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Livestock

Importance of measuring livestock key performance indicators

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Key messages

- **Mixed farming businesses will benefit by using key performance traits to develop a flock of highly efficient sheep.**
- **Animals should be individually measured to determine their performance for the major profit drivers of meat, wool and progeny, and then selected to remain in the flock on this merit for optimum enterprise productivity, and therefore profitability.**

What is the issue?

Current record meat and wool prices are paving the way for substantial profitability growth in enterprises throughout the Australian sheep industry. However, in many mixed farming businesses across southern Australia, including the Eyre Peninsula, livestock are still considered to be an inferior enterprise when compared to the higher investment of time, money and effort into cropping. Progression in the cropping industry can be attributed to the advancement in plant genetics (genotypes) and technologies that enable the grower to measure their crop performance (phenotypes) and manage the cropping system responsively. Unfortunately, there has been poor uptake of this improvement process in the sheep industry, and as a result productivity and efficiency gains remain stagnant in flocks of many mixed enterprises.

To capture potential productivity and profitability gains with current markets, phenotypic traits or key performance indicators (KPI's) that optimise enterprise income should be measured. Businesses that are recording and selecting on animal phenotypes, and introducing new genotypes accordingly, are optimising their productivity and capitalising on the high prices. They have a significant advantage over those who don't measure flock production traits and tolerate substandard livestock to persist in their sheep flocks (referred to as 'passengers').

Why do the trial?

Mixed farming businesses need a system that can develop a highly efficient sheep flock using KPI's. Currently, standard KPI's in livestock enterprises include stocking rate, gross margin per area, cost of production per unit, quantity and quality of meat and wool produced, and profit from livestock trading, wool and meat sales. Generally, emphasis is placed on these measures according to area or whole flock, but the importance of production characteristics from individual animals is often not as valued as it ought to be. For example, profit drivers should be considered by determining the kg of wool produced per kg of animal in a Merino enterprise, or kg of lambs weaned by kg of ewes joined in a self-replacing enterprise, before determining how this fits into profitability per area or enterprise. Efficiencies are gained when you can improve the output per animal for the same cost of production.

Animals should be individually measured to determine their performance regarding phenotypic traits of reproduction, growth rates, wool and meat production, health status and lifetime performance in these areas, including their progeny. They can then be selected to remain in the flock on this production merit, and subsequent profitability.

Table 1 Minnipa Agricultural Centre individual sheep data records (2010-2018)

Year of measurement	2010	2011	2012	2013	2014	2015	2016	2017	2018
Birth (0-24 hours)									
Sire pedigree	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dam pedigree	✓		✓	✓	✓	✓	✓	✓	✓
Birth date			✓	✓	✓	✓	✓	✓	✓
Birth weight	✓		✓	✓	✓	✓	✓	✓	✓
Birth type	✓		✓	✓	✓	✓	✓	✓	✓
Lamb vigour			✓	✓	✓	✓	✓	✓	✓
Maternal temperament			✓	✓	✓	✓	✓	✓	✓
Rectal temperature			✓	✓	✓				
Birth mob/paddock		✓	✓	✓	✓	✓	✓	✓	✓
Death date			✓	✓	✓	✓	✓	✓	✓
Cause of death			✓	✓	✓	✓	✓	✓	✓
Marking (6-8 weeks)									
Marking date	✓	✓	✓	✓	✓	✓	✓	✓	✓
Breech & body wrinkle	✓	✓	✓	✓	✓	✓	✓	✓	✓
Weaning (12-14 weeks)									
Weaning date	✓	✓	✓	✓	✓	✓	✓	✓	✓
Weaning weight	✓	✓	✓	✓	✓	✓	✓	✓	✓
Yearling (10-13 months)									
Body weight	✓	✓	✓	✓	✓	✓	✓	✓	✓
Eye muscle depth	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fat depth	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sheep class		✓	✓	✓	✓	✓	✓	✓	✓
Breech & body wrinkle	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fleece weight	✓	✓	✓	✓	✓	✓	✓	✓	✓
Wool quality*	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hogget (13-18 months)									
Body weight	✓	✓	✓	✓	✓	✓	✓	✓	
Horn/Poll		✓	✓	✓		✓	✓	✓	
Sheep class	✓	✓	✓	✓	✓	✓	✓	✓	
Pedigree (DNA)		✓							
Adult (18 months or older) – annual measure									
Body weight	✓	✓	✓	✓	✓	✓	✓	✓	
Sheep class		✓	✓	✓	✓	✓	✓	✓	
Pregnancy scan	✓	✓	✓	✓	✓	✓	✓	✓	
Progeny number	✓	✓	✓	✓	✓	✓	✓	✓	
Rearing number	✓	✓	✓	✓	✓	✓	✓	✓	
Fleece weight	✓					✓	✓	✓	
Wool quality*	✓						✓	✓	

**Wool quality includes (µm, Mic' Dev, S.D., C.V, SpinF, Curv', C.F%, YLD%)*

How was it done?

Individual animal data for the Minnipa Agricultural Centre (MAC) research sheep flock have been captured annually since 2010. The data have been used to benchmark the livestock enterprise, and using KPI's, determine separate animal performance and efficiency within the flock. Measurements collected from the research flock are listed in Table 1.

Analysis has been undertaken on adult ewes born from 2010-2015 and hogget ewes born in 2016 which have recorded at least one pregnancy (therefore have a set of reproductive measures) to give dataset accuracy, i.e. avoids comparing cull or consistently dry animals against pregnant or lactating animals.

What happened?

Table 2 presents the average and range of a series of productive measures from the maiden (2016 drop) and adult (2010-2015) ewe flock at the MAC. The importance of reporting the range of data as well as the average is to show the large differences in production measurements across the flock, demonstrating that some animals are more productive than others, as determined by progeny, wool and meat records.

Using this information can make selection decisions easier within a flock, particularly if the purpose of culling animals is not always obvious. Understanding how individual ewes are performing based on KPI's of the entire flock can assist in choosing the most productive, therefore most profitable animals, which can increase the rate of flock improvement substantially.

Comparing how an animal is expressing traits such as number of progeny, kg of wool or kg of meat per annum against their dry weights (which relates to the amount of feed required by the animal to produce that amount), is one way to analyse the information collected as a KPI. This can be assessed in several different ways.

Table 3 shows a selection of ten ewes from the MAC flock with varying ages and dry weights to represent the range of the best (good) and the worst (poor) production measures. Drops from 2012-2016 have been chosen for the most comprehensive set of information and to compare maiden ewes.

Table 2 Minnipa Agricultural Centre weight, progeny, wool and meat production measures for maiden (2016 drop) and adult (2010-2015 drop) ewes

Measure	Maidens (2016)		Adult Ewes (2010-2015)	
	Average	Range	Average	Range
Weight (kg)				
Dry (joining)	46	37 - 55	68	41 - 100
Wet (scanning)	58	43 - 72	69	44 - 94
Wet (3rd trimester)	59	42 - 77	70	44 - 95
Wet (weaning)	68	50 - 88	75	48 - 111
Progeny				
Total number of lambs born	0.9	0 - 2	2.5	0 - 9
Total number of lambs weaned	0.8	0 - 2	1.9	0 - 9
No. progeny weaned per annum	0.8	0 - 2	0.8	0 - 3
Wool				
Total kg of GFW	10.6	6.2 - 15.3	18.6	2.4 - 38.6
Kg wool per annum	5.3	3.1 - 7.7	5.3	0.8 - 8.9
Meat				
Total kg of lambs weaned per ewe	27	0 - 78	57	0 - 281
Total kg of lambs weaned (-dries*)	39	24 - 78	85	17 - 281
Kg lambs weaned per annum	27	0 - 78	21	0 - 72
Kg lambs weaned per annum (-dries*)	39	24 - 78	31	6 - 72

**minus the ewes which were dry in that particular year*
***average number of years of data for maidens is 1 and adult ewes is 2.4, total average 2.2 years*
****number of animals in maiden group is 109 and adult ewes is 681, total number 790 animals*

Table 3 'Good' versus 'poor' ewes in the Minnipa Agricultural Centre flock (2012-2016 drops) in relation to dry weights and KPI's

			Ewe weights (kg)			KPI's per annum		
Category	**Ewe**	**Drop year**	**Av. Dry joining**	**Av. Wet pre-lamb**	**Av. Lactating**	**kg lambs weaned**	**kg wool cut**	**no. progeny weaned**
Good	A	2016	49.0	54.0	65.0	66.0	6.5	2.0
	B	2015	56.6	77.0	69.0	59.0	6.2	2.0
	C	2014	64.6	69.5	64.8	57.0	6.9	2.0
	D	2012	83.4	94.8	91.1	70.3	7.1	2.0
	E	2014	76.1	77.0	68.4	64.5	7.7	2.0
Poor	F	2012	80.2	76.5	88.0	31.0	5.2	0.3
	G	2013	60.2	49.5	61.3	25.0	3.8	0.7
	H	2014	73.2	71.5	72.7	38.0	3.7	0.5
	I	2015	56.4	69.0	72.8	30.0	4.7	0.5
	J	2016	47.5	70.5	73.0	25.0	3.8	1.0

Table 4 'Low' versus 'high' ewe dry weight in the Minnipa Agricultural Centre flock (2012-2016 drops) in relation to dry weights and KPI's

			Ewe weights (kg)			KPI's per annum		
Category	**Ewe**	**Drop year**	**Av. Dry joining**	**Av. Wet pre-lamb**	**Av. Lactating**	**kg lambs weaned**	**kg wool cut**	**no. progeny weaned**
Low	K	2016	37.0	53.0	56.0	26.5	5.7	1.0
	L	2013	59.0	60.3	61.3	31.8	6.9	1.3
	M	2015	49.1	53.0	64.5	35.0	5.2	1.5
	N	2015	49.9	57.0	64.0	32.0	7.0	1.0
	O	2014	53.6	64.0	63.8	29.5	6.7	0.7
High	P*	2016	55.2	58.0	72.5	41.5	5.3	1.0
	Q	2015	71.1	78.0	87.5	38.3	7.5	1.5
	R	2013	84.9	83.3	88.4	21.6	6.2	0.8
	S	2011	87.1	85.0	87.0	23.0	5.2	1.0
	T	2014	85.4	80.0	85.0	30.5	4.2	0.5

**Ewe P is included in the 'high' weight category as it is the heaviest animal in the 2016 drop (maiden ewes)*

The KPI's in Table 3 show that high levels of meat, wool and reproductive production can be achieved with a range of weights, with the MAC flock recording the most productive animals having dry weights between 49 kg to 83.4 kg. These ewes have achieved over 57 kg of lamb weaned, 6.2 kg of greasy wool cut and reared two lambs per annum over the measured period. This is compared to the 'poor' animals that have weaned under 38 kg of lamb, cut under 5.2 kg of wool and weaned one lamb or less per annum, with dry weights ranging from 47.5 kg to 80.2 kg.

As an example, the contrast between ewe A (good) and ewe F (poor) shows that ewe F is almost an extra 30 kg heavier at dry weight, yet is weaning under half the kg of lambs, cutting over a kilogram less wool and weaning less than a quarter of the progeny per annum than ewe A. There are many other comparisons that could be made, but a key trait to observe in Table 3 is the amount of product (meat, wool or progeny) that has been produced per kg of dry ewe, considering the energy (food and water) inputs into that animal. This demonstrates the greater efficiency of some ewes over others, and highlights the importance of measured livestock data.

Another way to assess the information is by likening 'low' versus 'high' ewe dry weights directly with production data and KPI's. Table 4 presents the history of the ten ewes in their age groups with the lowest dry weights, compared to the highest dry weights and how their production measures differ.

Table 4 shows that the lowest dry weight ewes ranged from 37 kg to 59 kg and produced 27-35 kg of lambs weaned, 5-7 kg of wool cut and weaned between 0.7-1.5 lambs per annum. Ewes with the highest dry weight range of 55 kg to 87 kg produced 22-42 kg of lambs weaned, cut between 4.2-7.5 kg of wool and reared 0.5-1.5 lambs per annum.

Using an example from Table 4, the low versus high dry weights of ewes L and R, both dropped in 2013, can be compared by calculating the amount of product that they have produced per 10 kg of body weight. This equates to 5.39 and 2.54 for kg of lambs weaned, 1.17 and 0.73 for kg of wool cut and 0.22 and 0.09 of lambs weaned per annum for the 'low' weight ewe L and 'high' weight ewe R respectively, portraying that greater weight does not necessarily result in additional product.

What does this mean?

Understanding the KPI's in a sheep enterprise is important to ensure that your flock is continually progressing by culling out under-performing animals. Production data can go unnoticed if not measured over several years, which allows poor ewes to remain in the system and can subsequently lead to them breeding meagre progeny. The three KPI's presented in this article were chosen due to their significant impact on overall enterprise profitability. Meat, wool and progeny per head are the major profit drivers of self-replacing enterprises and therefore important traits to measure.

Being 'time-poor' is one of the main reasons for poor uptake of current technologies in the livestock system, however the adeptness at which these traits can be captured using innovative technologies is becoming considerably more efficient and cost-effective. Implementing sheep handling and measuring technologies provides sheep enterprises with the opportunity for optimum productivity, and therefore profitability, with reduced labour intensity.

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Useful resources

Nuffield Farming Scholarships Trust Report - Optimising ewe performance for a productive sheep enterprise and a high quality finished lamb. James Drummond, 2015. Available online at www.nuffield.com.au.

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