2013 EGF ICELAND

The Role of Grasslands in a Green Future

Threats and Perspectives in Less Favoured Areas

Edited by

Á. Helgadóttir
A. Hopkins

EGF

VOLUME 18
GRASSLAND SCIENCE IN EUROPE

Farming systems in mountain regions of NE Portugal: conversion from conventional production to organic production

Fernández-Núñez E.[1], Moreira N.[2], Cabanas J.[1], Pires J.C.[1], Aguiar C.[1], Bernardo A.[3], Rodrigues M.A.[1] and Pires J.M.[1]
[1] *Mountain Research Centre (CIMO), IPB, Bragança, Portugal*
[2] *School of Agriculture and Veterinary Sciences, UTAD, 5001-801 Vila Real, Portugal*
[3] *Direcção Regional de Agricultura e das Pescas do Norte, Montalegre*
Corresponding author: esther.fernandez@ipb.pt

Abstract

The energy efficiency of a mountain mixed-farming system in NE Portugal was analysed for the period 2002-2003. The energy calculation included the energy of all inputs (fertilizers, fuels, concentrates for cattle) on farm production and the energy of outputs (bovine meat). The energy values were calculated by multiplying the quantities of inputs, indoor system production and outputs by their energy content. The efficiency of the farm (output/input) was 0.12. The results showed a low efficiency of the farm. However, these results were not due to the high inputs required by the farm (as in intensive systems) but it was due to the low use of available feed.

Keywords: agro ecosystems, sustainability, beef cattle

Introduction

The livestock sector has expanded rapidly in recent decades and demand for livestock products is expected to continue to grow strongly through the middle of this century, driven by population growth, rising affluence and urbanization (FAO, 2009). Decisive action is required to satisfy this growth in ways that support society's goals for poverty reduction and food security, environmental sustainability and improved human health (FAO, 2009). The agricultural landscape in the NE of Portugal is characterized by a pattern of small, fragmented farms that traditionally produced food mainly for family consumption. At the beginning of the 20th century, these farming systems integrated agriculture (mainly cultivation of cereals and potato) and livestock grazing into common long-term fallows, stubbles and rangelands, together with the private farm pasture areas. The aim of this study was to evaluate the energy efficiency of a farm in the highlands of NE of Portugal, as representative of the mixed-farming systems in these regions, and also to evaluate its suitability for organic animal production.

Material and methods

The farm was located in Salto, Montalegre region (NE Portugal), and was monitored and studied during 2002-03, recording all activities as well as the inputs, farm production and outputs. The altitude is around 950 m a.s.l., with annual precipitation and annual average temperature of 1455 mm and 9.9°C, respectively. The farm had an area of 35.8 ha divided into 33 fields: *meadows* (15 fields, 22.6 ha) used for grazing and hay cut (spring), *forage* that included maize, rye; and some vegetable gardens (7 fields, 4.15 ha), *shrubs and forest* (9 fields, 7.8 ha) used only for grazing and *chestnut* (2 fields, 1.3 ha). The farm produced beef cattle of the 'Barrosã' local breed with a stocking rate of 0.52 LU ha^{-1}. Livestock total live weight was 8942 kg in the base year 2002. Summer grazing on pasture was for approximately

231 days, about 8 h day^{-1}. Winter grazing was on meadows, and on rye forage. Meadow hay was part of the daily diet of adult cattle from October to April, and of calves throughout the year. Concentrates were also part of the diet of calves from 2-3 months until 6-8 months old, when they were sold. Maize complemented the diet from September to October (38 days). At the end of summer, land was ploughed and sown with rye for forage and part for grain. Farmyard manure was spread on meadows in autumn (28 Mg ha^{-1}), and before planting potatoes (vegetable garden) and sowing maize (forage) (152 Mg ha^{-1}) in spring, together with mineral N, P and K fertilizers. In order to determine the on-farm production (meadows for grazing and hay, rye and maize for forage, shrubs and forests) the following homogeneous areas were identified: two types of hay meadows, two types of grazed shrubs and forests areas, and three types of annual crop areas (for rye, maize and potatoes). In each area three enclosure cages were randomly distributed in all grazed crops. The samples were harvested inside the enclosure cages (0.25 m^2), at the beginning of spring, at the hay cut (June/July), at the end of summer and at the end of autumn. All samples were dried to constant weight at 60ºC (48 h) for yield determination. Maize yields were obtained by sampling (0.25 m^2), at the time of forage cutting during the growing season. All the remaining data were obtained by the farmer. The energy efficiency that describes the relationship between the energy outputs of a system and energy inputs needed to operate the system (Mikkola and Ahokas, 2009) was estimated (Figure 1). The energy values were calculated multiplying the quantities of inputs, productions inside the system and outputs, by the energy content values referred by Gliessman (2007) for fertilizers, farmyard manure and concentrates, by Demarquilly *et al*. (1980) for meadows and forage, by Leme *et al.* (2000) for meat and by Bayliss-Smith (1982) for fuels and machinery (including maintenance). There was no human labour from outside the system.

Results and discussion

From the flow diagram of this system (Figure 1), the following results were found: i) despite being a traditional mixed-farming system (Moreira, 1981), the output of vegetal component in this farm was nil (Figure 1) and therefore the animal component (bovine meat: 9986 MJ) was the only output from the farm; ii) there were reduced inputs, compared with previous studies (Kainz, 2005 and Funes-Monzote *et al*., 2009), and outputs (bovine meat); iii) high importance of farmyard manure inside the system, to which the shrub litter used is indispensable (70-90 t ha^{-1} yr^{-1}); iv) low system efficiency (0.12), as a result of low outputs (only meat), since the inputs cannot be responsible for this value; v) this efficiency is explained by the low stocking rate (0.52 LU ha^{-1}), since it could be raised 2 LU ha^{-1}, the maximum allowed in organic farming; and vi) considering the amount of feed produced inside the system converted into meat using the efficiency of 3% (Spedding, 1979), the system efficiency could potentially be raised up to 1.83, a value near to that obtained by Intxaurrandieta and Arandia (2008) for livestock production in organic farming (2.19). Nevertheless, Spedding (1979) refers an efficiency of 0.18 for bovine meat production systems, when considering all the inputs into the system that applied in this case study.

Conclusions

The low efficiency of the farm is a result of the low stocking rate, which was not adjusted to the farm production (pasture and forage), and to there being no output of crops. The risk of unsustainability of this farm is only due to a low efficiency in the use of the forage and pasture resources. This farm is perfectly suited to organic farming, paying attention to the low inputs and local breed used.

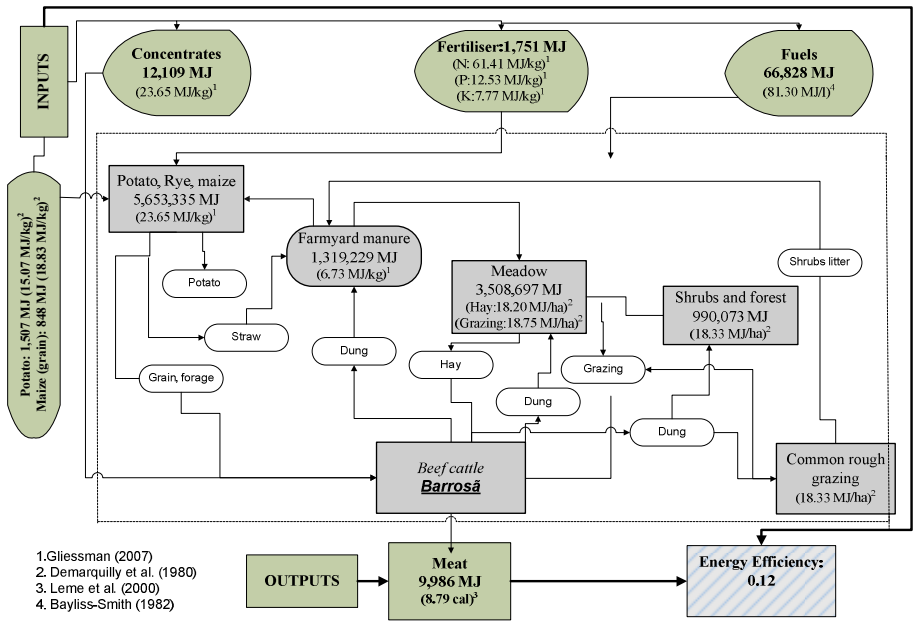

Figure 1. Flow diagram of the farm.

Acknowledgements

The authors would like to thank the farmer, Domingos Ferreira Barroso, for collaboration in this study.

References

Bayliss-Smith T.P. (1982) *The Ecology of Agricultural Systems*. Cambridge University Press, Cambridge, 112 pp.

Demarquilly C., Andrieu J. and Sauvant D. (1980) Tableaux de la valeur nutritive des aliments. In: Actualités Scientifiques et Agronomiques. Ed. INRA, pp. 519-584.

FAO (2009) *Livestock in the Balance. The State of Food and Agriculture*, FAO, Rome, 180 pp.

Funes-Monzote F.R., Monzote M., Lantinga E.A and van Keulen H. (2009) Conversion of specialised dairy farming systems into sustainable mixed farming systems in Cuba. *Environment, Development and Sustainability* 11, 765-783.

Gliessman S.R. (2007) *Agroecology. The Ecology of Sustainable Food Systems*, CRC Press, Boca Raton, London/New York, 384 pp.

Intxaurrandieta J.M. and Arandia A. (2008) Sistemas ganaderos, energía y emisiones. Análisis comparativo de explotaciones de ganadería rumiante en Navarra. III Congreso AERNA.

Kainz M. (2005) Enhancing sustainability by landscape-design and conversion to organic agriculture. In: Kopke U., Niggli U., Neuhoff D., Cornish P., Lockeretz W. and Willer H. (eds) *Research on Sustainable Systems.* 15th IFOAM Organic World Congress IFOAN, Australia, pp. 438-442.

Leme P.R., Lanna D., Henrique W., Alleoni G.F. and Boin C. (2000) Substituição do grão de milho por polpa de citros em vietas com diferentes níveis de concentrado. 2. Taxas de deposição e composição química corporal. *Revista Brasileira de Zootecnia* 29, 3.

Mikkola H.J. and Ahokas J. (2009) Energy ratios in Finnish agricultural production. *Agricultural and Food Science* 18, 332–346.

Spedding C.R. (1979) *An Introduction to Agricultural Systems*, Applied Science Publishers, LDT, Barking, Essex.