Sheep breeding organisation and recording in Iceland

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ABSTRACT

There are a total of some 710 000 winterfed sheep in Iceland, all of which are of the native Iceland breed. The organisation of the breeding work is in the hands of the Agricultural Society of Iceland. Sheep recording schemes have a long-standing tradition in Iceland. There are 140 local associations recording about 200 000 ewes. The most important traits in Icelandic sheep breeding are fecundity of ewes and weaning weight of lambs, but conformation and wool quantity are also considered. Level of productivity is high. The use of AI is of great importance in the sheep breeding work. Nearly all the selection of lambs for replacement is within flocks and selection work must be undertaken during a few weeks in the autumn when the sheep are taken from mountain grazing.

Keywords Iceland; Iceland sheep; sheep recording; breeding; AI.

INTRODUCTION

As in most other affluent countries agriculture in Iceland has shown a decline in the last decades. Today about 7% of the labour force is engaged in agriculture. The sheep production sector contributes 35 to 40% of the total income of farmers in Iceland. Sheep production is of greater importance in Iceland than it is in other Nordic countries. The number of winterfed sheep is 713 000. In Norway there are 1 000 000 winterfed sheep, 150 000 in Sweden and less than 100 000 in the other Nordic countries.

Over 90% of the sheep production in Iceland is in the hands of farmers who have all their income from farming, but in other Nordic countries much of the sheep production is a part-time farming enterprise. Either all the farm income is derived from sheep or from mixed farming with sheep and dairy production. Specialised sheep farms have a total of 300 to 600 winterfed ewes.

The *per capita* consumption of lamb is greater in Iceland than in any other country (40 to 50 kg). Until recently, 30 to 40% of the sheep meat was exported, mainly to the other Nordic countries, but in the last few years this market has been declining because of increased production in these countries. In the last 5 years there has been a decline in sheep numbers and quota restrictions on the production of individual farmers have been imposed.

THE INDUSTRY

The Sheep Breed

There is only one breed of sheep in Iceland, the native Iceland sheep, which was brought from Norway with the settlers some 1100 years ago. The Iceland breed belongs to the short-tailed North European group of sheep of which related breeds are the Spaelsau (Norway) and the Finnish Landrace.

There have been some imports of sheep from other countries which have resulted in outbreaks of serious diseases. With the importation of Karakul sheep from Germany in 1933, two slow virus diseases (maedi visna and jaagziekte) were introduced into Iceland and these diseases had a major effect on the sheep industry. In eradicating these diseases all sheep in over half the country were slaughtered (Palsson, 1976). The number of sheep in the country was 450 000 in 1950 but since then there has been a steady increase to 900 000 in 1978. From the time of the disease eradication scheme Iceland has been dividied into 22 districts, with transportation of sheep between these districts being banned. All imports of sheep are now prohibited.

The Iceland sheep breed shows a great deal of variation in appearance. There is a substantial diversity in colour (Adalsteinsson, 1970) with 15 to 20% of the sheep being non-white. Some 70% of the total population is horned and the mature weight of ewes and rams is approximately 60 and 90 to 100 kg respectively. The ewes are prolific, early maturing and good milkers. Variation in conformation is greater than in many other sheep breeds. The fleece is a mixture of long, coarse, outercoat fibres and short, fine undercoat fibres, with an average weight of about 2.5 kg.

Sheep Management

The proximity of Iceland to the polar circle affects sheep management practices. Grass grows for only some 4 months of the year and the sheep must be fed indoors for 6 months.

The lambing season is very short, only 3 weeks in May or extending into the first week in June. In summer most of the sheep are released for common grazing on mountain pastures until mid-September. At this time a proportion of the lambs are slaughtered

direct from mountain grazing, but some are grazed on cultivated pastures for 3 to 5 weeks. Lambs are therefore slaughtered at an age of 120 to 150 days. The killing season lasts for one month or less, and the mean carcass weight is 14.0 to 15.5 kg.

A description of the feeding of sheep in Iceland was given by Palsson (1962), and Adalsteinsson (1970) described the recording practices in the mating and lambing seasons.

SHEEP BREEDING STRUCTURE

Breeding Organisation

The organisation of sheep breeding is undertaken by the Agricultural Society as stipulated in the Improvement of Livestock Act (1931), the last revision taking place in 1973. The Agricultural Society is the centre for the agricultural extension service in the country. One or 2 advisers on sheep production work in the Society and they guide the extension work in sheep breeding, feeding and management. The Breeding Council includes the breeding adviser of the Society and 4 local advisers. The organisation and processing of data from the Sheep Recording Associations is in the hands of the Society.

The next step is the District Agricultural Societies, of which there are 15 in the country. Every Society has at least one adviser in agriculture, most of them more, and there are a total of some 30 to 40 local advisers in agriculture. They work on different aspects of agriculture but none of them specialise in sheep.

The base of the sheep breeding organisation is the Sheep Recording Associations. Several farmers in the same locality form a Sheep Recording Association to collaborate on sheep breeding and recording. Each association is responsible for performance recording, and arranging meetings on various matters relating to sheep husbandry. There are 140 such associations in the country.

It is worth nothing that neither breed societies nor flock books have ever existed in Iceland.

Sheep Recording

The first sheep recording association in Iceland was founded in 1940. During the first 25 years, all data processing was by hand and was therefore limited to calculations of flock means for different traits. At this time only a selected proportion of the ewes in the flocks were generally recorded. In the years 1967 to 1970 the recording system was computerised and many different indices were employed. Farmers were encouraged to record all ewes in their flocks, to the extent that over 90% of flocks in the recording scheme presently record all ewes.

Table 1 shows some figures on the development of sheep recording in Iceland during the last 30 years. In the last decade there was a very rapid increase in the number of recorded sheep, mostly from new and bigger flocks joining the recording scheme. This increase must be interpreted as a measure of the popularity of this scheme among farmers. More and more sheep producers realise this as a necessary part of farm control and flock management.

Now about 28% of all ewes in the country are recorded in the sheep recording scheme. This can be compared with 26% of ewes in Norway. Few countries in the world would have more comprehensive sheep recording.

All recording is undertaken by the farmer, which is quite different from the other Nordic countries where specialised staff carry out most of the recording work. The recorded data are sent from the farmer direct to the Agricultural Society for processing. Local advisers assist the farmers on use of the results derived from the records.

The following items are recorded:

- year of birth and tag number of each individual
- pedigree (most animals will have full pedigree information)
- premating, postmating and prelambing live weights of ewes, ram mated to ewe, day of lambing, number of lambs born and reared
- fleece weight
- lamb sex, colour, disposal of lambs, diseases, grazing treatment of lambs in the autumn, autumn weight of lambs, carcass weight and grading of carcasses.

The recording scheme in Iceland puts particular emphasis on lamb carcass weight. The recording of all items is not compulsory, but identification, number of lambs and some weight information for lambs is mandatory. There is no recording of wool quality traits. It is noted that the introduction of new traits for recording is sometimes difficult. Some 8 years ago fleece weight recording was introduced but still only some of the ewes are recorded for this trait.

TABLE 1 Some figures on the progress in the Sheep Recording Associations in Iceland.

Year	Number of flocks	Number of ewes	Lamb carcass weight/ewe	Number of lambs born
1954	831	14413	18.2	1.33
1964	881	33697	20.8	1.47
1974	730	70721	24.1	1.65
1984	1201	197820	23.5	1.64

The major factor determining whether or not a farmer will join the recording scheme is the tagging of lambs at birth, which occurs at the same time as the peak workload on the farm. The State covers the cost of the recording scheme in Iceland, not exceeding NZ$0.50/ewe recorded. This cost restriction may at times have prevented more rapid progress in the recording scheme.

Results from the Recording Scheme

The results from the recording scheme are used by advisers and farmers for both selection and management decisions. It should be emphasised that the management information provided by the recording scheme is of great value for the indoor feeding systems in Iceland. This factor must always be considered in any revisions of the recording scheme in order to attract the interest of the farmers in performance recording work.

Several selection indices are processed in the recording scheme. All calculations of breeding values are done on a within-flock basis. When the index system started, standard correction factors for environmental effects were used for all flocks, but experience showed that this form of correction was not satisfactory. A short description of the form of corrections is as follows.

Number of lambs born is corrected only for the effect of age of ewe. The age effect for young ewes varies greatly from flock to flock and is corrected by the use of factors estimated separately for each flock. Number of lambs born is used in all indices because of a higher heritability than for number of lambs weaned (Jonmundsson, 1977b). Results from extensive Icelandic studies show the heritability of number of lambs born to be 0.15 to 0.20 which is high compared with estimates obtained for other breeds (Hallgrimsson, 1966; Jonmundsson, 1977b). The loss of lambs from birth to weaning is 6%. The percentage of barren ewes is low (1 to 2%).

Some of the corrections of weaning weight are confounded by the different grazing treatment of lambs in many flocks in the autumn. Lambs may either be slaughtered direct from the mountain grazing areas, or grazed on cultivated pastures for some time before slaughter. This often results in 2 quite different groups of lambs. The choice of lambs in these groups varies from flock to flock and from year to year but is often related to some of the other fixed environmental effects (sex, birth/rearing rank, age etc). All calculations are performed within these effects. The greatest effect is that of birth/rearing rank. Correction for single-reared twins is estimated within flocks but for other birth groups that include only a few lambs, standard national correction factors are used. Age-of-dam effects use corrections estimated within flock and age-of-lamb effects by correction factors that are a mixture of within-flock and standard estimates.

Corrections for weight of lambs from hoggets provide some special problems, but these corrections must be estimated within-flock since information from the production records of the hogget is a good indication of her subsequent productivity.

Lamb carcass weight is used in all indices. The carcass weight of lambs retained in the flock for replacement is estimated from their live weights using information on the carcass dressing percentage of lambs in the flock that were slaughtered. A detailed description of the corrections used was reported by Hallgrimsson and Jonmundsson (1979).

The following selection indices are calculated in the Sheep Recording Scheme:

(i) Ram index for slaughter lambs. For all rams which have progeny records, an index for sire of slaughter lambs is calculated using carcass weight, dressing percentage, carcass grade and amount of tan fibre in the wool. Carcass weight is the dominant trait. Every year this index is calculated for 2000 to 2500 one-year-old-rams, since the use of ram lambs for breeding is common in Iceland.

(ii) Ram index for daughter productivity. This index is calculated for all rams that have daughter records and includes prolificacy of daughters and carcass weight of their lambs. The relative weighting for prolificacy is about 70% in this index. There is little selection based on this index, since the ram will first have a useful index at 3 years of age. However, this information is useful in pedigree selection. The ram index for daughter productivity is of great importance for rams selected for use in AI.

A production score for ewes is also calculated. This is meant to be a measure of the maternal ability of the ewe and includes information on lamb weaning weights. The mature live weight of the ewe is also taken into account since the heavier ewe must produce more in order to meet the increased maintenance cost, particularly when the indoor winter feeding costs are as high as they are in Iceland. Information on the prolificacy of the ewe is given as the number of lambings and how often the ewe has lambed 1, 2 or 3 lambs. The reason for not including this trait with the production score in an index is that farmers vary in the relative emphasis they will give to each trait in selection.

For ram lambs used for replacement, indices are calculated which include the same genotypic information as in the ram indices (pedigree information) and the weaning weight of the lamb. These indices are calculated when the ram lambs are selected at 5 months of age.

It has been found that the ram index for daughter productivity works satisfactorily but the ram index for slaughter lambs shows lower accuracy than expected.

Organised Progeny Testing of Rams

Organised progeny testing of rams has been carried out for about 2 decades, but it has not become common

practice in sheep breeding in Iceland (only 100 to 150 rams tested annually). The ram circle system used in Norway has been tried in Iceland, but without success. Rather, progeny testing is performed within flocks by using 6 to 15 ram lambs to produce about 40 progeny each. The traits recorded in this testing, in addition to those recorded in the sheep recording scheme, are information on carcass traits, scores for muscularity in the loin and the legs, and some carcass measurements. These traits are included in an index. Although there is limited use of this test, many of the top rams from this testing programme have an influence through their use by AI. The main reason for the limited use of this progeny testing programme is that the farmers do not consider that the test gives extra information compared with the ram index they get from the sheep recording scheme.

AI in Sheep

The use of artificial insemination (AI) in sheep is a highly important factor in sheep breeding in Iceland and has had a long history in the country. It was started in 1939 as one means of fighting against contagious diseases. From that time AI of sheep has become more widespread, particularly after synchronisation of oestrus of ewes was introduced (Dyrmundsson, 1977).

Three stations for insemination of sheep are run in the country, operating for a fortnight before the normal mating season starts. About 50 rams are used in these stations every year. The use of each ram is variable but the rams in greatest demand are used for more than 2000 inseminations in the season. In the last few years about 25 000 ewes have been inseminated annually, with an average conception rate of about 70%. Trials with the use of frozen semen are in progress but results have been disappointing so far, and the cost/semen dose is much higher than for chilled fresh semen.

The best rams found in the country are selected for use at the AI station but there are very strong veterinary restrictions which affect this selection. Usually only rams tested for productivity of daughters are selected for use, which results in a rather high age of rams kept at the stations (normally 3 to 6 years). Since a very high percentage of lambs sired by AI rams are kept for replacement in the flock, the farmers will not use rams by AI unless they are of proven merit. The rams from the planned progeny testing scheme are therefore valuable for this purpose. Many of the top rams have come from the Hestur Experimental Farm, where planned progeny testing has been running for nearly 30 years with special attention to carcass traits (Thorsteinsson and Bjornsson, 1982).

It is clear that such use of AI in sheep is a very effective way of disseminating genetic merit in the population. At the same time the use of AI creates ties between flocks which should facilitate the use of BLUP methodology for across-flock estimation of breeding values of animals.

Selection

The main stage of selection in sheep breeding in Iceland is when lambs are selected for replacement. This selection must be performed immediately after the lambs come from mountain grazing areas in late September (i.e. at 120 to 150 days of age). The replacement percentage is about 3% for ram lambs and 25% for ewe lambs. Some further selection is done for the rams at one year of age based on progeny test results. Very little voluntary culling is performed on ewes, which are mostly culled for age at 7 to 10 years.

Most of the lamb selection is conducted within flocks, since the genetic differences between flocks in weaning weight has been reported to be of minor importance (Jonmundsson, 1977a). All ewe lambs for replacement will be born within the flock and for rams 70 to 80% will be homebred. Rams are occasionally purchased from other flocks to introduce new strains. Stud breeding is unknown in Iceland and the price of breeding rams has always been very low, only a little higher than their slaughter value.

Emphasis is paid to many traits in the selection of sheep in Iceland and varies widely among farmers. Prolificacy is a trait of major importance for the economy of sheep production. In flocks where the twinning percentage is 85 to 95%, which is common, selection differentials for this trait will often be small. Selection is undertaken for weaning weight in all flocks; however, a strong negative genetic correlation (-0.4) between direct and maternal weaning weight has been found to occur (Jonmundsson, 1981). For a long time, conformation has been important in Icelandic sheep selection, much of it being based on external measurements. There is greater variation and higher heritabilities for many such measurements in the Iceland sheep than for most other sheep breeds. In selection for fleece weight, no measurements are available when the selection must be performed. Wool quality traits are poorly defined except for the incidence of tan fibres which is regarded as a quality fault. This trait has a high heritability and performance selection can easily be applied (Adalsteinsson, 1975). Non-productive traits are usually disregarded in selection decisions.

The selection of ewe lambs for replacement is performed by the farmer. Lambs are drafted at weighing on the basis of the selection indices of the parents, with final selection being based mainly on the recorded weaning weights. In selecting replacement rams a similar procedure is used with 2 to 3 times the number of replacement rams being drafted initially. Final selection is often conducted by the local adviser.

Field days for sheep farmers held by the Agricultural Society are worth mentioning. On these days the farmers bring their rams together for grading (Palsson, 1962). There is little genetic benefit from this grading and in the last few years efforts have been made to change the system by reducing the emphasis

on adult rams and paying greater attention to ram lambs. For the advisory work these field days are, however, a very effective form of spreading information and advice to the farmers.

The use of AI is a form of elite mating, so the replacement rate for lambs by AI sires is very high (70 to 90% for ewe lambs and 50 to 70% for ram lambs).

Information is not available as to the efficiency of selection in the sheep recording associations. When the recording scheme was computerised and selection indices introduced it was found that only 30 to 40% of possible selection differentials for prolificacy and weaning weight were being used (Jonmundsson, 1975). These results were used in the extension work at that time and it is expected that selection is much more effective now.

Estimates of the realised genetic gain in the Icelandic sheep population are not available. The results from the sheep recording scheme shown in Table 1 give a progress of 0.7 to 1.0% in ewe production. Most of this can be attributed to increases in prolificacy but much less from increase in weaning weight. It is likely that much of this is a genetic gain. Some improvement in feeding and management would also have taken place during this period. Factors contributing in an opposite direction include the following: the inclusion of whole-flock recording in recent years instead of only a selected proportion in earlier years, increased grazing pressure because of increased numbers of sheep, and the entry of new flocks with longer recording histories. Two further points should be noted first, this last decade was the coldest in Iceland this century, leading to a considerable reduction in grass production, and secondly, since the introduction of the production quota system many farmers no longer aim for maximum production levels in their flocks.

The Future Development of the Recording Scheme

Forecasting into the future of the sheep industry is difficult. Sheep production is the backbone of farming in many districts of the country. At the same time the industry is faced with market difficulties.

The domestic lamb market will meet increased competition from other types of meat. The quality of the meat is therefore expected to become of increasing importance, particularly reduced fat. This trait must therefore be included in the breeding objectives. The aim is to get carcass weight, carcass grading and fat measurements for each carcass directly from the abattoir. Other traits that should be considered in the breeding objective are fleece weight and easy care traits (e.g. birth difficulties).

The introduction of BLUP evaluations of animals will also be considered. The structure of the data in the recording scheme is such that a considerable gain in accuracy may be expected from the use of this method. The limited computer capacity available for the processing of data from the recording scheme has prevented the use of this method until now.

The use of AI in sheep is expected to be of great importance in sheep breeding in the next few years. The use of reliable methods for across-flock estimation of ram breeding values is therefore highly important.

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