Profitability Analysis of Different Reproduction Methods with Dohne Merinos

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Abstract

The management of new technology for farming is important, as it has an influence on the profitability of the farm. With the development of new technology, new breeding methods have been developed and have an influence on the profitability on a sheep farm. This article studies the difference in gross margins for three kinds of reproduction methods with sheep namely: Conventional, Artificial Insemination and Cervical Insemination. Four different scenarios have been developed and for each of the scenarios the gross margins have been calculated, according to the assumptions made in the scenario. This resulted in the comparison of the new breeding technology against the conventional technology, taking into account the all the different factors. It was found that with the use of newbreeding technological methods insheep (A.I. and C.I.) a producer can increase the profitabilityof his herd, despite the higher capital investment required.

Introduction

Profitability and management of new technology are very importantin farming. Deviation from good management practices will have a negative influence on the production and reproduction ability of the farm and thus on the profitability. The advantage of good management is that success is almost guaranteed. Part of the management process for a Dohne Merino producer is the decision about reproduction technology to be used. Several new reproduction methods had been developed, and the implementation and the adoption of these modern technologies are affected by several key factors. This paper will firstly provide background on conventional and artificial reproduction methods and compare some key advantages and disadvantages of each method. Further some basic gross margin models has been developed using standard assumptions for each of the four scenarios. Each scenario complies with the standard assumptions and other deviations that can occurand provide the background information to determine the gross margins that can be compared for each method used, to determine the most profitable method.

Adoption of technology in agriculture

According to economists, the rapid change in the structure of the U.S. hog industry has been causedby several factors, with development and adoption of new technology being almost the most important (Gillespie, Davis &Rahelizatovo, 2004). Artificial insemination and oestrus synchronization are technologies that can help with the reproduction management in herds. According to Rees, Parcell, Patterson, Smith & Poock (2010), the usage of these technologies can increase the production efficiency of the herd and enhance the genetic characteristics, while the study by Gillespie *et al* (2004) state that the usage of breeding technologies allow for the timely production of greater number of consistent quality hogs with a given set of resources. There are several limitations for the adoption of new technology, as it may require some fixed costs that are associated with new instrumentsand investments inlearning time, locating and developing markets and training labour. These new costs may sometimes reduce the adoption of new technology and the low adoption rate of small farmsshows the vital relationship between farm size and adoption rate (Just &Zilberman., 1983). As mentioned in the paper by Rees *et al.* (2010), the adoption of the Artificial Insemination technologies is less than 10 %. Risk can be seen as a key factor in the adoption of new technologies and the farm size has a critical role in the adoption of new technology. Just and Zilberman (1983) has researched three situations of farm size in relation to technologyadoption. The resultsshow that high fixed cost can prevent small farmers from adopting technology (Just & Zilberman, 1983). These results are also reflected in the study done by Gillespie *et al*. (2004), which shows the greater number of hogs the producer owns the higher the rate of adopting Artificial Insemination.

The adoption of new technologies can play a major role in enhancing the productivity of animals due to two features. First the perceived riskiness of the future farm yield after the adoption of the new technology and secondly, the production or price uncertainty related to farming itself (Koundouri, Nauges & Tzouvelekas, 2006). The findings of research paper by Rees *et al* (2010), suggest that the adoption of artificial insemination technology is influenced by human capital, measured by age and information usage, as well as natural capital that represents nine Missouri regions. Results from the study from Kim and Chavas (2003), indicate that technological progress contribute to reducing farm risk over time, but these results can vary (Kim & Chavas, 2003).

Background to reproduction methods

Each of the reproduction methods has different key aspects that are identified with the specific method but there are factors that are similar in more than one of the methods. The following section provides basic background of each method, with summaries of the important advantages and disadvantages.

Conventional reproduction method

Group or flock breeding is when the rams are added to the ewes as a group for a period of more or less 34 days. Thenumber of rams is normally calculated as 3 to 4 % of the total number of ewes (Calldo, Melville, & Calldo). The matingcapabilities of the rams are to breed between 30 - 40 ewes per ram in a season or in other terms between 1 or 2 ewes per ram per day. The advantages of this method include that very little time, labour and costs are required (Calldo *et al.*).There are several disadvantages, which will have an effect on the reproduction of the herd. Some of these disadvantages include: Rams are not used to their full potential and the older dominant rams have the tendency to keep other rams away from the ewes. Young ewes are not mated because the rams usually prefer the matured ewes (Calldo *et al.*). A disadvantage is that due to the large number of rams needed for reproduction; it leads to a situation where inferior rams are purchased to save costs. Because of the inferior rams that are bought, producers struggle to supply their herds with genetic improvements.

Artificial reproduction methods

Artificial Insemination is one of the most cost effective ways to improve a gene pool, because high quality semen can be purchased without the investment in and any expenses that are associated with buying a ram, boar or bull (Gillespie *et al*,. 2004). Breeding technologies, like Cervical Insemination and Laparoscopic Insemination, help with the timely production of greater number of consistent quality animals from a set of resources. In a study done by Gillespie *et al.* (2004), evidence from the United States show an increase in technical efficiency associated with improved breeding technologies in the pig industry. The increase in piglets per farrowing sow for the period 1991 to 2001 increased from 15.8 piglets in 1991 to 17.6 piglets in 2001 this is an efficient increase of 11 % (Gillespie *et al.*, 2004).

There are two Artificial Inseminationmethods that can be used, Cervical Insemination (C.I.) and Laparoscopic Insemination (L.I.).

C.I. requires a relative small investment initially, as the adoption of the new technique is not associated with great costs and it is an easy to learn technique. The method provides the opportunity for a producer to impregnate 400 ewes with the semen from a single ram within a period of 3 weeks, after the semen has been collected from a ram artificially and been applied as live part volumes to a number of ewes (Greyling *et al*., 1988). To make use of the C.I. method a producer has to undergo the necessary courses.

Laparoscopic Insemination is a specialized technique that has to be done by a veterinarian (Gillespie *et al.*, 2004) where fresh or frozen semen are placed directly into the uterine horns of a ewe. The semen from a single ram can be used to inseminate more than a thousand ewes over a period of 2 to 3 weeks. An example of the successful use of Laparoscopic Insemination is where a producer had inseminated 299 ewes with fresh semen and got the following results: 277 ewes fall pregnant and produced 52 single lams, 179 twins and 46 triplets; this resulted in a lambing percentage[4] of 183 %. To obtain these kind of figures there are some important aspects to consider for success. Healthy fresh semen has to be used; with the ewes producing healthy ova, the ova and semen must unite in a favourable environment where fertilisation can take place and develop (Ramsem, 2010).

Table 1 gives a short description for each of the reproduction methods in key areas that have been identified as important in reproduction decision making.

Table 1: short explanations of the different production methods

Aspects	Conventional	Artificial Insemination	Laparoscopic Insemination
Genetic Improvement	Little and slow	Good and fast improvement	Maximum improvement, best rams used for a large number of ewes. Relative economic value added – illustrates the additional income from the lambs of a ram above average lambs income.
Strategic utilization of feeding	Less effective, 5 weeks mating period, 5 weeks lambing	Feeding can be planned and done strategically	Shortest time for nutritional stimulus, only for lambing period, creep feeding and finishing of lambs.
Lambing period	Minimum of 5 weeks	Shortened to 1 – 3 weeks	Ultra short period of ± 5 days
Usage of lambing cages	Can be utilized, but not optimally	Good utilization	Optimum utilization because of ± 5 days of lambing
Management and labour	Long term supervision during lambing	Shorter term supervision	Ultra short term for supervision, but requires maximum attention for the period
Management of lambs	Large age differences	Uniform lamb groups, accurate records with simultaneous weaning and	Lambs of similar age concentrated and simplified tasks. Lamb cages are effective

[4] Lambing percentage = Number of lams/ number of ewes inseminated

		marketing	and safe
Summary for herd producer	Small financial investment	Improved genetics and the benefits of synchronization	Rapid breeding and management benefits
Summary for the stud producer	Best rams	Are used with great success on stud farming	Optimum usage of best genetics, management benefits over the lamb's lifetime.

Source: Ramsem (2010)

Assumptions of the Gross margin analysis model

To determine the gross margin of each production method, five scenarios where created, each with certain assumptions to help with the calculations. The scenarios are based on a constant breeding herd; all the lambs that are born are marketed at an average live weight of 42 kg, with a slaughter percentage of 46 % or 19.78 kg and a market carcass price of R 33.00/ kg. The ratio of ram to ewe lambs are 50:50 and the number of lambs are calculated using the weaning percentage.

Other important facts are that the farm is within 200 km of Ramsem, Bloemfontein, and only the necessary A.I. equipment is bought by the producer, although it is important to mention that there is other equipment that can be purchased also to simplify the process. There are two permanent labourers on the farm, and therefore only two additional labourers are hired for the short period when the C.I. and L.I. is done. The cost of rams for every method, except Laparoscopy where semen are bought, is paid over a two year period and only half of the purchase price of the rams are thus included in each year. The rams that are used for C.I. are more expensive, because the producer can buy less rams, with better genetic capabilities, for the same amount of ewes.

The basic costs and quantities of the model are illustrated in Table 2.

Table 2: Cost Model information

	Quantity	**Cost / unit**
Ewes		
Conventional, A.I. and Laparoscopy	300	
Rams		
Conventional	12	R 3 000
C.I.	4	R 8 418
Laparoscopy (Semen)	300	R 60
Lam cages	260	R 55
Veterinarian	300	R 38
Labour	120	R 6.31

Scenarios fitted to the model

Scenario 1

This scenario includes all of the standard assumptions, except that it will describe the effect on the herd without the usage of lambing cages. Lambing cages have a large positive influence on the weaning percentage of a herd. According to Dr. Jasper Coetzee (2007) the usage of lambing cagesincrease the weaning percentage by more or less 10 % in comparison without the use of lambing cages. The weaning percentage for the Conventional, C.I. and L.I. are 90 %, 110% and 110 % respectively without the use of lambing cages. The gross margin analysis is shown in Table 3.

Table 3: Gross margins for scenario 1

	Conventional	C.I.	L.I.
Revenues			
Marketing Income	R 176 239.80	R 215 404.20	R 215 404.20
Relative Economic Value added			R 6 765.00
Revenues	R 176 239.80	R 215 404.20	R 222 169.20
Expenses			
Rams	R 30 000.00	R 16 836.00	
Semen			R 18 000.00
C.I. Equipment		R 4 497.00	
Synchronisation		R 8 935.00	R 8 935.00
Nutrition Stimulus Rams	R 2 110.03	R 628.63	
Nutrition Stimulus Ewes	R 10 689.18	R 10 689.18	R 10 689.18
Veterinarian			R 11 400.00
Additional Labour		R 1 514.40	R 1 514.40
Expenses	R 42 799.20	R 43 100.21	R 50 538.58
Gross Margin	R 133 440.60	R 172 303.99	R 171 630.62

Scenario 2

All the standard assumptions and costs are used in scenario 2. The usages of lambing cages have an important effect on the weaning percentage. Where the loss of lambs was at 15 % in scenario 1, in this scenario only 5 % is lost (Coetzee, 2007). The weaning percentage is thus 100 %, 120% and 120 % for each of the methods. The calculations of the gross margin for each of the methods are illustrated in Table 4.

Table 4: Gross margins for scenario 2

	Conventional	C.I.	L.I.
Revenues			
Marketing Income	R 195 822.00	R 234 986.40	R 234 986.40
Relative Economic Value added			R 7 380.00
Revenues	R 195 822.00	R 234 986.40	R 242 366.40
Expenses			
Rams	R 30 000.00	R 16 836.00	
Semen			R 18 000.00
C.I. Equipment		R 4 497.00	
Synchronisation		R 8 935.00	R 8 935.00
Nutrition Stimulus Rams	R 2 110.03	R 628.63	
Nutrition Stimulus Ewes	R 10 689.18	R 10 689.18	R 10 689.18
Lambing Cages		R 7 150.00	R 7 150.00
Veterinarian			R 11 400.00
Ewe feeding pre and during Lambing Cages		R 38 933.58	R 38 933.58
Additional Labour		R 1 514.40	R 1 514.40
Expenses	R 42 799.20	R 89 183.80	R 96 622.16
Gross Margin	**R 153 022.80**	**R 145 802.60**	**R 145 744.24**

Scenario 3

Scenario 3 is the same as scenario 2, but is aimed at producers that have a very high weaning percentage, due to very good management. Producers strive for the highest possible weaning percentage and it must be as close as possible to the lambing percentages. The weaning percentages are 110 %, 145 % and 155 % respectively for Conventional, C.I., and L.I.

Table 5: Gross margins for scenario 3

	Conventional	C.I.	L.I.
Revenues			
Marketing Income	R 215 404.20	R 283 941.90	R 303 524.10
Relative Economic Value added			R 9 532.50
Revenues	R 215 404.20	R 283 941.90	R 313 056.60
Expenses			
Rams	R 30 000.00	R 16 836.00	
Semen			R 18 000.00
C.I. Equipment		R 4 497.00	
Synchronisation		R 8 935.00	R 8 935.00
Nutrition Stimulus Rams	R 2 110.03	R 628.63	
Nutrition Stimulus Ewes	R 10 689.18	R 10 689.18	R 10 689.18
Lambing Cages		R 7 150.00	R 7 150.00
Veterinarian			R 11 400.00
Ewe feeding pre and during Lambing Cages		R 38 933.58	R 38 933.58
Additional Labour		R 1 514.40	R 1 514.40
Expenses	R 42 799.20	R 89 183.80	R 96 622.16
Gross Margin	**R 172 605.00**	**R 194 758.10**	**R 216 434.44**

Scenario 4

Scenario 4 is aimed at a stud breeder to produce stud animals that can be marketed and sold on auctions, and on the normal producer who aims at improving the animals in his herd. The marketing of lambs differ from the previous scenarios. Some of the lambs are marketed as stud rams and ewes; this means that they will be sold at a higher price than the other lambs. This premium supplies the producer with new revenue option that increases his gross margin. The lambs sold as stud animals are shown separately in the gross margin tables as lambs and the normal marketing lambs are still shown as marketing income.

Table 6: Gross margins for scenario 4

	Conventional	C.I.	L.I.
Revenues			
Relative Economic Value added			R 7 380.00
Marketing Income	R 195 822.00	R 187 989.12	R 182 114.46
Lambs		R 92 373.30	R 137 373.30
Revenues	R 195 822.00	R 280 362.42	R 326 867.76
Expenses			
Rams	R 30 000.00	R 32 000.00	
Semen			R 18 000.00
Synchronisation		R 8 935.00	R 8 935.00
C.I. Equipment		R 4 497.00	
Nutrition Stimulus Rams	R 2 110.03	R 628.63	
Nutrition Stimulus Ewes	R 10 689.18	R 10 689.18	R 10 689.18
Lambing Cages		R 7 150.00	R 7 150.00
Veterinarian			R 11 400.00
Ewe feeding pre and during Lambing Cages		R 38 933.58	R 38 933.58
Additional Labour		R 1 514.40	R 1 514.40
Expenses	R 42 799.20	R 104 347.80	R 96 622.16
Gross Margin	R 153 022.80	R 176 014.62	R 230 245.60

Findings and discussion

The gross margin for each of the reproduction methods depends heavily on the deviations from the standard assumptions. These deviations identify several of the key factors in reproductiontechnology that can play a role to increase the revenue generatedand the gross margin with sheep farming.

A conventional commercial approach to sheepfarming method is illustrated in scenario 1, where the sheep are kept in the veldt to lamb. The rams and ewes are fed with a nutrition stimulus for the required period, but there are no other expenses like lambing cages included. The results of the gross margin show that the artificial methods provide the producer with larger gross margin than with the conventional method. This is due to the larger income that is obtained with the marketing of more lambs from a higher lambing/weaning percentage. The expenses that are allocated to each of the method does not show a big difference, accept for the difference between the conventional and L.I. methods. The C.I. method has the largest gross margin of the three methods. The margin though is just a fraction larger than

the L.I. method, but both of the artificial methods margins are much higher than the conventional method.

The difference in the gross margin from scenario 1 and 2 illustrates the effectiveness of lambing cages. The usage of lamb cages has a major effect on the gross margin asthe cages do not only protect the lambs from predators and other negative environmental factors, but also strengthens the bond between the mother and the sibling while the producer has more control over the animals. All of these small factors play a major role in a higher weaning percentage that has an impact on the total revenue and better gross margins. The weaning percentage is very important for any livestock farmer, as his revenue depends on the number of animals that are weaned and sold. The producer would thus like to increase his lambing and weaning percentages, which will increase revenue. With the use of the artificial reproduction methods; Cervical and Laparoscopic insemination, the costs are higher, but the lambing percentage is higher, together with the use of nutritional stimulus. These factors increase the number of twins that are born.

Scenario 3 is a scenario that illustrates the effect of what can happen when a producer has the managerial ability to obtain high lam – and weaning percentages. The weaning percentages that are used in this scenario can be achieved, as some producer has achieved these percentages (published by Ramsem, Bloemfontein 2010). The production methods and management have to be done exactly as prescribed, these factors include the usage of lamb cages, nutritional stimulus for the rams and ewes, period of nutritional stimulus must be correct and the management of the lamb and ewes has to be precise. The pre mentioned factors are a few of the managerial and more advancedproduction technologies thathave to be implemented to get these weaning percentages. The gross margin of this scenario shows that the higher investment in the C.I. equipment is worthwhile, as the additional income that is obtained, shows an increase of 12 % over the income of the conventional method. The margin obtained with the use of the L.I. indicate an even better improvement, as the margin is 11 % higher than with C.I. and 25 % higher than with the conventional method.

Scenario 4, which is aimed at the stud breeder, show just how effectively the advantages are that are obtained from the usage of new reproduction technology. The fact that stud breeders want to produce the best possible genetics in their offspring, can play a big role in the adoption of the new methods. The use of the new technology methods provide the producer with a change to produce lambs with good genetic characteristics from rams that were tested

for these genetic characteristics and the improvement in genetics is also faster than the other methods. The difference between the three reproductive methods in this scenario is caused by the difference in ram costs and the revenue obtained.From the gross margin analysis it can be seen that the gross margin from the use of L.I. is 29 % higher than the gross margin from C.I. and 50 % higher than the gross margin obtained with the conventional method. These gross margins from both, L.I. and C.I., shows the advantage of using the available technology, and thus increasing the profit that can be achieved with the herd. With the advantage comes the disadvantage or drawback from the usage of the methods, as it may require an initial investment from the producer. This result is that that in the first year there will have to be additional investments and l expenses. The biggest difference in expenses is that with the conventional method, the acquirement of the rams is the biggest expense as it contributes 70 % of the costs. With the artificial reproduction methods, the acquirement of the rams for C.I. and the semen for L.I. are only 31 % and 17 % respectively. The biggest costs from the artificial methods are the feeding of the ewes while they are in the lambing cages during the lambing period, which will have an initial effect on cash flow. Lambing cages are37 % of the expenses from C.I. is allocated to the lamb cages and feeding and 40 % for L.I. Other expenses for C.I. that differ from the conventional method are synchronisation, C.I. equipment, nutrition stimulus for rams and ewes, Lambing cages and the additional labour.

Conclusion and Recommendations

The adoption of new technology plays an important l role in the reproduction of animals and the gross margin and income. C.I. and L.I. have providedproducers with a technology to enhance their animals' genetic pool considerably. The advantage of using Artificial Inseminationis thefast genetic improvements, because the producer has the option to inseminate his very best ewes with specific, chosen and tested ram semen. This provide the producer with a question, if he wants to enhance his herds genetics in a very short period or even over a longer period, but minimizing costs, how would he achieve this objective? From the analysis that was done with the gross margin calculations it is obvious that the artificial methods provide the producer with the opportunity to enhance his genetics while improving his gross margins. The other option available to the producer is to purchase very expensive rams, that can be used over a period of 3 to 4 years, but this production method are associated with a lot of risks. The risks include injury, infertility and even early death

because of natural circumstances. This research provide an economic basis for a producer to evaluate the different re-production technologies available and the associated costs and gross margins of each re production technology.It is not only the reproduction method that has an influence on the gross margin and income of sheep farming, but there are several other factors that have an influence on the gross margin and success of the different reproduction methods.Factors include the nutritional stimulus, usage of lambing cages, synchronisation and other management techniques. The producer must always keep these factors in mind when he makes decisions about reproduction technologies and the costs associated with each.

Taking thementioned factors into account, the artificial reproduction methods are the most profitable. The conventional method can be an option, given certain scenarios, as indicated.In the case of the new re production technologies, higher initial investments and high demand on management will be compensated for in higher gross margins and faster genetic improvement of the flock-which will also be to the long run benefit of the farm.One of the key issues will be the managerial ability of the farmer to manage the new reproduction technologies and the higher initial investments'.

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