Chapter 6

ADOPTION OF VETERINARY SURGEON SERVICES

6.1 INTRODUCTION

Diseases and parasites form one of the main constraints to sheep and goat production. The economic losses due to diseases and parasites are considerably high, especially in densely populated areas with poor nutritional grazing value, and where veterinary and diagnostic services are weak (Devendra & McLeroy, 1982). Animal disease control in developing countries has been universally the concern of government and public service (Wilson & Lebbie, 1996).

The veterinary surgeon is the best qualified professional who, when integrated in an extension network service with experienced extension and health officers, can control diseases and parasites by using modern medication technologies. These livestock technologies must be progressively adopted and mastered by livestock farmers, with the help of extension or animal health officers under close supervision of a veterinary surgeon.

In the past, the government used to station at least one veterinarian in the region and provided veterinary surgeon services and extension to former homeland farmers in Qwaqwa. State veterinarians provided free services to farmers who could buy medication at a subsidised price. These conditions were essential to an adequate diffusion and adoption of new livestock veterinary technologies.

Agricultural development programmes and awareness campaigns for farmers in the former homelands in rural areas in South Africa have increased over the past 10 years. However, many of these programmes were not successful due to insufficient technology diffusion programmes (Kirsten, 1994).

After the general elections of 1994 the Department of Agriculture went through many policy changes that have resulted in less availability, accessibility and affordability of veterinary surgeon services. This became a major constrain to the adoption and usage of veterinary surgeon services by the livestock farmer in the former homelands, as the subsidised veterinary surgeon services were withdrawn by the government. In this process a number of farmers who want to adopt this technology could not obtain or afford it. These farmers will be described in this section as potential adopters. No research has been done in South Africa to determine the characteristics of these adopters and potential adopters of veterinary surgeon services and the important variables (predictors) contributing to the adoption of this technology.

Identifying the variables that differentiate between those who adopt or are willing or wanting to adopt veterinary services, and those who do not, can have promising and cost-saving impacts on the planning and execution of future programmes. In the past the conventional approach of adoption or non-adoption was used in most of the adoption studies (Feder, Just & Zilberman, 1985; Lin, 1995). In these studies adopters were seen as those farmers using the technology during the survey period, and in theory an assumption is made that the supply of a new technology (inputs or services) is elastic. This definition is too restrictive for developing countries, as the supply of inputs or services embodying the new technology, is often not elastic due to its inaccessibility (Nichola, 1996). If the inputs or services are in short supply or excess demand (need), not all the farmers who would like to use these inputs or services would be able to obtain or afford them.

An effort will be made in this chapter to determine whether the characteristics of the potential adopters gravitate more to those of the adopters or to those of the non-adopters by testing the hypothesis that the variables predicting adoption and potential adoption are different and that actual adoption would be influenced by those variables determining the rationing of inputs or services. The characteristics and the possible predictors of the

different adoption groups and its combinations of veterinary surgeon services are presented in Annexure C. The identified predictors of adoption of veterinary surgeon services (using the conventional definition) by small ruminant farmers in Qwaqwa will be compared with those of the adapted definition which includes both adopters and would-be (potential) adopters by using a logit modelling approach. The application of the theory of Von Thünen (Barlowe, 1978) within the transaction cost concept will be used as an illustration of farmers who want to use veterinary surgeon services but are unable to do so due to its inaccessibility as well as the unavailability thereof at certain cost levels and the location of the farm..

It was hypothesised that family size, indebtedness, literacy and arithmetic abilities of farmers, availability of credit, information sources approached to make financial and marketing decisions and local markets will not influence adoption of this technology. These variables were therefore excluded from the veterinary surgeon services function in an effort to reduce the number of variables. It was also argued that family size will not determine whether a farmer will use veterinary surgeon services or not. Indebtedness has its origin from crop production and should not influence the decision whether to adopt veterinary surgeon services or not.

6.2 RESULTS AND DISCUSSION

The aim of this section is to present the characteristics of the different adoption groups (farmers), identify possible predictors of adoption (p-values $\leq 0{,}15$) to be included in the different logistic models and to discuss the empirical results of the different models fitted.

For veterinary surgeon services two logit models are fitted in this chapter with the following dependent variables:

- Adopters *versus* potential adopters and non-adopters (conventional definition).
- Adopters and potential adopters *versus* non-adopters (adapted definition).

Adopters of veterinary surgeon services were defined as follows:

- ***Adopters*** (n = 51): use veterinary surgeon services at least once per year.

- ***Potential adopters*** (n = 35): would have used veterinary surgeon services if it were available or accessible.
- ***Non-adopters*** (n = 13): do not use and would not use veterinary surgeon services under any circumstances.

The potential adopters were first grouped with the non-adopters (n = 48) (conventional definition) and then with the adopters (n = 86) (adapted definition) in two different analyses to identify the predictors affecting the specific group of adopters. The characteristics of the adoption groups are presented by using the definition of adopters (A) (n = 51), potential adopters (Pot/A) (n = 35) and non-adopters (N/A) (n = 13) as given above.

The continuous variables with the possible predictors are summarised in Annexure C, Table C.1. The percentage distribution of the categorical variables in the different adoption groups are summarised in Annexure C, Table C.2.

The probit and logit models presented similar results. For the sake of brevity only the results of the logit model are presented in Table 6.1 and 6.2. Of the 13 possible predictors (farming experience with livestock, farming efficiency, management skills, total livestock income per livestock unit (LSU), extension officer visits, sheep LSU's as percentage of total small ruminant LSU's, training sources on medication usage, roads, transport, institutions [government and cooperative extension and agricultural research], suppliers of inputs, location of farming [Old Qwaqwa] and breeding technology) used in the estimation of the first logit model based on the conventional definition (adopters *versus* potential and non-adopters), four (one continuous and three categorical variables) were retained (p-values $\leq 0{,}15$) in the final model (Table 6.1). These predictors therefore contribute significantly to the adoption of veterinary surgeon services (conventional definition).

In the second logit model, using the adapted definition (adopters and potential adopters *versus* non-adopters), five possible predictors (farming efficiency, mortality rate, sheep LSU's as percentage of total small ruminant LSU's, information sources approached for technical decisions and breeding technology) were used, from which three (one continuous and two categorical variables) were retained in the final considered model (Table 6.2). These predictors therefore contribute significantly to the adoption of

veterinary surgeon services (adapted definition) and can differentiate between adopters and potential adopters in Qwaqwa.

Table 6.1: **ADOPTION OF VETERINARY SURGEON SERVICES : CONVENTIONAL DEFINITION**

Adopters (n=51) *versus* potential and non-adopters (n=48)					
Dependent variable: ***A binary variable: 1 for adopters and 0 for non-adopters & potential adopters***					
Variable	**Parameter estimate**	**Standard error**	**Wald Chi-square**	**Probability >Chi-square**	**Odds Ratio**
CONTINUOUS VARIABLE					
Livestock income per LSU	0,003	0,009	10,014	0,0002	1,003
CATEGORICAL VARIABLES					
Roads	1,504	5,201	8,359	0,0038	4,499
Suppliers of livestock inputs/outputs	2,243	6,320	12,496	0,0004	9,422
Breeding technology	1,496	5,816	6,613	0,0101	4,462
Intercept	−3,274	7,660	18,268	0,0001	–
Percentage of farmers classified correctly (99)*					74,5%
Percentage of adopters classified correctly (51)*					74,5%
Percentage of potential and non-adopters classified correctly (48)*					74,5%

* Using a cut-off point of >0,05.

The results in Table 6.1 indicate that if a predicted probability of adoption of >0,5 is considered to define adoption, the model correctly classifies the adoption category of 74,5 per cent of the 99 farmers in the sample. This model classifies 74,5 per cent of adopters and also 74,5 per cent of the potential adopters and non-adopters (in one group) correctly.

In the conventional definition of adoption there are 52 per cent adopters who make use of veterinary surgeon services at least once a year and 48 per cent of the farmers who do not use these services. The total livestock income per LSU per year is the only continuous variable that contributes to the adoption of veterinary surgeon services. This variable is one of the most important measurements of livestock income of the small ruminant farmer (financial efficiency). Farmers with a higher total livestock income per LSU per year are more likely to make use of veterinary surgeon services. It is, however,

important to realise that this relationship can be more complex than a simple cause/effect, as higher financial efficiency may be a predictor as well as a result of the use of this technology. The annual livestock income per LSU is R381 for the adopters, which is significantly higher than R236 per LSU per year for the potential and non-adopters. It can therefore be deducted that the use of a veterinary surgeon increases total livestock income per LSU per year and *vice versa.*

The significance of breeding technology (usage of registered or grade rams), as a predictor of the adoption of veterinary surgeon services, is an indication that farmers making use of the more expensive rams, will be more inclined to use veterinary surgeon services. Adopters of breeding technology make significantly more use of veterinary services (70%) than the potential and non-adopters (53%). It is, however, important to realise that this relationship can, as in the case of annual livestock income per LSU, also be more complex than a simple cause/effect. The use of registered or grade rams may be a predictor as well as a result of the use of veterinary surgeon technology. Farmers with more expensive sires will tend to take better care of their animals. They will probably have a higher opportunity cost or incentives in using a veterinary surgeon when their animals become sick. The predictors "availability of roads" and "accessibility of input suppliers" also contribute to the adoption of veterinary surgeon services technology in this definition of adoption. These findings correspond with those of Mellor (1990:81), and are in agreement with the technology diffusion theory of Feder *et al.* (1985), Hayami and Ruttan (1985) and Wheeler and Ortmann (1990). For example, the significance of roads and input suppliers is an indication that the total support system needed for technology adoption is not well developed in Qwaqwa. If road infrastructure and institutions such as suppliers of livestock inputs were available and accessible to more farmers, the adoption level of veterinary surgeon services could have been much higher. These results also reflect the barrier effect of increased transportation costs on new technology adoption, as indicated in the model of Von Thünen (Barlowe, 1978).

In Qwaqwa, after the withdrawal of government paid state veterinary surgeons, the supply of veterinary surgeon services became very limited and non-adopters therefore less

elastic. Sick animals have to be transported over long distances at relatively high costs[1] to private veterinary surgeon clinics, therefore the cost of veterinary surgeon services and medication information increase with a consequent decrease in demand for such technology (Figure 6.1). It can be assumed that farmers do not make more use of the new technology simply because of its relatively high costs or because the expected incentives of these technologies are perceived not to be cost-effective. The conceptualisation of the theoretical approach of the Von Thünen model of regional economics (Barlowe, 1978; O'Kelly, 1988) adapted to the situation in Qwaqwa is explained in Figure 6.1.

Figure 6.1: **Supply and demand of veterinary surgeon services in Qwaqwa**

Rx_1 Cost of government veterinary surgeon services was free (1993).
Rx_2 Cost of private veterinary surgeon services at Phuthaditjhaba in Qwaqwa. (Veterinary surgeon services cost + transport to Phuthaditjhaba.)

[1] Fully subsidised government veterinary surgeon services were available free of charge at the sheering sheds up to 1993. Only a private veterinary surgeon is at present available in Puthaditjhaba for three hours per week where transportation cost is up to R250 (100 km @ R2,50/km). When a farmer has to travel to Harrismith to the private veterinary clinic, the transportation cost doubles to R500 per trip.

Rx_3 Cost of private veterinary surgeon services at Harrismith.
$Rx_3 = Rx_2$ + transport costs from Phuthaditjhaba to Harrismith.
OA Total number of small ruminant farmers.
OA Elastic supply curve of government veterinary surgeon services:
OJ Adopters JA Non-adopters.
BC Elastic supply curve of veterinary surgeon services in Phuthaditjhaba for three hours per week.
OL Adopters LJ Potential adopters JA Non-adopters.
CD Less elastic supply curve of private veterinary surgeon services at Harrismith.
OH Adopters HJ Potential adopters JA Non-adopters.
JK Demand curve of farmers for veterinary surgeon services. If the incentive or economy of a technology increases, the demand curve will shift upwards and more farmers will become adopters and less potential adopters.

If farmers have to travel to obtain veterinary surgeon services (which leads to transport costs), it becomes a supply as well as a demand problem at a specific point. If a veterinary surgeon is stationed in Qwaqwa and paid by the government (like it was before 1994) and these services are available at no cost (Rx_1), a certain number of farmers will adopt (OJ) this technology and a lower number of farmers (JA) will not (non-adopters). When the government decided to withdraw veterinary surgeons from the sheering sheds and Qwaqwa, the only option was to use private veterinary surgeons who were available in Phuthaditjhaba at a price (Rx_2) for only three hours a week, which includes veterinary fees plus transport costs. At this cost the supply is elastic and the number of adopters reduce to OL, creating a number of would be or potential adopters (LJ), who can no longer afford such costs. In this case, potential adopters are those farmers who have the need for veterinary surgeon services but not the means to get hold of it. These farmers can be regarded as potential adopters as they would have been adopters at lower cost. Variables motivating the adoption decision may therefore be confused with those that indicate the ability to acquire the limited technology. If the farmers need veterinary assistance at any time during the three weekly hours the private veterinary surgeon is available in Phuthaditjhaba, they have to travel with their sick animals to Harrismith. In this case the total costs for obtaining the veterinary services at Harrismith are increasing to Rx_3 due to extra transport costs (Rx_3 - Rx_2). This increased cost (Rx_3) causes a further reduction on the number of adopters (to OH) and a consequent increase of potential adopters (to HJ).

The results of the model discussed above are done in the context where the assumption of an elastic supply of veterinary surgeon services is not violated (which is not the case in Qwaqwa). Therefore, some of the coefficients estimated are expected to be biased.

Table 6.2: **ADOPTION OF VETERINARY SURGEON SERVICES : ADAPTED DEFINITION**

Adopters & potential adopters (n=86) *versus* non-adopters (n=13)

Dependent variable: ***A binary variable: 1 for adopters & potential adopters and 0 for non-adopters***

Variables	Parameter estimate	Standard error	Wald Chi-square	Probability >Chi-square	Odds Ratio
CONTINUOUS VARIABLES					
Farming efficiency	0,036	0,016	4,984	0,026	1,036
Type of farmer (Sheep LSU's as % of small ruminant LSU's)	0,017	0,010	3,206	0,073	1,017
CATEGORICAL VARIABLES					
Breeding technology	1,528	0,743	4,229	0,040	4,610
Intercept	−1,282	0,0925	1,921	0,166	
Percentage of farmers classified correctly (99)*					83,7%
Percentage of adopters & potential adopters classified correctly (86)*					95,3%
Percentage of non-adopters classified correctly (13)*					0,0%

* Using a cut-off point of >0,05.

The results in Table 6.1 indicate that if a predicted probability of adoption and potential adoption of >0,5 is considered to define adoption and potential adoption, the model correctly classifies the adoption category of 83,7 per cent of the 99 farmers. The model correctly classifies 95,3 per cent of adopters and potential adopters (in one group). None of the non-adopters are correctly classified by this model. This, however, does not mean that the model cannot distinguish between adopters and potential adopters (in one group) *versus* non-adopters, but only that if a cutoff point of 0,5 is used, separation is not made. The adopters and potential adopters have a median predicted probability of being an adopter/potential adopter of 0,96, whereas the non-adopters have a median predicted probability of 0,72. Using a cutoff point of 0,9 would lead to 68,6 per cent of adopters and potential adopters, and 75 per cent of non-adopters being classified correctly.

In the second analysis the effect of scarcity or the lack of availability and accessibility of veterinary services is removed (Table 6.2). A logit model for the adoption of veterinary surgeon services technology was re-estimated under a broader (adapted)

definition of adoption. In this definition, adopters are not only farmers who actually adopted veterinary services, but also those farmers in the sample who would have used veterinary services had it been available and accessible (A & Pot/A: n=86) and non-adopters (N/A: n=13). Weaning percentage, one of the most important technical and economical efficiency parameters on small ruminant farming, was used to test farming efficiency since it reflects fertility, conception rate, lambing percentage and mortality rate (Greyling, 1998). The hypothesis is that more efficient farmers will be more likely to make use of veterinary surgeon services.

The empirical results indicate that from five possible predictors used to estimate this model, only two continuous variables (farming efficiency and type of farmer) and one categorical variable (breeding technology) contributes significantly to the adoption of veterinary surgeon services. These results correspond to the findings of Mellor (1990).

The variable type "farmer (sheep or goat farmer)" reveals that sheep farmers are more likely to be adopters and potential adopters of veterinary surgeon technology than goat farmers. In addition, those farmers who use the more expensive registered and grade rams that most probably result in a higher efficiency as well as a higher weaning percentage (Greyling, 1998), are more likely to use veterinary surgeons (A = 62%; Pot/A = 71%; N/A = 25%). These results reveal that the characteristics of potential adopters gravitate more to those of the adopters than to those of the non-adopters.

Both models identify breeding technology as a significant contributor (predictor) of adoption of veterinary surgeon services. This variable appears to be critical in the adoption/diffusion process under both scenarios of elastic and non-elastic supply of veterinary surgeon services. Farming efficiency (technical and economical) (adapted definition), and livestock income (financial) efficiency (conventional definition) are also highly significant predictors. These results also stress the importance of access to high quality breeding stock and information on the improvement of farming and financial efficiency and its contribution to adoption decisions.

In the past veterinary surgeons, livestock inspectors and extension officers visited the sheering sheds on a regular basis to examine sick animals and they also brought medication (at subsidised costs) with them. Farmers did not need roads to go to a veterinary surgeon or to get hold of veterinary drug suppliers, as it was brought to them. The significance of the variables "roads" and "supplier of veterinary inputs" with the conventional definition and not with the adapted definition, is an indication that if the supply of veterinary surgeon services were elastic, potential adopters could get veterinary surgeon services, and roads and suppliers of veterinary inputs would not have an influence on the adoption of this technology (like it was before 1994).

If the new policy introduced in Qwaqwa after 1994 regarding the agricultural extension services is to be maintained, this result suggests that the roads and transport network and institutions need to be improved in former homelands of South Africa.

6.3 CONCLUSIONS

The results discussed in this chapter indicate that the adapted definition of adoption presented a more accurate model of prediction than the conventional definition, as the characteristics of potential adopters gravitate more to adopters than to non-adopters. When the assumption of elastic supply of services or inputs, and increased transportation costs as a cause of the location of the farms is violated, potentially misleading conclusions can be made regarding the significance of variables that contribute to the prediction of the adoption of technologies based on the traditional definition of adoption, and make it difficult to clearly interpret the cause-effect-relationship between factors. In the conventional type of adoption studies farmers who would have adopted new technologies, will be classified as non-adopters. Restricted access to inputs or services in rural developing areas as well as the unavailability of roads, are major constraints for the farmers who wish to adopt new technologies that are not readily available or accessible. In future studies for these types of farmers, it is important to consider the use of the suggested adapted definition of adoption used in this chapter. If additional transport costs to the price of inputs or services are ignored, it may lead to policy

recommendations that would not solve the real problem to accelerate adoption and would concentrate on activities among those farmers who are already adopting new technologies. Instead, these recommendations must rather concentrate on the improvement of infrastructure or other ways to affect inputs or service prices with a less elastic supply, and increase the supply or access to information on new technologies and critical factors limiting adoption.

The radical change from 1994 in the government's policy on agricultural development in Qwaqwa, and the discontinuation of a locally stationed veterinary surgeon (subsidised by the government) who was available on a regular basis at the sheering sheds, seem to have contributed negatively to the use of veterinary surgeon services by the local farmers. Currently the poor road infrastructure, the difficult access to the inputs, outputs, services, information and the non-subsidised veterinary services provided by a private veterinary surgeon, is a major constraint to most of the potential adopters. The diffusion programmes in New Qwaqwa continued after 1994 through Agriqwa, but were suspended in Old Qwaqwa or handled by inexperienced extension officers. The explanation for this result is that the farmers in New Qwaqwa, who adopted veterinary surgeon services, started farming approximately nine years ago, and the farmers in Old Qwaqwa who want to adopt the technology have been farming for a longer period. Seventy-seven per cent of the potential adopters are from Old Qwaqwa.

The other section of livestock veterinary technology, namely medication technology usage, needs further attention. In Chapter 7 attention will be given to the transfer and adoption of four groups of medication as well as the determination of predictors contributing to the adoption of the different groups of medication.