ESTIMATING THE WELFARE GAINS FROM THE "FLYWISE" PROGRAMME

R Simmer and D Collins*

Contributed Paper at the
36th Annual Conference of the
Australian Agricultural Economics Society
A[illegible]an National University, Canberra, 10-12 February, 1992

*Institute of Animal Production and Processing
CSIRO Corporate Centre
Limestone Avenue, Campbell
PO Box 225
Dickson ACT 2602

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Richard Simmer and David Collins[2]

ABSTRACT

The "Flywise" programme was initiated by NSW Agriculture in 1988 as an information programme. The main aim was to increase producer awareness of sheep blowfly strike, and to subsequently encourage producers to adopt more effective control strategies against strike. The analysis looks at the adoption of two control techniques available to producers, and measures the likely gains from an increase in adoption of these two techniques. Modelling was via an Edwards and Freebairn framework and gains were measured in terms of producer and consumer surplus.

Gains for producers were greatest when adoption of mulesing was increased, however gains were also recorded for NSW producers from the increased adoption of jetting techniques, in particular when using triazines instead of organophosphates. Consumers also benefited from increased adoption as a result of lower prices for the sheep related commodities. Some leakage of gains to overseas consumers would also be likely due to the export orientation of the industry.

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BACKGROUND

One of the major parasites affecting the productivity of sheep is the Australian blowfly Lucilia Cuprina. Beck et.al.(1985) estimated that the cost to the Australian sheep industry from Lucilia Cuprina was, on average, $2000 per farm in 1985. This cost comprises expenditure on controlling the strike (63%) and losses resulting from mortality, wool loss, and infertility (37%).

The magnitude of losses which result from blowflies prompted the NSW Department of Agriculture to undertake an extension programme aimed at increasing the awareness of farmers to the control strategies available, and how these strategies can be integrated to provide effective protection against flystrike. This programme was initiated in 1988 and is called "Flywise".

In this study the economic gains, measured in terms of producer and consumer surplus, from the more effective control of blowflies as a result of the "Flywise" programme is estimated. Gains are estimated from greater adoption of a more effective blowfly control programme, using an adaptation of the Edwards and Freebairn approach to estimating productivity gains in part of an industry (Edwards and Freebairn, 1982).

The "Flywise" programme initiated by NSW Agriculture is assumed here to have four main impacts. Firstly, it is anticipated that more producers will adopt mulesing as a form of control and secondly, there will be a shift towards the recommended "V" mules method of the mulesing operation. Thirdly, with the now inherent resistance problems of using organophosphates as a jetting chemical, the "Flywise" programme will effect a shift to the use of Triazines and Synthetic Pyrethroids as a jet chemical. In respect of this point, there will be an increase in the use of Vetrazin, which has little resistance problems. Lastly, there will be an increase in the adoption of jetting as a control strategy, whether it be with Organophosphates or one of the other two above mentioned groups of chemicals.

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[3] This project was undertaken at the instigation of Dr John Steel, Head, McMaster Laboratory, CSIRO, Sydney, and with the encouragement and collaboration of Dr Helen Scott Orr, Chief, Division of Animal Industries, Mr Ian Roth and other officers of NSW Agriculture. The project was coordinated under the direction of Dr Jim Johnston, Manager, Institute of Animal Production and Processing, CSIRO, Sydney. Their assistance and comments along with those of other staff of CSIRO and other State Departments of Agriculture are much appreciated. Naturally however, all remaining errors in this paper are the responsibility of the authors.

To estimate the economic gains from "Flywise" it was necessary to construct a spreadsheet model which allows the impact of different levels of adoption of blowfly control strategies, with strike rates, to be determined. In the spreadsheet, productivity losses were expressed as a function of the strike rate and a regional perspective was taken in order to account for the different outputs.

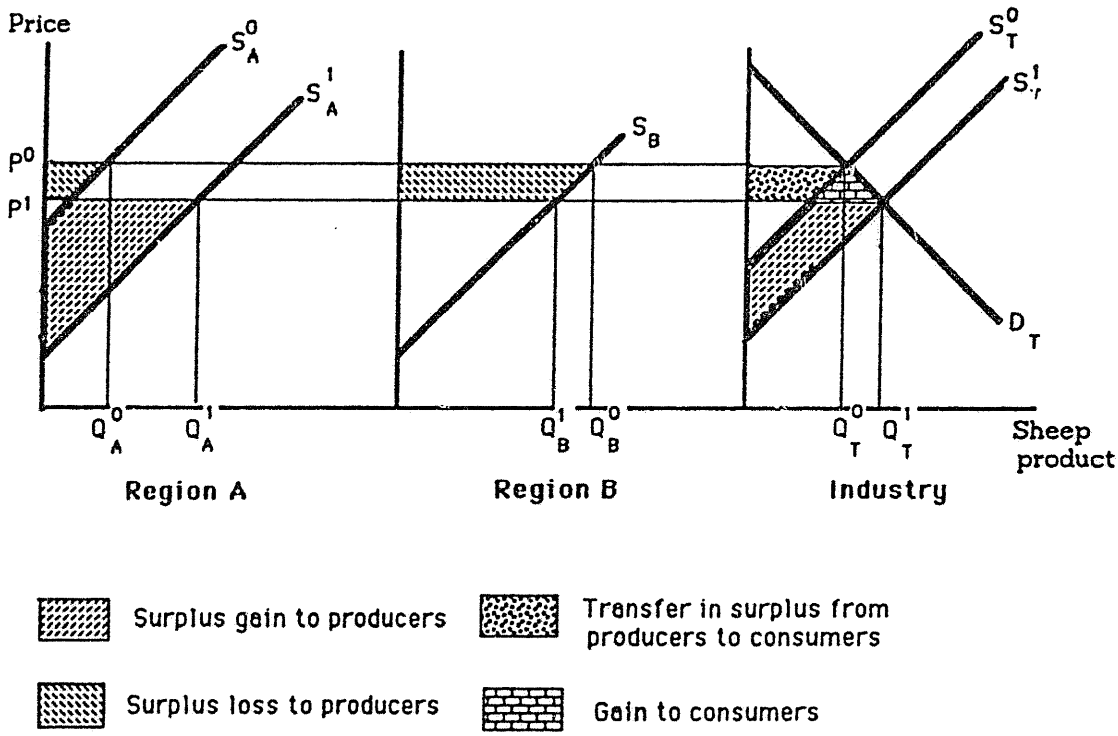
The two main areas of blowfly strike on a sheep are the body and the breech. Control methods which are available to graziers comprise those that reduce the predisposing conditions for strike in sheep and chemical treatments which prevent a strike occurring. Control methods which reduce predisposing conditions to breech strike include mulesing, crutching, tail stripping, tail docking, and drenching. Methods which reduce predisposing conditions to body strike are shearing, breed selection (Monzu, 1986), and culling.

THE MODEL

The analysis is based upon the Edwards and Freebairn model, which provides a framework for estimating economic welfare via the calculation of, and subsequent addition of, producer and consumer surplus. Estimation is via a comparative static situation, whereby the regional supply curve shifts outwards due to an increase in productivity from the adoption of the "Flywise" programme. Industry supply will also shift outwards, although the extent of this shift will depend greatly upon the proportion of total industry supply that the adopting region holds. The distribution between producer and consumer surpluses depends upon the elasticities of supply and demand, estimates of which were derived from Dewbre et.al.(1985). Due to the export orientation of the Australian wool industry, many of these gains will be captured by overseas consumers, thus the distribution of gains between domestic and overseas consumers should also be measured. The effects of the increase in supply in the region are depicted in Figure 1 below.

Figure 1 depicts an outward shift in supply in Region A which results from the productivity gains in that region from adopting the "Flywise" control strategies. Region B is a non adopting region and therefore experiences no such supply shift, however the Industry as a whole does register an increase in supply, as supply here is an aggregation of that for adopting and non adopting regions (Region A plus Region B). It is important to note that the supply curves are assumed to be linear, this is a simplifying assumption made in order to estimate the change in economic welfare. Furthermore, the nature of the supply shift is assumed to be parallel. This is a crude but necessary assumption as the distribution of gains between high and low cost producers is unknown (Rose, 1980).

Figure 1: The Gains From The Increase in Productivity in a Part of an Industry.



source:Collins and Poulter, 1990.

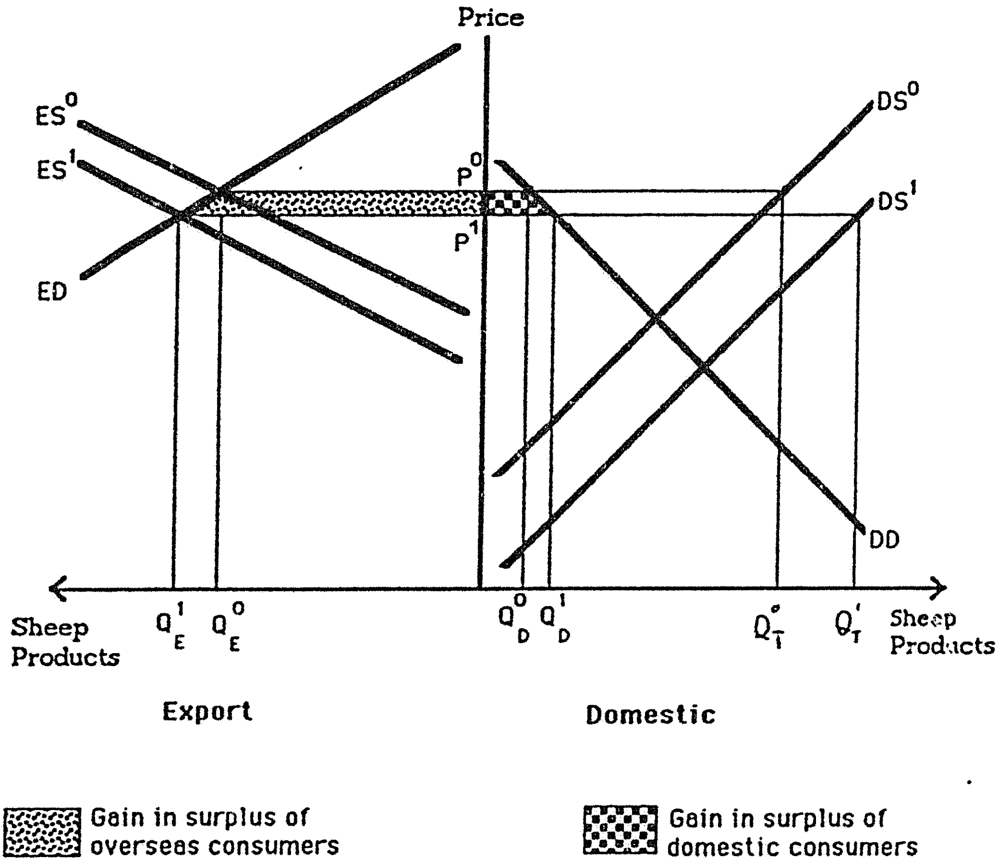
Due to the characteristics of the demand function, there will be a price effect as a result of the increase in supply. A Price decrease as a result of an increase in supply will filter back to the region where adoption was first undertaken and reduce the gains generated.

Producer surplus is measured as the area above the supply curve, bordered by the price line. Region A will see a gain to producers due to the outward shift in supply, however there is also a loss to these producers from the subsequent decrease in price, the net gains then for producers in Region A will depend upon which of the surpluses dominate upon addition. Region B producers will experience a loss only as a result of the decrease in price. The Industry in total will exhibit the producer gain shown for Region A and the summation of the producer losses for Region A and Region B. Consumer gains are the summation of the direct transfers from producers and the increased supply of sheep commodities.

Gains accrue to both domestic and overseas consumers due to the export orientation of the industry, as mentioned earlier. The distribution of gains between these two groups depends upon their relative demand elasticities and their share of total output. Figure 2 displays the distribution of consumer surpluses between these two groups in an Excess Demand/Excess Supply framework.

Original domestic production is at the level Q_T^0 and demand at Q_D^0. At price P^0 this creates excess supply in the domestic industry, as shown in the Export market as Q_E^0. Excess demand exists in this market, therefore the excess domestic production is exported. When domestic supply increases, and price correspondingly decreases, to P^1, excess supply on the domestic market now becomes Q_T^1 minus Q_D^1, which is equal to Q_E^1. Excess supply has thus shifted outwards along the excess demand curve. Consumer surplus is the area below the demand curve bordered by the price line. Thus in the domestic market consumers gain as a result of a decrease in price. Similarly, overseas consumers also gain.

<u>Figure 2: Flow Effects from Productivity Increases in the Domestic Market.</u>



source:Collins and Poulter, 1990.

The analysis is conducted with Region A representing NSW, as "Flywise" is a NSW programme. Within NSW three zones exist, as classified by ABARE (1991); High Rainfall, Sheep Wheat, and Pastoral. Region B is represented by the rest of Australia. This in no way means that the rest of the Nation's sheep producers are ignorant towards flystrike or that other State Departments of Agriculture are doing nothing to ameliorate the effects of flystrike. The study looks only at the welfare gains to NSW producers from adopting "Flywise" strategies. NSW is split into three zones mainly for the purposes of showing how production of the same product can vary between regions. The major differences between these zones are in stocking rates, types of sheep carried, enterprise structure, weather, types of flystrike.

MODEL DATA

A spreadsheet driven evaluation model was constructed to estimate the welfare gains from greater adoption of blowfly control methods. The spreadsheet was structured such that production losses and control costs in each of the three zones could be estimated. Production data are provided in Table 1.

Table 1.

DATA	Pastoral	Sheep Wheat	High Rainfall
Sheep No's (m sheep)	8.6	45.2	16.1
Merino %	75.0	75.0	75.0
Lamb %	25.9	24.3	22.0
Wool Cut kg/sheep	5.07	4.55	4.60
Wool Price c/kg	793.60	880.07	913.86
Mutton Price c/kg	15.00	15.00	15.00
Lamb Price c/kg	70.00	70.00	70.00
Replacement Cost:$/sheep			
Merino Ewe	13.50	13.50	13.50
Merino Wether	7.00	7.00	7.00
Merino Lamb	30.00	30.00	30.00
British Ewe	18.75	18.75	18.75
British Lamb	32.00	32.00	32.00

source: ABS (1990), AMLC (1990), AWC (1990).

Costs of control were obtained for the three main methods of blowfly control, namely, crutching, jetting, and mulesing. These costs are shown in Table 2. The cost of jetting labour was taken as the contract rate as these rates would account for such items as wear and tear on equipment, depreciation, as well as running costs.

Similarly, the opportunity cost of using jetting equipment is seen to reflect the opportunity cost of employing capital in the jetting process. In practice this means that the producer has to decide whether to use a hand jet, which requires a certain level of skill in operation to be fully effective, or to use some other jetting technique such as an automatic jetting race. The latter method involves a more capital intensive setup and is considered to be less effective than hand jetting (NSW Agriculture, 1990). Jetting chemical costs were based on average retail values throughout NSW.

Crutching costs were obtained from NSW Agriculture (1991), contract rates varied between zones. Crutching costs seem at first glance to be a little inflated, however if the overheads of the operation are considered, which are similar to that of shearing, the cost estimates seem less anomalous. Mulesing costs were also obtained from the same source. Both of these cost estimates included mustering, and when compared to figures provided by Agcost (which did not include mustering, but was added subsequently), there was a high degree of similarity (Agcost, 1991).

Table 3 contains the percentage use of individual methods of control across NSW. The percent of sheep jetted did not vary between zones (Beck et.al. 1985). The percent of sheep mulesed did however vary between zones Brideoake (1979). Because sheep are crutched more than once in an operation year in some zones, the proportion of sheep crutched can be over 100%. In the high rainfall zone crutching is more commonly practiced because conditions in this zone are wetter and crutching can be used successfully to reduce the risk of breech strike.

<u>Table 2: Costs of Individual Control Methods:cents/sheep.</u>

ZONE	Jetting					
	Jet lab	Op	Vetra	Opp. Cost	Crutch	Mules
Pastoral	15.00	4.50	40.00	7.10	67.00	30.00
Sheep Wheat	15.00	4.50	40.00	7.20	79.00	34.00
High Rainfall	15.00	4.50	40.00	7.20	81.00	36.00

Table 3: Use of Individual Methods: %.

ZONE	Jetting	Mulesing	Crutching
Pastoral	60.00	69.00	94.00
Sheep Wheat	60.00	61.00	96.00
High Rainfall	60.00	63.00	114.00

Table 4: Production Losses From Strike.

Production Losses	Wool Weight kg/hd	Death Loss %/strike	Ewe Fertility c/hd/strike
Pastoral	0.34	12.00	111.00
Sheep Wheat	0.34	6.50	152.00
High Rainfall	0.34	1.00	175.00

Production Losses from strike are reported in Table 4. The three main losses associated with flystrike are wool weight loss, mortality, and fertility loss in struck ewes. An estimate of wool weight loss was obtained from Beck et.al. (ibid) and Both death loss and ewe fertility loss were obtained from King (1992).

"Flywise" was introduced as an information programme aimed at getting producers to adopt some form of integrated pest management. It was anticipated that the adoption of certain control strategies would lead to a reduction in the strike incidence on NSW farms. In particular, the programme was interpreted as promoting the increased use of jetting and mulesing to prevent flystrike. Table 5 provides figures for the expected reduction in strike incidence from the adoption of these strategies in various forms. In the analysis four impacts of the "Flywise" programme were considered. The reduction in the strike incidence from the adoption of mules only, jetting with organophosphates, jetting with triazines, and substituting organophosphates with triazines were used to simulate the welfare gains from "Flywise". Diazinon and Vetrazin were taken to be the organophosphate (Op) and the triazine chemicals respectively.

The reduction in strike incidence was determined for adult sheep and lambs. Lambs were taken to include weaners up to one year of age. Figures vary between the two types because lambs are more susceptible to body strike and adults are more prone to breech strike (Raadsma, 1988). Expected reduction in the percent of sheep struck is presented in Table 5. A decrease in strike from the adoption of a strategy will increase production by decreasing production losses.

Table 5: Reduction in Flystrike: Percent of Total Sheep Struck.

	Mules Only	Jet with Op	Jet with Triaz	Jet Switch to Triaz.
Adults	8.4	6.2	9.5	3.3
Lambs	23.4	15.1	23.4	8.3

The strike incidences reported in Table 5 were derived from information on recorded strike incidences in selected field trials. Figures for mules only were derived from Watts, Murray, and Graham (1979) and coincided with those of Dun and Donnelly (1965). Similar figures were also presented in Bryant and Watts (1983).

Figures for the effectiveness of Jetting chemicals were obtained from tests conducted by Ciba Geigy (1979). Although, this information is somewhat dated, it is unlikely that the strike incidences have changed to any significant extent. Even though organophosphates can be less effective due to the resistance of flies to these products, because there has been an increase in the use of other techniques to combat flystrike, Op resistance may have stabilised some time ago.

The spreadsheet model used in the analysis uses the adoption rates of each strategy as the basis upon which change will occur. Initially, the adoption rates for the two types of jetting were increased, as with the adoption rate for mulesing. For the evaluation an increase of 10% in the use of the four options considered was used to estimate the gain generated by the "Flywise" programme.

RESULTS

Increased welfare gains were estimated under an assumed 10% increase in the number of sheep in NSW treated by each of the four options considered. The spreadsheet model combines both the physical and economic impacts of fly control and incorporates the Edwards and Freebairn model as discussed previously.

As shown in Table 6 gains were recorded for an increase in mulesing of 10% for producers in NSW (PS NSW). However some of this gain would be offset by a loss in non adopting areas, that is the rest of Australia (PS REST). This loss results from the decrease in the price of sheep commodities as supply increases in NSW. Gains to consumers were also substantial. Australian consumers received the greater proportion of the gains as compared to overseas consumers. Although a production gain of $2.95m would be realised at a cost of $0.643m, because of the effect on commodity prices, the total gain to producers is only $1.76m. The figure "k", which represents the productivity gain on a per sheep basis, was estimated at 37 cents.

Table 6: Estimated Gain Under an Increase in Sheep Mulesed by 10%.

Increase Mulesing by 10% $m	Wool	Meat
PS NSW	2.02	0.14
PS REST	-0.37	-0.03
PS AUS	1.65	0.11
CS AUS	0.07	0.07
TOT AUS	1.72	0.18
OS	0.40	0.01
Production Gain $000 total	2952.86	
Control Cost $000 total	643.36	
Estimate of k $/sheep total	0.37	

Table 7 shows the gains that were estimated assuming there was a 10% increase in the adoption of jetting with organophosphates. Not surprisingly gains are distributed in an analagous fashion to those for the mulesing case because the supply and demand elasticities are the same. However, the gain from using organophosphates are much lower in magnitude than for mulesing, reflecting a narrowing of benefits to the costs incurred. In this simulation, production gains were slightly covered by the increase in control costs. The per head production gain was estimated at 3 cents.

Table 7: Estimated Gain Under an Increase in Op Jetting by 10%.

Increase Jetting by 10%, Op	Wool	Meat
PS NSW	0.18	0.01
PS REST	-0.03	0.00
PS AUS	0.14	0.01
CS AUS	0.01	0.01
TOT AUS	0.15	0.02
OS	0.03	0.00
Production Gain $000 total	1884.43	
Control Cost $000 total	1682.01	
Estimate of k $/sheep total	0.032	

Table 8: Estimated Gains Under an Increase in Vetrazin Jetting by 10%.

Increase Jetting by 10%, Vetra	Wool	Meat
PS NSW	0.90	0.06
PS REST	-0.16	-0.01
PS AUS	0.73	0.05
CS AUS	0.03	0.03
TOT AUS	0.76	0.08
OS	0.18	0.00
Production Gain $000 total	2902.91	
Control Cost $000 total	1878.28	
Estimate of k $/sheep total	0.16	

In Table 8 jetting was also considered but based on the use of triazines (specifically Vetrazin in this case). Simulation results indicate that the triazine chemical is more profitable compared to organophosphates. The per sheep productivity gain was estimated at over five times that for organophosphates (16 cents per sheep).

The benefit of switching to jetting with triazines was examined in the fourth simulation. The reason that these chemicals are more effective may be explained by the resistance to Op's that could occur with extended use on a property over time. The results for this trial are presented in Table 9. In the simulation, the per sheep productivity gain was estimated at approximately 13 cents. When compared to the use of organophosphates alone, there are obvious benefits from switching towards triazines.

Although the analysis considered the use of mulesing and jetting separately, "Flywise" looks at increasing the use of these methods of control in an integrated manner. Producers do not rely solely on one method of control and producers often combine mulesing and jetting. This strategy would give greater protection to both older and younger sheep against breech strike as well as body strike. The economic gains from using jetting and mulesing together are reported in Table 10.

As can be seen from Table 10, jetting with triazine (Vetrazin) combined with mulesing, gives an increased benefit to the producer. Most of the benefit is obtained from the mulesing operation, as can be seen by comparing the benefits in Table 6 with those in table 8. Productivity gains from adopting mulesing and jetting with triazines is in the order of 53c per sheep and for an average size property of 2000 sheep, this translates into a gain of approximately $1100.

Table 9: Estimated Gains from Substituting Vetrazin for Op's in 10%.

Substitute Vetra for Op in 10%	Wool	Meat
PS NSW	0.70	0.05
PS REST	-0.13	-0.01
PS AUS	0.57	0.04
CS AUS	0.02	0.02
TOT AUS	0.59	0.06
OS	0.14	0.00
Production Gain $000 total	1018.46	
Control Cost $000 total	221.15	
Estimate of k $/sheep total	0.13	

Table 10: The Estimated Gains from a Combined Strategy of Mulesing and Jetting.

	Mules + Jet Op	Mules + Jet Vetra
PS NSW $m	2.2	2.92
Production Gain $000	4837.29	5855.78
Control Cost $000	2325.36	2521.64
Estimate of k $/shp	0.39	0.53

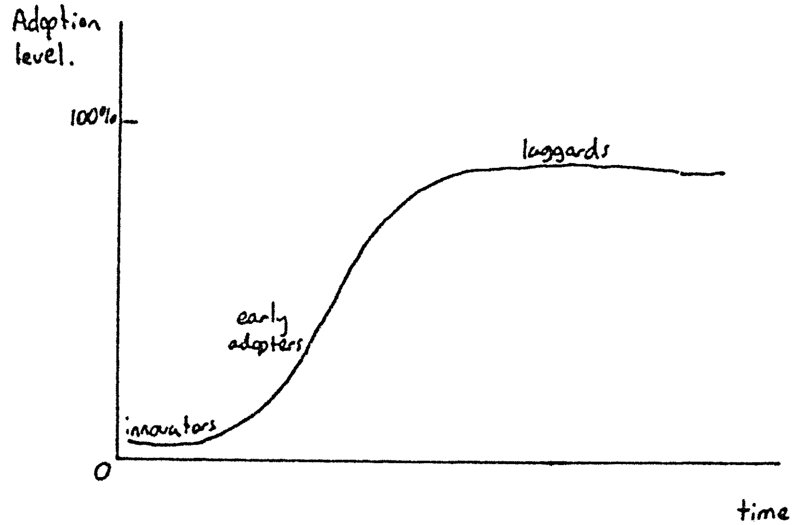
DISCUSSION AND CONCLUDING REMARKS

The analysis of different blowfly control strategies indicate that there are benefits from adopting the blowfly control methods recommended in "Flywise". It was estimated that mulesing and jetting would provide NSW producers with productivity gains of around 40 cents per head with greater gains possible if triazines were to be used as jetting chemical.

The adoption of triazines may not be feasible across all producers. Costs of control of using a chemical such as Vetrazin may limit its use in many cases. Further, in areas where flystrike is less than that reported in this study the gains from adoption of mulesing and jetting may be overstated. Whether or not there is symmetry around the averages used in this evaluation study is unknown.

Another reason that the gains from "Flywise" could be overstated in this study is that the 10% increase in adoption could be difficult, and therefore costly, to achieve. This could be due to the attitude towards risk of many producers which could limit widespread adoption of control methods. The adoption analysis of Rogers (1962) consists of there being three types of primary producers, in terms of the speed they adopt new technologies or innovations. Producers that adopt the technological improvement early are known as "innovators", and largely undertake research and experimentation on their own part. A second group of adopter, classed as "early adopters" are those producers who are quick to adopt new technologies and methods as they perceive that they will be able to achieve some form of benefit. Lastly there is the group of producers described as "laggards", who are very slow to adopt for a large number of reasons, finance and pessimism being two of these (see Figure 3).

Figure 3: Adoption Levels over Time.



source: Arnon 1989

The propositions put forward by Rogers (1962) that are relevant to this study imply that increasing current levels of adoption of the four strategies considered may well be difficult, with cost being a major prohibitive factor. Costs of using mulesing and triazine jet chemicals are not negligible. If the gains estimated from a ten percent increase in adoption are only generated gradually over a longer period of time the attraction of investing funds in extension programmes now would be reduced to a large extent. Because of these problems there is a need for a comprehensive study on the attractiveness of extension programmes aimed at increasing the level of adoption of mulesing and jetting above current levels.

REFERENCES

ABARE, (1987). Australian Agricultural and Grazing Industries Survey, AGPS, Canberra.

ABS, (1990). "Livestock and Livestock Products, 88-89." Catalogue #7221.1 to 7221.6.

Agcost, (1991). "Guide to NSW Contract Rates 1991." NSW Agriculture and Fisheries.

AMLC (1990). **Statistical Review**, July 89 - June 90.

Arnon,I. (1989). **Agricultural Research and Technology Transfer**, Elsevier Applied Science, New York.

AWC (1990). **Minimum Reserve Price Schedule 1990/1991**,Australian Wool Corporation, Melbourne.

Beck, Moir, and Meppem. (1985). "The cost of parasites to the Australian Sheep Industry." **QRRE** 7(4).

Brideoake,B.R. (1979). "The estimated cost of blowfly control in the Australian Sheep Industry." Paper presented at the "National Symposium on Sheep Blowfly and Flystrike in Sheep: Second National Symposium." NSW Dept. of Agriculture, Sydney.

Bryant and Watts. (1983). "The cost of breech strike and its control in Merino breeding flocks." Paper presented at the "National Symposium on Sheep Blowfly and Flystrike in Sheep: Third National Symposium."

Ciba Geigy, (1979). Vetrazin Technical Manual, Sydney.

Collins,D. and Poulter,D. (1990). "Estimation of welfare gains from the Parasite Control Programme 'Wormkill'." Paper presented to the 34th Annual Conference of the Australian Agricultural Economics Society, University of Queensland, 13-15 February.

Dewbre,J. Shaw,I. Corra,G. and Harris,D. (1985). "EMABA:Econometric Model of Australian Broadacre Agriculture." AGPS, Canberra.

Dun,R.B. and Donnelly,F. (1983). "The effectiveness of the mules operation when carried out in conjunction with lamb marking." **Aust. J. Exp. Agric. Anim. Husb.** 5 pp.6-10.

Edwards,G.W. and Freebairn,J.W. (1982). "The social benefits from an increase in productivity in a part of an industry." **Review of Marketing and Agricultural Economics**. 50 (2)

King,R.L. McShane,R.N. and Pauley,J.R. (1992). "An investigation of the economic feasibility of the CSIRO's Autocidal Techniques for the genetic control of the Sheep Blowfly in Australia." Draft only.

Monzu,N. (1986). "Flystrike- a manual for its prevention and control." West Australian Dept. of Agric. Bulletin #4101.

NSW Agriculture, (1991). **Livestock Budgets Central West Slopes and Plains**. Farm Business Notes #45

_______________ **Winter Crop and Livestock Budgets**. Farm Business Notes #46.

Raadsma,H.W. (1988). "Flystrike" Paper presented at the T.G. Hungerford Sheep and Wool Refresher Course, August.

Rogers,E.M. (1962). **Diffusion of Innovations**, Macmillan, London.

Rose,R.N. (1980). "Supply shifts and the size of research benefits: comment." **American Jnl. of Agric. Econ**. 62 (4).

Watts,J.E. Murray,M.D. and Graham,N.P.H. (1979). "The blowfly strike problem of sheep in NSW." **Aust. Vet. Jnl**. 55 pp.325-34.