The 83rd Annual Conference of the Agricultural Economics Society

Dublin

30th March to 1st April 2009

Labour Management for Profit and Welfare in Extensive Sheep Farming

Kirwan, Susanne[1], Thomson, K.J.[2], Edwards, I.E.[3] and Stott, A.W.[1]

Summary

Sheep welfare is an emerging topic in research and food marketing, and recent studies suggest that farm labour is a key factor for both animal welfare and productivity in extensive sheep farming systems, although little research has been done into labour utilisation in these systems. This paper reports field data collection on two commercial farms and the use of a linear programming (LP) model to link labour economics and animal welfare analysis. The model maximises the number of ewes to clooked after over the lambing period, when constrained by labour availability for various key tasks and by a pre-determined level of sheep welfare. The results show a trade-off between welfare level and labour input per sheep. Dropping tasks with less significant welfare and productivity consequences is an effective way of increasing carrying capacity (from 977 ewes/shepherd to 1428), as is working longer hours (1174 ewes/shepherd) or only doing the legal minimum of welfare checking (labour reduced from 0.68 min/ewe to 0.44 min/ewe) . The field data suggest that farmers currently provide high welfare, and that, despite much time spent away from the flock (e.g. driving), they spend a large amount of time (39% of total) with their sheep.

Keywords: Labour, Sheep, Linear Programming, Animal Welfare

JEL codes: Q10, Q19, Y1

[1] Susanne.Grund@sac.ac.uk / Alistair.Stott@sac.ac.uk Scottish Agricultural College, Kings Buildings, West Mains Road, Edinburgh, EH9 3JG
[2] K.j.thomson@abdn.ac.uk Dept. of Geography & Environment, University of Aberdeen Elphinstone Road, Aberdeen AB24 5UA
[3] I.e.edwards@abdn.ac.uk Institute of Biological and Environmental Sciences, University of Aberdeen, St Machar Drive ,Aberdeen AB24 5UU

Introduction

To remain economically viable, especially after recent and possible future CAP reforms, hill farms have to adapt to changing markets and social expectations as regards farm practices, which include the maintenance of livestock welfare standards. Already there is evidence that farming activity is in steep decline in some hill areas (2008), with consequences for local economies, the environment and animal welfare. Addressing this situation will require careful re-assessment of the efficiency of resources used, chief among which is farm labour (Oglethorpe 2005). However, little information is available on labour use in extensive sheep farming systems in Britain and other extensive sheep systems (e.g. Australia). Without this information, advice on better labour utilisation in such systems is hard to formulate, and farmers are unlikely to respond effectively to change. This paper addresses the problem by examining farm labour utilisation and sheep welfare in some detail, using a combined case study and modelling approach.

Labour usage in extensive hill farms has altered dramatically in recent years, with changes in farming structure and practices, and new technologies ranging from quad bikes to new veterinary products. However, information about labour requirements and usage has not kept pace: what there is, e.g. Nix (2002), provides only average labour requirements per month across all sheep farming systems. Greater understanding is needed of not just how much time is required to operate the relevant farming systems, but how it is deployed at critical times, and what impact that deployment has on business productivity and profit, and on sheep welfare.

The welfare of farmed sheep is an important consideration that is greatly influenced by farm labour management. Even though public concern about extensive sheep welfare is still low compared to that for other livestock species (European Commission 2007;Goddard *et al*. 2006). Animal rights activists have raised arguments in favour of hill sheep farming (CIWF) as well as concerns (e.g. Advocates for Animals). The relative neglect of the topic by animal welfare scientists until now is beginning to be addressed in publications (e.g. Fitzpatrick *et al*.(2005) and new books (e.g. Dwyer (2008).

In extensive sheep farming, labour is one of the main factors impacting on sheep welfare (Goddard et al. 2006;Stott et al. 2005) and lambing is the time of the highest labour demand (Carson et al. 2004;Fisher 2001). Lambing labour has been studied, but typically with a focus more on the welfare of the ewe and lamb rather than the labour implications (Dwyer & Lawrence 2005).This study therefore focused on labour deployment at lambing time; other periods such as gathering, shearing and winter feeding will not be discussed further in this paper.

Labour data can be collected in a variety of ways: directly or indirectly, self-reported or observed, and in real time or afterwards. According to (Burke et al. 2000), the difference in self-reported total times compared to those collected by time-and-motion observation is small. However, the difference in the number of individual tasks reported is very significant, leading to a longer estimated time per task if self-reported. This difference stems mostly from different perceptions of what is considered an activity or task between reporting persons (Burke *et al*. 2000). So, in order to get as close as possible to consistently defined and accurate labour measurement of time and tasks at lambing, direct observation by one observer was chosen.

The objective of this study was to first to identify and quantify labour tasks at lambing for a commercial extensive sheep farm, and then to use these data to construct a LP model which simulates labour use and the resulting carrying capacity of the farm. The simulations are aimed at imitating real farm changes such as increased or decreased labour, changes in concern for welfare, or changes in sheep varieties.

Methods

A pilot study in 2007 was undertaken to prepare for the main field study in 2008, and to determine suitable data recording techniques. This resulted in a list of all tasks observed during that lambing season, and on this list was based the recording and modelling in the following year.
The main field study consisted of lambing visits to two extensive sheep farms, one in Scotland (Farm S) and one in England (Farm E). Each visit lasted ten days during spring 2008. During each of the visits, the entire working day of the farmer was observed with regards to tasks and duration of each task. All data on lambing was classified by task, and the duration of each task was immediately recorded into Microsoft Excel™ via a PDA.

While the individual findings of labour demand per task and percentages of tasks as part of the total labour would have been interesting to study, to answer broader questions about welfare-labour and productivity interactions, not confined to the current situation of the two study farms, a linear programming (LP) model was developed, based mostly on coefficients calculated from the data gathering. In addition, the LP model provided an overview of labour allocation to competing activities on a daily basis throughout lambing. Because modelling all labour tasks separately would have resulted in a very large and inflexible model, the labour activities were grouped into the five classes: (i) fixed and planned or changing with stock numbers; and within the changing by flock size group, planned (ii) and then unplanned and their potential welfare impact - from (iii) prevention of sheep loss, to (iv) lesser welfare impact, to (v) no welfare impact but carried out for other reasons (e.g. management purposes).

The only exogenous data used in the LP model was information relating to birth distributions over the lambing period, taken from the Scottish Agricultural College Hill Sheep Research Farm at Castlelaw.These data were difficult to collect in the study fieldwork, as a large number of ewes lambed unobserved, often in locations hidden from view. The LP was run in a framework based on Microsoft Excel.

The LP model consisted of rows with labour tasks grouped as described above. The labour utilisations of each group were specified on a day-to-day basis for 21 days for ewes and lambsseparately , the number of lambs born each day being calculated from total ewe numbers. Initially, the model was used for a basic verification run, using all figures and coefficients as found on the commercial farms and the birth distributions observed at the SAC research farm. The basic-run results closely simulated the actual flock sizes observed on each farm (see below). Further simulations included varying the levels of welfare and labour input available, as explained below.

Results

The first outcome was the task list from the pilot study, detailing the individual tasks on which labour time is spent during lambing, and the times spent on these tasks. The majority of tasks, with a large proportion f labour used, were taskssuch as driving to and from fields (26% of total working time), preparing materials (6%) or checking for potential lambing problems (22%). Typical welfare-required labour inputs for tasks, such as lambing or mothering up, occupied only 0.7% and 0.25% of the total time worked per day, respectively.

The LP model itself is a result as the construction itself is entirely based on field data without the need for expert evidence. The main output of the model is sheep numbers and labour usages at peak time shown in Table 1. The common factors, derived from fieldwork, of all optimisations shown in Table 1 were the proportion of viable lambs per ewe (0.8), the feeding regime (pasture plus some additional feed), and the availability of two shepherds per flock. The different runs explored different welfare/labour input scenarios. The *basic run* (column (1) in Table 1) used the farm data directly to establish the maximum carrying capacity of the farm, based on total labour availability. On Farm E, the estimated number of 1954 ewes per two shepherds working together ewes matched the actual number of 1700 quite well.

The first set of non-basic simulation runs, Reduced Welfare levels (column(2), reduced in three steps the labour input into welfare-relevant tasks, and calculated the number of ewes that could be kept under these settings given the additional time available. The simulations Different Labour time available (column (3)) used the same settings as the basic run, but with varying amounts of time available to undertake all tasks. A simulation with a Reduced-Labour sheep variety of (column (4)) was the result of reducing by 90% the need (frequency) to mother up and actively lamb ewes without changing other factors in the basic run. The “Legal Minimum” run (column (5)) was the result of reducing ethical regard to unnecessary suffering by carrying out only the legal minimum amount of daily checking; for this scenario only, sheep numbers were fixed and labour time was calculated from these.

Table 1: LP Model Results by Run Specification

	Basic Run	Reduced Welfare Requirement (3 levels)	Different labour time availability (2 lower, 1 higher)	Reduced-labour sheep variety	Minimum legal management only*
	(1)	(2)	(3)	(4)	(5)
Constraint					
Maximum daily labour available (minutes)	660	660	480/600/720	660	660
Checks per day	3	3	3	3	1
Results					

No. of ewes	977	977/992/1428	389/781/1174	1005	977
No. of lambs	910	910/924/1329	362/727/1077	935	910
Daily labour time used (mid-period) (min)	660	660	480/600/720	660	414
Labour time (min) per ewe & lamb(s) **	0.68	0.68/0.67/0.46	1.24/0.77/0.61	0.66	0.42

*For this run, ewe numbers were set and labour demand calculated based on sheep numbers.

Table 1 shows that there is a trade-off between welfare level and labour input per sheep, as can be seen the labour time per sheep/lamb row in column (2). As the level of welfare concern is raised, more sheep can be carried per farm with regard to labour. Dropping tasks with less significant welfare and productivity consequences is an effective way of increasing carrying capacity of labour, as is working longer hours (see column (3)) or only doing the legal minimum of welfare checking (see column(5)). Working shorter hours, as could be caused by moving to part-time farming, increases labour demand per sheep steeply (column (3)).

However, reduced-labour variety sheep (Column (4)) in themselves allow only a small increase in carrying capacity as long as the ewes are managed in the same way as in the basic run apart from checking frequency. The final run, observing only the legal minimum, shows that farmers actually put in a lot more labour than they are required to do, since the basic run has more than double the labour input per sheep.

Discussion

Before modelling, a surprising amount of time was observed to be spent on tasks which the welfare literature (e.g. (Dwyer & Lawrence 2005)) tends to omit (driving, preparing materials etc.) because it focussed more on sheep than humans. The explanation may be that the welfare literature refers to labour starting when a shepherd is with his flock, or heavily emphasises time which shepherds spend directly interacting with sheep.

The maximum sheep-to-shepherd ratio recommended by the Farm Animal Welfare Council (FAWC) is 1000:1, but the modelling shows that theoretically there is room for more sheep than were observed on the study farm. The decision of farmers to keep 1000 or fewer ewes could have a number of reasons, e.g. farm business, labour availability, fodder supply). Any additional time needed – whether through higher sheep numbers or more stringent legal requirements – would risk having inadequate time to deal with emergencies.

Three individual tasks deserve a second look: firstly, times spent driving to and from various fields turned out to be a crucial factor in the time available to look after stock directly. The large amount of time spent with no apparent benefits to the stock, in terms of productivity or welfare, is typical for amalgamated farms that consist of several historic farms with scattered in-bye land, as commonly found in Cumbria, the Peak District and some parts of Scotland. One of the SAC farms part of the and the study farm in the Peak District are examples of this situtaion. While uniting several uneconomic farms may seem like a labour- and cost-effective measure, in the case of the study farm it actually took time away from welfare-relevant tasks and added to fixed labour costs. This study has identified tasks outside the actual time spent with the flock as large consumers of time without welfare or productivity impact of any kind. Despite the large share those tasks have in lambing labour, they are underrepresented in the literature.

Secondly, active lambing only occupies a very small amount of time, so that even an improved reduced-labour sheep variety which reduces the need for assisted lambing will not save the farmer much time. However, such breeds do aid sheep welfare of individual sheep, even if the rest of the system is not changed at all. However, it is safe to assume that the welfare of ewes would be better than the situation in the basic run, because fewer ewes would require lambing aid, given that lambing aid is such a small consumer of time. This change would not be very obvious in the model results because to do so the model would require much more detail on animal welfare, even though it is of paramount importance to an individual sheep requiring assisstance.

Thirdly, a factor with a direct connection between labour time at lambing and throughout the year is the "quality of life" of the ewe. Hill sheep have a good quality of life by being able to express many natural behaviours and facing fewer risks than wild sheep. However, this favourable welfare situation is under threat from labour pressures, and therefore future policy decisions have to be seen from both a welfare and labour impact point of view. Much policy, such as for example the recent castration legislation (Defra 2003), is designed with the individual sheep in mind, disregarding the effect the task has on the welfare of the entire flock. Mandatory tagging regulations (Defra 2009) have little to do with sheep welfare or farm productivity; however, if they come into force in 2011, they will certainly affect sheep welfare and productivity, and should be examined with regard to both aspects of the sector in general.

In summary, it can be said that, based on this small field study, that British extensive sheep farmers tend to spend more labour than makes economic sense but at the same time provide a much higher welfare level than they are legally required to do. There may not be much scope to enhance productivity on the farm level in extensive sheep farming, but this study suggests that there is still scope to make more efficient use of the labour available by changing its allocation between different tasks. The detailed fieldwork of this study highlights labour usage during lambing and potential areas to economise on labour use per ewe.

References

Burke, T. A., McKee, J. R., Wilson, H. C., Donahue, R. M. J., Batenhorst, A. S., & Pathak, D. S. 2000, " A Comparison of Time-and-Motion and Self-Reporting Methods of Work Measurement", *Journal of Nursing Administration*, vol. 30, no. 3, pp. 118-125.

Carson, A. F., Dawson, L. E. R., Irwain, D., & Kilpatrick, D. J. 2004, "The Effect of management system at lambing and flock genetics on lamb output an dlabour requirements on lowland sheep farms.", *Animal*, vol. 78, pp. 439-450.

CIWF. Higher Welfare Alternatives. http://www.ciwf.org.uk . 2009. 8-3-2009.
Ref Type: Electronic Citation

Defra. Code of Recommendations for the Welfare of Livestock - Sheep. www.defra.gov.uk . 2003. 3-3-2009.
Ref Type: Electronic Citation

Defra. Newly negotiated sheep EID rules come into force. www.defra.gov.uk . 2009.
Ref Type: Electronic Citation

Dwyer, C. 2008, *The Welfare of Sheep*, 1 edn, Springer.

Dwyer, C. M. & Lawrence, A. B. 2005, "Frequency and Cost of Human Intervention at Lambing: An Interbreed Comparison.", *The Veterinary Record*, vol. 157, pp. 101-104.

European Commission. Attitudes of EU citizens towards Animal Welfare. Special Euro barometer. European Commission . 2007. 14-6-2008.
Ref Type: Electronic Citation

FAWC 1994, "Report on the Welfare of Sheep", *FAWC Reports* pp. 20-25&29.

Fisher, M. 2001, "New Zealand farmer narratives of the benefits of reduced human intervention during lambing in extensive farming systems.", *Journal of Agricultural and Environmental Ethics*, vol. 16, pp. 77-90.

Fitzpatrick, J., Scott, M., & Nolan, A. 2005, "Assessment of pain and welfare in sheep", *Small Ruminant Research*, vol. 62, no. 55, p. 61.

Goddard, P., Waterhouse, T., Dwyer, C. M., & Stott, A. W. 2006, "The perception of the welfare of sheep in extensive systems.", *Small Ruminant Research*, vol. 62, pp. 215-225.

Nix, J. S. 2002, *Farm Management Pocketbook* University of London, Wye.

Oglethorpe, D. R. 2005, "Livestock Production post CAP reform: implications for the environment", *Animal Science*, vol. 81, pp. 189-192.

SAC - Rural Policy Centre. Farming's Retreat from the Hills. www.sac.ac.uk . 2008. 18-1-0009.
Ref Type: Electronic Citation

Shafford, H. L., Hellyer, P. W., & Turner, A. S. 20000, "Intra-articular lidocaine plus bupivacaine in sheep undergoing stifle arthrotomy.", *Veterinary Anaesthesia and Analgesia*, vol. 31, no. 1, pp. 20-26.

Stott, A. W., Milne, C. E., Goddard, P., & Waterhouse, A. 2005, "Projected effect of alternative management strategies on profit and animal welfare in extensive sheep production systems in Great Britain", *Livestock Production Science*, vol. 91, pp. 161-171.

Turner, J. Silent lambs. www.advocatesforanimals.com . 2004. Advocates for Animals. 11-12-2008.
Ref Type: Electronic Citation