









Article

Country Perspectives on Hay-Making Landscapes as Part of the European Agricultural Heritage

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Abstract: This paper provides an overview of traditional hay-making structures and the related agricultural landscapes in Europe. The information was collected using a standardised questionnaire that was completed by experts from different countries. What all countries had in common was that hay production with its corresponding structures was widespread. However, the scope and importance differed among the countries today. We found differences in type and extent, in degree of awareness, and in the cultural meaning of hay-making structures. The differences were connected with built structures, as well as with other tangible and intangible aspects of cultural heritage. The distribution of the broad variety of hay-making-related structures, especially semipermanent ones, has changed throughout history, as well as the hay-making techniques, as a result of agrarian specialisation, land reclamation, and consolidation. Today, in some countries, the relevance of hay-making was mainly connected to horse keeping and landscape management (like in Germany and Hungary), while in others (like Slovakia and Slovenia), it was still predominantly used for cattle and sheep.

Keywords: hay-making structures; biocultural heritage; traditional land use; landscape character

1. Introduction

Agriculture, grazing, and hay making have played determining roles in human history, as providing food for the ever-growing population has always been one of the most important tasks. Grazing was undertaken not only on open grasslands but also in forests, which shows the struggle of farmers to find enough food for their livestock, and it was often connected to the use of commons [1]. In the past, food production and protection of grasslands was decoupled [2], which has caused natural and environmental problems recently, decreasing the potential of delivering ecosystem services [3]. Thus, finding a sustainable way of making hay is essential for a viable future.

Today, grasslands cover more than one-third of the European agricultural area. However, they are very diverse in terms of management, yield, and biodiversity value. Lesschen et al. [4] distinguished between production grasslands mainly for fodder production and seminatural grasslands. The latter provide a large range of ecosystem services, including biodiversity. As Špulerová et al. [5] pointed out, a large number of definitions exist in the scientific literature. However, different national policies and statistical surveys make it difficult to obtain comparable statistics about the actual extent of hay production in Europe. Nevertheless, we can say that hay production landscapes do exist all over Europe. Even if their extent and the production process have changed, they still have significant importance. Many of them are recognised as high-nature-value (HNV) farmlands [6].

Špulerová et al. [5] summarised that structures for the making and storing of hay are part of the agricultural landscape of meadows and pastures, and their distribution patterns, as well as their characteristics and regional features, depend on geographical area, climate, culture, and intensity of agriculture. They could—and often still can—be found in regions traditionally specialising in animal husbandry, as well as in regions of mixed farming. They are features of a cultural landscape cultivated by man, and their aim was to store hay, necessary for the survival of farm animals during winter or even in dry periods during other seasons.

Hay production and harvesting, known as “making hay”, “hay making”, or “doing hay”, involve a multistep process: cutting, drying or “curing”, raking, processing, and storing [7]. In some regions, e.g., in the Alps and the Carpathians, the preparatory work to be performed also includes clearing the fields of stones, raking, activating the irrigation system, and activities for the maintenance and restoration of the quality of the meadow, like fertilizing (manuring) and scattering hayseeds [8–10].

Both the need for drying hay and the traditional methods for achieving this were similar across Europe. Grassland landscapes and their activities related to hay making and production also need attention for their high biocultural ecosystem service provision values, which are related to the “multifunctional landscapes” located close to settlements, “cultural landscapes” associated with agricultural land, “wild animal resources” along the coastlines, “outdoor recreation and biodiversity”, and “passive cultural values” widely distributed in high- and moderately populated areas. High agricultural and cultural values have also been identified by stakeholders as places for outdoor recreation, biodiversity, agricultural products, and cultural heritage [11].

Particular features that carry the biocultural value of hay making are traditional buildings or structures used to dry freshly cut forage quickly and to protect it from moisture. The “ancient” forms of traditional hay-making structures are disappearing due to mechanisation and the related use of new materials and new technologies.

This article compiles information about hay-making structures in Europe. It is a kind of second part of two related articles about this topic by the same group of authors.

The article concentrates on the national situations of hay-making structures and on national particularities. The information was collected by members of the Institute for Research on European Agricultural Landscapes e.V. (EUCALAND) [12], a nonprofit association that unites European researchers and practitioners in order to raise awareness of agricultural landscapes as part of our European heritage [13–15]. Since 2006, the EUCALAND network has collected information about European agricultural landscapes (EALs).

The aim is to make the agricultural landscapes of Europe, with their visible and invisible characters and their tangible and intangible values, legible and accessible to the people, who can then better recognise and use them and, above all, to respect and preserve their identity and heritage. This article is based on the definition that hay is made from grass and herbs grown in meadows normally not used for grazing [13].

The country information on hay-making-related structures does not deal with barns or with tools, machines, or more recent forms, like hay balls. It follows the division of three types made by Špulerová et al. [5] (Figure 1).

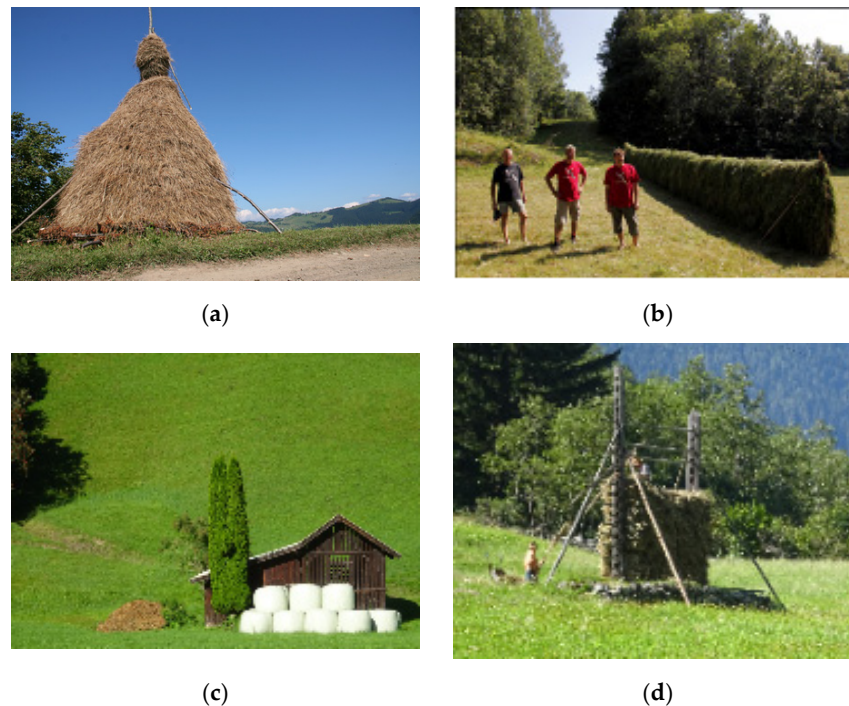


Figure 1. Three types of hay-making structures can be defined for Europe [4]. (a) Type 1: temporary haystack. Wooden sticks (between 3 and 5) are used to hold the grass (photo: Alexandra Kruse, 2009, Biosphere Preserve near Rakhiv, Ukraine). (b) Type 1: temporary light wooden drying rack, sometimes with wires (photo: Oskar Puschmann/NIBIO, 2011, island of Furøya, south Norway). (c) Type 2: traditional small hay barns onsite in meadows (photo: A. Kruse, 2015, Mölltal, Austria). (d) Permanent hayrack structure: most typical for Slovenia; can be found all around the Alps, especially in Austria and Italy (photo: A. Kruse, 2015, Mölltal, Austria).

Type 1: temporary haystack. Between three and five wooden sticks are used to hold the grass (Figure 1a). In this case, the base is made from beech or spruce branches, sometimes still with their leaves. In some countries, mainly in Scandinavia, temporary structures are composed as light, linear constructions using wood or wires (Figure 1b).

Type 2: traditional small hay barns onsite in meadows occurring especially where villages and/or farms are too small for storing hay or where infrastructure is missing for transport in summer (Figure 1c).

Type 3: permanent hayrack structures, still as light constructions, traditionally from wood. Today, they often have vertical concrete beams and sometimes concrete bases (Figure 1d). They are most typical for Slovenia but can be found also all around the Alps, especially in southern Austria, northeastern Italy, and central Switzerland.

2. Materials and Methods

2.1. The EUCALAND Questionnaire on Landscape Types

Each year, the EUCALAND members determine one landscape type to be described in a comparative manner based on a dedicated, standardised manual and questionnaire [13].

Both were developed by EUCALAND members within the framework of the Eucaland Project during 2007–2009. The manual is available online [12] in order to invite as many experts as possible to contribute national data to every year's landscape type. The questionnaire includes nine questions about the landscape type. The following results (country synopses) are arranged accordingly:

1. Does it (or did it ever) exist in the country?
2. National name(s) and description from the national perspective.
3. Short description of the genesis (history) in the country.
4. Is it related to special physical geography conditions, substrate, altitude, climate, hydrology, slope, or aspects?
5. How is it used today?
6. Is it perceived as threatened? If so, by whom (experts/common people)?
7. Is it related to specific structures (types of settlements, objects, architecture, farms, or land use organization), functions (cultivation method, long traditions, seasonal uses, or different uses regarding ownership (communal or private)), values (aesthetics, spatial appreciation, symbolism, folklore, religious aspects, artistic representations, etc.), products, specific local traditional practices, biodiversity, or agrobiodiversity (indigenous varieties and species)?
8. To what extent is it recognised and known by the broad public?
9. What is the legal situation of the European agricultural landscape? Are there protections and/or funding schemes?

The questionnaire is used by the researchers without questioning or interviewing people. A first presentation of several landscape type descriptions has been published as the FEAL e-Atlas [16].

Table 1 shows the variety and also parallels in nomenclature towards hay making.

Table 1. Terms related to hay making in different languages.

| English | Czech | Dutch | French | German—Austria | German—Germany | Italian | Hungarian | Norwegian | Slovakian | Slovenian |
|---|---|--|----------------|------------------------|--|---|---------------------------------|---|---|--|
| barn | stodola | hooibergen, hooischuren | grange, | Scheune, Stadel, Stadl | Scheune | Fienile, scapita, barc, tabià | istálló | låve | štál, stodola, humno | hlev, štala |
| small barns (barracks) (in meadows, type 2) | oboroh, brah | steltenberg, stoltenberg, schuurberg | meule carrée | Heubarge | Barg (rare) | baita in the Alps Fienile in the plain liguria: barc(o), barco, stali fieno | abora széna-kunyhó | løe | sennik, stodólka, šopka, štálik, koliba | senik, svisli, parma |
| hay | seno | hooi | foin | Heu | Heu | | széna | høy | seno | seno, mrva |
| hay ball | Baliky sena | hooibalen | Balles de foin | Heuballen, Heuburde | Heuballen | balle di fieno | szénabála | høyballe, rundballe | baliky sena | bale |
| hayrack (type 3) | sušák sena | hooimijten, schelven, klampen, ruiters | râtelier | Harfe, Harpe | Raufe, Heuharfe | towards AT: Harpfe, Köse, Hilge; towards SI: Kazuc, Kozolec, harpfe, arfa, faver, kèisn, kozolec | szénatartó | hesje | petrevec, kopeneč, navid'la, kozák, babiak | kozolec (kozovc, kozuc) (many diff. terms for many diff. types including toplar) |
| haystack, hay heap (type 1) | kopa, kúpa, kopka, kopice, kopen, kopenec kúly, trojáky, štangle, Áčka ostrva | Hooiberg, opper | meule de foin | Heuschöber | Heuschöber, Trischen, Stanken, Heinzen | meda (de fen), covone | szénakazal, szénaboglya, boglya | såte, stakk (often around wooden stick) høysåte, høystakk, hesjestaur, treraje | ostrva (wooden), koly, kopy, kopy, stohy sena | senena kopica, kopa sena, stog, oslica, lovnica, ostrnica, preprostí, kozolec |
| hayloft | senik | hooizolder | grenier à foin | Heuboden | Heuboden | fienile | szénapadlás | høyloft | sennik | senik |

2.2. Terminology of Hay-Making Structures

In line with the fact that hay-making was and still is present in all European countries, there are many national and regional terms, and these are used also in the article to represent country synopses of hay-making structures (Table 1).

3. Results—Country Synopses

In the following, we provide an overview of traditional hay-making structures and the related agricultural landscapes in Europe. The examples show a large span, from hay production more or less as niche products up to still an essential part of agricultural production. The national importance of hay making is to some degree reflected by the lengths of the subsections. However, what all countries had in common was that hay production with the corresponding structures was widespread and still existed. Nevertheless, the scope and importance differed among the countries today. We found differences in the type and extent, in the degree of awareness, and in the cultural meaning of hay-making structures. The differences were connected to the built structures, as well as to other tangible and intangible aspects of cultural heritage. The distribution of the broad variety of hay-making-related structures, especially semipermanent ones, has changed throughout history, as well as the hay-making techniques, as a result of agrarian specialisation, land reclamation, and consolidation.

3.1. Austria—Hay Products as a Contribution to Keep the Alpine Cultural Landscape Intact

In Austria, temporary, semitemporary, and permanent structures related to hay production were and are still very common all over the country (Figure 2) [17]. Since the introduction of bale pressing and silage, the plastic-wrapped silage bales are dominant on the highly productive, more or less flat soil in the lower areas (Figure 1c). While hay production has been abandoned in the high, steep slopes, it has shifted to the rather flat and more easily accessible meadows. This transfer could be facilitated, as the growing of cereals in the eastern Alps was abandoned.

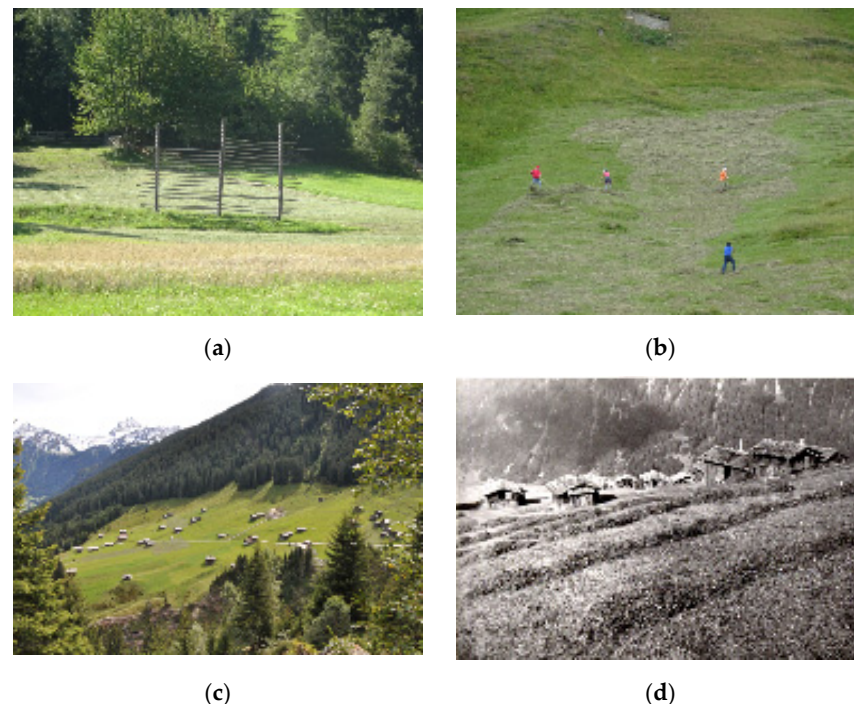


Figure 2. Some impressions of hay making in Austria—before and currently. (a) Hayrack—a traditional structure (type 3), which might not be in use today. However, mowed grass is still around (photo: Alexandra Kruse, 2015, Mölltal, Austria). (b) Manual mowing for nature protection reasons (photo: Alexandra Kruse, 2015, Grossglockner High Alpine Road, Hohe Tauern National Park). (c) Wooden houses called Maisässe connected to cheese production related to vertical transhumance Almwirtschaft in the Alps (photo: Peter Strasser, 2010, Montafon, Vorarlberg). (d) Historic photo of Maisässe, Montafon, Vorarlberg, with rows of cut grass in the foreground (photo: archive of Dr. Wolfgang Pfefferkorn).

Traditional farms, especially in the Alps, were small and did not have much space for storing hay. Therefore, many small wooden cabins are common features in Austrian landscapes [17], as well as in Switzerland. These so-called *Stadel*, or *Barge*, consisted of wooden houses for storing hay. *Maisässe*, however, were connected to cheese production related to vertical transhumance *Almwirtschaft* (three-level agriculture) in the Alps (Figure 2c,d). *Maisässe* (in Bregenzerwald, *Vorsässe*) were (block-/wooden) houses for temporary residence for family members in May/June and September–November. During these times, the cattle grazed directly in the meadows around the *Maisässe*, so there was no need to feed hay. Hay that was harvested during high summer (while the cattle were at the *Almen/Alpen*) might rather be transported directly to a farm in the valley and not stored at the *Maisässe* until winter. Consequently, *Maisässe* were, rather, ensembles of residence houses without storage facilities (as there were also no stables for the animals).

Another reason for the small barns was that sometimes the meadows were located at quite a huge distance from the main farm. The steep land and the short time available for the hay harvest required decentralised storage. Two solutions developed with regional differences in applications: (1) temporary storage of hay in the meadows and transport of hayballs (*Heuburden*, *Heuballen*) in winter with sledges and (2) bringing the cattle to the hay instead of the other way around (a praxis we also found in some parts of Switzerland). Livestock were closed in one stable (barn) until the hay was eaten and then moved to the next one.

This method was part of the three-level agriculture that was characterised by a kind of nomadism of the family members: in May/early summer, parts of the family moved with the cows (and even chickens to provide eggs) to the midlevel (*Vorsäss* or *Maisässe*), while at the upper level (alpine region, *Almen*), often professional alpine herdsman and dairymen took care of the livestock [18].

Due to the large number of buildings that each farm had and the relatively small quantity of hay kept in individual stables, the building method was very simple. Often, the stable only consisted of a cattle shed and a hay room (Figure 2) [18]. Today, most of these small barns are abandoned. In some municipalities, there are discussions about what to do with the high number of these tiny barns when there is a consensus for maintaining them for landscape and cultural identity reasons.

Also, the Slovenian *kozolec* (Figure 11) is present in Austria. Some of them are still in use. In Figure 2c, we can see how these traditional hayracks were used: The man on the left gives the hay with the help of long sticks to the man who is on the *Harpe*. Despite mountain farming constantly declining, traditional hay production still exists, especially on steep slopes or for biodiversity respective to nature preservation reasons (Figure 2b). Therefore, here we would like to focus on the particularities of Austria: Political commitments, as well as financial support through the Federal Ministry for Agriculture, the nine provinces, and by certain municipalities has led to the connotation that hay making constitutes an important contribution to keep biodiversity and, therefore, the alpine cultural landscape intact. The Federal Ministry of Agriculture, Forestry, Regions, and Water Management supports the management of mountain meadows within the framework of ÖPUL 2023. This is an Austrian programme to promote environmentally friendly, extensive agriculture that protects the natural habitat. ÖPUL 2023 not only serves to maintain area-wide agriculture and the cultural landscape but also promotes sustainable development of rural areas and meets the increasing demand for environmental services in society [19]. In addition, the nine federal states and individual communities support the preservation of poor grasslands and, thus, biodiversity in different ways. One example is the *Heugabelaktion* (pitchfork action) in Walgau, Vorarlberg, where, thanks to mowing and hay making, thirteen part-time farmers in the municipality of Frastanz in Walgau are supported so that the poor meadows in the steep slopes are preserved [19]. Consequently, we found a high appreciation among the people, which are also consumers. Awareness about hay and related products are often seen as a synonym for an intact home. There are popular hay festivities, with “hay queens”

that are well-known also abroad. Furthermore, there are national labels for the marketing of hay, as well as milk and cheese made from hay milk, to name only a few examples.

The recent meaning of hay in Austria, as well as its marketing, shall be briefly demonstrated with two examples: “Bio-Hay-Region” [20] was founded in 1996 by 13 organic farmers from two villages in the region of Trumer Seenland. Today, this kingdom stretches from Salzburger Lake District (from Oberndorf to St. Gilgen) to the western part of Salzkammergut (Mondseeland) and has 240 members from 27 municipalities. Since 2005, it has been represented by a hay queen. Whether at festivals, receptions, events, company visits, or trips abroad, the hay queen is always present. These festivals are very popular. At the Thanksgiving Festival at Vienna’s Heldenplatz (Heroes Square) in the Austrian capital, more than 250,000 visitors attend. Further regular events are Green Week in Berlin, Germany, the largest organic trade fair in the world in Nuremberg, Germany, or the Apple Blossom Festival in south Tyrol, Italy. The hay queen can only be a daughter of one of the 240 member companies. Among the members are also shops for organic products, direct sellers, farmer’s markets, farms that offer holiday stays, and school milk farmers. In Austria, there exist approximately 100 farmers and six dairies for milk production that are officially recognised as school milk farms by the authorities. Only these are allowed to receive EU subsidies for school milk.

In 2004, the ARGE Heumilch Österreich (ARGE means a working group in the sense of a consortium) was founded in Vorarlberg, which today counts around 8000 hay milk farmers (mainly from mountain farms) and more than 60 farmers and dairies. The main production areas are Vorarlberg, Tyrol, Salzburg, and Styria. The members deliver 420 million kg of hay milk annually, which means 15 percent of the total milk delivered in Austria. Across Europe, the amount of hay milk is only three percent. Hay milk has its own quality label, which guarantees milk that is entirely produced without fermented feed [21]. Hay milk as a label has nearly 28.000 followers on Facebook. Meanwhile, hay milk has also been introduced in Germany, Slovenia, and Switzerland.

3.2. Germany—Horse Keeping as an Important Hay Consumer

Although hay making in Germany has drastically reduced within the last 40 years, we can state that it is still a common, well-known, and highly appreciated feature of German agricultural landscapes. This can be underlined by the popularity of the numerous Thanksgiving festivities all over the country (Figure 14).

The most common German term for haystack is *Heuschober*, which describes the pushing of the hay to one place (Figure 3c). In addition, there are regional terms, especially in the south close to the Alps. *Stanker* or *Heinzen* are variations of haystacks that exist only in the Vorland of the Alps (Figure 3a). In former times, most commonly hay was stored on a triangular wooden structure (Figure 3c). These structures have more or less vanished since the introduction of ball presses in the 1940s. These were first in a rectangular shape with a weight of 15–45 kg and were later round bales of 200–400 kg (Figure 3b), which were even later replaced by those wrapped in plastic (Figure 1d) like in other countries, too.

Today, in areas with more productive soils silage making is dominating, while hay making remains on less productive soils. However, the traditional haystacks have remained only in a few regions, e.g., in Spreewald close to Berlin (Figure 3c), on wet soil, in areas enclosed by forest, and in the Voralpenland (Figure 3a). Due to the German climate, hay is mostly stored in barns, in separate buildings, or on the rooftops of stables.

Today, we found manual mowing only where either the morphology of the terrain does not allow machines, e.g., on steep slopes, or for protection measures often conducted by volunteers and/or associations.

These less productive grasslands are recognised for their high value regarding biodiversity and are sometimes even integrated into landscape protection programmes. These habitats are endangered through the following:

1. non-use and overgrowing of bushes and trees, especially on hilly, steep slopes;
2. Use of pesticides and fertilisers.



Figure 3. Impressions of hay production in Germany. (a) Haystacks, called Stanker or Heinzen, in the Vorland of the Alps. These names are not common in the other parts of Germany (source: District Garmisch-Patenkirchen). (b) Hay bale (photo: Alexandra Kruse, 2007, eastern Frisia). (c) Haystack (photo: Christine Schottdorf-Timm, 2004, Spreewald, south of Berlin).

Apart from traditional cattle feeding, today hay is used for horses and pets as fodder. Therefore, even city children know hay very well. Some regions export hay to those areas where horse keeping has become one of the most valuable income sources for farmers. In addition, private hay making for sheep, etc., is very common. Hay is sold online and locally, e.g., via eBay, as well as on professional exchange platforms with daily hay prices [22,23]. Hay meadows are considered as something positive and are related to wellbeing and high-quality food, particularly in combination with orchards (*Streuobstwiesen*). It is used as a component in herbal teas and nature-based cosmetics.

Within the tourism sector, so-called hay hotels are widespread. Different levels exist, from using hay in normal beds to sleeping with or without sleeping bags and blankets in a barn or on a rooftop directly in the hay. Although they exist all over Germany, one can say that they are more common in northwestern Germany and are often connected with long-distance cycling. There is a register of hay hotels in Germany [24].

3.3. Hungary—Meadow Haystacks Are a Vanishing Feature in the Agricultural Landscape

Due mostly to very intensive farming, traditional hay making can be considered as a relic of former times, but it still exists (Figure 4c). Today, meadow hay is stored mostly in 200+ kg round bales (Figure 4b). Recognising the beneficial physiological properties of meadow hay, it lives in a renaissance even on intensive dairy farms. Meadow hay is fundamental in the feed of horses, sheep, and beef cattle. In Hungary, traditional hay-making technology is a feature of the past, and new technologies, while efficient, have been established not using traditional structures. Different from most European countries, grass-baled silage production (wrapped plastic bales) is an existing technology, but it is not very common in Hungary. Regardless of their recognised high value, hay balls are often left in the field (Figure 4c). Sometimes they fall apart, become mouldy, and finally lose their value.

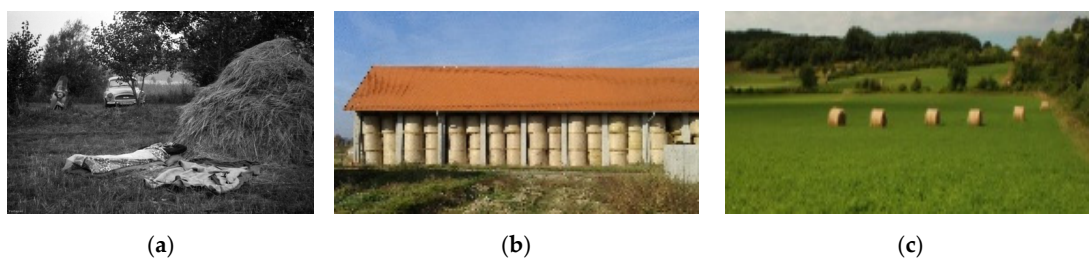


Figure 4. Hay impressions from Hungary. (a) Awakening by a haystack (photo: Reprinted from József Drimbe, 1968 [25]). (b) Modern hay bale storage building (photo: Dr. S. Orosz). (c) Round balls left in the field without protection and without a later use (photo: C. Centeri).

Hay is also used to produce biofuels, and sometimes it is used as heating material. Interestingly enough, although hay is considered a niche product in Hungary, there are still many different uses: animal husbandry, mulching, energy production, decoration of village entrances, and material used for gifts and flowers. Also, it is very famous for young people, couples, and people looking for partners. Hay, as a coupling platform, is often used in social media as a “romantic background”, along with straw. This might follow a tradition once founded by the famous photos of József Drimbe (Figure 4a).

There are no widely used common structures or traditions practised related to meadow hay production. However, there is a famous book by József Bedők (1954) about hay, hay production, and the meaning of hay, especially regarding biodiversity and meadows systematically, which is still well-known.

3.4. Italy—Hay Highways from the South to the North

Hay making (*baite*) and related structures are part of the Italian agricultural landscape of meadows and pastures, where the production is still related to animal breeding and high-quality products, even if, like in other European countries, plastic-wrapped hay balls are dominating the production today. Until the 1970s and 1980s, hay production was still an important pillar of the traditional alpine economy. Some examples of traditional remnants are compiled in Figure 5. They are maintained as characteristic landscape features and parts of the cultural heritage. Nevertheless, general awareness can be considered low.

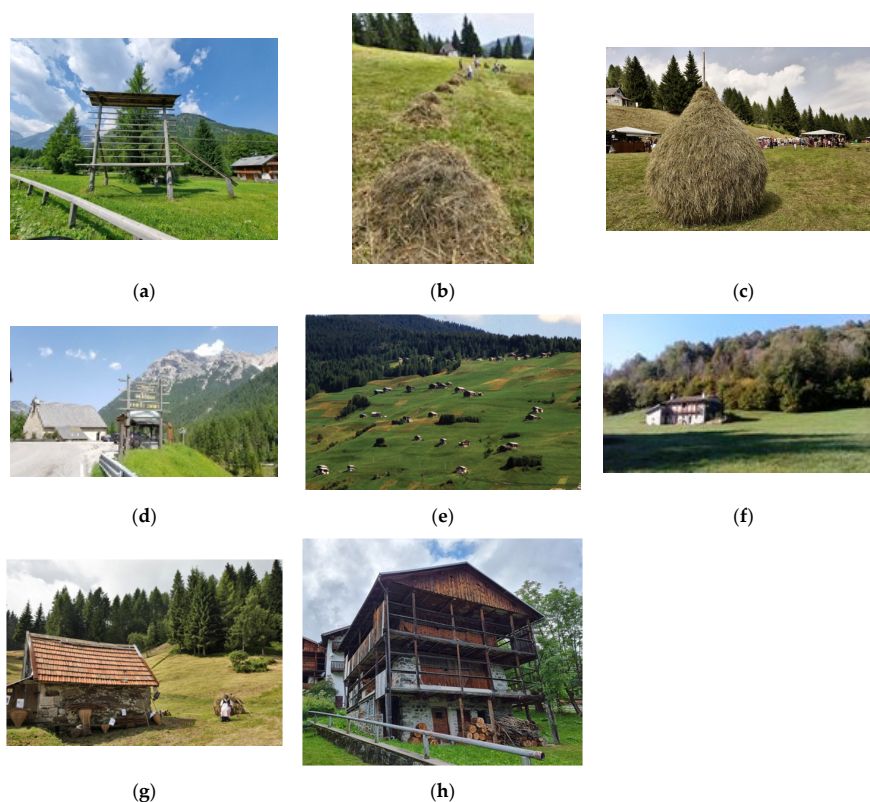


Figure 5. Examples of traditional hay production and related structures from Italy. (a) Traditional small barns for storing hay (photo: V. Ferrario). (b,c) In the Italian Alps, manual hay making is very rare, generally limited to cultural events (Fasin la mede, Sutrio Friuli Venezia Giulia, photos: E. Falaschi 2022). (d) The symbolic value of arfa (like the Slovenian kozolec) is exploited for tourism purposes (photo: V. Ferrario). (e) Small hay barns in the mountains (photo: V. Ferrario). (f) Stone structure used for seasonal summer hay making in the Carnic pre-Alps (photo: M. Sigura, 2022). (g) Tourist events raise awareness about hay production and pass traditional knowledge from generation to generation (photo: E. Falaschi 2022). (h) Drying balconies at multifunctional houses in the Alps (photo: V. Ferrario).

The origins of hay barns and their landscapes are very old; some scientists date them back to prehistory. The maximum diffusion was in the mediaeval times, when the tools for cutting grass were invented (hay sickle). Since then, animal fodder has also been available in the winter. On the Lombard plain, the explosion of agricultural production and, consequently, of forage and hay storage took place during the XVIII and XIX centuries. However, it is very difficult to give an overview on the national situation due to the high landscape variety in Italy.

Today, in the Italian Alps, as in Italy in general, manual hay making is very rare, generally limited to cultural events (*Fasin la mede*, Sutrio Friuli Venezia Giulia (Figure 5b,c)).

Baites are still part of the traditional alpine agricultural system, based on dairy production and mostly connected to vertical transhumance, from the valley (*fondovalle*) to the mid-slope settlement (*maggeno*, a settlement inhabited from May to June) and the alps (*alpeggio*, used in July and August). It is an extensive system. *Baites* were isolated (called *nata* in Valtellina), usually in the centres of pastures and meadows, or they were close to settlements.

Hay barns on the plain are used all year long. They belonged to a mixed system of cereal and milk production, but now, Italian agriculture tends towards monoculture.

Haylofts are usually on the upper floor above a cow barn or a stable. If hay production is high, there can also be specific hay barns, even outside of a farmstead. They are also related to the high production of fresh grass and hay made by *marcite* meadows (a meadow irrigated also in wintertime) in correspondence to fresh water available all year long.

The Italian structures on the north border have several similarities with those from Austria and Slovenia (Figure 5a,d). However, the names for these hayracks are differing according to their geographical location, as *kazuc* or *kozolec* on the border with Slovenia and *harpfe* or *kose* in areas close to Austria. While in former times most structures were made from wood, today different materials are used: wood, straw, and metal. Multiple structures are used by more than one family.

In the Alpine area, we found an architectural specialty: drying balconies (Figure 5h). In these multifunctional wooden houses, balconies are used for drying not only fodder but also cereals and other products, like chestnuts, corn, and fruit.

Traditional small barns for storing hay have many regional names and different architectural shapes (Figure 5a). In the mountains, small hay barns are located in meadows close to the villages (Figure 5e). Most of the traditional buildings, especially stone barns, have changed their use. Today, they are used for the storage of wine or as rural tourist accommodations (Figure 5f).

Regarding awareness and policies, it can be said that hay-making structures are recognised in regional and local planning processes as cultural heritage, e.g., for landscape planning at regional or provincial levels, as well as in local plans at the municipality level and by local action groups.

In Italy, guidelines for the reconstruction and conservation of traditional barns and some other hay-making structures do exist, including financial support. Currently, the value of hay-making structures is related to the cultural dimension of traditions and historical memory. Especially during summer, events are organised to refresh the traditional work of mowing and building sheaves, as well as to discover local products and naturalistic itineraries (Figure 5b,c,f).

3.5. The Netherlands—Hay Export and Innovative Hay Barracks

In a large part of the country (not everywhere), one or more haystacks exist [26]. However, in the Netherlands, a distinction can be made between the “polder” landscapes of the northwestern half of the country and the higher, sandy southeastern half. In the northwestern part, hay structures are mainly built of metal and concrete, while in the east the traditional wooden haystack is even more common. In many of the polder landscapes, grassland occupies almost the whole agricultural area, and the farmers specialise in dairy farming. Some regions export hay, particularly to the sandy landscapes. In those regions

where there is a surplus of hay, the sheds and racks serve as motifs for postcards and have been mapped, a fact that supports their importance (Figure 6b). A plan from 1583 shows farm houses with haystacks in Hagestein on the Lek. Hay must have been imported since the Middle Ages. From the Netherlands, pictures and maps of haystacks exist from the 15th century onwards and, in some other countries, even since the 14th century. These historic sources prove that haystacks and other related hay-making structures have rarely changed since that time.

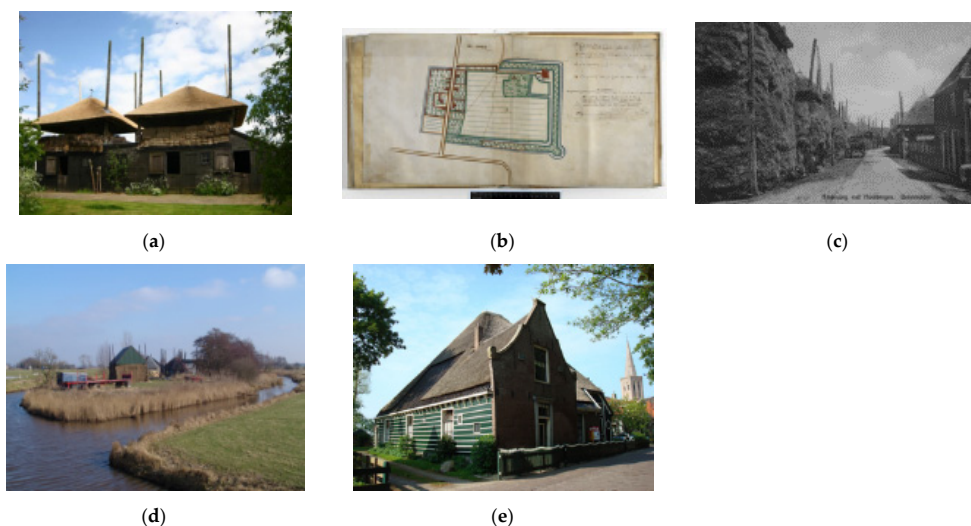


Figure 6. Some impressions of hay making and related structures in the Netherlands. (a) A Dutch hay barrack (photo: W. Lanphen). (b) A plan from 1583 showing farm houses with haystacks in Hagestein on the Lek, with its special haystacks (source: Het Utrechts Archief, toegangsnummer 216 Dom Kapittel, inventarisnummer 1648). (c) Postcard from 1930 showing the enormous amount of hay at this village, stored at the village’s edges in order to decrease the risk of fire (photo: Archief gemeente Zwartewaterland). (d) Rare example of traditional Dutch hay barrack (photo: S. Jurgens). (e) Impressive example of a warfthouse, an all-in-one building for living, production, stable, and hay loft (photo: S. Jurgens).

In the sandy landscapes, hay was scarce and highly valued. In many villages, the best meadows were divided already during the late Middle Ages and show extreme fragmentation of ownership. Parts of the meadows were irrigated to improve hay production. The Dutch word for meadow, ‘*made*’, is related to the verb for mowing.

Many old farm buildings were built partly for hay storage (for example, the *stolpe*, in parts of Germany known as *heubarg*). Figure 6e shows an impressive example of a warfthouse, an all-in-one building for living, production, stable, and hay loft.

Specialised hay barracks must have resulted from hay production surpassing the storage capacity of farms (Figure 6a,c,d). This Dutch specialty was also exported overseas. The roof can be lifted and lowered according to the level of hay. They are no longer in use, some have been re-used, and some are ruined, but many also still stand (Figure 6a,d).

Hay is still produced for fodder, but it is now usually rolled into plastic bags and then stored. There is not much folklore around hay production left, even when a substantial part of the farming population seems to have been conceived in a haystack or hayshed. Specialised hay meadows have mainly disappeared. Some former “water meadows”, as well as “blue grasslands” and other species-rich grasslands, have been preserved, mainly for ecological purposes.

Today, the hay barracks and haystacks are cherished. Many of them formerly in agricultural use have disappeared or have been improperly restored or rebuilt. Also, other structures inspired by haystacks appear instead sometimes to be used for storage of cars or other equipment, and some have been rebuilt into summer cottages.

Regarding awareness, there is a “Hooibergmuseum” and a book, *Hooibergen in Nederland*.

3.6. Norway—Zip Lines for Hay Transport

Hay-making structures have been a common feature in the Norwegian agricultural landscape for a long time. As cool and regionally quite wet climatic conditions are unfavourable for cultivation of crops, animal husbandry has always been an important part of Norwegian agriculture, especially towards the north of the country where plant production grows increasingly difficult. Actually, only 3% of the country's area is arable land, just one-third of which is suitable for cereal production, while 37% productive and unproductive forest and 50% mountains and wetlands provide extensive outfield resources for seasonal livestock grazing and production of winter fodder. Before 1900, hay was mostly harvested from outfields, mainly in forests and from mountain grasslands, while infields were reserved for the growing of cereals. Later, hay fodder was also produced on infields [27].

Subsequent to harvesting, grass had to be dried before storage. Depending on the general climate and actual weather conditions, this was performed directly on the ground or in simple stacks (*såte*), which did not include physical structures in the landscape. However, other alternatives were stacks built around wooden sticks (*stakk*) or drying racks (*hesje*), which were constructions of vertical wooden sticks interconnected with several levels of horizontal sticks or metal wires on which grass was hung up for drying. These were either of a temporary or permanent nature (Figure 7a,e).

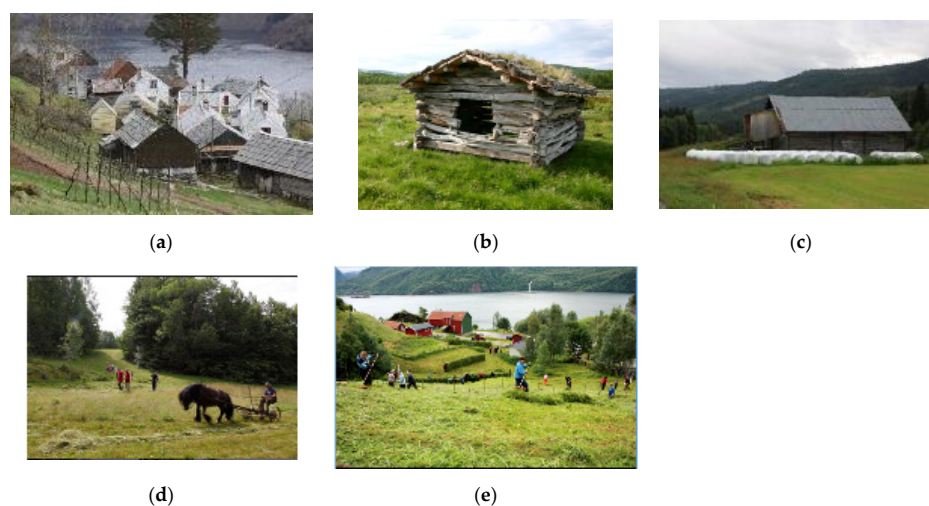


Figure 7. Impressions of hay-making landscapes from Norway. (a) Permanent hay-drying racks (photo: K. Stensgaard, Havrå, Osterøy municipality, west Norway). (b) Restored outfield hay barn (photo: Y. Rekdal, Os municipality, east Norway). (c) Modern round bales placed next to a presumably empty hay barn (photo: K. Stensgaard, Gausdal, east Norway). (d) Historical hay mowing and temporary drying rack (photo: O. Puschmann, island of Furøya, south Norway). (e) Annual voluntary collective hay mowing (photo: R. Nystabakk, O. Puschmann, Sørfold municipality, north Norway).

Prior to more intensive rainfall events, hay had to be moved indoors for storage. Hay or fodder barns (*høyløeffôrløe*) are, thus, another type of hay-making structure (Figure 7b) [28]. Timber of uneven birch stems resulted in good ventilation to prevent the hay from moulding. The barns were situated on or close to infield meadows, on farmsteads, or as so-called outfield barns (*utløe/uteløe*) in forest or mountain areas. Hay barns were constructed as separate buildings or, especially if situated on farmsteads, combined with cereal or livestock barns. In the latter case, hay was stored on the floor above the livestock (*høyloft*) to ease portioning and passing down the fodder to the animals as needed. The hay floors of these combined barns (*låve*) were often accessed for filling via a barn bridge (*låvebro*). Separate hay barns were often more well-kept than, for example, livestock barns because they were not exposed to substances that would accelerate decomposition of timber. Later, other ways of

construction took over, e.g., lighter wooden construction, metal cladding, or combinations with concrete.

Often, hay had to be transported to permanently settled farmsteads. Longer distances were frequently covered with sledges after snow had fallen. A physical landscape structure for hay transport down hillsides was zip lines (*løypestreng*, Figure 8a) [29]. Zip lines were permanent constructions, and their maintenance or repair required rather sophisticated knowledge and skills. Zip lines were frequently used on the very steep hillsides along fjord valleys of glacial origin in western Norway. A more advanced form of zip lines enabling the transport of different goods in both directions was ropeways (*taubane*). However, these kinds of transport facilities were at least as important for the cash crop of timber as they were for hay.

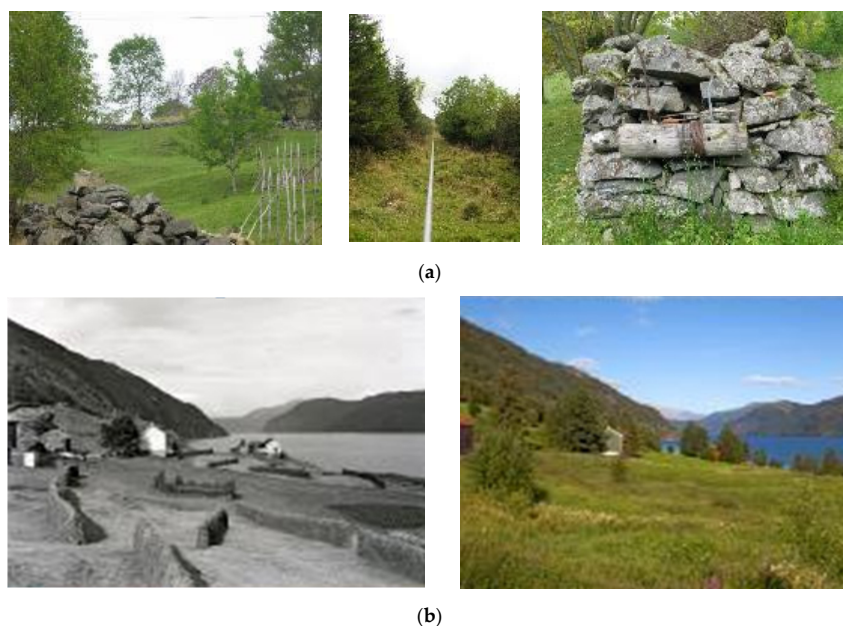


Figure 8. Norwegian landscape values and historic landscape elements related to hay making. (a) Zip lines used for downhill transport of hay from meadows to barns, especially on very steep slopes (photos: S. Eiter, Havrå, Osterøy municipality, west Norway). (b) Disappearance of a hay meadow with drying racks between 1960 and 2013 (photos: L. Kvantoland/Sørfold historielag, O. Puschmann, Sørfold municipality, north Norway).

Today, the use of hay as winter fodder has, to a large degree, been replaced by silage, either from permanent silos or round bales (Figure 7c). Round bales are temporary landscape structures but can be highly visible. Vernacularly, they are also called tractor eggs. Whilst white plastic was most common for many years, other colours have become available more recently. In 2016, farmers could order light pink plastic, thereby expressing their support and contributing with a financial donation to work against breast cancer; in 2017, the optional colour was blue to fight prostate cancer; and in 2018, yellow was chosen to support work against cancer affecting children. However, recent focus on environmental problems connected to plastic waste has started to motivate several farmers to use round bales to a somewhat lesser degree and to store as much fodder as possible in permanent silos.

Non-manured or -fertilised hay meadows are considered as cultural landscape features of special value in terms of biological diversity. However, the area covered by such hay meadows has decreased a lot (Figure 8b). This ecosystem and nature type is called seminatural mown grassland (*semi-naturlig eng med slåttemarkspreg*) and is regarded as critically threatened (CR) on the Norwegian Red List of Nature Types of 2018 [30]. These areas were difficult to access for increasingly large machinery and have been abandoned and have become subject to woodland regrowth, while other areas have been intensified to

increase yields. More than 80% of the remaining areas lack management or are subject to inappropriate measures, and fragmentation continues.

Hay meadows are a selected habitat type according to the Norwegian Natural Diversity Act [31]. The Action Plan for Hay Meadows in Norway has been implemented since 2009. The Action Plan covers management of approximately 700 hay meadows, often by volunteers (Figure 7e). Financial support is provided to landowners and farmers who carry out management of the hay meadows according to a plan prepared by biologists.

3.7. Romania—Hay Making Still Present Everywhere

For hundreds of years, natural grasslands have been used for hay production in Romania in a proportion of more than 95%. The grasslands were formed from the previous forest deforestation, which subsequently, under the influence of natural factors, were covered with a coating of a diversified botanical species. These changes have led to the emergence and perpetuation of various types and formations of grassland that are well-defined in floristic terms according to the stationary natural conditions (soil, climate, slope, etc.). Primary natural grassland occupies a small portion (2–3%) of the total area, in the alpine area and in the delta and steppe areas [32].

Hay making is still an important feature of Romanian agricultural landscapes, with many related structures in the meadows (Figure 9). Mowing by hand on steep slopes does still exist, and we also found a large variety of haystack frames and tripods, which sometimes remain all year long in orchards, gardens, and meadows (Figure 9b–f).

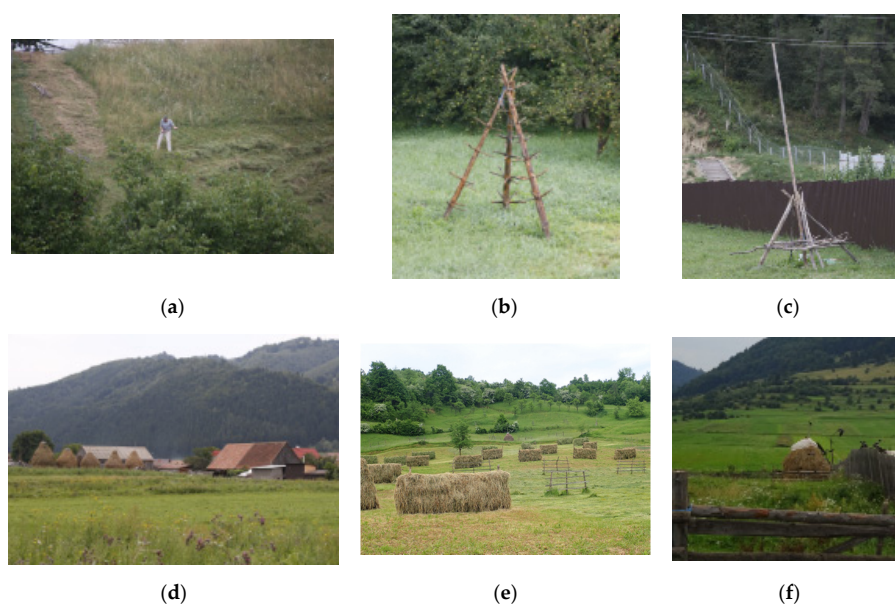


Figure 9. Impressions of hay-making structures from Romania. (a) Mowing by hand in the Carpathian Mountains (photo: A. Kruse, 2017). (b) Haystack frame: tripod (photo: A. Kruse, 2017, Carpathian Mountains). (c) Empty structure of a tripod with a central wooden pole (photo: A. Kruse, 2017). (d) Haystacks in a row in the backyard of a farm (photo: A. Kruse, 2017, Piatra Craiului National Park). (e) Simple drying racks reminiscent of the “Scandinavian type” (photo: D. Kladnik, 2023, Mara Mures). (f) Haystack with simple rain protection and a wooden fence to protect from being eaten by the cattle during the grazing period (photo: A. Kruse, 2017, Piatra Craiului National Park).

Hay is the main resource of fibrous feed, especially during winter. Grassland hay represents about 50% of the total UAA (utilised agricultural area). The used name is *fân* for hay. There is a special word for hay mown in autumn: *otavă*. Hay production is the main occupation of livestock farmers. For a long time, hay was considered the cheapest feed.

Today, permanent grassland occupies a total area of 4.81 million hectares, 9% more than three decades ago, of which 3.61 million hectares are used as pastures and 1.20 million

hectares as meadows. Related to the population, grassland surface is 0.22 ha/inhabitant compared to only 0.14 ha/inhabitant in the European Union. In Romania, the area of permanent grasslands is 20% of the total area of the country, or 33% of agricultural land [33]. These grassland surfaces, in terms of usage, are used in a proportion of about 70% (3.40 million ha) as animal-grazed pastures, and 30% (1.41 million ha) are used as mowing fields, such as hayfields for hay making. The average annual production of hay in Romania is about 2000 tonnes, according to the following production: 10% in the plains, 70% in the hills, and 20% in the mountains [32]. In the plains with limited precipitation, today the preparation of hay is still performed directly on the ground using two processes: drying in branches (for 1–2 days) and drying in waves (for 3–4 days), after which the hay is gathered in a haystack. In the hills and mountains, hay is dried on trays, stacks, huts, and fences (Figure 9b,c). In plain grasslands with a higher proportion of legumes, hay preparation is achieved by baling after cutting the plants mechanically and drying them in turfs [33].

According to the statistics, we found that the last three decades have seen a sharp drop in livestock (46% for cattle and 48% for sheep), while the surface of permanent grassland has increased by 10–12% [33]. This has had drastic consequences for the vegetation and valorization of these lands. Thus, in most areas of grassland, especially in hill and mountain areas, it has had negative effects on the vegetation biodiversity. This has strongly influenced Romania's grassland's functional structure, especially the aggressiveness of invasive species (field fern, bulrush, and semishrubs) replacing the valuable species on more than 30% of the surface [32]. In this context, there has been a significant decrease in hay production, especially in mountainous grasslands.

After 1990, important changes were made in the production technology and use of hay, particularly in harvesting, by using modern equipment for mowing, hay-drying preparation, collection (baling and foiling), transport, and storage. However, on versant (slope terrain) grasslands, especially in mountain areas, hay making using hand tools is a traditional practice.

As a special Romanian feature, it can be mentioned that the national honey production is directly linked with hay production.

3.8. Slovakia—Hay Meadows as Biodiversity Refuges

Hay production is still widespread in Slovakia. Hay meadows were usually extensively managed. Therefore, they are rich in biodiversity and represent part of a typical mixed agricultural system composed of arable fields, grasslands, orchards, etc. High cultural-historical value was designated for mosaics of arable fields and permanent grassland with almost completely preserved forms of traditional use. These traditional landscapes were created by arable crop rotation, traditional hay making, and the use of draught animals. They were mainly located in the most accessible areas near dwellings. Steep slopes and long, narrow fields were not accessible for heavy machines, and therefore, traditional management has been preserved there [34]. In Slovakia, traditional agricultural landscapes with hay making occurred mainly in mountainous and submountainous areas. These areas were colonised during several reclamation phases: the German colonisation by colonists mainly from German-speaking countries, especially in the 12th–14th century, as well as the colonisation of uncultivated and cultivated land mainly by the native population in the 13th–15th century that is called “Sholty's internal colonisation”. Last but not least, the mountainous area settlement, the so-called “Wallachian colonisation”, by shepherds of Romanian and Ruthenian nationality in the 14th and 15th century took place.

The result of these reclamations was a mosaic landscape with grasslands and arable land. In some regions, pasturing was widespread. Shepherds built their cow barns, chalets, and sheepcotes. Seminatural grasslands, which have arisen as a result of colonisation and deforestation, are characterised by high species diversity. They present, together with haylofts, typical features of a mountain landscape before collectivization.

Different types of hay-making structures have been developed from region to region; therefore, there are a variety of local names for hay-making structures (Table 1).

One can say that the Slovakian haystacks consist either of three- to five-metre-tall spruce stakes with side branches or smooth stakes and cross pins or of a pyramidal stand consisting of several horizontal sticks (Figure 10b,c). The wooden structures remain in the meadows all year long. They are movable and are sometimes grouped in one corner (Figure 10c). After the collectivisation of agriculture in the 20th century, the traditional *ostrva* gradually was replaced by factory-made wooden or metal structures.

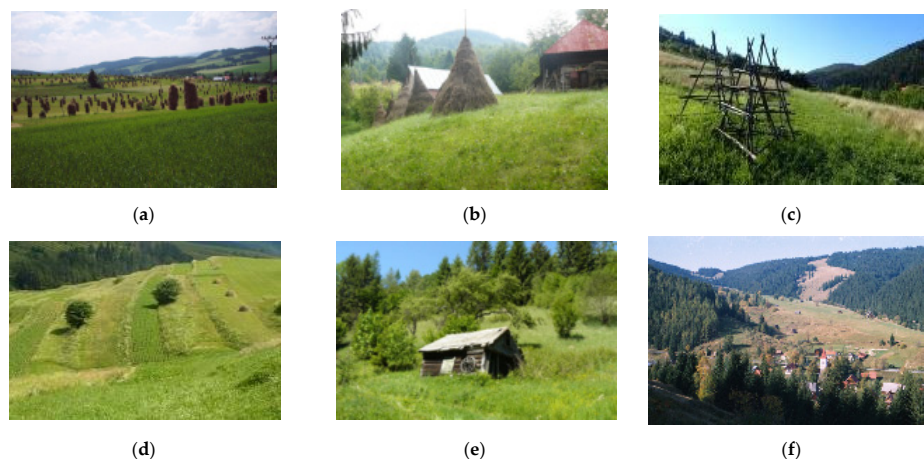


Figure 10. Impressions of hay-making structures in Slovakia. (a) Small, slim haystacks (photo: J. Špulerová, Orava region). (b) Three- to five-metre-tall spruce stakes (photo: J. Špulerová, Gemer region). (c) Wooden structures (photo: J. Špulerová, Orava region). (d) Haystacks without any holding structures at all (photo: J. Špulerová, Liptov region). (e) Relics of small hay lofts in remote areas (photo: J. Špulerová, Gemer). (f) Meadow landscape in Slovak mountains (photo: M. Slámová, Nižná Boca).

The Slovakian classification of traditionally mowed meadows in terms of species composition and ecological requirements covers three types: (1) wet meadows, (2) mesophilic meadows (including orchard meadows), and (3) dry meadows [35]. In the past, meadows were situated on the floodplains of major rivers and streams in mountain and in foothill areas on less fertile soil or less accessible areas unsuitable for arable land. Today, traditionally managed meadows are especially preserved in mountainous and foothill areas up to 1100 m above sea level, which were unsuitable for land transformation into fields or intensively managed meadows during collectivisation. Furthermore, on shallow soil and higher slopes, which were unsuitable for new mechanisms, they have also remained. Last but not least, they occur in areas close to settlements or dispersed settlements, like orchard meadows, as narrow parcels on terraces or grassland pasture landscapes, etc. Wet meadows on floodplains in the lowlands and valleys have been preserved only as fragments, often as legally protected areas mostly kept within the management of nature and landscape. Specific water meadows or flooded meadows occur in the hilly terrain of the Hriňová cadastral area. A system of catchworks distributed water from the streams and springs to the meadows on the slopes to increase grass and hay biomass production for the cattle traditionally bred there. Currently, the catchworks are only partially functional, and meadows suffer from drought mainly during the spring and summer seasons [36].

As a heritage of the Wallachian colonisation, we found mountain meadows above 1200 m with meadow and pasture traditions [35]. The management is according to the desired quality of the hay meadow. Some are mown once or twice a year and occasionally grazed; others have a mixed management scheme with one cut and grazing afterwards. Mosaic mowing represents a fruitful compromise between mechanisation and nature conservation (Figure 10d,e).

The main threats identified were conversion to arable land, drainage, construction, and abandonment. Abandonment followed by fast succession especially threatens the high-altitude seminatural grasslands. However, abandonment and plant succession still represent risks for species-rich hay meadows. An applicable solution is land acquisition

for the management of the protected areas and the accession of funds for conservation measures from different sources (e.g., EU Life programme or national grants) [37].

In addition to haystacks, there exist several types of lofts or small barns (*senník, stodôlka, šopka, štálik, koliba*; Figure 10e,f), which are mostly located in the meadows themselves for the following reasons:

- Remoteness from the villages in mountainous terrain,
- Lack of roads that allowed the transport of dry hay into a village and if the hay was transported (only by sledges in winter),
- Lack of storage facilities in villages,
- Fire hazards.

In the past, hay was stored outside or in wooden haylofts bearing features of folk architecture (small houses usually used for seasonal living and livestock housing). These haylofts or “open-air” hay-making structures situated on meadows are features completing the visual character of some mountainous landscapes, and they are attractive for tourists. Haylofts were generally one-room wooden buildings with gabled rooves and no ceiling. During autumn, hay lofts lodged shepherds, too. Most of these hay lofts disappeared from the country during the collectivisation of agriculture. Barns at farm settlements for storing hay are used less than in the past, mainly due to a decline in livestock production. At the moment, they are used for storing agricultural equipment and tools.

Today, they are very rare in the country and appear only as separate, isolated objects, mostly unused. Others were rebuilt as cottages (holiday homes).

Hay-making structures have been preserved only in certain regions with extreme natural conditions that are not suitable for heavy machines. Currently, hay is stored in round bales in large-capacity wooden or metal buildings whose volumes in space, textures, and colours visually appear alien in the landscape and negatively influence the quality of the visual aspects of the landscape.

Due to their significance for biodiversity, there are several Slovakian protection schemes in place. In the White Carpathians, important areas have been purchased by nature conservation authorities and restored to species-rich hay meadows to invert the transformation into arable land during collectivisation [37]. In other areas, productive grasslands are managed by cooperatives of local farmers, which were re-established after the communist era at the end of the 20th century. The cooperatives have no interest, however, in managing the hardly accessible grasslands, especially hay meadows. The cooperatives have slowly eliminated small plots and property borders, causing changes in the landscape structure [38].

Awareness of hay production and related structures is common. There is a national research agenda, as well as some private initiatives. Hay meadows are connected to landscapes of high cultural value with many positive attributes:

- Aesthetic value and inspiration for artists,
- Folklore, folk songs (*travnice*), and maintaining traditions,
- Educational value (ethnological, biological, and biodiversity information),
- Biological gene pool and source of biodiversity, which might become of new importance with respect to changing conditions due to climate change,
- Historical value and traditional ecological knowledge.

3.9. Slovenia—Land of the Hayracks

Slovenia is known as the birthplace of hayracks, which are integral to its countryside and exhibit remarkable diversity (Figure 11). Hayracks are known throughout the country, except for the Littoral Region (extreme southwest), Bela Krajina (extreme southeast), and Prekmurje (extreme northeast). These structures hold immense cultural value, as evident in their depiction on postage stamps and their use as decorative elements throughout the country.



Figure 11. Impressions of hay-making structures in Slovenia. (a) Geographical distribution of different hayrack types in Slovenia [39]. (b) Typical Slovenian alpine cultural landscape with interweaving of hay racks and haylofts in Bohinj, NW Slovenia (photo: D. Kladnik). (c) Making haystacks, which once was widespread in the western and southern parts of modern Slovenia but has almost completely disappeared during the last decades (photo: M. Pavšek). (d) Haylofts, typical hay-making structures on southern slopes of Julian Alps, NW Slovenia, are usually located in meadows in the vicinity of villages (photo: D. Kladnik). (e) The first known depiction of hayracks as permanent objects from about 1660 to 1670 in meadows and at farms on the outskirts of today’s Slovenian capital, Ljubljana (Juvanec, 2007). (f) Stacking grain in a hayrack, as depicted on a copperplate by Valvasor in his famous book *Die Ehre des Herzogthums Crain* (1689). (g) Haystacks are a popular subject of Slovenian painters, including the impressionist Matej Sternen, who depicted the haystacks near Škofja Loka in 1912 [40]. (h) One of the longest simple, stretched hayracks in Slovenia is located in close vicinity to Lake Bled, NW Slovenia (photo: M. Geršič). (i) Abandoned hayrack, an atypical combination of a simple, stretched hayrack and a “goat” hayrack in Domžale, central Slovenia (photo: D. Kladnik). (j) A brick toplar (coupled hayrack) with ornaments is the most sophisticated form of hayrack and a veritable treasure trove of folk architecture (Nazarje, north Slovenia) (photo: P. Pipan). (k) Symbolic “welcome” hayrack in Nadgorica, a village which was a few decades ago included in Ljubljana (photo: D. Kladnik). (l) Privately owned open-air museum called Dežela kozolcev (Land of Hayracks) in Šentrupert, lower Carniola (photo: A. Kruse).

The value of hay is demonstrated through the multitude of names associated with its acquisition and storage, as well as the various types of structures built for this purpose. These structures fulfil other agricultural needs and store tools and machinery, shaping the Slovenian landscape. However, hayracks are gradually disappearing due to the abandonment of remote and steep lands unsuitable for mechanised farming.

The origins of flatland meadows can be traced back to ancient times, while meadows in hilly areas are a result of highland colonisation between the 13th and 16th centuries. Then, landowners prioritised the cultivating of agricultural land over forested areas, which significantly boosted their incomes. Meadows are integral to traditional polyculture agriculture, emphasising crop and livestock production, primarily cattle breeding. Hay production on meadows indirectly supports the preservation of remote settlements, the traditional cultural landscape, and biodiversity.

According to agronomic definitions, permanent grassland refers to agricultural land used to grow grasses and other fodder plants untouched by agricultural rotation for at least five years [41]. Meadows refer to grassy lands cultivated to produce fodder for livestock. They require careful cultivation, regular cleaning, fertilising, and mowing at various frequencies based on fertility and care intensity.

The most extensive meadows, known as *senožeti* (literally, 'hay reap') or *košenice* (known as such mainly in lower Carniola), are typically mowed once a year. In contrast, the most intensive ones are mowed five or more times annually. *Senožeti* are especially prevalent in the hilly regions of western Slovenia. During their peak usage at the turn of the 19th and 20th centuries, they were widespread and were even recognised as an independent land category in Austro-Hungarian cadastral statistics for a time [42]. Due to rapid soil depletion caused by constant use and inadequate fertilisation, trees, particularly alders, were planted among the grasslands to maintain natural fertilisation. With the diminishing importance of agriculture and the abandonment of more distant agricultural lands, the trees grew uncontrollably over time, so today, most of such areas can be considered forest.

In 1994, Slovenia had 366,372 hectares of meadows, accounting for 18.1% of the country's territory [42]. While meadow area has increased due to the intensification of animal husbandry and the abandonment of fields, the ageing population and lack of agricultural labour have led to the abandonment and overgrowth of unprofitable meadows located far from farmers' homes, resulting in an overall decrease in meadow area. By 2020, the area of permanent meadows had decreased to 271,136 hectares, or 13.4% of the country's territory [43]. Natural meadows and bogs covered 1.94% of Slovenia's surface in 2018 [44]. Despite recent revitalization efforts, orchard meadows recognised in the Slovenian land categorization have diminished in importance and are without any significance for hay production.

The number of mowings per year depends on meadow quality and altitude. The dried hay from the first mowing in mid-May is called *seno*, hay from the second mowing at the end of June is *otava*, hay from the third mowing in August is *otavič* (also referred to as *otavnik*, *tretjakovica*, or *vnuka*), and hay from the fourth is *otavnica* [42]. Mowing, drying, and harvesting hay remains one of the most essential agricultural tasks.

Haystacks (*senene kopice*), once widespread throughout Slovenia (especially in the western and southern regions, where hayracks were scarce, Figure 11c), have nearly disappeared due to the adoption of baling and silage for fodder. More advanced structures for drying and storing hay, such as haylofts and hayracks, have also lost their primary roles.

In the mountainous countryside, one can still find numerous small buildings, typically wooden (occasionally brick), intended for hay storage and situated in the middle of meadows where mowing occurs. These structures are called *seniki* or *svisli* (Figure 11d).

As already mentioned, in Slovenia, various types of hayracks exist, each serving different drying and storage needs and fulfilling multifunctional purposes. The primary categories include single, double (*toplars*), and leaning hayracks. Hayracks can accelerate hay drying when placed in well-ventilated areas perpendicular to prevailing dry winds. An *ostrv* refers to a spruce stake with cut side branches used to gather hay in a haystack.

Hayrack construction originated during the late Middle Ages, when they were built near castles and monasteries for grain drying. Maps from the second half of the 17th century depict hayracks (Figure 11e), and they are also featured in the first comprehensive monograph about the Duchy of Carniola by Valvasor in 1689 (Figure 11f).

Their proliferation was influenced by increased agricultural tool usage and development, which required additional space beneath the *toplars*. These structures, which at the same time served practical and aesthetic purposes, were positioned near villages, between farmlands, and especially in meadows. Their prevalence, diversity, and harmonious integration into the cultural landscape have inspired numerous artistic depictions (Figure 11g). Extensive research by geographers, ethnologists, architects, art historians, and researchers from schools and popular surveys have contributed to our understanding of hayracks [45–48].

Regarding awareness, we would like to draw attention to several notable monographs, which have been published on the subject. Some have focused exclusively on hayracks [40,49–54], while others have encompassed all farm buildings (e.g., [47,55,56]) or folk architecture in general (e.g., [57,58]). Anton Melik, a respected Slovenian geographer, wrote the renowned book *Kozolec na Slovenskem* (Hayrack in Slovenia) in 1931. This comprehensive work explored the various forms of hayracks, considering regional differences and their evolution over time. Melik also included examples of hayracks and hay-making structures from neighbouring Alpine countries, Switzerland, Scandinavia, Belarus, China, and Japan.

Based on the existing typologies, the main types of hayracks, listed from simplest to most sophisticated, include hayracks without roofs (*kozolec*, *brez*, or *strehe*); leaning hayracks (*prislonjeni kozolec*); simple, stretched hayracks (*stegnjeni kozolec* or *samec*; Figure 11h); “cloaked” hayracks (*stegnjeni kozolec s plaščem*); “goat” hayracks (*kozolec na kozla* or *kozolec na psa*; Figure 11i); double stretched hayracks (*dvojni kozolec*); and *toplars* (coupled hayracks) (derived from a German-dialect word, *doppler*; Figure 11j). Each type is associated with various dialect names.

With the widespread adoption of baling and silage for fodder, the need for hay drying in hayracks and storage in haylofts or upper sections of *toplars* has significantly diminished. Consequently, many hayracks are deteriorating and are in need of maintenance. Restoration efforts focus on hayracks that serve nonagricultural purposes, as financial support for restoration is lacking. Additionally, reclassifying agricultural land as construction land has removed numerous hayracks. The remaining hayracks are being repurposed as sheds for agricultural machinery and tools, for drying corn and corn cobs, and for storing firewood. They also serve as welcoming structures (Figure 11k) and platforms for advertising messages. Some *toplars* have been converted into holiday homes and residential buildings, while others are used for tourism, particularly as picnic sites. Miniature hayracks are popular souvenirs. The hayrack’s distinct shape has also inspired modern architectural concepts in household construction.

There is a significant awareness of the vast variety and uniqueness of hayracks in Slovenia. The general public recognises their aesthetic and national value. It is crucial to emphasise their indispensable role in preserving the characteristic rural cultural landscape.

The exact number of hayracks in Slovenia remains unknown. The Institute for the Protection of Cultural Heritage of Slovenia has protected 1500 hayracks, with only two declared as cultural monuments of national importance.

Šentrupert in lower Carniola is home to the privately run open-air museum *Dežela kozolcev* (Land of Hayracks; Figure 11l), where visitors can learn about the development of hayracks and the distinctive features of hayracks in the Mirna River Valley. Other notable venues include a cluster of hayracks, primarily *toplars*, in the village of Studor v Bohinju (northwest Slovenia), as well as the small, open-air hayrack museums in Rogatec (eastern Slovenia) and near Pleterje Charterhouse Monastery (southeast Slovenia).

To raise awareness of the importance of hay, the promotion of hay milk (see the Austrian part of this article) has become crucial and a recognizable brand in marketing for some dairy-oriented farms.

4. Discussion

4.1. International Parallels of Hay-Making Structures in Common Biocultural Heritage

In several European countries, especially in the east, seminatural meadows comprise small remnants of former mountain hay meadows, which, together with haylofts, retain the typical mountain landscape features existing before collectivisation [35]. Furthermore, the country synopses make clear that hay making is not limited to mountain areas but exists all over the countries. The similarities are that hay-making meadows are often characterised by a high number of built cultural elements and a high degree of biodiversity and, therefore, often belong to valuable, sometimes even protected, landscape types [59]. In European countries, mechanisation development during the last decades has most often replaced traditional hay-making techniques. Consequently, hay is stored in rectangular or round bales and often wrapped in plastic. However, even if the method of production has changed, the hay itself has never disappeared and is still used for different purposes. In the first place, it is still used as animal fodder, followed by usage as components of tourism, wellbeing, or cultural activities. The national descriptions show that hay-making structures were and still are common all over Europe, which is also true for further countries that are not represented by a national overview in this article, like Ukraine (Figure 12).

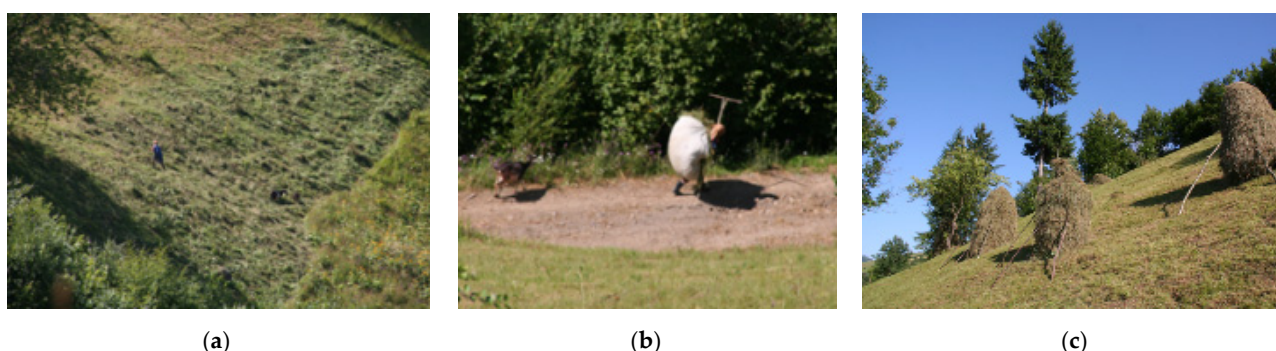


Figure 12. These impressions from Ukraine show how similar hay making still is in many European regions. (a) An elderly woman mowing steep hills near Rakhiv, Ukraine, accompanied by her two goats (photo: A. Kruse). In (b), she is carrying the grass home in a blanket (photo: A. Kruse). (c) Haystacks on slopes at a Biosphere Preserve near Rakhiv, Ukraine (photo: A. Kruse).

There were regional differences, as well as many parallels and commonalities. The geographical distribution, similar to other aerial drying sheds, e.g., for maize (Figures 5h and 11l), was related to climatic and geological factors and was influenced by tradition, too. Hayracks that resemble the Slovenian *kozolec* can be found all around the Alps, in Scandinavia, and in northern Russia, as well as in the mountainous western parts of China and in Japan. Also, techniques and structures have been and still are quite similar.

Why do we care about hay-making structures and hay-making landscapes? The previous country chapters show that, no matter the dramatic changes in agricultural production, hay still is important to people. Not only is it important for agriculture, but it also bears high identification potential in rural areas [60]. It is often connected to wellbeing and a feeling of “the good old times” (Figures 4a and 13), although hay making is most of all connected to hard work. Of all the structures, grasslands are true systems of “cover crops”. They cover the soil with vegetation throughout the agricultural year, directly contributing to the improvement of soil fertility, preventing soil erosion, and contributing to the binding of carbon dioxide and to the diversification of animal feed; finally, they are continually adjusting natural factors [61–63]. The versatility of these surfaces is given by the vegetal coating, consisting of many valuable species of animal feed, which also provide

and maintain the ecological balance of the various relief formations. Permanent grassland areas are part of the rural area with all the other socio-economic activities specific to them.

The biodiversity of species, botanical genera, and families existing in grasslands also gives increased recreational satisfaction for people through the aesthetic value of these species. In this case, the maintenance of this feature is dependent on the preservation of the existing biodiversity in grassland vegetation cover. To mention only one example, in terms of Romania, a typical rural country, the recovery of permanent grassland is connected to the multifunctionality of these lands according to the natural resources they offer: animal feed resources, ornamental and aesthetic resources, and energy resources.

4.2. Natural and Cultural Values

Grasslands, through their floral structure, are also an important reservoir of melliferous resources and, in this regard, significant for the local economy, as shown in the Romanian part. In the past, hay has been crucial for livestock farming and the related farmer communities. It seems as if this has always been the case. We rarely find an agricultural topic so well-documented in historic paintings as the hay harvest (Figure 13).

Many values are connected to hay, by far more than being nutritious winter fodder for livestock:

- Aesthetic values, including inspiration for artists, folklore, and the maintenance of traditions,
- Educational values (ethnological, biological, and biodiversity information),
- Genetic values in terms of biological gene pool, sources of biodiversity, and adaptation strategies in times of climate change [64].

Large shares of hay-making grasslands belong to natural habitat types of community interest whose conservation requires the designation of special areas [59,65]. Therefore, the maintenance of hay meadows, especially in mountains and at dry or humid sites, is financially supported by states, e.g., Norway, Germany, Romania, Slovakia, and Slovenia.



Figure 13. Haystacks in paintings. (a) Middle part of the Haywain Triptych by Hieronymus Bosch around 1516, Museo del Prado, Madrid [66]. (b) “Summer” from a French Hours’ book, 15th century ([67], cover photo). (c) One of the haystacks paintings of Claude Monet from the cycle “The Giverny Years 1883–1926” [68].

Knowing that hay making is quite hard physical work, especially when it was still hand work, it is astonishing—by analysing paintings—that hay making was and still is, associated with fun, beauty, community, and cooperation. This is especially true for the paintings of Claude Monet, who worked on this topic in many different facets for decades (Figure 13). His hay paintings bear a romantic, aesthetic aspect. As an interesting side effect, the authors would like to point out that the translation from the original word for Monet’s paintings, “meule”, into English “grainstacks” is wrong because the latter means cereals, not hay.

4.3. Awareness of Hay-Making Structures against Abandonment Threatening Their Existence

The compilation of national information also showed that there was a lot of awareness, as well as positive images, connected to hay:

- Wellbeing and healthy, high-quality food,
- Biodiversity,
- Tradition, sense of place, and regional/local identification,
- Holiday feelings, culture, fun, etc.

In nearly all the countries, there was a positive awareness towards hay and related structures. As listed in the national overviews, we found museums, books (both scientific and photographic ones), associations, and festivities. This included contemporary and historical photographs, paintings, and buildings. Slovenia, which can be described as a country of haylofts, had a strong relationship with haylofts in contemporary architecture, such as bus stops, roundabout decorations, and last but not least, tourist shelters. Various promotional activities provided historical, cultural, and economic context for understanding the rural landscape [69].

However, the national compilations also showed that many facts are still unknown, especially concerning recent and historical extents and distributions of hay-making landscapes, as well as in terms of today's economic importance of these landscapes for different business branches, such as agriculture, tourism, cosmetics, wellbeing, and food.

Contrary to the positive awareness of hay-making structures of the broad public, in most countries, the same threats were pointed out: abandonment followed by fast succession reducing seminatural grasslands, especially in mountainous areas, and thereby threatening the high degree of biodiversity. This fact has to be mentioned. In Romania, an applicable solution for maintenance was land acquisition of protected sites and accession of funds for conservation measures from different sources, e.g., Life and national grants [37]. In Slovakia in the White Carpathians, important areas have been purchased by nature conservation authorities and restored to species-rich hay meadows [38].

Maybe even more than the grasslands, the related hay-making structures are endangered by abandonment and non-use. As all the authors indicated, there is a large number of these structures, starting with the light drying racks (including the famous Slovenian *kozolec*) and ending with the numerous small wooden barns in the meadows. As described, now only a very small share is still used, re-used, or transformed for further occupation—not to speak of the movable, nonpermanent haystacks, a feature which is vanishing in western Europe.

This compilation showed that hay-making structures and hay grasslands are often well-known and highly appreciated by the public and even motives for identification and sense of place [5]. They are linked to festivities throughout the year (Figure 14).



Figure 14. Thanksgiving festivities are very common in Germany. (a) Every year, tractors are decorated and many different objects are created from hay. (b) Some farmers take the opportunity to advertise their hay for sale. (Photos provided by Katrin Pütz, (a) taken in 2022, (b) taken in 2014).

From an economic point of view, it is interesting to see that today, like in former times, there is a hay business, including online markets at local, regional, national, and international levels (Figure 15, [22,23]), as can be shown by the following two examples.

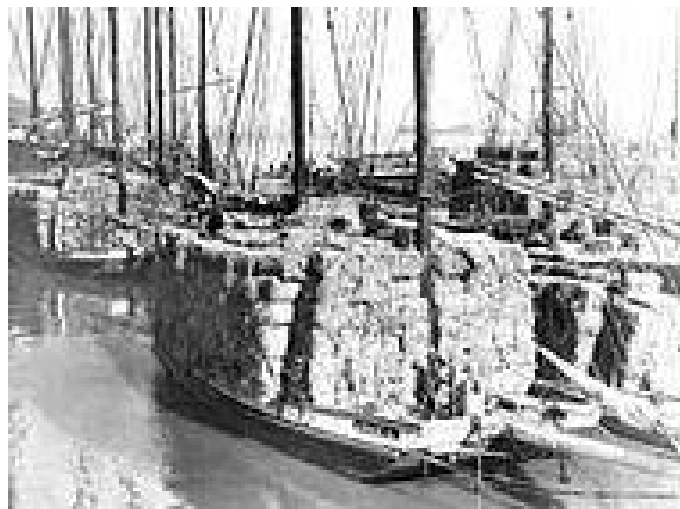


Figure 15. Hay scow at San Francisco in the late 19th century [70].

In 2014, Iceland exported five times more hay to the Faroe Islands, where there is not enough space for local hay production [71], as well as to the European continent, than in the years before. The amount of 300 tonnes per year has increased up to 1500 tonnes. In 2004, the price per kg was about ISK 17; today, it is ISK 40. Óskar Eyjólfsson from Hjarðartún, one of the main Icelandic hay exporters, explains that the European countries produce mainly crops but not enough hay for themselves. Also, in Italy we found the so-called Hay Highway from the south to the north. Italy is one of the countries that imports hay, especially from Slovenia.

4.4. Educational Value of Hay-Making Structures

Another common fact was that traditionally managed hay-making meadows, particularly those manually mowed with scythes, were becoming rare in all the countries. Traditionally managed meadows have persisted mainly in remote areas with no access for machinery on rugged terrain with steep slopes. However, there could be observed a kind of revival due to the already discussed biodiversity value. In most countries, the maintenance of high-biodiversity meadows and hay making depended at least partly on the engagement of volunteers, NGOs, or national protection schemes. It must be considered whether the social benefit of maintaining these meadows does not allow financial rewards for the activities, not least to the farmers. Many volunteer organisations kept the tradition of cutting the hay manually with scythes, especially on poor soil or steep areas in the mountains. In this attempt, even simple drying structures from other European countries were introduced. We found an example where simple hayracks reminiscent of the Norwegian ones, were erected in Germany as a training module for nature protection measures, where laypeople learned how to mow grass by hand and to build simple drying structures, conducted by the Association for Environmental Protection in Winterberg, Sauerland.

Not only in Slovakia, hay-making structures were well-known to the public [72], especially among the rural population. Between various festivities, there are some festivals focusing on meadow cutting and hay making. Also, volunteers mow steep slopes, which is at the same time an intergenerational action, where seniors teach young ones how to mow with a scythe (Figure 2b).

Thus, manually mowed meadows might be perceived as natural educational trainers for nature conservationists and enthusiastic nature-loving people, as well. Currently, the ancestral tradition of scythe mowing is preserved as intangible cultural heritage. Following

this context, in the last few years, the interest in the scythe has grown remarkably, and so has the sale of *The Scythe Book*. This book has been supplemented with an addendum on the practical use of the scythe [73]. In May 2021, the paper edition of the book was succeeded by an audio edition. Maybe in the future, regarding the needs for the nature protection and preservation of some biotopes, vocational educational training courses on traditional manual mowing and hay-making techniques might be developed.

As already pointed out, there is a positive awareness towards hay and related structures. We found museums, books, associations, and festivities (Figures 11 and 14). This also included contemporary and historic photographs and paintings. Various promotional activities provided historical, cultural, and economic contexts for understanding the rural landscape [69]. A greater awareness of hay-making structures may help inhabitants, visitors, and readers to increase their appreciation for a state's rich agricultural and architectural legacy and to find alternative solutions for how to maintain and secure this agricultural heritage.

However, the national compilations also showed that many facts are still unknown, especially concerning recent and historical extents and distributions of hay-making landscapes and also related (built) constructions. Also, in terms of today's economic importance of these landscapes for different business branches, such as agriculture, tourism, cosmetics, wellbeing, and food, there are no reliable, condensed or statistical information existing.

5. Conclusions

Cultural and natural ecosystem services are considered services with nonmaterial and, respectively, immaterial benefits. Thus, recreational services related to grasslands include a range of possibilities that meet the aesthetic and spiritual requirements of humans, especially when practising close-to-nature tourism in areas where permanent grasslands are located.

Today, hay-making structures are considered parts of cultural heritage. In this way, they are considered as tools for the following:

- Maintaining the identity of places,
- Supporting the cohesion and vitality of local communities,
- Supporting rural tourism.

Awareness of hay-making structures helps inhabitants, visitors, and readers to increase their appreciation for a state's rich agricultural and architectural legacy. A future topic of the EUCALAND community network might be a collection of national barns, which reveal an enormous variety and a lot of rural and, respectively vernacular heritage, that is still unexplored. Since landscape is shaped by the co-evolution between nature and human activities, both anthropogenic and environmental features must be integrated. This implies considering farm buildings together with an associated agro-ecosystem's elements from a structural or a functional point of view. In mountain areas, the rural buildings and structures for the drying of products and the permanent meadows are an essential combination for rural heritage, strictly linked with meadows as agro-ecosystem components.

Author Contributions: Members of the EUCALAND network ("European Culture expressed in Agricultural Landscapes") from different European countries conducted this work. All co-authors collected, prepared, and analysed the data. A.K. and J.Š. conceptualised and wrote the manuscript with the input of other co-authors. Final reviews were conducted by A.K., J.Š., S.E., C.C. and M.S. (Martina Slámová) Final language check was performed by S.E., P.S. and A.K. Country sections were written by the following: Austria—A.K. and P.S.; Germany—A.K.; Hungary—C.C.; Italy—V.F. and M.S. (Maurizia Sigura); the Netherlands—S.J. and H.R.; Norway—S.E., H.S. and K.S.; Romania—T.M. and D.N.; Slovakia—J.Š. and M.S. (Martina Slámová); Slovenia—D.K. Introduction, Discussion, and Conclusion sections were conceptualised by M.S. (Martina Slámová), J.Š., V.F., S.E. and A.K. with support from the other co-authors. Z.K. contributed to Table 1 by providing Czech translations. All authors have read and agreed to the published version of the manuscript.

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