ADOPTION OF VETERINARY SURGEON SERVICES BY SHEEP AND GOAT FARMERS IN QWAQWA

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ABSTRACT

A number of technology transfer (diffusion) programmes involving amongst others veterinary surgeon services subsidised by the government, were launched in the former homelands of South Africa between 1980 and 1993. Many of these programmes were discontinued after the general election of 1994. In order to evaluate the adoption of technology in Qwaqwa, a former Sotho speaking homeland, two Logit models were fit using the ***conventional definition*** *of an adopter and an* ***adapted definition****, which included potential adopters with the adopters. Where the* ***conventional definition*** *of adoption was estimated, livestock income per LSU, ram technology, roads and suppliers of livestock inputs are significant variables contributing to adoption. The results of the* ***adapted model*** *reveal that farming efficiency (weaning percentage), type of farmer (sheep as percentage of the total small ruminant herd) and ram technology, prove to be significant variables predicting adoption. It was also found that the characteristics of potential adopters gravitate more to adopters than to non-adopters. These results indicated that the* ***adapted definition*** *presented a more accurate prediction than the* ***conventional definition****. The results of this study indicate the policy necessary to further accelerate the diffusion of veterinary surgeon services by means of the development of a better infrastructure, the reintroduction of subsidised veterinary surgeon services at the sheering sheds as well as a better flow of information to farmers in Qwaqwa.*

UITTREKSEL

'n Hele aantal tegnologie-oordragingsprogramme, wat onder andere veterinêre dienste wat deur die regering gesubsideer is, insluit, is tussen 1980 en 1993 in die voormalige tuislande geloods. Verskeie van hierdie programme het ná die algemene verkiesing van 1994 doodgeloop. Ten einde die aanvaarding van tegnologie in Qwaqwa, 'n voormalige Sotho-sprekende tuisland, te evalueer, is twee logistiese modelle gepas waar daar gebruik gemaak is van die ***tradisionele definisie*** *van 'n aanvaarder en 'n* ***aangepaste definisie*** *wat die potensiële aanvaarder by die aanvaarder-groep insluit. Die betekenisvolle veranderlikes waar die* ***tradisionele definisie*** *van aanvaarding geskat*

is, is lewendehawe-inkomste per GVE, ramtegnologie, paaie en verskaffers van lewendehawe, wat bydra tot aanvaarding. Die resultate van die ***aangepaste definisie*** *dui daarop dat boerdery-effektiwiteit (speenpersentasie), tipe boer en ramtegnologie betekenisvolle veranderlikes is wat bydra tot die voorspelling van die aanvaardingsproses. Dit het verder aan die lig gekom dat die karaktertrekke van die potensiële aanvaarder meer neig na die aanvaarders as die nie-aanvaarders. Die resultate dui verder daarop dat die* ***aangepaste definisie*** *'n meer akkurate voorspelling as die* ***tradisionele definisie*** *vir aanvaarding van die gebruik van veterinêre tegnologie gee. Die resultate van die studie dui op beleidsaspekte wat nodig is om die oordraging van veterinêre dienste te versnel deur middel van die ontwikkeling van 'n beter infrastruktuur, die herinstelling van gesubsidieerde veterinêre dienste by die skeerskure en die verbetering van die vloei van inligting na boere in Qwaqwa.*

1. INTRODUCTION

Technological breakthroughs in agriculture during the first three decades after the Second World War mainly concentrated on crop production (wheat, rice, and later maize) (Hayami & Ruttan, 1985). In the livestock production sector, besides the substantial improvements in the poultry and dairy production systems, the development of the other livestock technologies was neglected, because the returns on crop technology were much larger than those of livestock technologies (De Boer, Knipscheer & Kartamulia, 1992). Nevertheless, veterinary surgeon services remain an important variable for any livestock farmer, as disease and high mortality are major constraints on livestock production in Southern Africa (Makinnon, 1985).

As in many other former homelands, five major livestock and three cash crop technology transfer (diffusion) programmes (subsidised by the government) were launched between 1980 and 1993 in Qwaqwa, a former Sotho speaking homeland. After the general election of 1994 most of these programmes on livestock technology transfer were abandoned and small ruminant farmers were left on their own regarding technology transfer and adoption (Claassens, 1998). In spite of this, casual observation reveals that some of the farmers in Qwaqwa still use veterinary services, whilst others have stopped or never used it.

The conventional approach of adoption or non-adoption, where the supply of inputs or services were assumed to be elastic, was used in most of the adoption studies in the past (Feder, Just & Zilberman, 1985; Lin, 1995). In these studies adopters were seen as those farmers using the technology during the survey period. In developing countries this definition is too restrictive, as the supply of inputs or services embodying the new technology, is often not elastic due to the scarcity thereof (Nichola, 1994). Increasing cost of new technologies (inputs, services and information) caused by transportation costs can, according to the model of Von Thünen (Barlowe, 1978), also have an effect on the elasticity of inputs and services. If the price of inputs or services, due to additional transport costs, increases not all the farmers who would like to use these inputs or services would be able to obtain or afford them.

To the author's knowledge, very little research has been done in South Africa on the general

characteristics of livestock farmers and on the adoption of veterinary surgeon services and medication technologies. Much less is known about the characteristics of the former homeland small ruminant farmers adopting medication technology. This is very strange for a country where most of the land[1] is not suited for crop production, and livestock farming therefore, based on ruminant production, is the main alternative for food production.

The identification of variables that determine the adoption of veterinary technology in order to differentiate between those who adopt or are willing or wish 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 this paper an attempt is made to test the hypothesis that the variables that determine adoption and potential adoption are different and that actual adoption would be influenced by those variables determining the rationing process for the inputs or services. In this paper the identified determinants of the adoption of veterinary surgeon services by small ruminant farmers in Qwaqwa will be compared with a broader definition which includes both adopters and would-be (potential) adopters by using a Logit approach.

2. THE STUDY AREA

Qwaqwa[2] was chosen as study area, as it is mainly a livestock production area with very little high quality arable land for cash crops (Vrey & Smith, 1980). The farmers in the sample had two basic land tenure systems, namely communal farming (Old Qwaqwa) and farming on consolidated land which is rented from the government with the option to buy the farm (New Qwaqwa).

One of the goals of the medication technology transfer programme in Qwaqwa (1980-1993) was to provide the most important veterinary drugs at an affordable price (subsidised price) and to help the local small ruminant farmers in their decisions regarding the correct use of medication (Claassens, 1998). Veterinary surgeons and extension officers (in the government's service) played a major role in this medication technology diffusion process of “learning by doing”.

According to Naude (1998) the National Defence Force stationed at least one veterinary surgeon in Old Qwaqwa during his compulsory military service. As a result Old Qwaqwa was never without a permanent veterinary surgeon until 1994. Most significantly the services of the surgeon, six animal health officers, and one government veterinary surgeon that assisted in transferring new medication technologies in Qwaqwa were supplied to the farmers free of charge. Extension officers and animal health officers played an important role through direct direct communiction with the local small ruminant farmers who, in many cases, do not understand either Afrikaans or English

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1 Fifty per cent of South Africa is classified as arid, 40 per cent semi-arid and 10 per cent sub-humid (Unesco, 1977).

2 Qwaqwa refers to two sections, the original Witsieshoek, an area of 50 172 ha, which is described as Old Qwaqwa (DBSA, Sec.2, 1985; Vrey & Smith, 1980), and New Qwaqwa, an area of 15 342 ha, an old portion of the Harrismith district which became part of Qwaqwa in 1984, as well as 59 000 ha in the Bethlehem/Harrismith districts which were divided into 115 farms.

and in many cases cannot read or write. Unfortunately, however, the initiation of a permanent veterinary service in Phuthaditjhaba was not successful (McDonald, 1998).

The medication technology transfer programme in Old and New Qwaqwa, according to Naude (1998), started in 1983, following the existing/ongoing diseases and mortality control programme (dipping, dosing and vaccinating) by the Veterinary Services Division of the Department of Agriculture. The area was divided into wards, with an animal health officer directly under the control of the veterinary surgeon as well as an extension officer in each ward. This resulted in a closer contact between the veterinary surgeon, animal health officers, extension officers and the farmers. Perhaps the most important action in this transfer process was the demonstrative part of medication usage (Naude, 1998). Small ruminant farmers formed groups and associations that bought medication in bulk at discount prices.

According to Claassens (1998) most of the extension activities were held at the shearing sheds on farmer days, which were regularly organised and presented by the different ward extension officers, specialised people from the Department of Agriculture, veterinary surgeons (private and government) and animal health officers. These farmer day intervals were once a month at the shearing sheds in Old Qwaqwa and fortnightly at different venues in New Qwaqwa.

Agriqwa, a corporation of the Qwaqwa Government, played a major role in small ruminant extension in New Qwaqwa (Claassens 1998). Veterinary surgeons and extension officers held frequent farmer days in New Qwaqwa. It was easier to get hold of the farmers in New Qwaqwa than in Old Qwaqwa where the farmers stay in the mountains with their herds.

After the general election of 1994 the Defence Force veterinary surgeon, the government veterinary surgeons and animal health officers were rationalised or employed in other capacities in Old Qwaqwa, as the Department of Agriculture was of the opinion that it was too expensive to continue these services in Qwaqwa (Olivier, 1998). The result was that the transfer of medication technology downscaled and even stopped in some wards (Olivier, 1998; Naude, 1998). Currently only one private veterinary surgeon runs a clinic in Phuthaditjhaba which is open twice a week for three hours (McDonald, 1998). Shearing sheds are mainly run by shearing associations themselves and visits from veterinary people are quite rare (Komako, 1998).

3. METHODOLOGY USED TO EXPLAIN TECHNOLOGY TRANSFER AND ADOPTION

In studies on technology adoption, discrete choice models – Probit, Logit and Tobit (Feder, Just & Zilberman, 1985; Lin, 1995) – are widely used. The Logit model is used in this study to determine predictors for the adoption of veterinary surgeon services. In the mentioned studies adopters are conventionally defined as farmers who use a specific technology during the survey period. In the theory on technology transfer and adoption the assumption is made that the supply of a new technology (inputs or services) is elastic. According to Nichola and Sanders (1996), scarcity of inputs or services result in a less elastic or even inelastic supply. The increase in the cost of new technologies caused by the transportation cost as farmers are allocated further away from input or

service centers, can also cause the supply function to become less elastic.[3] The absence of subsidies on veterinary services in South Africa makes the classical Von Thünen model of regional economics (Barlowe, 1978; O'Kelly, 1988) relevant in the adoption of technologies. Prices of outputs decrease and prices of inputs (services) increase, as farmers settle further away from input or output markets, which is a continuous relationship as the profitability of incentives of new technologies decreases. The cost of information on new technologies also rises due to increased transportation costs to obtain information. Many of the variables discussed in this paper are proxies for decreased profitability as one moves away from the urban centre or institutions and it becomes harder to get information on the profit or incentives of new technologies. If the technology is available, farmers who want or need it, will use it. If the technology is not available and extra transport costs have an increasing effect on the price, farmers who want to adopt it cannot afford it anymore and become non-adopters**.**

In Qwaqwa where sick animals have to be transported over long distances to clinics (up to 100 km), one would therefore assume that the supply of veterinary surgeon services would be elastic at the sheering sheds and less elastic elsewhere inside and outside Qwaqwa. Because of the less elastic supply function and the limited supply associated with these services in Qwaqwa, the cost of veterinary surgeon services increases. Farmers therefore do not make use of the new technology simply because of the relatively high costs or because the expected incentives of the new technologies are perceived not to be cost effective. These farmers can be regarded as potential adopters; they would have been adopters had the costs been lower or available at the sheering sheds. Variables motivating the adoption decision may therefore be confused with those that indicate the ability to acquire the scarce technology.

For these reasons Nichola and Sanders (1996) came to the conclusion that the traditional definition of adopters and non-adopters is too restrictive. They argued that under these circumstances the definition of adopters should include would-be or potential adopters. According to them, most diffusion studies have too narrow a definition of adoption when inputs or services are subsidised and rationed as has generally been the case where the state has been promoting the introduction of new technologies, especially for poverty alleviation purposes. In most of the former homelands of South Africa, inputs and veterinary surgeon services were subsidised, therefore two types of adopters should be used in defining an adopter, namely those actually adopting and those that say they would adopt if they could have obtained the inputs or services (potential adopters).

Because of the similarity of circumstances in Qwaqwa with those that Nichola and Sanders (1996) have described, it was decided to compare their adapted definition of adoption with the conventional one, keeping Von Thünen's theory in mind.

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3 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). If a farmer has to travel to Harrismith to the private veterinary clinic, the transportation cost doubles to R500 per trip.

The collection of farm level data as possible predictors for the adoption of veterinary surgeon services was based on the adoption-diffusion theory and past empirical work. The literature on diffusion (transfer) and adoption of agricultural technologies suggests that the adoption behaviour of farmers is explained by farmer and household characteristics (Wheeler & Ortmann, 1990), perceptions about agricultural technology (Feder, Just & Zilberman, 1985) and institutions and infrastructure (Hayami & Ruttan, 1985). A questionnaire was developed to obtain information on these variables from randomly selected small ruminant farmers in Qwaqwa. A proportional stratified sample of 99 small ruminant farmers (63 in the Old Qwaqwa and 36 in the New Qwaqwa) was selected.

The age of the farmers is the only variable that had a normal distribution and therefore the mean will be used as a statistic summary. All the other variables had skew distributions which makes it necessary to use the median in these cases since it is a more representative criterion in a data set where the distribution is skew (Steyn *et al.*, 1995). The explanatory variables of adoption of veterinary surgeon services were divided into two sections, namely continuous and categorical explanatory variables. Two tests were used to determine the difference between the groups for each of the twelve continuous explanatory variables, namely the t-test in the case of normally distributed variables and the Mann-Whitney test for variables with skew distributions. To determine the difference between the groups for each of the fourteen categorical explanatory variables the Chi-square Test or Fisher's Exact Test were used. Once the variables that differentiate between the two groups were identified ($p \leq 0,15$) (Table 1), Logit models were fitted with these variables as independent predictors for both groups of adopters. Stepwise selection was used in the modelling (Hosmer & Lemeshow, 1989). It was expected that the low number of "pure" non-adopters of 13 would restrict the number of explanatory variables that are significant in the model.

The dependent variables in the Logit functions are the adopters *versus* potential adopters and non-adopters as well as the adopters and potential adopters *versus* non-adopters. Adoption of veterinary surgeon services was 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 in any circumstance.

The potential adopters were grouped first with the non-adopters (n=48) (conventional definition) and then with the adopters (n=86) (adapted definition) in two different analyses to identify the variables affecting the specific group of adopters. No previous studies were done on the diffusion and adoption of medication technologies in the former homelands. Stepwise selection was used, as no precedent exists to provide a guide in the selection of relevant variables to either replicate or refute previous results. This brings to pass that a larger number of explanatory variables will be considered in the models than would have been done under normal circumstances.

4. RESEARCH RESULTS AND DISCUSSION

The significance level of the different variables studied is presented in Table 1. The variables with significant differences ($p \leq 0,15$) to be included in the models as possible predictors are presented in bold. When the non-adopters and potential adopters were in one group, six continuous variables "farming experience", "farming efficiency", "management skills", "livestock income per large stock unit (LSU)", "extension officer visits" and "type of small ruminant farmer" were significant and therefore identified as possible predictors of adoption of veterinary surgeon services. Seven categorical variables "training sources on medication usage", "external infrastructure (roads and transport)", "institutions (government and co-op extension and agricultural research, and suppliers of inputs)", "Old/New Qwaqwa" and "breeding technology" were significant and therefore identified as possible predictors. Some of these differences such as extension officer visits, roads and transport refer to the model of Von Thünen since the farmers who can obtain these services are closer, and closer means more profitable, so they adopt and others do not. These are all proxy variables for the cost of information, and the input-output prices and therefor profitability.

When the adopters and potential adopters were in the same group (adapted definition), three continuous variables "farming efficiency", "mortality rate" and "type of small ruminant farmer", and two categorical variables "technical information sources" and "breeding technology" were significant and therefore identified as possible predictors of adoption of veterinary surgeon services. Most of the differences disappear when some of the restrictions are alleviated and potential adopters are seen as adopters.

Table 1: Definition of Possible Predictors for Inclusion in the Empirical Models (p≤0,15)			
VARIABLES		**Conventional definition A *vs* P/A & N/A (n = 51 & 48)**	**Adapted definition A & P/A *vs* N/A (n = 86 & 13)**
CONTINUOUS VARIABLES			
Age	Age of farmer	0,856[1]	0,531[1]
Education	Educational level of farmer	0,620[2]	0,807[2]
Farming experience	Farming experience with livestock (years)	**0,058**[2]	0,564[2]
Farming efficiency	Weighted weaning percentage of small ruminants	**0,015**[2]	**0,021**[2]
Management skills	Days planned ahead	**0,040**[2]	0,840[2]
Entrepreneurship	Level of entrepreneurship – Total score	0,521[2]	0,206[2]
Livestock income per LSU	Cattle, sheep and goat income per LSU (Rand)	**0,003**[2]	0,604[2]
Mortality rate	Mortality as % of total small ruminant herd size	0,686[2]	**0,122**[2]
Extension officer visits	Number of extension officer visits to the farm or shearing shed per year (number per year)	**0,005**[2]	0,730[2]
Sample size		**51 & 57**	**86 & 12**
Purpose of farming	Rated importance (1-4) of keeping small ruminants for normal farming	0,417[2]	0,593[2]
Type small ruminant farmer	Sheep LSU's as % of small ruminant LSU's	**0,050**[2]	**0,077**[2]
CATEGORICAL VARIABLES			
Risk	Attitude towards risk – Seeking, neutral, averse	0,639[3]	0,483[4]
Training sources on medication usage	Sources approached by farmer to make specific decisions or attain information regarding medication usage (extension sources, co-farmers, books & self)	**0,082**[4]	0,482[4]
Record-keeping	Farmer keeping any kind of records	1,000[4]	0,348[4]
Financial management	Farmer keeping income & cost records thoroughly and complete	0,183[3]	0,981[3]
Information sources:			
Technical	Sources approached by farmer to make technical decisions or attain information (extension sources, co-farmers, books & self)	0,446[4]	**0,067**[4]
New technologies	Sources approached by farmer to get information on new medication technologies (extension sources, co-farmers, books & self)	0,979[4]	0,500[4]
External infrastructure	Farmer stated that the specific infrastructure is freely and easily accessible or available		
	Roads	**0,003**[3]	0,641[3]
	Transport	**0,010**[3]	0,207[4]
	Telephone	0,320[4]	1,000[4]
Institutions	Farmer stated that the specific group of institutions are freely and easily accessible		
	Government and co-op extension and agricultural research	**0,045**[3]	0,504[4]
	Suppliers of inputs & markets	**0,003**[3]	0,535[4]
New/Old Qwaqwa	Location of farmer	**0,149**[3]	0,539[4]
Mating seasons	Farmer making use of any of the four mating seasons	0,384[3]	0,733[4]
Breeding technology	Farmer using registered or grade rams	**0,076**[3]	**0,009**[4]

1. T-test
2. Mann-Whitney Test
3. Chi-Square Test
4. Fisher's Exact Test

The Probit and Logit models presented similar results and therefore only the Logit results are shown in Table 2.

Table 2: Logit Model Results

DEPENDENT VARIABLES	Conventional definition A vs P/A & N/A (n = 51 & 48)	Adapted definition A & P/A vs N/A (n = 86 & 13)
Adoption: A binary variable: 1 for adopters & potential adopters and 0 for non-		X
EXPLANATORY VARIABLES: COEFFICIENTS (p-VALUES)		
CONTINUOUS VARIABLES		
Farming efficiency		0,0356 (0,0256)
Total livestock income per LSU	0,0029 (0,0002)	
Type of farmer (Sheep LSU's as % of small ruminant LSU's)		0,0171 (0,0733)
CATEGORICAL VARIABLES		
Breeding technology	1,4956 (0,0101)	1,5283 (0,0397)
External infrastructure (roads)	1,5038 (0,0038)	
Institutions (suppliers of inputs)	2,2430 (0,0004)	
Percentage of farmers classified correctly (99)	74,5%	83,7%
Percentage of adopters classified correctly	74,5%	
Percentage of adopters & potential adopters classified correctly		95,3%

1. The numbers in brackets are the probabilities of Chi-Squared statistics.

In the conventional definition of adoption there were 51 adopters who made use of veterinary surgeon services at least once a year and 48 did not use these services. The empirical results as shown in Table 2 indicate that only one continuous variable and three categorical variables explain adoption. The total livestock income per LSU was the only continuous variable that contributes to the prediction of the adoption of veterinary surgeon services. This variable is one of the most important measurements of livestock income (financial) efficiency of the small ruminant farmer. The farmers that are more commercially orientated are more likely to make use of veterinary surgeon services at least once a year. It is, however, important to realise that this relationship can be more complex than a simple cause effect, as higher financial income may be a predictor and/or result of the use of the services of a veterinary surgeon. The median livestock income per LSU is R381 per LSU per year for the adopters, and R236 per LSU per year for the potential and non-adopters. The categorical variables "usage of registered or grade rams", "the availability of roads" and "the 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). Most of these results are consistent with the technology diffusion theory of Wheeler and Ortmann (1990); Feder, Just and Zilberman (1985) and Hayami and Ruttan (1985), for example the significance of roads and input suppliers is an indication that the total support system for technology adoption is not in place in Qwaqwa. If road infrastructure and institutions such as suppliers of livestock inputs were in place, more farmers would have adopted veterinary surgeon

services. This result also coincide with the barrier of increased transportation costs on technology adoption as indicated by the model of Von Thünen (Barlowe, 1987).

Seventy-one per cent of the adopters, and 53 per cent of the potential and non-adopters use breeding technology. Fifty-nine per cent of the adopters indicated that roads as an infrastructure exist or are in an usable condition, against 29 per cent of the potential and non-adopters with the same opinion. Suppliers of veterinary inputs (input suppliers, output markets and banking services) were freely and easily accessible to 47 per cent of the adopters, but only to 19 per cent of the potential and non-adopters. The significance of breeding technology (usage of registered or grade rams) is an indication that farmers making use of the more expensive rams will tend to make more use of the services of a veterinary surgeon. However, as stated earlier, there were farmers in Qwaqwa who were non-adopters of veterinary surgeon services, not by choice but due to the limited availability of veterinary surgeon services at the sheering sheds and in Phuthaditjhaba. The above estimation is done in the context where the assumption of elastic supply of veterinary surgeon services is not violated (which is not the case). Therefore some of the coefficients estimated are expected to be biased. 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 farmers (99). This model correctly classifies 74,5 per cent of adopters.

In the second analysis the Logit model was re-estimated under a broader definition of adoption. In this estimation adopters are not only farmers who actually adopted veterinary services, but also those farmers in the sample who would have used veterinary services if they were available and accessible. In this model there were 86 adopters and potential adopters, and only 13 non-adopters. Weaning percentage was one of the important technical and economical efficiency factors of small ruminant farmers since it reflects fertility, conception rate, lambing percentage and mortality (Greyling, 1998). This variable was therefore used to test technical and economical farming efficiency. The expectation is that more efficient farmers will be more likely to make use of veterinary surgeon services.

The empirical results indicate that two continuous variables and only one categorical variable explain adoption. Farming efficiency and type of farmer were the significant continuous variables and breeding technology the only significant categorical variable explaining adoption when the effect of scarcity or the lack of availability and accessibility of veterinary services is removed (2nd column, Table 2). This also corresponds with the findings of Mellor (1990), as well as the results from the model of Von Thünen where the input-output prices and costs of information (veterinary services, extension and institutions) increases as the location of the farmer are further away from these information sources. The median weaning percentage of the adopters and potential adopters was 54 per cent and the non-adopters 31 per cent. The adopters and potential adopters have a median of 76 per cent (mean 70%) sheep LSU's and the non-adopters 48 per cent sheep LSU's. These results reveal that sheep farmers are more likely to adopt veterinary surgeon services than goat farmers. Those farmers who use more expensive (registered and grade) rams are more likely to use veterinary surgeons (A & P/A – 67%; N/A – 25%). This will most probably result in a higher efficiency, a higher weaning percentage as well as a higher return to the other technologies (Greyling, 1998). This reveals that the characteristics of potential adopters gravitate more to

adopters than to non-adopters. If a predicted probability of adoption of >0,5 is considered to define adoption, the model correctly classifies the adoption category of 83,7 per cent of the farmers (99). The model correctly classifies 95,3 per cent of adopters and potential adopters (in one group).

Both models identify breeding technology as significant. This variable appears to be critical in the adoption/diffusion process under both scenarios of elastic and less elastic supply of veterinary surgeon services. Farming efficiency – technical and economical (adapted definition), and livestock income (financial) efficiency (traditional definition) – are also highly significant. The significance of these results is to further confirm the importance of access to high quality breeding stock and information on the improvement of weaning percentage and income (marketing) to small ruminant farmers in making adoption decisions. In the past veterinary surgeons, livestock inspectors and extension officers visited the sheering sheds on a regular basis and they brought medication inputs with them and also examined sick animals. These farmers then did not need roads to get to a veterinary surgeon or to go to veterinary drug suppliers, because 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 is elastic, potential adopters can get veterinary surgeon services, and roads and suppliers of veterinary inputs will not have an influence on the adoption of veterinary surgeon services. The results obtained is an indication that the significant variables (livestock income per LSU, usage of registered or grade rams, the availability of roads, the accessibility of input suppliers) must be attended to when adoption policies are set for veterinary surgeon services technology diffusion in rural areas in South Africa for small ruminant farmers in former homelands. The provision of extension officer services, a functional road network and institutions that can provide the necessary inputs must receive specific attention.

5. CONCLUSIONS

These results discussed indicated 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 (Von Thünen's model) 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 interpret clearly the cause-effect-relationship between factors. Farmers who would have adopted new technologies will be classified as non-adopters in the conventional type of adoption studies. 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 a new technology that is not readily available or accessible. In future studies on these farmers, it is important to consider the use of the suggested adapted definition of adoption in this paper. If additional transport costs to the price of input 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) that was available on a regular basis at the sheering sheds, seems 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 or services and the non-subsidised veterinary services provided by a private veterinary surgeon are major constraints to most of the potential adopters. The results of this study indicate that more farmers would have used veterinary services if these support services were available and accessible.

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