional redundancy, enabling the plant community to better withstand and recover from abiotic stressors such as heat and water scarcity. As a result, the system exhibits greater resistance and adaptive capacity to the negative impacts associated with climate extremes.

Land access/management challenge: this solution will not impact the global performance of the farm facing loss or limited access to agricultural land because it cannot address the root cause of the problems, namely that the farm losing access to grassland that it was able to use before.

Multi-species Grasslands for Climate Change Adaptation

Cost-benefit Analysis

Costs	Benefits
Socioeconomics: • Cost of sowing multi-species grassland mixtures. • Seed costs (variable depending on species composition and quality).	• Increased farm economic security due to more stable yields under variable weather conditions. • Reduced need for mineral fertilisers. • High nutritional value of forage improves feed efficiency and animal performance. • Potential reduction in long-term feed-related costs due to improved self-sufficiency.
Health & Welfare: • Highly productive or selected plant species may be unsuitable for horses with low nutritional requirements if not properly managed (e.g. risk of excess energy intake). • Management required to avoid ingestion of unfavourable or over-mature vegetation.	• Grazing behaviour supports improved digestive health and gut function in horses. • High botanical diversity contributes to improved overall health status. • More balanced nutrient intake due to mixed species composition. • Increased opportunity for species-appropriate feeding behaviour.
Environmental Sustainability: • Botanical composition may change over time, potentially reducing the proportion of beneficial species such as legumes. • Risk that alien (non-native) species may spread. depending on management conditions.	• Increased biodiversity at field level. • High proportion of legumes improves soil fertility through nitrogen fixation. • Improved soil structure and biological activity. • Enhanced ecosystem stability and resilience to climatic stress.
Cooperation between Farms: • No significant costs identified.	• Facilitates exchange and trade of forage between farms (e.g. purchase of preserved forage). • Attractive integration option for crop farmers using multi-species grassland in rotations for soil improvement. • Encourages collaboration between livestock and arable farming systems. • Strengthens regional agricultural cooperation and resource sharing.

Additional Resources

Publications

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Annex

Ideas to Animate a Workshop About the Solution

- Invite an agricultural advisor, forage specialist, or seed company working with grassland mixtures to sponsor or support the workshop.
- Identify a model farm with established multi-species grasslands to host the practical part of the workshop.
- Include field-based exercises where participants assess sward composition, compare plant diversity, and observe grazing behaviour in practice.

Proposed Structure for the Workshop on Grasslands in Equine Farms

1. Introduction to multi-species grasslands
- What are multi-species grasslands and how do they differ from simple grass stands or monocultures?
- Key components: grasses, legumes, and additional herb species adapted to site conditions.
- Types available: temporary vs. permanent grasslands, and different seed mixture compositions depending on use (grazing, mowing, mixed systems).

2. Benefits of multi-species grasslands in equine farms
- Increased resilience to climatic variability and more stable forage production.
- Improved forage quality and nutritional balance for horses.
- Reduced need for mineral fertilisation due to nitrogen fixation by legumes.
- Support of natural grazing behaviour and improved animal welfare.
- Contribution to biodiversity and ecosystem services.

3. Practical applications on equine farms
- Establishment of temporary multi-species grasslands within crop rotations.
- Use for grazing systems, mowing systems, or combined use.
- Adaptation of species mixtures depending on horse category (maintenance horses, sport horses, broodmares, foals).
- Management of grazing intensity to maintain sward diversity and avoid dominance of single species.

4. How to choose the most suitable system
- Assessment of farm objectives (production, conservation, mixed use).
- Evaluation of soil type, climate conditions, and long-term management strategy.
- Selection of species based on intended use and horse nutritional requirements.
- Comparison of seed mixtures and establishment strategies.

5. Hands-on demonstration
- Field observation of different grassland plots and species composition.
- Identification of key grasses and legumes in mixed swards.
- Demonstration of grazing behaviour and selective feeding by horses.
- Practical evaluation of pasture condition and biomass distribution.

6. Maintenance and troubleshooting
- Monitoring botanical composition over time.
- Adjusting grazing pressure to maintain diversity.
- Over-sowing or reseeding strategies when species decline.
- Managing dominance of aggressive or undesirable species.

7. Case studies and real-world examples
- Examples of farms successfully using multi-species grasslands in equine production.
- Discussion of implementation strategies and challenges.
- Lessons learned from long-term management and adaptation.

8. Cost analysis and return on investment (ROI)
- Initial establishment costs (seed, sowing, land preparation).
- Long-term savings through reduced fertiliser input and improved forage efficiency.
- Economic benefits of increased yield stability under variable climate conditions.
- Improved farm resilience and reduced feed dependency.

9. Q&A session
- Open discussion of practical challenges and farm-specific situations.
- Exchange of experiences between participants.
- Clarification of management strategies and species selection.

10. Wrap-up and resources
- Summary of key principles of multi-species grassland management.
- Further reading materials and technical guidance sources.
- Contacts for seed suppliers, advisors, and demonstration farms.
- Information on regional support programmes for grassland systems.