Current trends in lamb production with particular reference to New Zealand

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Information on the production, processing, and marketing of lamb in New Zealand is presented. Consideration is given to new practices such as genetics and animal breeding, nutrition, and flock management that have been introduced in sheep farming to improve production, the acceptability of the product, and to combat rising costs.
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Inligting oor die produksie, verwerking en bemarking van lamsvleis in Nieu-Seeland word aangebied. Aandag word gegee aan nuwe praktyke soos genetika en diereteelt, voeding en kuddebestuur wat by skaapboerdery ingevoer is om produksie, sowel as die aanvaarbaarheid van die produk te verbeter en om stygende kostes te bekamp.
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New Zealand production statistics

In 1982 there were 70,3 million sheep in New Zealand and of these, 50,8 million were breeding ewes. These produced approximately 99% of lambs based on ewes mated and lambs tailed or docked. Of the 50,5 million lambs tailed in 1982, nearly 36 million were slaughtered for export or were consumed in New Zealand (NZMPB, 1983a). This is the highest-ever figure of lamb production in New Zealand.

These lambs were produced on 35 000 farms in virtually every district in New Zealand. They were slaughtered in any one of the 35 licensed lamb and mutton-processing plants and in 1983 lamb was exported to 81 countries. The EEC took 191 027 tonnes in 1983, or 44,7% of the total lamb exports, and the Middle East took 142 856 tonnes, or 33,4%. Among the EEC countries, the United Kingdom took 87,6% of the total lamb exports and among the Middle East countries, Iran was by far the largest importer of New Zealand lamb and took 122 184 tonnes in 1983 or 85,6% of all sendings to the region. In third position was the USSR to which 35 800 tonnes, or 8,4% of total exports, were shipped. In fourth position was North America to which 16 550 tonnes, or 3,9% of total lamb exports were sent (NZMPB, 1983a).

The United Kingdom has been New Zealand's main lamb market since the first shipment of frozen meat left New Zealand on 15 February 1882. That initial cargo comprised some 598 lamb carcasses of a total mass of 10,7 tonnes and 4 311 mutton carcasses that sold for a higher price per pound than the lamb (Barton, 1984). This indicated that a century ago the demand was for mutton rather than lamb.

Trade figures indicate that Iran will this season take a greater tonnage of lamb than Great Britain. This is the first time Britain has not been the main outlet for New Zealand lamb.

Source of New Zealand lambs

The on-farm production of lambs for meat purposes is primarily based on a long-woolled, white-faced breed of ewe which may be mated to a ram of the same breed, or to a Down-type ram of a single-purpose meat type. The predominant ewe breed is the Romney, or to a lesser extent the Coopworth and the Perendale, both developed in New Zealand by interbreeding the cross between the Romney ewe and the Border Leicester ram in the case of the Coopworth and the Romney ewe and the Cheviot ram to produce the Perendale. These two synthetic breeds have a higher fertility than the Romney and they are more easily managed (Dalton, Clarke, Rattray, Kelly & Joyce, 1978).

Because the New Zealand national flock is expanding in numbers, more lambs are born of the breeds involved in the capital ewe flocks, that is, the wool breeds, chiefly the Romney, Perendale or Coopworth. Consequently the castrated male lambs of these breeds and a proportion of cull ewe lambs are slaughtered for export together with both sexes of lambs from the wool-breed ewes, but sired by the various Down breeds. These latter lambs are thicker muscled but a proportion may be more fatty than the straightbred lambs of the wool breeds.

Currently there is a monetary advantage in New Zealand to the farmer to produce straightbred lambs for slaughter of the wool breeds as he is not only paid for the carcass, but also for the wool on the pelt which is often greater in amount than that present on Down-cross lambs. To a large degree this situation determines the emphasis breeders place on wool relative to meat quantity and quality; consequently when wool prices are high the type of lamb being produced in greater volume is leggier and less deeply-fleshed simply because Down sires are not being used extensively. Nevertheless the ratio of prices for wool and lamb meat would need to change considerably before there is a return to placing greater selection pressure on carcass traits.

Types of lambs produced in New Zealand

The average age at slaughter of New Zealand lambs would be approximately 4,5 months, but once the animal is 12 months old, or its carcass is heavier than 25,5 kg, it is not classified as lamb but is allocated to the mutton grades where it attracts a lower price per kilogram.

The mean dressed-carcass mass (with kidneys, and kidney and channel fats removed) of export lamb carcasses is about 13,3 kg with 75–80% of these falling within a narrow mass-range of 3,0 kg about the mean. The mean mass of lamb carcasses exported in the last 12 years has not varied by more than 1,0 kg with a low of 12,9 kg in the 1977/78 season and a high of 13,9 kg in 1975/76.

A new development is the production of B (Beta)-grade lambs. These are lambs slaughtered before 6 weeks of age with carcass masses less than 7,5 kg. About 60 000 carcasses of B-grade lamb were produced last spring and were exported mainly to the Italian 'Abbachio' market.

All lambs for export are graded by employees of the meat-processing companies and their grade standards are checked by Supervising Graders of the New Zealand Meat Producers Board. The Board has statutory authority to determine grades of export carcasses and it undertakes this task in a responsible manner. From time to time grade standards and nomenclature are amended to accommodate not only changing production patterns, but also changing market demands.

The present grades of export lamb segregate carcasses into categories on the basis of fatness (NZMPB, 1983b). To a lesser extent conformation, or shape is also taken into account. There are five fatness categories or grades based on GR measurements: A — almost devoid of fat; YL — up to 6 mm; YM — up to and including 7 mm; PL — over 6 mm and up to and including 12 mm; PM — over 7 mm and up to and including 12 mm; T — over 12 mm and up to and including 15 mm; F — over 15 mm. The GR measurement is taken 11 cm from the midline with the probe inserted to the rib bone. The depth of tissue (mainly fat) at that point determines the grade of the carcass (NZMPB, 1983b).

Most carcasses are not probed, but where the grader wishes to check his subjective appraisal of fat thickness, or in the case of carcasses on the border between one grade and another, he will rely on the probe measurement to determine the grade. In practice he is grading lamb carcasses coming off the dressing chain at the rate of seven a minute so his decisions must be made quickly. Once carcasses are assembled, according to grade, on the 'cooling floor' the senior plant grader checks them and any that are wrongly graded are moved to their appropriate grade.

A waterproof paper tag is attached to one hock of each carcass. This tag has been printed by a computer and contains information specific to the individual carcass, namely, carcass mass, grade, owner of the lamb at slaughter, its carcass serial numbers for the day of slaughter and for the season to date, date and time of slaughter, processing plant identification number, and number of the chain on which the carcass was dressed. Some of these details are needed for payment to the producer, others for the plant management and some are required by importing countries. Not all slaughtering plants have these computer facilities at the carcass grading station, but most will have them in the near future. If a carcass is wrongly graded the details are fed into the computer and a corrected tag is printed and affixed to the carcass.

Consumer preferences for lamb

The pattern of lamb consumption appears to be changing world-wide (Frazer, 1984; Kempster, 1984). In the largest and most sophisticated supermarkets in the northern hemisphere, lamb is now the only red meat sold bone-in and untrimmed of excess fat, especially intermuscular fat. This situation presents a continuing and growing impediment to the sale of lamb, especially of small cuts and joints. The working housewife requires meat that can be prepared for the table quickly; this requirement excludes roasts of legs and shoulders. To fulfil the demand for grilling meats, the butcher cuts as many chops as he can from a lamb carcass, including parts of the leg and shoulder, or indeed the whole of both of them.

A further major problem of lamb is its relatively high fat content. The proportion of fat in the average New Zealand lamb carcass is about 32%; this tissue in the leanest grade is about 20% of the carcass mass, but it is over 35% in carcasses in the heaviest mass-range (Kemp & Barton, 1966). Little precise information is available concerning the fat content that consumers will accept or reject in any of the markets supplied by New Zealand, but it is believed that consumers are demanding less fat; consequently grade standards have been changed recently to meet the assumed need for less fat and to provide a basis by which carcasses having fat levels above specified maxima can be penalized.

Fat in cooked lamb is less acceptable than pork, beef, chicken or turkey fat mostly because its melting point is lower so that the fat tends to solidify in the mouth leaving an unpleasant taste and furriness of the tongue, palate and teeth (Shorland, Czochanska, Barton & Rae, 1967). In addition, most of the flavour of cooked meat arises from the fats. Lamb is unacceptable to many consumers because of its cooking odour and flavour. This is particularly the case if lambs before their slaughter have been eating certain plants, especially white clover (*Trifolium repens*) which is an important botanical component of New Zealand pastures (Cramer, Barton, Shorland & Czochanska, 1967; Barton, 1972). Growth of lambs grazing white clover is significantly better than that of lambs grazing ryegrass (Barton & Ulyatt, 1963).

The need for heavier lamb carcasses

Heavier carcasses with an optimum fat content present better merchandizing opportunities. Their legs are larger and these can be cut in two, thus providing greater mass in the two cuts than would be possible if small legs from 13,3 kg carcasses were similarly cut. (Of all New Zealand lamb carcasses sold in the south of England the legs of 85% of them are cut and sold as two entities.) Alternatively, chump chops can be cut off the leg and sold for grilling or other quick cooking methods. The size of the ribeye of the loin and rack would also be larger and more appealing to the customer if cut from heavier carcasses. The hard-to-sell shoulder (or indeed any cut) could be boned, defatted, and sold in rolls held together by netting or other material. The boning and fat trimming of cuts from light carcasses would, however, be uneconomic in most situations.

There is a strong positive correlation between carcass mass and carcass fat content (Barton & Kirton, 1958). Payments to producers in the past have penalized heavier lamb carcasses because most of them contain more fat than the consumer will tolerate. This is the main reason why New Zealand lambs are lighter at slaughter than those of most other countries. It is now apparent, however, that considerable effort will be needed to encourage the production of heavier lamb carcasses if the New Zealand industry is to remain viable. This is simply because with rising costs of processing, shipping and marketing, only heavier carcasses can carry these costs. Most of these costs are calculated on a per-carcass basis and, accordingly, the heavier the carcass the lower these charges will be per kilogram. It is considered that the New Zealand national lamb carcass mass should increase as quickly as is practical from its present 13,3 kg to about 20 kg (Barton, 1972).

With this background to lamb-meat production, processing and marketing it is now appropriate to consider new practices that have been incorporated in sheepfarming to improve production, the acceptability of the product and to combat rising costs. Some of these procedures are concerned with genetics and animal breeding and others with nutrition and flock management. These will now be dealt with briefly in this paper.

Genetics and animal breeding

Objectives in sheep breeding have been considered by Rae (1982) who indicated that in apparel wool production, clean-fleece mass and average fibre diameter are the two most important traits, while in general-purpose wools fleece mass, good colour, and possibly better bulk are needed. He maintained that reproductive rate is always a most important trait whenever the farming system involves sale of lambs. In specialized meat breeds, increasing growth rate and reducing carcass fatness are the traits of most significance with possibly some attention to limiting lamb mortality (Rae, 1982).

Although wool production and lamb production are closely related and are usually part of the same system, attention here will be focussed on lamb production.

The financial return from a flock of breeding ewes is strongly correlated with the number of lambs produced yearly. If reproductive rate is improved more offspring will be available for selection of replacement animals so that those added to the breeding flock should be of higher genetic merit. The surplus stock — in greater numbers — are available for sale either as breeding animals or for slaughter.

According to Rae (1982), reproductive rate, considered as the number of lambs weaned per ewe exposed to the ram each year, is a complex trait. It is a function of three components: Fertility, fecundity, and lamb survival. A change in reproductive rate may result from changes in any one or combination of these three components or by shortening the interval from one lambing to the next.

The heritability of fertility in the ewe is generally considered to be 10–15%, therefore, fertility should improve slowly if selection pressure is applied to this trait.

In any system of meat production, the number of lambs sold and the price received, will largely determine the financial returns of the producer. If genetic improvement results in more lambs per 100 ewes lambing and these lambs attract a higher price, then the financial returns will be greatly enhanced. This then should be the goal of the lamb producer, but he first needs to know what attributes of the lamb make it valuable to the buyer before he can embark on an improvement programme. Aspects of this have already been considered as far as the consumer of lamb is concerned, but other considerations must also be taken into account, such as wool, body size, and freedom from structural defects. Space does not allow a fuller discussion of these attributes.

Group breeding schemes

In New Zealand the first co-operative sheep-breeding scheme was established in 1967 (Rae, 1976). Further schemes have been developed not only in New Zealand, but in Australia (Peart, 1982), Republic of South Africa (McMaster, 1982), the United Kingdom (Williams, 1982) and in some South American countries (Gamarra & Carpio, 1982). The aim of these group breeding schemes is to bring together from contributing flocks high-performing ewes from which rams are produced (Parker & Rae, 1982). The rams with the highest breeding value are used in the nucleus flock or in the flocks of members of the co-operative breeding group. Other rams may be sold to those outside the scheme.

This breeding programme has demonstrated that genetic improvement for the attributes considered important can be made quite rapidly if selection pressure is applied to these traits. Ewe fertility, lamb weaning mass, hogget fleece mass and live mass are the main traits taken into account in these breeding schemes. More recently, however, selection is also being directed towards breeding for resistance to facial eczema — a disease caused by a fungal toxin present on pastures in some autumns in the warmer regions of New Zealand; grass staggers — another fungal contamination of pasture; footrot because of bacterial infection of the hooves; 'dagginess' because of diarrhoea; and reduced fatness. Not all breeding groups are adding these other traits to their breeding programme, but already those groups which have included one or more of them report that progress is being made. These developments will be of considerable value in lamb production and already commercial producers are showing keen interest in them.

Stud sheep breeders believe they are not in a position to breed for genetic resistance to various diseases partly because their breeding goals are concerned with producing sheep of attractive appearance, but more importantly, their flock sizes are mostly too small to enable effective selection to be employed in the improvement of productive traits, let alone breeding for resistance to disease.

Sheep performance recording (Sheeplan)

Group breeding schemes and pedigree sheep breeders have been helped greatly by the New Zealand national flock recording scheme (NFRS) established in 1967 and modified and expanded in 1976 to become the programme now known as Sheeplan (Daniell & Callow, 1982). The following measurements of productivity are incorporated in Sheeplan: Number of lambs born or reared; lamb weaning mass; hogget live mass obtained in the autumn when the young sheep are 4–8 months old, or a mass in the winter when the sheep are 8–12 months old, or in the spring when they are 12–15 months old; hogget fleece mass when the animal is 10–15 months old; hogget clean-scoured fleece yield; fibre diameter; and colour (from laboratory testing).

Number of lambs born must be recorded by all members of Sheeplan. This makes it possible for information on the dam concerning number of lambs born to be used for genetic assessment of the progeny, especially the ram progeny. The keeping of records on the sire of each lamb makes it possible to analyse half-sister and sire-progeny information.

In the case of flocks of the prime-lamb sire breeds, a common option in the Sheeplan programme includes the number of lambs born, weaning mass, and an autumn live mass.

Very recently, members of Sheeplan have been able to have their sheep probed ultrasonically for depth of subcutaneous fat over the 13th rib (Purchas & Beach, 1981; Purchas, Rae & Barton, 1982). This technique provides information on the fat status of the animal and is part of the project to reduce fat levels in New Zealand export lamb carcasses.

Management practices in lamb production

In most sheep-raising countries, sheep and lambs graze pasture the whole year round or are provided with supplementary feed in seasons of pasture shortage. In extreme conditions sheep may be fed indoors in the winter and early spring. Ewes in most countries produce lambs in the spring, but in South Africa and Australia, for instance, lambing may occur in the autumn as well as in the spring. Most breeds of sheep mate only in autumn; however, the Merino, Dorset Horn, Poll Dorset, and a limited number of other breeds, will mate at various times of the year. In New Zealand, essentially all ewes are exposed to the ram in the autumn only. The spring-born lambs are available for slaughter about 3 months after their birth, but in practice lambs, in decreasing numbers, will be slaughtered through to the following spring. The peak killing months are December and January with poor continuity through the autumn and winter. Processing plants achieve their full capacity for only a few weeks under these circumstances and then their production falls to low levels.

Enormous resources of money and plant are involved to provide a slaughtering facility capable of meeting peak demand and this naturally adds to the costs of processing livestock. Some debate has continued over this important question of seasonality in the meat industry, but little of a constructive nature has emerged, largely because of the complexity of the issues involved. Furthermore, the value of a lamb carcass to the New Zealand producer is relatively small and consequently costs of production must be kept low if the lamb-production enterprise is to be economically viable. This situation largely precludes the use of expensive feedstuffs and housing to maintain and finish lambs through the late autumn and winter. Nevertheless some effort is being directed towards alleviating the worst aspects of seasonality of animal production from pasture. A wide-ranging review of aspects of this problem has been undertaken by Taylor (1982).

One approach has been to lengthen the growing season of pasture so that the winter low-production period is shortened. This can be achieved by fertilizing (topdressing) the pasture in the winter with nitrogeneous fertilizers. Although this is a relatively expensive procedure it has application under certain circumstances. Mob-grazing of pastures when ewes do not have lambs with them ensures that all herbage is eaten quickly and the sward grazed uniformly. This technique also has beneficial effects on pasture growth resulting from hoof action that consolidates the soil and thickens the sward, thereby encouraging the growth of more productive species and the elimination of those grasses, clovers and weeds that cannot survive grazing pressure. In addition, large mobs of sheep grazing a confined area spread fairly evenly their urine and faeces so that soil fertility is improved and greater pasture growth over a longer period of time each year is the outcome. This then leads to more lambs being produced per unit area and the growth rate of these lambs should be better because of improved nutrition of their dams and the lambs themselves after weaning.

Smaller paddock or field size has also been demonstrated to have desirable effects on lamb production mainly through better utilization of the herbage grown. Controlled grazing enables the farmer to adjust the feed intake of his stock from month to month or day to day depending on the requirements of the sheep in terms of physiological need. Surplus grass can be 'stored' *in situ* until the animals have a need for it at physiologically critical times such as shortly before lambing or prior to the beginning of the mating season.

Live mass at mating

The live mass of ewes at mating influences their fertility levels. In general, the heavier the ewes are at mating the more lambs they will produce. It was shown by Coop (1962) that for a 4,5 kg increase in live mass there will be a 6% increase in twinning. Twinning increases linearly with increasing live mass of the ewe at least up to 70 kg.

Ram to ewe ratios

The sheep industry in New Zealand has normally allowed for two to three rams per 100 ewes at mating. Studies by Allison (1975) have shown that when ram to ewe ratios from 1–50 to 1–210 have been used there have been no large differences between the percentage of ewes mated in the first cycle, returns to service, barrenness or twinning. Field-trial results suggest that at least double the usual (1–50) ratio can be joined successfully with groups of rams without loss of fertility.

Other techniques of modifying reproductive performance

Apart from the influence of ewe live mass and the ratio of ram to ewes at joining there are a number of other procedures that can be used to modify reproductive performance. These techniques include induction and synchronization of oestrus, better nutrition of ewes and rams, time of mating, stimulation of ovulation, and increase in ovulation rate by the use of gonadotropins, artificial insemination, natural mating procedures, and reduction in perinatal lamb losses by provision of shelter and improved nutrition in late pregnancy especially of ewes carrying two or more foetuses. These and other aspects of improving reproductive performance of sheep have been reviewed by Allison (1982).

Some procedures that may modify lamb carcass composition and quality

Emphasis throughout this paper has been on the need to reduce fat levels and increase lamb carcass mass. Ways of achieving this have been considered, but a number of other procedures and influences should be mentioned because of their relevance to the scope of the present paper.

Kirton (1983) has reviewed much of the literature relating to management items affecting lamb production which are under the control of the farmer. These include such factors as carcass mass, age and maturity, nutrition, stocking rate, non-castration of male lambs and other sex effects, hormones and other anabolic agents, rotational grazing, early weaning, and various additional environmental considerations that are known to influence carcass quality, composition and mass. He concluded that there is clearly no one simple management practice that is likely to result in lambs of desirable carcass composition. There are, he maintained, a number of practices, that if applied in combination, can move carcass size and composition in the desired direction.

Of the short-term management practices available to reduce carcass fatness, increasing the stock rate will reduce the fat levels of the lambs and increase the quantity of meat production per unit area of land. If twinning is increased there will be a reduction in the amount of fat in carcasses of twin lambs and there will be an increase in the meat production per ewe raising twins. Increased stocking rate and more twins raised will usually result in a reduction in carcass mass.

If ram lambs are left entire they will likely be heavier and less fatty than wether lambs (their half-brothers) and especially so in comparison with ewe lambs (their half-sisters) raised in the same environment. (See Purchas, 1978; Kirton, Clarke & Hickey, 1982.)

By using breeds of rams of larger mature size the progeny will be less fatty and will have heavier mass at slaughter (*cf* Kempster, Cuthbertson & Harrington, 1982; Kirton, 1983). However, there is considerable variation within breeds for most traits including body composition and mass and, accordingly, the 'best' animals within a breed may perform better genetically than average to poorer rams in the preferred breed.

An interesting influence of a plant species on carcass composition of lambs grazing it has been reported by Purchas & Keogh (1984). They conducted several trials involving comparisons between white clover (*Trifolium repens L.*) and a tetraploid lotus (*Lotus pedunculatus Cav.*). Lambs which grazed lotus were less fat than lambs of the same mass that grazed white clover. Purchas & Keogh (1984) explained this result on the basis that the protein of lotus is to some extent protected by tannins from rumen degradation, thus effectively increasing the protein content of lotus available to the animal. A diet high in protein is known to decrease fatness of lambs (Ørskov, McDonald, Grubb & Pennie, 1976).

Parker & Pope (1983) in their appraisal of the past 25 years in sheep production in the US have reviewed much of the literature of pertinence to the American scene. They concluded their paper by considering future research for the sheep industry and maintained that '. . . A greater overall input (of research) will be required during the next 25 years than has existed in the past if the sheep industry is to achieve its potential value for food and fiber production in the United States'. The same conclusion is almost certainly valid for the other sheep-producing countries including New Zealand.

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