

# A Nuffield Farming Scholarships Trust Report

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Red meat carcass payment: are there better systems than the EUROP grid?

**Keith Williams** 

July 2014



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# A Nuffield (UK) Farming Scholarships Trust Report



Date of report: July 2014

*"Leading positive change in agriculture.* Inspiring passion and potential in people."

Title	Red meat carcass payment: are there better systems than the EUROP grid?			
Scholar	Keith Williams			
Sponsor	Royal Welsh Agricultural Society			
Objectives of Study Tour	To look at other red meat classification systems to see if it is possible to implement a more accurate carcass assessment and payment system in the United Kingdom.			
Countries Visited	Ireland, Australia, New Zealand, America and around the UK.			
Findings	• The EUROP grid does not assess saleable meat yield.			
	• An objective mechanical system of carcass classification removes the subjective human element.			
	• Need to reward the more efficient carcass.			
	• The bonus system of the EUROP grid is to the detriment of animal welfare at lambing and calving.			
	• Need to educate farmers that they are producers of food.			
	• Need to educate consumers that not all fat is bad and how to get the best from quality meat.			

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#### DISCLAIMER

The opinions expressed in this report are my own and not necessarily those of the Nuffield Farming Scholarships Trust, or of my sponsor, or of any other sponsoring body.

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# 1. Introduction

#### 1a. My background



#### Me, Keith Williams

I am a beef and sheep farmer from the hills of mid Wales. I farm "The Hendy" with my wife and family; it is a 380 acre family farm. The Hendy has been in my family since 1902. It was taken over by my father in 1952, and I, the youngest of five children, took over from my parents in 2001. I attended a small local primary school called Franksbridge CP School which had a total attendance of around 40 children in the whole school, not per class. I then went on to Builth Wells High School, which I left with 7 GCSEs. I returned home where my father had just purchased a new 60 acre parcel of ground which helped to keep a young man busy ploughing and improving for a while.

Back to today; we run a small pedigree Welsh Black herd of 22 cows and followers which are polled. We have recently done some performance recording work with the cattle and for the past two years have put a young bull into performance trials at Aberystwyth University. The results have been pleasing, particularly with regard to feed conversion rates. The range between the bulls on trial was from 4.2:1 to 7.8:1, with our bull at a feed conversion rate of 4.5:1.

The sheep flock is a bit of a mix, starting with Welsh Mountain, some Mule and Texel and, in later years, we have used the Lleyn to concentrate more on the maternal side, and attempt to increase our lambing percentage. We also run a small flock of pure Texel sheep which we performance record. We aim to sell as many lambs and cattle to Waitrose as we can as part of our policy of keeping a low cost of production while selling to a premium market. Both the sheep flock and the cattle herd are closed apart from the purchase of rams and bulls.



We were a demonstration farm for HCC (Hybu Cig Cymru/Meat Promotion Wales) from 2008 until 2011 when we concentrated on soil and grassland management. I also undertook a scholarship with HCC in 2008 travelling to New Zealand to study "Farming without subsidies".

In 2013 we entered the Famers Weekly awards for "The Sheep Farmer of the Year" and were pleased to have been judged the winner for that year.

#### 1b. My study background

As I mentioned previously, we have a Texel flock which we performance record and in our selection criteria we have targeted maternal, growth rate, and muscle depth traits. Maternal traits are followed to take care of the next generation of ewes, and growth rates to get a lamb to killing weight

sooner and so more efficiently. Muscle depth is important because our end product is red meat which is pure muscle; the greater the muscle depth on a carcass the more red meat is produced. We have been performance recording our sheep since 2009 and our flock index has risen from an average of 138 up to 278 last year. For muscle depth we now have an average muscle depth EBV of 252, which puts the average sheep in our flock within the top 7% of the national flock.

I fail to believe that the grader, who stands at the end of the kill line, can tell how much muscle depth or area of eye muscle each carcass has, just by looking at it.

We then select high performance rams from this flock to use in our main commercial flock to produce prime lambs for slaughter. I try to see most of our lambs killed and graded in the abattoir and I fail to believe that the grader, who stands at the end of the kill line, can tell how much muscle depth or area of eye muscle each carcass has, just by looking at it. It is this that has driven my Nuffield Farming study; to find a more objective, consistent grading system that can measure the amount of saleable meat yield for each carcass and reward the higher value carcass, without human variability.



# 2. How grading currently works in the UK

Carcasses graded under the current system in the UK are given a grade on the "EUROP" grid. (*See Figure 1.*) The EUROP grid is a five by five grid with conformation on one axis and fat cover on the other. For conformation, "E" is given to the better conformed carcasses and "P" to a poorer conformed carcass. An "S" grade has recently been added at the most conformed end to account for the extreme Texel and Beltex carcasses. In cattle the "O" grade has been split into "O+" and "O-".

Fat cover is assessed on the other axis with "1" being too lean and "5" being an over fat carcass. In sheep the "3" and the "4" grades have been split to give "3/4L" and "3/4H". In cattle just the "4" grade has been split into L and H.

	Conformation Classification					
		E	U	R	0	Р
L	1	-15	-15	-25	-35	-50
atic	2	+10	+5	Base	-10	-40
ific	3L	+10	+5	Base	-10	-40
ass	3H	+5	+3	-5	-15	-40
t C	4L	-25	-25	-25	-25	-40
Fa	4H	-40	-40	-40	-40	-40
	5	-60	-60	-60	-60	-60

The carcass comes to the end of the kill line and passes over scales to collect the weight and it is at this point that a grader decides, purely on the visual appearance of the carcass, what grade it should be given. This grade then determines the value of the carcass depending on where it falls on the

EUROP grid. The grade is totally subjective and dependent on an individual grader's opinion, so that different graders may give different grades for the same carcass.

Different abattoirs may also use different dressing specifications. This dressing specification can vary depending on what the end customer may request, but could involve the removal of the tail, the channel fat and the kidneys and also the removal of the flaps from the carcass. The amount that is removed obviously has an effect on the final The grade is totally subjective and dependent on an individual grader's opinion, so that different graders may give different grades for the same carcass.

weight of the carcass and so on the final value of that carcass.

Under European legislation cattle are required to be classified under the EUROP system and price reporting is related to this system. There is no requirement for lamb to be reported in such a way but abattoirs implement the same system for lamb as they do for cattle.



# 3. My study tour

#### Where I went and why I chose these countries

After some internet research, talking to fellow farmers, reading the farming press and listening to previous Nuffield Farming Scholars, I chose to go to the following countries:

Firstly I went to Ireland in June 2013	because it is within Europe and is under the same EUROP grid grading system as we are in the rest of the UK. However, the Irish Government has implemented and subsidised the installation of a Visual Image Assessment (VIA) system and now 90% of their cattle are graded using VIA.
I travelled to Australia during October 2013	to look at the Meat Standards Australia (MSA) grading system which has been developed to give each piece of meat a score for eating quality when cooked using different methods.
I chose to visit New Zealand	because I consider them to be our greatest competitor on grass finished lamb. I wanted to look at their ability to achieve such a long shelf life on their product, and so be able to transport their product to the UK by ship; the cheapest form of transport.
I then went to America	because their grading system is focused more around the eating quality of the final product and is based on the age, sex, breed, feed and length of feeding period. The grading system in the United States has no requirements for conformation criteria.

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# 4. Different systems in different countries

#### 4a. Ireland

With Ireland being a part of Europe, it is a legal requirement for them to report cattle grades under the EUROP grid system. As in the UK, I found an element of distrust between farmers and the abattoirs about the grading. In **2002 a trial was set up by Teagasc,** the Agriculture and Food

Development Authority in Ireland, to look at the benefits of mechanical visual assessment systems. The trial looked at the 'BCC2', a system manufactured by SFK Technology in Denmark; the 'VBS 2000', manufactured by E+V Technology in Germany and 'VIAscan', from Meat and Livestock Australia. Following the introduction of government grants to install such systems, most abattoirs switched over to a VIA system in 2004. The change-over was agreed between

As in the UK, I found an element of distrust between farmers and the abattoirs about the grading.

the meat industry, the Department of Agriculture and farmer representatives.

At the same time, a "Quality Payment System" was set up which gave a bonus payment to beef from the suckler herd rather than beef derived from the dairy herd. The system chosen was the VBS 2000 from E+V Technology, and the machines were set up to grade to the EUROP grid. The machines are verified before each grading session and the whole system is overseen by the Department of Agriculture to give confidence to the farmer.

The grid was changed to a fifteen by fifteen grid by splitting all the grades using +, = and - suffixes. The machine was found to grade conformation accurately but was not as accurate on fat cover. Fat colour had an effect on the grade achieved, with yellower fat from grass and forage finished animals gaining a fatter grade and whiter fat from cereal finished animals grading leaner. The machine was also grading carcasses at a slightly leaner grade than the human graders. Farmers that I spoke to seemed to be more content with the machine grading and felt that it was more consistent.

One abattoir owner that I spoke to had set up a viewing room for farmers to enable them to watch the grading of their cattle. He said that when the machine grading was first installed, a lot of farmers came to see their cattle graded but now only a few farmers a week come to watch. The room had the added benefit of improving bio-security, with farmers not actually going in to the kill line, and it stopped any harassment or coercion of the graders. There was also a significant drop in complaints about the grade the cattle achies

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There was the potential for this system to assess the actual meat yield of a carcass and to set up a payment-by-yield arrangement. However, there was more resistance from farmers to this and it was felt there would need to be a period of time, possibly years, with the two systems running side by side, to enable farmers to get used to it. This time scale would also give farmers a chance to find out which type of animals would perform best under a new payment system.

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While I was talking to one of the farmers involved in the original setup negotiations, he told me that he was sending a few of his cattle to a small local supermarket. They required an "R4L" on the EUROP grid but he was paid on the actual amount of saleable meat yield from the carcass. There had been an incidence where two heifers of the same grade had achieved a saleable meat yield difference of 8%. On a 350kg carcass that would be a difference of 28kg at a price of 4 Euro/kg, equating to 112 Euro of difference between animals. There were also some disadvantages of a yield system to certain breeds of cattle; Charolais and Simental breeds would be at a disadvantage due to their bone size which could affect the carcass yield.

He also felt that a totally new payment structure could be set up based on either a percentage or factor of the selling price of the final product.

#### 4b. Australia

In Australia there was a very detailed grading system which was called "Meat Standards Australia". It had been developed by Meat and Livestock Australia after a prolonged period of declining consumption of beef in Australia. It was established in 1999, following trials which started in 1996, and represented a new approach to the classification of beef which was targeted more to the eating experience for the end consumer. It was rolled out for lambs in 2007.

It not only looked at the carcass after slaughter but also at the animal during its life. A system was set up to look at the relationship between the animal traits: genetics, growth rate, marbling, "ossification" score (physiological age of an animal measured by looking at the amount of cartilage that had turned to bone), how the animal had been fed, lairage (which had an effect on the ultimate pH), processing (which affects the pH, speed of chilling and hanging method), and the ageing process.

There are three quality levels: MSA 3, MSA 4 and MSA 5. The six possible cooking methods were considered which were grilling, roasting, stir fry, slow cooking, shabu shabu (thin slice) and corning (a brined joint normally boiled), and the customer's eating experience was assessed. They used taste panels in eight different countries covering over 675,000 consumers trying 529,480 beef samples from 52,948 individual cuts of beef (May 2007). These consumers then ranked their eating experience using scores: tenderness 40%, juiciness 20%, flavour 10% and overall liking at 30%. The MSA then established a four grade system which was: 2 star (unsatisfactory), 3 star (good everyday), 4 star (better than everyday), 5 star (the premium).

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Following the responses from the 80,000 taste panels, a real insight was given as to what consumers would be willing to pay for the different grades in relation to each other. In Australia, Ireland and the



USA, consumers were prepared to pay on average twice as much for a 5 star piece of meat as they were for a 3 star piece. In Japan the consumer was willing to pay almost three times as much for the 5 star piece of meat as they were for a 3 star piece. The MSA now grades 80% of the beef in Australia.

The Centre for International Economics estimated that the total research and development for the MSA system had cost approximately AU\$85m. Up until 2007/2008 it had been estimated that the overall financial benefit had been in the region of AU\$300m, which shows a good return on the investment made. That return would have kept on increasing since those figures were calculated. Various studies have tried to show how this total benefit has been shared back up the supply chain. The difference between an ungraded carcass (one failing to attain an MSA quality grade) and a 3 star carcass was estimated at between 4 and 6.8%, for the whole carcass at retail value.

The study then further split the retail premium down into 19% for the retailer, 38% for the wholesaler and the remaining 43% went to the farmer. In financial terms, if a carcass has a retail value of £3000 in the UK, and there was a consumer premium of 5% for a 3 star grade, a premium of £150 would be shared: £28.50 for the retailer, £51.00 for the wholesaler and £64.50 for the farmer. It is hard to say whether this would be the same if implemented in the UK because of the different levels of meat eating quality and the question of how much of the premium would actually get passed back to various parts of the supply chain.

One of the biggest influences on eating quality in Australia was the amount of *Bos indicus* genetics found in individual animals (tropical humped necked cattle such as Brahman). The higher the level of *Bos indicus* genetics there were, the greater the detrimental effect on eating quality, through increased toughness. A close correlation was demonstrated between the height of the hump and the amount of *Bos indicus* genetics in the animal. It was stated that every millimetre of hump height equated to 2% of *Bos indicus* genetics. The MSA grading system took account of this by measuring, and heavily penalising, the height of the hump on the

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carcass. The favoured breeds were the "British" breeds, namely the Angus and the Hereford, which had higher levels of tenderness and juiciness because of their higher marbling levels. Breeders were then crossing the *Bos indicus* cattle with the "British" breeds at differing levels, trying to improve eating quality and achieve an MSA grade and therefore a premium.

Younger cattle are generally of better eating quality because they have less connective tissue development. The MSA system measures the age of the animal as the biological age, which is assessed by looking at the amount of cartilage that has turned into bone in the joints of the carcass. This measurement is called ossification and is used to age an animal, rather than dentition. Females mature more quickly than steers and will have a higher level of ossification. Bulls are excluded from the MSA grading system. Nutrition has a marked effect on the level of ossification, with poorly fed animals having a higher level. The practice of a period of "storing" an animal, for example overwintering, would also have this effect. An animal which has had health issues also has greater



ossification. Whether this is due to the illness or injury or to the longer finishing period and greater age had not been determined.

Nutrition also has a huge role to play when considering eating quality. It is desirable for animals to be on a rising plane of nutrition before slaughter, to have adequate fat cover and sufficient levels of glycogen. The fat cover is required to achieve a good level of marbling for increased juiciness and tenderness. It will also prevent the carcass from cooling too fast, causing "cold shortening" and the resulting toughness.

Glycogen is the energy stored in the muscles and, after the animal is killed, the glycogen turns into lactic acid and is measured by the pH of the meat. The pH of a live muscle is just above 7.0; it will temporarily fall to around 6.4 during exercise. To be acceptable for MSA grading the pH needs to be below 5.7. Glycogen levels have an effect on the pH levels within the muscles post slaughter. If the animal has a low glycogen level, or is stressed pre-slaughter and uses up its glycogen, this can result in low lactic acid levels which lead to high pH levels in the meat. The meat, known as "dark cutters", will be darker and more purple in colour and is heavily discounted.

This nutritional status has logically meant that most of the animals in Australia are being finished in feedlots on high starchy feeds. The animals will be sent directly to slaughter to decrease the time without feed which is involved with the market process, and to reduce the stress levels. To obtain an MSA grade, cattle must not be mixed with other cattle for two weeks prior to slaughter, and must stay in their bunch as they pass through the abattoir.

Hormonal growth promotants are implants inserted into the ear under the skin. These implants have a well known benefit to the growth rate and fleshing of an animal. However, MSA has established that they have a negative effect on eating quality by slowing down the process of muscle breakdown that occurs during ageing. They also inhibit the level of marbling within individual muscles.

Marbling is the level of intramuscular fat. Marbling has a very positive effect on the eating quality of meat with increased levels of juiciness and tenderness. It appears as flecks of white within the muscles once the carcass has cooled down and the fat has turned white. Marbling shows up more in the forequarter cuts and becomes less as you move closer to the hind quarter. The greatest effect is in the high value loin cuts.

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Marbling is not only influenced by the level of nutrition, being the last layer of fat to be laid down, but also by genetics. Certain breeds have higher levels of marbling than others. The Angus is the favoured breed in Australia, but there is still great variation within breeds. As this intramuscular fat is the last type of fat that is laid down, there can be a detrimental effect on the saleable meat yield. This is due to the higher level of subcutaneous (rib cover) fat trimming that is required before retailing the joint of meat. Based on the MSA model it is estimated that beef with the highest marbling score is worth 35p/kg more than beef with no marbling. The level of marbling is measured within the eye muscle at the twelfth rib, with scores ranging from MSA 200 to MSA 1100 in increments of 10.

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Meat colour has an important influence on the consumer at the point of purchase. The meat colour is assessed at the same location as marbling, on a scale from 1 to 7, with 1 being subdivided into a, b, and c. To fit into the MSA system meat colour needs to be between 1b and 3. So 1a and anything over 3 is automatically removed from MSA grades. Fat colour is also recorded at the same site but there is no MSA score for fat colour as it does not actually affect eating quality. Subcutaneous fat depth is measured in millimetres and requires a minimum rib fat depth of 3mm.

There are two main methods of hanging a carcass: "Achilles hung" or "tenderstretch". Traditionally carcasses are hung by the Achilles tendon. In this case the spine is curved and the hind quarter muscle fibres have less tension on them allowing them to overlap as they go through *rigor mortis,* resulting in a slightly tougher meat to eat. By using tenderstretch the carcass is hung by the pelvis which then stretches the spine and the hind quarter muscles as the hind leg hangs down at 90 degrees to the body. As a result the muscles are under tension and the muscle fibres are not allowed to overlap. Under the tenderstretch hanging method, carcasses are dressed while hung by the Achilles tendon and then re-hung by the pelvis before entering the chiller.

Ageing has an effect on tenderness and all MSA graded meat has a mandatory minimum of 5 days of hanging as part of this process. The ageing of meat can occur at any temperature except when frozen. The changes in the meat alter its properties, particularly the tenderness. The method of hanging has an influence, with tenderstretch carcasses ageing faster.

All this information is collected on the grader's hand-held computer which performs calculations to determine the eating quality scores, the ageing requirements, and suitable cooking methods for each cut of meat within the carcass.

The development of the MSA grading system has a simple aim: to grade meat that will eat well. Feedback is given to the producer on the kill sheet, detailing the number of cattle that have achieved an MSA grade, and the reasons for the ones that failed to reach a grade. This information then enables the producer to see which areas need attention, whether it is genetics, handling or other management decisions. The process for lamb is different, with the criteria for grading resulting in simply a pass or fail. I saw no evidence that their export customers were requesting an MSA grade and it was only being used within Australia.

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While in Australia I met with Rob Cumine who was the Agricultural Manager for Coles, a supermarket that, with Woolworths, supplies 80% of the grocery market in Australia. They bought their lamb through their own buyers who went into the markets and bought the specific lambs that they wanted: a 22kg carcass with an adequate level of finish. These lambs were then contract killed and Coles exported to Asia the parts of the carcass that they did not require; mainly the 5th quarter, ribs and flaps. They bought 450,000 cattle, 1.8 million lambs and 600,000 pigs per year. The reasons they gave for buying in the market was that they trusted their buyers' expertise to source a lamb of the desired weight, that appeared to be healthy and looked to be on a rising plane of nutrition.



Exporters were driving for a larger carcass of 28-30kg for the Eastern markets, which made it harder for them to find the right size and level of finish that they required. It was also felt that different abattoirs gave different grades, particularly on fat cover. They felt that the MSA grading system was the best there was for eating quality but there also needed to be a link to saleable meat yield to encourage the farmer to produce a more efficient carcass. There was also a feeling that the current price of lamb could force it to become a niche market at the premium end of the market, which in the long term would be to the detriment of the lamb industry.

#### 4c. New Zealand

In New Zealand the grading system only measures fat cover and weight. Weight is taken at the end of the kill line before entering the chiller and fat is also measured at the same time. The fat cover is a physical measurement on the twelfth rib, 10cm from the spine, and scored in increments of 5mm up to score 4. Score 5 then covers everything that is 21mm and over. (*See photograph below*). There are two main lamb slaughter companies, Alliance and Silver Fern Farms, both of which are farmer owned co-operatives. Both of these companies are looking at rewarding lamb carcasses more accurately on saleable meat yield. They have chosen to go different ways when it comes to the classification of carcasses.



Knife for measuring fat depth



Alliance has chosen to grade all their lambs by VIAscan, a system that has been developed over a period of years: taking pictures of the carcass and then comparing these to a data bank of photographs of lamb carcasses that have previously been through the system. Alliance was the company that did all the research with the VIAscan Company to develop the system. They put lambs past the cameras and then boned out thousands of carcasses to verify the accuracy of the photographs. The saleable meat yield of individual carcasses and individual cuts were recorded and used to create the algorithms that are used to run the VIAscan system. The carcasses varied from 9kg to 24kg. They claimed that the system was 98% accurate on saleable meat yield and this was due to the data sets that only they had, to back it up. From this data they concluded that a human grader is 65–75% accurate on fat yield whereas VIAscan was 80%+ accurate.

Silver Fern Farms have chosen to go down the route of "X-ray" grading. This system operates by the kill line passing through an X-ray room and the carcasses are X-rayed using a Dual Energy X-ray Array (DEXA). The X-rays are non-ionizing radiation so that there is no risk of radiation and associated cancer fears for consumers. These DEXA X-rays then give images from which it is possible to work out the meat, fat and bone yield of not only the carcass but also the primal cuts. The weight apportioning of primal cuts is 98% accurate. The system is capable of running at 30 carcasses per minute so would easily work under abattoir conditions.

Following on from the imaging there is the option of installing robotic cutters which would cut the carcass into primal cuts. These cutters are more accurate than a man on a band saw; at an accuracy of over 99% compared to a man with a band saw who would be in the 70% region. The robotic cutters used are circular serrated blades or straight blades, depending on which cut is involved. These reduce bone dust and give a higher percentage of higher value cuts, helping to increase the saleable value of the carcass. There is also an improvement in the hygiene of the carcass and benefits for health and safety with a machine using the sharp tools rather than a human. They also have the benefit of replacing the highly skilled staff; those that are often harder to recruit.

I also went to see a smaller privately run abattoir operated by Progressive Meats. This abattoir had a system of its own which paid for carcasses using a combination of the saleable meat yield, pelt and wool quality. The kill sheet showed the saleable meat yield for the fore, middle and leg, giving yield as a percentage against a standard index of 100%. It also showed: the total number of carcasses, total hot weight, average live weight, average hot carcass weight, dress out %, value/kg, value/head, total value, a preferred special score and a comment on presentation. *(See photo of carcasses on next page)* 

This abattoir was paying a premium for higher yielding carcasses and was therefore attracting the higher yielding, better quality carcasses. It also used spray chilling, which is a system of chilling carcasses using a light spray of cold water rather than cold air as in most chillers. It sprays water for 20 seconds every 3 minutes until the carcasses reach chilled temperature. This method of chilling reduces the loss of weight from hot to cold weight. Currently in the UK we lose 0.5 kg from an 18kg carcass which is a loss of about 2.75%. Using spray chilling the weight loss was just 0.75%. They also stated that lambs that were killed the morning after a night in lairage would kill out half a kilo lighter than their cohorts would kill out on the previous afternoon. It also used an objective fat measurement which was to physically measure the fat cover over the twelfth rib.





Lamb carcasses after they have been classified and sorted in New Zealand

#### 4d. America

The grading system in the USA is based on two categories, a quality grade and a yield grade. In cattle the quality grade has seven categories: Prime, Choice, Select, Standard, Commercial, Utility and Cutter. The categories Prime, Choice, Select and Standard are used for younger prime animals. The Commercial, Utility and Cutter categories are used for older cattle and some of the younger cattle that do not qualify for the better grades going into the processed meat sector. The yield grade has five categories numbered from 1 to 5. Yield grade 1 would have the higher level of "cutability", giving the greater percentage of saleable cuts from the carcass.

A set of classification standards was set up in 1916 and used as a base for the reporting of "dressed beef carcasses" markets since 1917. The specifications have changed as time went by with increased understanding and research. On June 3rd 1926 a revised version of these standards was taken as the Official United States Standards for the Grades of Carcass Beef, and used from May 1927 when the voluntary beef grading and stamping service started.

The official standards were amended in July 1939 to provide a single standard for grading and labelling of steer, heifer and cow beef according to similar inherent characteristics. These amendments also changed the grading terms Medium, Common, and Low Cutter to Commercial, Utility and Canner respectively. In 1941 a further amendment made similar changes to bull beef giving the following grades for all beef; Prime, Choice, Good, Commercial, Utility, Cutter and Canner. In 1950 the official standards were revised by combining Prime and Choice into the Prime grade; renaming the Good grade as Choice, and dividing the Commercial grade, by putting beef from younger animals into the top half and calling them Good, while retaining the Commercial grade for the remainder. In 1965 following research on the effect of maturity on palatability, changes were made to the Prime, Choice, Good and Standard grades.



The minimum level of marbling in the youngest category of animal was not changed but, for the older cattle, an increased level of marbling was required as they aged. At the same time, to achieve a conformation grade, there was the requirement for the development of specified muscling. The



Randy Hammerstrom (left), Officer in charge United States Department of Agriculture, Livestock and Grain Market News Service who showed me around farms, feedlots and introduced me to a lamb selling co-op and Leonard Woody, United States Department of Ag

requirement for all carcasses to be "ribbed" before grading was also implemented. Ribbing is when the one side of the carcass is partially separated into a hind quarter and the fore quarter at the twelfth thoracic vertebra by a saw cut, at a point which leaves not more than one half of the vertebra on the hind quarter. A knife cut across the rib-eye opposite the saw cut and extending perpendicular to the outside skin surface of the carcass. The cut is continued between the twelfth and thirteenth ribs far enough to expose the rib-eye muscle for grading.

In 1973 official standards were revised with regard to young bulls. This was brought about following earlier research showing young bulls to be more efficient than steers in the feedlot, in terms of both feed conversion and growth rate. Research had shown that beef from such animals was less palatable and more variable than steer beef and there was the belief that the category of "bull" was detrimental to its acceptance. So a classification of "bullock" was developed. "Bull" was still retained as a classification for the more mature bulls.

In 1975 the conformation requirement was removed, following evidence that variations in conformation were unrelated to variations in palatability, and that yield was a better indication of retail cuts and carcass value. An additional change was made to reduce the maximum age for steer, heifer and cow beef allowed in the Good and Standard grades, to the same as the Prime and Choice grades. In 1987 the grade of Good had its name changed to "Select". The specification for the grade did not change it was just the name to allow for better marketing of this grade of meat.



Classification of beef carcasses is based on evidence of maturity and sex at the point of slaughter. The classes are steers, bullocks, bulls, heifers and cows. Steer, bullock and bull carcasses are different because of the presence of the "pizzle muscle" (attached to the penis) and associated "pizzle eye" next to the rear of the aitchbone. If present, the fat in the cod area is rough and irregular while, in heifers, the fat is much smoother. To differentiate between steer, bull and bullock carcasses the pizzle muscle is used, which is much smaller in steers, light

... the grade of Good had its name changed to "Select". The specification for the grade did not change it was just the name to allow for better marketing of this grade of meat.

in colour and fine in texture. In bull and bullocks it is relatively large, dark red in colour and coarse in texture. Bull and bullock carcasses will normally have a developed crest on the back of the neck.

There is also the "jump" muscle which is the development of a round muscle next to the hip bone in bullock and bull carcasses, but in carcasses with a considerable amount of external fat this muscle may be obscured. Although the development of these sexual characteristics is the main factor, weight would also be given to the colour and texture of the meat. In bull and bullocks the meat will be darker red with a dull "muddy" appearance and may even have an iridescent sheen. The meat will also often have an "open" texture. The only difference between bull and bullock carcasses is the ageing measured by the level of ossification. Heifer and cow carcasses are distinguished by the size of the pelvic cavity and the shape of the aitchbone. In heifers the pelvic cavity is relatively small and the aitchbone is curved, while a cow would have a larger pelvic cavity and the aitchbone is straight.

Marbling is measured at the cutting of the twelfth and thirteenth rib. It is compared to a set of cards which show the different levels of visible intramuscular fat from Slightly Abundant, Moderate, Modest, Small, Slight, Traces and Practically Devoid. *(See photo on next page)* 

This is the reason why grading takes place twenty four hours after kill; to allow the intramuscular fat to solidify and to turn white so that it is seen more easily. At the same site the colour of the lean meat is also assessed, with the darker the red, the older the animal is judged to have been. The condition of the "dark cutter", which is related to the reduced level of sugar in the muscles at the time of slaughter, is not considered to be detrimental to the palatability of the meat, but may be downgraded a whole grade because of its visual appearance. There is a relationship between marbling, maturity and grade as shown in *chart at foot of of next page*.

The yield grade is judged by four main characteristics: the amount of external fat, the amount of kidney, pelvic, and heart fat, the area of rib-eye muscle, and the carcass weight. The external fat is measured at ribbing site, being the thickness of fat laid down over the rib-eye, perpendicular to the outside surface and three quarters of the way along the muscle from the chine bone end. This measurement may be adjusted if a visual assessment of other parts of the carcass - for example the brisket, the cod, the udder or the flanks - are deemed to be leaner or fatter than the rib-eye fat depth measurement.





**Marbling grading cards** 



Chart to show relationahip between flank far streakings, maturity and quality

The amount of kidney, heart and pelvic fat is assessed visually and expressed as a percentage of the carcass weight. This fat is removed on closely trimmed joints and so impairs the yield of saleable meat from the final weight of carcass. For every extra 1% of kidney, pelvic and heart fat, there is a reduction of 20% of a yield grade: therefore a 5% increase of fat would be a downgrade of a



complete yield grade. The rib-eye area is assessed but may be physically measured using a grid, calibrated in tenths of a square inch. As the rib-eye area increases so does the yield grade. An increase of one square inch would give a 30% of a yield grade increase. Hot carcass weight (or cold carcass weight x 102%) is then added to a mathematical equation to determine the final yield grade. An increase of carcass weight by 100 pounds would decrease the yield grade by about 40% of a grade. The yield grade is correctly determined by the following calculation:

# Yield grade = 2.50 + (2.50 x adjusted fat thickness, inches) + (0.20 x percentage kidney, pelvic and heart fat) + (0.0038 x hot carcass weight, pounds) – (0.32 x area rib-eye, square inches).

The result of the mathematical equation is always rounded down, so even if a grade calculated out at 3.9 it would still be rounded down to a yield grade 3. These descriptions facilitate the subjective determination of the yield grade without making detailed measurements and calculations. The yield

grade for most beef carcasses can be accurately determined on the basis of a visual assessment. The training period for new graders is of 12 weeks duration and you can see why it takes so long.

The grading of sheep carcasses started in 1931 and has also gone through many changes as new research and developments have occurred. There are the two grading axis, as there are for beef, quality and yield. The quality grades for sheep are The grading of sheep carcasses started in 1931 and has also gone through many changes as new research and developments have occurred.

Prime, Choice, Good, Utility and Cull. The yield grades are from 1 to 5, with 1 being awarded to the carcass to yield the most saleable meat. There is also the differentiation of Lamb, Yearling Mutton and Mutton carcasses.

Quality grades are based on two different evaluations, these being the "palatability-indicating" characteristics of the lean meat and the conformation of the carcass. The palatability-indicating characteristics are the level of fat streakings on the flank muscles, and ossification of the "break" joint. The break joint is when the front trotter is broken off at the ankle joint to reveal the bone and cartilage development. A young animal will have "ridges" within its joint and as the animal matures it changes to a more defined "spool" joint.

Consideration is also given to the colour and ageing characteristics of the lean meat. The level of fat streakings on the flank muscles must increase in proportion to the increase in the ageing to achieve a similar grading. The fat streakings are categorised in descending order of fatness as being: Abundant, Moderately Abundant, Slightly Abundant, Moderate, Modest, Small, Slight, Traces, Practically Devoid and Devoid.

The conformation is assessed by the thickness of the muscles and the overall thickness and fullness of the carcass. Superior conformation indicates a higher proportion of edible meat-to-bone ratio and a higher proportion of the carcass in the more popular joints. The quality standards apply to both sexes of sheep; however, entire males which have thick neck and shoulders are heavily downgraded, dependent on the level of masculinity shown. Such downgrades may vary from half of a grade for a



young lamb, in which such characteristics are barely noticeable, to two full grades for a mature ram in which they are prominent.

Yield grade is based on the level of external fat on the carcass. It is measured by a fat probe over the centre of the rib-eye, perpendicular to the outside surface between the twelfth and thirteenth ribs. As the level of fat increases, the yield of saleable meat decreases. Each increase of 0.05 inch of fat cover over the rib-eye lowers the yield grade by half a grade. The adjusted fat thickness range for each yield grade is as follows:

Yield grade 1 = 0.00 – 0.15 inch Yield grade 2 = 0.16 -0.25 inch Yield grade 3 = 0.26 – 0.35 inch Yield grade 4 = 0.36 – 0.45 inch Yield grade 5 = 0.46 inch and greater

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J B Swift's abattoir at Bordertown, Australia, where robotic cutters were used following X-ray grading.



### 5. Discussion

In this chapter I will discuss what I have learnt whilst on my Nuffield Farming travels, both abroad and here the UK. I have talked to farmers, processors, graders, local butchers, retailers, supermarkets, scientists and researchers, and the vast majority have been very helpful, with very few not willing to get back to me. Most people have been very open with me and have even trusted me with commercially sensitive information. I will not repeat it here, but it has given me a greater understanding of the industry and some of the problems which affect each sector. My views have been formed by this information.

At the start of my Nuffield Farming study I wrote a brief outline of what I wanted for the future of red meat grading for the UK. It read:

"We need a system in the UK that will give timely, accurate and consistent measurements of the yield of meat from a carcass with a targeted payment system."

My thoughts are still very similar to this but how it is to be achieved is complicated. It is very difficult to look at one element of a whole supply chain without also looking at other parts that would be affected. It will require actions, understanding and no doubt some compromise all the way along the supply chain from producer, to processor, to retailer and the consumer.

The system of how farmers are paid for a carcass obviously has a major effect on the carcass that they produce as they try to take advantage of any bonuses or rewards within that system. The current system, the EUROP grid, rewards in the form of bonuses for a carcass with greater conformation and penalises for poorer conformation. It then also has penalties for either excessive fat cover or for being too lean. There are further penalties for a carcass being too light or too heavy.

	Conformation Classification					
uc		E	U	R	0	Р
	1	-15	-15	-25	-35	-50
atio	2	+10	+5	Base	-10	-40
ific	3L	+10	+5	Base	-10	-40
ass	3H	+5	+3	-5	-15	-40
t C	4L	-25	-25	-25	-25	-40
Fa	4H	-40	-40	-40	-40	-40
	5	-60	-60	-60	-60	-60

A typical EUROP grid showing bonuses and penalties

The payment system is based on the grid *(see above),* with a base price given for R2's and R3L's (shaded blue). This price would be the quoted price for lamb at that particular abattoir, and will vary between different abattoirs. The bonuses indicated on the grid are for improved conformation at the required fat levels of 2 and 3L (for lamb). There are penalties for under-finished carcasses and the penalties increase as fat cover increases above required level and/or conformation decreases. The bonuses are relatively small for the increased conformation. Farmers will chase these bonuses even when in reality they would not cover the extra costs incurred. These costs are incurred because of lower lambing/calving percentages due to the amount of terminal genetics in the maternal side, and the increased lambing/calving problems caused by the use of well-conformed sires.

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# 6. Methods of classification

#### 6a. Visual image assessment grading

Visual Image Assessment (VIA) grading is a system where a carcass is passed in front of a camera and light array. The lights shone on the carcass are in strips of light and shade to give a degree of depth of the carcass. A picture is then taken of the carcass and compared with a database of photographs of previous carcasses which have been recorded and boned out to show the saleable meat yield of that carcass. A grade is then given to this carcass, which is the same as the given grade for a photograph of a carcass already in the database. The algorithms used within this system are the strongest or weakest link to this method. They require a lot of data collection and verification which is expensive and time consuming.

From the information I have gathered, this system needs careful setting up with regard to the level and source of lighting. The surrounding environment also needs to be correct, otherwise light reflecting from a roof or wall will mean it will be difficult to get a clear image to be analysed. VIA grading does very well on carcass conformation but there has been an issue with getting an accurate assessment of the level of fat cover. With the increased use of mechanical hide removal, the carcass outline can actually be changed if some subcutaneous fat is removed with the hide. Carcasses that cannot be mechanically graded could be given a "lot average" payment, or be graded by the human grader. There was no issue with this method of grading not being able to cope with commercial line speeds. There could be a cost to altering the kill line to achieve enough space for the system setup as it would require more space than that is currently required by the grader.

#### 6b. X-ray grading

X-ray grading is when a carcass is passed through an X-ray chamber and the resulting image can show the yield of meat, bone and fat within that carcass. The first and obvious question to be raised is the public perception of X-ray radiation and the risk of this causing cancer. However, I was assured that the X-rays used are non-ionizing and are not considered to be any risk. The information gathered would be more than sufficient to provide a saleable meat yield payment system, but probably the greatest advantage for this system would be the ability to then follow the X-ray machine with robotic cutters which would cut the carcass into primal cuts.

When I saw X-ray grading in operation in Australia it appeared to work well and to work at line speeds capable of 5300 lambs per 8 hour shift. This would compare with most abattoirs in the UK running at approximately 500 lambs per hour or 4000 per 8 hours. It is expensive to install, although I have read an independent report, commissioned by MLA and Scott Engineering, which suggests that as long as there is enough throughput in an abattoir, it is capable of a payback period of less than 3 years. ... probably the greatest advantage for this system would be the ability to then follow the X-ray machine with robotic cutters which would cut the carcass into primal cuts.

The benefits of X-ray grading include achieving a higher



percentage of higher value cuts because the splitting of the carcass into primals is done at the most beneficial point. This ensures that there is more meat on the higher value cuts and less bone dust. There is also a benefit on health and safety grounds because humans are not operating the cutting machines. The requirement for skilled labour is also reduced, giving a saving on wages. This would equate to a return of over 33% which is not insignificant. If robotic cutters were to be installed as well as the X-ray chamber there would need to be considerable modifications to the kill line with associated expense and "down time" for the abattoir.

#### 6c. Meat Standards Australia

Meat Standards Australia (MSA) grading concentrates more on the eating quality of a cut of meat and the factors affecting eating quality before slaughter, during processing and how the cut is cooked.

- Factors under the producer's control include the genetics, the animal age, the growth path, the selling method and pre-slaughter stress.
- The processor has control over pre-slaughter stress, cold and hot shortening, hanging method and ageing.
- The retailer is then responsible for the integrity of the meat; that is to say, what it says on the pack is what is actually in the pack.

The MSA then tells the consumer the best way to cook individual cuts. One of the greatest influences on eating quality is the glycogen levels at point of slaughter. Glycogen is the amount of energy that is within the muscles which is depleted by a lack of food and an increased stress level.

#### 6d. United States Department of Agriculture grade

The classification system set up by the United States Department of Agriculture (USDA) has evolved over a long period of time. It has changed over this period, becoming more focused on the eating quality of the carcass. This has led to the greater use of traditional breeds and in particular the Angus breed, which is probably due to its successful marketing strategy. The evolution of the USDA system has been science-led which has found that conformation confers no benefit on the eating experience for the final consumer. It also recognises that the age of the animal has an effect on eating quality. The age is measured as a physiological age, through the amount of ossification found in the cartilage and bone of the carcass.

The sex of an animal and whether males are left entire are also found to have an effect on eating quality, as are the level of feeding and the length of time of the feeding period. The longer that an animal is fed, the greater the level of intramuscular fat that it will contain. Even though a high level of trimming of subcutaneous fat will be required, it is still considered desirable for the improved succulence, eating quality and "cookability".



# 7. What I thought were the best bits of all the systems

All the systems that I saw had advantages over the EUROP grid. The VIA system took the subjective human element out of the grading system and, where this was in place in Ireland, the farmers in general had accepted it as a fairer system as it more accurately reflected the saleable meat yield of

each carcass. However, some finishers of dairy bred animals felt that they were losing out compared to the EUROP grid method. In one abattoir I visited, complaints about the grading of their animals by farmers had dropped considerably after the installation of the VIA system.

The Australian system (Meat Standards Australia) was more focused on the eating experience and this should lead to the greater satisfaction of the end consumer which, for the long term interests of the red meat industry, is crucial. It was used in the supermarkets within Australia but there seemed to be little demand from their customers abroad.

I felt that the X-ray grading system was a very good system, particularly when it was followed by a robotic cutter, as it made the processing a lot safer, hygienic and more efficient. It was safer because there was less human involvement in the cutting process, which also made it more hygienic; more efficient because more meat stayed on the higher value cuts and there was less waste and less bone dust.

The American system showed that an improved level of conformation gives no improvement in eating quality. The best way to improve eating quality is through genetics, how an animal is fed, age, and the level of intramuscular fat.

From what I have seen in other countries, I think it is possible to improve the classification system in the UK in many ways. The greatest impact would be from the implementation of an objective mechanical grading system. This would give farmers more confidence in the grading process so long as the algorithms that drive the machines are controlled by an independent body. I would suggest that this could be done by the levy bodies. The grading at all abattoirs would be constant and farmers would be able From what I have seen in other countries, I think it is possible to improve the classification system in the UK in many ways.

All the systems I saw

had advantages over

the EUROP grid.

to compare the prices quoted from each abattoir. There are different systems capable of doing this.

My favoured method would be the X-ray grading system because of the ability to then follow the X-ray machine with robotic cutters, which would cut the carcass more efficiently into primal cuts. However, there would be difficulties in how this message was presented to the public in case the wrong impression was given about the radiation used in the X-ray machine, which may lead to concerns about a possible link to cancer.

The VIA system would be capable of giving an improved grading method compared to the current EUROP grid, but is purely a classification system. It would have benefits for the processor as they



would be able to see which carcasses would be best suited to which particular market; which carcass is best to sell whole and which is best for cutting.

There are also other technologies which are in development which may in time prove to be useful. One such system currently being looked at by Quality Meat Scotland is "Hyperspectral Imaging". Whilst in America I was told that the amount of computer capacity needed to run this system was too great. However, as computers become more powerful, or it is possible to narrow the spectrum as it is examined, this may become more practical. As we have a wider range of sheep breeds and crosses in the UK compared to the other countries that I visited, further trials on the systems discussed above should be carried out.

Other improvements that could be made would be to remove the deduction from the carcass weight for the difference between hot and cold weight. One abattoir in New Zealand was using a spray chilling system in the chiller, where the carcasses were sprayed with cold water for 20 seconds, every few minutes, for two and a quarter hours, which virtually removed this weight loss. They claimed that this system paid for itself in less than 12 weeks.

Paying for the full weight of the carcass should also be implemented rather than the current system of rounding down to the nearest half kilo. The processor sells the whole weight, so the farmer should get paid for the whole weight.

By improving the classification system and the way that carcasses are paid for, farmers would very soon change their production systems to attract the premiums for the higher saleable-meat yielding carcasses. This would then provide more of the meat required by the supermarkets and farmers could reap the benefits of the work done by organisations like Signet on performance recording and in particular, muscle depth scanning. farmers could reap the benefits of the work done by organisations like Signet on performance recording and in particular, muscle depth scanning.



# 8. Conclusions

- **1.** The EUROP grid does not work for the farmer or the supermarket. It is not fit for purpose as it does not predict saleable meat yield or reward the more efficient carcasses with higher saleable meat yield.
- **2.** A mechanical system would be objective and consistent across different abattoirs compared to the subjective human based EUROP grid.
- **3.** To improve the efficiency of the carcass production cycle, a system needs to be implemented to reward the carcasses which produce a greater saleable meat yield.
- **4.** The EUROP grid currently rewards greater conformation, which adds nothing to the eating experience, but is detrimental to animal welfare at lambing and calving time as it can create more birthing problems.
- 5. Education is needed for the farmer in relation to the fact they are "food producers" not just producing lamb or beef. Consumers need to be educated that not all fat is bad and that a level of intramuscular fat will actually add to the eating experience.

# 9. Recommendations

- 1. Trials into X-ray and Visual Image Assessment carcass classification should be carried out in this country, with its wider gene pool of breeds and crossbreds.
  - 2. Dressing specification should be standardised across the whole country.

- 3. Remove the "cold" weight payment, and pay for the whole weight of the carcass, not round down to the nearest half kilogram.
- 4. Educate farmers about what factors affect the eating quality of their product. This is probably best done by the levy boards.
- 5. Educate consumers that not all "fat is bad". Some intramuscular fat is required for a piece of meat to be cooked properly and for the consumer to enjoy a better eating experience. The supermarkets are best placed to do this.



#### 10. After my study tour

I have learnt a lot during my Nuffield Farming study tour and this has convinced me that the current grading system of red meat needs to change. I think that a better system would improve the

efficiency of the carcass if the saleable meat yield was better rewarded. I believe that the future of red meat classification within the UK will change, hopefully sooner rather than later. In my conversations with people along the whole of the supply chain they all seem to agree that change needs to happen. However, because of the shrinking in size of both the sheep flock and cattle herd nationally there is a big concern, particularly in the processing sector, that if they are the first to change they will lose market share.

... people along the whole of the supply chain all seem to agree that change needs to happen.

VIA is actually going to be used in an abattoir in Perth, Scotland starting in the middle of August 2014 and a number of farmers will then be able to choose to be paid either by yield or by the EUROP grid. A number of supermarkets are now looking into various methods of mechanical classification and I hope that they will not all go in separate ways. If they do then it will make it harder for the farmer to compare the different payment schemes, based as they would be, on different classification systems.

I have been talking to the levy boards and, particularly in Wales, trying to influence their thinking with what I have learnt on my Nuffield Farming travels. To change the current arrangements, the whole country would need to change at the same time in order to avoid a situation where the first abattoir installing a new system lost throughput. It would therefore have to happen at a political level. I have been talking to senior civil servants within the Welsh Government and will continue to apply any influence that I can, whenever I can.



#### **11. Executive summary**

For over forty years the system of grading red meat in the United Kingdom has been the "EUROP" grid. This system in its most basic form is a five by five grid showing conformation, most conformed being "E" and poorest conformed being "P", and fat cover on a scale of 1 to 5, with 1 being the leanest and 5 being the fattest. At the end of the kill line in the abattoir, a grader visually assesses the carcass and awards it a grade for conformation and fat cover. This is a purely subjective appraisal of the carcass. As science and technology is increasingly used in the livestock sector, in particular with the use of Estimated Breeding Values (EBVs) for greater muscle depth, it is more difficult for a human grader to see within a carcass to see the great volume of meat in the eye muscle of that carcass.

With this in mind I wished to see if there was a more objective system of grading a carcass, and then to possibly set up a payment scheme that would reward the more efficient carcass which has the greater amount of saleable meat yield. I chose to go to see abattoirs, processors, retailers, researchers and industry bodies in Ireland, Australia, New Zealand and America. Ireland, although in the EU, is currently grading 90% of its cattle using Visual Image Assessment. Australia has developed the "Meat Standards Australia" (MSA) scheme which scores a piece of meat on its predicted eating quality. New Zealand is probably our greatest competitor for grass fed lamb and they are doing work on VIA and X-ray grading systems. America has a system of looking at the animal's background, meat and fat colour and cover to then work out a yield and eating quality grade.

The systems used in other countries show that a consistent, objective meat classification system is possible to operate. There are difficulties with some of the systems but, as more practical experience is gained, the operating algorithms that run them will become more refined. Trials need to be carried out in this country to show if it is possible to run such systems here in the UK on the wide range of breeds and crossbred animals we have. A classification system should be introduced in the UK that rewards the higher saleable meat yielding carcass, as opposed to conformation, with an associated payment system to make the meat production supply chain more efficient. It would achieve this by rewarding the production of these higher meat yielding carcasses and reduce losses at birth from the more conformed sires which would also help improve animal welfare.



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