ECONOMICS OF DEER ARTIFICIAL INSEMINATION AND EMBRYO TRANSPLANTS FOR FARMERS

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SUMMARY: To evaluate AI and ET investments, farmers must consider the costs of materials and services required. They must also consider the 'opportunity cost' of money used since there is usually a considerable time delay between initial cash outlay and when deer produced can contribute to income in some profitable way.

INTRODUCTION

Artificial Insemination (AI) and Embryo Transplant (ET) procedures are still in a 'development phase' so far as commercial viability for deer is concerned.

However, for the short time these techniques have been available, their impact has been considerable, and fueled by:

(1) New Zealand deer farmers remain interested in the commercial potential of exotic deer bloodlines. AI and ET methods have the ability to reduce prohibitive costs and time delays associated with quarantine and transport of live deer from abroad.

(2) Conversely, AI and ET methods improve our prospects for export markets in semen and embryos.

(3) AI and ET can increase efficiency of herd improvement programmes. As examples, by ET genetically elite parents can be represented by several offspring per season, and AI is the vital component of sire referencing (progeny testing) schemes.

There seems no doubt that use of AI and ET procedures by deer farmers will increase.

In discussing the economics of AI and ET, this paper will focus on farmers PURCHASING semen or embryos to produce live deer. Throughout, I will be calling on experiences with Central Southland Veterinary Services Limited, whom I have assisted on various projects.

Five factors that influence a farmers decisions to purchase semen or embryos and utilize AI or ET are:

(1) Farm Management Options and Costs.
(2) Market Prices for Semen and Embryos.

(3) Veterinary Costs.
(4) The real cost of live progeny produced.
(5) Risks and Uncertainties affecting results.

ARTIFICIAL INSEMINATION

(1) FARM MANAGEMENT OPTIONS AND COSTS

AI has been a new technology for deer farmers so some strategy to promote and explain the details had to be decided on.

A first point should be whether the AI investment is likely to complement a farmer's deer breeding programme and produce live animals that will be profitable. At the end of the day our farmer clients foot all the bills and their only sustainable chance of recouping costs is extra production from the AI produced deer.

Decisions to use AI for other reasons must be partly speculative.

This point needs stressing because often, in discussions about AI the focus seems to fall on some relatively minor point (like a $10 difference in veterinary charges per hind) compared to the farmers total cash outlay into the whole operation.

Farmers always need to know the actual costs they will have to pay. But to discuss only this point would be a rather shallow approach to justifying the total cash investment from a farm management point of view. In most cases to date, farmers have considered AI particularly as a means of producing improved male offspring that could be used as herd sires, and generally semen from stags representing some elite bloodline has been purchased.

The alternative has usually been not to access that particular bloodline at all, or pay a fairly high price for a live stag.

Hence in my experience, most farmers have considered AI as a means to produce progeny they have had every intention of keeping and evaluating at least through to 15 months or some later age. So in assessing the viability of the AI investment, it has been necessary to stress the cost associated with the time delay from initial cash outlay (vet costs, semen etc) until any offspring could first be considered usable in some profitable way.

(2) MARKET PRICES FOR SEMEN
(3) VETERINARY COSTS
(4) REAL COST OF LIVE PROGENY PRODUCED

The layout of facts discussed with farmers to explain these aspects is illustrated in Table 1 for an example of 10 hinds inseminated with semen costing $500 per straw in March 1989.

Table 1. ARTIFICIAL INSEMINATION

Semen $500 per straw
Costings per 10 hinds on insemination programme

10 hinds x CIDRS @ $10 (vet)	=	100
10 hinds x PMS @ $5 (vet)	=	50
Farmers local vet assistance	=	180
Insemination fee 10 hinds @ $30	=	300
Semen COST, 10 STRAWS @ $500	=	5000
		====
SUB-TOTAL (1)		5630
		====

AI SUCCESS RATE		30%	40%	50%	60%	70%	80%
TOTAL $'s OWED AT CONCLUSION OF AI	(1)	5630	5630	5630	5630	5630	5630
No. conceptions		3	4	5	6	7	8
Cost/pregnancy	(1a)	(1877)	(1408)	(1126)	(938)	(804)	(708)
Interest on totals (1) @ 15% pa from 1/4/89 to 31/3/90.	(1b)	844	844	844	844	844	844
TOTAL $'s OWED AT WEANING 31/3/90	(2)	6474	6474 (Deer are weaners)	6474	6474	6474	6474
Interest on totals (2) @ 15% pa from 1/4/90 to 31/3/91.	(2b)	971	971	971	971	971	971
TOTAL $'s OWED AT 31/3/91	(3)	7445	7445	7445	7445	7445	7445
		====	====	====	====	====	====
COST PER DEER AGED 15 MONTHS	(3a)	(2482)	(1861)	(1489)	(1241)	(1064)	(931)
Costs/live deer if one death		3722	2482	1861	1489	1241	1064
Increase in costs per live deer .. 1 vs 0 deaths		+1240	+621	+372	+248	+177	+133

FACTOR COSTS CONTRIBUTING TO FINAL TOTAL COSTS (row 3).

* Veterinary costs for the 10 hinds	@ $630	= 8.5	percent
* Semen outlay, 10 straws	@ $5000	= 67.0	percent
* Interest charges (eg 15% p.a.)	@ $1815	= 24.5	percent
	$7445	100.0	percent

From TABLE 1, the following points are made:

(1) Figures in row 1 are true 'overheads' since they represent cash outlayed no matter what result is achieved. As these 'overheads' are spread over more conceptions (row 1), live deer at weaning (row 2) or deer aged 15 months (row 3), the cost of each animal to the farmer decreases (rows 1a,3a). This point alone places moral responsibility on the AI team to produce good results.

(2) Interest has been charged from the initial payment of 'overhead' costs for 12 months till weaning (row 1b), then again for a second twelve months from weaning until the deer are 15 months (row 2b). In this case, age 15 months is assumed the earliest the deer 'could be considered usable in some profitable way'.

(3) In Table 1, to acknowledge opportunity cost of cash 'overheads' and the time money is outlayed before earliest reimbursement, an interest cost is justifiably made. The 15% p.a. rate used is about the lowest figure one could imagine using at the present time.

The true opportunity cost of money is likely to be much higher on most deer farms. For example, investing $5630 of 'overheads' on weaner stags for venison could produce 30% return per annum and if this were a practical alternative on our example deer farm, a 30% interest figure would be the opportunity cost against which cash in the AI programme should be evaluated.

(4) Also from Table 1, if none of the $5630 'overhead' costs were spent, the 10 hinds would still be naturally mated and calve. No extra calves result specifically from AI. Hence at the end of the exercise the true accumulated costs of AI (row 3, Table 1) must be recouped only from the increase in quality of calves produced.

This clearly illustrates that to evaluate an AI programme, a detailed insight of the farmers objectives are necessary. We must be satisfied that deer produced from AI can justify the extra true costs (row 3, Table 1) over and above what would be returned by calves produced naturally by the herd, and specifically from those hinds put forward for AI.

From the outset targets should be set for recouping the accumulated costs of the programme.

In the context of the above points, TABLE 2 shows the impact of changes in the price of semen and interest rates (representing the opportunity cost of capital), on the AI investment decision. In Table 2 a 60% success rate through to offspring being 15 months old is assumed from inseminating 10 hinds.

Table 2. IMPACT OF CHANGING INPUT COSTS ON FINAL COST OF DEER AT 15 MONTHS

10 HINDS : AI SUCCESS RATE 60%
OPPORTUNITY COST OF INITIAL CASH OUTLAY (1) 15% P.A.

	(A)	(B)	(C)	(D)
Semen cost per Hind	15	45	150	500
Vet expenses per Hind	35	63	63	63
Initial outlay/10 Hinds (1)	500	1080	2130	5630
TOTAL $ OWED, DEER 15MTHS (2)	661	1428	2818	7446
Cost/deer aged 15 mths	(110)	(238)	(469)	(1241)
PERCENTAGE OF COSTS (2) AS:				
Semen	23	32	53	67
Vet expenses	53	44	23	9
Interest Charged	24	24	24	24
	100	100	100	100

10 HINDS : AI SUCCESS RATE 60%
OPPORTUNITY COST OF INITIAL CASH OUTLAY (1) 30% P.A.

	(A)	(B)	(C)	(D)
Semen cost per Hind	15	45	150	500
Vet expenses per Hind	35	63	63	63
Initial outlay/10 Hinds (1)	500	1080	2130	5630
TOTAL $ OWED, DEER 15MTHS (2)	845	1825	3600	9515
Cost/deer aged 15 mths	(141)	(304)	(600)	(1586)
PERCENTAGE OF COSTS (2) AS:				
Semen	18	25	42	52
Vet expenses	41	34	17	7
Interest Charged	41	41	41	41
	100	100	100	100

Features from Table 2 are:

(1) The semen cost/straw of $15 in column (A) estimates the approximate cost of stag collection and processing to produce a straw, with nil added value for the semen. The veterinary expenses at $35 per hind are about as low as we could reasonably expect, even doing large numbers by intra-uterine AI. Hence column (A) could illustrate the case where a farmer collected semen from his own stag to AI a large group of his own hinds.

At the 60% AI Success Rate, deer produced at 15 months have cost either $110 at 15% 'opportunity cost on cash outlayed' or $141 where 30% interest is charged.

(2) If in column (A) the $15 semen straw cost, plus $35 vet expenses are accepted as 'practical minimums' for intra-uterine inseminations, then their sum of $50 could represent a price that could be offered for a natural sire mating fee to 'break-even' with the $50 minimum cost per deer AI'd. (Note there is no added value for semen genetic quality being considered here. Also, conception rates for natural mating could easily be better than those achieved from AI).

Up to a $50 service fee would represent a fairly attractive offer for many stag owners, and provide for the semen buyer an easy alternative to AI.

(3) The 'weightings' that should logically be give to semen costs, veterinary expenses, and the opportunity cost of money being used 'to pay the AI bills' is shown in the percentage break-down's in Table 2. Vets can note that as semen price increases, their expenses (as here assumed) become a relatively minor component of the overall issue.

Since, when semen is expensive the farmer gets a much better deal from higher 'success rates' (Table 1), we have another incentive for the inseminating and farm management team to do a good job .. in respect of the farmer's position of 'risk carrier' in the venture.

TABLE 3 further illustrates this point. It shows for the semen charges per hind and vet expenses quoted, how the farmer incurs increasing costs per deer produced at 15 months, if AI 'success rates' fall from 70 to 60, 60 to 50, or 50 to 40 percent at the lower and higher opportunity cost situations.

In arguing what veterinary expenses should be, Table 3 suggests that if in attempting to compromise on these costs the farmer gets a 10 percent poorer 'success rate', he probably will be worse off, since his final cost per deer is in most cases increased by a greater amount than we could imagine the veterinary input to be reduced by.

TABLE 3. INCREASES IN COST PER DEER AGED 15 MONTHS , AS SUCCESS RATE OF AI PER 10 HINDS DECLINES,AND AS INTEREST CHARGED VARIES DEPENDING ON OPPORTUNITY COST OF CAPITAL OUTLAYED IN THE VENTURE.

Semen Charge per Hind	Vet Expenses per Hind	SUCCESS RATE OF AI PER 10 HINDS 70% to 60%	to 50%	to 40%	
15	35	+16^^	+22^^	+33^^	15%
15	63	+25	+34	+52	Interest
45	63	+34	+48	+71	Charged
150	63	+67	+94	+141	on $
500	63	+177	+248	+373	Outlay

Semen Charge per Hind	Vet Expenses per Hind	SUCCESS RATE OF AI PER 10 HINDS 70% to 60%	to 50%	to 40%	
15	35	+20^^	+28^^	+42^^	30%
15	63	+32	+44	+66	Interest
45	63	+43	+61	+91	Charged
150	63	+86	+120	+180	on $
500	63	+227	+317	+476	Outlay

EMBRYO TRANSPLANTS TO RECIPIENT HINDS

All the above concepts illustrated for AI, apply in a similar way to evaluating the profitability of Embryo Transplant programs.

TABLE 4 shows for an ET programme, the effects discussed in Table 1 for AI. All trends are similar for ET although their magnitude is greater due to the higher price for embryo's compared to semen.

The costs for deer aged 15 months, generated in Table 4 for an embryo 'success rate' of 50%, can be compared with prices currently being received for pure-bred deer of elite exotic lines.

(5) RISKS AND UNCERTAINTIES AFFECTING AI AND ET RESULTS

For both AI and ET a good level of operator skill is required. Trauma caused by the surgical procedures does not appear to worry the deer. If recipient hinds do not 'hold' to artificial insemination or embryo implantation, we assume conception to natural mating at the next breeding cycle will not be affected.

Table 4. EMBRYO TRANSPLANT TO RECIPIENT HINDS

Example: Embryo cost $3500
Costings per 10 hinds on recipient programme

10 hinds x CIDRS @ $10 (vet)	=	100
10 hinds x PMS @ $12 (vet)	=	120
Farmers local vet assistance	=	180
Implantation fee 10 hinds @ $100	=	1000
EMBRYO COST, 10 @ $3500		35000
		=====
SUB-TOTAL (1)		36400
		=====

TRANSPLANT SUCCESS RATE		30%	40%	50%	60%	70%	80%
TOTAL $'s OWED AT CONCLUSION OF ET	(1)	36400	36400	36400	36400	36400	36400
No. Pregnancy's		3	4	5	6	7	8
Cost/pregnancy	(1a)	(12133)	(9100)	(7280)	(6067)	(5200)	(4550)
Interest on totals (1) @ 15% pa from 1/4/89 to 31/3/90.	(1b)	5460	5460	5460	5460	5460	5460
TOTAL $'s OWED AT WEANING 31/3/90	(2)	41860	41860	41860	41860	41860	41860
				(Deer are weaners)			
Interest on totals (2) @ 15% pa from 1/4/90 to 31/3/91.	(2b)	6279	6279	6279	6279	6279	6279
TOTAL $'s OWED AT 31/3/91	(3)	48139	48139	48139	48139	48139	48139
		=====	=====	=====	=====	=====	=====
COST PER DEER AGED 15 MONTHS	(3a)	(16046)	(12035)	(9628)	(8023)	(6877)	(6017)
Costs/live deer if one death		24070	16046	12035	9628	8023	6877
Increase in costs per live deer .. 1 vs 0 deaths		+8024	+4011	+2407	+1605	+1146	+860

FACTOR COSTS CONTRIBUTING TO FINAL TOTAL COSTS (row 3).

* Veterinary costs for the 10 hinds	@ $1400	=	2.9 percent
* Embryo's, 10 hinds	@ $35000	=	72.7 percent
* Interest charges (eg 15% p.a.)	@ $11739	=	24.4 percent
	$48139		100.0 percent

Deaths of hinds directly attributable to the techniques used have been very low.

This does not mean we are oblivious to the possibility that things can go wrong. The approach has always been to discuss in-depth the techniques with farmers and work with them through every stage. We have 'sold' this approach by pointing out the following two points:

* That 'economics' for the farmer depend so much on the team producing good conception rates in the deer AI'd or ET'd.

* Making a special effort to work with the client to take every viable step to ensure a good 'success rate' is obtained.

From a farm management point of view, many of the things that can contribute to a better success rate have a very low cost relative to the total at stake. Hence if something that might go wrong can be eliminated, we have done so.

For example, stress in deer has been a major factor known to influence results. To minimize a range of potential stress factors the following is suggested:

* Deer on the programmes should have a good temperament especially toward handling in deer yards.

* Early weaning in late February-early March is advised.

* After weaning, regular non-stressful handling of recipient hinds to familiarise them with the AI/ET procedures.

* Grazing hinds near to entire stags or with vasectomised stags.

Care of semen and embryos during the on-farm phase of operations has also been emphasised. Sudden changes in temperature, and dust, can easily occur in deer sheds and affect the viability of thawed semen and embryos. To avoid these risks we have curtained off pens where semen has been thawed and vets have been operating. Heaters in the curtained-off pens have maintained constant warm temperatures. The AI/ET working area has been cleaned and in many cases, the floor concreted.

On the day of operation, its been useful to set-up equipement in sheds well before-hand to avoid any last minute panic around recipient hinds.

Extra labour is needed to help maintain a steady throughput of

hinds.

CONCLUSION

Under good conditions targets of 70 percent conception rates with intra-uterine AI can be set, and 50 to 70 percent 'hold rates' implanting embryos to recipient hinds. Whilst these success rates are not always obtained, the objective must be to MAKE EVERY EFFORT TO GET THEM, because good 'success rates' protect the farmers substantial investment.

Much publicity about artificial insemination and embryo transplant procedures is generated by groups with a vested interest in supplying the OPERATING SERVICES.

The farmer brings a wider perspective. His money carries most of the risk.