SUPER-G
SUSTAINABLE PERMANENT GRASSLAND

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Complete sward renewal through sward destruction and reseeding – advantages and risks

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- **DESCRIPTION:** Spraying off the existing sward using non-selective systemic herbicide (eg. glyphosate) or cultivation by ploughing or disk tillage (on shallow, stony soils) and seedbed preparation are two methods of eliminating the existing plant species and then replacing them with selected, desired plant species by drilling or broadcast sowing

- **RATIONALE:** Complete sward renewal is used when the existing sward is not meeting current land management objectives (has less than 50% of the desired species and/or contains undesired species) and other improvement methods (fertilisation, intense grazing, overseeding) will not provide the desired results.
  - ✓ The current sward often has a high proportion (typically over 20%) of undesirable species or weeds that are difficult to control, e.g. *Deschampsia cespitosa*, tufted sedges, rushes, dicotyledon rhizomatous weeds, *Taraxacum officinalis, Rumex obtusifolius, Cirsium arvensis*, and in some regions also *Carduus acanthoides, Tanacetum vulgare*, and on wet meadows on loose peat-muck soils, *Filipendula ulmaria, Geum rivale, Polygonum bistorta*.
  - ✓ Reseeded desired species could be productive species (cultivated grasses and legumes) or species that support pollination, biodiversity or deeper rooting for drought resilience and higher carbon sequestration, such as chicory or plantain
  - ✓ Successful reseeding of a grass-legume mixture can provide the farmer with more and better forage quality, faster sward regrowth, greater fertiliser use efficiency, and, as a final result, lower forage costs

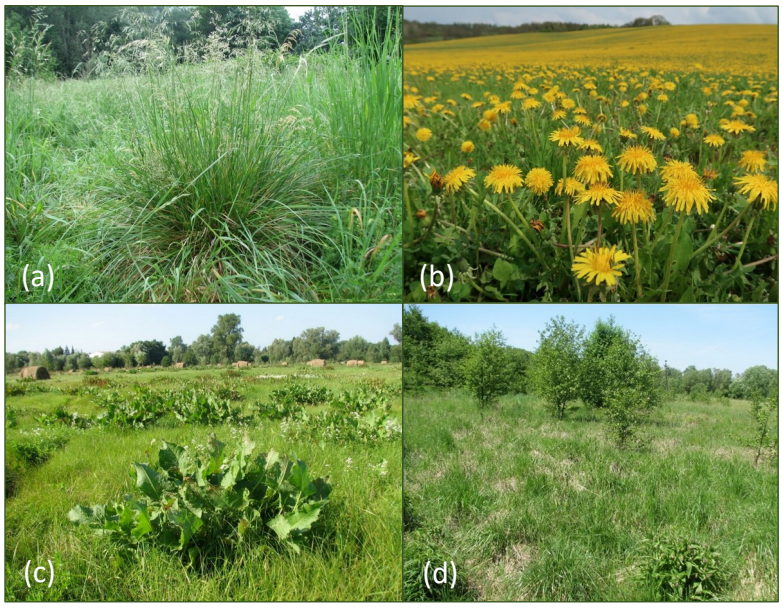

Fig.1: (a) Degraded wet meadow sward with a high share of Deschampsia cespitosa (more than 30%), known as tufted hairgrass (very low quality species) requires complete sward renewal. Photo: Maria Janicka; (b) Taraxacum officinalis (dandelion) invasion in early spring – poor pastures. Photo: Stanislav Hejduk; (c) Degraded grassland through strong development of Rumex obtusifolius (broad-leaved dock). This nitrophilous species reduces grassland production and decreases the feeding value of the sward. Cultivation causes root fragmentation and facilitates vegetative reproduction of the weed; (d) An abandoned grassland with a high proportion of tufted species and many gaps (bare soil or 'thatch') in the sward. Single shrubs and trees present. Complete sward renewal is required to enhance productivity. Photos: Maria Janicka

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- **MECHANISM OF ACTION:** In intensively utilised grasslands, the proportion of legumes and cultivated grasses usually decreases over time. If the poor sward quality and low forage yield is a result of poor nutrient management, water stress (drought), soil compaction, low pH or some other management issue, then the above growth limiting factors should be addressed first. Otherwise, reseeding will not have the desired effect.
  - ✓ Destroying the original sward by ploughing, discing, rotavating or spraying off with herbicide (glyphosate) allows maximum opportunity for sown species to become established. In the case of strong weed infestation both spraying with non-selective herbicide and tillage are recommended
  - ✓ When troublesome weeds dominate, it may be necessary to spray twice; the first spraying (in early autumn) destroys the existing sward, and the second (in spring before sowing) - destroys the regenerated vegetation and emerging annual weeds. This should increase the proportion of sown species - high productive grasses and legumes – that establish. Where the main objective is to increase biodiversity, regionally native herb species and hemi-parasitic plants can also be sown.
  - ✓ In combination with herbicide use, cultivations should be carried out seven to ten days after spraying. Where direct-drilling is used, it is important to allow sufficient time between herbicide application and seed sowing. Rolling after drilling ensures good seed-to-soil contact.
  - ✓ Fertiliser use should also be considered; the key nutrient for grass and legume establishment is phosphorus, which stimulate root growth. Grassland renewal provides a good opportunity to incorporate farmyard manure (FYM) into the soil.
  - ✓ Liming is also important to achieve target soil pH and support the growth of legumes regardless of how the PG is renewed, and also, neutralise the organic acids released by the decomposing old sward
  - ✓ If sward renewal is successful, it will increase productivity, reduce reliance on manufactured nitrogen fertilisers (more legumes), increase resilience to drought (more deep rooting legumes and herbs), improve forage quality (high quality species) and/or improve biodiversity (species rich mixtures).

Fig.2: (e) Physical destruction of old sward (ploughing); (f) Chemical destruction of the sward by spraying using non-selective herbicide. Photos: Maria Janicka

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- **POTENTIAL FOR APPLYING THE MANAGEMENT OPTION:** 'Destroying' the existing vegetation through cultivation can be used in any biogeographic region and in situations where cultivation is not limited by topography. Some sites may not be suitable, for example where there are visible archaeological features, potential damage to bird habitat, or risk of soil erosion (cultivation should only be used on flat to moderately sloping land)
  - ✓ Mechanical destruction of grassland swards should be avoided on peat-muck soils (the top layer strongly dries up, and sowing very often fails). In drier habitats, chemical destruction of the existing sward is more effective than mechanical
  - ✓ Herbicides can only be used on conventional (non-organic) farms and should be prioritised at sites where mechanical cultivation is difficult or impossible. This option is recommended when the existing sward contains less than 50% of the desired species
  - ✓ Efficiency of renewal depends on the availability of water for seedlings, so the time of sowing is very important, especially in drier habitats. In central Europe, soil moisture conditions are usually best in early spring and late summer/early autumn

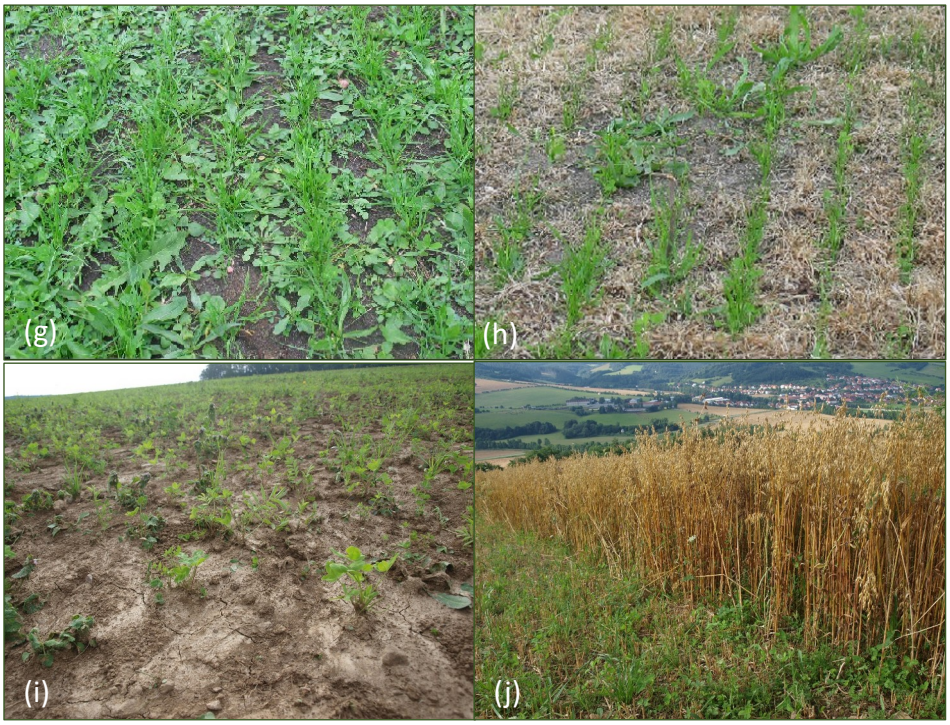

Fig.3: (g) Weed infestation after original sward destruction by cultivation; (h) Much lower weed infestation after sward destruction by non-selective herbicide spraying. Photos: Maria Janicka; (i) Soil water erosion on newly established grassland, after renewal on a hillside; (j) Oats as nurse-crop for PG establishment after PG renewal. Photos: Stanislav Hejduk

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Practical considerations for the Continental biogeographic region

Currently, 5-8 species (varieties) of grasses and legumes, adapted to pastures and meadows, are most commonly used for permanent grassland renewal.

Examples of suitable pasture and meadow species:

Pastures	Meadows
Periodically wet Black bent, red top (*Agrostis gigantea*), Alsike clover (*Trifolium hybridum*)	**Wet, periodically flooded** Meadow foxtail (*Alopecurus pratensis*), Reed canary-*grass (Phalaris arundinacea*), Tall fescue (*Festuca arundinacea*), Black bent, red top (*Agrostis gigantea*), Fowl blue grass (*Poa palustris*), Alsike clover (*Trifolium hybridum*)
Moderately moist Meadow fescue (*Festuca pratensis*), Timothy (*Phleum pratense*), *Festulolium* – pasture type, Perennial ryegrass (*Lolium perenne*), Smooth meadow grass (*Poa pratensis*), White clover (*Trifolium repens*)	**Moderately moist** Meadow fescue (*Festuca pratensis*), Timothy (*Phleum pratense*), *Festulolium* – meadow type, Smooth meadow grass (*Poa pratensis*), Red clover (*Trifolium pratense*)
Periodically dry Cocksfoot (*Dactylis glomerata*), Red fescue (*Festuca rubra*), Tall fescue (*Festuca arundinacea*) – pasture type Black medic (*Medicago lupulina*), Birdsfoot trefoil (*Lotus corniculatus*) Cichory (*Cichorium intybus*) Plantain (*Plantago lanceolata*)	**Periodically dry** Cocksfoot (*Dactylis glomerata*), Tall fescue (*Festuca arundinacea*), Tall oat-grass (*Arrhenatherum elatius*), Smooth brome grass (*Bromus inermis*), Red fescue (*Festuca rubra*), Yellow oat-grass (*Trisetum flavescens*) Birdsfoot trefoil (*Lotus corniculatus*)

Advantages

Complete sward renewal is considered the most effective method of sward improvement. High yields of forage with high feed value are usually achieved faster compared to other methods. When herbicide treatment is followed by direct drilling, the dead biomass from the original sward acts as a mulch, protecting the soil surface from erosive rain and conserving soil moisture. Compared to overseeding, sown species have better access to light and water, due to lack of competition from the original sward. By ploughing, topsoil compaction can be eliminated, and lime and organic manures applied and incorporated into the topsoil.

Disadvantages/risks

Complete rennovation is a costly method (labour, diesel, machinery, seeds). After ploughing, the soil can dry out rapidly and weed infestation can occur through rapid germination of the soil seed bank (e.g. *Rumex obtusifolius*). Ploughing can also release significant amounts of carbon dioxide (1 - 10 tons of organic carbon loss per hectare and year through oxidation) and nitrous oxide (due to mineralisation and nitrification) from the soil and can lead to undesirable leaching of nutrients (esp. nitrates: 30 - 100 kg N-NO3- per ha in the winter following late summer/autumn ploughing). Concentration of leached nitrates in underground water under renewed grassland (up to 60 mg N-NO3/l) can significantly exceed the standard for potable water (11 mg N-NO3/l). Forage production is substantially reduced in the renovation year. Although permanent grasslands can provide excellent protection against soil erosion, this is not the case for several weeks after complete sward renewal.

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- **SUPPORT:** Grassland renewal is not supported in any European country. This option can be implemented without financial support, as the increasing forage production and its quality should cover the renewal costs.

- **EXAMPLE OF GOOD PRACTICE:** Think twice before ploughing up the existing grassland. Remember that this is a 'last resort' method, so only use it when other rennovation methods (intense grazing, fertilisation, overseeding) will not provide the desired results.
  - ✓ The best renewal effects are achieved when botanical composition of the old sward consists of low productive species which completely cover the soil surface (red fescue, brown top – *Agrostis stolonifera*) and do not allow for the successful establishment of valuable grasses and legumes. In this case, complete sward renewal through sward destruction and reseeding can significantly increase grassland productivity. Due to the slow initial growth and development of legumes (and weed infestation), grass-legume mixtures are sometimes, especially in undulating areas, sown with a nurse-crop such as barley (grown for whole crop silage) or oats (for silage)
  - ✓ For example, the average (for 5 years after renewal) hay dry matter (DM) yields obtained on farms in the White Carpathians (Czechia) and in Austria were about two to four times higher (6.2-7.1 t DM/ha) compared to the yields from the original sward (1.5-3.1 t DM/ha). In central Poland, the difference was smaller, but also large, with the reseeded meadows (at 5.6-6.8 t/ha) yielding over two times the original sward (2.5-3.2 t/ha). This allowed for 3 cuts or 2 cuts and grazing, whereas before the renovation only one cut was harvested per year. One of the reasons for such high yield increases is the generally low level of PG fertilisation in Central Europe. Seed mixtures with a legume content of 15-30% and organic matter mineralization after soil tillage supply the new sward with nitrogen and other nutrients
  - ✓ However, the effect of sward renewal on improving forage quality can be even greater than on increasing yield
  - ✓ In Western Europe, where some farmers use higher fertiliser application rates on their PG, sward renewal may not be as profitable due to a generally higher proportion of productive species

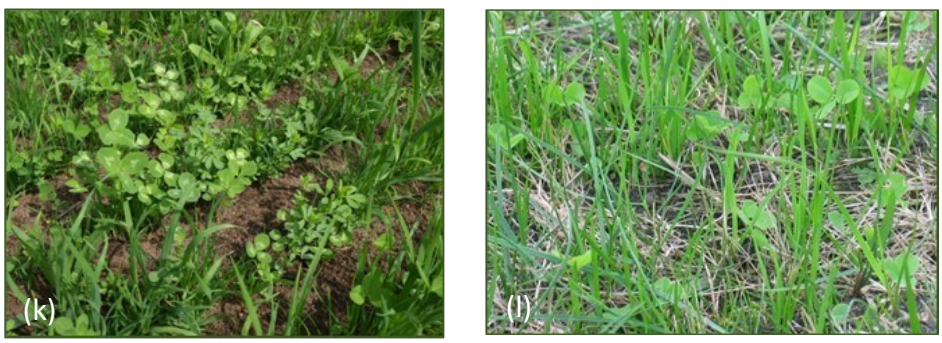

Fig.4: Young grass-clover stands, developing after original sward destruction: (k) by ploughing. Photo: Stanislav Hejduk; (l) by spraying with non-selective herbicide and direct drilling. Photo: Maria Janicka

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