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REGENERATIVE GRAZING AS AN ELEMENT THAT SHAPES GRASSLAND ECOSYSTEM SERVICES

Iwona Radkowska[1], Adam Radkowski[2]

[1]National Research Institute of Animal Production, Department of Cattle Breeding,
32-083 Balice near Kraków
E-mail: iwona.radkowska@iz.edu.pl, phone: 666 081 249
ORCID: 0000-0002-8780-1585
[2]University of Agriculture in Kraków, Department of Agroecology and Plant Production,
Al. Mickiewicza 21, 31-120 Kraków
E-mail: adam.radkowski@urk.edu.pl
ORCID: 0000-0002-3146-6212

Abstract

Contemporary agriculture encounters several obstacles, including scarcity of resources, growing demand, mounting production expenses, and the need to achieve climate neutrality. One of the main challenges that agriculture will face in the years to come is finding a way to balance climate neutrality with the growing need for food. This generates interest the development of more sustainable agricultural systems and practices. Regenerative agriculture (RA) serves as a viable alternative to traditional agriculture. It is not a specific practice, but a combination of many sustainable farming approaches, including elements of integrated, precision, and organic farming. Regenerative agriculture in its broadest sense is aimed at restoring and improving biodiversity, soil fertility, and the provision of ecosystem services, such as carbon sequestration and water retention. Similarly, regenerative livestock grazing is a holistic agro-ecological method that combines climate and biodiversity protection with generating sufficient grass sward productivity. Regenerative grazing is founded upon ecological principles and the interdependence between grassland ecosystems and ruminant animals. Regenerative grazing aims to rejuvenate soil that has been harmed by excessive grazing, enhance soil fertility, promote biodiversity, minimise the reliance on chemical fertilisers and pesticides, decrease carbon dioxide emissions, and generating sufficient income to create profitable farms that produce high-quality food. Regenerative grazing prioritises minimising or eliminating tillage, enhancing the variety of plant and animal species, and promoting the growth of soil microbial life. Efficiently managed livestock grazing does not inflict damage upon the land, but rather aids in the rejuvenation of soil structure, which is advantageous for the grazing animals. The paper seeks to clarify the fundamentals of regenerative grazing and its advantages in light of the obstacles confronting contemporary agriculture, particularly the prudent utilisation of grasslands.

Keywords: grassland, regenerative grazing, biodiversity

Introduction

Environmental protection and the climatic impact of many industrial systems, including agriculture, have received growing attention in recent years. One challenge that must be overcome is the reduction of greenhouse gas emissions. According to EU objectives, Europe aims to become the first continent to achieve carbon neutrality by 2050. This would be accomplished by implementing the European Green Deal. The primary objectives for agricultural production are as follows: a decrease of at least 55% of net greenhouse gas emissions from agricultural activities by 2030; a 50% reduction in the utilisation of chemicals and pesticides, a 50% decrease in nutrient losses while simultaneously enhancing soil fertility and reducing fertiliser usage by at least 20%; a 50% reduction in the sale of antimicrobials for livestock and aquaculture; and the establishment of organic farming on 25% of farmlands. The ambitious objectives of this programme will be accomplished by implementing a range of strategies to address climate change and preserve biodiversity in agricultural landscapes throughout Europe.

Impact of grazing on grasslands

Livestock grazing has become the predominant land use globally, encompassing around 25% of the Earth's land area. Additionally, it serves as a significant catalyst for the diversification of grasslands (Rupprecht et al., 2016). Regrettably, inadequate organisation and management of grazing may lead to a decline in productivity, diminished deposit of soil carbon, and a loss of biodiversity in plant and animal groups. Grazing animals affect species composition by consuming biomass, redistributing nutrients via faeces and urine, causing soil compaction and erosion by trampling (Eichberg and Donath, 2018), and using their fur, hooves and faeces to facilitate seed dispersion (Freund et al., 2015). Grazing animals modify habitat conditions and generate microhabitats for plants (Deák et al., 2017).

The diversity of meadow and pasture flora is influenced by several natural factors, including climate, water availability, soil composition, landform, and human activities such as fertilisation, maintenance, usage, and production intensification. The majority of grasslands have been formed and now exist as a result of sustained human use over many millennia (Dengler et al., 2014; Leuschner and Ellenberg, 2017). Meadows and pastures serve as a reservoir of species variety for several vascular plants (Wilson et al., 2012; Chytrý et al., 2015). Approximately 30% of agricultural land in EU countries is classified as high nature value, according to Keenleyside et al. (2014). Traditional animal husbandry was the predominant land use in Europe until the 19th century (Leuschner and Ellenberg, 2017). Unfortunately, with the rise in animal production, the significance of grazing diminished in preference for intensive indoor housing systems. According to a study by Hobohm et al. (2021), the population of herbivores grazing in Europe has decreased by more than 90% in the last century. In addition, the political transformation in Central and Eastern Europe in 1989 led to a significant decrease of 50-70% in cattle populations in those areas (Isselstein et al., 2005). The cattle population in Poland has seen a decline of almost 50% throughout the last three decades (Diagram 1).

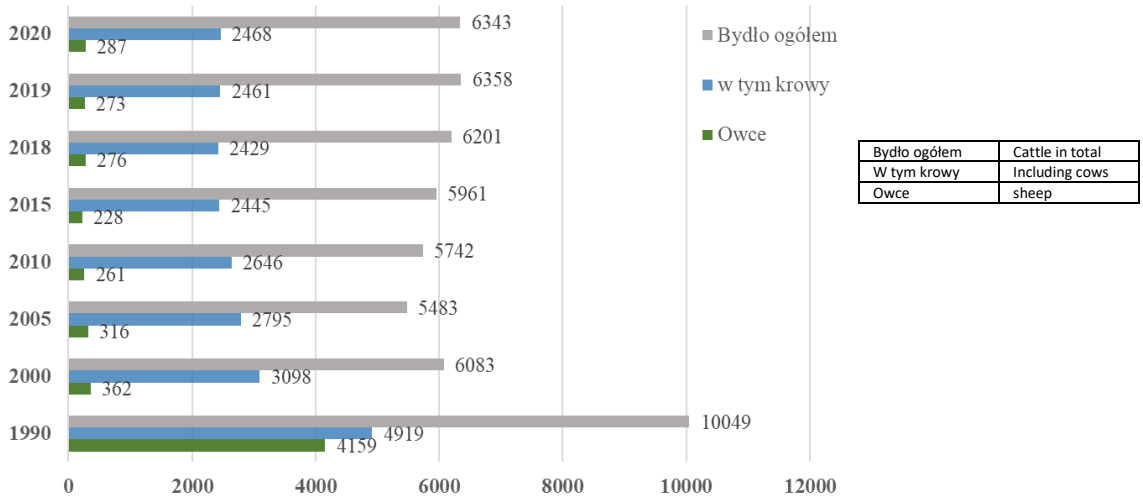

Diagram 1. Changes in ruminant population from 1990 to 2020 (in thousands) (own compilation based on Central Statistical Office data, 2021)

The decline in ruminant livestock populations, along with the rise in animal efficiency and the shift in housing methods (such as free stall barns and TMR feeding), have significantly influenced grasslands. Increasingly larger regions are progressively becoming unusable and then transforming into scrub or forest due to natural succession, leading to a substantial decline in their biodiversity. Helm et al. (2006) state that in Estonia, a significant portion of grasslands, ranging from 59% to 94%, has been transformed into secondary scrub and woodland due to disuse. Poland has witnessed a marginal increase in grassland coverage, while seeing a significant reduction in pasture acreage, dropping from 1477,000 hectares in 1990 to a mere 414,000 hectares in 2020 (Diagram 2).

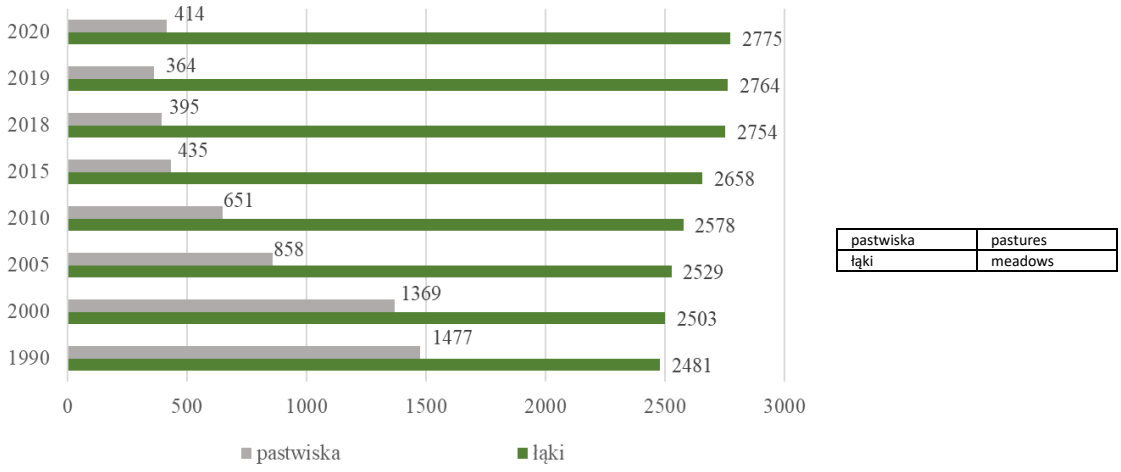

Diagram 2. Changes in the structure of meadows and pastures from 1990 to 2020 (in thousands of hectares) (own compilation based on Central Statistical Office data, 2021)

There are numerous varieties of grazing that may be categorised as intensive, semi-intensive and extensive. Grazing methods found within these types include the rotating quarter grazing and the free-range methods. Rotational grazing involves grazing animals based on a predetermined grazing plan, which takes into account factors such as pasture size, productivity,

and animal stocking density. Implementing rational and effective grazing management practices ensures that the soil remains well cultivated to promote soil water retention and the development of grass in subsequent cycles.
The excessively intensive use of meadows and pastures negatively impacts their biodiversity. The introduction of higher levels of nitrogen, agrochemicals, and intensified land use leads to land degradation and a decline in biodiversity (Henle et al., 2008). Therefore, rational grazing management is important. The use of grassland for foraging purposes must be carefully managed to ensure the preservation of its biodiversity. Regrettably, the attainment of large yields does not promote species variety. A negative correlation exists between the productivity of communities and their species richness, as shown by studies conducted by Gross et al. (2009) and Socher et al. (2012). According to Chapman (2001), the productivity of meadows and pastures may be improved by using more mineral fertilisers and using them more often. However, this practice also leads to a significant decline in the botanical variety of grasslands. A study conducted by Heineken in 1990 revealed that the biodiversity of organic grassland is much greater, with up to ten times more species compared to conventional grassland.

Animal stocking density significantly affects the level of plant selection, the quantity of forage consumed, and the amount of forage left behind. The botanical makeup of the sward, the stage of growth, and the weather pattern are also crucial factors, which is why the animal stocking rate cannot be considered a constant value. Low stocking density leads to an accumulation of fodder left behind, resulting in decreased pasture utilisation.

The concept of regenerative grazing

The impact of grazing on agroecosystems is contingent upon factors such as the habitat, the kind of animals being grazed, the level of grazing intensity, and the grazing regime, including the length of grazing (D'Ottavio et al., 2018; Bengtsson et al., 2019). Overgrazing is a significant contributor to the deterioration of pastures, resulting in soil erosion and the spread of weeds and invasive species, as well as desertification or desiccation. The areas in Europe that face the risk of overgrazing include central, eastern, and southern Europe (Török and Dengler, 2018).

The notion of regenerative grazing has been developed as a means to mitigate the adverse impacts of intensive grassland use. Providing a precise description of regenerative grazing is challenging due to the absence of an universally accepted and agreed-upon definition. It can be described as a holistic method of livestock grazing management that focuses on effectively dividing plots and determining the optimal time of grazing on each plot. The primary objective is to improve the health of the soil, plants, and animals involved. There are no universally applicable principles for managing grazing. It is necessary to tailor the management approach to the evolving requirements of the animals and consider the productivity and variability of each specific pasture. There are no rigid rules for introducing or transitioning to regenerative agriculture or regenerative grazing, since methods and practices will differ across farms and regions. Regenerative grazing refers to a kind of controlled grazing in which the farmer has control over the location and duration of animal grazing. The objective of this grazing technique is to prevent both insufficient and excessive grazing of the pasture. In a regenerative grazing system, animals are rotated to graze on certain sections of the pasture for brief periods (ranging from a few hours to a maximum of three days), which is then followed by extended periods of allowing the grass to rest and regrow, thereby promoting the renewal of vegetation. Regenerative grazing aims to replicate the conditions in which grasslands began and developed, namely the mutually beneficial interaction of grasses, ruminants, predators, and soil microbiota. These interdependencies have made grasslands the world's dominant biome, with the soils underneath them being the most carbon-rich soils on Earth. This grazing method

aligns with the principles of regenerative agriculture, which focuses on minimising or eliminating soil disturbance, promoting a wide variety of plant and animal species, enhancing soil microbial activity, and ensuring profitable farms and fair compensation for agricultural labour (Lal, 2020).

The regenerative grazing method aims to facilitate optimal plant regrowth during grazing intervals, promoting the development of deeper roots. This, in turn, enhances soil structure, fertility, and nutrient accumulation. The resultant grass is thick and compact, which hinders water flow and enhances water absorption during intense rainfall, hence mitigating soil erosion. Pastures have low fertilisation requirements because of their deep, well-established root structure, which enables increased nutrient absorption from the soil. This reduces groundwater contamination. Grazing contributes to the reduction of greenhouse gas emissions by enhancing soil health, leading to heightened efficiency in carbon sequestration. Additionally, the more uniform dispersion of manure aids in the reduction of methane emissions. Another advantage is the economic aspect, as it decreases the cost of harvesting and feed provision for the animals, while also diminishing the need for fertilisers and pesticides due to better soil fertility.

A regenerative grazing system establishes a network of connections both inside the farm and outside it. Properly arranging the production of fodder on pastures is anticipated to improve soil structure and biology (Glover et al., 2010). Enhanced soil condition leads to increased fodder output and quality, resulting in better nutrition and animal health (Paine et al., 1999). Better animal health results in reduced utilisation of veterinary medications (Waller, 2006), enabling the production of superior quality goods for human consumption (Provenza et al., 2019). Enhanced soil function may also bolster local resistance to severe weather events, such as by enhancing water retention (Park et al., 2017a). Improved soil and animal well-being results in decreased expenses and heightened farm profitability. Consequently, increased farm earnings facilitate the sustenance and growth of agri-food businesses (Rosset, 2000; Tuck and Pesch, 2019). The interactions and processes described above are inherently interconnected, which means that regenerative agriculture requires a thorough and systematic approach (Figure 1).

Animal selection for regenerative grazing

A vital element of a regenerative, extensive grazing system involves carefully choosing a suitable species of grazing animals. These animals should be able to efficiently utilise the available forage and, in ecologically significant areas, serve as an active means of protecting the environment (Szymanowska et al., 2019). Indigenous and local animal breeds have a natural inclination towards prolonged grazing due to their well-suited adaptation to challenging subsistence conditions. They efficiently use the available, even lower-quality fodder. A comprehensive strategy is necessary to optimise the management of semi-natural grasslands, which are defined by the presence of grasses, dicotyledonous plants, shrubs, and trees. This approach should integrate traditional practices with contemporary research methodologies. Indigenous breeds that are well-suited to certain conditions are likely to be the most efficient in maintaining this unique habitat. Comparative research on the environmental effect of various breeds within the same species are few in the scientific literature (Kovácsné Koncz et al., 2020; Pauler et al., 2019). Animals in the pasture exhibit selective consumption of plants, with their preferences for certain plant groups being determined by their species. Cattle, sheep, and horses preferentially consume grasses and legumes, while goats can graze on shrubs and young tree shoots. Introducing grazing goats that are well-suited to the local environment and have a diet that includes shrubs and woody plants might be a potential method for making wastelands usable for grazing, since various plant types are preferred by these goats (Elias and Tischew,

2016). Utilising animals, particularly sheep and goats, for grazing is a very successful approach to mitigate secondary succession in ecologically significant ecosystems.

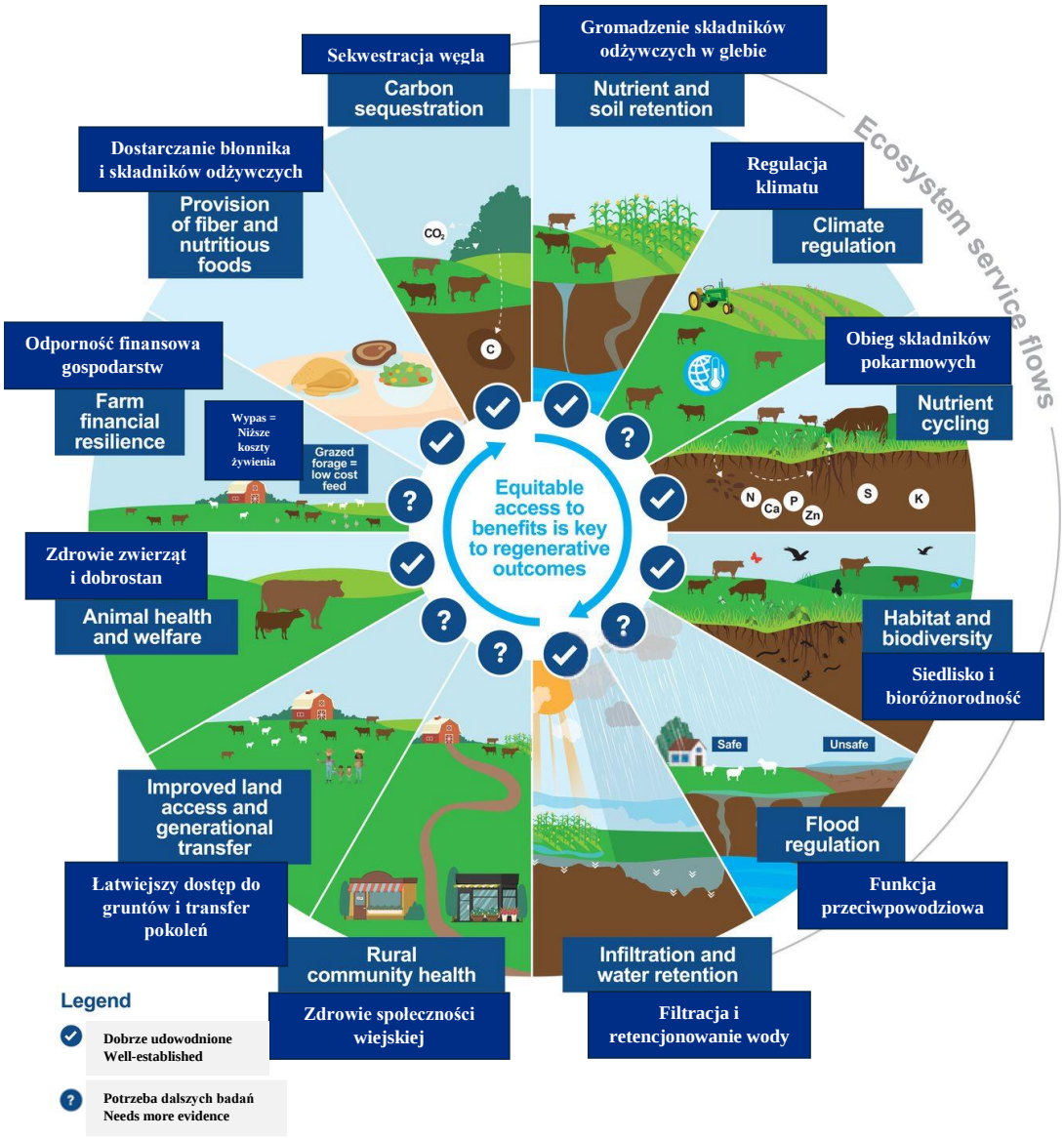

Fig. 1. Benefits of on-farm and off-farm regenerative grazing (Spratt et al., 2021)

In addition to livestock, free-ranging animal species are an integral part of the European landscape, providing important ecosystem services (Pascual-Rico et al., 2021). They are important consumers of grassland forage and also contribute to the transmission and spread of plant seeds. However, excessive populations of game animals, especially wild boar, often cause damage to the ecosystem, degrading natural grassland and forest habitats.

An essential aspect of maximising the use of grazing land is effectively organising grazing activities, including both biodiversity and animal welfare. This requires using the knowledge, experience, and traditional and local wisdom of the farmers. Investing in education and information to assist grassland management is advantageous for both the environment and local populations, who could benefit from sustainable regenerative agriculture (Molnár et al., 2020). Continued investigation and active participation in these activities may provide enduring

advantages for individuals, animals, and the interconnected environments they collectively form.

Regenerative grazing vs. animal health and welfare

Multiple scientific studies demonstrate the advantageous impacts of pasture-based management on animal wellbeing. Pasture-based management of cows decreases the likelihood of several health issues, including mastitis (Bendixen et al, 1986; Washburn et al, 2002; White et al, 2002), endometritis (Bruun et al, 2002), Salmonella enterica infection (Veling et al, 2002), placental retention (Bendixen and al, 1987a), and ketosis (Bendixen as al, 1987b). In the same way, regenerative grazing positively impacts the health and well-being of animals. Reducing animal stress levels and herd disease incidence has been shown to have many positive effects. These include a decrease in somatic cell and bacterial counts in milk, a decrease in lameness and leg and hoof injuries, and a decreased need to reduce herd numbers. Silvopastoral grazing, a component of regenerative agriculture, effectively mitigates heat stress on grazing animals and enhances the flow of ecosystem services, such as carbon storage. Enhanced animal well-being could offset expenses related to pharmaceuticals, veterinary care, and the process of reducing animal populations.

Ecosystem services in regenerative grazing

Regenerative livestock grazing positively impacts grassland ecosystems. It increases the density of the grass cover and sward, enhancing soil fertility, preventing erosion, and reducing nutrient runoff caused by water infiltration (Park et al., 2017b). Permanent perennial grassland enhances water quality (Dinnes et al., 2002) and improves soil water storage capacity by accumulating organic matter (Rawls et al., 2003). Grasslands have a great ability to absorb large quantities of water, such as during periods of severe rainfall. This helps to reduce the quantity of nutrients and sediment that are washed away from the land (Basche and DeLonge, 2019). Permanent vegetation cover is essential for the prevention of erosion and the preservation of moisture. Regeneratively grazed pastures also support a diverse range of insect and bird species without compromising production (Lwiwski et al., 2015; Goosey et al., 2019). Regenerative grazing has the potential to tackle climate change on a global scale through various means, such as decreasing dependence on fossil fuels and synthetic fertilisers, as well as increasing the absorption of carbon by perennial plant communities and its storage in soils (Rotz et al., 2009; Spratt et al., 2021). The extent and consistency of carbon sequestration depend on soil structure, land use, weather conditions, and the grazing regime (Conant et al., 2017). In addition, regenerative grazing has the ability to decrease the methane (CH4) concentration in the intestine when compared to traditional grazing, since the grazed fodder is more easily digested. Properly balancing animal diets, enhancing the quality of the forage base, and supplementation with methane-reducing chemicals may somewhat mitigate the volume of methane emissions from ruminants (Thompson and Rowntree, 2020). The adverse ecological consequences of animal agriculture may be somewhat mitigated by preserving and using grasslands and pastures and implementing extensive grazing practices (Bellarby et al., 2013). Managed grazing techniques may aid in climate change mitigation by enhancing carbon sequestration. Hence, it is essential to advocate and support rotational-regenerative grazing strategies in order to achieve sustainable livestock production.

Summary

The promotion of sustainable agriculture in relation to the preservation of High Nature Value (HNV) has been advocated since the early 1990s. Biodiversity conservation depends not only on protecting rare or endangered species and ecosystems in designated locations, but also on the preservation of certain farming systems and practices. Agricultural activities are designed to promote and are closely connected to high biodiversity. This sort of agriculture might be regarded as the optimal approach to regenerative agriculture, since it promotes the preservation of biodiversity and the enhancement of ecosystem services (Bengtsson et al., 2019). High natural value agriculture has the potential to provide significant revenue for rural communities and promote rural development by using land that is marginal or unproductive. High-nature-value agriculture incorporates several aspects that are deeply rooted in cultural history and traditional ecological knowledge (Molnár and Babai, 2021).

Regenerative farming approaches align with the existing climate policy and EU plans by clearly acknowledging the impact of livestock on carbon management and biodiversity protection. Grasslands cover around 40% of the Earth's land surface and contain about 15% of the world's carbon, with 90% of it being stored underground. The carbon balance is largely influenced by the intensity of animal husbandry and the quality and composition of the feed provided. Introducing regenerative grazing may to some extent mitigate the negative effects of carbon balance resulting from animal production. According to Bellarby et al. (2013), extensive grazing leads to permanent pasture and grassland ecosystems becoming net sinks of greenhouse gases. Furthermore, the implementation of rotational grazing has less detrimental effects on soil and plants compared to continuous grazing (di Virgilio et al., 2019).

Permanent grasslands often represent regions that are only suitable for grazing and have few other uses. Particularly if they are situated in sparsely populated areas where social or physical constraints (such as geography) hinder the intensification of land use. Extensive grazing systems provide an extra benefit and assistance via the products derived from animals that feed on pasture. These products are of superior quality due to their elevated levels of unsaturated fatty acids, vitamins, and phenols (Radkowska et al., 2018; Cabiddu et al., 2019). The resultant goods have health-promoting qualities while also aligning with the ecological and ethical principles in agriculture. Moreover, the use of high-nature-value agricultural methods may foster the growth of agro-tourism. This strategy has the potential to appeal to visitors who are specifically interested in adopting an environmentally friendly and sustainable way of life. Consequently, this may have a positive impact on the local economy by encouraging economic growth. Furthermore, it is crucial to provide education to local people about the advantages of regenerative agriculture and the significance of goods produced in accordance with its principles. In the face of worldwide difficulties presented by climate change, the practices of sustainable agriculture and responsible resource management have significance not only in terms of ecology, but also in relation to economics and social accountability.

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