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The Dohne Merino as a practical example of successful adaption to environmental and economic factors

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Summary

By introducing genes for fertility, prolificacy, growth rate, carcass quality and hardiness into the local Merino by officials of the Dept of Agriculture at the Dohne Agricultural Research Station in South Africa more than 70 years ago, a new dual-purpose Merino was developed which would eventually combine fine merino wool with high fertility and prime lamb production. This paper describes how, with the application of innovative breeding systems, the Dohne Merino, as the new breed was known, was improved to a level where it has enabled sheep breeders worldwide to adapt their enterprises in various ways to increase productivity and profitability.

Sub Title: Adapt and Fly

The sour grassland of the Eastern Cape is a particularly harsh environment for Merino sheep of the type that was available in the early and mid 1900s. The high summer rainfall, acidic soils and natural grassland of very low nutritive value gave rise to numerous problems such as low fertility, poor growth rates and severe internal and external parasite infestations. While the region was renowned for its high quality wool, this was primarily produced from wether flocks. Very few Merino flocks in the region could sustain numbers by breeding, and it was general practice for wool growers to purchase young wethers at the many sales that were an annual feature in the better sheep country to the north and west.

The initial Adaptation – introducing greater genetic variation

When the Dohne Agricultural Research Centre was established near the town of Stutterheim in 1937, the Director, Mr JJJ Kotzé, a visionary and a genius, made it his priority to develop a better adapted and more productive sheep type for the region. In 1939 he mated the newly imported German Meat Merino with ewes of the local Peppin strain. Although having been bred separately and selected for meat traits for more than a century, the German Merino proved extremely compatible with the local Merino strains, both having originated from the same Spanish stock. An entirely new set of genes for fertility, prolificacy, growth rate, carcass quality and hardiness was introduced, paving the way for the development of a new dual-purpose breed, which through selection would eventually combine fine merino wool with high fertility and prime lamb production. Mr Kotzé set the standards according to

which the new breed should be selected and developed, and by enlisting and supervising many local private breeders, the Dohne Merino, as it became known, rapidly gained ground.

In a few decades Dohnes completely revolutionized sheep farming in the Eastern Cape. Where previously wool growers had not been able to sustain sheep numbers and had to rely on regular purchases from far afield for their sheep enterprises to remain viable, the advent of the Dohne completely reversed this trend and the region became a net exporter of sheep. In February 1980 on the first annual sale of Dohne Merinos at Kei Road, a full clearance of 2300 Dohnes including commercial ewes, stud ewes and rams changed hands - profound testimony to the success of the new breed which rapidly spread throughout the country, where it excelled in better environments.

Adaptation No. 2 Measurement as an aid to selection

Shortly after the formation of the Dohne Merino Breed Society in 1966 a decision was taken to record pedigrees and to adopt measurement of the main production traits as an aid to selection. Initially this comprised Body Weight at 100 days of age and at 12 months of age, which considerably enhanced the rate of progress. When the South African Fleece Testing Centre began operation in 1970 a fleece analysis of each animal became mandatory and Fibre Diameter and Clean Fleece Weight were added to the list of traits that were recorded. In the 1970s this was a very contentious issue among Merino breeders both in South Africa and in Australia and resulted in a high degree of polarization between the animal scientists who advocated measurement, and traditional breeders who were opposed to it. However, unencumbered by tradition and being innovators by nature, Dohne Breeders easily embraced measurement as an integral part of the breeding programme. After 1973 all animals were selected on the basis of their measured relative productivity. A database was established at the Society's office incorporating the pedigree and measured performance of every animal recorded in the register. Ultimately this database would enable the Society to fully exploit new technology as it become available for the calculation of breeding values.

By consistent selection based on measurement of the most productive animals in each generation, really positive and rapid progress was achieved in the first few decades of the Dohne's existence, progress that would be considerably accelerated with the adoption of new and innovative breeding systems.

Adaptation No. 3 – Scrapping of competitive Shows

After objective measurement gained favour, more and more breeders were reluctant to isolate sheep at a young age to prepare them for competitive shows. In the modern context of animal breeding, the success of a stud is determined by its economic performance in a commercial environment, and not by its performance in the show ring. Success in the show ring became irrelevant because it was based on the subjective evaluation of a few artificially prepared animals, often unrepresentative of the stud concerned. All animals were now being evaluated according to their measured relative efficiency as producers of marketable produce in a commercial environment. Show success was therefore no longer of any use to breeders or their clients and if continued would have been detrimental to both. At the Annual General Meeting in June 1978 it was unanimously resolved that competitive showing of Dohne Merinos would cease and that alternative means of publicity and reward for outstanding achievement in sheep breeding would be investigated. This was a major departure from industry practice and far from being contentious, it evoked widespread praise and support from many quarters, including the media.

The appearance and type of the highest producing animals became the norm to aim for. When running all animals together up to test age (12 months) in a natural commercial situation, as was required by the management system, Nature was far better at defining and demonstrating the most efficient type of animal. A vigorous and plain-bodied type began to emerge.

Adaptation No. 4 – Innovative breeding systems

As an understanding of population genetics as advocated by geneticists in the 1970s began to take root a number of large scale breeding schemes began to emerge in New Zealand and Australia. The principles originally advocated by Prof Al Rae of Massey University and applied by Tony Parker of the Romney Development Group in NZ and Jim Shepherd of the AMS in Western Australia, involved the identification of very high producing ewes in a number of participating flocks or studs, concentrating these in Co-operative Nucleus Ram Breeding units from which rams were distributed to the contributors. In this way very high selection differentials were achieved, considerably speeding up the rate of progress to the benefit of all the participants. Very often this entailed the screening of large numbers of commercial ewes from which the most productive were promoted to ram breeding flocks. Jim Shepherd often stated that it was tantamount to a national sin not to identify high performing females in commercial flocks and use them in ram breeding programmes. This led to his de-registration “for conduct contrary to the objects and ethics of the Australian Stud Merino Breeders’ Association”. Fortunately the Dohne Merino Society in South Africa had no such reservations and firmly advocated the incorporation of highly productive commercial flock ewes into the system.

The system was known as the Open Nucleus System – “open” because the nucleus was open to the introduction of high performing sheep from outside, even from affiliated commercial flocks. The Dohne Merino Society immediately incorporated the system in its breeding policy. This was achieved firstly by establishing a Foundation Flock Register whereby the number of ewes in a stud could be augmented by the introduction of high performing ewes from an affiliated commercial flock. Secondly, following the example of Australia and New Zealand, by establishing a number of Co-operative Nucleus Flocks to which participating Stud contributed their most productive ewes in exchange for the best rams bred in the Nucleus.

The system was fully exploited by progressive stud breeders. A large number of highly productive rams emerged from the system - rams that were widely used and had a profoundly positive effect on the productivity of the breed. As technology advanced and more efficient systems of animal evaluation and across-flock comparisons became possible, the system was largely replaced in the 1990s by Sire Reference Schemes which offered a more effective means to evaluate and compare animals in different studs and to monitor the effectiveness of the Ram Selection Indices that were coming into general use.

Adaptation No. 5 – Ram Selection Indices

As computer technology became more sophisticated it became possible to formulate ram selection indices whereby the various traits were combined in an index according their relative contribution to the overall economic performance of the breed. It became very important to accurately define breeding objectives and to design selection indices that would effectively achieve the defined objectives. As meat

and lamb prices improved and wool prices stagnated in the 1980s and 1990s it became very clear that reproduction and growth rate were by far the most important income drivers and therefore needed to receive the highest priority in any selection index.

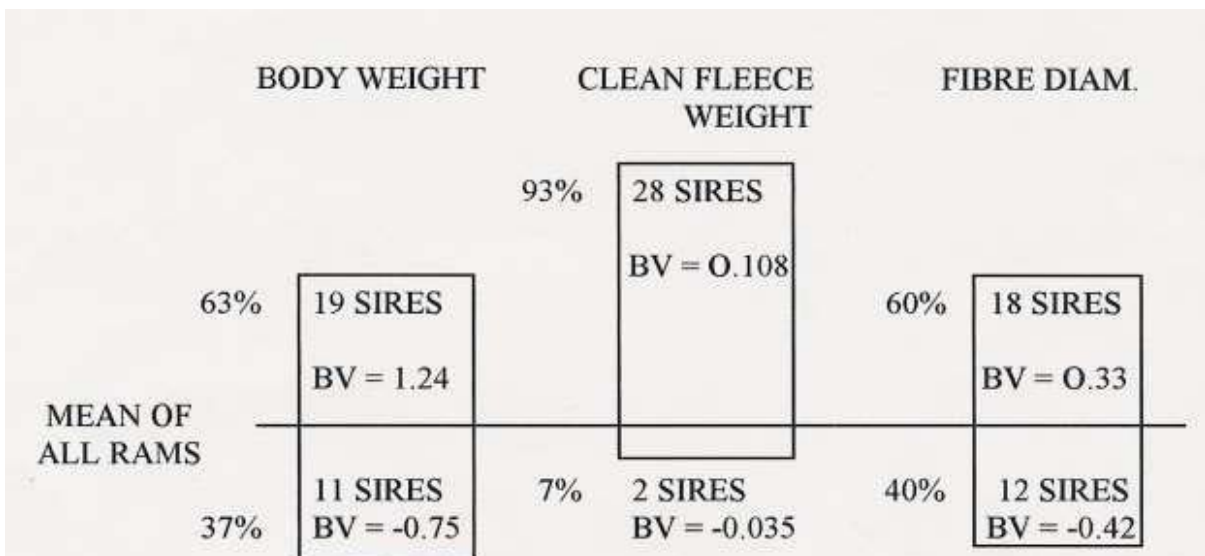
Even up to 1990 however, increasing fleece weight and reducing fibre diameter were still the top priorities, but this was to change. The sheep were probably already genetically capable of growing more wool than the environment could sustain, and that this was impeding their potential for meat production. It was necessary to take a hard look at the economics of sheep and wool production. It became clear that excessively high fleece weight, relative to body weight, was negatively correlated with the traits that influenced meat production – hardiness, reproduction rate and growth rate. This observation was supported by ground-breaking research by scientists such as Danie Wentzel (1991) and Tino Herselman (Herselman *et al* 1993). This was a radical departure from conventional wisdom where increasing fleece weight, even to this day, seems to remain the main selection objective in Merino circles. It became necessary to carefully monitor the effect of our ram selection index.

The Dohne Selection Index up to 1990 was: $(1 \times BW) + (15 \times CFW) + (-2 \times FD)$
where BW = Yearling Body Weight, CFW = Clean Fleece Weight and FD = Fibre diameter.

With higher premiums for fine wool in 1990 it was amended to: $(1 \times BW) + (15 \times CFW) + (-3 \times FD)$

Information from Sire Reference Schemes resulted in a major modification in 1995. The analysis of sire performance showed that 93% of the 30 top sires were breeding excessive fleece weight (Figure 1), deviating from the principle of true dual-purpose sheep.

Figure 1. Breeding values of the 30 top sires in 1995



From the 1990s wool was no longer the main income driver. The key to increasing profitability was not fleece weight *per se* but rather the correct relationship between fleece weight and body weight – a

ratio that became known as the **Wool Production Potential**, where clean fleece weight was expressed as a percentage of body weight at test age (WPP%). With the data constantly being accumulated it was very easy to determine the level of this ratio for each breed and each flock of sheep in South Africa. It soon became evident that at levels above 7%, reproduction and growth rates were severely impeded. Evidence in the most profitable flocks showed that the optimum ratio for maximising income from meat and wool lay between 5% and 6%. Sheep that fall within this range simply live easier, have more lambs that grow faster and can handle more stress.

In 1995 the Selection index was amended to **(1 x BW) + (8 x CFW) + (-5 x FD)** effectively reducing the fleece weight component and increasing the emphasis on fibre diameter. The WPP% and fibre diameter declined, the fitness of the sheep improved dramatically as did lambing percentages and growth rate. In 1996 the average WPP% of all Dohne's was 6.76% and the average lambing % was 108%. Thirteen years later in 2009 the WPP% was 5.15% and the lambing % over all studs had risen to 141% (Figures 2 and 3).

Figure 2.

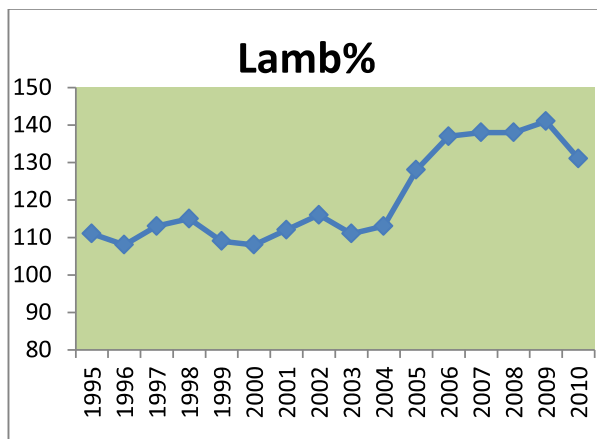
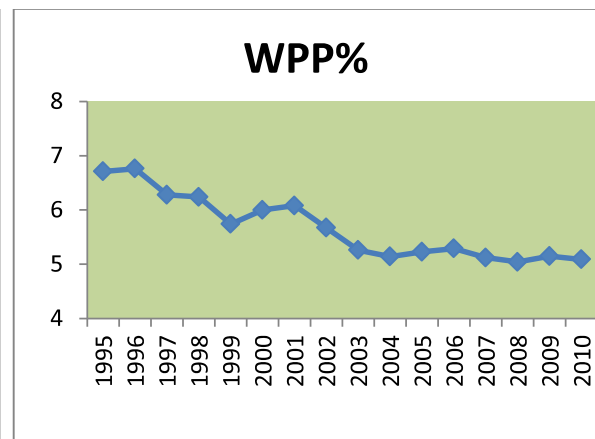
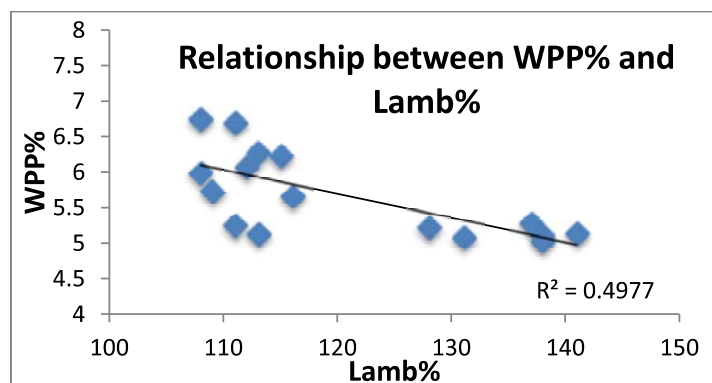


Figure 3.



While a proportion of the improved reproduction must be attributed to better management, there is nevertheless a strong relationship between reproduction and WPP% (Figure 4).

Figure 4.



In 2006 the Selection Index was again adjusted to **(1 x BW) + (6.7 x CFW) + (-4 x FD)** to maintain fleece weight at a constant level.

The selection index was changed in 2008 to **(3.95 x BW) + (22.00 x CFW) + (-8.05 x FD)**. The resulting relative selection pressure on Body Weight was 65 %, Clean Fleece Weight 20% and Fibre Diameter 25%.

“The current weightings have not changed fleece weight much. In the 2011 drop, the average fleece weight increase was only + 0.03. The argument was not to let WPP% go below 5%. Since body weight increased substantially it was felt that we needed to increase fleece weight very slightly to maintain the dual-purpose characteristics of the breed. The trend is sufficient proof that the slight adjustment in 2008 was justified. We are monitoring the situation very carefully not to deviate too far from the delicate balance between wool production and body weight” (Kobus Delport, Personal communication).

From March 2014 yearling body weight was replaced by weaning weight and weaning weight maternal in the selection index, which will effectively enhance the early growth and prime lamb attributes of the breed.

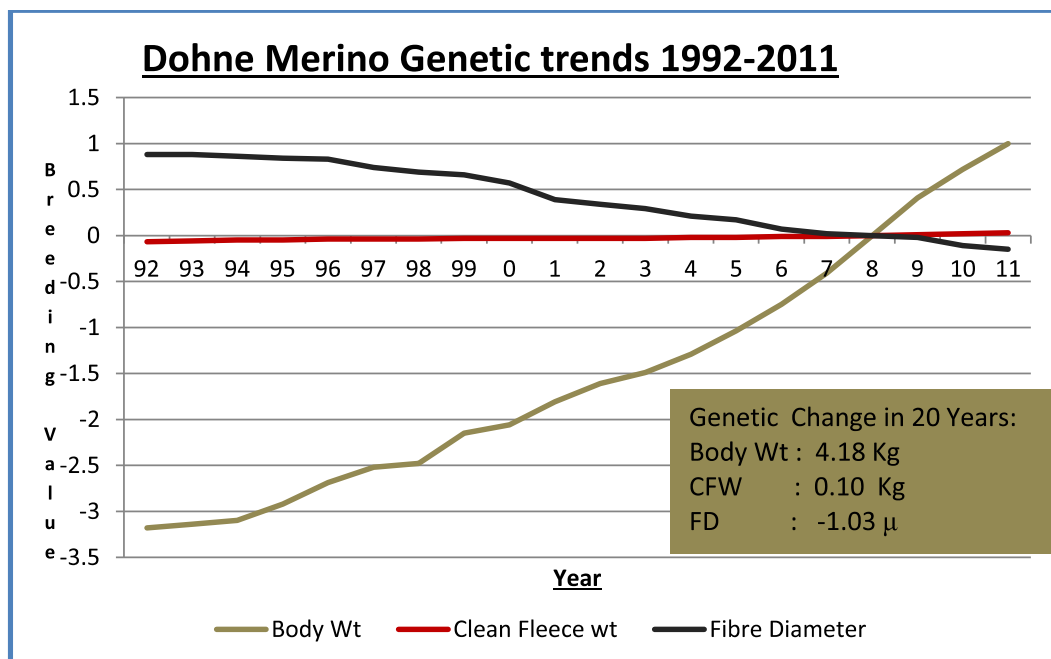
$$SI = (3.95 \times \text{Wean EBV}) + (22.00 \times \text{Clean Fleece Weight}) + (-7.00 \times \text{Fibre Diameter})$$

Where Wean EBV = (0.5 x Weaning wt. direct EBV.) + Weaning wt. Maternal EBV.

Genetic trends

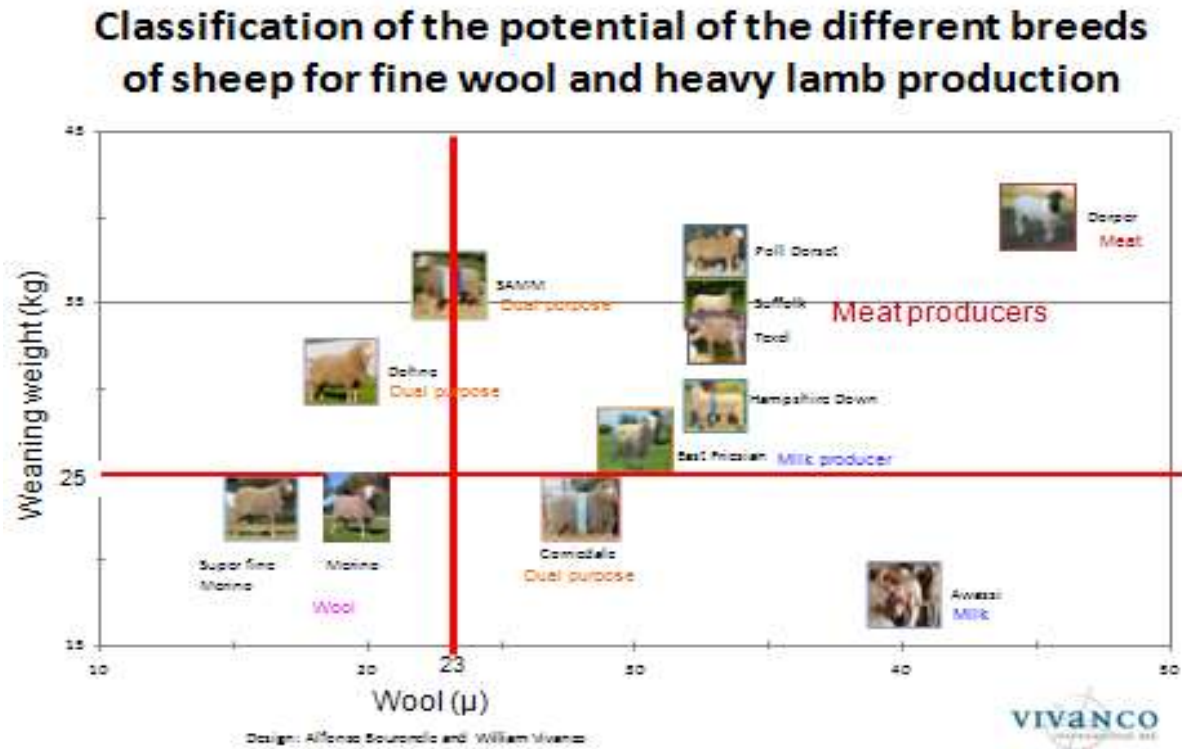
The various adaptations that have been made over the past 20 year have been highly successful in increasing the productivity and adaptability of the Dohne Merino in the many habitats and environments in which they are being run today, fully realising the original breeding objective.

Figure 5.



Where do Dohne Merinos rank currently amongst the sheep breeds of the world? (Figure 6.)

Figure 6. (Design: Alfonso Bouroncle and William Vivanco)



The potential of the Dohne to combine elite fine wool and prime lamb production places it firmly in a position to meet current international demand. Worldwide the demand and preferences (and consequently the prices) for sheep products are focused on fine wool (less than 23 microns, ideally in the range of 17 to 20 microns) and lamb meat either from just weaned lambs (weaned at 110 days) or hogget (24 to 32 weeks of age) with carcass weights of 15 and 25 Kg respectively, with very low back fat measurements, high yield in lean meat commercial cuts and tenderness (William Vivanco, Personal communication, 2013).

Adaptations in Australia 1998 – 2014

The first Dohne Merinos reached Australia in 1998, the initial breeders being Alex Leach and Geoff Beeck of Katanning, WA, followed soon after by Graham Coddington, Roseville Park, Dubbo and Uardry, Hay NSW. Many other importations of Dohne embryos followed and by using sophisticated reproduction techniques the numbers of pure Dohnes increased very rapidly in Australia. Upgrading programmes

with the first young rams that became available were immediately commenced and Australian woolgrowers were able to experience for themselves the dramatic improvement in profitability of the first and subsequent generations of Dohne progeny. In the better environment in Australia the results were even more impressive than in South Africa. The Australian Dohne Breeders Association was formed in 2000. The South African breeding, recording and grading system was adopted, and later enhanced by the addition of traits such as CV% and carcass traits (muscle and fat depth). Full pedigree, birth records and performance were recorded and maintained independently by the NSW DPI within the Dohne Database and across-flock EBVs were routinely calculated. Even though Dohne breeders rapidly built up their pure Dohne numbers evidence of genetic improvement soon became apparent (Figures 7 and 8). The index values are based on across-flock EBVs for the relevant traits therefore all the environment effects have been removed leaving only genetic differences being reported.

Figure 7. Number of Stud Sheep

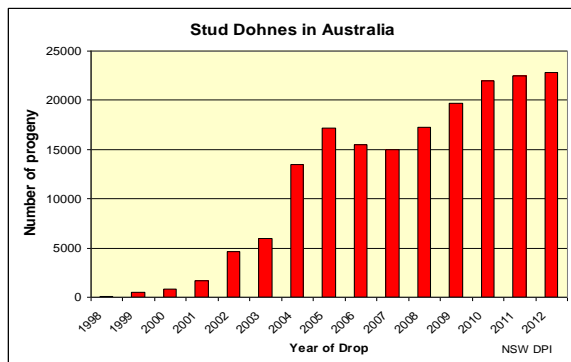
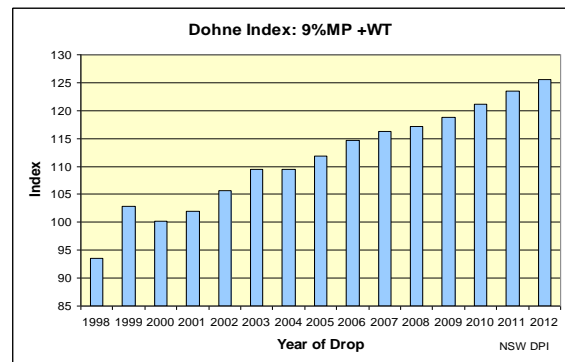


Figure 8. The Dohne Index: 9%MP + WT



While fully maintaining the amount and quality of Merino wool production, the most important **adaptation** that was now available to Australian wool growers using Dohne rams, **was the addition of prime lamb production in self replacing flocks**. At a time when lamb prices were rising rapidly this was an additional lucrative income source in traditional wool growing enterprises. Even F1 (first cross) Dohne lambs easily met prime lamb export standards.

The rate of progress to date in respect of all traits recorded has been very positive. The Breeding Values reported in Figures 9 -12 are "Australian Sheep Breeding Values" (ASBVs) as generated by Sheep Genetics since June 2011.

Figure 9. Weaning Body Weight (WWT)

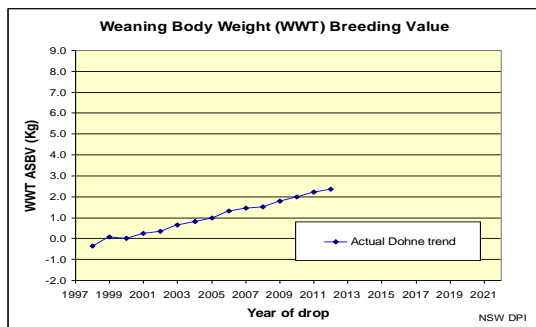


Figure 10. Yearling Body Weight (YWT)

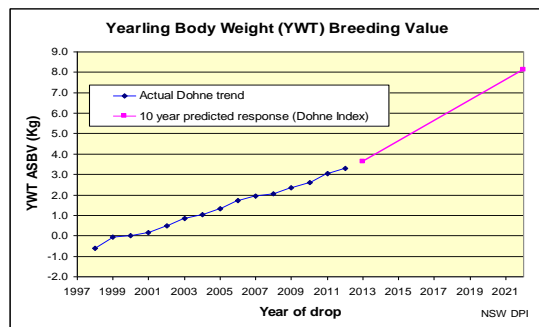


Figure 11. Yearling Clean Fleece Weight (CFW)

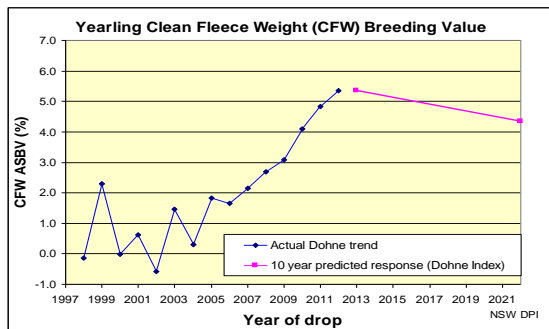
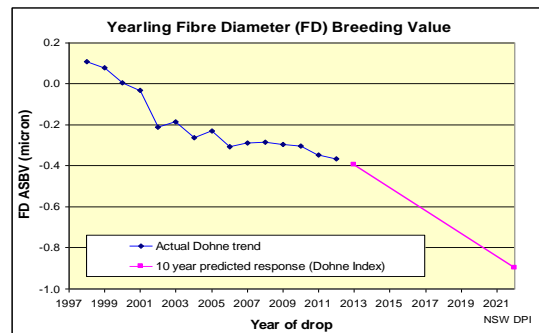


Figure 12. Yearling Fibre Diameter (FD)



The rapid increase in Clean Fleece Weight, as indicated in Fig. 11 could be a matter of concern, but it has been only 2.5% in 5 years, which is a relatively small change. At the same time Body Weight has also been increasing so the crucial balance between Clean Fleece Weight and Body Weight is being maintained. The current Dual-purpose index based on a 9% micron premium was introduced in 2005. In June 2011 the emphasis on bodyweight in the index was proportioned between weaning weight (60%) and yearling weight (40%). (Alan Casey, Personal communication). The predicted slight downward trend in Clean Fleece Weight in Fig. 11 is in line with the breed objective which seeks to increase body weight, maintain fleece weight and reduce fibre diameter. When the index is revised, no undue pressure should be placed on increasing fleece weight. Excessive fleece weight in relation to body weight will have a negative impact on fitness traits which will impair the inherent excellent dual-purpose characteristics of the breed.

Adaptations in South America 2002 – 2014

An important **adaptation** currently taking place in South America is the reduction of Fibre Diameter in the local Corriedale and other coarse woolled breeds. The replacement of medium and coarse wool (23 to 34 microns diameter) in almost all their industrial uses by synthetic fibers has caused a decrease in demand and prices. All the prospective analyses indicate that this tendency will continue in the future (Vivanco, 2007). Because of the importance of lamb meat as an export commodity in most South American sheep producing countries it was important to consider a breed capable of weaning weights of 30+ kg and wool under 23 microns. Only one breed fits these criteria (Fig. 6).

Chile and Uruguay in the last 7 to 10 years initiated pioneering work to change the Corriedale base with the South African Dohne Merino. Uruguay (INIA Uruguay and Cabaña TresArboles) introduced the Dohne in that country in 2002, and in 2004 Cabaña Josefina in Chile started a Dohne breeding programme. The results obtained in both countries have been outstanding and to date considerable reduction in Fibre Diameter has been achieved resulting in an initial increase in wool income of at least 60%. At the same time significant increases in reproduction and weaning weights have been observed in flocks being upgraded to Dohnes. The Dohne Merino is well established in Uruguay with at least three studs and their satellite flocks supplying rams in increasing numbers to commercial sheep

breeders. Workers in Peru and Argentina have followed suit, importing Dohne embryos and semen from Australia.

The Chilean Dohne programme was developed within the framework of a project funded by the Foundation for Agrarian Innovation (FIA). The initiative was launched in April 2003 and the first Dohne embryos were imported in 2004 by Hugo Vera of Cabaña Josefina in the Magallanes region, who has been responsible for increasing the number of pure-bred Dohnes and distributing them to other breeders. Further north in the Aysen province a Dohne breeding programme is being operated by INIA, the Chilean National Institute of Agricultural Innovation at Tamei Aike and Cochrane. This programme, initiated by Filipe Elizalde seeks to provide pure Dohne rams and semen, as well as Dohne x Corriedale rams, for a large group of small commercial breeders in the region. Many thousands of Corriedale ewes have been inseminated over the last few years and the improvement of the wool clips of these smaller breeders has been very positive with a decrease in the order of 5 to 8 microns.

In Argentina the breeding programmes to produce pure Dohne rams and semen from Australian importations was initiated by the Instituto Nacional de Tecnología Agropecuaria (INTA) at various venues such as Mayo River Experimental farm, Chubut and Rincon de los Morros, Santa Cruz. Numbers have increased rapidly. The leader of the group in Trelew is Andres La Torraca, who was responsible for the introduction of Dohnes to Argentina in 2005. INTA is responsible for the genetic evaluation and the assessment of the productivity of Dohnes in different environments as a pure breed and for crossbreeding on Corriedale and Merino. The improvement program includes an open nucleus, and all registered animals have full pedigree and performance information.

The Stud Register and the breeding programme is supervised by the Asociación Argentina Criadores de Merino Argentina (Association of Argentina Merino breeders) and 5 private studs currently exist, mainly in Patagonia. It is significant that there is full co-operation between Dohnes and Merinos in Argentina, which is as it should be, since they are both versions of the same breed. Rams are being used in various environments (Corrientes, Entre Rios north east of Argentina, Buenos Aires, Rio Negro, Chubut, Santa Cruz and Tierra del Fuego) in crossbreeding programmes on Corriedale and Merino. (Dr Alejandro Vozzi, personal communication)

At the instigation of Dr William Vivanco, INIA Peru (Peruvian National Institute of Agricultural Innovation) initiated a pure bred Dohne breeding programme in 2005 with material from Australian Dohne studs. The objective was to provide rams and semen to upgrade the local "Criollo" sheep (sheep naturalized to the high Andes from their introduction by the Spaniards 500 years ago). These sheep have very poor productive characteristics - coarse wool and very low body weights. Corriedale sheep and their crosses with the Criollo are also involved at two different locations, one in the central highlands at 3200 meters elevation (Experimental Station Santa Ana, Huancayo, Peru) and the other in the southern highlands at 3,900 meters elevation (Experimental Station Illpa, Puno, Peru). Dr Vivanco has persuaded two very important mining companies to react positively to his recommendation to sponsor the re-orientation of sheep production towards fine wool and high quality lamb meat in these deep rural areas using the Dohne Merino as the basis. The programme is currently well underway.

At 52 degrees south the Falklands are a difficult environment for sheep production. Traditionally sheep production has been from broad wool breeds such as Corriedale and Polwarth with low wool cuts and lambing percentages of 60% and less. The establishment of an abattoir giving Falkland sheep farmers

access to the international meat market, enhancing the possibility of increasing income from the meat component of the flock, together with a decline in price of strong wools, provided the incentive in the early 2000s to **adapt** to a dual-purpose fine wool breed in the 18 to 23 micron category. Dohne Merinos, with their reputation for hardiness, easy care, high fertility and prime lamb potential were a clear option and from 2003 a number wool growers began importing Dohne embryos and semen from both Australia and South Africa. Outstanding results have been achieved with an increase in production and revenue from finer wool and meat, as well as an increase in the value of breeding stock. (Neil Judd, Ben Bernstein and Andrez Short, personal communications)

The Versatile Breed

The slogan adopted by Dohne breeders in South Africa is “The Versatile Breed”, and judging by the positive impact the Dohne has had in many countries, this is very appropriate. The Dohne is truly an example of how the Merino has been successfully adapted to meet the requirements of a range of different applications in different countries.

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