Chapter 1

INTRODUCTION

"... the great invention of the nineteenth century was the invention of the method of invention"

Alfred North Whitehead (1925).

1.1 BACKGROUND

Technology transfer and development is not a new concept, it has been around since mankind discovered things that they did not know before (Finlayson, 1995). A farmer is a rational decision-maker who normally strives for a better standard of living and seeks ways of adopting new technologies to accomplish this goal. Issues surrounding the relationship between differences in spatial location of farming activities, land utilisation patterns, the costs of adopting new technologies, costs of obtaining inputs, output services (markets) and information on new technologies, date back to the early nineteenth century. Johann Heinrich von Thünen, a German landowner and economist, developed a model in 1826 distinguishing between farmers located in concentric circles closer and further away from service and information centres (market places). He concluded that as farmers are located further away from these centres, the total production costs increase, due to increased transaction costs to obtain inputs, services and information, and the realised income from agricultural products decreases (price obtained at the market minus transaction costs) (Barlowe, 1978).

The adoption of new agricultural technologies has attracted considerable attention from development economists because the majority of populations in less developed countries derive most of their livelihoods from agricultural production (Feder, Just & Zilberman, 1985). Larson and Frisvold (1996) came to the conclusion that traditional extensive cropping systems are not sustainable and contribute to a large extent to the present state of soil degradation and poverty of farmers in Sub-Saharan Africa where, according to the Food and Agricultural Organization (FAO, 1995), at present more than one-third of its human population is classified as chronically under-nourished. In cases where new technologies were not adopted, the per capita cereal production in Sub-Saharan Africa declined at an average annual rate of over one percent between 1961 and 1991 (Sanders, Shapiro & Ramaswamy, 1996).

According to the Food and Agricultural Organization of the United Nations (FAO, 1995) the average contribution of animal products to the world food supply, in terms of calories and protein, is increasing, but the livestock contribution to African diet is declining. However, livestock potential to increase food production, including crop production in Africa, is now being recognized as a pastoralist production, particularly small ruminant production that is the only source of food which an arid ecosystem can sustain (Qureshi, 1996). Animal agriculture in Africa is, therefore, of immeasurable strategic importance, notwithstanding the fact that it is still, to a large extent, an industry practised by traditional stockman at subsistence level. This immense potential is limited by the traditional land tenure systems and subsistence farming practices (traditional technologies) that unfortunately seldom assure, or generate, adequate returns which can promote the development of more commercially orientated livestock production systems (Hofmeyer, 1996). New agricultural technologies and practices which are accepted by farmers within their operation capacity and render positive incentives, can contribute considerably to the alleviation of poverty and its related problems in this part of the international economy (Qureshi, 1996, Pinstrup-Andersen & Pandya-Lorch, 1997).

If agricultural technologies developed for farmers in developing countries are not transferred in a correct (appropriate) manner and adopted accordingly, all the effort by the researchers who developed new technologies would have been in vain. This is probably

why transfer and adoption of new technologies is perhaps one of the most popular written-about and controversial topics in developing agriculture.

Due to climatic conditions, South Africa is regarded as an arid to semi-arid country (Table 1.1), and one which is predominantly suited for livestock farming. The livestock industry in South Africa, to a large extent, forms the backbone of the South African agricultural industry, contributing to more than 50 per cent of total farm income (Van Niekerk, 1996). This, as well as the fact that no research was previously done on livestock veterinary technology transfer and adoption by emerging black small-scale farmers in South Africa, were the main motivations for this study. This type of research is essential for adequate supportive governmental policy formulation to develop the agriculture and alleviate poverty in former homeland rural areas of the country.

Table 1.1: **BIOCLIMATOLOGY OF SOUTH AFRICA**

Climatic zone	Area (%)	Annual rainfall (mm)	Annual evapora-tion (mm)	Aridity index
Arid	50	<500	>2 500	<0,2
Semi-arid	40	500 – 750	2 500 – 1 500	0,2 – 0,5
Sub-humid	10	>750	<1 500	>0,5

Source: United Nations Educational, Scientific and Cultural Organisation (UNESCO) (1977).

The present political priority is to reduce the differences created in the past, by supporting and developing the emerging semi-commercially orientated black livestock farmers in South Africa. In order to attend to these objectives, a functional extension network must be in place to introduce specific livestock technology programmes and guarantee a quality information flow in order to diffuse and transfer new tested and adapted livestock technologies, including veterinary technologies. Identifying small ruminant farmer characteristics, their needs and main constraints as well as the factors contributing or impeding the adoption of these modern and more productive technologies, is essential in order to identify and introduce the right policies. This basic step of new policy formulation cannot be overemphasised, and if this basic knowledge is not available, misleading actions and policies will not generate the desired results. This may result in a waste of time and resources.

The implementation of adapted technologies and a well-structured technology diffusion system to attend to the needs of the farmers involved, are therefore necessary for the development of a sustainable agriculture in South Africa (Düvel, 1994b).

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 universally been the concern of government and public service (Wilson & Lebbie, 1996). The correct usage of medication technologies is an important factor for the success of any livestock farming activity, as disease and high mortality are major constraints on livestock production in Southern Africa (McKinnon, 1985). The lack of information on the transfer and adoption of livestock veterinary surgeon services and medication technologies in South Africa makes this study important for the farming community, as well as the policy-makers of this country involved in extension programmes concerning small ruminant production and transfer of livestock veterinary technologies.

Qwaqwa, a former Sotho-speaking homeland (Figure 1.1), was chosen as study area because, 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. Qwaqwa was one of the former homelands where these programmes were very active up to 1994. The black farmers in the former homeland of Qwaqwa who farm mainly with sheep (mutton and woolled) and goats (Boer and Angora) (in this study referring to as small ruminant farmers), used to receive regular veterinary and extension visits and could buy veterinary medication at a subsidised price at the shearing sheds and farmer days. However, after the 1994 general elections, most of the programmes on livestock technology transfer were abandoned and the small ruminant farmers were left on their own. Casual observations reveal that some of the farmers in Qwaqwa still use livestock veterinary technologies, whilst others have stopped using them as they are no longer available at subsidised prices at the sheering sheds (Claassens, 1998; Naude, 1998; Olivier, 1998). The effect of the suspension of veterinary services and subsidised medication at the sheering sheds and farmer days have contributed to an increase on the costs of these technologies, particularly regarding the transaction costs involved in obtaining these services, inputs and information.

1.2 PROBLEM SETTING

In the former homelands of the Republic of South Africa, low productivity and high mortality rates among small ruminants (sheep and goats) are believed to be serious due to poor nutrition, diseases and parasites (Greyling, 1998). Very little is, however, known about the characteristics of small ruminant black farmers in these areas and farm-level factors (predictors) contributing to or affecting the adoption of new livestock veterinary technologies. It is extremely important to obtain this information for the formulation of appropriate and effective supporting agricultural policies. Well-formulated policies can improve the productivity of the more commercially orientated small ruminant farmers in former homelands and rural areas. The positive aspects could be strengthened and replicated in other areas of the country and the negative aspects minimised.

The Department of Agriculture has been the major vehicle of technology transfer to the former homeland farmers. With the country's political changes following the 1994 general elections and the restructuring of the extension services from the Department of Agriculture, there is a general perception that the present services are not efficiently transferring and supporting the adoption of technologies. It is important to evaluate the technology diffusion process and to identify factors to accelerate the process.

There is a need to identify the factors that contribute positively to the adoption of new livestock technologies, as well as those that represent main constraints for the diffusion/adoption process. This information is essential for policy-makers.

1.3 MAIN RESEARCH OBJECTIVE

The main research objective is to identify and evaluate the critical factors (variables) that predict the adoption of livestock veterinary technologies by small ruminant farmers in Qwaqwa.

1.3.1 Sub research objectives

- To determine the present adoption level of livestock veterinary technologies by small ruminant farmers in Qwaqwa.
- To identify the farm-level factors (predictors) affecting the decision to adopt small ruminant livestock veterinary technologies (veterinary surgeon services and medication technologies).
- To identify major constraints to accelerate the adoption of recommended livestock veterinary technologies by small ruminant farmers in Qwaqwa.
- To estimate the effects of the extension services and the present policies on the diffusion of small ruminant livestock veterinary technologies.
- To supply information to agricultural policy-makers to formulate more adequate agricultural policy guidelines on the diffusion of livestock veterinary technology transfer to small ruminant farmers in the former homelands and other rural agricultural development areas of South Africa.

1.4 OUTLINE OF THE STUDY

The underlying concern of the study is the identification of predictors contributing to the transfer and adoption of livestock veterinary technologies in Qwaqwa. In **Chapter 2** a literature review is done on agricultural technology transfer and adoption. The methodologies used by other researchers on technology transfer and adoption are identified and discussed. Variables (predictors) contributing to agricultural technology transfer and adoption in general, and when available more specifically on livestock technologies, are identified and discussed briefly.

The measurement of the dependent variables as well as the explanatory variables, hypothesised to affect the adoption of livestock veterinary technologies to be included in the applicable discrete choice models, are dealt with in **Chapter 3**. In the same chapter attention is also given to the survey, including the development of the questionnaire

(Annexure A). The chapter concludes with a short discussion of the methods followed to determine the possible predictors and the models (Annexure B) used to identify predictors contributing to adoption. In **Chapter 4** a description of the study area is given, as well as a background regarding the technology transfer programmes that were active in Qwaqwa until 1994. Factors influencing farming practices in Qwaqwa are also discussed in the same chapter.

In **Chapter 5** a description is given of the surveyed data that is used in the modelling of the adoption of livestock veterinary technologies.

The adoption of veterinary surgeon services technologies is analysed in **Chapter 6**. In this chapter a theory is developed to describe the so-called potential adopters of veterinary surgeon services where these services are not available and accessible to small ruminant farmers that would have adopted these services had it been available and accessible. This chapter also makes a distinction between the conventional definition of adopters (potential adopters classified as non-adopters) and the adapted/proposed definition of an adopter (potential adopters classified as adopters), for a less elastic/non elastic supply of technologies. **Chapter 7** deals with five models of medication technology adoption in the four more important distinct groups of livestock medication, namely external parasite remedies, internal parasite remedies, antibiotics and vaccines. In the final chapter (**Chapter 8**) a summary of results is given in terms of the explanatory variables included as predictors in the seven different logit models. The chapter concludes with general conclusions and recommendations for further research.