

The economic value of grassland products

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Summary: The economic value of grassland products is not always clear. In addition to demonstrating the social benefits of grassland products, the objective of the present study is to present the value of their diverse forms of utilization and their definitions in practice. This study groups marketable and non-marketable grass products and introduces a new category, the animal husbandry value of grasses. Among other factors, economists differ from researchers in other areas of science, as they are basically motivated by three issues. The first question economists always raise is: “What can it be used for?”, the second is: “What is it worth?”, and the third is: “How can it (its value) be determined?” Any answers to any further questions are subordinated to the answers to these three.

Keywords: grassland utilisation, replacement value, value of grass in animal husbandry

A wide range of grassland farmers try to define the social benefits of grasses. Social benefits can be of a very wide scale, as they are basically related to the question “How useful are they for humans?”. The approaches of economists and grassland farmers are not contradictory; in fact, they complement each other well. To answer the three questions raised by economists, grassland farmers need to determine the details of major grassland uses and the interdisciplinary correlations of their benefits. In exploring what the major factors of **grass utilization** are, we first studied their benefits by looking at how they are utilized.

The benefits of grasses can be classified as follows:

- a) They provide forage for grazing animals and thus make vegetation suitable for human consumption. Animals transform vegetation and produce e.g. milk, meat and wool for human consumption and use.
- b) They have developed a natural environment of vegetations where medicinal plants and herbs can be collected and used for human consumption.
- c) Their surface cover protects life-giving soils and croplands from the harmful effects of natural disasters and human intervention, erosion and deflation.
- d) They provide a natural environment for smaller-larger animal species living on them, maintaining and ensuring the potentials of biodiversity.
- e) They keep not only surface soils, but croplands in suitable conditions, as well. Grasses are specially related to soils: dead plant residues generate humus, which promotes the formation of different soil structures. The fibrous root system of grasses directly advances the formation of soil structures.

- f) In our direct human environment, they contribute to “human aesthetics” and relaxation. A beautiful lawn enhances the friendliness of our environment, the value of the scenery that we directly see.
- g) They are natural areas for doing sports, recreation activities (e.g. football fields) by the construction of man-made sports grounds in urban areas or by transforming the natural environment (golf courses).
- h) In the form of a naturally generated “**biomass**” or established culture (energy grass), they are renewable energy sources for humans.
- i) They directly ensure numbers of entrepreneurs (enterprises) enough to live on, as entrepreneurs produce (grass) seeds or give advice on grasses.

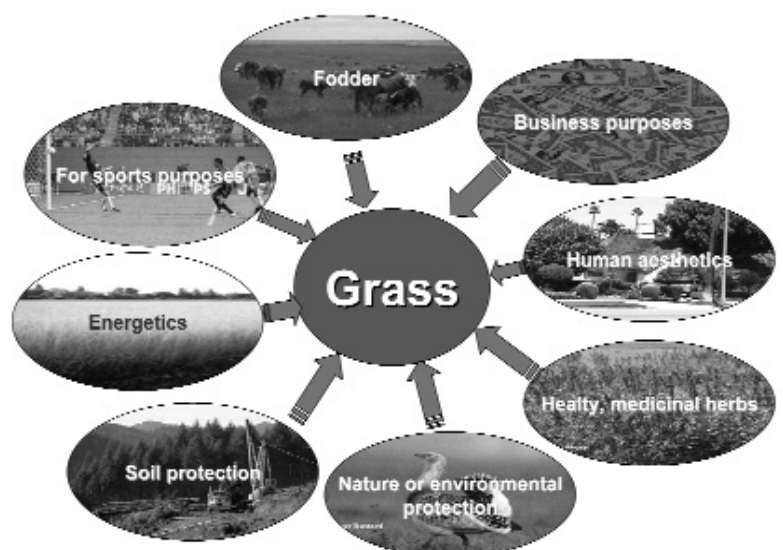


Figure 1: Areas of grass utilization

The list of social benefits derived from grasses is far from complete (e.g. they bind carbon dioxide and dust particles or produce oxygen), but here only those benefits are highlighted, which are related to well-definable (economic) areas of utilization. *Figure 1.* presents the areas of grass utilization

The more concrete forms of these areas of utilization are the following:

1. Animal nutrition

Animal nutrition is one of the “most ancient” areas of grass utilization closely related to human history. Besides natural grasses, grassland products are cut green for forage in the vegetation period from areas established subsequently; after the vegetation period, they are used as hay or haylage.

2. Health care, medicinal plants (herbs)

The use of herbs and medicinal plants gathered from meadows and pasturelands is still traditional and characteristic in Hungary. Their special, individual use is in health care, where not only medicinal raw materials, but fitness and wellness cures involve grassland products, as well.

3. Soil protection

Grasses are of high significance for their products (forage-medicinal plants-herbs) and for their special “protective” characteristics. In areas subjected to soil erosion, deflation caused by wind and in areas of planted orchards and vineyards we utilize the traits of grasses that they physically protect and improve soils, preventing weeding and protecting soils from desiccation.

4. Nature and environmental protection, biodiversity

Soil protection implies that plant communities can survive and provide places for animals to live, nest and hatch on grasslands. Grasses receive protection and care, to ensure that they can maintain species utilizing them as nesting grounds. Our pristine grasslands are botanical curiosities and they are individual zoologically, as well as a result of their multiple natural interactions. Specific plant communities form specific eco-synoses and thus they maintain the biological diversity of animal life. Biological diversity means a single function of several components: the number of occurring species, the richness of species, their genetic variability within species, the diversity of ecosystems, and the occurrence of species among other species and the balance of their occurrence.

Functional diversity expresses the biological roles of species or species groups in a specific ecosystem and those ecological processes, which are performed by certain organisms, populations and communities. In a broader sense, biodiversity includes the metabolism capacity of ecosystems (Kátai 2004; Jávora et al., Molnár et al., 1998).

5. Pleasant human environment

A special area of grass utilization can be the provision of a “human aesthetics” i.e. making our direct residential areas more semi-natural. Parks in settlements, grasslands around community houses, ornamental gardens around private houses directly determine the general impressions of humans. Their overall importance has oftentimes some

significance beyond themselves as compared to other possibilities for their use.

6. Utilization for sports

This is a highly significant utilization of grasslands. If we only consider the size of football fields, their calculated area exceeds 1000 ha in Hungary. From the viewpoint of benefits, sports utilization of grasslands belongs to the wide range of uses for developing pleasant human environments, but due to its functional speciality, it is worth mentioning it separately. The maintenance of grasses, and the related labour costs, can be more complex than the most intensive plant production sectors.

7. Energetics

Surveys on renewable, renewed and non-renewable energy resources made the general public realize that the termination of fossil energy utilization is within alarming proximity worldwide. However, the exhaustion of carbon and petroleum oil resources, the reduction of natural gas reserves directed the attention of researchers, developers and analysts towards the utilization of renewed energy. In addition to the utilization of solar, water and wind energies, that of “bio” energy has come into the limelight. One of its areas is “energy grass”, a specifically new potential not only for those who possess grasslands, but for those farmers who have plough lands and who perform their activities under less favourable circumstances. To our present knowledge, energy grass is a “novelty” heading for a specific career, which can transform our earlier, related ideas on the potentials of grassland utilization.

8. Business profitability

None of the experts of grassland management speak or want to speak about the fact that this “area” is excellent for making a living and performing business activity. However, if these are not taken into consideration, the scope of grass utilization cannot be regarded complete. The most natural elements of profitability are seed-grain production (including cleaning and selection), technological development, improvement, and also the market sale or simply the selling of all these products. Moreover, profitability can manifest in a land owner’s leasing his pastureland if he will not perform farming activities. A lease is the periodical letting (transfer) of grassland products, which is compensated. Compensation can be of many kinds, but the most widespread form is when it is compensated through payment.

Following the revision and definition of the most significant areas of utilization, the second question can be raised: How much the product of utilization is worth for us in terms of money? Can this benefit be expressed and measured in money? The answer is yes. The products of grassland do have their values (prices) in terms of money, as e.g. seeds, forages, medicinal plants and herbs are not inexpensive. However, are these benefits of identical values? The answer is inevitable: they are naturally not. The third baseline question is: Are these benefits of identical values? Is there a pattern, or perhaps the applied methods are different from each other? The answer here is also evident and can be worded

immediately (even if we do not consider economics): there cannot be only a single pattern; it would be all too simple.

In the following part of the study, we explore the key area of our study: what grasses are worth and how their value may be defined.

Relation of demand and supply

First of all, we start from the economic principle that the price (value) of a product is determined by **the relation of demand (buyers) and supply (vendors)** according to current market conditions. In the case of low supply, high demand raises the price. On the contrary, the same product, if supply is high and demand is low, is worth an insignificant amount or more precisely, can be sold at a lower price. This correlation is true of both grasses and grassland products. If there were no other influences, the question could be answered: the value of grasses is determined by the relation of current demand and supply, i.e. the value evaluation of market is dominant, there is no need for further investigation. **It is worth as much as it is paid for.** The problem is merely the fact that in the case of grasses, buyers are usually vendors as well! Grassland products, taking especially domestic conditions into consideration, do not provide or hardly provide market commodity supply that is why they are called “non-marketable” products. Direct commodity supply can include seeds (grass and lawn mixes) or rarely baled hay or grass meal. The majority of grasses are used in animal husbandry as “own” forage, where “clear market” conditions are difficult to find. The solution of the problem is further complicated by the fact that a clear demand-supply principle is not valid for the few marketable grassland products, as disturbing elements can emerge! (E.g. the price diverting potentials of companies in monopolistic positions or the effects of the market regulating measures of the state itself or perhaps the price influencing potential of products from foreign trade). The problem is more complicated as it seemed for the first sight, so the subject matter needs more detailed study.

Evaluation of non-marketable and marketable products

When determining the value of grasses, we start from the potentials of utilization and we sum up grassland products again. Which are marketable and non-marketable grassland products? (Table 1.)

Table 1: Evaluation of the utilization potentials of grasslands on the basis of their marketability

Product/Name	Marketable	Non-marketable
Forage for own use		+
Forage for sale	+	
Medicinal plant, herb	+	
Soil protection		+
Nature and environmental protection, diversity		+
Pleasant human environment	+	+
For sporting purposes	+	
Energetics	+	
Business utilization	+	

From own sources

In the case of marketable utilization, the price of grassland products can be determined relatively simply. **The relation of demand and supply is dominant; however, the basis of price determination is the cost of production.**

Cost of grasses as the baseline of selling price

When costs are calculated, it is advisable to separate expenditure related to natural grasslands, pristine grasslands, artificial or planted grasslands.

In both cases, costs should be divided in two large groups, which are the following:

In the case of planted grasses, the costs of establishment and the expenditure of annual utilization are separated (Tables 2., 3.)

Table 2: Costs of grassland establishment (1EUR=260 HUF)

Name of technological operation	Cost (HUF/ha)	Cost (EUR/ha)
Soil preparation	8 000 – 35 000	31-135
Cost of fertilizers	4 000 – 12 000	15-46
Cost of seed-grains (40 kg/ha):	36 000	138
Sowing:	4 000 – 8 000	15-31
Weed control, mowing for cleaning	4 000 – 12 000	15-46
Total:	56 000 – 103 000	215-396

Table 3: Costs of grassland utilization (hay) 1 EUR=260 HUF

Name of technological operation	Cost (HUF/ha)	Cost (EUR/ha)
Mowing (1-3 occasions):	4 000 – 12 000	15-46
Swath management	2 000 – 6 000	8-23
Baling + transport	5 000 – 25 000	19-96
Total:	12 000 – 43 000	46-165

Source: Lapis M. 2004.

If the grassland product is forage for sale, the starting point is the cost of production for forage. Here, we can use the cost calculation well-known in accountancy. The direct costs of product production (materials, e.g. fertilizers, personal costs, divided mechanical services, accounted depreciation, other direct costs and standard, indirect or general costs) are to be taken into consideration.

This can be the basis for the determination of selling price. The production cost of the product is also influenced

Table 4: Production costs of grassland products

Name	Production cost of hay value	
	Irrigated	Non-irrigated
Grass for grazing	100	117
Hay (small bale)	139	161
Hay (large bale)	152	173
Haycock	183	207
Haylage	163	185

Source: Marselek, 1997.

by the applied technology. *Table 4.* presents the production costs of grassland products conserved in different ways as compared to pastureland grasses.

Type (1), production cost of hay value (2), non-irrigated (3), irrigated (4), grass for grazing (5), hay (small bale) (6), Hay large bale (7), haycock (8), haylage (9)

Furthermore, the relation of demand and supply can be an influencing factor for product price. If demand is low, producers can only sell products at a price about the production cost (e.g. baled hay). If demand is high, the producer can gain extra profit above his accounted expenses, as he can sell his products at much higher prices than his expenditures.

How can we determine the price of other marketable products?

Medicinal plants and herbs can be included in the marketable category of products if collected products are sold. In this case, the calculated personal-type surplus costs of picking-collecting are added to the annual costs of the applied production technologies. The starting point of selling can be the calculated production cost, but in this case, demand will be the decisive factor in price calculation.

The category of business benefits includes leasing lands, which in turn also belongs to the marketable category of products. In the case of leasing non-products, the gold crown value of the land is decisive. Naturally, this value is also affected by the relation between supply and demand. If there is great demand for leasing, prices can be raised. Today the rent for a grassland of 1 ha is 1500–6500 HUF. With area payments valid for grasslands (see later), the rent is likely to rise.

Determining the prices of non-marketable products

Several grassland products are included in the non-marketable category, e.g. nature, soil, area and environment protection, human aesthetics, utilization for sports and primarily animal forage (as own-produced forage). The economic value of non-marketable utilization can only be calculated approximately. The literature of economics knows two kinds of approaches: the first is the method of deducting from the marketable end-product produced as a result of “produce”, and the second is the method based on so-called

replacement value. As we have already mentioned in relation to marketable utilization methods, production cost or production cost can be the starting points here as well. Therefore, the products of non-marketable utilization should yield as much as their production in terms of money cost.

The determination of grassland value is specific in the case of nature, soil and area protection. The rate of

damage caused by nature can only be calculated, e.g. profit lost in eroded or deflated areas or surplus weed killing and soil cultivation costs in grasses between the rows of orchards, vineyards. The effect of grasses as products is the most difficult to calculate in nature protection, as it is highly complicated. This effect may include issues of botany and animal protection, as grasslands occasionally provide living spaces for rare, protected plants and also animals, thus facilitating the sustenance of the widest possible range of biodiversity. The latter two characteristics can only be expressed in terms of tangible values only highly figuratively; we can only determine or calculate theoretical value.

Similarly, the determination of price-value needs thorough circumspection to provide human environment, landscape, to facilitate relaxation, to enhance our human aesthetics in the case of grasses or lawns in home gardens or around residential areas. The basis of value determination is also the cost of establishment, which is subsequently raised by the value of positive externalities calculated in terms of money, such as e.g. the value of spare time spent by the owner of a home garden in a peaceful environment. This can also be expressed in terms of money only highly figuratively, by methods already developed in environmental economics. One of these methods is the method of “travel cost”, when the investigated issues are: how much travel to the nice holiday or recreational area costs and how much the user pays for the time spent there.

The determination of grassland utilization value for sports purposes is also specific, as a massive, dense, homogenous and extremely tramping-resistant, quality grass surface is to be developed. This increases the establishment costs and production costs in itself as the starting prices for the determination of actual economic value. At the same time, the price influencing effect of demand and supply can already be felt in this method of utilization. Consider the case of the cost of purchase for sports fields of equal size and quality in Budapest or Hortobágy, Wimbledon or in the deserts of Mongolia. Naturally, in the event of utilization for sports purposes, the enhanced expenses of maintenance are to be taken into consideration as well.

Figure 2. sums up the cost factors to be considered in the event of certain methods of utilization, *Figure 3.* shows what factors are to be considered when the marketable prices of grasses are calculated.

We have not mentioned the forage value of grass, as this figure is detailed below.

Forms of utilization (1)	Costs of establishment, renewal (2)				Annual cost of maintenance (3)						Ground-rent, taxes (12)
	Material(4)	Personal costs (5)	Service (branch work)(6)	General (7)	Material (4)	Personal (8)	Service (9)	Depreciation (10)	Other (11)	General (7)	
Forage (new, establishment, renewal) (13)	+++	+++	+++	++	+	++	++	+	+	+	+ ?
Forage, own (existing) (14)					+	++	+++	+	+	+	+ ?
Forage for sale (15)					+	++	+++	+	+	+	+
Human aesthetics (16)	+++	+++	+++	+	++	+	++	++	+		
For sporting purposes (17)	+++	+++	+++	+	+++	+++	+++	+++	+	++	
Medicinal effect collection, sale (18)					+	+++	+++	+	+	+	+
Soil protection (19)	+++	+++	+++	++	+	++	++	+	+	+	
Leasing (20)											+++
Sale (21)											+++

Note: the number of + relates to the volume of costs; +++ very high, ++ high, + arising

Figure 2: Costs of grasses in different forms of utilization

Grassland products as the value of forages, definition of value

If grassland products are sold e.g. as hay, they are worth as much the market is ready to pay for this marketable forage. This figure may be higher than the production costs, but it may be lower as well. If producers use their own products as types of forage, their values can be determined in two ways.

1. *Deducting from products:* for non-marketable forages, a solution is when the basis of calculation is the marketable end-product, which has been produced by using the previously-mentioned forage. In other words, the value of grassland is calculated from the produced and sold

volume i.e. from the value of animal products, meat, milk and wool. The value of grassland cannot be determined precisely, but the other expenses in the course of producing a product can be calculated, e.g. those for other forages, wages, dues or accounted depreciation and their costs and prices. Therefore, when this method is applied, first we calculate the costs without grassland expenditures. This calculation is presented on Table 5. Deducting this calculated cost from the return of sales, we get a result which is corrected with the so-called income requirement, from which we get the value or price of grassland deducted from grassland products. It can be expressed in a formula as follows:

Forms of utilization	Value of forage		Value of medicinal effect	Life performance of animals	Estate value	Value of protected area	Subsidy	Human aesthetics, positive externalities	Extra profit	Nature protection
	Non-marketable	Marketable								
Forage for own use	+++		+	++			+			
Forage for sale		+++					+		++	
Human aesthetics					+++			+++		+
For sports					++			+	++	
Medicinal effect, collection, selling			+++				?+		+	
Soil protection						+++	+			+
Leasing					+++		+		++	
Seed-production							+		+++	
Sale					+++		+		++	

Note: the number of + relates to the volume of values; +++ very high, ++ high, + considerable

Figure 3: Factors influencing the value of grasses in different utilization methods

Price and value of grasses = $\hat{A}-TK-J$ where:

- \hat{A} = the return of sales from products (meat, milk, wool) HUF/EUR
- TK = accountable costs of animal husbandry **not affecting** grassland management (HUF/EUR)
- J = expected income need (HUF/EUR)

Table 5: Costs of animal husbandry products without grassland costs

Material costs (1)
Out of this :
– forage costs excluding grass (2)
– energy costs (3)
– material costs of artificial insemination (4)
– medicine, nutrition, premix costs (5)
– costs of used water (6)
– other material costs (7)
Personal type expenses(8)
– wages (9)
– contribution to be paid after wages (10) Divided costs: (11)
– tractor costs (12)
– lorry costs (13)
– service costs (14)
– other divided costs (15)
Accounted depreciation (16)
Other direct costs (17)
General costs (18)
Total costs of animal husbandry excluding grass (19)

The determination of grassland product value deducted from products can be extremely precise, but several problems emerge in relation to the generalization of this value. If this is deducted from other end-products, grassland values can be different. The determination of income need can be calculated on the basis of the user’s subjective decisions. Therefore, the values and prices of grasslands can be different. If grassland value is calculated on the basis of merely a single end-product with constant profit requirement, it approximates the actual market price.

2. Determination of the forage value of grass on the basis of replacement value

Replacement value can be calculated if grasses substitute or supplement other forages. The basis of calculation in this event is the prices of replaced forages, considering their inner content and animals’ nutrient

needs. Logically, the calculation is extremely simple. It answers the question, how much HUF/EUR value of other (marketable) forages grasses can replace or supplement through their inner content. In addition to logical simplicity, the determination is much more complicated, as several elements are to be considered simultaneously. Determination is facilitated by linear programming long time well-known in programming. In an LP model, the following dependent and independent variables are to be taken into account:

- nutrient needs of animals
- nutrient content of forages
- costs and area needs of forages
- biological and technological restricting factors,
- the volume of expectable alternative income,
- the nutrient content of grasses.

All these elements affect the complex economic value of a grass product, for example, hay. The calculation of complex economic value is based on shadow price analysis, Given a normal LP model:

$$\begin{aligned}
 x &\geq 0 \\
 A_1x &\leq b_1 \\
 A_2x &= b_2 \\
 A_3x &\geq b_3 \\
 Z &= \sum_{j=1}^{n_1} x_j p_j \rightarrow \max.
 \end{aligned}$$

The solving matrix is the following:

	x_1	...	x_j	...	x_n	
u_1	a_{11}	...	a_{1j}	...	a_{1n}	b_1
u_2	a_{21}	...	a_{2j}	...	a_{2n}	b_2
\vdots	\vdots		\vdots		\vdots	\vdots
u_i	a_{i1}	...	a_{ij}	...	a_{in}	b_i
\vdots	\vdots		\vdots		\vdots	\vdots
u_m	a_{m1}	...	a_{mj}	...	a_{mn}	b_m
	p_1	...	p_j	...	p_n	z

$p_j > p_1, p_2, \dots, p_n$
 $\frac{b_i}{a_{ij}} > \frac{b_1}{a_{1j}}, \frac{b_2}{a_{2j}}, \dots, \frac{b_m}{a_{mj}}$
 $\tau = a_{ij}$
 $\delta_1 = \frac{a_{1i}}{a_{ij}}, \delta_2 = \frac{a_{2i}}{a_{ij}}, \dots,$
 $\delta_0 = \frac{b_i}{a_{ij}}$

After the first iteration the result is:

	x_1	u_j	x_n	
u_1	$a_{11} - \delta_1 a_{1j}$	$-\tau a_{1j}$	$a_{1n} - \delta_n a_{1j}$	$b_1 - \delta_0 a_{1j}$
u_2	$a_{21} - \delta_1 a_{2j}$	$-\tau a_{2j}$	$a_{2n} - \delta_n a_{2j}$	$b_2 - \delta_0 a_{2j}$
\vdots	\vdots	\vdots	\vdots	\vdots
x_j	δ_1	T	δ_n	δ_0
\vdots	\vdots	\vdots	\vdots	\vdots
u_m	$a_{m1} - \delta_1 a_{mj}$	$-\tau a_{mj}$	$a_{mn} - \delta_n a_{mj}$	$b_m - \delta_0 a_{mj}$
	$p_1 - \delta_1 p_j$	$-\tau p_j$	$p_n - \delta_n p_j$	$z - \delta_0 p_j$

As we can see if the x_j variable inside the basis is x_j , the shadow price of x_n variate can be formulated with the formula of $p_{i-1} - \delta_{i-1} p_j$, or $p_{n-1} - \delta_n p_j$.

Let us assume that after "i" iteration we get the optimum solution and the x_n source (variable) does not get into an optimal structure.

In that case the shadow price of x_n is :

$$p_{n_{i-1}} - \left(\delta_{n_i} \cdot p_{j_{i-1}} \right)$$

It can be formulated where :

p_{ni-1} = after the i-1-iteration the x_n sources' target function

δ_{ni} = after the i iteration the row of the generation element's n-type adequate

p_{ji-1} = after the i-1 iteration the column of generation element's target function

How is the x_n germane shadow price modified if we increase the target function with constant L?

It is unambiguous that x_n germane shadow price also is modified by constant L because its value is directly affected by the original target function:

$$p_n \rightarrow p_n - \delta_n p_j \dots \rightarrow p_{n_{i-1}} - \delta_{n_i} p_{j_{i-1}}$$

$$p_n + L \rightarrow p_n + L - \delta_n p_j \dots \rightarrow p_{n_{i-1}} + L - \delta_{n_i} p_{j_{i-1}}$$

If we choose the dual variable $p_{n_{i-1}} - \delta_{n_i} p_{j_{i-1}}$ to constant L, in that case the shadow price will be equal with 0 (zero) which means an alternative optimum solution.

If the

$$L \geq p_{n_{i-1}} - \delta_{n_i} p_{j_{i-1}}$$

then variable x_n can also get into the basis. Ensuing from this point, it can define the initial x_n germane target function value, which above the variable can get into the optimal structure. Therefore, we can add the shadow price of germane x_n variable to the initial target function.

In animal feeding, the target function of LP models is the minimalization of the cost per area. In such a case, the initial value of the target function and distinction of the shadow price of variables (which are not in the optimal solution) can show us the limit value in under which the variable can get into the optimal structure.

That is to say, an animal fodder which is not in the optimal structure can get into the optimal solution if its initial target function is:

$$p_n - \left(p_{n_{i-1}} - p_{j_{i-1}} \right)$$

less than the above distinction.

It follows that if we want to know the limit price of fodders, the initial target function should be increased to an extremely great value. This means that the fodder has no

chance to get into the optimal solution, which means at the same time that it has a shadow price as well. The limit price can be determined by the distinction of the extremely great value and the shadow price.

The value of target function in a feeding LP model differs depending on cost or area minimalization. In cost minimalization the value of target function is the price of the fodder (Ft/kg, or EUR/kg). In area minimalization, the target function value is the specific area's demand of a fodder. (m²/kg).

The limit price of the grass product is the distinction of the value of target function and its shadow price. The cost effect of a grass product (K_h) shows the distinction of the limit price and factual price (P_{ne}) of a grass product.

$$K_h = \left(p_{n_1} - p_{n_{i-1}} - \delta_{n_i} \cdot p_{j_{i-1}} \right) - p_{n_0}$$

$$K_h = \text{Limit price} - \text{Factual price (cost)}$$

The unit of the K_h is Ft/kg, or EUR/kg. If the value is positive the grass product has a fodder cost reducing impact, if negative, then it has a fodder cost increasing effect. The effect of exemption areas for a grass product is the release value. The release value can be calculated by a similar method as the limit price (cost), namely: the release value (T_h):

$$T_h = p_n - p_{n_{i-1}} - \delta_{n_i} \cdot p_{j_{i-1}}$$

$$T_h = \text{Grass target function value} - \text{Grass shadow price}$$

The only difference compared with the cost effect is the divergence of the target function value, namely, the target function value is the specific area demand of fodders. (P_n unit is m²/kg).

After determining the release value, the economic effect of exemption areas for a grass product can be calculated.

A simple way to get a better understanding is to study an average (expected) income from field crops.

$$T_{ge} = T_h \cdot I$$

where:

T_{ge} = economic effect of exemption areas for a grass product (Ft/kg or EUR/kg)

T_h = release value of a grass product (m²/kg)

I = average field income (Ft/m², or EUR/ m²)

The amount of Complex Economic Value of grassland product is the sum of cost effect and economic effect of exemption areas. (K_{ge_n}):

$$K_{ge_n} = K_h + T_{ge}$$

All these factors are presented in *Figure 4*.

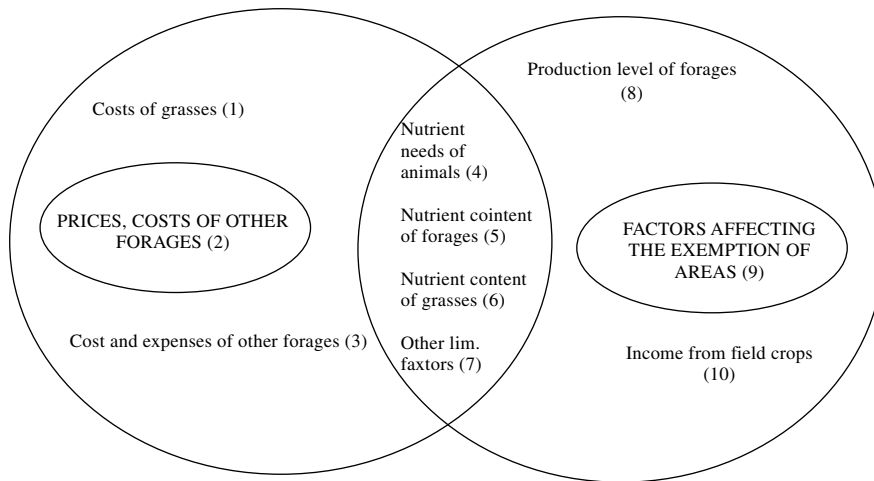


Figure 4: The feeding value of grasses

We present the results of the two model calculations to determine the so-called economic value by the above mentioned method. In the first case, the economic value of grasses was examined in the event of foraging ewes in three age groups, in 5 body mass categories. This is presented in *Figure 5*. It can be clearly seen that the nutrition needs of animals also influence the economic value, which varies in the range of 8.7–9.3 HUF/kg in for ewes. (3–3,5 Eurocent)

The same calculation was performed for the forage portion model of finishing cattle in three body mass categories, taking 5 days' body mass growth into consideration. It can be seen that the **complex economic value** of grasses for grazing varies in the range of 4.8–9.0 HUF/kg in the event of feeding feeder cattle (1,8–3.4 Eurocent) – (*Figure 5*).

The determination using replacement value has its evident advantages and disadvantages as well. Its advantage is that it determines the economic value of grassland products relatively precisely, but for merely in the given

animal species and way of utilization, for which the LP model was developed. Therefore, an exact price for further generalization cannot be determined either, and the economic value can only be expressed in intervals. A further hindrance of the method is that a linear programming model has to be developed, which is a complicated task for farmers in practice.

The animal husbandry value of grassland products

This study has mentioned the way of determining the value of various grassland products and their areas of

utilization several times, and we have demonstrated two methods to determine their foraging value. The question can be raised: is this the single value of grasses in animal husbandry and foraging? The answer “no” has been given earlier as several other value increasing effects can be taken into consideration. They are presented on *Figure 6*.

The animal husbandry value of grasses is determined by the nutritional value of grassland product itself. This is different in the case of green grass, hay, silage, haylage, and straw or grass meal. Generally, it can be concluded that grasses are the cheapest and the most natural forage varieties for ruminants. Their use can replace other main forages to be produced perhaps in plough lands, so the area-exempting effect of grasses has to be considered as well. Focus on the area-releasing effect was presented in the description of LP model (*Figure 4*).

The effective economic benefit of area-exemption is that through a different way of utilization, alternative income can be generated in the saved areas. Hungarian grassland products, which are mostly utilized by foraging, are highly rich in minerals and medicinal plants that improve the

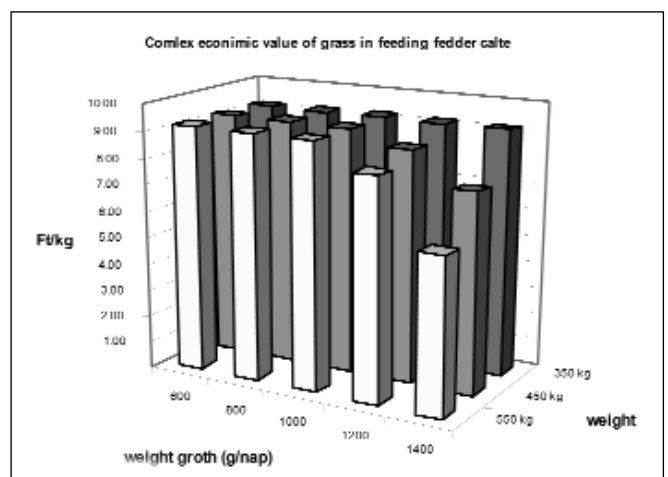
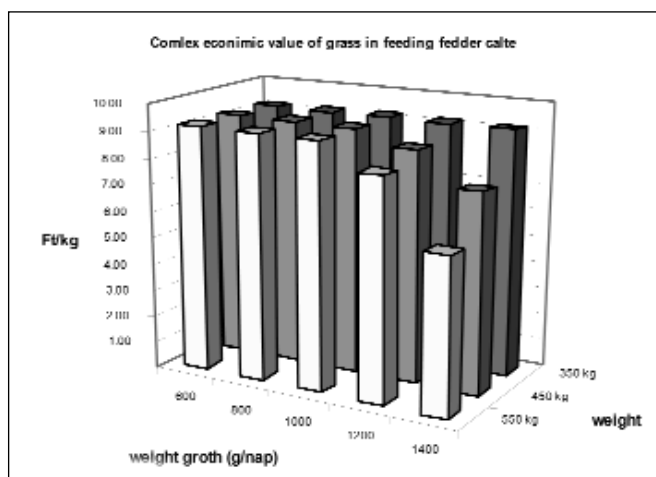


Figure 5: The complex economic value of grasses for grazing in feeding ewes and feeder cattle. (On the basis of Szöllösi's calculations 2004) Feeding ewes (1), weight (2), until 3-month pregnancy (3), until 3 month pregnancy (4), lactating ewes (5), beef cattle (6), weight gain (7)

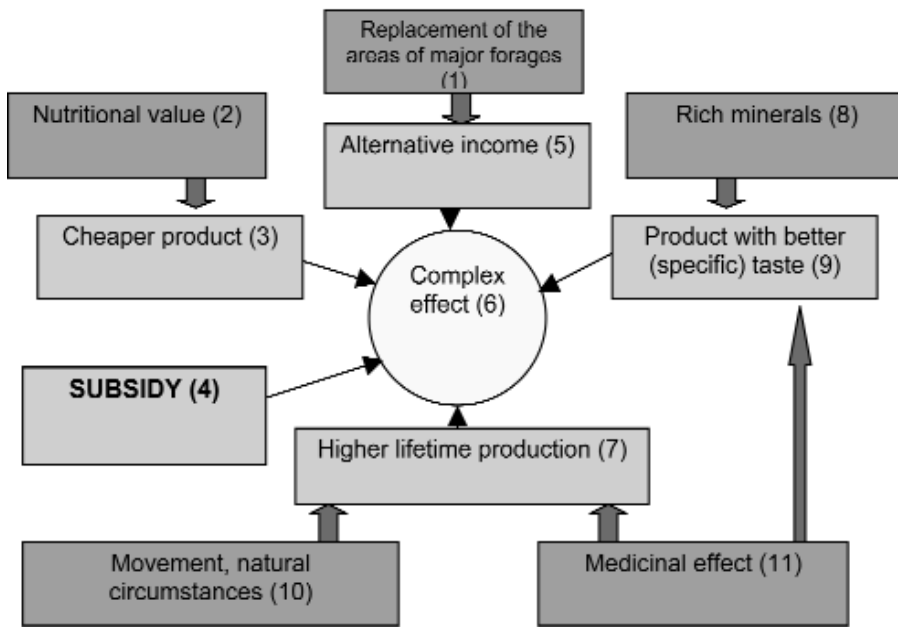


Figure 6: The value of grass in animal husbandry

health of grazing animals, therefore enhance the animals' life performance and the resulting product will become more suitable for human consumption (Stefler-Vinczeffy 1998).

It is also worth mentioning the plant communities that have developed on our natural grasslands, provide nutrition of full value for animals. Therefore, they are cost effective because animals do not need to be fed with separate premixes and additives. A primary advantage of keeping grazing animals is that as a result of movement and natural circumstances, these animals' life performance is greater, and they are healthier. It has double consequences. Greater life performance decreases losses due to selection; moreover, diseases, which abruptly emerge in the event of barn arrangement, do not manifest. When determining the animal husbandry value of grasses, subsidies must be regarded as well. This study highlights merely two forms of subsidy that provide grazing animal farmers with income. The first is the so-called area aid (Single Agricultural Payment System), given to each grassland user (producer or leaseholder) in a simplified method of payment.

Its volume is 68 Euro/ha. The second form of highlighted subsidy is the support invited in the tender of the Agro-Environmental Management Program of the National Agriculture and Rural Development Plan. The agricultural and environmental management measures of grasslands include so-called target programs of grassland management, ecological grassland management and sensitive natural areas. The first target program contains the management of grassland habitats and the transformation of

plough land species into grasslands of multi-species, as a separate subsidized area. Those farmers can participate in the target group of grassland habitat management, who possess a minimum of 1 ha grassland and an animal stock of at least 0.2 animal unit/ha. In the case of grazing, animals can feed for the maximum of ten days in an area, and foraging takes place in the form of herding or periodically. Pesticides and under seeding cannot be applied in these areas, farmers cannot control weeds chemically and cannot fertilize lands, and neither can they irrigate grasslands. If they do not utilize their areas under the grassland habitat program through grazing but mowing, the concerned regulation stipulates that mowing is banned under wet conditions and mowing machines have to be equipped with an alarm chain for games.

The rate of annual subsidy for the participants in this target-program is further 58.82 Euro/ha, which is equivalent to 15.000 HUF/ha. The subsidy rates for grassland management target programs are presented in Table 6.

As was mentioned in the introduction of the present study, the animal husbandry value of grasslands, taking the above mentioned factors into consideration, is wide-ranging, complicated and complex. It is affected by feeding value related to grassland utilization, greater animal life performance, specific end-products due to the rich nutrient supplies of grasses, and last but not least, the effects of provided subsidy as well. On the basis of all these factors, we can draw the conclusion that grasses as forages are worth much more than the value we can characterize by their inner content.

The study highlighted the fact that the survey of certain utilization potentials is far from being complete, although methods to explore them are available. However, several areas of utilization have not yet been explored, so there might be hidden potentials for grassland farmers and professionals of economics to work them out in details.

Table 6: Grassland management target programs

Target program	Subsidy HUF/ha	Subsidy €/ha
B.1. Grassland management target programme		
a) maintenance of grassland habitats	15 000	58.82
b) change from tillage to multi-species grasslands (14)	74 000	290.20
B.2. Ecological grassland management target programme	15 000	58.82
B.3. Grassland management in sensitive area target programmes		
B.3.1. Habitats for great bustard	32 000	125.49
B.3.2. Habitats for corncrake	28 000	109.80
B.3.3. grassland management with development of habitats	25 000	98.04
B.3.4. Establishment of grasslands on sensitive natural areas	75 000	294.12

This study strived to answer three questions. The first was how grasslands and their products can be utilized. The second, how much utilization is worth and the third, how its value could be determined. On the basis of the above mentioned we have answered quite a few questions but there are still some problems to be solved and answered by others.

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