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CHAPTER 1. THE SHEEP MEAT INDUSTRY

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Introduction

Grain is used in a variety of lamb finishing systems ranging from intensive indoor feedlots, where it is the main source of nutrition, to supplementation in paddocks where it may be targeting specific deficiencies in the lamb's diet, for example lambs on cereal stubbles may be supplemented with lupin grain to provide protein. The level of inputs and outputs vary depending on the intensity of the enterprise. The existence of a wide range of systems throughout the sheep meat industry demonstrates that many different finishing systems are perceived to be profitable. Profitability is dependent on the costs and efficiencies associated with production. Costs change depending on the economic environment but if the biological parameters have been established, an economic environment can be overlaid to predict the profitability. This review discusses the current specifications and requirements of the sheep meat industry and assesses the biological performance of lambs and sheep that are grown for slaughter using grain feeding systems.

Development of the sheep meat industry

Australia is one of the world's major producers of sheep meat contributing around 10 per cent of the world's total lamb and mutton production. In 2000, over 16.3 million sheep (mutton) and 18.4 million lambs (lamb) were slaughtered for a total sheep meat production of 710,000 tonnes carcase weight (ABARE 2001a). The production of 365,000 tonnes of lamb was slightly higher than the 345,000 tonnes of mutton. The major market for lamb is the domestic market which in the year 2000 consumed about 65 per cent of all production. In comparison with this, almost 70 per cent of mutton produced was exported (MLA 2003). Meat and Livestock Australia (MLA) reported that lamb consumption in Australia in 2001 was 11.7 kg/head and mutton 5.3 kg/head (MLA 2003).

Lamb production has increased markedly since 1980 to current levels (Figure 1.1). This additional product has been mainly destined for export, domestic consumption of lamb having remained relatively constant over the period. The proportion of lamb exported has risen from around 15 per cent in 1980 to over 30 per cent in 2000 (ABARE 2001a).

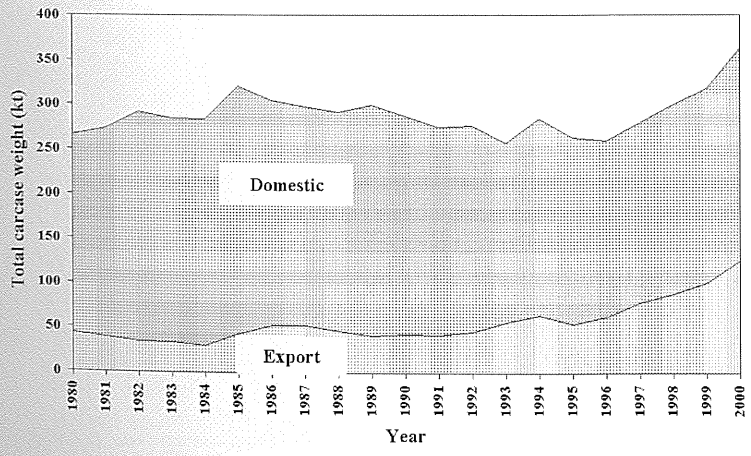

Figure 1.1. Domestic and export consumption of Australian lamb from 1980 to 2000 (ABARE 2001a).

The Australian lamb industry has undergone major changes particularly in the last 10 years. During this time the profitability of wool declined and as a result, more emphasis was placed on meat production. Changes in the lamb industry have been largely driven by consumers, particularly in the market for lambs. Consumers have become more demanding in terms of their requirements for a more consistent high quality product, especially one that is lower in fat content. This demand was recognised in the early 1990s when a coordinated national program was devised in response to the decline in domestic consumption of sheep meat and to stimulate exports (Thatcher 1992). This was known as the 'Elite Lamb Program' and was based on the production of heavier, leaner lambs. The Elite Lamb Program initially set specifications of 18-26 kg carcase weight and fat score 2-3 but with development, efforts concentrated on weights above 22 kg and GR fat measurement[1] 6-15 mm (McLaughlin 1992).

Current specifications and requirements

The Elite Lamb specifications for larger, leaner lambs represented a major advance in directing production requirements that better matched consumer expectation. Today's markets also demand the continuous availability of a product that is of consistently high eating quality.

Large, lean lambs

Specifications for carcase weight and fatness may differ from place to place and from time to time within the domestic market and also between different export markets. Davis (2003) has categorised the market specifications for lamb in Victoria and these are summarised in Figure 1.2.

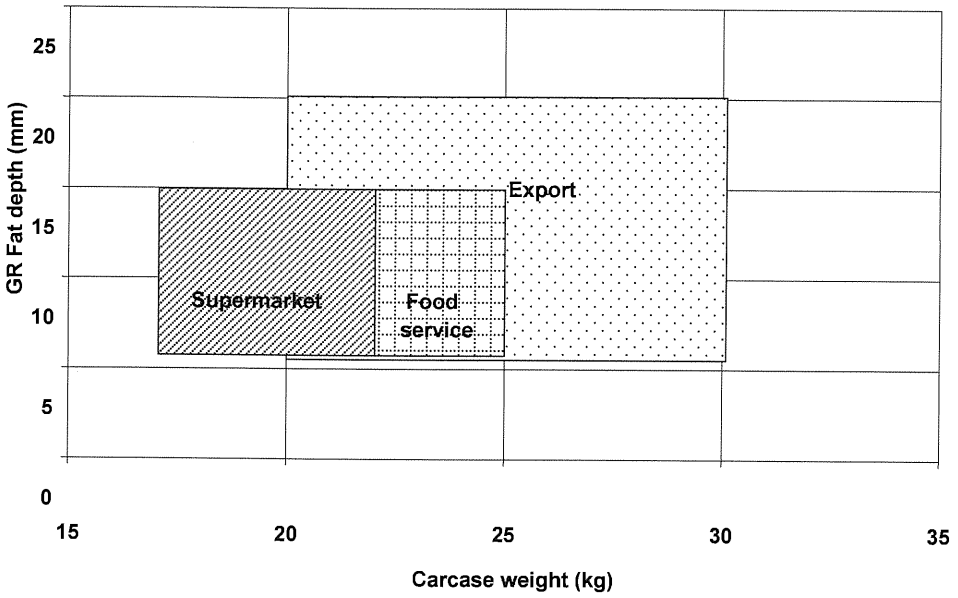

Figure 1.2. Typical market specifications for lamb.

[1] Fat scores refer to the soft tissue depth at the GR site which is at the 12th rib and 110 mm laterally from the spinous processes of the vertebral column over the epaxial musculature [Nugent, T. (2002). 'Practice makes perfect in fat scoring lambs'. *Farming Ahead*, No. 100, pp. 50-51.].

Carcase weight

Hall *et al.* (2000) noted an increase in the average carcase weight of Australian lamb from 17.5 to 19.5 kg between 1990 and 1999, while Shands *et al.* (2002) reported that the average weight of lamb carcases increased by 3 kg between 1990 and 2002. Australian Bureau of Agricultural and Resource Economics (ABARE) statistics indicate that while the average weight of lamb carcases has increased from 16.6 kg in 1980 to 19.9 kg in 2000, the rate of increase has accelerated with over half the increase taking place since 1995 when the average was 17.9 kg (ABARE 2001a). It appears that the trend towards increasing carcase weight is gathering pace.

Fatness

As well as a demand for heavier carcases there has also been a demand for leaner carcases. Price grids used as the basis for trading generally reflect the demand for leaner carcases with highest prices being paid for carcases in the fat score 2-3 range or 6-15 mm GR tissue depth measurement. Hall *et al.* (2000) observed that despite an increase in carcase weight there had been a simultaneous reduction in fat levels in the order of 10-20 per cent. This has created a need to change production systems as the easy solution to provide heavier carcases is to feed animals for longer periods to achieve extra weight targets. However this would result in increasing fatness which is contrary to market demands. White *et al.* (2002) studied relationships between carcase weight and fat depth (GR) measurement in a domestic abattoir in alliance and industry lambs. They found that there was an increase in fat depth of 1 mm for every kilogram increase in carcase weight. At any given carcase weight the alliance lambs were about 2 mm fatter than the industry lambs, which they attributed to differences in genotype and production system. These workers also noted some variation in the fatness at different times of the year after adjusting to equal weight. These variations were attributed to factors such as time of lambing and seasonal pasture growth patterns.

Other carcase specifications

While carcase weight and fatness are the main criteria for determining suitability of lamb for different markets there are others that may be more or less important. Hopkins (1995) attempted to determine the impact of carcase characteristics on retail value by studying assessments made by wholesalers and retailers of carcases with a range in carcase weight, fatness, conformation and fat distribution. There were clear indications that characteristics other than weight and fatness influenced the assessment of value. Meat colour was used although its relative importance varied between assessors. Conformation was a consistent factor considered and when carcases were subjectively valued there was a clear preference for carcases with hind legs that had a muscular 'U' shape rather than an angular 'V' shape. This accords with some industry practices that carcases are graded or visually assessed for quality even if they do meet specifications for weight and fatness.

Meeting weight and fatness specifications

Pirlot *et al.* (1992) did a study in Tasmania in the early stages of the Elite Lamb Program (November 1989-October 1990) of the number of carcases that would meet specifications of 22-26 kg and fat score 2-3. Of the 108,028 lamb carcases that were included in the survey, only 626 met the Elite Lamb specifications (< 0.5%) and only 5095 (4.7%) were within the weight range. Pirlot *et al.* (1992) noted a tendency for heavier carcases to be over-fat and suggested strategies such as producing induced cryptorchids at lamb marking (short scrotum ram lambs). They also suggested a move toward direct sales, because the saleyard system appeared to favour fatter lambs.

In order to comply with the requirement for heavier carcase weight and lower fatness, industry has made use of the LAMBPLAN breeding system to identify genetic material that can more closely match the specifications of the market (Banks 2000). LAMBPLAN allows selection of animals with more desirable traits for growth rate, fat depth and eye muscle

depth. This enables shifting of weights to higher levels while restricting and even reducing fatness levels. Another way of achieving this shift is by using crossbreeds with later maturing characteristics (sheep which fatten at heavier weights).

Hall and Holst (1992) suggested the use of breeds differing in their fattening characteristics, variation in type within breed as well as manipulation of sex differences to increase the proportion of lambs that met specifications. They reported the results of an experiment in southern New South Wales which showed that the proportion of lambs meeting Elite Lamb specifications varied according to sire and sex. They found that while only 6 per cent of lambs from ewes sired by rams with a relatively poor lean growth LAMBPLAN index met specifications, 64 per cent of cryptorchids from ewes sired by rams with a relatively high index for lean growth met specifications.

Because factors such as variation in birth date and growth rate increase the difficulty of producing even lines of lambs that meet specifications, Ferrier *et al.* (1995) recognised the desirability of an ability to manipulate composition by nutritional means and studied the effects of a variety of growth paths. These authors, along with Hall *et al.* (2001) found that carcase fatness could be reduced by restricting the rate of growth.

Producers wishing to change from their traditional pasture-based system and target heavyweight lambs may need to adopt grain supplementation systems or finishing strategies. In this situation, the pasture may not sustain adequate growth for the time required to achieve heavier target weights. For example, Moore *et al.* (1993) modelled the forage required for producing large, lean lambs at several different sites in New South Wales and Victoria over a period of years. At all sites, grain supplementation was needed in most years. In New South Wales at Cowra, there was a 50 per cent probability of a suitable season for producing heavy lambs, and supplementation would be necessary in other years; whilst Glen Innes was more reliable at 75 per cent probability, but grain supplementation at lambing would always be needed.

Grain finishing has emerged as one tool that can be used to meet the nutritional needs of growing lambs when pasture declines in quality and quantity at the end of the growing season. The most extreme shortfall of pasture occurs in poor seasons or drought and in these situations there is a rise in the prevalence of opportunistic feedlotting. Opportunistic feedlotting also occurs when terms of trade are favourable.

Meat quality

Tenderness and flavour

Consumers now expect lamb-eating qualities such as tenderness and flavour to be of a high standard and that these standards will be consistent throughout the year. A survey conducted in Victoria and reported by Hall *et al.* (2000), highlighted the variability in tenderness as measured by shear force, an objective measure of the energy required to shear a standard-sized sample of meat. In response to the demands for greater eating quality, a major program has been developed along similar lines to the Meat Standards Australia program for beef, to investigate factors affecting eating quality and to implement a system that will guarantee eating characteristics. Good eating quality has been related to plane of nutrition in finishing lambs (Pethick *et al.* 2000).

Meat colour

Another aspect of quality relates to the visual appeal of the meat and in particular, meat colour. Unappealing meat colour or dark, firm and dry (DFD) meat has been shown to be a significant problem in lamb. The condition is closely linked to muscle glycogen levels at the time of slaughter. Low glycogen levels in meat result in meat with high pH (above 5.7) and a dark, firm and dry (DFD) appearance that is rejected by consumers. DFD also presents problems in cooking and shelf life. The incidence of DFD in lambs processed by a leading Western Australian processor was estimated at around 30 per cent (D.W. Pethick 2003,

pers. comm.). Pethick also carried out two studies in which pH was measured in the semimembranosus and semitendinosus muscle of lambs. He reported that 29 per cent of carcases had pH levels above 5.7 in the semimembranosus muscle and 87 per cent in the semitendinosus muscle in one study and 45 per cent and 82 per cent respectively in a second study (D.W. Pethick 2003, pers. comm.). In a retail audit of lamb sold in Sydney, Canberra, Melbourne and Perth, Safari *et al.* (2002) found that 10.3 per cent had a pH above 5.8.

The effects of nutrition were studied by Pethick and Rowe (1996) who fed sheep on 4 levels of intake of a pelleted ration estimated to result in growth rates of 0, 50, 100 and 200 g/day. Muscle glycogen levels measured in the semimembranosus and the semitendinosus muscles by biopsy and following slaughter showed that a significant and linear increase in glycogen levels occurred with increased feed intake. This study highlighted the importance of good nutrition prior to slaughter as a strategy to minimise the occurrence of DFD meat. Short-term grain finishing is one method that producers have adopted to ensure forward growth rate is maintained to maximise glycogen levels in muscle prior to slaughter. While this management strategy has become popular, recent work has shown that eating quality of pasture-finished lambs is equivalent to grain-finished lambs when an adequate growth rate can be maintained (Pethick *et al.* 2002). Grain finishing aimed at optimising meat quality is therefore most relevant at times of the year when pasture or alternative feed sources are not adequate to maintain lamb growth.

Consistent supply

The lamb meat industry requires a consistent, year-round supply of lambs for high value domestic and export markets and to make efficient use of processing facilities. Traditional lamb production systems rely on turnoff of suckers at the end of the growing season so that there is a short period of abundant supply followed by long periods without a supply. This is particularly the case in areas like Western Australia where there is a very seasonal pasture production pattern. The extension of the supply of lambs has been made possible through the use of a greater spread of lambing times and the use of an increasing variety of production systems. While most lambs are finished on pasture, a range of other systems have been developed based on fodder crops, use of feed budgeting and supplementary feeding. Lot feeding has been a further development that enables the supply of lambs to be maintained independently of pasture availability. It is an important management strategy for finishing lambs during the annual autumn feed gap through to early winter in Mediterranean environments such as Western Australia.

Marketing systems

A number of selling systems are available for sheep meat ranging from 'over-the-hooks' sales where price is based on carcase weight and fat specifications, to paddock sales based on price per head. It is generally accepted that over-the-hooks sales are favoured where it is important that carcases meet relatively tight specifications as is increasingly the case with today's lamb markets. Premium prices are paid when the carcase meets specifications and discounts applied to carcases that do not meet specifications. This system has the advantage of providing a guarantee of price where a producer is confident of meeting the specifications and removing the risk to the processor of paying too much for carcases that are of low value. Over-the-hooks or direct sales also provide a mechanism for feedback of carcase and price data that can be used by producers to indicate where improvements can be made in production systems. Despite the advantages of over-the-hooks marketing, a survey reported by ABARE (2001b) showed that auction sales were the dominant sale method for lambs in 1999-2000, accounting for 45 per cent of sales while over-the-hooks and paddock sales were the only other significant methods accounting for 33 per cent and 22 per cent respectively. In New South Wales, over-the-hooks marketing had increased to 40 per cent of sales but recent droughts have affected marketing decisions, reduced carcase weight specifications and tested the loyalty of alliance members to their processor.

The last 10 years have seen the emergence of a number of partnerships or alliances that have been developed in response to the need for a product that meets tight specifications, is consistently in supply and provides guaranteed returns. These alliances generally involve producers, processors and sometimes retailers and can be formal or informal. Formal alliances may have membership fees, a code of practice, well defined target carcase specifications and may brand their product to promote consumer recognition. There are now more than 20 branded lamb alliances throughout Australia and in 2001, more than 10 per cent of all lambs slaughtered were sold through an alliance (Hancock and Stephens 2002). An example is the 'Q Lamb' alliance in Western Australia, which started as a combination of producers and a lamb processor. In the initial stages only about 70 per cent of lambs were hitting weight and fat targets and other qualities were variable (Trefort 2002). However with use of feedback information and close consultation on development of production systems, the success rate has improved dramatically. The introduction of a retail partner and development of the Q Lamb brand appears to have guaranteed continued success of the venture. Similarly the 'Tender Plus' brand, located in northern New South Wales has benefited from the formation of an alliance. Tender Plus is a manufacturer of lamb, beef and smallgoods providing customised portions for the hotel and restaurant trade in Australia and Asia. Tender Plus needed to ensure continuous supply of suitable lamb to meet increased demand and began working with a New South Wales Agriculture Product Development Officer in 2000. An alliance was formed between producers and processor. From an initial kill of < 600 lambs weekly they are now forecasting a demand of 3000 weekly (P.J. Holst 2003, pers. comm.).

Role of grain feeding in sheep meat production

Grain finishing systems in the Australian prime lamb industry

In the 2002 ABARE survey of prime lamb producers, the majority identified pasture as their management strategy for finishing prime lambs for slaughter (Connell *et al.* 2002). The survey showed that 59 per cent of producers used pasture as their main method of finishing lambs, with a further 24 per cent indicating pasture with the use of supplements (Table 1.1). Only 3 per cent of producers nominated feedlotting as their main method of production.

Table 1.1. Main method of finishing lambs for slaughter, by State. Adapted from Connell *et al.* (2002).

State	Grain finishing			Non-grain finishing	
	Feedlotting	Pasture plus supplement	Fodder crops plus supplement	Pasture	Fodder crop
Western Australia	19%	29%	3%	49%	
New South Wales	2%	27%	15%	50%	7%
Victoria	1%	20%	5%	64%	9%
South Australia	1%	22%	4%	72%	1%
Queensland		9%		75%	16%
Tasmania		14%	14%	56%	16%
All States	**3%**	**24%**	**8%**	**59%**	**6%**

Feedlotting was most common in Western Australia, where 19 per cent of prime lamb producers identified it as their main finishing method (Table 1.1). One per cent of prime lamb producers in South Australia and Victoria and 2 per cent in New South Wales used feedlotting. There was no specialist feedlotting of lambs in Queensland or Tasmania.

Supplementation was identified as a key strategy for finishing prime lambs in both pasture and fodder-based systems (Table 1.1). The use of grain in paddock-based feeding systems

is common in most States with a national average of approximately one third of producers using grain and pasture as their predominant method of finishing lambs.

Sheep meat enterprises

Sheep meat enterprises can be classified as:

1. a specialist crossbred prime lamb production system;
2. prime Merino lamb production that exists in conjunction with a wool enterprise; and
3. mature cull animals, predominantly Merino, that are slaughtered for mutton (Dowling and Wiese 2001).

In specialist prime lamb production systems, terminal sires are mated to Merino or Merino-cross ewes with the intention that all progeny will be sold as prime lambs. The focus of these enterprises is the production of meat. In contrast, there are many competing markets for sheep produced in a traditional Merino wool-based system. Sheep can be sold for slaughter as prime lambs, sold for live export as lambs or adult wethers, or retained for breeding and wool production and eventually sold into the mutton market when culled for age or other reasons. Clearly, the focus of Merino-based production systems is not always meat production therefore grain is more likely to be used in lower amounts for strategic supplementation and maintenance feeding.

In a specialist prime lamb production enterprise, the use of grain will depend on the availability of alternative feed resources and specific target market specifications of the enterprise. When cheaper feeds are available, grain is less likely to be used.

Finishing prime lambs

The majority of prime lambs in Australia are finished on pasture or fodder crops (Table 1.1). In areas with a suitably long growing season or in favourable seasons, good management of paddock feed will ensure a high quality, inexpensive source of feed. Grain is a more expensive feed source and while grain-based diets can promote higher growth rates and a better feed conversion ratio than pasture, the economics of various feed sources have to be considered (McClure *et al.* 1994; Notter *et al.* 1991; Pethick *et al.* 2002).

The comparative advantages of different finishing systems change with the economic and climatic environments. During the late 1970s and early 1980s, there was increased interest in intensive feedlots in Australia (Hall and Mulholland 1982). The interest diminished when producers and researchers concluded that there was no benefit from using intensive feeding systems due to problems with adaptation of sheep to the diet and confinement (Hall and Mulholland 1982; Mulholland 1986; Suiter and McDonald 1987). In addition, the profitability was often marginal. However, the consumer pressure placed on the industry for more consistent supply and quality has led to renewed interest in intensive grain feeding. The definition of 'feedlotting' has expanded to include not only intensive indoor or outdoor feedlots, but also finishing systems for animals confined to small paddocks with self-feeders. However, the continued operation of feedlots and other semi-intensive systems is only possible because of the price differentials generated by the demand for high quality consistent product in the marketplace.

Supplementing prime lambs with grain

The role of grain feeding in backgrounding[2] or growing strategies for prime lambs varies in different regions of Australia. In most cases only a portion of the lamb crop will need supplementation because the early-born, single lambs usually attain marketable weights within the forage growth season. Key influences determining the extent of supplementary grain use are the local climate and associated growing season, the availability of alternative feed resources and the availability of irrigation. Grain is used as a supplement in a wide variety of paddock-based feeding systems including stubbles, dry pastures and fodder crops. Grain is more expensive than the basal feed source in these feeding systems so strategic supplementation is used to achieve the growth rate required to reach the target market.

When supplements are offered to grazing animals, in principle the intake of basal feed can either stay the same (supplementation), increase (complementation) or decrease (substitution). Ideally, the intake of basal feed will remain the same so the full benefit of additional protein and energy supplied by the supplement can be realised, but in practice this rarely occurs. When feeding for production as opposed to maintenance, using increased quality and quantity of supplements, the substitution rate is likely to be greater (Dove 2002). The challenge in simple paddock-based grain feeding systems is to maximise the use of all feed resources by achieving complementation and/or minimising substitution.

Finishing older sheep

Mutton is a significant industry, representing around 50 per cent of the annual sheep meat production in Australia (Meat and Livestock Australia 2002). Sheep slaughtered for mutton are predominantly culled Merino animals sold either through saleyards, direct paddock sales or consignment to an abattoir (Dowling and Wiese 2001). The carcase requirements of the mutton industry can generally be met by extensive grazing systems but grain supplementation may be required to finish animals during seasonal feed gaps. Although intensive feeding does not result in economic feed conversion ratios, producers who have established a feedlot for finishing lambs may also use this area to finish older sheep for sale or slaughter (Bryant and Kirby, refer appendix). Despite the apparent inefficiencies of using grain for finishing cull animals, this strategy creates a wide range of benefits and options for producers (Gulbransen 1990). Strategic finishing of cull animals can be a profitable enterprise due to benefits such as the increased price per kilogram for a better finish, reduced grazing pressure, accelerated disposal of cull animals, earlier cash-flow and out-of-season production.

The relative price commanded by lamb and mutton reflect the fact that eating quality of meat declines as sheep age (Pethick *et al.* 2003). Recent research by Wiese *et al.* (2000) and Pethick *et al.* (2003) has demonstrated that criteria for the current AUS-MEAT Ltd. dentition categories for sheep meat (lamb - 0 permanent incisors, hogget or yearling mutton - 1 to 2 permanent incisors, mutton - 1 to 8 permanent incisors) do not necessarily correlate with meat eating quality. Therefore it may be advantageous for the Australian sheep meat industry to consider alternative classifications. An increased role for grain feeding of older sheep could arise if a niche market for larger, older carcases developed and price premiums were offered for high quality sheep in this age category.

[2] Backgrounding is the system of preparing weaners on a property for entry into a feedlot at the correct body weight and already adapted to a grain diet. Sheep are grown at a slower rate in comparison to finishing growth rates for a reduced cost. Animals are normally introduced to trough feeding (e.g. containing grain and hay) and become used to confinement in small paddocks/yards and human handlers.

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