SUPER-G
SUSTAINABLE PERMANENT GRASSLAND

MEDITERRANEAN
BOREAL
ALPINE
PANNONIAN
CONTINENTAL
ATLANTIC

Irrigation of grasslands

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- **DESCRIPTION:** Irrigate grassland to reduce soil moisture deficits at critical times during growth to optimise yields and nutrient uptake. It can also be used to supply nutrients, raise soil temperatures in winter and control pests.

- **RATIONALE:** Grasslands can be irrigated both in summer, to prevent drought, and in winter, to increase soil temperature, favour snow melt, bring in sediments, and extend the productive season. In both cases, irrigation i) increases biomass production, ii) reduces the need to preserve feed due to a longer grazing season, iii) stabilises grass production, iv) maintains valuable forage species in the sward, v) fertilises poor soils using sediments or diluted slurry (fertigation), and vi) controls some pests and animals (e.g. cockchafers or mice).

  In recent years, grassland irrigation has mainly been used to increase summer production or extend the growing season, primarily in the Mediterranean areas.

Fig.1: Aerial Winter irrigation in the Po plain, IT
https://www.pim.mi.it/biciclettata-nel-paesaggio-delle-marcite-della-vallata-del-ticino/

Fig.2: Sprinkler irrigation in the Eastern Alps in Italy
photo: Stanislav Hejduk

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- **MECHANISM OF ACTION:** Irrigation methods used in grassland range from traditional systems to modern ones. Traditional irrigation systems use surface water from rivers or canals, delivered through permanent ditches to fields that are land graded with a specific slope that depends on the type of soil. These systems are applied both on mountain, hilly and plain areas, with regional diversity. They require large amounts of water, high flow rates, and manpower not only during events, but also all throughout the year for the maintenance of the land grading and ditches. These systems are still used in some alpine and subalpine areas, where the availability of surface water is still guaranteed. The efficiency of these systems, calculated as the plant-available to supplied water ratio, is very low, and are therefore banned at times of water shortage. Nevertheless, the inefficiency of the delivery systems ensures a degree of groundwater recharge that is an important resource downstream, while transforming a running ephemeral surface water into a slowly-moving ground reservoir.

Modern systems such as sprinklers are now used in areas where big investments were made in burying pipes and installing collective or private electric or engine-driven pumping stations. These systems, that ensure higher water use efficiency in terms of grass production, are used in intensively-managed areas where the investment and energy costs are rewarded by high income from quality cheese production (e.g. in the areas of Parmigiano Reggiano and Fontina cheeses in Northern Italy).

Irrigation can help to overcome drought, which can reduce organic carbon storage and stocks under grasslands due to lower photosynthetic activity and higher rates of soil organic matter mineralization.

Fig.2: Acid grassland with grassy tussocks (a) and bare ground (b).
Accessed at: Rampisham Down Factcheck #1: Lowland Acid Grassland; A Rare Habitat with Rare Plants a new nature blog
check the citation or permision

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Potential for applying the management option

Irrigation has been widely used in the past to increase yields in grassland areas. Irrigation in Europe was performed using surface water delivered using ingenious systems and collective work to maintain ditches and land grading. Some Mediterranean and central European regions were scattered with irrigation structures that have shaped the landscape.

Estimating the true area of irrigated grassland in Europe is difficult. Some sources state it is 10% of the total UAA, while some others estimate c. 10% of the surface of permanent grassland in Mediterranean regions and c. 3% in Atlantic regions. The reduction of grassland irrigation is due to changes in the way livestock are managed and fed and a widespread cultivation of summer arable crops that are much more profitable for modern markets.

Modern irrigation systems have been recently developed or promoted to increase the profitability of grassland areas. These initiatives recognise the importance of maintaining grasslands on farm, and the ecosystem services they provide.

On the other hand, modern systems must face i) the shift from manpower to other (preferably renewable) sources of energy, and ii) a shortage of water, both due to competition from other more profitable crops and from other human activities, all within the context of climate change that has reduced the usability of rainfall and increased the evapotranspiration demand.

Modern systems use electronic sensors and devices that allow i) soil water content monitoring, ii) prompt intervention when the soil water content reaches specified threshold values and before the plant experiences water stress, iii) calculation and delivery of specific amounts of water that ensure minimum losses, iv) optimisation algorithms that combine actual soil and plane statuses with weather forecasts and farm constraints. The uptake of such systems is increasing, due to technical improvements and a reduction in the cost of ICT systems.

These modern support systems can be applied both to traditional surface irrigation, using automated closures, or to sprinkler systems, such as pivot or lateral move irrigation systems.

Practical considerations

If there is a choice between gravity and sprinkler delivery systems, some studies have demonstrated limited effects of the type of irrigation distribution system on grassland productivity and species composition, at least in the short term. However, remarkable effects have been observed when comparing the presence and absence of irrigation in leys and permanent grasslands, both in terms of forage productivity and quality, since beneficial forage species tend to require more water than weeds.

In Northern Italy, for example, 65% of the permanent or temporary grassland area is irrigated using surface systems, while only 31% uses sprinkler irrigation systems, mainly hose reel irrigation. This indicates a still predominant use of traditional techniques, that may be replaced in the next few years, due to water shortage issues.

Fig.3: Traditional closure, western Po plain, IT
photo: Laura Zavattaro

Fig.4: Automated closure, eastern Po plain, IT
www.crpa.it/

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Support

Public subsidies are generally needed to change from a low-efficiency to a high efficiency irrigation system, particularly when farm incomes are low, as is often the case on grassland farms. Maintaining higher efficiency systems also adds to operational costs, which vary according to international energy prices. Higher costs and their uncertainty may prevent farmers from investing in irrigation systems on grasslands, which can put the profitability and existence of these grasslands at risk.

Example of good practice

Several examples exist on the use of irrigation systems coupled with Decision Support Tools (DSTs, e.g. www.irriframe.it) that calculate a water balance to define the right amount and timing of water to deliver to crops. Although developed in other contexts (horticultural crops, fruit trees), these systems can successfully be applied to arable crops and grasslands. The water balance is calculated using meteorological data, which can be easily gathered from local meteorological services, and crop coefficients that vary with the growth stage of plants. The system alerts the farmer when the calculated soil water content reaches a pre-defined threshold. The predicted soil water content can also be double-checked using sensors placed in the soil at various sites and depths.

The farmer should update the DST regularly with information on the effective irrigation supplied, the utilisation dates, and the growth stages of the most represented plants (that affect the crop coefficients). The soil texture data are also needed to predict soil moisture deficits, but a specific calibration of the system is sometimes recommended to improve the quality of predictions. The most advanced tools are also connected to a weather forecast service, to fine-tune the time and amount of water delivery on the basis of future rainfall and evapotranspiration.

DSTs are very effective in helping farmers improve water management, but their use is limited to those situations where the farmer has unlimited access to water. If water is instead managed by an association or irrigation consortium that determines the timings for water delivery to single farms and fields, the benefits of such systems is more limited.

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