Article

Value in Grass – Matter of Fibre and Carbs

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Abstract: Climate adaptation is a major challenge. Chasing the sufficient amount of hay is getting in higher priority. Distant mass hay producers give favourable offers despite long distances. Quality is also gaining position and indicators like RFQ (Relative Forage Quality) is highlighting the marketing language. Hay market as we knew no longer exists in Hungary. Most farmers produce their own hay and do not spend extra cents to buy bales. Climate change however, force them to adapt and store more bales for the future. Horse owners and dairy farmers are the main driver to convince hay producers to provide high quality forage. We gathered Hungarian regional hay-price information and evaluated the trends in this sector. The demand-driven hay-price is in contradiction with premium quality timothy grass hay.

Keywords: grassland, replacement value, hay market

1. Introduction

Beef and milk production should be based on high quality forage. Farmers and agroholdings represent two side of the river. Smaller farms focusing on simple feeding system while the feeding lots and industrial size dairy farms concentrate on mass production with diverse total mixed ration (TMR) feeding. Quantity is overwhelming quality issues despite quality control. The question of high-quality hay is evergreen topic, where quantity is often stands on the sideline. Droughts are more severe and rainfall's frequency is less predictable. Climate change is getting closer to daily farming where high yields hard to accomplish [1]. Dairy farming reacts fairly quickly in diet feeding as nutritionists tend to mix more digestible fibre into TMR. The goal is to reduce the rumen passage rate (RPR). For that matter meadow hay, with its low lignin content, is an increasingly tempting alternative of alfalfa hay. Efforts have been made to reduce lignin content [2] in alfalfa, using gene silencing, however these breeds (HarvXtraTm) are still not widely available. Grasses are good carotene sources especially *Agropyron cristatum* and *Festuca rubra*. Valuing grass from farmers perspective does not sound difficult. As a starting material its value as raw forage straight from pasture and profit realises in meat, milk or wool. During winter feeding, quality hay becomes more valuable in TMR therefore costs start to rise. Even in beef cattle business quality hay is essential to keep on level the daily gain. Eventually quality hay, with high digestible fibre, should be the ultimate goal for every farmer to maximize their profit. Hay prices however do not follow market rules.

Hungarian grass hay production has a long production especially in grass meal export. This premium product is an excellent β-carotene source but high energy prices forced to decline this sector. Quality supplementary feed additives require strict qualification system and this affects on hay qualification as well. As the European hay market is very fragmented every producer has their own qualification system but most of them based on sense perception. We introduce our data through the Hungarian scoring ISO system [3]. The primary goal was to determine the average animal carrying capacity around the country [1].

2. Materials and Methods

In the United States *Relative feed value* (RFV) has been used for years to compare the quality of legume and legume/grass hays and silages. One index for price hay and also predict animal performance. In recent years Hungarian dairy sector also applies this index to decide which diet suits better in TMR. RFV is also used for hay auctions in US and predictably in the near future at Hungarian farms as well. Digestible dry matter (DDM) is based on Acid detergent fiber (ADF), and takes account Dry matter intake (DMI) potential (as a percent of body weight, BW) from Neutral Detergent Fiber (NDF). The final formula is the following: DDM = 88.9 - (0.779 x % ADF) | DMI = 120 / (% NDF) | RFV = (DDM x DMI) / 1.29

We have gathered hay yield data from 63 farms around Hungary. Dataset was built on historical data between 1965-2017. Based on yield, quality (K-value by Balazs [4]), RFV and market data, we have categorized the farms' regular hay purchase price.

Determine the value of grass

Since the local farmers hard to convince to produce quality instead of quantity we also made economical calculation. Every farmer have their own priorities but cost effectiveness is evenly important. One says grass is valuable replacement mass forage, according to another opinion hay is exclusive forage, therefore quantity is primer issue. Generally speaking, quantity is the only important. Couple of farmers realized that higher nutritive content, quicker rumen passage seriously affect on profitability. Previously, a detailed study was carried out [5] where the author suggested two approaches to consider.

Deducting from products

Calculation based on a marketable product like beef or milk. This approach focus on added value as well, where a geographical identified (GI) product highly increase the importance of grassland. Eventually, the profit generated from the final product indicates the base value of the grass forage.

Feeding value based on replacement value

This point of view is very precise, when grass substitutes or supplements other forages. This complex method based on nutritional value and price matrix [6]. In case we wish to replace maize silage with grass silage, the actual cost for one kilogram of maize plus its nutritive impact, defines the replacement value of grass. The following factors effect on the final value of hay: nutrient needs of animals, nutrient content of intensive forages, costs and area requirements, biological and technological restricting factors, volume of expected alternative income, grass nutrient content. Calculate reference replacement values depends from several factors (see above) however keeping cattle on grass could cost about 1.62-2.92 Eurocents/kg.

Pasture profit index (PPI)

Most countries where grass is important part of the forage production, calculates with its own economic valuating formula. PPI is a selection tool developed by Teagasc in Ireland [7-9]. This decision making index comprises the following indices: spring DM yield, mid-season DM yield, autumn DM yield, quality (across the months of April to July), 1st and 2nd cut silage DM yield and persistency. The Total economic merit is calculated from these above mentioned indices. For clearance 1st rank perennial ryegrass cultivar on the 2018 recommended list (Teagasc, Ireland; Table 1).

Table 1. Pasture Profit Index Values (€ ha^{-1} $year^{-1}$)

Variety name[1]	Ploidy[2]	Heading date[3]	PPI[4] €/ha	Spring growth[5]	Summer growth[6]	Autumn growth[7]	Quality[8]	Silage[9]	Persistency[10]	Total Yield[11] (t DM ha^{-1})	Mean DMD[12] (g/kg)	1st cut silage[13] (t DM/ha)	2nd cut silage[14] (t DM/ha)	Ground cover Score[15]
Aberclyde	Tetraploid	25-May	225	57	48	37	55	28	0	10.96	856.2	5.01	3.73	5.6

Source: https://www.agriculture.gov.ie/media/migration/publications/2018/GrassWhiteCloverRecListVarietiesforIreland220218.pdf

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Digestible dry matter (DDM) is based on Acid detergent fiber (ADF), and takes account Dry matter intake (DMI) potential (as a percent of body weight, BW) from Neutral detergent fiber (NDF). The final formula is the following:

DDM = 88.9 - (0.779 x % ADF)

DMI = 120 / (% NDF)

RFV = (DDM x DMI) / 1.29

Example: Alfalfa hay or haylage with 32% ADF and 40% NDF

(Plug in values for ADF and NDF on a dry matter basis)

DDM = 88.9 - (0.779 x 32) = 63.97

DMI = 120 / 40 = 3

RFV = (63.97 x 3) / 1.29 = 149

Above 150 (RFV) starts the real quality.

NDF 624 ADF 361 DDM=60,78 DMI=1,92 RFV= 90,46

3. Results

We have validated and compared the yield and nutrient content data (Table 2.). The animal carrying capacity is varying between 0.4-3.3 LU ha^{-1}. Grass quality (K-value) and hay feeding value (RFV) is connected due to late mowing. Yields are strongly depend from rainfall.

Table 2. Average hay yields and quality at different climate sensitivity categories in Hungary

Climate sensitivity	K value	RFV	Average green yields (t ha^{-1})	Animal carrying capacity (LU ha^{-1})
Extremely sensitive	2	Poor	3-4	0.4-0.8
Very sensitive	1-3	Poor	2-3	1.2-1.6
Moderately sensitive	1>	Poor	4-5	1.6-2.5
Least sensitive	3-4<	Medium	10	2.5-3.3

Quality is secondary at hay purchase deals. As EU regulations control the earliest cutting date at 15th of June on NATURA grasslands, baled hay has medium or poor quality (RFV<150). High in fibre and low in protein. Feeding these bales is inevitable but necessary to give supplemental forage as well. During wet years the price can be low as 14 € per bale, while in dry years hay price may climb over 32 € per bale. Horses and big yielder dairy cows cost much more. Premium hay (low ash, no stones, no mould) can bear the costs (transport and storage) due to its high nutritive value. The calculated price typically refer to a 250-300 kg 150 Ø round bale and depends on transport distance, where 20 km is the profitability limit in an average season. The needs and price sensitivity of horse owners are quite different. Reliable, continuous supply, perfect hay composition and quality are the keys for running a good hay-producing holding (Table 3).

Table 3. Meadow hay price (€ per ton) in average season in 2019 (550 mm annual rainfall)

Hay Quality Class (K-value)	Horse[2]	Dairy cow	Cattle	Sheep
Excellent (Premium herb-hay)	100 – 104	90-95	-	-
Good	65	32,4	-	-
Medium	32,4	16,2	16,2	16,2
Fair	-	-	15	14
Poor	-	-	-	10

4. Discussion

Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

5. Conclusions

So far the hay quality and digestibility is not a major issue in Hungarian farmers' mindset. However climate change and high standards in foraging both dairy and beef sectors require better hay. Small and medium scale hay producers are not forced to make high quality meadow hay because of low price and livestock farms self-sufficiency. The bigger farms and horse stables however are looking for premium quality because the long term cost reduction in supplementary feeds.

Oportunities and Perspectives

Quality hay production is not an easy task and climate dependent. Historical weather and yield data in open databases is a must to evaluate farm productivity. This database requires regular, georeferenced, yield reports and nutrient analyses. The big data set opens new breakout points like amino-acid specific feeding. Hay quality is a corner stone in dairy farming regarding dry matter uptake and rumen passage rate. Sustainable, high performance, beef and cheese production inevitably counts on a general hay qualification system integrated with a digital hay market. Climate change adaptation is also urging the revision of irrigation technologies. Flood irrigation is still a feasible solution on pastures.

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