# AN ANALYSIS OF THE USE OF MASS

# APPRAISAL METHODS FOR AGRICULTURAL PROPERTIES

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# ABSTRACT

Farms are highly heterogeneous and never identical. No two farms are ever alike in terms of (1) the basic resources, land, labour, or capital that are available, (2) the way these resources or factors of production are combined, or (3) in terms of the amounts of various crops and livestock produced. There are numerous factors that influence the price of a farm and some of these factors are not monetary related. This makes the task of the valuer complex, and it increases the possibility of large differences in the estimated market value determined and the actual selling price.

The development and use of AVM (Automated Valuation Method) models in the valuation of especially residential property, is a worldwide phenomenon. The majority of AVM models use MRA (Multiple Regression Analysis) as a basis. The accuracy of a MRA relies heavily on the quality and accuracy of the data that are used. Thus, the availability of quality and accurate data has a significant impact on the potential accuracy of a MRA.

Accurate MRA valuation estimates will be fair to individual farm owners regarding their municipal tax assessments and it will lead to a wider use of MRAs for the valuation of farms, with the associated benefits of lower valuation costs and speedier valuations, especially by financial institutions.

This study analyses the unique and distinctive attributes of farms, which must be taken into account when a MRA model is developed. By following a stepwise regression approach, a regression model is developed which is fairly accurate, but it does not achieve a high level of accuracy.

Furthermore, the results of the study show that it is difficult to have enough appropriate and accurate data available to develop a regression analysis for agricultural property to satisfy accuracy requirements. Although it is difficult, it is possible to develop MRA models that are fairly accurate. Therefore, if MRA models are currently used for the municipal valuation of farms, which are not fairly accurate, it should be possible to improve the accuracy. However, maximum accuracy cannot be achieved with MRA models. Thus, it cannot replace a valuation done by a skilled and knowledgeable professional valuer, when maximum accuracy is required.

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# CHAPTER 1

# ORIENTATION

## 1.1 INTRODUCTION

The value of a specific agricultural property is determined by a wide variety of factors. Some of these factors are monetary related and others are not.

Van Schalkwyk (1995: 174) stated that "Contrary to many other findings, returns to farming were found to be only one of three major factors (apart from land price expectations) explaining the boom of the 1960s to early 1970s and the bust of the late 1970s to 1980s. Inflation and the opportunity cost of capital played equally important roles in explaining land price changes. This indicates a strong influence of macroeconomic phenomena in farmland prices".

Barry, *et al.* (2000: 344) pointed out that "Land values are also influenced by many special factors that may differ among potential buyers. To illustrate, an agricultural producer with excess machinery capacity may place greater value on a new tract of land than will a neighbour who must buy more machinery to operate the added land. Some non-monetary factors are pride of ownership, family tradition, hobby farming, and rural living".

The above demonstrates that specifically in the case of agricultural property, there are numerous factors that influence the price. The fact that some of these are not monetary related, makes the task of the valuer complex, and it also increases the possibility of large differences in the estimated market value determined and the actual selling price.

## 1.2 OBJECTIVES

The professional valuation of agricultural property is a complex matter. Not only does it necessitate a detailed knowledge regarding the science of valuation and

knowledge regarding applicable legal issues, it also necessitates an intimate knowledge of a number of factors that are specifically applicable to agricultural land.

Some of these factors are:

1. Agricultural properties are heterogeneous in their make-up. Two farms can be adjacent to each other and be of similar size, but they can differ regarding the type of farming practised, the soil type, terrain, water rights, existence of servitudes and the value of the fixed improvements that enhances the farm's profitability. Thus, the two farms' value will differ substantially.

2. The values are not only influenced by monetary factors, but also by non-monetary factors such as pride of ownership, family tradition, hobby farming, and rural living.

3. Ownership of farmland is more often than not, an emotional issue. This leads to the situation that the farm's value is, in the opinion of the owner, higher than what the valuation estimate may indicate.

Hager & Lord (1985: 23) stated "the success of a valuation relies heavily on personal knowledge and expertise and interpretation of the many variables which exist".

An important part of the valuation process when valuing an agricultural property is to do a thorough property inspection, in order to verify first hand all the relevant factors and data which can influence the value of the property. This physical inspection has the distinct advantage that the heterogeneous factors applicable to a specific agricultural property, are taken into proper account.

The development and use of AVM (Automated Valuation Method) models in the valuation of especially residential property, is a worldwide phenomenon. The majority of AVM models use MRA (Multiple Regression Analysis) as a basis.

With the advancement of computer technology and subsequent appropriate software programs, the use of MRA became popular and relative easy to perform.

One of the important reasons for the development and use of AVM models in the valuation of residential property for municipal taxation purposes, is to avoid the physical property inspection that is part of the traditional valuation process. The benefits of avoiding the physical inspection are, amongst others, a lower cost and greater speed to do the valuation.

The accuracy of a MRA relies heavily on the quality and accuracy of the data that are used. Thus, the availability of quality and accurate data has a significant impact on the potential accuracy of a MRA.

In certain specific farm valuation circumstances, it may occur that the need for an AVM approach (where no traditional farm inspection is done) exists, for example:

1.  A municipal valuation process requires a large number of farms to be valued. More often than not, time constraints exist, budgetary constraints to pay for professional valuations (where a thorough inspection is done) exist, and a shortage of qualified professional valuers to do the valuations.
2.  A financial institution wants to speed-up the turnaround time for loan applications, by eliminating the necessity for a professional valuer to inspect the farm and do a valuation in the normal way.
3.  If MRA models can be developed (which satisfy minimum accuracy requirements) the use of MRA in the valuation of farms can be expanded to other possibilities, such as for first time loan applications as well as second mortgage application, for rental determination and for financial statement purposes.

This study has five objectives:

1.  To describe briefly the application of general valuation theory in the valuation of agricultural property; discuss the factors that influence farm prices and the various distinctive attributes that are inherently part of farms, which should be taken into consideration when valuing agricultural property. It is these price-

influencing factors and distinctive attributes, which cause farm valuations to be complex and make it relatively difficult to satisfy accuracy requirements.

2.  To briefly discuss the concept of mass valuations and general use of AVMs in the international valuation industry. An understanding of its advantages, disadvantages, constraints and possibilities are necessary in order to identify the inherent difficulties that exist in its possible application in farm valuations.

3.  To determine if it is possible to develop a linear multiple regression model for the valuation of farms (which satisfies accuracy requirements) with data that is reasonably available.

4.  To contribute to the knowledge regarding the improvement of the accuracy levels of MRA models in farm valuations.

5.  To determine the limitations that these MRA models might have regarding its applicability to farm valuations.

## 1.3   IMPORTANCE OF THE STUDY

There are currently a number of municipalities that use MRAs in the valuation of farms for levying municipal tax purposes.

At the moment municipalities compensate for possible inaccuracy in MRAs that they utilise, by using a lower than estimated value of the farms. All the farms are taxed for example at only 70% of the value that the MRA estimates. In this way they avoid the majority of complaints they would have received if the basis was 100% of the value the MRA estimates. In order to compensate for the potential loss in income, because the municipality use only 70% instead of 100% as the base, they increase the rate at which the tax is levied. Thus, municipalities found a way to use MRAs for mass valuations, even if the MRA does not have a fair degree of accuracy. This approach apparently solves the problem the municipality has with the relative inaccuracy of the MRA. It is however not fair to the individual farm owner who now pays more than his

fair pro-rata share, because the value estimate of his specific individual farm was relatively (say 25%) higher than the values of similar properties. Currently consistency is more important for municipal valuations, than accuracy.

Financial institutions, which lend money to farm businesses, are aware of the potential accuracy pitfalls of the use of MRAs for farm valuations. Therefore, at the moment it is not used or only used in a very limited way. This study is important for a number of reasons:

1. It will help to improve the knowledge regarding the data requirements necessary for the development of accurate MRAs in farm valuations.
2. It will explain the potential pitfalls of the use of MRAs in farm valuations.
3. It will lead to more accurate MRA valuation estimates, which will be fairer to individual farm owners regarding their municipal tax assessments.
4. It may lead to a wider use of MRAs for the valuation of farms, with the associated benefits of lower valuation costs and speedier valuations, especially by financial institutions.
5. It will indicate the way forward wherein more research is needed, to enable the industry to develop more accurate MRA models for farm valuations.


## 1.4.    PROBLEM STATEMENT

There are many reasons why the market value of farmland stirs up intense emotion, these are *inter alia*:

1. Farmland is the livelihood of a commercial farmer, and as such is comparable to the business that a business owner possesses.
2. Many farms are owned by the second, third and even fourth generation offspring of the original buyer, resulting in an intense emotional involvement to the specific farm. In some cases, the current owner's ancestors are buried on the specific farm.

3. Farmers often value rural living and consider the farmers "way of life" as an important reason for being involved in a farming business. Therefore, they are reluctant to sell and leave farming as a way to earn a livelihood.

4. Farmland, when taken care of is an asset, which is durable and does not depreciate, except in countries where private property rights are not respected. It is considered an excellent hedge against the effects of inflation over the long term.

The above often results (in the opinion of the farm owner) that the market value for his specific farm is higher than the estimated market value. However, the same farm owner favours a lower market value estimate when it forms the basis of a municipal tax assessment.

It is therefore of the utmost importance that the valuation estimate of a farm must satisfy accuracy requirements.

Farm properties are highly heterogeneous in their physical attributes and there are numerous factors which influence the market value of a specific farm. These facts imply that there are many different independent variables, which have to be considered in a MRA. Therefore, a large volume of appropriate and accurate data will be needed to develop a MRA, which will satisfy accuracy requirements. The question arises if there are enough appropriate accurate data available to develop such a MRA?

The research questions can be summarised as follows:

1. Determine if it is possible to develop a linear multiple regression model for the valuation of farms (which satisfies accuracy requirements) with data that is reasonably available?

2. How does the development of an accurate MRA model contribute to the knowledge regarding the improvement of the accuracy levels of MRA models in farm valuations?

3. What are the limitations of these MRA models, regarding their applicability to farm valuations?

## 1.5   METHODOLOGY

**Literature study**

An extensive literature study was done on how general valuation theory is applied in the valuation of agricultural property. This was done in order to understand the factors that influence farm prices and to understand the various unique and distinctive attributes that are inherently part of farms and which should be t considered when valuing agricultural property. It is these value-influencing factors and distinctive attributes, which cause farm valuations to be complex and which make them relatively difficult to satisfy the accuracy requirements, specifically when MRA models are developed for farm valuations.

A literature study was done to establish what is meant by mass appraisal methods and how widely they are applied internationally. An understanding of their advantages, disadvantages, constraints and possibilities are necessary in order to evaluate their possible application in farm valuations.

**Explanation of statistical terminology**

In chapter 4 the researcher explained the statistical concepts and statistical indicators that were used to evaluate the MRA models. They are explained on a very basic level  because it is probable that valuers will want to read this study, and the average valuer does not have sufficient knowledge to understand  the  statistical terminologies that are used.

## Data acquisition and locality

Data to use for research purposes on farm values (which have appropriate and accurate information regarding possible variables) are not readily available. It was difficult for the researcher to acquire data.

To personally visit a large number of farms, do a professional valuation of each farm and in this way obtain accurate and appropriate information to enable the researcher to develop accurate MRA models, would have been too costly in terms of travelling and accommodation costs.

Various possible information sources were investigated . Eventually Mr Deon van Onselen, from Spectrum Valuers and Mr Helmut Drewes,  owner of the Agrista software programme, made sufficient data available to enable the researcher to develop a number of regression analysis models.  A non-disclosure agreement, regarding the confidentiality of individual farm owners' information was signed.

The data consisted of 15 valuations, plus three comparable transactions per valuation. Thus, a total of 15 valuations plus 45 real transactions, giving 60 data sets regarding 60 farms.

A quantity of 60 observations and 10 independent variables, gives a ratio of 6:1 (observations: independent variables), which is considered to be sufficient. A ratio of 4:1 is considered the minimum (Australian Property Institute, 2015: 489).

 The area consists of the JR, KR, KQ, LR, LS and MT  registration divisions. It is the western area of the Limpopo province. It can be described as the area north of the road from Bela-Bela (Warmbaths) to Northam, and west of the road from Bela-Bela (Warmbaths) to Makhado (Louis Trichardt). The only exception is four farms that are close to Letsitele in the eastern part of the Limpopo province

The aim of the researcher was to use data, as far as possible, that are from a homogeneous area regarding its natural habitat. The farms are primarily located in the eco-zone "mixed bushveld ", as classified by the South African National Biodiversity Institute (2005: 26).

An eco-zone is defined as "an area where there is relatively uniform geology (soil) and therefore landform (landscape), as well as uniform altitude, latitude, longitude, rainfall and climate in general" (South African National Biodiversity Institute, 2005: 9).

Eco-zone " Mixed Bushveld"  is described as: Altitude of 700 - 1 100 m; Rainfall 300 - 500 mm; mostly in the form of thunderstorms. The summers are hot, reaching temperatures of 35° C and more by day, with only occasional frost during winter nights. Due to the low rainfall, grasses do not form dense uniform stands. Grass types are mainly a mix between types with a higher grazing value and types with a lower grazing value.

Twenty-four farms have Thabazimbi as the nearest town, four farms have Vaalwater, eight have Mookgopong (Naboomspruit), four have Alldays, four have Warmbaths (Bela-Bela), four have Makhado (formerly Louis Trichardt), four have Letsitele and eight farms have Lephale (formerly Ellisras) as the nearest town.


**Independent variables used**

In this study, the researcher analysed 10 independent variables:

1   Date the sale took place,

2   Size of the farm,

3    DVI (depreciated value of improvements),

4    Quality of the grazing,

5   The number of hectares per livestock unit needed,

6   Number of hectares legally under irrigation,

7   Distance from the farm to the closest town,

8    lTourism infrastructure on the farm,

9   How mountainous is the topography,

10   Is there a proper game fence on the farm.

The reasons for the use of these specific 10 variables are that various researchers identified them as having a significant influence on farm values:

1. Woolford & Cassin (1983: 214 & 216) used MRA successfully in an assignment to determine the 1916 market value, of a large volume of farmland parcels. The assignment was done in the early 1980's. They used:
   a. Date of sale
   b. Productive capabilities of the property
   c. Distance from town
   d. Presence of streams
   e. Nature and extent of improvements
   f. Extent of cultivated land.
   g. Recent weather trends.

2. Bourhill (1998: 81) did a stepwise regression analysis on 47 variables that could have a possible affect on land prices. He identified nine variables, which have the most significant affect on farm prices. Seven of the variables that Bourhill identified, are included in the 10 variables the researcher used:
   a. Farm size,
   b. Selling price of comparable farms
   c. Topography (slope),
   d. Distance from nearest town.
   e. Existence and quality of infrastructure (DVI), including a second house.
   f. Is there any tourism infrastructure on the farm.

Two variables that Bourhill used were non-farm factors such as "does the buyer own the adjacent farm ?" and " how many years farming experience does the buyer has?" The researcher used only farm factors.

3. Four of the six variables that Steyn (2003: 95) considered are included in the 10 variables used by the researcher:
   a. Size of the farm,

b. The size and quality of the house (DVI)

c.  Any tourism development in existence and

d. The distance from the closest town.

The researcher used four more variables, than Steyn.

4. Pienaar (2015: 71-84) described 12 variables that have a specific influence on the value of a farm. Seven of these 12 variables are included in the 10 variables the researcher used. Pienaar did not do any statistical research on the importance of the various variables, it is his opinion, as a professional valuer who specializes in farms.

5. Own knowledge and personal experience regarding the most important possible factors that are considered by a potential buyer of a farm (and therefore will influence the price) in the "mixed bushveld" eco-zone, was also used.

**Stepwise regression method**

The process that was followed was a stepwise regression approach. The researcher developed 16 MRA models. Eight of these models, when statistically analyzed, were inaccurate to the extent that they could not be described in this research therefore, eight models are discussed in chapter 4. The objective was to improve each model that was developed until a model was developed that satisfied accuracy requirements.

## 1.6   LIMITATIONS

There is very little literature available regarding the application of MRA models in the valuation of farms, thus the researcher focused primarily on the literature available as it is applied in the mass valuation of residential property.

The availability of sufficient appropriate and accurate data to develop MRA models, were a limitation. Therefore further MRA models, which included the depreciated value of improvements, could not be developed.

This study was not meant to be an all inclusive and detailed study on the use of mass appraisal methods for agricultural properties. However, it is intended to give a general view of:

1. the uniqueness of agricultural property and how this uniqueness makes accurate farm valuations complex and difficult,
2. mass valuation methods; its advantages, limitations and possibilities for use in the valuation of farms,
3. how to develop MRA models for farms, the difficulty in developing models that satisfy accuracy requirements and the limitations of these models.

## 1.7   PLAN OF THE STUDY

This chapter  provides the orientation for the rest of the study. It describes the objectives, importance of the study and the problem statement. In the description of the methodology of the research, the process that was followed and specific problems regarding the acquiring of data that was experienced, is described. The limitations of the study are explained to ensure that the reader does not have a misconception regarding the scope of the study.

Chapter 2 briefly describes the application of general valuation theory in the valuation of agricultural property, discusses the factors that influence farm prices and the various distinctive attributes that are inherently part of farms, which should be taken into consideration when valuing agricultural property. It is these price-influencing factors and distinctive attributes, which cause farm valuations to be complex and makes it relative difficult to satisfy accuracy requirements.

In Chapter 3 the concept of mass valuations and general use of AVMs in the international valuation industry are discussed briefly. This will lead to an understanding of its advantages, disadvantages, constraints and possibilities, which

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will make it possible to identify the inherent difficulties that there are in its application in farm valuations.

Chapter 4 deals with the development of linear multiple regression models, through the process of stepwise regression, for the valuation of farms. These MRA models have to satisfy accuracy requirements. It also describes the limitations that these MRA models might have, regarding their applicability to farm valuations. The researcher explains, on a very basic level, the statistical concepts and statistical indicators that were used to evaluate the MRA models.

In Chapter 5 the research questions are answered, the shortcomings of the MRA model will be explained and the requirements for further research are discussed.

# CHAPTER 2

# THE APPLICATION OF VALUATION THEORY IN FARM VALUATIONS

## 2.1 INTRODUCTION

Agricultural properties have many unique and distinctive attributes that are inherently part of farms, which should be taken into consideration when valuing agricultural property.

To be a successful professional valuer of agricultural property, one needs very specific valuation knowledge and expertise regarding farms and the farming industry.

Suter (1992: 39-41) described the knowledge and experience that a professional farm valuer should have as follows:

1. Considerable technical knowledge about many agricultural topics.
2. Usually, born and reared on a farm.
3. Usually, have an agricultural college degree or diploma.
4. Acquired skills from agronomy, engineering, animal science, economics, law and psychology.
5. Has a feel for the soils, topography, drainage, irrigation facilities and the practices influencing the crops raised in the area.
6. He has a feel for the contribution of various buildings and improvements and whether the farm's resources, as an operating unit, are balanced.
7. Has a feel for the farm real estate market and for factors such as product prices, costs, earnings, rental rates, government regulations and the idiosyncrasies of both buyers and sellers of farms in his area.

The valuer who does not have the above-mentioned farm background and knowledge will, when he submits a written report, generally display a naive understanding, if not gross ignorance, of many agricultural matters (Suter, 1992:41).

Not all appraisers have the skills or the expertise required to appraise farms or ranches (Suter 1992: 41).

This chapter will focus primarily on discussing and explaining how various valuation concepts should be applied when valuing agricultural properties, with their unique and distinctive attributes.


## 2.2  DISCUSSION OF CONCEPTS

In this study, the term "valuation" is often used interchangeably with the term "appraisal", and the words "agricultural property" is used interchangeably with the words "farmland" or "farms".


### 2.2.1  Valuation and the valuation process.

According to Jonker (2014: 26), a valuation is in essential a prediction of the price that would be paid for the article.

The purpose in farm valuations is not to estimate what a farm is worth, but to estimate at what price it will most likely sell in today's market (Berhman, 1995: 7).

The  Appraisal Institute (2000: 27) described it as "the process of estimating the value of an identified interest or interests in a specific parcel of real estate as of a given date".

The valuation process (AI, 2000: 37) involves three major activities:

1. The collection of all the relevant data.
2. Inspection of the subject property, comparable sales, the area and the neighbourhood.
3. Organisation and analysis of the data to arrive at a value opinion for the subject property.

Betts (2013: 47) described the appraisal process as consisting of four steps:

1. Identify the appraisal problem to be solved.
2. Identify the appropriate solutions.
3. Execute the appropriate scope of work.
4. Report the findings and conclusions reached.

The valuation of a property involves a thinking process through which the valuer arrives at an estimate of the market value of the property. The judgement of the valuer is an important component of this process. This process results in an assessment of the market value of the property (Gildenhuys, 2001: 207).

It is clear from the above that the estimate of the market value is not an exact science, but that it is an informed opinion of a professional person (the valuer) after following certain methodology (valuation methods) in a thinking process. Therefore, valuations can easily differ in determined market value.

Pienaar (2015: 55) stated that there is a general belief in the valuation industry that it is acceptable for valuers to differ by as much as 10%. A difference of 50%, for the same farm is unacceptable and damages the integrity of the industry.

Ratterman (2007: 1) alluded to the psychology of the valuation process. He described the process as a request the client has in which he asks the valuer: "tell me what a buyer will think of this property, and what you think he will be willing to pay. Thus, the valuation process requires the valuer to study the behaviour of buyers and sellers and their mental processes to predict what they will do when they buy and sell property. Basically, appraisers study what human beings have done in the past so they can predict what they will do again in similar circumstances".

Simpson (1997: 5) commented that a valuer should have an efficient property inspection system in place. It is best for the valuer to use prepared forms. A form should:

1. request only relevant information,
2. request the data in the same sequence that the valuer inspects a property,
3. be flexible,

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4. be easy to complete.

The part of the valuation process where the inspection of the subject farm is done is extremely important. This is where the valuer has to apply his personal knowledge and skill, as Suter (1992: 39-41) described it:

1. As the valuer walks a given subject farm he should have a feel for the soils, topography, drainage, irrigation facilities and the practices influencing the crops raised in the area.
2. He should have a feel for the contribution of various buildings and improvements and whether the farm's resources, as an operating unit, are balanced.

## 2.2.2 Price

The price refers to a sale or transaction price, thus it is not an estimate but a fact. The market value is a subjective value by a person on the valuation date, while the price is an objective figure of a transaction between a buyer and a seller.

The International Appraiser Institute (2000: 32) defined it as "the price represents the amount a particular buyer agrees to pay and a particular seller agrees to accept under the circumstances surrounding the transaction".

## 2.2.3 Value

According to the Appraisal Institute (AI) "the term value is often used imprecisely in common speech, but in economics it has a specific meaning which distinguishes it from the concepts of price, markets, and cost" AI (2000: 11).

The AI states the following:

1. Value is created in the minds of the people who make up the market for that commodity. It is influenced by four factors namely utility, scarcity, desirability and effective purchasing power.
2. The utility is the ability of a product to satisfy a human want, need or desire. The characteristics of a property such as size, design and location influence its utility and thus its value.
3. Scarcity is the present or anticipated supply of an item relative to the demand. Desirable agricultural land is limited and has therefore greater value.
4. Desirability is the purchaser's wish for a property to fulfil certain human needs.
5. Effective purchasing power is the ability of the potential buyers to pay for the property.

Turner (1977: 1) made the point that in economic theory, for a product or factor of production to have a cash value, it must satisfy three criteria:

1. It must have utility
2. It must be capable of ownership
3. It must be limited in supply.

Van Schalkwyk (1995: 21) commented: "persons buy or own farms for many reasons. In general, they hold or own farms because this enables them to obtain certain satisfactions, which they could not otherwise enjoy. These satisfactions are often income-inspired, but stem also from satisfactions other than making money. At some income level, and this varies widely, additional income has to compete with other satisfactions. In other words, there are multiple desires, multiple sources of satisfaction, and hence multiple reasons for farm ownership".

### 2.2.4 Market value

The market value can simply be referred to as what the property can be sold for on the open market.

The American Appraisal Institute (2000: 27) defines it as "The most probable price which a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and the seller each acting prudently and knowledgeably, and assuming the price is not affected by undue stimulus. Implicit in the definition is the consummation of a sale as of a specified date and the passing of title from seller to buyer under conditions whereby:

1. Buyer and seller are typically motivated.
2. Both parties are well informed or well advised, and acting in what they consider their own best interest.
3. A reasonable time is allowed for exposure in the open market.
4. Payment is made in terms of cash in U.S. dollars or in terms of financial arrangement comparable thereto; and
5. The price represents the normal consideration for the property sold unaffected by special or creative financing or sales concessions granted by anyone associated with the sale".

The South African Institute of Valuers (SAIV, 2014: 6-3) referred to the definition of the International Valuation Standards Committee namely, "*the estimate amount for which a property should exchange on the date of valuation between a willing buyer and a willing seller in an arm's-length transaction after proper marketing, wherein the parties had each acted knowledgeably prudently and without compulsion*".

In South Africa - as in other countries - case law made a significant contribution to the development of the concept of market value.

In determining the market value Jonker (2014: 29) distinguished between,

1. What  price **could** have been obtained;

2. What price **would** have been obtained, and;
3. What price **should** have been obtained?

In (1) it implies the highest price doctrine, (2) implies the probable doctrine, while (3) implies the degree of perfection of how well informed the buyer and seller is.

Jonker (2014: 35) concluded that our courts (and thus a valuer) should determine the price for which the property **would probably** have been sold on the date of the valuation. This value represents the market value on the valuation date.

The definition of market value evolved from the applicable law as well as the numerous court cases, over the years. Jonker (2014: 38) defined the current accepted South African (legal) definition of market value as follows:

*"The price that a willing and informed purchaser will pay a willing and informed seller in a normal open market transaction at the date of valuation, when neither party is under any anxiety or compulsion to sell or purchase, other than their normal desire to transact".*

### 2.2.5  Market value and the characteristics of agricultural property

Suter (1980: 3) stated that farms are bought and sold, sometimes as businesses, sometimes because they are enjoyable places to live, sometimes as investments, and sometimes as insurance against a declining currency value.

The farmland market does not have the characteristics of a purely competitive market, which are (Van Schalkwyk, 1995: 36):

1. The product of each seller is identical, that is, homogeneous.
2. There are many buyers and sellers in the market, and each transaction is relatively small to the aggregate volume of transactions.
3. There is free entry and exit from the market for both buyers and sellers.
4. The product is perfectly mobile, so that no buyer is prevented from buying something simply because of the cost or effort to obtain it.

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5. Buyers and sellers possess perfect knowledge regarding the product and the market.

Suter (1980: 3) stated: "no two farms are ever alike in terms of (1) the basic resources (land, labour, or capital) that are available, (2) the way these resources or factors of production are combined, or (3) in terms of the amounts of various crops and livestock produced". Thus, the product is never identical or homogeneous.

There are not always a large number of buyers and sellers in the market. There may be a large number of buyers, but only a few landowners willing to sell; or a large number of landowners wanting to sell but only a few buyers (Turner 1977: 37). This is the situation in the case of restitution or expropriation. There may be a large number of possible affected farms, but there is only one buyer, namely the government, in restitution cases.

Generally, there are only a very limited number of farms, in a specific area, available to buy. Landowners tend to have a long-term view in owning farmland; they do not sell their farms easily.

The availability of credit affects free entry and exit from the market. The amount involved in a farmland transaction is generally substantial. There are not a large number of buyers who possess the cash reserves or have access to large credit amounts, to be able to buy a farm.

The fixed location of farmland tends to localise the market, thus a possible buyer of farmland will not buy easily if the property is geographically too far from him.

It is clear that the agricultural property market does not meet the requirements for a purely competitive market.

Van Schalkwyk (1995: 120) mentioned that in most countries of the world one of the major advantages of ownership of land has been its price appreciation over time. Unlike most other resources, land does not depreciate or deteriorate if managed properly. This increase in net worth can be used as collateral for borrowing funds, as well as a cushion or reserve against short term financial losses that may require

financing. Thus, land ownership has important capital appreciation and risk reduction dimensions for the farm owner.

Turner (1977: 89-90) wrote that many attempts have been made by agricultural economists to relate the price of agricultural land to economic factors such as underlying interest rates, the productivity of agriculture and the level of farm income and farm rents. He mentions that S.G Sturmey also identified the influence of legislation as a factor. One of the strongest correlations that exists is that between the price of agricultural land and the Financial Times ordinary share index.

Van Schalkwyk (1992: 36-41) comments that the factors that influence the supply and demand function of farmland can be allocated in three categories, namely:

1. Farm resource factors, such as topography, soil potential,, percentage of farm that is arable, extent of irrigation and average rainfall.
2. Non-farm factors, such as debt per hectare and population density
3. Interest rates

Van Schalkwyk (1992: 51) did a regression analysis study which indicated a high significance between debt per hectare and the value per hectare. He concluded that the more willing financial institutions are to provide debt to farms in a specific area, the higher the farm values will be in that area therefore, the availability of credit to the farmer is capitalized in higher farm values.

He further concluded (Van Schalkwyk, 1992: 62) that the correlation between the debt per hectare, the population density and the farm values are so significant that farm values are not a good indicator of farm resource quality. Farm values are highly correlated with the gross farm income (Van Schalkwyk, 1992: 169)

Van Schalkwyk (1995: 23-35) found that there are a number of reasons why farmland value changes, some of these are:

1. Changes in net farm income
2. Changes in rental income
3. Government agricultural programmes
4. Technological advance

5. The demand for larger farm units
6. Pressure from an increasing population and affluence
7. Anticipated increase in the value of farmland
8. Macro-economic variables, such as the general price inflation and interest rates

He states that although net farm income and farmland value have not always moved in the same direction, net farm income is still believed to be one of the major determinants of farmland value. However, van Schalkwyk determined (1995: 174) that the most important reason for farmland price movement is the expectation that potential buyers and sellers have of the direction of future price movements.

This is a very important finding as it has a direct applicability on farmland values where restitution or expropriation processes are under way.

Bourhill (1998: 92) mentioned that the effect of expectations on price could not be quantified, but it appears that this has a significant influence on prices.

Murray (1969: 39) commented that market value stands out as the preferred approach when valuing farmland, because it includes the income and cost elements but also non-income features of a farm such as attractiveness or nearness to a town. Market value has won the approval of the courts because of its objective nature.

Bourhill (1998: 92) determined that the most important determinant of land value (within a relatively homogenous area) is the size of the farm.

He found that easily recognisable productivity features such as arable land has a high impact on the value of a farm.

He further found that factors such as:

1. Buyer's age and experience,
2. distance from town,
3. sales of adjoining properties,
4. degree of infrastructure
5. a second dwelling,

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6. interest rates,

7. percentage arable land,

8. and slope,

All explained variations in farm prices.

A review of the factors affecting land prices shows that external (non-farm) and non-economic factors complicate the analysis and cause a gap between market value and productive value, which in turn varies from submarket to submarket.

He states that the finding regarding the influence of interest rates on farm values has implications on the land reform programme in that concessionary interest rates or grants will be capitalised into land values. This will benefit existing landowners and make restitution more expensive.

He concludes by stating that in South Africa land prices are driven by factors which are difficult to predict and to quantify. Bourhill (1998: 94) stated "It is hardly surprising that valuation is termed the Achilles heel of the land reform programme".

Pienaar (2015: 71-84) discussed 12 factors that influence a specific farm's value additional to the factors that influence the farm values of an area. He named the following:

1. The unique combination of natural resources on a farm; namely the land type, soil form and grazing capacity. Every farm has a different unique combination of these natural resources.

2. The topography of the specific farm. Farmland with very steep slopes is not ideal for cattle farming.

3. The presence of rights, servitudes and endorsements.
   Rights such as the right to use water, deeds of lease and zoning rights can have a positive or negative influence on the farm's value.
   The existence of power lines, pipelines, canals and right-of-way servitudes influence the value negatively.
   Usufructs and notarial deeds have an influence.

4. The level of infrastructure development has a direct influence on the value.

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5. The utility of the land.

   Irrigation land and permanent crops are more expensive than grazing.

6. Location in relation to markets and input suppliers.

7. Access to the farm.

   How easy or difficult it is to access the farm by road and how good or bad are the roads leading to the farm.

8. Farm shape and outlay.

   A game farm should be as square as possible for the best movement of game and optimal utilisation.

9. Farm extent.

   Small farms tend to fetch higher prices per hectare than larger farms.

10. Condition of the veld

    The value of farms with overgrazed veld is lower than a farm where the veld is managed prudently.

11. Labour versus capital intensity.

    Labour intensive farms have normally a higher potential profitability but it has the risk of labour strikes and unrest. This can influence the value positively or negatively.

12. The potential of the specific farm.

    The potential is the unique combination of the specific farm regarding its natural resources and topography in combination with the potential level of management expertise applied.

### 2.2.6  The value of farms expropriated

Agricultural property is the type of property that is expropriated the most. Therefore, the various laws that determine how a farm should be valued when the State wants to expropriate it, is of great importance to farm owners and to farm valuers.

It not only affects the price of the specific farm that is expropriated, but it also affects the value of the surrounding farms.

Pienaar (2015: 59-60) commented that government's original goal was to have 30% of farms by 2014 to be owned by black people. The restitution process resulted in an above normal increase in farm values in the affected areas. The reasons for this effect are twofold:

1. There was a decrease of supply of farms because the new owner, after a restitution process, is not allowed to sell the farm for 10 years. Therefore, the number of farms available in the affected area is less than what normally would have been the supply.
2. There was also a degree of opportunism. The general expectancy in the market is that if government is the buyer, prices should be higher than normal.

Two acts directly prescribe how the value of a farm should be determined in expropriation proceedings.

The first one is Section 25 of the Constitution of 1996, Act 108 of 1996 and the second is the Expropriation Act of 1975, as amended. The Expropriation Act of 1975 as amended is in the process of being repealed and replaced with the Expropriation Act, of 2016. It has already been approved by parliament. The final step before it becomes law is for the President of South Africa, to sign it.

### 2.2.7  Market value and the Constitution of 1996

South Africa held its first democratic election in 1994. During the years that preceded 1994, the different political parties and interest groups went through an intense negotiation process, to negotiate a new constitution. This culminated in the Constitution of the Republic of South Africa that was formally adopted by Parliament in 1996, and which is considered by many as one of the best constitutions in the world.

Section 25 of the Constitution of 1996, Act 108 of 1996, deals exclusively and specifically with property rights, restitution and expropriation. It reads as follows:

"(1) No one may be deprived of property except in terms of law of general application, and no law may permit arbitrary deprivation of property.

(2) Property may be expropriated only in terms of law of general application:

    (a)  for a public purpose or in the public interest; and

    (b)  subject to compensation, the amount of which and the time and manner of payment of which have either been agreed to by those affected or decided or approved by a court.

(3) The amount of the compensation and the time and manner of payment must be just and equitable, reflecting an equitable balance between the public interest and the interests of those affected, having regard to all relevant circumstances, including:

    (a)  the current use of the property

    (b)  the history of the acquisition and use of the property

    (c)  the market value of the property

    (d)  the extent of direct State investment and subsidy in the acquisition and beneficial capital improvement of the property; and

    (e)  the purpose of the expropriation.

(4) For the purposes of this section:

    (a)  the public interest includes the nation's commitment to land reform, and to reforms to bring about equitable access to all of South Africa's natural resources; and

    (b)  property is not limited to land.

(5) The State must take reasonable legislative and other measures, within its available resources, to foster conditions, which enables citizens to gain access to land on an equitable basis.

(6) A person or community whose tenure of land is legally insecure as a result of past racially discriminatory laws or practices is entitled, to the extent provided by an Act of Parliament, either to tenure which is legally secure or to comparable redress.

(7) A person or community disposed of property after 19 June 1913 as a result of past racially discriminatory laws or practices is entitled, to the extent provided by an Act of Parliament, either to restitution of that property or to equitable redress.

(8) No provision of this section may impede the state from taking legislative and other measures to achieve land, water and related reform, in order to redress the results of past racial discrimination provided that any departure from the provisions of this section is in accordance with the provisions of section 36(1)".

What is clear from paragraph (3) of section 25 of the Constitution is that the market value of the property is only one of five relevant factors that should be taken into consideration when determining an amount of compensation. Furthermore, the amount should be just and equitable to both the seller as well as to the public interest.

Van der Walt (2011: 510) stated that the fact that compensation may be, but need not be, equal to market value is not startling; a similar conclusion has been reached in other jurisdictions, such as German law, European Union law, in some Commonwealth jurisdictions and Irish law.

How to apply section 25(3) in practise when the value of a farm has to be quantified, leads to various court cases.

Jonker (2014: 199) referred to the *du Toit v Minister of Transport* case where the majority ruling in the Constitutional court held that the market value of the farm should be the starting point in determining an amount that is just and equitable. Thereafter an amount may be added or subtracted, as the relevant circumstances in section 25(3) requires.

The court ruled that the compensation may not exceed market value, to prevent the individual unduly benefiting at the expense of the public (Mooya, 2014:18).

Mooya (2014: 18 - 23) argued that in order to apply Section 25(3) in practise, a farm should be valued according to its use value. The use value being the net present value of the cash flow or other benefits that an asset generates for a specific owner under a specific use.

He further commented (2014: 23) "It has to be remembered that valuation of agricultural properties is a specialised skill".

There are two, amongst others, detrimental implications of Mooya's view, to the value of the subject farm:

1. The highest and best use of a farm will not be taken into account to determine the compensation.
2. The use value, as Mooya describes it, with specific reference to the capitalisation rate that should be used, is in most cases lower than the market value.

## 2.2.8 Market value and the Expropriation Act of 1975

The right of a sovereign to acquire a subject's property was first limited by Magna Carta, that was imposed on King John by English barons at Runnymede in 1215 (Magna Carta: Internet). English law was amended in 1919 to provide for compensation that recognised market value.

Murray (1969: 7) stated that fair market value is the general standard used in providing compensation to owners in expropriation cases. This has proved to be the only satisfactory basis for rewarding the owner whose property is taken. The general principle is that fair market value for the property taken will make the owner "whole"; that is, it will enable him to replace what has been taken from him.

Gildenhuys (2001: 275-291) described the requirements that the Expropriation Act of 1975 determines, as follows :

1. The market value is the price the seller would have obtained during an imaginary transaction.
2. The property must be valued for its current use, but if a more advantageous use is probable, it must be taken into account.
3. The value must be determined as it was on the date that the notice of the expropriation was served on the owner.
4. The willing seller and willing buyer principle refers to a notional seller and a notional buyer, and not to the specific current owner of the property as the seller, or to the State/specific legal entity as the buyer.
   a. Thus, no subjective or emotional value that the property may have for the current owner may be taken into account, when a valuation is done of the property.
   b. If the neighbour of the subject property is a willing buyer, and the property has a certain potential value for the neighbour that he is willing to pay for, the market value has to be based on the price the neighbour is willing to pay.
5. The open market principle requires that proper steps were taken to advertise the property and let all likely purchasers know that the land is in the market for sale. Every person desirous of purchasing is able to make an offer.
6. The compensation may not be more than the summation of the market value of the property and the real financial loss the expropriation caused the owner.
7. If the subject property exists out of more than one title deed, every title deed can be valued on its own as well as the whole property as a unit. The highest market value when the summation of the value of all the title deeds is compared to the value of the property as a unit, is the compensation amount that should be paid.

An important factor is that the highest and best use of a farm should be taken into account, when the market value is estimated.

### 2.2.9 Expropriation Act, 2016

The Expropriation Act of 2016 has been approved by parliament and is currently at the Office of the President of South Africa for signature.

The Expropriation Act, 1975, predates the expropriation mechanism provided for in section 25 of the Constitution. The Constitution is the supreme law of the Republic, legislation or conduct inconsistent with it is invalid, and the obligations it imposes must be adhered to.

The Expropriation Act, 2016 seeks to align the Expropriation Act, 1975 with the Constitution and to provide a common framework to guide the processes and procedures for expropriation of property by organs of state.

Section 12(1) of The Expropriation Act, 2016 repeats the exact wording of section 25(3) of the Constitution, indicating the intention to align The Expropriation Act, 2016 to the Constitution.

Provision is made in section 12(2) of the Expropriation Act, 2016 for factors, which must not be taken into account when the amount of compensation is determined. These include:

(a) the fact that the property has been taken without the consent of the expropriated owner or expropriated holder;

(b) the special suitability or usefulness of the property for the purpose for which it is required by the expropriating authority, if it is unlikely that the property would have been purchased for that purpose in the open market;

(c) any enhancement in the value of the property, if such enhancement is a consequence of the use of the property in a manner which is unlawful;

(d) improvements made on the property after the date on which the notice of expropriation was served upon the expropriated owner and expropriated holder; except where the improvements were agreed on or were undertaken in pursuance of obligations entered into before the date of expropriation;

(e) anything done with the object of obtaining compensation there for.

(f) any enhancement or depreciation, before or after the date of service of the notice of expropriation, in the value of the property in question, which can be directly attributed to the purpose in connection with which the property was expropriated.

Clause 21, provides for both a mediation procedure as well as determination by a court of the compensation amount

### 2.2.10  Market value and land reform

Bourhill (1998: ii) stated that the success of land reform depends on the credibility and equitability of property valuations, which have a history of unreliability and lack of uniformity.

He commented that a number of valuation concepts, pertaining to agriculture, are widely misunderstood. There appears to be a lack of understanding of the true origins of value and of the changing market environment.

There appears to be an underlying bias towards overvaluation where the State is buying (Bourhill, 1998: ii). He did not prove this statement, but he mentioned it as his opinion.

### 2.2.11  The task and ethics of the valuer

The role of the valuer is that of interpreter of human behaviour, and more specifically, of the economic behaviour of buyers and sellers in a market. The purpose for which an estimate is required should not influence the estimate (Bourhill, 1998: 16). He further stated that the valuer should be impartial, and should not have the interests of any one party at heart.

The functions of a valuer and those of a real estate consultant are not the same. A property consultant advises a client in the latter's interests. A valuer should not have the interest of any party at heart. A valuer should not be influenced with the estimate

the owner has of its own property. The valuer must be at all times be impartial (SAIV, 2014: 1-5).

The SAIV (2014: 1-9) states that the valuer does not create value. His function is to estimate it. Furthermore, it is not the valuer's role to settle disputes, that is the prerogative of the courts. Giving evidence in explanation of his valuation is one of the duties of a valuer who is often called as an expert to provide testimony.

Bourhill (1998: 17) observed that it is a well known fact that a valuer's opinion is usually biased in favour of the client who pays his fee. He referred to Suter (1992) who stated: "that in expropriation cases, the valuer is almost always biased in favour of the expropriatee for the simple reason that he must come "eyeball to eyeball" with the landowner whereas he will never have to answer to the taxpayer. Any inconsistency and biases are soon uncovered in the court room".

(Suter 1992: 480) mentioned that in expropriation cases, there is an unconscious bias, which nearly always influences the expert witness in favour of the party who calls them.

Suter (1992: 41) stated that a qualified appraiser needs to have a high level of honesty and integrity. If for example his client asks him to value the farm for a given amount, he should "either turn the job down or straighten out his client".

Behrman (1995: 88) quoted Gildenhuys & Grobler "A valuer must be independent. It is not his function to plead the case of the client, but it is proper to argue the correctness of his own valuation. Experience shows that the evidence of valuers tends to favour their clients. It has been suggested that the courts should make allowance for such unconscious prejudice on the part of the valuer. It is to be hoped that the higher professional status of valuers will curb such tendencies."

Millington (2000: 260) commented that the quality of service provided by the valuation profession is what it will be judged by, thus it is important that valuers should always act objectively and with complete integrity. They should seek to adopt realistic assumptions and should be wary to incorporate speculative assumptions.

Pienaar (2015: 427) delivered a number of comments regarding ethical behaviour of the farm valuer:

1. To be a valuator is a professional career, and a valuer should always behave and perform within the ethics of the profession.
2. A valuer has only one chance to keep his good name.
3. A valuer should always be consequent.
4. If a valuer gets a second opinion, it does not mean he is less knowledgeable, but that he is trying to do a better valuation.
5. A valuer should always be objective although a value could be a subjective issue.
6. Comparable transactions must be evaluated and validated, not just listed.
7. The valuer must not be biased because of the treatment (good or bad) experienced at the hands of the client or owner of the farm. It often needs guts to stand firm and adhere to sound principles.
8. It is often good practice to sleep over a valuation and read it again the next morning, before sending it off.
9. Integrity is not negotiable, it is a must!

All the above facts and opinions lead to the conclusion that the valuer of farm property must at all times be professional, unbiased and intellectually honest when he does a valuation. Not only is it required by the South African Institute of Valuers, by the courts of law and by the valuation industry as a whole, but the valuer who does not adhere to this will soon be uncovered in the court room.

In expropriation cases, the professional valuer of the farm should keep in mind there is always a definite possibility that he will have to testify in a court of law, motivating and explaining his valuation of the farm. There are several reasons why a farm owner may be willing to challenge the price he is offered, in a court of law:

1. When a farm is expropriated the farm owner is forced to sell, therefore he is emotionally motivated.
2. Farms are expensive assets and the farm owner wants to make sure he gets a just and equitable compensation.

## 2.2.12  Highest and Best Use

The highest and best use principle is important to the potential value of farm properties. There are usually various alternative enterprises as well as various alternative improvements that should be considered. The potential highest and best use on a farm can have a large impact on the value of the farm.

The Appraisal Institute, (AI) defines the highest and best use as " *the reasonably probable and legal use of vacant land or an improved property, which is physically possible, appropriately supported, financially feasible, and that results in the highest value" (* AI, 2000: 148).

The AI illustrates this definition by giving a practical farming example. If the farm is improved with structures used for grain production and the property is located in an area where the soil and climate are suitable for grain production, then the highest and best use will be for raising grain and the value of the structures enhances the value of the property.

However if this specific farm is located in an area where vegetable and fruit production are the only profitable crops to produce, the value of structures for grain production will not add to the value of the farm.

In South Africa a typical example of this is the tobacco farming industry. Over the years tobacco farming generally declined in profitability as well as in some areas poor quality of irrigation water forced farmers to stop producing tobacco. Structures used solely for producing tobacco on such a farm, will not contribute to the value of the farm.

According to the Appraisal Institute (2013: 336-337) "highest and best use analysis actually involves two separate analyses:
1. Of the subject property's highest and best use of the site as though vacant
2. Of the highest and best use of the property as improved

The analysis of land as though vacant focuses on alternative uses of the land.

The valuer seeks the answers to several questions (Australian Property Institute, 2015: 209-210):

1. Should the land be developed or left vacant?
2. If left vacant, what type of farming activity should be practised?
3. If developed, what kind of improvements should be built?

Testing each reasonably probable use for legal permissibility, physical possibility, financial feasibility, and maximum productivity.

When the valuer does an analysis of the property as improved, the focus on alternative uses considers three possible actions related to the current improvements:

1. Retain the improvements.
2. Modify the improvements in some way, such as conversion, renovation, or alteration.
3. Demolish the improvements and redevelop the land."

The questions that should be considered are (a) what is the market value of the vacant land and (b) what is the market value as it is currently improved. If the value of the improvements add to the value of the vacant land, then the value of the improved property , is higher than the vacant land (Australian Property Institute, 2015: 210)

The rainfall, temperatures, topography and soil types (Murray, 1969: 385-392) typically determine the highest and best use of farmland; this includes the highest and best combination of enterprises. The valuer must ascertain if the subject property is developed and farmed according to the highest and best norms of the area where the farm is situated. If not, the farm must be valued as if it is developed to its highest and best use, and the cost to develop it as such should be deducted to determine the market value.

AI (2000: 149) stated:  "...thus, an analysis of a property's highest and best use is truly a property-specific economic study of market forces".

The valuation of vacant agricultural land, with specific development potential, is an example where the valuation principle of highest and best use is applicable. The specific tract of land can be adjacent to a town or industrial area.

In this instance, the envisaged highest and best use must be probable, not merely possible, as judged by an informed developer or urban planner (Jonker, 2014: 49).

Jonker (2014: 46) described it as follows: "When considering the highest and best use of real estate, we should not be indulging in feats of the imagination, to create a unique improvement that has never been tested in the reality of the market place. The envisaged highest and best use must be probable, not merely possible".

In the case *Sri Raja Vyricherla Narayana Gajapatiraju Bahadur Garu v Revenue Divisional Officer, Vizagapatam (1939),* Lord Romer held that "the value of the potentialities must be ascertained by the arbitrator [which includes the valuer] on such materials available to him, and without indulging in feats of the imagination".

Gildenhuys (2001: 306) alluded to the *Town of Dieppe v Snitch (1997)* case where the judge commented: "It is not enough that the lands have the capability of rezoning. In my opinion, probability connotes something higher than a 50% possibility".

Jonker (2014: 49) stated: "...the quantification of potential value has been the subject of many Supreme Court cases in South Africa. Some principles that have emerged from these judgements are:

1. A speculator, expecting a higher than present use value can be regarded as a hypothetical willing purchaser.
2. In expropriation valuations, a commercial zoning for which a market value exists should be sought if the present zoning does not cause the property to enjoy a possible open market value.
3. The potential of subdivision of farmland for residential township purposes must be considered.
4. The highest and best use of a property can only be considered if it is clear that the owner and a willing purchaser were aware, or could reasonably have known about the existence of such potential."

Gildenhuys (2001: 308) mentioned that it can be a very difficult task to quantify the highest and best use of agricultural property. In the case *Minister of Water Affairs v Mostert and Others 1966,* the court had to determine the value of farmland, which was not yet developed as irrigation land, but had the potential of being developed as irrigation land. The court took as basis the value of developed irrigation land and deducted the cost to develop it as irrigation land.

When farmland is expropriated for town development reasons the potential value of the property must be determined on the basis of what would a potential buyer be willing to pay, and not on the basis of the profit the current owner hopes to make, if he sells the erven at a later stage.

Because there are numerous variables that have to be considered when town development is involved, it is very difficult to do a valuation of vacant farmland on the comparable sales method. The land residual method is the most appropriate method to use in this instance, however great care must be taken to avoid the common pitfalls of this method. These pitfalls can lead to a total wrong answer of the value that is determined (Gildenhuys, 2001: 241).

The SAIV (2014: 2-10) describes the highest and best usage as *"the most probable use of a property, which is physically possible, appropriately justified, legally permissible, financially feasible and which results in the highest value of the property being valued".*

The SAIV further mentioned that once analysis establishes that one or more uses are probable, they are then tested for financial feasibility. The use which results in the highest value is considered the highest and best use. However, this use must be reasonably probable and not only wishful thinking.

**2.2.13  Onus of proof**

"The South African courts have held that there is no onus of proof upon either party (except in some municipal valuation matters), and the arbiter or judge should act as a valuer, and determine the market value based upon all the evidence laid before him. Each valuer giving evidence at a hearing needs to put his evidence, opinion and facts before the arbiter or judge" (Jonker, 2014: 56).

However in the case where a special potential of a property is contested, the onus of proof lies on the party that claims that a property has a special potential (Gildenhuys, 2001: 303).

**2.2.14  GIS (Geographic Information Systems)**

GIS is a marriage between computerised mapping and database management systems (Castle, 1998: xiii)

The Dictionary of Real Estate Appraisal (2015: 101) defines GIS as "A system or process that electronically captures, stores, analyzes, manages, and presents data linked to location, primarily in map form. Layers of illustrative information can be selected and displayed such as aerial photography, topographic maps, flood maps, streets and roads, earthquake information, zoning overlays, political boundaries, and other forms of geographically referenced data."

The use of GIS programs is a valuable tool in the valuation of farm properties.

One of the programs that is widely used by farm valuers is Google Earth. Quite a number of physical attributes can be identified and evaluated with Google Earth. To name a few examples:

1.  The topography of the terrain.
2.  The presence of rivers
3.  The presence and extent of irrigation systems and cultivated lands.
4.  The presence of buildings and other infrastructure.

The program "Planet GIS Explorer" is useful to provide spatial information regarding a specific farm. It can also be used as an overlay over Google Earth, which enables the valuer to see exactly the boundaries, of a specific title deed, on the geographic map.

The website: www.agis.agric.za  is a website that was developed and is maintained by the Department of Agriculture. This website has information such as:

1. Topographic information,
2. Soil and climate information,
3. Vegetative information such as grazing capacities and veld types.

## 2.2.15 Irrigation

The presence of developed or potential irrigation on a farm has a large influence on the value of the farm.

The first thing the valuer has to determine is if the irrigation is lawful. If the use of water for irrigation is not lawful in terms of the National Water Act of 1998 (if the farm owner does not have a water licence), the irrigation may not be valued as a contributing factor to the value of the farm.

The Water Act of 1998 stipulates that water use is permissible without a licence in the following situations:
1. If it is a continuation of an existing lawful use.
2. If it is for reasonable domestic use in one's household.

A factor that increases the complexity regarding the lawfulness of water usage for irrigation purposes is that the Department of Water Affairs has not yet issued, a licence to all the farm owners who qualify for a licence. Many farmers still have only a water registration certificate. Registration certificates were issued by the Department of Water Affairs merely as an indication that the usage of the water is registered; it is not an authorization or entitlement to use the water. The valuer needs

to evaluate the registration certificate in order to determine if it allows lawful use of water for irrigation (Pienaar, 2015: 178).

According to Pienaar (2015: 184) there are four potential possibilities regarding irrigation land on a farm:

1. Irrigation land.

   The land is cleared of bush, cultivated, equipped with mainlines and for which there is enough lawful irrigation water available to be irrigated annually. This land has the highest value.

2. Equipped land.

   The land is bush cleared, cultivated, equipped with mainlines but there is not enough lawful irrigation water available to be irrigated annually, but it can be utilised in crop rotation. This land has a lower value than irrigation land, but a higher value than potentially irrigable dry land.

3. Potentially irrigable dry land.

   This is land that is bush cleared, cultivated but not equipped with mainlines, but it can be equipped with mainlines because there is sufficient lawful irrigation water available to irrigate the land. This land has a lower value than the equipped land.

4. Potential irrigable veld.

   This is land that is currently veld, not cleared of bush, not cultivated, not equipped, but it can be cultivated, equipped and irrigated because there is enough lawful irrigation water. This land has the lowest value of the four above-mentioned possibilities.

## 2.3. PURPOSE OF THE VALUATION

Pienaar (2015: 89) pointed out that the valuer's instruction from the client ought to determine for what purpose the valuation should be done. The purpose will also influence the valuation method to be used.

The valuer should state early in the valuation report what the valuer's instruction was. This then forms the background against which the rest of the valuation report should be read.

### 2.3.1 Valuations for financiers

Pienaar (2015: 87) stated that valuations for financial institutions are aimed at determining the value of the security for a bond and therefore the financial institution is interested in the value of the land and fixed improvements only.

They cannot register a mortgage over movables, although they can register a notarial bond, which is regarded as poor security.

Financial institutions prefer not to finance more than 50% of the realistic market value the farm. However, each financial institution has its own rules and guidelines regarding risk, and lending policy.

### 2.3.2 Valuations for municipalities

The Municipal Property Rates Act, (Act 6 of 2004) stipulates that the market value of farmland should be determined:

Inclusive of licences, permissions and privileges (e.g. water and business rights), and illegal improvements and uses, but excluding movable equipment and machinery, water pump installations, annual crops and growing timber.

The stipulation that illegal improvements and uses should also be taxed makes the valuation for municipal rates and taxes the only case where illegal improvements and uses are included in the valuation. This applies to illegal irrigation as well (Pienaar 2015: 88).

It is important to note that the Act made provision for a valuation without a physical inspection. This makes it possible for mass valuation methods to be used.

### 2.3.3  Valuations for land claim purposes

The Land Claim Commissioner seeks the realistic market value of a farm property. Normally this would exclude the movables, centre pivots and livestock. It does not however make sense to buy an irrigation farm without its centre pivot and pumps. It makes sense to include this in the valuation but stipulate specifically that it is included. It should be specified separately.

### 2.3.4  Valuations for a sale

Millington (2000: 49) commented that a valuer may be asked what a property will fetch if sold. In doing the valuation the valuer will consider all the likely purchasers in the market at the time and all the alternative properties available to them. He will then estimate what would result from all the competition between the various potential purchasers.

### 2.3.5  Valuations for a purchase

Millington (2000: 49) further describes that if the reason for the valuation is that the client is considering buying a specific property, the valuation should not be as far-ranging in scope as one for sale. The valuer's consideration must be directed towards the requirements of one person, the client. The client's subjective requirements may result in a value being lower to him, or conversely it may result in a higher valuation because the subject property fits the clients' requirements exactly.

## 2.4.   PROPERTY  VALUATION APPROACHES

Pienaar (2015 :86) states that the method used is largely determined by the purpose and type of value required. The valuation method that best reflects the current market value of the farm is therefore the appropriate method to use.

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The Appraisal Institute, (2000: 43) recommends that all the methods that can be applied should be used when doing the valuation assignment. The final step in the valuation process is then the reconciliation of the different value indications derived in the various methods.

The appraiser should examine the strengths and weaknesses of each approach and determine why the approaches produce different value indications. The appraiser must then communicate to the reader why one approach is given primary consideration or why another approach might not be given much consideration (Appraisal Institute, 2000: 45).

Hendrikse (2015: 221) commented that virtually any type of property can be valued by using either the Comparable market transaction approach, or the Productive value approach or lastly the Depreciated replacement cost approach. He concluded that it is preferable to use at least two of the approaches because the comparison of the two value estimates will either confirm the conclusions or highlight inconsistencies that should be investigated.

### 2.4.1. Comparable market transaction method (direct sales comparison)

In practise, only three types of property lend themselves readily to the use of direct sales comparison. These are residential property, development land and agricultural property (Shapiro, *et al.*, 2009: 51).

This method involves the use of other farm transactions where farms have recently changed ownership, using as bases the price paid for these properties in actual market transactions.

The values per hectare of these comparables can then be applied to the land components of the subject property (Pienaar, 2015: 91).

According to the International Valuation Standards (2011: 26) "[it] provides an indication of value by comparing the subject asset with identical or similar assets for which price information is available".

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Jonker (2014: 75) mentioned that the South African courts have held that the comparison sales method is the most acceptable method of quantifying most property values. Where it is appropriate, the comparative approach is the method of choice.

Jonker refers to the case *Minister of Water Affairs v Mostert & Others 1966*, the court stated "Comparable transactions, particularly where the sale are concluded after objective and impersonal bargaining, afford the most satisfactory evidence of a fair market value because it demonstrates how circumstances have affected the minds of purchasers*".*

There is no misleading manipulation of data and the reasonableness of the valuers estimate and the limits between which it may possible fall, are easy to judge.

According to Behrman (1995: 12) this approach is based on two thoughts:

1. that an informed seller will not sell a given property for less than equally desirable properties are commanding in the market place, and
2. an informed buyer will not pay more for a given property than the cost of acquiring some equally desirable property.

The same reasoning applies in the valuation process.

Behrman defined a comparable transaction as "it is one which has recently sold in an arm's length transaction between seller and buyer, each of whom supposedly represent, respectively, all sellers and buyers in the community".

The courts do not refer to a mirror-like image or to an identical property, but to similar property.

Behrman referred to the case the *Minister of Agriculture v Davey 1981*, where the court described it as "The first matter to consider, in such a case, is whether the land sold is similar, and here, regard must be had to factors such as the location of the land, its size, physical characteristics, purpose, surrounding and so on. It is also necessary to look at the sale itself. The purchase price should not be accepted without further analysis because factors such as time of sales, the circumstances of sale, whether it is a free open market transaction or a forced sale, or a sale under

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special circumstances and the conditions of the sale, may all have a bearing on the purchase price agreed upon. Evidence may also show that for some reason or other, a particular sale is out of line with prevailing market value of such land'.

Behrman (1995: 13) listed six examples when the data of a comparable farm transaction, should be discarded:

1. Sales between related persons or members of the same family (this is quite common in farmland transactions).
2. Sales in which one party was obligated in some way to the other party, for example a sale with a leaseback provision.
3. Forced sales to quickly obtain cash, or which an executor or estate administrator ordered.
4. Sales made in a distressed market, for example in an area where present land use patterns have been frozen by zoning regulations or where there are pending land claims or expropriation processes.
5. Transactions with a rate of interest that is considerably lower than market rate.
6. Sales, which include extenuating circumstances, which obviously influenced the price.

Pienaar (2015: 92) described it in plain terms; "that the sold farms should be in the same area and have the same natural resources, such as carrying capacity, the same irrigation water sources and soil potential. The sales should not be older than two years".

The two year time period is only possible when there are plenty of sales.

According to Gildenhuys (2001: 216) the comparable market transaction method is not reliable when there are not enough comparable market transaction that took place, or when too many adjustments are needed. The prerequisite to use this method is the data availability of enough comparable transactions.

The appraiser should seek to find comparable sales with situations, attributes and terms as similar as possible to the subject. His first objective should be to find sales that would appeal to the same buyer as the subject farm (Ratterman, 2007: 3).

He further stated that the difficulty in predicting the future behaviour of buyers depends on the amount and similarity of prior comparable sales available. It is also important to keep in mind that when the decision to buy a property is made, the buyer always considers the alternatives available.

To ensure the best and most accurate analysis possible, the appraiser needs to decide what comparable sales will represent the actions of buyers and sellers in the subject's market segment. The best practice is to use comparable sales that represent the actions of the typical buyer of the subject property (Ratterman, 2007: 49).

**When no comparable sales of similar farms are available**

Because farm properties are highly heterogenous it does happen that there are no comparable transactions available to the valuer, or there is only one transaction of similar properties that satisfy the normal criteria for a comparable sale. This places the valuer in a predicament, because he has to do a valuation.

One of the reasons that there are no comparable transactions may be that the market experiences a severe lack of demand because of macroeconomic reasons. This a normal market behaviour. In such instances, the market exposure period should be extended (Jonker, 2014: 79).

When the valuer cannot find comparable sales, he should take note of the case law in the case *Pietermaritzburg Corporation v SA Breweries Ltd 1911,* "It may not always be possible to fix the market value by reference to concrete examples...His [the valuer's ] duty then would be to take into consideration every circumstance likely to influence the mind of the purchaser...He would have to employ his skill and experience in deciding what a purchaser ... would be likely to give ... he would, to the best of his ability, be fixing the market value of the property".

When there are no comparable sales available, it is recommended that the valuer evaluate the possibility to use the productive value method, as was held in the case of the *Minister of Water Affairs vs Mostert & Others 1966*. "...When comparable transactions is not available or satisfactory, the valuer would normally have regard to evidence which indicates what the fair market value probably would be in the light of the income that may be derived from the land."

However, in valuing agriculture property, it frequently occurs in practice that the productive value approach cannot be applied, due to a lack of reliable financial information regarding the income and expenses of the farm or due to lack of information regarding the appropriate capitalisation rate that should be used. Furthermore, farming income and costs can vary substantially from year to year making the productive value approach difficult to implement.

In the valuation of farmland, it often happens that the only method that can be applied in practice is the Depreciated Replacement Cost method.

## Adjustments needed

To enable the valuer to determine a value for the subject property based on comparable transactions, a number of adjustments are often needed.

Bourhill (1998: 22) quoted Maritz (1987) "the most important differences between the comparables and the subject property are identified and it is indicated whether or not the subject property is superior, inferior or as desirable as the comparable property".

According to Behrman (1995: 14) value adjustments when valuing farms are typically made for six factors namely:

1. date of sale
2. location
3. farm size
4. productive capacity

5. extent of improvements
6. type of farming enterprise

Plus or minus adjustments are made for each factor of each comparable sale.

Ellenberger (1982: 97) wrote that the valuer must look for similar qualities in the selected comparables. "Defects and shortcomings must be noted as well as any extraordinary features not in keeping with the conventional type of farming in the neighbourhood."

Boykin (2001: 49) stated that to be used as a comparable, a land sale should have similar zoning, have similar terrain, access, and be situated a relative short distance from the subject property. In short the sale land should be a reasonably close substitute for the subject land. A valuer should avoid using sales that differ substantially in size from the subject farm.

Suter (1980: 31) commented that there is a general tendency for farm sale prices to decline as farm size increases. In a study that was done regarding 431 farm sales in Western Illinois, U.S.A. it was found that the average price for a farm with the size between 10 and 59 acres was $747 per acre, and the average price for a farm larger than 260 acres was $564 per acre.

Pienaar ( 2015 : 97) mentioned that it is a well-known phenomenon that smaller farms tend to fetch a higher price per hectare than larger farms in the same area. He warned that there are usually few farm transactions that are properly comparable. Farms differ in composition and development.

Bell & Bowman (2002: 92) alluded to a formula that was developed by the City of Pretoria, and which has become widely used for valuing residential erven in a mass valuation. This formula makes it possible for the valuer to calculate a subject property value, taking as starting point a comparable property transaction where the erf is of a different size. Thus, it quantifies in a mathematical equation the market value relationship of different erven sizes.

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The valuer applies this formula to calculate an adjusted size of the subject property, and then uses the adjusted size to calculate the value of the subject property. This adjusted size leads to the correct market value, of the subject property.

$\underline{A} = [(X^2 + 19X) / (X + 1)] M / 7$

Where $\underline{A}$ = adjusted area in m²

$\quad X = A / M$

$\quad A$ = area of subject property in m², and

$\quad M$ = 50% of the comparable area in m².

For example when a subject erven size is 1,100 m², its adjusted area ($\underline{A}$) is 1,041 m².

$\quad \underline{A} = [((1,100/500)^2 + 19(1,100/500)] / ((1,100/500) + 1)] 500/7$

$\quad\quad = [(4.84 + 41.8) / 3.2] 71.429$

$\quad\quad = 1,041$ m²

If the comparable erven of 1,000 m² sold for R 70,000, then the subject erven of 1,100 m² has a value of 1,041 m² x R 70,000 = R 72,877. Thus, while the subject erven size is 10% larger than the comparable erven, the estimated market value is only 4.1 percent greater.

Enslin (2015: personal communication) applied this formula in numerous farmland valuations. The area in m² variable, is expressed as a per hectare variable. He found that this formula leads to a credible determined market value of the subject property. Thus, it can also be used in farmland valuations, to link comparable transactions of properties with different sizes, to the value of the subject property.

However, care must be taken not to use a comparable farm that differs too much in size with the subject farm. If the adjustment calculated is more than 20%, it is preferable not to use this farm as a comparable. If a suitable comparable cannot be found, the adjustment should be capped on the maximum of 20%.

The SAIV (2014: 7-7) refers to the fact that the locality of the subject farm to the comparable farm, must be close enough so that the soil types and the veld types of the two farms are similar.

The South African National Biodiversity Institute (2005: 26) did a classification of the Limpopo, Northwest, Mpumalanga and Gauteng provinces into different eco-zones.

They define an eco-zone: "[it] is an area where there is relatively uniform geology and therefore landform (landscape), as well as uniform altitude, latitude, longitude, rainfall and climate in general. Soils are all derived from rocks, and therefore in any single eco-zone are from a similar base".

If a farm valuer uses comparables within the same eco-zone as the subject farm, he ensures that the comparables have, broadly speaking, the same natural resources.

Gildenhuys (2001: 216) stated that any adjustment is the result of the interpretation of the valuer. The more the adjustments, the higher is the possibility for a market value estimate that is contestable. He also refers to the fact (Gildenhuys, 2001: 225) that the way in which the adjustments are made and the ability of the valuer in making these adjustments, will determine the reliability of the valuation.

Ratterman (2007: 53) made the point that it is the valuer's job to try and replicate the buyer's situation and research his actions. Thus, the valuer must know which attributes of the farm the buyer will evaluate and influence his willingness to pay a certain price. These attributes must be taken into account when adjustments are made to estimate a market value of the subject property.

On the very important question of "how much is the correct adjustment?" Ratterman (2007: 57) commented that it is usually a matter of opinion. This opinion is a function of logic, experience, knowledge of the market and research.

The adjustment process requires considerable in-depth agricultural knowledge as well as the ability to skilfully evaluate and correctly interpret each relevant attribute of each comparable transaction. The adjustments that are needed are part of the valuation process, which cannot be done by a person who does not possess this knowledge and skill, regarding specifically agriculture properties. This is also the part

of the process where mistakes are easily made, which will lead to a wrong valuation of the subject farm.

It is recommended that the valuer compile an adjustment grid in which he allocates weights and values (based on his logic, experience, knowledge of the market and

research) in order to estimate a quantified adjustment for each relevant attribute that needs to be adjusted for the subject farm. This will assist the valuer not to pull figures out of thin air.

Suter (1992: 493) stated it is beneficial for the valuer to itemise each adjustment because the valuer can then show he did not merely pull figures out of thin air. He further states that the inexperienced and naive appraiser often uses the thin air approach.

## 2.4.2. Productive value  (income capitalisation) method

The International Valuation Standards (2011: 26) definition is: "the income approach provides an indication of value by converting future cash flows to a single current capital value.

Bourhill (1998: 25) mentioned    "This method proceeds from the principle that the price which can be paid for a property is the present value of all the net financial advantages that can be obtained from the property in the future."

When the reason for the appraisal is to determine the amount of a loan that can be paid back from the farm's net income, the productive value approach is usually the preferred approach. Thus, it calculates a value that reflects the farm's economic viability.

According to Behrman (1995: 19) this approach is based on the assumptions that those persons interested in buying or owning the farm are interested primarily on money returns that can be obtained on their investment.

It can be used to value a farm that is being leased by the owner. In this instance the correct capitalisation rate should be found in the agricultural property market, where

farms that were leased are sold, and the appropriate capitalisation rate (income multiplier) can be calculated. However, it is quite possible that there are not enough comparable transactions in the market to determine the capitalisation rate, thus great care must be taken when using this method.

Pienaar (2015: 101) described the productive value approach as being based on the income generating capability of the farm property. It is calculated as the net farm income capitalised at a realistic rate of return.

This means that the amount of capital employed, to generate a specific income, is determined. The amount of capital employed includes all capital employed to generate the income. Thus, it includes the value of the farmland, livestock, equipment, tractors and machinery.

It therefore implies that the value of the farming business or unit, and not just the value of the land is calculated. It determines the value of the farm business as a going concern.

Pienaar (2015: 102) described the formula to be used as :

$$Pv = \frac{NFI - \text{manager remuneration}}{\text{Capitalisation rate}} \times \frac{100}{1}$$

Pv = Productive value

NFI = Net Farm Income (before interest, tax and rent)

If the value of the land has to be determined, it is very important that the valuer must remember to subtract the value of the movable assets. If it is not subtracted it will lead to unrealistic and inflated farmland values.

The formula to be used is :

$$\text{Land value} = \frac{NFI - \text{manager remuneration}}{\text{Capitalisation rate}} \times \frac{100}{1} - \text{value of movable assets}$$

Barry et al. (1995: 347) added growth, inclusive of inflationary gains and increases in returns, to the equation by adjusting the capitalization rate downward. They argue that the possible impact of potential growth on the current value of the farm, as perceived by the investor must be included in the calculation. This could be important especially when a rate of return is determined.

This however is based on assumptions regarding the potential growth, which can be contestable on its correctness.

Jonker (2014: 89) described this method as a calculation where each anticipated future payment or receipt is discounted to present value (using the compound interest formula) and each of these present value amounts are added to produce the discounted present value of the entire future income stream. When there is a negative cash flow period (a period where expenses exceed income) it must be deducted from the present value of the positive cash flows. This method can be used when the expected income stream may be irregular or variable.

Pienaar (2015: 103) pointed out that to apply the productive value approach numerous realistic assumptions are required of which yield, cost, price and capitalisation rate is critical. A constant yield and income are assumed.

Climate plays a huge role in agriculture; therefore, yields vary from one year to the next. The challenge lies in deciding on a realistic and sustainable yield. Long-term average yields for the immediate area should be used but the specific farm's soil potential and its nutrition levels should be taken into account.

Murray (1969: 381-382) stated that with a farm valuation yields must be used that will be achieved by a typical manager. It is not correct to value a farm based on yields that are achieved by an outstanding farm manager.

One of the biggest assumptions to make is to decide which price is to be used for the product. In a deregulated market environment the maize price, as an example, is highly volatile, it can double in 12 months, and decrease by 35% in a further 12 months. The price that the valuer decides to use has a huge impact on the value of the farmland that is calculated.

Farming income and costs can vary substantially from year to year making the productive value approach difficult to implement.

Pienaar (2015: 106) stated the following disadvantages of the productive value approach:

1. Productive value does not equal the market value
2. Running concern value includes livestock, machinery and equipment.
3. The value is often a function of the manager's ability.
4. Too many variables and assumptions have to be used, which is subjective
5. This method does not take note of the scarcity factor.

Steyn (2003: 45) mentioned that a prerequisite for the productive value approach is that the farm income must exceed the farm expenditure, thus there must be a net farm income.


## Capitalisation rate

Betts (2013: 454) described the capitalisation rate as the link between an income estimate and a value estimate. Therefore selecting the appropriate rate is a critical part of the productive value approach.

According to van Schalkwyk (1995: 124) one of the most difficult decisions required in using the income approach in the valuation of farmland, is the choice of the appropriate capitalisation rate. From a conceptual viewpoint, the capitalisation rate should reflect the cost of capital or the cost of funds committed to the purchase of the land. However, adjustments are necessary to reflect differences in the risk associated with farmland compared to alternative investments.

He argued that as a group, farmers may use a lower capitalisation rate because of their propensity for farming and a preference to live on a farm. He therefore suggests using the annual return on government stock, as a capitalisation rate. Because the rate of government stock is low, the use of it as a capitalisation rate might lead to a productive value that is over estimated.

Pienaar (2015: 103) mentioned that "the capitalisation rate is suppose to be equal to the opportunity cost of an investment with a similar risk profile, which means what percentage return on capital can be realised on the alternative investment. It is said that, in order to determine the capitalisation rate, 21 (meaning a large number) assumptions have to be made".

Behrman (1995: 20) described the capitalisation rate as the rate which could be obtained on a comparable investment to invest not only in an alternative farm or property, but in the next best alternative opportunity in the community".

**Different capitalisation rates**

Confusion often exists in the minds of valuers regarding different capitalisation rates, and when to use which rate. It may also be that some valuers might not really understand that there are in principle two commonly used different capitalisation rates when valuing farmland, and that the valuer must be able to make an informed decision when to use which rate.

Betts (2013: 455) described the two most commonly used capitalisation rates.

Interest capitalisation rate (discount rate).

The interest capitalisation rate is the rate on invested capital. This term means the same as what is also referred to as the yield rate or the discount rate.

When the reason for the appraisal is to determine the amount of a loan that can be paid back from the farm's net income, the interest capitalisation rate (discount rate) is used in the productive value formula. Thus, it calculates a value that reflects the farm's economic viability, or in other words the income generating capability of the farm property.

In practice, the required interest capitalisation rate (discount rate) is based on the current long-term interest [mortgage] rate on loans to acquire similar properties than the subject property (Coetzee & Steyn, 2004).

Ellenberger (1982: 157) makes the point that an interest rate is in fact not a capitalisation rate. An interest rate is a rate required to attract capital for investment and is merely a component of a capitalisation rate.

However if the reason for the appraisal is when a potential buyer wants to invest in farm property, and he has to decide between various investment possibilities, the valuation must determine a value which will give the investor a competitive yield on his investment in the farm.

In this instance, the valuer must determine a discount rate that will give the potential investor a similar yield to other investment options (Behrman, 1995: 20).

According to Shapiro, et al. (2009: 89) the valuer should have some knowledge of the levels of yields on most types of investments and of the principal factors influencing them. The valuer must have a clear idea not only what the yield in the market is doing but also why the market is doing it, and most important what the market is likely to do in the future.

The SAIV (2014: 9-12) states that an interest rate is in reality not a capitalisation rate. An interest rate is a rate that is required to attract capital and is merely a component of a capitalisation rate.

According to Pienaar (2015: 86) the value of a farm that is calculated with the productive value approach (using the discount rate), is in extensive types of farming such as cattle and sheep which are usually lower than the market value, and in intensive types of farming such as fruit and pig farms which are usually higher than the market value. This is normally referred to as the difference between the productive value and the market value.

This difference between productive value (when using the discount rate) and the market value is a subject of much debate in the land reform process, where it is claimed by government that prices paid for farmland are too high.

## Overall capitalisation rate

Betts (2013: 455) described the overall capitalisation rate as the relationship between the first year net income and the market value for the total property, or in other words, the ratio of net income to market value.

In theory the market value of an agricultural property which is determined by using both the comparable market transaction approach and the productive value approach (using the overall capitalisation rate), should be exactly the same value (Behrman, 1995: 34).

The correct overall capitalisation rate should be determined by calculating the ratio of net income to market value in different transactions, using comparable transactions in the comparable market transaction approach.

Jonker (2014: 84) stated, "the capitalisation rate of properties must be found in the property market ".

The Appraisal Institute (2000: 45) mentioned that the valuer derives an appropriate rate or factor to apply, by researching comparable data. Selected comparable properties are analysed to determine the relationship between their estimated incomes and their sale prices. From this relationship, a capitalisation rate or an income multiplier can be estimated.

In theory the overall capitalisation rate could also be calculated by starting with the yield on a risk-free investment (government bonds) and adding various premiums; for example various risk premiums, plus a burden of management premium. It necessitates a number of assumptions and is dependent on the correctness of the assumptions. The assumptions can easily be wrong. This approach is therefore not recommended and should only be used when comparable transaction data is not available, to enable the valuer to calculate the overall capitalisation from comparable transactions in the market.

**The difference between the productive value (when using the discount rate) and the market value of farmland**

The smaller the gap between the productive and the market value, the more affordable it is for the buyer to repay loans, from net income generated on the farm.

Van Schalkwyk (1995: 148) stated "the size of the gap between the productive value and the market value of farmland, is of major importance for land reform purposes, especially if the affordability of a basically market oriented land reform is taken into account".

In a study, he calculated the capitalisation rates that will minimise the difference in value with the market value for crop producing areas, for cattle grazing areas and for sheep grazing areas. He determined that the crop producing areas reflect a higher capitalisation rate than the cattle grazing areas, and the sheep grazing areas reflected the lowest capitalisation rates. These differences correspond with the relative risk associated with the various farming types. Crop production has a higher risk than cattle farming, and sheep farming has the lowest risk.

Murray (1969: 184 & 247) described that the difference between the productive value and the market value is in fact the value of the non-income features of the farm.

### 2.4.3. Depreciated Replacement Cost method

The International Valuation Standards (2011: 27) defined it as "[It] provides an indication of value using the economic principle that a buyer will pay no more for an asset than the cost to obtain an asset of equal utility, whether by purchase or by construction".

This approach is based on the assumption that the value of an item should not be more that the cost of the item when new. Thus, the cost approach sets an upper limit for the value.

The Appraisal Institute (2000: 43) described this method as being based on the premise that an informed buyer of property would not pay more for a property than

the cost of the land, plus the current cost of replacing the improvements, less the applicable depreciation from all causes.

According to Behrman (1995: 32) it is done by studying each of the component parts of the farm. The various types of land are classified, measuring each type against comparable sales in the area. Buildings and improvements are inventoried weighing the value of each while bearing in mind both replacement cost and contributory value. The contributory value is the value that each building contributes to the market value of the farm.

Some farm valuers are critical of the cost approach, because the sum of the values of each of the various parts of the farm is typically greater than the farm's total value.

However, there are certain instances where the cost approach can be useful:

1. Where a farm, if it were to be sold, would be sold in several parcels or pieces, (e.g. different title deeds).
2. When sales data relating to unimproved land and the cost of constructing buildings are easily available.
3. Where the subject farm has a huge investment in specialised buildings, e.g. a pig farm or broiler houses.
4. When it is not possible, for some or other reason, to apply the comparable sales or the productive value approach.

Pienaar (2015: 91) argued that the cost approach plays an important role in most valuations, and some of its uses are:

1. It is allowed for valuations for expropriation, if it is not otherwise possible to obtain a realistic market value for improvements.
2. It is often used when partners want to split up their farming business, or the other partner buys out a partner.
3. It can be used in combination with other valuation methods. Using a combination of valuation methods is acceptable and sometimes good practice.

Many farm valuers find this approach indispensible, because in numerous cases there are not comparable properties (with similar buildings and improvements) available. Therefore, to value the land as if vacant, and to add the depreciated market value of the buildings, is a practical and very often the only approach, which can be used.

De Leeuw (2003: 7-9) describes four components of depreciation that should be taken into account, in order to arrive at the contributory value.

1. Physical depreciation, may be equated to the cost of repairing those components of the structure to a pro rata proportion of the realistic lifespan of the structure.
2. Functional obsolescence, occurs when the existing structure is lacking in terms of its use when compared to a modern structure.
3. Economic obsolescence, occurs when a structure cannot produce the same economic results as is expected in the market place.
4. Purchaser resistance occurs when, for example, a purchaser is buying a farm with a building he does not really need, or the building has excessive space such as a mansion on a farm.

He recommends that a deduction of at least 5% should be deducted for each component. Take note that the percentages (for each component) are multiplied with each other to calculate the total depreciation percentage. He alluded that valuers easily make the mistake to deduct a too low total percentage of depreciation, with the end result that a structure is valued for more than its actual contributory value.

Pienaar (2015: 340) was of the opinion that the location factor (the cumulative effect of functional, economical and purchaser resistance) for houses on farms is normally 50% or higher.

Pienaar further argued that the reason why it often happens that the sum of the various parts of the farm is greater than the realistic market value, is because the valuer does not depreciate the replacement cost of the buildings adequately.

The underlying principle in the depreciated replacement cost approach is that the cost of a building does not represent the value of the building. The replacement cost is only the starting point of the calculation, from which the correct depreciation for each of the components should be deducted.

The SAIV (2014: 5-4) defined the replacement cost as "the substitution of a building by a new one, which will conform to the size and the existing useful purpose which the old one serves". This must be distinguished from the reproduction cost, which is the cost to re-create or duplicate an existing building by one that is the same in all details.

According to Pienaar (2015: 332) with a farm valuation the valuer must distinguish between class 'A' buildings which are valued additional to the land component, and class 'B' buildings are those that are valued as part of the land component.

Examples of class 'A' improvements are; sheds, garages, storerooms, chemical stores, ablution facilities, management and labour housing. It also includes specialised improvements for example chicken broiler houses, abattoirs, grain silos, pack houses and piggery houses.

Examples of class 'B' improvements are fences, pipelines, roads, erosion works (weirs), normal livestock-handling facilities, irrigation mainlines, furrows, and canals. If the class 'B' improvements are in a poor condition, e.g. the fences, the value of the grazing on the farm will be valued lower than the norm. The same applies to substandard irrigation infrastructure. The opposite applies to above-standard class 'B' improvements.

To avoid the possibility of any misunderstanding, Pienaar stressed the point that the valuer must state clearly in his valuation report, which improvements were categorised as class 'B' improvements, and were therefore included in the value of the land.

Class 'A' improvements must be valued by applying the depreciated cost method. The underlying principle is that cost is not equal to value (Pienaar, 2015: 333).

The Australian Property Institute (2015: 203) commented that for a rural building to be useful it must contribute to the operating efficiency of the farm.

The Appraisal Institute (2000: 132) mentioned that the first step in the building description is to determine the size. The size is calculated by measuring the outside perimeter of the structure, excluding unenclosed areas. The size of the unenclosed areas must be measured and valued separately. Accurate building measurements are very important.

### 2.4.4. Proactive comparable method

Pienaar (2015: 106) explained that this method can be used when there is a lack of reliable comparable transactions.

Guidelines for an area are developed proactively (annually). These guidelines for a specific area are then used as benchmarks for farmland values. The guidelines are derived from actual transactions that have been analysed and evaluated. Examples of guidelines are; value/ha for a specific soil type where dryland crop production is done, value/ha for each of a specific veld type, value/ha for centre pivot irrigation, etcetera.

What is important is that various stakeholders such as valuers, financial institutions, agricultural cooperatives and land reform offices must participate when the guideline values are determined.

### 2.4.5. Land residual method

This method is used to determine the value of the land only. The value of the land, as if it is vacant, is calculated by deducting the value of the improvements from the total value.

This method has been considered by the South African courts on a number of occasions, both in the valuation of income-producing properties and in self

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liquidating development properties, e.g. township land. Notwithstanding criticism and caution this method was approved (Jonker, 2014: 85).

Bourhill (1998: 34) suggested that this method is only reliable when the improvements are totally depreciated, or not at all. He mentioned that this method has been considered a number of times in our courts, and that it has respectively been approved with caution and rejected outright.

Many authors (Appraisal Institute, 2000,;Behrman, 1995,;Pienaar, 2015; Steyn, 2003) who wrote regarding the different methods that are applicable when valuing agricultural property, do not mention the land residual method as a possible method for the valuation of farmland.

However, while the Land residual method may not be a preferred method, there are, at times, no alternative available to value unimproved land.

## 2.4.6  Reconciliation and the final opinion of value

Betts (2013: 489) recommended that the valuer should do a general review of the appraisal. This review can be divided into two steps, namely review the overall appraisal process and review for technical accuracy.

Evaluate the intended use of the appraisal, the method(s) used and the data collected. Make sure that the data you collected are correct.

Betts further explained that if more than one valuation method was used and the values differ, the values must be carefully evaluated against the intended use of the appraisal and the correctness and availability of data. The valuer must then apply his personal knowledge and skill and reach a final value conclusion.

Sorenson (2010: 96) commented that it is important to apply tests of reasonableness before finalising the value. These tests include:

1. Checking if the capitalisation rate appears reasonable.
2. Reconciling the final value conclusion with the replacement cost.

3. Make sure similar units of comparison were used.

Suter (1992: 147) commented that all calculations must be checked.

Pienaar (2015: 419) stated that when valuing a farm all the valuation methods must be considered. The method used must then be explained in the valuation report as follows:

1. Motivate why the method used is the best method for the specific valuation.
2. Describe the method and explain how it was applied.

Suter (1992: 309) commented that no single approach to the value of a farm is likely to work best all of the time or for all farms in any given area. It is better to use all three methods, if possible, because each method serves as a check on the others before arriving at a final value.

"Each of the various approaches to value should be carefully weighed. The extent to which each has relevance should be considered in terms of (1) the subject property itself and its origins of value, (2) the reason for and most likely use to be made of the appraisal, and (3) the reliability of each source of information, series of data, or evidence that contributed to the findings" (Suter, 1992: 310).

Suter (1992: 313) concluded by stating, "the final value need not be the average figure. It should be a value based on facts and the evidence, which best supports such value. It should be a value that has been established impartially. It should be one which is fair and reasonable".

### 2.4.7  Partial takings

According to the .Appraisal Institute (2013: 5) "the total range of private ownership interests in real property is called the *bundle of rights*. Imagine a bundle of sticks in which each "stick" represents a distinct and separate right or interest. The bundle of rights contains all the interests in real property, including the right to use the real

estate, sell it, lease it, enter it, and give it away, and each "stick" can be separated from the bundle and traded in the market."

Farmland is often subjected to the taking of one of the sticks of property rights, for example a new high voltage power line that is going to be erected across the farm, or a new road that will be built across the farm. Thus, it is referred to as a partial taking, the whole property is not taken, only certain specific property rights on a specific geographic area of the farm.

The above situation is referred to as an easement in some countries, in South Africa it is referred to it as a servitude.

The Australian Property Institute (2015: 90) defines an easement as: "an interest in real property that transfers the use, but not the ownership, of a portion of an owner's property." Easements usually permit a specific portion of a property to be used for identified purposes, such as access to an adjoining property, or as the location of a certain underground utility like a pipeline, or an overhead easement like an ESKOM power line.

A servitude (easement) can be created through the exercise of expropriation (eminent domain). Expropriation is the right of government to take private property for public use upon the payment of just compensation. This right can be exercised by a government agency or by an entity acting under governmental authority such as a public utility or right of way agency.

Pienaar (2015: 74) described the influence on the value of the farm because of power line servitude, in three ways. Firstly, it is the loss of full utilisation of the specific affected land. Secondly, the area is occupied by pole structures and lastly the subjective issue related to the spoiling of the scenery. Pipelines and canal servitudes are very similar to power line servitudes.

Servitudes are registered on the title deed of a property.

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Gildenhuys (2001: 352-353) commented that in most cases the just compensation that should be paid to the owner of the property, can be determined by the "before-and-after" method. He elaborated that the owner should be compensated in full, but not in excess.

Eaton (1995: 291-307) describes the before-and-after method:

1. The first thing the valuer should have is a proper understanding of the proposed use of the taken portion/easement, as well as the rights that are being acquired by the government agency/public utility.

2. Secondly, do a valuation of the whole property as it is before the portion/easement is taken, utilising all applicable valuation methods.
   o In this process, an evaluation must be done of the highest and best use of the whole property before the portion is taken.

3. The third step is to start the process all over again, but the larger parcel (the parcel that remains the property of the owner) as if the portion/easement has already been taken, is now valued.
   o Again, the influence of highest and best use should be taken into consideration.

4. The difference in values determined in step two and step three, equals the value of the servitude.

Gildenhuys (2001: 338) stated that in the majority of Anglo-American judicial systems, the before-and-after method is considered the preferred valuation method, because it leads to the most equitable value. He alluded to the commentary in the "Uniform Eminent Domain Code" where it is spelled out that the before-and-after valuation method is usually the most equitable.

He mentioned that sometimes there are exceptional circumstances when the before-and-after method cannot be used. One example is when the portion of property that is taken is so small that the loss of ownership has no negative value influence on the property as a whole. Another example is when the property as a whole is extremely large and complex to value, thus it is not cost effective and practical to

value the property as a whole. In these exceptional cases, it may be the best to value the portion that is taken on a hectare or square metre basis.

Suter (1992: 542-545) was also of the opinion that the before-and-after method should be considered as the valuation method in an easement for power line or pipeline takings.

He described two types of effects that a high voltage transmission line has:
1. The physical effect of the towers and the overhead lines, resulting in a possible loss in production utility for the farmer.
2. The electromagnetic field effect beneath the power lines that can have a negative stress effect, which will lead to lower crop production yields as well as lower calving percentages in animals.

Suter (1992: 493) commented that some valuers prefer to itemise each of the various damages. "This is the most advantageous because the appraiser can then show he did not merely pull the figures out of the air. (The thin air approach is often used by the inexperienced and naive appraiser.)"

Ellenberger (1982: 180) stated that the before-and-after method is usually employed in estimating the financial loss suffered when an easement is valued.

Enslin (2015) identified 12 different aspects that can have a negative impact on the value of a farm because of a high voltage power line:
1. The extent of the servitude
2. Visual effect, especially on a game and tourism farm.
3. Impact on the ecology and landscape of the farm.
4. Location on the subject property (is it right across the middle of the farm or on one of the boundaries?).
5. Distance it crosses the farm
6. The impact it has in relation to the extent of the farm.
7. Impact on the production process and the productivity of the farm.
   Game cannot be herded underneath a power line and game-capturing or

crop-spraying helicopter pilots do not want to fly underneath a high voltage power line.

8. Any impact on infrastructure on the farm.

9. Potential fire hazard which inevitably goes hand in hand with the presence of high voltage transmission lines.

10. The presence of workers on the farm during the construction phase, and the potential risks related to workers such as littering, uncontrolled fires, theft and hygiene factors.

11. Unannounced entrance of workers in the future (when they want to cut the grass or clear the brushes underneath the power lines) and the potential risks related to workers such as littering, uncontrolled fires, theft and hygiene factors.

12. Potential buyer's resistance and stigma.

These effects must be taken into account when the valuation of servitude is done, during the "after" phase, of the before-and-after method.

## 2.5. SUMMARY

The literature study and discussion in this chapter show that there are many unique and distinctive attributes that are inherently part of farms, which should be taken into consideration when valuing agricultural property. These factors and attributes cause farm valuations to be complex. Therefore, a valuer who does farm valuations must have specialized knowledge as well as specialized skills regarding the quality and quantity of the farm production factors and the different farm enterprises. He must have:

1. acquired skills regarding agronomy, engineering, animal science, economics, law and psychology.

2. a feel for the soils, topography, drainage, irrigation facilities and the practices influencing the crops raised in the area.

3. a feel for the contribution of various buildings and improvements and whether the farm's resources, as an operating unit, are balanced.

4. a feel for the farm real estate market and for factors such as product prices, costs, earnings, rental rates, government regulations and the idiosyncrasies of both buyers and sellers of farms in his area.

5. the skill, knowledge and sixth sense to accurately do adjustments from comparable sales, to estimate a credible opinion on the market value of the subject property.

6. the skill and knowledge to be able to correctly analyse the possibility of an alternative highest and best use of a farm.

A MRA model, which endeavours to satisfy accuracy requirements, will have to successfully take into account these value-influencing factors and distinctive attributes. If not, the MRA model will not satisfy accuracy requirements.

Furthermore, all five valuation methods (the comparable transaction-, productive income-, depreciated cost-, pro-active comparable- and land residual method) are used in the valuation of farms. It depends greatly on the unique circumstances of the individual farm, which method will result in the most credible value opinion. A MRA model will have to reflect these unique factors to be able to satisfy accuracy requirements.

In Chapter 3 the concept of mass valuations and general use of AVMs in the international valuation industry are discussed. This will lead to an understanding of its advantages, disadvantages, constraints and possibilities, which will make it possible to identify the inherent difficulties that there are in its application in farm valuations.

# CHAPTER 3

# BACKGROUND AND LITERATURE STUDY OF MASS VALUATIONS

## 3.1 INTRODUCTION

There is very little literature available regarding mass valuations and the use of AVMs (Automated Valuation Methods), specifically for the valuation of agricultural property. Thus, the researcher focused mainly on the literature as it relates to residential and commercial property. However, some literature research regarding the application to farms is discussed

With the advancement of computer technology, it is a fact that some form of computer assistance is necessarily part of a mass valuation approach.Computer Assisted Mass Valuation (CAMA) systems or Automated Valuation Methods (AVM) can use various methods of which Multiple Regression Analysis (MRA), Comparable sales analysis or Artificial Neural Networks are the more common used methods.

The Appraisal Institute (2013: 295-296) commented that property tax assessors have used regression models for mass appraisal for many years, especially in highly developed residential markets. Regression models also form the basis for many AVMs.

Kauko & d'Amato (2008: 1) argued that quantitative methods are undergoing a massive renaissance. One of the specific reasons for this upsurge is because of economic globalisation, a homogeneous valuation method is required all over the world.

Moore (2005: 1) did research to determine the accuracy of different CAMA methodologies such as the market-tuned cost approach, the adaptive estimation procedure, Multiple Regression Analysis (MRA), comparable sales analysis and Artificial Neural Networks. Moore found (2005: 52) there is a significant statistical

difference in results measured by COD. MRA had the lowest COD and the cost approach had the highest COD.

In this study the focus will be on the use of Multiple Regression Analysis (MRA), in computer assisted models. The advancement of computer technology has made the use of MRA much easier in practise.

Murray (1969: 275) commented that the application of statistics to appraisals has been a potent challenge since 1920. He stated that regression analysis has been the focus of studies designed to find a statistical or econometric approach to value. He described it as a method whereby actual sales are analysed for the contribution of different variable factors such as soil productivity, distance to town, quality of buildings, and the like. "Once an equation has been established which accounts for the major variable factors affecting value, it can be used to estimate the value of a farm in the same area".

Gujarati & Porter (2009:15) defined regression analysis as "[it] is concerned with the study of the dependence of one variable, the *dependent variable*, on one or more other variables, the *explanatory variables,* with a view to estimating and/or predicting the mean or average value of the former in terms of the known values of the latter".

Steyn (2003: 9) described multiple regression analysis as a mass valuation method. It is a mathematical technique to calculate the values of farm properties, as an example, by using a mathematical equation. Certain data are necessary to determine the values of farms in a specific geographic area, for example the recent transaction prices of farms, and other attributes that influence the prices. The equation uses attributes that are known, are measurable and that influence the process of price determination. Known qualitative attributes are valued on a value scale (or as either present or not present, as a binary variable) and used in the equation. Each variable or attribute carries a certain weight in relation to each other in the equation.

This mathematical equation is used, if it satisfies certain minimum statistical requirements, to calculate the value of a farm property in a specific area.

The Appraisal Institute (2013: 295) defined regression analysis: "[It] is a statistical technique in which a mathematical equation can be derived to quantify the relationship between a dependent (outcome) variable and one or more independent (input) variables."

In appraisals, the dependent variable is usually the price or rent. The independent variables are usually broadly derived from the four forces that affect value (social, economic, governmental, and environmental) as well as the physical characteristics of the land and improvements.

Often, the value affect of the four forces are discounted for by using the property sales or rents of comparable properties. The relevant physical characteristics of comparable property data should be included as independent variables. In some instances it is also necessary to include a date of sale variable (or variable set) to account for economic change over time. Sometimes it is necessary to include an environmental variable or variables when investigating the effects of an external environmental factor, such as traffic noise or factory odour.

There are questions in certain circles regarding the accuracy and validity of normal valuation procedures.

McGreal et al. (1998: 57) stated, "recent research within the U.K. has increasingly questioned the validity and accuracy of valuation procedures. Statistical methods of analysis are perceived to provide a more objective approach, based upon the rigours of the scientific method, thus yielding an understanding of the key variables and the means by which they are analysed". Thus, these scholars hold the view that a statistical method (with computer assistance) is more reliable and accurate than a traditional valuation approach.

## 3.2 MASS VALUATIONS

Mass valuation is a term, that is used when a large number of properties have to be valued, using some kind of computer assistance in order to do the valuation quicker and more cost effectively

The SAIV (2014: 14-1) alluded to the definition of the IAAO regarding mass appraisals: "[it is] the process of valuing a group of properties as of a given date using common data, standardised models and statistical testing".

"Valuation is, by nature, an approximation, and the precision demanded needs to be weighed against the cost of producing value" (Bond & Dent, 1998: 373).

The method used is to analyse as many possible transaction, within a specific homogenous area, and use this information on the rest of the homogenous area.

Steyn (2003: 30) wrote that mass valuation is a process where a large number of properties are valued by means of standardised techniques. A prerequisite is the availability of enough accurate data in electronic format.

Borst [publishing date is not mentioned in the book] (2) was of the opinion that there are two primary technical challenges in developing a good value estimate. One is to incorporate the effects of location within the model structure, and the second is to take market trends into account, in the model structure.

Thompson stated (2008: 31 & 41) that stratification of residential market into rational market segments, is the key to producing usable models and establishing the proper sub-populations for valuation using comparable sales.

Thompson (2008: 318) wrote: "Accuracy and robustness across space and time are the clearest problem for modelling".

The strength of the AVM model approach lies in large part with the ability to identify and apply the adjusted prices from comparable sales to the valuation of subject properties.

The SAIV (2014: 14-2) mentioned that in a mass appraisal situation, valuation models must be developed that replicate the forces of supply and demand over an entire city. The valuer's judgement relates to groups of property rather than single properties.

Des Rosiers & Thériault (Kauko & d'Amato, 2008: 111) wrote that hedonic price modelling is popular because of two main reasons. "First, it rests on multiple regression analysis which is a conceptually sound and very powerful analytical device that combines probability theory with calculus, thereby allowing the sorting out of crossed influences that affect property values. Second, it perfectly fits the very definition of market value, expressed as the most probable price that should be paid for in a competitive and transparent market setting."

## 3.3 COMPUTER ASSISTED MASS APPRAISAL (CAMA) AND AUTOMATED VALUATION MODELS (AVM'S)

CAMA (Computer Assisted Mass Appraisal) and AVM (Automated Valuation Models) are related technology. CAMA dates back to the 1970s while AVM is a more recent emerging field emerging in the 1990s (Borst, 1).

Borst (2) describes the distinction as follows: "the major distinction between a CAMA estimate of value and that produced by AVM is the effective date of the value estimate. CAMA systems value all properties in a jurisdiction as of a statutory valuation date such as January 1 of each year. AVM systems do usually produce a value estimate with the sale date of the subject property".

Both CAMA systems and AVM systems have a mathematical model, intended to represent a valuation estimation formula.

CAMA systems are typically used by municipalities for determining property tax bases.

The IAAO Standard on Mass Appraisal of Real Property (2013: 5) states that the primary focus of mass appraisals is for ad valorem tax purposes.

Borst mentioned that there is a distinction in the exact methodology used to achieve an estimate of market value. CAMA systems may use market-tuned cost approach as one of the methods used. AVM systems do not use the cost approach. Both systems use either Multiple Regression Analysis (MRA), or comparable sales analysis or Artificial Neural Networks as possible methods.

Smoothy, Louw & Weichardt (2004: 6) described CAMA as the appropriate use of computers, computer databases and statistical analysis tools by CAMA analysts, as well as a variety of support staff, to value properties in a time and cost effective manner. They also state that CAMA is reality for all forms of mass appraisal.

Boshoff & de Kock (2013: 4) referred to the definition of the Collateral Risk Management Consortium that an AVM can be defined as the generic term for any electronic analytic algorithm, process or model that is intended to estimate the value of an individual property, without human assistance (other than the entry of the data).

The IAAO (2003: 32) described an AVM as a mathematically based computer program for software that produces an estimate of market value, based on analysis of location, market conditions, and real estate characteristics from information that was previously separately collected. The distinguishing feature of an AVM is that it is a market appraisal produced through mathematical modelling. Credibility of an AVM is dependent on data used and the skills of the modeller producing the AVM.

The Appraisal Institute (2013: 296) defined an AVM: "Computer software that queries property and market data, analyses comparable property and market information to assign a value or range of values to a particular property, or generates metrics applicable to assessing the credibility of valuation-related statements or conclusions".

Borst (xviii) was very specific that computer assisted valuations are estimates of values and not appraisals.

"The term appraisal has a very specific meaning. It is an opinion of value developed by an appraiser. A value estimate produced by CAMA/AVM is not an appraisal. It can become an appraisal if an appraiser, after reviewing relevant information,

renders an opinion of value based on the estimate. Simply said only humans do appraisals; machines do not".

SAIV (2014: 1-19) stated that "although AVMs use the term valuation, it is not a valuation and has created a great deal of confusion amongst property owners. [It] is rather a statistical assessment as opposed to a valuation."

The Appraisal Institute (2013: 298) commented also, that the output of an AVM is not by itself an appraisal. The output may be used as a basis for opinions and conclusions in an appraisal or appraisal review, if the appraiser believes the output is credible.

The Appraisal Institute (2013: 297) alluded to Advisory Opinion 18 of the Uniform Standards of Professional Appraisers Practise, "an appraiser should be able to answer affirmatively to the following questions before deciding to use an AVM as an appraisal or appraisal review:

1. Does the appraiser have a basic understanding of how the AVM works?
2. Can the appraiser use the AVM properly?
3. Are the AVM and the data it uses appropriate, given the intended use of the assignment results?
4. Is the AVM output credible?
5. Is the AVM output sufficiently reliable for use in the assignment?"

Gilbertson & Preston (2005: 129) commented that the real danger remains that; automated products will be confused with traditional valuations when this is not the case. "Valuations are a professional opinion and must be clearly distinguished, perhaps even with the use of different words. In this context, is it time to redefine valuation?"

Kane, Linné & Johnson (2003: ix) wrote that the techniques of mass appraisal and single-property appraisal continue to converge.

### 3.3.1 Advantages and shortcomings of AVMs

Tretton (2007: 488 & 505) wrote that automated valuation models (AVMs) are in use around the world with varying degrees of sophistication. Most of these AVMs value residential property.

Tretton (2007: 505-508) mentioned and described the different advantages that AVMs have:

1. Full transparency and public access facilitated.

   There has been an increase in the demand from the public for more information and for immediate access to data. Increasing the amount of information available "online" not only has its own justification but also increases public confidence in the integrity of the assessing body and its valuations.

2. Low cost.

   Revaluations will be significantly cheaper when done using an AVM model compared to when it is done as a new valuation using the traditional valuation process.

3. Consistency.

   In property taxation there has long been a conflict or potential conflict between accuracy and uniformity. Uniformity of assessment is highly desirable with a property tax as the principle of fairness is very much bound up with the acceptability of the tax to the public. AVMs deliver a high degree of consistency.

4. Speed.

   The more automated an assessment process becomes, the quicker a revaluation can be done.

5. Annual revisions are possible.

    The period between revisions varies greatly between jurisdictions. There is however a trend that revision periods become shorter.

Considerable criticism in the U.S.A. can be found of AVMs used by commercial companies for loans rather than those used for property taxation:

1. Concern that the public does not appreciate the difference between an automated valuation and one which involves an inspection, an appreciation of condition and a careful examination of comparable evidence close to the property. The Appraisal Institute for Canada's 2002 Position Paper (Tretton 2007: 505-508) saw a danger of automated valuations being misrepresented as being equivalent to a professional appraisal. It wants the public to be properly informed of the differences and calls for the two types of valuation to be clearly distinguished.

2. The use of outdated or very limited data. A recurring theme being the lack of data available outside the public sector.

3. Failure to take account of all the variables affecting value – a lack of individual inspection of the property. It appears that there are some AVMs in use seeking to achieve more than they are realistically capable of and using less than satisfactory or sufficient data.

4. There is great re-assurance in having a "real person" undertake the valuation. The public will be content with the use of AVMs providing they have the re-assurance that an expert person controls the program and the outputs are reviewed and refined by the expert. There is concern at inflexibility in automated systems. Where there is a large market for fairly homogenous properties such as is often the case with residential, then it is possible to set up a process to value such properties. This is more difficult when there are few properties or where the market is limited.

Tretton (2007: 482) concluded that: "Automated valuation programmes assist in the production of a valuation but its quality and accuracy are data and valuer led.

One size does not fit all and there is no automated replacement for the subjective professional judgement of the valuer."

Gilbertson & Preston (2005: 127-129) commented: "the fact that a valuer has little if any input is seen as a double-edged sword. It eliminates human error and bias but takes out of the equation not only the physical property inspection but also the skill, judgement and experience of the valuer".

SAIV (2014: 1-19) stated that the most common error in an AVM assessment is that an internal inspection of the subject property has not been conducted, which necessitates that many assumptions having to been made.

### 3.3.2  Constraints on AVM use

Robson & Downie (2008: 6) referred to specific constraints on AVM use. These are:

Data limitations; AVMs depend on the accuracy, comprehensiveness and timeliness of the data they use; without sales or value data they cannot produce a result. They are most reliable when valuing typical properties in stable neighbourhoods at prices close to the median for the locality, and less reliable when there are incomplete data records, few sales in a geographical area, unique properties or unique local markets. The difficulty of modelling purchasers' preferences for non physical property characteristics such as views, gardens and sunshine are mentioned".

The need to inspect property; AVMs can only capture information about a specific property's internal or external condition, improvement or disrepair, if the property is inspected and the data fed into the model. However, adding photographs and mapping information value determinants such as orientation and aspect can help overcome some situational omissions.

Risk Acceptance; The main impediment to further using AVMs is caution over inaccuracy. Where accuracy is less critical, for instance when credit capacity is good,

and where the physical property has already been checked, as for second mortgages, AVMs may be judged acceptable despite this concern.

This leaves loan origination at high loan to value ratios as the least likely scenario for AVM use. Expensive and slow traditional valuation processes were being replaced by instantaneous and cheap AVMs, tempered by the countervailing pressure to maintain prudent loan decisions. The mechanics of this trade off are complex, requiring decision rules which mix AVM confidence scores with credit and capacity assessments and Loan to Value (LTV) ratios. Lenders face the challenge of generating their own rules, which have to evolve constantly in response to market changes.

Thompson wrote that the phrase "garbage in/garbage out" captures the key message that the quality of the values produced is directly impacted by the quality of the data which are analysed and used to produce the value estimates (Thompson: Kauko & d'Amato 2008: 28). Kane, Linné & Johnson (2003: 149) commented that AVMs require adequate data sales and those values must be reviewed in the field for accuracy.

### 3.3.3 Municipal taxation

One of the major problems that municipalities faces is the extraordinary high administration cost to determine the values of agricultural properties (Fisher, 1996: 314).

Other cost issues are:

1. Cost implications when there are appeals against the valuations.
2. Costs related to the regular review of valuations of agricultural properties

Therefore, there is a very real cost benefit for municipalities to use AVMs for agricultural valuations.

A major advantage of real property tax is the relative ease with which land and buildings can be located and identified, and their stability over time. The immobility of real estate compared, for example, to income or sales prevents simple migration to other jurisdictions in response to the tax, although in the long run investment can shift to other jurisdictions (Youngman, 2006: 3).

However, at the moment municipalities compensate for the possible inaccuracy in MRAs that are applied, by using a lower than estimated value of the farms. All the farms are taxed for example at only 70% of the value the MRA estimates. In this way they avoid the majority of complaints they would have received if the basis was 100% of the value the MRA estimates. In order to compensate for the potential loss in income, because the municipality use only 70% instead of 100% as the base, they increase the rate at which the tax is levied. Thus, municipalities found a way to use MRAs for mass valuations, even if the MRA does not have a fair degree of accuracy.

This approach apparently solves the problem the municipality has with the relative inaccuracy of the MRA. It is however not fair towards the individual farm owner who now pays more than his fair pro-rata share, because the value estimate of his specific individual farm was relatively (say 25%) higher than what is the credible value of his property.

### 3.3.4  Categories of AVMs

Boshoff & De Kock (2013: 5-6) allude to the three categories of AVMs that Robson & Downie distinguish:

1. Hedonic models; It mirrors the process used by valuers and uses regression techniques to estimate the contribution of each property to the overall value.

2. Intelligent systems; Neural network or artificial intelligence models, which identify the variables relevant to value and learn about changes in the

relationship between these variables and value, continually updating the model based on new transaction data.

3. Hybrid AVMs; Indicate an intermediate service level between a standalone AVM and a desktop or drive by valuation named the Appraiser Assisted AVM (AAAVM). An AAAVM starts by providing an AVM and comparable transactions. The valuer then verifies the valuation and accepts or refers it for further investigation.

### 3.3.5 Components and process flow of a mass appraisal system

The SAIV (2014: 14-3) describes the components, which make up a mass appraisal system in the following diagram:
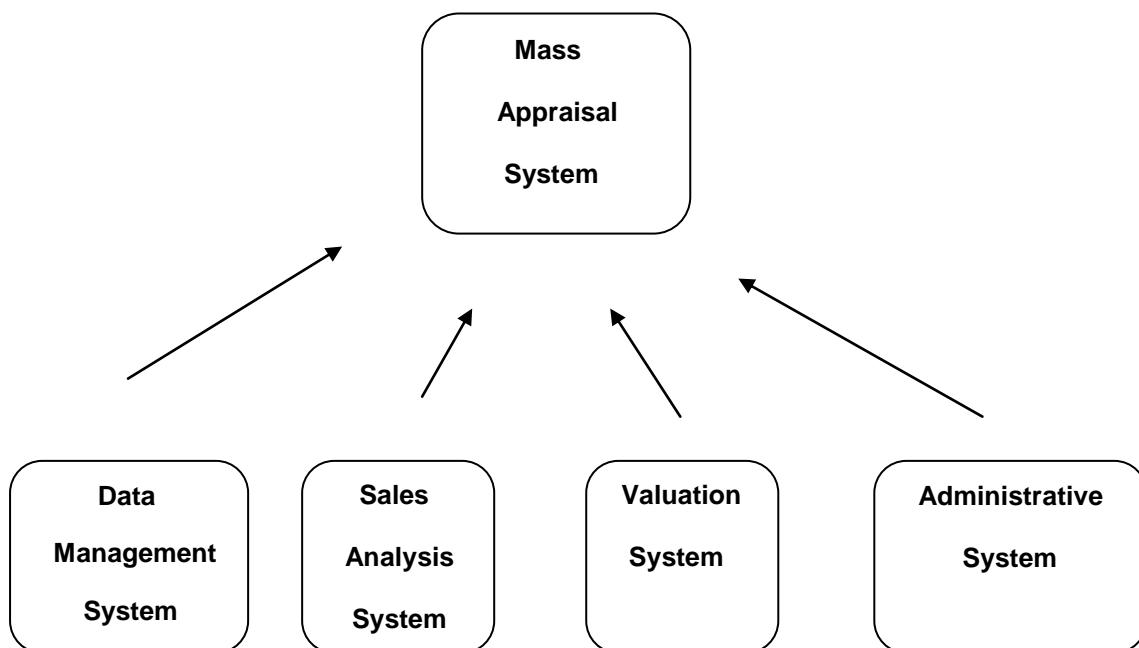
Borst (4) describes the process flow as follows:

```
                    ┌──────────┐
                    │  Sales   │
                    │ History  │
                    └────┬─────┘
                         │
                         ▼
  ╭─────────────╮   ╭─────────────╮    ┌──────────┐
  │    Model    │   │    Model    │    │ Subject  │
  │Specification│──▶│ Calibration │    │Properties│
  ╰─────────────╯   │  Software   │    └────┬─────┘
                    ╰──────┬──────╯         │
                           │                │
                           ▼                ▼
                    ┌──────────┐     ╭─────────────╮
                    │ Calibrated│    │  Valuation  │
                    │   Model   │───▶│  Software   │
                    └──────────┘     ╰──────┬──────╯
                                            │
                                            ▼
                                     ┌──────────┐
                                     │ Estimated│
                                     │  Values  │
                                     └──────────┘
```
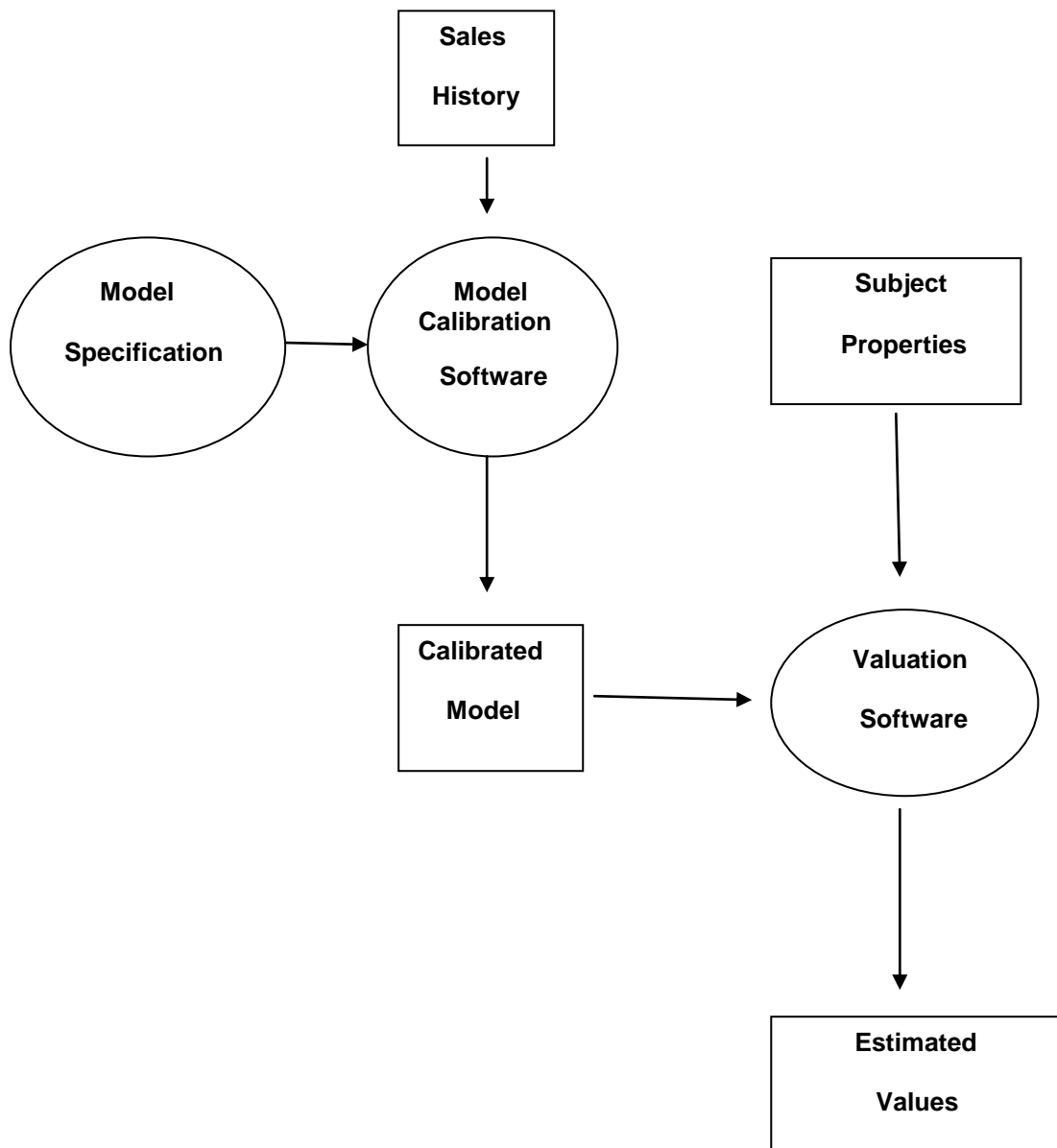
### 3.3.6  Trends and opportunities in the use of AVMs

In 1999, according to Waller (1999: 287), two major participants in the U.S.A. second mortgage markets, namely Federal National Mortgage Association (Fannie Mae) and

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the Federal Home Loan Mortgage Corporation (Freddie Mac), were strongly encouraging the development and use of AVMs in appraisals.

Robson & Downie (2008: 4) found that AVMs are in use right around the world. This includes India, Russia, South America and many smaller countries. Some countries are "early stage" users and some (like Sweden, U.S.A. and Canada) are "established" users. The established users have confidence in its use for second mortgage purposes and are beginning to use it also for first mortgage purposes.

They also found that a successful AVM model in one country cannot be duplicated in another country. It has to be adapted to a specific country's factors that drive values.

Computer assistance in the valuation industry is of significant economic importance. According to Borst (2) in the United States the total property tax revenue is more than $400 billion annually, and the total value of the annual loan activity is in excess of $1.5 trillion.

According to Gilbertson & Preston (2005: 126-127) the hallmark of a maturing market economy is wider property ownership and a greater use of property assets as security for loans. The amount of loans with property as security is rising fast Therefore, the dynamics of the market place for valuations are changing.

Property serves as security if defaulting by the borrower occurs. The effectiveness of this safety valve makes borrowing against property as security the most common basis for loans. This makes banks the biggest purchasers and users of valuations.

They stated that competition between lending banks in the provision of valuation services, is stimulating greater use of technology. Many of the objective elements needed to produce a valuation; collection, organisation, formatting of data are ripe for automation and valuers are seeing a progressive shift towards automated processes.

Gilbertson & Preston (2005: 128) indicated there is no way back from evolution in technology. Herein lies an opportunity for valuers. AVMs can have a range of uses, including as a quality control tool in the mortgage origination process, as a

supplemental test for the reasonableness of other valuation methods and to help inform the valuer of his/her next step.

"If AVMs are properly understood and used, they will become a valuable part of the valuation process rather than the process itself" (Gilbertson & Preston: 2005, 128).

"The greatest risk to the valuation profession is that commoditisation and automation creep up incrementally, ignored by reluctant professional valuers. The challenge is to embrace this shift and to maximise the use of technology where it is appropriate. There is no substitute for the skill of a competent and experienced valuer" (Gilbertson & Preston: 2005, 128).

Gilbertson & Preston (2005: 139) concluded that market forces are putting pressure on valuations, as we know it. Valuers cannot resist market forces; the consequence of failing to respond is an inevitable decline in the long term. Some changes, like increased automation bring new opportunities as well as threats, and the ability of the profession to capitalise on the opportunities depends largely on its ability to deal with the threats.

Waller (1999: 291-292) was of the opinion that AVMs will certainly change the work of appraisers. Routine jobs, such as refinancing or home equity loans in which there is little doubt that the property will carry the debt; an AVM estimate of the value is sufficient. AVMs provide a defensible estimate of value, for a financial institution, that is relatively accurate. He concludes: "AVMs are here to stay. They will never replace the traditional appraiser, but they will redefine and enhance appraisals ".

Mooya (2011: 2265 & 2280) wrote that the rise in the use of AVMs poses questions about the long-term survival of the property valuation profession. AVMs provide quick and cheaper valuations, which in this very competitive market place put them at a distinct advantage over traditional approaches. He concludes that there is no normative reason or reasons of inappropriateness, why AVMs should not completely replace valuers.

The SAIV (2014: 14-3) commented that CAMA is a more efficient use of resources and provides considerable savings, which is to the benefit of the ratepayers. "It is a

reflection of how the world changed. Today we live in an information era, in which new technology is key".

Boshoff & De Kock (2013: 7-8) find that in South Africa, where there is a shortage of valuers, because the majority of them are approaching retirement age, the use of AVMs in valuing commercial property can alleviate this problem to an extent. However, the majority of professional valuers in South Africa view AVMs as a threat to their jobs. They further found that valuers in South Africa are open to the notion of using AVMs as a supplement, rather than a replacement for their traditional services.

They concluded: "it is difficult to predict the future of the valuation profession, as the profession is constantly under scrutiny and pressure. Costs and speed of delivery are major drivers for AVM development; however, one should consider the quality of valuations. In order to survive the development and implementation of AVMs, valuers in practise will have to change and adapt. The availability and quality of data are key factors, which will distinguish between valuers and valuation companies. The valuation profession is moving from a service- to a product-oriented industry."

Robson & Downie (2008: 7) summarised: "the U.S. has pioneered AVM development as providers seek added value from their systems. The main areas of innovation involve the integration of collateral, credit and capacity data and decision rules in electronic loan decision-making platforms. AVMs were increasingly being integrated into these platforms in the U.S.A. to create a unified risk management solution. AVM cascades, AVM testing, fraud detection systems and hybrid AVMs involving rules based election of valuation service levels fit neatly into this type of approach.
In the U.S.A. the barriers between human and electronic service levels are becoming blurred as AVMs become part of a more complex range of services, in which valuers engage with and modify AVMs and the comparables and data provided with them, moving from a single figure output towards the richer information traditionally supplied as an appraisal. It is clear from the U.S. experience that although many valuations will eventually be carried out electronically, human valuers will not become obsolete. They are required to interpret, check and evaluate AVM outputs and where valuers choose to add AVMs to their toolkit they can add value and speed to the professional service offered".

Robson & Downie (2008: 7-16) did an on-line questionnaire survey wherein 473 worldwide valuers participated. They found that 44% of the respondents believe that valuers can benefit by using AVM data.

However, 87% of the respondents believe that valuations are more accurate than AVMs because of valuers' local knowledge, and a very high 90% of the respondents agreed that valuers' ability to evaluate comparables is a major advantage over AVMs.

According to the Appraisal Institute (2013: 297), financial institutions can use AVMs for; quality control functions, to prequalify borrowers, conduct audits, mitigate loss, assess portfolios of loans, provide home equity loans and numerous other functions.

They comment that practising real estate appraisers are working to gain an understanding of AVM technology and shifting markets for appraisal services, to determine how best to take advantage of new business opportunities resulting from AVMs.

The Appraisal Institute (2013: 297) concluded: "Although AVMs were initially perceived as a means of replacing human appraisers with machines, they have developed more recently into underwriting devices and tools designed to assist appraisers and appraisal reviewers."

It is clear from the above discussion that the survival of the valuation profession, depends on their ability to use their informed judgements to produce valuations significantly better than an AVM, with no human intervention.

### 3.3.7 The use of AVMs in the valuation of commercial properties

Gilberston & Preston (2005: 127) indicated that there is not access to enough highly comparable data, and that is why using automated mass valuation technology is much more complex in the commercial property sector, than in the residential property sector.

Tretton (2007: 488 & 505) commented that achieving an AVM for commercial property is clearly more difficult, due to the paucity and complexity of evidence, though considered by many to be an achievable goal.

He stated that the importance of [data] quality cannot be over-emphasised. It is no coincidence that the most highly developed commercial AVM appears to exist in Hong Kong where 99% of property is rented and the Commissioner's knowledge of transactions is very high. The key is data. The poorer the quality or quantity of data the less feasible automation becomes.

Tretton (2007: 486 & 508) indicated that: "in the commercial property sector paucity of evidence makes the consideration of automated valuations much more complex. The complexity of transactions and the lack of recorded transactions suggest professional judgment has to be paramount in determining the levels of value to be considered."

He concluded that there are limited AVM models in use for commercial property valuation and it is suggested that these models be a supportive tool rather than a fully automated valuation, as the degree of human involvement varies.

"As is found in many areas full automation is not the answer. Even in Hong Kong where the commercial AVM has come closest to reality there remains a great deal of operator control and intervention".

Gilbertson & Preston (2005: 127) made the point that AVMs for commercial property could not really be viewed as valuations, if it is based on the sole use of a computer without the intuitive input of the valuer. Commercial property AVMs are a subjective-objective balancing act and require a safety mechanism to verify the valuation. Upsetting this balance opens the process to new risks.

Boshoff & De Kock (2013:12-13) found that 50% of the professional valuers they interviewed in South Africa, were of the opinion that AVMs can only be used for residential valuations, to a certain degree of accuracy. In their opinion, commercial

property is a much more involved valuation exercise and the risks associated with this type of property need to be balanced and managed.

The interviewees stated that a commercial valuation involves an analysis of the various value-forming factors applicable to commercial property that need to be taken into account. This includes adjustments to the value calculations. They doubted whether an automated valuation process would be able to perform all these functions and incorporate all these factors.

They stated that South African banks require that property valuations include an insurance replacement cost, therefore, it is impossible for an AVM to determine an insurance replacement cost, as there is no physical inspection.

Boshoff & De Kock (2013: 19) concluded: "...the majority (95%) of the respondents believed that these [AVM] models cannot be employed in the South African commercial property market. The future of AVM development in South Africa for commercial property valuations is, therefore uncertain and highly unlikely."

## 3.4   ACCURACY REQUIREMENTS

According to Pienaar (2015: 55) there is a general belief in the valuation industry that it is acceptable that different valuations of the same property can differ up to 10% in the value estimates.

In personal communications with a number of valuers, who specialise in valuing farms, the consensus opinion is that because farms are much more difficult to value than a residential property, the difference between a value estimate and the selling price of a farm should preferably not exceed 15%. If it does exceed 20%, the valuation is no longer credible.

Crosby et al (1998: 305) mentions that 'the margin of error' concept involves the proposition that, in considering whether a valuer exercised reasonable care and skill in carrying out a valuation, it is relevant to determine the extent to which that valuation departs from the 'true value' [selling price] of the property.

They found that valuers tend to lag the market, undervaluing in bull markets and overvaluing in bear markets.

Crosby et al (2000: 321-324) stated that they researched 120 pairs of fairly typical commercial investment valuations. They determined that 65% of the valuations is within 10% of each other and that 90% is within 20% of one another

Furthermore, they refer to a study done by Hutchison et al (1996) where the valuation estimates were compared with the actual selling price. The results of the research was similar, 65% of the valuations had a margin of error of less than 10% and 90% of the valuations had a margin of error of less than 20%.

Crosby (2000: 14-15) refers to cases decided in the High Court in Britain, between 1977 and the year 2000, in which the margin of error has been an issue. "In the majority of cases in which the judge has ruled on the extent of the bracket, the result lies between 10 per cent and 15 per cent either side of what is found to be the "true value" (or either side of the midway point in cases where no decision was reached as to the true value). Moreover, while individual experts may occasionally demand (or concede) a wider bracket, there is no recorded instance of anyone favouring a figure in excess of ±20 per cent. It appears therefore that, to date, ±20 per cent has been universally regarded as the absolute limit".

The IAAO (2013: 7) explains that ratio studies is a generic term used to determine the accuracy of appraisals. It provides information about a group of properties (not a single property) by dividing the appraised value of the group by the sale price of the group.

The IAAO (2013: 7) states: "there are two major aspects of appraisal accuracy: level and uniformity. Appraisal level refers to the overall ratio of appraised values to market values. Level measurements provide information about the degree to which goals or certain legal requirements are met. Uniformity refers to the degree to which properties are appraised at equal percentages of market value".

According to the IAAO (2013: 13) the most generally useful measure for uniformity is the COD (Coefficient of Dispersion)

However, what is important to take cognisance of is the fact that "ratio studies cannot be used to judge the level of appraisal of an individual property" (IAAO: 2013: 7).

Rossini & Kershaw (2008: 1) stated that very little is known about the accuracy of AVMs that are used in Australia for residential property mortgage security purposes and that most users of these products misunderstand the level of accuracy involved.

They did research to establish minimum requirements for accuracy in AVMs in the greater Adelaide Metropolitan area. They used 2 538 transactions that took place in 2005 and 2006 in their database. They did research to determine a standard of accuracy for individual valuation.

Rossini & Kershaw (2008: 8) concluded that for a "reasonable level of acceptance" of accuracy, the AVM should have a minimum of 90% of the individual estimates within a 20% accurate range and the COD (Coefficient of Dispersion) should be less than 10.

They stated that if only 80% of the individual estimates are within a 20% accurate range and the COD is more than 13, the AVM is "of no real value to users".

The mayor advantage of the Rossini & Kershaw study is that they established guidelines for the accuracy of individual property's, within a group of properties, appraisal accuracy.

The IAAO (2013: 17) prescribes specific maximum COD levels for specific types of properties:

1. Residential property, a COD of maximum 15% and
2. Income producing property, a COD of maximum 20%.

However, there is no category specific for farms.

The IAAO Standard on Mass Appraisal of Real Property (2013: 13) adds a description of "vacant land in rural areas, a COD of maximum 25%".

There is not a maximum COD level specified for a developed farm.

Wolverton (2009: 86) stated that a COD of less or equal to 15% is considered indicative of good uniformity.

Boshoff & de Kock (2013: 3) referred to the description that Robson & Downie (2007: 20-22) used of the range of valuation services typically offered in property markets:

1. Gold standard; after a physical internal and external inspection of the property, a qualified and registered valuer prepares the professional standard valuation in writing, and supported by market information.
2. Drive by and broker opinions; the next service level down from the gold standard is a drive by or external valuation, which involves an external physical inspection in order to confirm the property's existence and some of its physical characteristics.
3. Desktop; a desktop valuation excludes any inspection of the property, and the valuer may use satellite photographs, owner contact and market knowledge to establish information, as well as select and analyse appropriate comparables.
4. AVM; an AVM, at its most basic, provides only a valuation output; however, some AVM systems supplement the figure with various features, the most important being a list of comparable transactions and a measure of the expected accuracy, expressed as a confidence score.

In each case, there must be a balance between savings in time and cost, versus the property "risk factor".

The S.A. Property Education Trust (2004: 36-39) described the different classes of valuations, the purpose and accuracy required of each class:

Class A.
Accuracy:    Maximum.
Purpose:    For the preparation of court cases, arbitration and other

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disputes.

Methods: All possible methods

Time spent: The maximum amount of time.

Class B.

Accuracy: A high degree of accuracy is required.

Purpose: Purchase, sale, expropriation and the division of assets.

Methods: The applicable method, and wherever possible, verified by an alternative method.

Time spent: A reasonable amount of time.

Class C.

Accuracy: A fair degree of accuracy is required.

Purpose: Levying of assessment rates, granting of mortgage bonds, and insurance of improvements.

Methods: In general simple methods, requiring a minimum amount of time.

Time spent: Limited.

Class D.

Accuracy: Limited accuracy.

Purpose: Preliminary investigations, budget purposes.

Methods: Superficial and elementary. Often subjective.

Time spent: Very limited.

There is however no quantification of what is meant by the different accuracy levels.

Using the above purpose descriptions, CAMA and AVM systems could be classified as Class C valuations. That corresponds to the overall aim of CAMA and AVM systems, to lower cost and time needed to produce estimations of value, within the requirement of a fair degree of accuracy.

Based on the above information, the researcher concluded that a COD of less than 10% and a 90% of individual estimates within 20% accuracy qualifies as a high

degree of accuracy and a COD of 10% - 15% and 80% of individual estimates within 20% accuracy as indicative of a fair degree of accuracy.

## 3.5  THE  USE OF REGRESSION ANALYSIS IN THE VALUATION OF AGRICULTURAL PROPERTIES

Murray (1969: 276-285) described nine different studies that were done in the U.S.A. In the first study the sale prices of 160 farms from 1916-1919 in Minnesota were analysed. The last study he referred to was done in 1965 in the Mississippi River Delta where 1 378 land transfers were analysed.

Multiple regression equations were developed in each study, which typically took variables like the depreciated cost of buildings, land classification index, soil productivity index, land slope, drainage, water supply, distance to the market, distance to town, size of the farm and other variables into account.

 Murray concluded that : "the statistical approach could explain about three-fourths of the variations in values, but there was always a significant portion that was not explained by statistical analysis".

He also commented that the most promising field for the statistical approach is assessment, where mass appraising is required. "The statistical approach to farm value has definite limitations, but at the same time it provides powerful precise tools which will undoubtedly be used increasingly along with human judgement in improving the farm appraisal process."

There are similar complexities in the characteristics of both farmland and commercial property, which make the introduction of AVMs in the valuation of agricultural property extremely difficult. Arguably even more difficult than in the case of commercial property.

1. Farms are highly heterogenous. Suter (1980: 3) stated: "no two farms are ever alike in terms of (1) the basic resources (land, labour, or capital) that are

available, (2) the way these resources or factors of production are combined, or (3) in terms of the amounts of various crops and livestock produced". Thus, the product is never identical or homogenous.

2. The quality and availability of data, to develop successful AVM models to use in the valuation of agricultural property, are often not good and are extremely scarce.

Currently there are only a few municipalities in South Africa, which are using CAMA models, in the valuation for agricultural for property tax purposes. Cape Town municipality was the leader in developing a model in this regard.

Bell & Bowman (2002: 127-128) comment that CAMA valuation models could be developed for agricultural farms in South Africa. They refer to a model that was developed for the valuation of agricultural property:

Value of farmland = B1 x B2 x B3 x B4 x B5 x B6 x B7 x base rate x hectares of farm, where:

B1: population per hectare

B2: relative farm debt per hectare

B3: gross revenue per hectare

B4: annual rainfall

B5: rainfall stability

B6: soil arability

B7: percentage dry land/irrigated/grazing.

They are of the opinion that the basic data necessary to support CAMA modelling in any rural jurisdiction of South Africa is available from the Deeds Office and from the Surveyor General's office.

They concluded that implementation of CAMA techniques in the rural areas of the South Africa should proceed incrementally (Bell & Bowman, 2002: 133).

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Some financial institutions are moving in the direction of improving their database regarding agricultural property, to enable them to make better use of computer assistance, when valuating an agricultural property for purposes of financing. However, it is envisaged that this database will become a valuable part of the valuation process, rather than the process itself.

Boshoff & de Kock (2013: 6) refers to the process what Robson & Downie described as an AAAVM (Appraiser Assisted Automated Valuation Model). A value estimate provided by an AVM model plus data regarding comparable transactions. The valuer then verifies the valuation and accepts or refers it for further investigation.

There is currently no fully automated AVM model, for the valuation of agriculture property, in use in South Africa.

Suter (1992: 388) commented that regression type models can work, but not in all cases. He alluded to the fact that several key farms in each area need to be appraised in detail, as a check on the regression coefficients or weights that have been developed in an AVM model.

**A study done by Bourhill (1998).**

Bourhill (1998) did a study for the partial fulfilment of the requirements for a M Inst Agrar degree at the department of Agricultural Economics, University of Pretoria. The purpose of the study was to discover the driving force behind land prices to the extent that a better understanding of these forces will assist in valuations that are more reliable. He analysed 48 farm transactions, which mainly took place in the cattle grazing areas of Vryburg and Rustenburg. He did a stepwise regression analysis on 47 variables that could have a possible affect on land prices.

The stepwise regression lead to a multiple regression model where nine variables were identified as having the most significant effect on farm prices. These nine variables were:

1. farm size,

2. percentage arable land,

3. slope,

4. existence of a second house or cottage,

5. existence and quality of infrastructure

6. existence of other farm buildings

7. buyer's number of years of farming experience,

8. does the buyer own an adjoining farm,

9. distance from nearest town.

This regression model had a $R^2$ of 0.7151 and an adjusted $R^2$ of 0.6477.

He concluded by stating that it is clear that property variables as a whole can only partially explain land prices. The inclusion of certain buyer characteristics as two of the nine factors (namely the buyer's number of years of farming experience and does the buyer own an adjoining farm) that had the greatest influence on farmland prices, confirms the fact that non-physical factors have a significant impact on farmland prices.

"It is apparent that variation in land prices is attributable more to non-economic factors and less to income, than is often imagined" (Bourhill, 1998 : 91).

Possible shortcomings of the Bourhill study.

The study did not take into account a number of statistical indicators:

1. Neither the standard deviation of the error term, nor the COD were calculated or evaluated.

2. Although Bourhill concluded that it is clear that property variables as a whole can only partially explain land prices, he did not point out that an adjusted $R^2$ of only 0.6477 is actually a low score and that it implies that 35.23% of land prices cannot be explained by the variables in this model.

3. The model was not tested for autocorrelation or heteroscedasticity.

The researcher is of the opinion that the Bourhill study showed that it is highly probable that the model that was developed, is not accurate enough to satisfy accuracy requirements.


**A study done by Steyn (2003).**

Steyn (2003) did a study for the partial fulfilment of the requirements for a M.Sc. (Real Estate) degree at the University of Pretoria.

She developed a multiple non-linear regression model in which a number of property characteristics were related to the sale prices of farms, in a homogenous area north-west of Bloemfontein. Farms that were sold in the previous two years were identified, there were 23 in total, and analysed

Six variables were taken into account:

1. size of the farm,
2. the area in hectares that were arable,
3. the area in hectares that have natural pastures,
4. the extent and quality of a house
5. any tourism development in existence and
6. the distance from the closest town.

The $R^2$ was 0.95, which indicated a high level of relation between the dependent and independent variables and the COD was 18%.

Steyn (2003: 98) concluded that it is possible to develop a non-linear multiple regression model for farms, which can be used for mass valuations to estimate values for municipal taxation purposes.

However, it must be emphasised that the geographic area was small and homogenous.

Possible shortcomings of the Steyn study.

Although Steyn concluded that the model met minimum requirements, because the COD was 18% (indicating a fair degree of accuracy according to the International Association of Assessing Officers) and therefore can be used as a regression model for municipal taxation purposes, the study did not take into account a number of statistical indicators:

1. The standard deviation of the error term, was not calculated or evaluated. The researcher calculated the standard deviation of the error term, and found it to be $R$109 000.

   Furthermore, the researcher analysed the data and found that 9 out of the 23 farms (39%) predicted individual values, differed with more than 20%, from the actual selling price.

   Thus, 39% of the individual predictions this model calculated, has an error term of more than 20%. This implies that only 61% of the predicted values are within 20% of the actual selling price.

   The fact that the COD is higher than 15% and only 61% of the individual estimates varies less than 20% from the selling price, indicate according to the study done by Kershaw & Rossini (2008: 8)  an inaccurate model and it is "of no real value to users".

2. The adjusted $R^2$ value was not calculated.

3. The model was not tested for multicolinearity, autocorrelation or heteroscedasticity.

Thus, it is possible that, although Steyn concluded that the model is accurate enough because the COD is 18%, the model did in fact not satisfy fairly accurate requirements and it certainly has not a high accuracy.

The researcher is of the opinion that this study shows that even in a small homogeneous area, it is very difficult to have enough accurate and appropriate data available to develop a regression analysis model that is accurate enough to satisfy fairly accurate requirements.

## 3.6 SUMMARY

The distinguishing feature of an AVM is that it is a market appraisal produced through mathematical modelling. Thus, there is no physical inspection of the property Credibility of an AVM is heavily dependent on the quality and quantity of the data used and the skills of the modeller producing the AVM. "Garbage in/garbage out" captures the key message that the quality of the values produced is directly impacted by the quality of the data which are analysed and used to produce the value estimate.

The use of Multiple Regression Analysis (MRA) is probably the most common method. With the advancement of computer technology, the application of MRA models has become a worldwide phenomenon.

The fact that a valuer has little if any input, is seen as a double-edged sword. It eliminates human error and bias but takes out of the equation not only the physical property inspection but also the skill, judgement and experience of the valuer.

In the USA, in nine different studies done from 1916 - 1965, the statistical approach could explain about three-fourths of the variations in values, but there was always a significant portion that was not explained by statistical analysis.

The challenge to develop an AVM model that can replicate the forces of supply and demand over an entire geographically farming area, is huge.

The researcher concluded that a COD of less than 10% and a 90% of individual estimates within 20% accuracy qualifies as a high degree of accuracy and a COD of 10% - 15% and 80% of individual estimates within 20% accuracy as indicative of a fair degree of accuracy

To have acceptable quality data and sufficient quantity data available, to be able to achieve this, will pose a significant challenge in the endeavour to develop a successful AVM for farm valuations.

Chapter 4 deals with the development of linear multiple regression models, through the process of a stepwise regression, for the valuation of farms. These MRA models have to satisfy accuracy requirements. It also describes the limitations that these MRA models might have, regarding their applicability to farm valuations. The researcher explains, on a very basic level, the statistical concepts and statistical indicators that were used to evaluate the MRA models.

# CHAPTER 4

# STEPWISE DEVELOPMENT AND EVALUATION OF LINEAR REGRESSION ANALYSIS MODELS, FOR USE IN VALUING AGRICULTURAL PROPERTIES

## 4.1 INTRODUCTION

1. This chapter addresses three of the study objectives, namely: Determine if it is possible to develop a linear multiple regression model for the valuation of farms, which satisfies accuracy requirements, with data that is reasonably available.

2. Contribute to the knowledge regarding the improvement of the accuracy levels of MRA models in farm valuations.

3. Determine the limitations these MRA models might have, regarding its applicability to farm valuations.

A stepwise regression method is followed. The aim is to determine if it is possible by way of a continual refining process of a MRA model, to eventually build a model that satisfy accuracy requirements.

Each model is discussed regarding its statistical indicators and its limitations.

## 4.2 A BRIEF DISCUSSION OF CERTAIN STATISTICAL CONCEPTS

This section provides a brief discussion, on a basic level, of certain statistical concepts and statistical indicators that the researcher used and refers to in this study. The aim of this basic discussion is to make it possible for a person who does not have knowledge regarding statistical concepts and terminology, to understand the discussion in this chapter.

The statistical program that was used to process the research data is the IBM Statistical Package for the Social Sciences (SPSS Statistics). It is a program widely used by researchers, survey companies, marketing organizations and others (Statistical Package for the Social Sciences, [*http://www.spss.com*]).

In this study a number of statistical tests and indicators are used to analyse and evaluate the accuracy, applicability and statistical significance of the regression model.

It is important to keep in mind when evaluating the different statistical indicators of a regression model, to judge all the indicators of a model as a whole package, and not only one or two indicators. Therefore, it could happen that although a specific model has for example an adjusted $R^2$ of 0.8500 (which is significant), it can be too low on another critical indicator which then renders the model as a whole, statistically inferior or insignificant.

**Regression analysis**

Regression analysis is concerned with the study of the dependence of one variable, the dependant variable, on one or more other variables, the independent variables, with a view to estimate or predict the value of the former in terms of the known values of the latter (Gujurati & Porter, 2009: 15).

Multiple linear regression equations accommodate two or more independent variables, so the population linear equation is written as:

$$y = \alpha + \beta_1 X_{1} + \beta_2 X_2 + \beta_k X_k + \varepsilon$$

Where $k$ indicates the number of explanatory variables in the model. Inclusion of more than one explanatory variable increases the calculation complexity of linear regression analysis (Wolverton, 2009: 292).

In this study research is done to determine to what extent is farm values dependant on 10 different independent variables, which are described in paragraph 4.3.2.

**Error term**

In a regression model the relationship between the dependent variable and the independent variable is seldom exact, thus there is a difference between the predicted value and the actual value. This difference in the relationship is referred to as the error term (Gujurati & Porter, 2009: 4).

The error term, in this study, is the difference between the estimated value as calculated by the regression analysis models and the actual selling price of the farm.

**Hypothesis and the null hypotheses**

The hypotheses is that it is assumed that the value of the dependent variable in each MRA, is dependent on the independent variables,

The null hypothesis in each MRA is that the value of the dependent variable is not dependent, on the independent variables,

**t-Value (Significant Testing)**

The t-value is a statistical test to determine how significant is the difference between the mean of the actual selling prices and the mean of the estimated values, calculated by the regression analysis model (Gujurati & Porter, 2009: 4).

The t-value needs to be interpreted by using a Percentage Points of the t-Distribution Statistical Table. A t-value of 0 indicates that the value of the dependent variable is not dependant on the independent variable (Wolverton, 2009: 255). In a regression equation with 17 independent variables, a t-value of 1.740 and higher, indicates a p-value of .05 and lower.

**$p$-Value (Exact level of Significance)**

In statistics, the term "significant" means it is "probably true". The $p$-value indicates how likely it is something is not true. A $p$-value of 0.05 means there is a 5% probability that something is not true. Thus, it has a 95% probability of being true [*http://www.surveysystem.com*].

The p-value is defined as the lowest significance level at which the null hypothesis can be rejected (Gujurati & Porter, 2009: 835).

If the p-value of an independent variable is 0.04, it means that there is a 96% probability that the value of the dependent variable is dependent on the specific independent variable.

In the academic world a theory with a 95% probability of being true, is usually considered as significant. However, the American Statistical Association warns that the 95% rule of thumb is not supposed to be a gatekeeper whether work is publishable or not. "Well-reasoned statistical arguments contain much more than the value of a single number and whether that number exceeds an arbitrary threshold" (American Statistical Association Statement. 7 March, 2016)

**Stepwise regression**

This is the process whereby all the candidate independent variables in the model are checked to see if their significance has been reduced below the specified tolerance level. If a non-significant variable is found, it is removed from the model.

There are two opposing objectives during this process. The first objective is to have a regression model that is as complete and realistic as possible, thus every independent variable that is even remotely related to the dependent variable should be included. The second objective is to include as few as possible independent variables because each irrelevant independent variable decreases the precision of the estimated coefficients and predicted values. Thus, the process becomes a balance between simplicity (as few as possible independent variables) and model fit

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(as many as possible independent variables) (NCSS Statistical Software, 311-1 [*http://www.ncss.com*].

**Pearson *r*-Correlation coefficient**

Correlation coefficients measure the strength of linear association between two variables (Gujurati & Porter, 2009: 20).

It can vary numerically between -1.0 and 1.0. The closer the correlation is to 1.0 or to -1.0 the stronger the relationship between the two variables. A correlation of 0.0 indicates the absence of a relationship.

A positive correlation coefficient means that as variable 1 increases, variable 2 increases, and conversely as variable 1 decreases, variable 2 decreases. A negative correlation means that as variable 1 increases, variable 2 decreases and vice versa (Gujurati & Porter, 2009: 77).

**$R^2$**

The $R^2$ is the square value of the *r*-correlation value. It is also called the coefficient of determination.

The $R^2$ can vary numerically between 0.0 and 1.0. A value for example of 0.65 means 65% of the variation of the dependant variable is accounted for by the model. Thus, it also implies that 35% of the value of the dependent variable is not accounted for by the model.

If the number of variables (which do have a positive correlation with the dependent variable) are increased in the analysis, the $R^2$ value will increase. The danger with adding too many independent variables is that it may also increase the variance of forecast error (Gujurati & Porter, 2009: 493).

**Adjusted *R²***

For comparative purposes the adjusted *R²* is a better measure than the *R²*. The adjusted *R²* value is a calculated value that penalises the analysis model if independent variables are added to increase the *R²* (Gujurati & Porter, 2009: 493). When a variable is added to a model and the adjusted *R²* does not increase, the new variable is explaining no more than would be explained by adding any totally irrelevant random variable (Wolverton, 2009: 296).

**Standard Error of the Estimate**

This is also referred to as the root mean squared error.  It is the standard deviation of the error term (Statistical Package for the Social Sciences [*http:// www.spss.com*]).

When data is normally distributed, it is expected that approximately 67% of the data lie within ± 1 standard deviation of the mean (Australian Property Institute, 2015: 471)

An underlying assumption of regression models is that the error terms are normally distributed (Australian Property Institute, 2015: 487).

**COD (Coefficient of Dispersion)**

According to the IAAO (2013: 13) "the most generally useful measure of variability or uniformity is the COD. The COD measures the average percentage deviation of the assessed values to the selling prices, from the median ratio (assessed value to selling price) and is calculated by the following steps:

1. subtract the median from each ratio

2. take the absolute value of the calculated differences

3. sum the absolute differences

4. divide by the number of ratios to obtain *the average absolute deviation*

5. divide by the median

6. multiply by 100

The COD has the desirable feature that its interpretation does *not* depend on the assumption that the ratios are normally distributed".
The IAAO Standard on Mass Appraisal of Real Property (2013: 12) states that the most important measurement for uniformity is the COD.

Measures of dispersion facilitate comparisons of variability among two or more data sets (Wolverton, 2009: 76)

According to Wolverton (2009: 86) the COD is often used as a measure of uniformity in tax assessment studies.

He concluded by stating that coefficients of less than or equal to 15% are considered to be indicative of good uniformity, while higher coefficients are acceptable in extremely heterogeneous market areas.

### *F*-test

The *F*-test is a test to determine the overall significance of the estimated regression analysis It indicates how significant are the results of the Multiple Regression, given the number of independent variables used in the analysis (Gujurati & Porter, 2009: 240 -242).

There is an intimate relationship between the $R^2$ value and the *F*-value. When $R^2 = 0$ then $F = 0$ and when $R^2 = 1$ then *F* is infinite. Thus, the *F*-test is also a test of significance of the *R.*

*F*-test indicates a significant regression analysis it means that the values the model predicts are more accurate than simply the mean of the sample (Appraisal Institute, 2013: 734).

## Durbin-Watson

Auto correlation is tested by way of the Durbin-Watson test. The value is always between 0 and 4. A value of 2 means that there is no autocorrelation in the sample. Values approaching 0 indicate positive autocorrelation and values toward 4 indicate negative autocorrelation (Gujurati & Porter, 2009: 434 - 435).

Autocorrelation is the measure of a correlation between the error terms (Gujurati & Porter, 2009: 412).

An underlying assumption of regression models is that the error terms are independent (Australian Property Institute, 2015: 487).

## Multicollinearity

"In an ideal world regression coefficients on each explanatory variable would fully and independently reflect the relationship between the explanatory variable and the response variable. This ideal is seldom achieved, however" (Wolverton, 2009: 308).

Multicolinearity is when two or more independent variables have a strong correlation to each other. This implies that they overlap strongly in measuring the same attribute.

The use and interpretation of a multiple regression model depend on the assumption that the independent variables are not strongly interrelated (Australian Property Institute, 2015: 487)

## VIF

The speed with which variances of a variable increases can be seen with the VIF (Variance-inflatory factor). It shows how the variance of a variable is inflated by the presence of multicolinearity. The extent of colinearity increases as the variance of a variable increases (Gujurati & Porter, 2009: 328).

The IBM SPSS program measures multicolinearity with the VIF index. If there is no colinearity the VIF value will be 1, and it reaches infinity as the colinearity increases. As a rule of thumb, if the value of the VIF index exceeds 10, that variable is highly colinear (Gujurati & Porter, 2009: 340).

**Heteroscedasticity**

This tests the variance of errors over a sample. If the variance of error is unequal, the sample is heteroscedastic (Gujurati & Porter, 2009: 65).

It can be visually evaluated. When a graph of the regression analysis shows a systematic narrowing or widening of the range of the estimated values, it is an indication of heteroscedasticity (Australian Property Institute, 2015: 487 - 488).

An underlying assumption of regression models is that the variance of the error is homoscedastic, meaning the variance of the errors is equal (Australian Property Institute, 2015: 487).

**Accuracy requirement**

As discussed in Chapter 3 (paragraph 3.4):

1. When the purpose of the valuation is for purchase, sale, expropriation and the division of assets, a high degree of accuracy is required.
2. When the purpose is for the levying of assessment rates, granting of mortgage bonds, and insurance of improvements then a fair degree of accuracy is required. However, the terms "high degree" and "a fair degree" of accuracy are not quantified.
3. Rossini & Kershaw (2008: 8) concluded in their study that for a "Reasonable level of acceptance" of accuracy, the AVM should have a minimum of 90% of the individual estimates within a 20% accurate range and the COD (Coefficient of Dispersion) should be less than 10.

   They also stated that if only 80% of the individual estimates are within a 20% accurate range and the COD is 13, the AVM is "of no real value to users".

Based on the above information, the researcher concluded that a COD of less than 10% and a 90% of individual estimates within 20% accuracy qualifies as a high degree of accuracy and a COD of 10% - 15% and 80% of individual estimates within 20% accuracy as indicative of a fair degree of accuracy.

## 4.3 A STEPWISE DEVELOPMENT AND DISCUSSION OF REGRESSION MODELS

### 4.3.1 Data acquisition and locality

The data consisted of 15 valuations, plus three comparable transactions per valuation. Thus, a total of 15 valuations plus 45 real transactions, giving 60 data sets regarding 60 farms.

A quantity of 60 observations and 10 independent variables, gives a ratio of 6:1 (observations: independent variables), which is considered to be sufficient. A ratio of 4:1 is considered the minimum (Australian Property Institute, 2015: 489).

The area consists of the JR, KR, KQ, LR, LS and MT registration divisions. It is the western area of the Limpopo province. It can be described as the area north of the road from Bela-Bela (Warmbaths) to Northam, and west of the road from Bela-Bela (Warmbaths) to Makhado (Louis Trichardt). The only exception is four farms that are close to Letsitele in the eastern part of the Limpopo province. See Annexure A(ii).

The farms are primarily located in the eco-zone "Mixed Bushveld ", as classified by the South African National Biodiversity Institute (2005: 26). Eco-zone "Mixed Bushveld" is described as: "An altitude of 700 - 1 100 m; rainfall 300 - 500 mm; mostly in the form of thunderstorms. The summers are hot, reaching temperatures of 35 °C and more by day, with only occasional frost during winter nights. Due to the low rainfall, grasses do not form dense uniform stands. Grass types are mainly a mix between types with a higher grazing value and types with a lower grazing value".

### 4.3.2 Variables used

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See Annexure A(i) and A(ii) for the detailed information regarding the values of all the variables.

The researcher analysed 10 independent variables in seven different regression analysis models.

### 1.) Date

The transactions that were used in the data spanned over a period of six years, namely from 2009 until 2015. Transactions that took place in 2009 were given a numerical number of 7. Those in 2010 were given a 6, those in 2011 a 5 and so forth. Therefore, the data used in this research is time series data. Gujurati & Porter (2009: 21) describe it as data that were collected over a period of time.

### 2.) Size

The largest farm is 2,004 hectares and the smallest farm is 35 hectares in extent. Farms smaller than 35 hectares were not included in the data. The reason is that a property smaller than 35 hectares can be considered a smallholding rather than a farm.

A smallholding differs substantially from farms in the factors that drive supply and demand. Social forces, economic circumstances, environmental conditions and government regulations influence farm values substantially different from how it influences smallholding values.

Because this research aimed to develop possible regression models for farms, the smallholding size properties were excluded.

3.) DVI  (Depreciated Value of Improvements)

The valuation approach that was used to value the 60 farms is the Depreciated Replacement Cost method.

The Appraisal Institute, (2000: 43) described this method as being based on the premise that an informed buyer of property would not pay more for a property than the cost of the land, plus the current cost of replacing the improvements less the applicable depreciation from all causes.

Part of this approach is to estimate the value that the improvements contribute to the market value of the farm.

According to the method De Leeuw (2003: 7-9) described, there are four components of depreciation that should be taken into account, in order to arrive at the contributory value.

1. Physical depreciation, may be equated to the cost of repairing those components of the structure to a pro rata proportion of the realistic lifespan of the structure.
2. Functional obsolescence, occurs when the existing structure is lacking in terms of its use when compared to a modern structure.
3. Economic obsolescence, occurs when a structure cannot produce the same economic results as is expected in the market place.
4. Purchaser resistance occurs when for example a purchaser is buying a farm with a building he does not really need, or the building has excessive space such as a mansion on a farm. The DVI value could possibly have a large effect on the total value of the farm.

Pienaar (2015: 347) commented that 60% is a common total depreciation factor, for buildings on farms. The underlying principle in the depreciated replacement cost approach is that the cost of a building does not represent the value of the building. The replacement cost is only the starting point of the calculation, from which the correct depreciation for each of the components should be deducted.

In the sample of 60 farms, the percentage of the DVI in relation to total value was 52% in the highest case and 2% in the lowest case. The average was 17%. Therefore, if the DVI is undervalued or overvalued it has a large negative influence on the accuracy of the estimated total value of the farm.

### 4.) <u>Grazing</u>

The condition (quantity and quality) of the grass on each specific farm was indicated. The condition refers to how well the grass was managed by not allowing overgrazing to take place (Van Oudtshoorn, 1991: 43).

A value of 1 was given to poor grazing (overgrazing took place), a value of 2 for average (the same as the general condition of the area) and 3 for above average (the grass condition is conserved).

### 5.) <u>Ha/LSU</u>

The hectare per livestock unit is a ratio that was calculated by the Department of Agriculture. It indicates how many hectares a farmer needs, in a specific area, to maintain one livestock unit. A livestock unit consist of a 450 kg cow (AGIS: <u>*http://www.agis.agric.za*</u>).

This calculation took into account the long-term average rainfall of the area and the quality of natural grass. Thus, it is an indication of the carrying capacity of the veld in a specific area and this indicates the potential economic productivity of a farm (Van Oudtshoorn, 1991: 44).

The more hectares needed to carry one LSU, the less productive is the land.

### 6.) <u>Irrigation ha and Irrigation value / ha</u>

The irrigation hectare variable indicates the number of hectares under irrigation. It means that it is lawful to irrigate the number of hectares and that the area is properly cleared of bush, cultivated and equipped with mainlines.

The irrigation value / ha is the total value of the irrigation divided by the number of hectares.

### 7.) <u>Town distance</u>

The distance from town was calculated as the shortest distance by road.

A distance of less than 10 km was given a value of 1, 10 to 20 km a value of 2, 20 to 40 km a value of 3, 40 to 60 km a value of 4 and over 60 km a value of 5.

Close proximity to a town implicates easy access to schools, shopping centres, medical facilities and farming input suppliers, such as the local agricultural cooperative.

### 8.) <u>Tourism</u>

This indicates if there is any infrastructure on the farm to use as a tourism income generating resource such as chalets or a lodge. If there are any tourism facilities it was indicated by a value of 1 and if not, it was indicated by the value of 0.

### 9.) <u>Game fence</u>

This indicates if the farm has a proper 2,4 metre high (Bothma, 1986: 51) game fence on the boundaries. If it does have a game fence it was indicated by a value of 1 and if not, it was indicated by the value of 0.

10.) <u>Topography</u>

This variable refers to the physical features of the farm. Pienaar stated (2015: 73) that if the physical features suit the potential buyer he will be willing to pay more and vice versa.

For example, a farm with very steep slopes is not ideal for cattle farming. A farm that has less than 30% (of the total area) mountainous terrain, was given a value of 1, 30% to 70% a value of 2 and more than 70% of total area a value of 3.

### 4.3.3 The stepwise process

The researcher did not follow the sequence that the SPSS program automatically follows with a stepwise regression process. The researcher opted for a manual process where he has the opportunity to use both statistical indicators as well as his own experience of more than 30 years exposure to farms and farming, to decide which independent variables to eliminate during each step.

## Model 1

Dependent variable: Total Value

Independent variables: all 10 of the above-mentioned independent variables.

<u>Model summary.</u>

<u>Table 1.</u>

| Model | $R$ | $R^2$ | Adjusted $R^2$ | Std. Error of the Estimate | Durbin-Watson |
|-------|-----|-----|-----|-----|-----|
| 1 | 0.945 | 0.893 | 0.850 | *R* 1 748 826 | 1.915 |

The $R^2$ value of 0.893 is fairly high. It means that 89.3% of the variation of the dependent variable is accounted for by the model.

The adjusted $R^2$ value of 0.85 implies there is 15% of the variation is not accounted for by the model.

The standard deviation of the error term (value estimates) indicates that approximately 33% of the individual estimates differs more than $R$1748826 from the real value (if the data is normally distributed). These approximate 33% value estimates, are inaccurate with a large amount of money.

The COD (Coefficient of Dispersion) is 14%. This is lower than the maximum COD of 15%, which is the requirement for fair accuracy.

However, 23 individual farm estimates, out of the sample of 60 farms, have an error term of more than 20%. Therefore, only 62% of the individual estimates have an error term less than 20%. This indicates that this model is in fact not fairly accurate.

The significance points of the Durbin-Watson $d$ statistic is $d$(lower) = 0.913 and $d$(upper) = 2.383 at the 0.05 level of significance. The Durbin-Watson value of 1.915 falls between the $d$(upper) and the 4-$d$(upper) parameters thus it indicates that the value lies in the zone of no autocorrelation present (Gujurati & Porter, 2009: 435 & 888).

ANOVA

Table 2.

| Model 1 | df | $F$ | p-Significance |
|---|---|---|---|
| Regression | 17 | 20.642 | .000 |
| Residual | 42 | | |
| Total | 59 | | |

The df (degrees of freedom) of 17 and 42 indicates that for a $P$-value of 0.01 the critical $F$-value is 2.52 (Gujurati & Porter, 2009: 884).

The calculated $F$-value of 20.6 is more than eight times the critical $F$-value of 2.52 and therefore the level of significance of the results of the multiple regression model, given the number of independent variables used in the analysis, is high.

Overall the model is statistically significant (F = 20.6, p = .000)

Regression Correlations and Coefficients

Table 3.

| Independent variable | VIF | Pearson correlation | t-Value | p-Significance |
|---|---|---|---|---|
| Grazing | 1.773 | 0.166 | -.366 | .716 |
| Date | 2.779 | -0.263 | -1.689 | .099 |
| DVI | 1.760 | 0.512 | 4.000 | .000 |
| Size | 2.363 | 0.606 | 9.641 | .000 |
| Ha / LSU | 9.161 | -0.139 | -1.568 | .124 |
| Irrigation ha | 1.255 | 0.450 | 8.340 | .000 |
| Town distance | 2.552 | 0.245 | -.144 | .910 |
| Tourism | 2.934 | 0.201 | .347 | .730 |
| Game fence | 2.449 | 0.193 | .476 | .636 |
| Topography | 1.488 | -0.039 | 2.099 | .042 |
| Vaalwater | 5.349 | 0.103 | -.870 | .389 |
| Mookgopong | 3.348 | -0.232 | -1.428 | .161 |
| Alldays | 1.633 | -0.161 | -1.512 | .138 |
| Letsitele | 4.967 | 0.253 | -1.191 | .241 |
| Bela-Bela | 3.743 | 0.085 | .545 | .588 |
| Makhado | 3.000 | -0.119 | -2.243 | .030 |
| Lephalale | 2.276 | 0.160 | -.974 | .335 |

The VIF (variance-inflating factor) values are all well below 10, indicating that there is little or no multicolinearity present.

The Ha/LSU variable is the highest with a VIF value of 9.161 which is still below 10. A value of more than 10 indicates high multicolinearity.

The Size variable with a value of 0.606 has the highest correlation, the DVI variable with a value of 0.512 has the second highest correlation and the "irrigation ha" variable with a value of 0.450 has the third highest correlation.

The Topography independent variable has the lowest correlation.

The Date variable has a negative correlation, because the more years back the transaction happened, the lower the impact is on the dependent variable. Thus, it demonstrates that the price of the farms increased over time.

The Ha/LSU variable has a negative correlation, because as the number of hectares to sustain one livestock unit increases, the value of the farms decreases. Thus, it

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demonstrates that the price of the farms decreases when the carrying capacity decreases, which confirms logic market value expectation.

The independent variables DVI and Irrigation ha have both a p-value of .000, which indicates 100% probability of significance that the dependent variable is dependent on these two independent variables. Both the t-values are statistically significant at the p = 0.001 level.

Topography with .042 and Makhado with .030 have values with a higher than 95% probability of significance. Their t-values indicates statistically significance at the p = 0.025 level..

Town distance with p = 0.0910 has a less than 10% probability of significance. It has the lowest significance. The t-value is only -.144, which is statistically insignificant at a p = 0.25 level.

The graph of the regression analysis does not show a systematic narrowing or widening of the range of the estimated values, thus the model is homoscedastic.

Conclusion regarding Model 1

Although the COD of 14% is within the maximum of 15, only 62% of individual estimates are within 20% accuracy, indicating that the model is not fairly accurate.

There is a possibility that the model is accurate enough for the purpose of preliminary investigations or budget purposes. However, great care should be taken to avoid pitfalls because of the relative inaccuracy of the model.

## Model 2

Dependent variable: Total Value

The independent variable Town Distance was excluded in this model, because it had the lowest probability of significance and the lowest t-value in model 1..

Model summary.

Table 4.

| Model | R | R² | Adjusted R² | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 2 | 0.945 | 0.893 | 0.853 | R 1 728 640 | 1.914 |

The $R^2$ value of 0.893 is the same as in Model 1. It means that 89.3% of the variation of the dependent variable, is accounted for by the model.

The adjusted $R^2$ value of 85.3% is only 0.003 higher than Model 1. It implies there is 14.7% of the variation is not accounted for by the model.

The standard deviation of the error term of $R$ 1 728 640 is very similar to the amount in Model 1. It indicates that approximately 33% of the individual estimates differs more than $R$1 728 640 from the real value (if the data is normally distributed). These approximate 33% value estimates are inaccurate with a large amount of money.

The COD is 17%, which is higher than the COD of Model 1. It is also higher than the maximum COD of 15%, which is required for fair accuracy.

Furthermore, 22 individual farm estimates (out of the sample of 60 farms) have an error term of more than 20%. Thus, only 63% of the individual estimates have an error term of less than 20%. This also indicates that this model is not fairly accurate.

The significance points of the Durbin-Watson $d$ statistic is $d$(lower) = 0.951 and $d$(upper) = 2.330 at the 0.05 level of significance. The Durbin-Watson value of 1.914 falls between the $d$(upper) and the 4-$d$(upper) parameters, thus it indicates that the value lies in the zone of no autocorrelation being present (Gujurati & Porter, 2009: 435 & 888).

ANOVA

Table 5.

| Model 2 | df | *F* | p-Significance |
|---|---|---|---|
| Regression | 16 | 22.446 | .000 |
| Residual | 43 | | |
| Total | 59 | | |

The *F*-value is marginally higher than in Model 1.

The df of 16 and 43 indicates that for a *P*-value of 0.01 the critical *F*-value is 2.52 (Gujurati & Porter, 2009: 884).

The calculated *F*-value of 22.446 is close to nine times the critical *F*-value of 2.52 and therefore the level of significance of the results of the multiple regression model (given the number of independent variables used in the analysis) is high. Overall the model is statistically significant (F = 22.4, p = .000)

Regression Correlations and Coefficients

Table 6.

| Independent variable | VIF | Pearson correlation | t-Value | p-Significance |
|---|---|---|---|---|
| Grazing | 1.770 | -.263 | -.366 | .716 |
| Date | 2.526 | .512 | -1.829 | .074 |
| DVI | 1.755 | .606 | 4.060 | .000 |
| Size | 2.023 | -.139 | 10.494 | .000 |
| Ha / LSU | 9.059 | .450 | -1.607 | .115 |
| Irrigation ha | 1.245 | .201 | 8.481 | .000 |
| Tourism | 2.875 | .193 | .372 | .712 |
| Game fence | 2.301 | -.039 | .468 | .642 |
| Topography | 1.453 | .103 | 2.167 | .036 |
| Vaalwater | 5.349 | -.232 | -.881 | .383 |
| Mookgopong | 3.248 | -.094 | -1.447 | .155 |
| Alldays | 1.449 | -.161 | -1.582 | .121 |
| Letsitele | 4.946 | .253 | -1.214 | .231 |
| Bela-Bela | 3.736 | .085 | .547 | .587 |
| Makhado | 2.660 | -.119 | -2.369 | .022 |
| Lephalale | 2.259 | .160 | -1.000 | .323 |

The VIF values are all well below 10, indicating that there are little or no multicolinearity present.

The Ha/LSU variable is the highest with a VIF value of 9.059 which is still below 10. A value of more than 10 indicates high multicolinearity.

The Pearson correlation values are similar to the values of Model 1 therefore the comments made in Model 1 are also applicable to Model 2.

The independent variables DVI, size and irrigation ha have p-values of .000, which indicates 100% probability of significance. All the t-values are statistically significant at the $p = 0.001$ level.

Topography with .036 and Makhado with .022 have values with a higher than 95% probability of significance. Their t-values indicates statistically significance at the $p = 0.025$ level..

Grazing with a $p = 0.716$ has only a 28.4 % probability of significance. It has the lowest significance. The t-value is only -.366 which is statistically insignificant at a $p = 0.25$ level.

The graph of the regression analysis does not show a systematic narrowing or widening of the range of the estimated values, thus the model is homoscedastic.


Conclusions regarding Model 2

Although the Town Distance independent variable was excluded in Model 2, the statistical tests and technical indicators of Model 2 are for all practical reasons the same as for Model 1. The possible explanation for this is that there are too many other variables that have a large effect on a farm price, thus the effect of the Town Distance variable is negligible.

The COD of 17% and the fact that only 63% of individual estimates are within 20% accuracy, indicate that this model is not fairly accurate.

There is a possibility that the model is accurate enough for the purpose of preliminary investigations or budget purposes. However, great care should be taken to avoid pitfalls because of the relative inaccuracy of the model.

## Model 3

Dependent variable: Total Value

Both the independent variables Town Distance and Grazing were excluded in this model, because both these two independent variables had low values of probabilities of significance and the lowest t-values in Model 1 and model 2.

Model summary.

Table 7.

| Model | $R$ | $R^2$ | Adjusted $R^2$ | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 3 | 0.945 | 0.893 | 0.856 | R 1 711 542 | 1.911 |

The $R^2$ value of 0.893 is the same as in Model 2. It means that 89.3% of the variation of the dependent variable is accounted for by the model.

The adjusted $R^2$ value of 85.6% is marginally higher than Model 2 and Model 1. The fact that the adjusted $R^2$ is higher but that the number of variables is lower indicates that in the previous Models variables were used that did not explain more than what is explained by adding any totally irrelevant random variable.

The standard deviation of the error term of $R$ 1 711 542 is very similar to the amount in Model 2. It indicates that approximately 33% of the individual estimates differs more than $R$ 1 711 542 from the real value (if the data is normally distributed). These approximate 33% value estimates, are inaccurate with a large amount of money.

The COD is 18%, which is higher than Model 1. It is higher than the maximum COD of 15% for fair accuracy. Furthermore, 24 individual farm estimates (out of the sample of 60 farms) have an error term of more than 20%. Thus, only 60% of the

individual estimates have an error term of less than 20%. Both these values indicate that this model is not fairly accurate.

The significance points of the Durbin-Watson $d$ statistic is $d$(lower) = 0.990 and $d$(upper) = 2.278 at the 0.05 level of significance. The Durbin-Watson value of 1.911 falls between the $d$(upper) and the 4-$d$(upper) parameters thus, it indicates that the value lies in the zone of no autocorrelation present (Gujurati & Porter, 2009: 435 & 888).

ANOVA

Table 8.

| Model 3 | df | F | p-Significance |
|---|---|---|---|
| Regression | 15 | 24.414 | .000 |
| Residual | 44 | | |
| Total | 59 | | |

The $F$-value is marginally higher than in Model 2.

The df of 15 and 44 indicates that for a $P$-value of 0.01 the critical $F$-value is 2.52 (Gujurati & Porter, 2009: 884).

The calculated $F$-value of 24.414 is more than nine times the critical $F$-value of 2.52 and therefore the level of significance of the results of the multiple regression model, given the number of independent variables used in the analysis, is high.

Overall the model is statistically significant (F = 24.4, p = .000)

Regression Correlations and Coefficients

Table 9.

| Independent variable | VIF | Pearson correlation | t-Value | p-Significance |
|---|---|---|---|---|
| Date | 2.523 | -0.263 | -1.836 | .073 |
| DVI | 1.730 | 0.512 | 4.085 | .000 |
| Size | 1.856 | 0.606 | 10.953 | .000 |
| Ha/LSU | 7.902 | -0.139 | -1.597 | .117 |
| Irrigation ha | 1.227 | 0.450 | 8.672 | .000 |
| Tourism | 2.873 | 0.201 | .365 | .717 |
| Game fence | 2.259 | 0.193 | .426 | .672 |
| Topography | 1.450 | -0.039 | 2.207 | .033 |
| Vaalwater | 4.471 | 0.103 | -.814 | .420 |
| Mookgopong | 2.676 | -0.232 | -1.439 | .157 |
| Alldays | 1.439 | -0.161 | -1.572 | .123 |
| Letsitele | 3.910 | 0.253 | -1.189 | .241 |
| Bela-Bela | 3.396 | 0.085 | .697 | .489 |
| Makhado | 2.300 | -0.119 | -2.427 | .019 |
| Lephalale | 1.694 | 0.160 | -.952 | .346 |

The VIF values are all well below 10, indicating that there are little or no multicollinearity present.

The Pearson correlation values are similar to the values of Model 1 therefore the comments made in Model 1 are also applicable to Model 3.

The independent variables DVI, size and irrigation ha have p-values of .000, which indicates 100% probability of significance. All the t-values are statistically significant at the p = 0.001 level.

Topography with .033 and Makhado with .016 have values with a higher than 95% probability of significance. Their t-values indicates statistically significance at the p = 0.025 level..

Tourism with a p = 0.717 has a low 28.3 % probability of significance. It has the lowest significance of probability of the independent variables. The t-value is only -.365 which is statistically insignificant at a p = 0.25 level.

The graph of the regression analysis does not show a systematic narrowing or widening of the range of the estimated values, thus the model is homoscedastic.

Conclusions regarding Model 3

Although the Town Distance and the Grazing independent variables were excluded in Model 3, the adjusted $R^2$ and the $F$-value of Model 3 are marginally higher than in Model 2. Therefore, Model 3 is preferable over Model 1and Model 2.

The fact that the dependent variable indicated very little dependence on the grazing (veld condition)  and town distance independent variables is in line with the comments that Pienaar (2015: 126) made. He stated the possible explanation for this as being too many other variables which have a large effect on a farm's price, thus, the effect of the grazing variable is negligible.

The COD of 18% and the fact that only 60% of individual estimates are within 20% accuracy, indicate that this model is not fairly accurate.

There is a possibility that the model is accurate for the purpose of preliminary investigations or budget purposes. However, great care should be taken to avoid pitfalls because of the relative inaccuracy of the model.

## Model 4

Dependent variable: Vacant Land Value

Independent variables: DVI and Grazing were excluded in this model. Grazing has the lowest significance of the independent variables.

The reason for using Vacant Land Value as the dependent variable is that the DVI (Depreciated Value of Improvements) has a very high probability of significance (p = .000 and t = 4.085)   on the dependent variable.

The value of the independent variable DVI depends on how accurate the valuer estimated these values.

Because the value of the DVI is not included in the Vacant Land Value the DVI was also excluded as an independent variable.

Model summary.

Table 10

| Model | $R$ | $R^2$ | Adjusted $R^2$ | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 4 | 0.931 | 0.867 | 0.822 | $R$ 1 713 133 | 1.910 |

The $R^2$ value of 0.867 is marginally lower than in Model 2. It means that 86,7% of the variation of the dependent variable, is accounted for by the model.

The adjusted $R^2$ value of 82.2% is also marginally lower than Model 3. It implies there is 17.8% of the variation, is not explained by the model.

The standard deviation of the error term of R 1 713 133 is very similar to the number in Model 3.

The COD is 20%, which is higher than Model 1. It is higher than the maximum COD of 15% for fair accuracy. Furthermore, 28 individual farm estimates (out of the sample of 60 farms) have an error term of more than 20%. Thus, only 53% of the individual estimates have an error term of less than 20%. Both these values indicate that this model is not fairly accurate.

The significance points of the Durbin-Watson $d$ statistic is $d$(lower) = 0.990 and $d$(upper) = 2.278 at the 0.05 level of significance. The Durbin-Watson value of 1.910 falls between the $d$(upper) and the 4-$d$(upper) parameters thus, it indicates that the value lies in the zone of no autocorrelation present (Gujurati & Porter, 2009: 435 & 888).

ANOVA

Table 11.

| Model 4 | df | F | p-Significance |
|---|---|---|---|
| Regression | 15 | 19.134 | .000 |
| Residual | 44 | | |
| Total | 59 | | |

The *F*-value is marginally lower than in Model 3.

The df of 15 and 44 indicates that for a *P*-value of 0.01 the critical *F*-value is 2.52 (Gujurati & Porter, 2009: 884).

The calculated *F*-value of 19.134 is more than seven times the critical *F*-value of 2.52 and therefore the level of significance of the results of the multiple regression model, given the number of independent variables used in the analysis, is high.

Overall the model is statistically significant (F = 19.1, p = .000)

Regression Correlations and Coefficients

Table 12.

| Independent variable | VIF | Pearson correlation | t-Value | p-Significance |
|---|---|---|---|---|
| Date | 2.730 | -0.221 | -1.770 | .084 |
| Size | 2.173 | 0.657 | 10.168 | .000 |
| Ha/LSU | 8.032 | -0.109 | -1.568 | .124 |
| Irrigation ha | 1.117 | 0.432 | 9.167 | .000 |
| Tourism | 2.202 | 0.137 | .568 | .573 |
| Game fence | 2.346 | 0.183 | .399 | .692 |
| Topography | 1.479 | -0.035 | 2.151 | .037 |
| Vaalwater | 4.773 | 0.104 | -.813 | .421 |
| Mookgopong | 2.742 | -0.255 | -1.458 | .152 |
| Alldays | 1.563 | -0.108 | -1.596 | .118 |
| Letsitele | 3.869 | 0.213 | -1.144 | .259 |
| Bela-Bela | 3.389 | 0.090 | .724 | .473 |
| Makhado | 2.567 | -0.117 | -2.369 | .022 |
| Lephalale | 1.597 | 0.218 | -1.048 | .300 |
| Town Distance | 2.539 | 0.304 | -.119 | .906 |

The VIF values are all well below 10, indicating that there are little or no multicolinearity present.

The Pearson correlation values are similar to the values of Model 1, therefore the comments made in Model 1 are also applicable to Model 4.

The independent variables size and irrigation ha have p-values of .000, which indicates 100% probability of significance. All the t-values are statistically significant at the $p = 0.001$ level.

Date with .084, topography with .037 and Makhado with .022 have values with a higher than 90 % probability of significance. Their t-values indicates statistically significance at the $p = 0.05$ level.

Game fence with a $p = 0.692$ has a 30.8 % probability of significance. It has the lowest significance of the independent variables. The t-value is only -.399 which is statistically insignificant at a $p = 0.25$ level.

The graph of the regression analysis does not show a systematic narrowing or widening of the range of the estimated values, thus the model is homoscedastic.

Conclusions regarding Model 4

The dependent variable is Vacant Land Value and the independent variables DVI and Grazing were excluded in Model 4.

The adjusted $R^2$ and the $F$-value of Model 4 are marginally lower than in Model 3. Therefore, Model 3 is preferable over Model 1, Model 2 and Model 4.

The COD of 20% and the fact that only 53% of individual estimates are within 20% accuracy, indicate that this model is not fairly accurate.

There is a possibility that the model is accurate for the purpose of preliminary investigations or budget purposes. However, great care should be taken to avoid pitfalls because of the relative inaccuracy of the model.

### Model 5

Dependent variable: Vacant Land Value

Independent variables: All the transactions that have Thabazimbi as its closest town. This implies that the geographic area is much more homogenous than the geographic area in Models 1-4.

The DVI variable is also excluded because the dependent variable is the Vacant Land Value and therefore, does not include the value of the DVI.

All the other independent variables are included in this model. The aim of this model is to do a regression analysis regarding an area that is as homogenous as possible, and which is not influenced by the DVI, while using all the independent variable data available.

Model summary.

Table 13.

| Model | $R$ | $R^2$ | Adjusted $R^2$ | Std. Error of the Estimate | Durbin-Watson |
|-------|-----|-------|----------------|----------------------------|---------------|
| 5 | 0.910 | 0.829 | 0.794 | $R$ 1 843 643 | 1.777 |

The $R^2$ of 0.829 and the adjusted $R^2$ value of 0.794  is lower than the values of Model2 3 and 4.

The fact that that the adjusted $R^2$ value is lower than in previous models indicates that there are irrelevant independent variables in the analysis. It implies that only 79.4% of the variation in the value estimate is accounted for by the model. This is lower than the value in Model 3.

However the standard deviation of the error term, remains high at a value of $R$ 1 843 643.

The COD is 23%, which is higher than Model 1. It is higher than the maximum COD of 15% for fair accuracy and 10 individual farm estimates, out of the sample of 24 farms, have an error term of more than 20%. Thus, only 58% of the individual

estimates have an error term of less than 20%. This indicates that this model is not fairly accurate.

The significance points of the Durbin-Watson $d$ statistic is d(lower) = 0.506 and $d$(upper) = 2.613 at the 0.05 level of significance. The Durbin-Watson value of 1.777 falls between the $d$(upper) and the 4-$d$(upper) parameters thus, it indicates that the value lies in the zone which indicates that no autocorrelation is present (Gujurati & Porter, 2009: 435 & 888).

ANOVA

Table 14.

| Model 5 | df | _F_ | p-Significance |
|---|---|---|---|
| Regression | 9 | 23.860 | .000 |
| Residual | 14 | | |
| Total | 23 | | |

The $F$-value is the highest of all the models.

The df  of 10 and 49 indicates that for a $P$-value of 0.01 the critical $F$-value is 3.40 (Gujurati & Porter, 2009: 884).

The calculated $F$-value of 23.860 is seven times the critical $F$-value of 3.40 and therefore the level of significance of the results of the multiple regression model, given the number of independent variables used in the analysis, is high.

Overall the model is statistically significant (F = 23.8, p = .000)

Regression Correlations and Coefficients

Table 15

| Independent variable | VIF | Pearson correlation | t-Value | p-Significance |
|---|---|---|---|---|
| Date | 1.367 | -0.221 | -2.847 | .006 |
| Size | 1.976 | 0.657 | 9.358 | .000 |
| Ha/LSU | 1.364 | 0.134 | -2.724 | .009 |
| Irrigation ha | 2.529 | 0.432 | 8.553 | .000 |
| Tourism | 1.115 | -0.109 | .349 | .729 |
| Game fence | 1.874 | 0.304 | -.304 | .763 |
| Topography | 2.022 | 0.137 | 2.254 | .029 |
| Town Distance | 2.011 | 0.183 | 1.246 | .219 |
| Grazing | 1.268 | -0.035 | .365 | .717 |
|  |  |  |  |  |

The VIF values are all well below 10 thus, indicating that there are little or no multicolinearity present.

The Size variable with a value of 0.657 has the highest correlation. The Irrigation ha variable with a value of 0.432 has the second highest correlation. This indicates how the presence of irrigation adds to the value of a farm.

The independent variables size and irrigation ha have p-values of .000, which indicates 100% probability of significance. Both their t-values are statistically significant at the p = 0.001 level.

Date with .006, ha / LSU with .009 and Topography with .029 have values with a higher than 95 % probability of significance. Their t-values indicates statistically significance at the p = 0.025 level.

Game fence with p = 0.763, tourism with p = .729 and grazing with p = .717 have a the lowest probability of significance. Their t-values indicates statistically insignificance at a p = 0.25 level.

The graph of the regression analysis does not show a systematic narrowing or widening of the range of the estimated values, thus the model is homoscedastic.

Conclusions regarding Model 5

The adjusted $R^2$ and the $F$-value of Model 5 are substantially lower than Models 3 and 4.

The COD of 23% and the fact that only 58% of individual estimates are within 20% accuracy, indicate that this model is not fairly accurate.

The Durbin-Watson test, the multicolinearity and the heteroscedasticity tests of the model satisfy the minimum requirements.

There is a possibility that the model is accurate for the purpose of preliminary investigations or budget purposes. However, great care should be taken to avoid pitfalls because of the relative inaccuracy of the model.

## Model 6

Dependent variable: Vacant Land Value / ha

Independent variable: All the transactions that have Thabazimbi as its closest town. This implies that the geographic area is much more homogenous than the geographic area in Models 1-4.

The DVI variable is excluded because the dependent variable is the Vacant Land Value/ha and therefore, does not reflect the value of the DVI.

All the other independent variables are included in this model.

The aim of this model is to determine if a regression analysis where the dependent has a hectare as unit, and which are in a homogeneous area (Thabazimbi area) will result in more accurate value predictions.

Model summary.

Table 16.

| Model | R | R² | Adjusted R² | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 6 | 0.767 | 0.589 | 0.505 | R 6 867 | 1.799 |

The $R^2$ value of 0.767 and the adjusted $R^2$ of 0.505 is the lowest of all the models. It implies that 49.5% of the variation in value estimate is not accounted for by the model. This is a poor relation between the dependent variable and the independent variables.

The fact that the adjusted $R^2$ is much lower indicates that some of the variables that were used did not explain more than what is explained by adding any totally irrelevant random variable.

The COD is 34%, which is highest of all the models. It is higher than the maximum COD of 15% for fair accuracy and 15 individual farm estimates (out of the sample of 24 farms) have an error term of more than 20%. Thus, only 37% of the individual estimates have an error term of less than 20%. This indicates that this model is inaccurate.

ANOVA

Table 17.

| Model 6 | df | F | p-Significance |
|---|---|---|---|
| Regression | 9 | 7.011 | .000 |
| Residual | 14 | | |
| Total | 23 | | |

The $F$-value is the lowest of all the models.

The df of 10 and 49 indicates that for a *P*-value of 0.01 the critical *F*-value is 3.40 (Gujurati & Porter, 2009: 884).

The calculated *F*-value of 7.011 is 2,1 times the critical *F*-value of 3.40 and therefore the level of significance of the multiple regression model, given the number of independent variables used in the analysis, is reasonably significant.

Overall the model is statistically reasonably significant (F = 19.1, p = .000)

Regression Correlations and Coefficients Model 6.

Table 18.

| Independent variable | VIF | Pearson correlation | t-Value | p-Significance |
|---|---|---|---|---|
| Date | 1.367 | -0.242 | -1.410 | .165 |
| Size | 1.976 | -0.469 | -1.265 | .212 |
| Grazing | 1.364 | -0.012 | .011 | .991 |
| Ha/LSU | 2.529 | 0.051 | .007 | .994 |
| Irrigation ha | 1.115 | 0.553 | 4.444 | .000 |
| Town Distance | 1.874 | -0.371 | -1.214 | .231 |
| Tourism | 2.022 | 0.317 | .184 | .855 |
| Game fence | 2.011 | -0.444 | -1.576 | .121 |
| Topography | 1.268 | 0.214 | 1.010 | .317 |

The negative Date correlation indicates that the value per hectare decreases with the more years since the sale took place. This is expected. The negative Size correlation indicates that the value per hectare decreases with the area of the farm.

Only irrigation ha have a p-value of .000, which indicates 100% probability of significance. The t-value is statistically significant at the p = 0.001 level.

No other independent variable has a p-value of less than .100 which indicates a lower than 90 % probability of significance

Ha / LSU with p = 0.994 and grazing with p = .991 have the lowest probability of significance. Their t-values indicates statistically insignificance at a p = 0.25 level.

The graph of the regression analysis does show a systematic widening of the range of the estimated values, thus the model is heteroscedastic and as such does not satisfy one of the underlying assumptions of regression analysis.

Conclusions regarding Model 6

The adjusted $R^2$, and the COD of 34% of Model 6 are poor.

The COD of 34% and the fact that only 58% of individual estimates are within 20% accuracy, indicate that this model is highly inaccurate.

It cannot be used for any type of valuation.

## Model 7

Dependent variable: Vacant Land Value

Independent variables: reduced to only five, namely: Topography, Irrigation ha, Tourism, Date, Size. These variables have the  lowest p-values and the highest t-values-, as indicated in the Models 1-5.

A quantity of 24 observations and five independent variables, gives a ratio of 5:1 (observations: independent variables), which is considered to be sufficient. A ratio of 4:1 is considered the minimum (Australian Property Institute, 2015: 489).

 All the transactions that do have Thabazimbi as its closest town were used. This implies that the geographic area is as homogeneous as possible (with the data available to the researcher).

The aim of this model is to do a regression analysis regarding an area that is as homogenous as possible, where the most significant independent variables are used and which is not influenced by the DVI.

The reasons for using Vacant Land Value as the dependent variable are twofold:

1. the DVI) has a very high correlation of 0.512 (see the correlation in Model 3) with the Total Value dependent variable.
2. There is uncertainty regarding the accuracy of the estimated DVI values. The values of the DVI depends on how accurate the valuer estimated these values.

Model summary.

Table 19.

| Model | $R$ | $R^2$ | Adjusted $R^2$ | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| 7 | .971 | .943 | .927 | $R$1 055 333 | 1.889 |

The $R^2$ of 0.943 and the adjusted $R^2$ value of 0.927 is the highest of all the Models. This implies a high correlation between the dependent and the independent variables. The fact that the adjusted $R^2$ is higher but that the number of variables is lower indicates that in the previous Models variables were used that did not explain more than what is explained by adding any totally irrelevant random variable.

The standard deviation of the error term of $R$1 055 333, is the lowest of all the Models. It indicates that approximately 33% of the individual estimates differs more than $R$1 055 333 from the real value (if the data is normally distributed).

The COD of the error term is 14%. This is lower than the maximum COD of 15%, which is the requirement for fair accuracy.

Four individual farm estimates (out of the sample of 24 farms) have an error term of more than 20%. Thus, 83% of the individual farm estimates is within 20% from the actual selling price.

Thus, this model is fairly accurate but it still does not satisfy a high degree of accuracy or a "reasonable level of acceptance" according to Rossini & Kershaw (2008: 8).

The significance points of the Durbin-Watson $d$ statistic is $d$(lower) = 0.710 and $d$(upper) = 2.060 at the 0.05 level of significance. The Durbin-Watson value of 1.889 falls between the $d$(lower) and the $d$(upper) parameters. thus it indicates that the value lies in the zone of indecision which means that it is undecided if any autocorrelation is present or not (Gujurati & Porter, 2009: 435 & 888).

ANOVA

Table 20.

| Model 7 | df | *F* | p-Significance |
|---|---|---|---|
| Regression | 5 | 59.614 | .000 |
| Residual | 18 | | |
| Total | 23 | | |

The F-value of 59.614 is the highest of all the models. Overall the model is statistically significant (F = 59.6, p = .000)

The df of 5 and 18 indicate that for a *P*-value of 0.01 the critical *F*-value is 4.25 (Gujurati & Porter, 2009: 884).

The calculated *F*-value of 59.614 is more than 13 times the critical F-value of 2.80 and therefore the level of significance of the results of the multiple regression model, given the number of independent variables used in the analysis, is very high.

Regression Correlations and Coefficients: Model 7.

Table 21.

| Independent variable | VIF | Pearson correlation | t-Value | p-Significance |
|---|---|---|---|---|
| Date | 1.424 | 0.095 | -1.756 | .096 |
| Size | 1.756 | .493 | 9.170 | .000 |
| Irrigation ha | 1.045 | .756 | 14.416 | .000 |
| Tourism | 1.310 | .178 | .424 | .677 |
| Topography | 1.189 | -.072 | 3.305 | .004 |

The VIF values are all well below 10 thus, indicating that there are little or no multicolinearity present.

The independent variables size and irrigation ha have p-values of .000, which indicates 100% probability of significance. Both their t-values are statistically significant at the p = 0.001 level.

The date variable has a low significance with a p-value of 0.096

Topography with .004, have a p-value with a higher than 95 % probability of significance. The t-value indicates statistically significance at the p = 0.025 level.

Tourism with p = 0.677 has the lowest probability of significance. The t-value indicates statistically insignificance at a p = 0.25 level.

The independent variables; Size, irrigation ha and topography have p ≤ .05 values, which indicates a significance of at least 95%. All the t-values are statistically significant at the p = 0.001 level.

However, the tourism variable is insignificant with p = 0.677. The t-value is only -.424 which is statistically insignificant at a p = 0.25 level.

The VIF values are all well below 10 thus, indicating that there are little or no multicolinearity present.

The Irrigation ha variable with a value of 0.756 has the highest correlation. This indicates how valuable is the presence of irrigation to the value of a farm.

The Size variable with a value of 0.493 has the second highest correlation, which indicates the fact that the bigger the farm, the higher is the value. The fact that it is not the highest correlation may be indicative of the phenomenon that the bigger the farm, the lower is the value per hectare.

The Date variable has a slight positive correlation, which indicates that the selling price of farms (in the Thabazimbi area) did not increase over the last six years.

The Topography variable has a negative correlation, because the value of the farms decreases when the farm consists of a substantial area of mountainous terrain Thus, it confirms logic market value expectation.

The graph of the regression analysis did not show a systematic narrowing or widening of the range of the estimated values, thus the model is homoscedastic and therefore satisfies one of the underlying assumptions of regression analysis.

## Conclusions regarding Model 7

The adjusted $R^2$ and the $F$-value of Model 7 are substantially higher than any other Model.

The standard deviation of the error term of $R$1 055 333, is the lowest of all the Models.

The COD of 14% and the 83% individual estimates that are within the 20% accuracy requirement, indicate that this model is fairly accurate

However, it still does not satisfy a high degree of accuracy or a "reasonable level of acceptance", which is defined by Rossini & Kershaw (2008: 8) as a COD of less than 10 and 90% of individual estimates to be within 80% of accuracy.

The Durbin-Watson test, the multicolinearity and the heteroscedasticity tests of the model satisfy the minimum requirements.

## Limitations of Model 7

It covers only a small geographic area, namely the area around Thabazimbi.

One of the biggest limitations of Model 7 is that the dependent variable is the value of the vacant land, thus it is not the total value of the farm. It is the value without the depreciated value of the buildings.

In practice, it seldom happens that a farm has no buildings as improvements, therefore it implies that further research will have to be done to develop a model, which will accurately use variables for the depreciated value of the buildings, to enable the model to estimate the total value of a farm.

The reasons for using Vacant Land Value as the dependent variable are twofold:

1. the DVI has a very high correlation of 0.512 (see the correlation in Model 3) with the Total Value dependent variable.
2. There is uncertainty regarding the accuracy of the estimated DVI values. The values of the DVI depend on how accurate the valuer estimated these values.

## Model 8

A log-linear regression model, based on the same dependent and independent variables that were used in model 7, was developed to determine if the log-linear regression model is more accurate than the linear regression model.

Table 22

| Model | $R$ | $R^2$ | Adjusted $R^2$ | F - value |
|-------|------|------|----------------|-----------|
| 8 | .923 | .852 | .810 | 20.6 |

The adjusted $R^2$ of .852 is significantly lower than the adjusted $R^2$ of .927 in model 7.

The F-value is 20.6 while the F-value of model 7 is 59.6

The COD of the error term of model 8 is 17 %, which is significantly higher than the COD of 14% in model 7.

In model 8 there are only 16 of the 24 estimates that are within the 20% accuracy range. Therefore, only 67% of the estimates are within the 20% accuracy range. In model 7 the estimates has an 83 % accuracy ratio.

Conclusions regarding Model 8

Therefore, the log-linear regression model (model 8) is regarding the most important statistical indicators, inferior to the linear regression model (model 7) and it does not satisfy the accuracy requirements for a fairly accurate model.

Table 23: Summary of Variables used.

| Model | No. of farms in sample | Dependent variable | Independent variables |
|---|---|---|---|
| 1 | 60 | TV | DVI, date, size, grazing, ha/LSU, irrigation ha, town distance, tourism, game fence, topography, all the towns |
| 2 | 60 | TV | As in model 1, without town distance |
| 3 | 60 | TV | As in model 1, without town distance & grazing |
| 4 | 60 | VLV | As in model 1, without grazing & DVI |
| 5 | 24 | VLV | As in model 1, without DVI and with only the Thabazimbi farms. |
| 6 | 24 | VLV / ha | As in model 1, without DVI and with only the Thabazimbi farms. |
| 7 | 24 | VLV | Date, size, irrigation ha, tourism & topography and with only the Thabazimbi farms. |
| 8 | 24 | VLV | Log-linear regression Variables the same as Model 7 |

Legend

TV = Total Value

VLV = Vacant Land Value

VLV / ha = Vacant Land Value / ha

DVI = Depreciated Value of Investment

Table 24: Summary of statistical values

| Model | Adjusted $R^2$ | Std. Error of the Estimate | F- value | COD % | % of individual valuations that are within 20% accuracy |
|---|---|---|---|---|---|
| 1 | 0.850 | R 1 748 826 | 20.6 | 14 | 62 |
| 2 | 0.853 | R 1 728 640 | 22.4 | 17 | 63 |
| 3 | 0.856 | R 1 711 542 | 24.4 | 18 | 60 |
| 4 | 0.822 | R 1 713 133 | 19.1 | 20 | 53 |
| 5 | 0.794 | R 1 843 643 | 23.8 | 23 | 58 |
| 6 | 0.505 | R    6 867 | 7 | 34 | 37 |
| 7 | .927 | R 1 055 333 | 59.6 | 14 | 83 |
| 8 | .852 | | 20.6 | 17 | 67 |

<u>Model 7 yielded the best results.</u>

The aim of Model 7 was to do a regression analysis on an area that is as homogenous as possible, and which is not influenced by the DVI. Furthermore, to use only the five independent variables that have the highest probability of significance, as indicated by their p-values,  in models 1-5.

1. The dependent variable is Vacant Land Value and the independent variables are Date, Size, Irrigation ha, Tourism and Topography.

2. In order to ensure that the area is as homogenous as possible, only the transactions that took place where Thabazimbi is the closest town to the farms were used.

3. The DVI variable is excluded because the dependent variable is the Vacant Land Value and therefore, does not include the value of the DVI.

4. The adjusted $R^2$ value of 0.927 is the highest of all the models. It implies that only 7.3% of the variation in value estimate is not accounted for by the independent variables. This is an excellent statistical value.

5. The standard error of the estimates, is the lowest of all the models.

6. The COD of the error term is 14%, together with model 1 the lowest of all the models.

7. Four individual farm estimates (out of the sample of 24 farms) have an error term of more than 20%. Thus, it implies that 83% of the individual farm estimates are within 20% from the actual selling price. This is the only model that have an accuracy of more than 80% individual estimates within the 20% error term.

8. This model is the only model in this study that is fairly accurate but it still has not achieved a high level of accuracy

9. The Durbin-Watson test, the multicolinearity and the heteroscedasticity tests of the model satisfy the minimum requirements.

## 4.4 CONCLUSION

The fact that a valuer has little if any input when using a MRA, is seen as a double-edged sword. It eliminates human error and bias but takes out of the equation not only the physical property inspection but also the skill, judgement and experience of the valuer.

The results of this stepwise regression analysis showed that it is extremely difficult to have enough appropriate and accurate date available to develop a regression analysis for agricultural property, which satisfies accuracy requirements.

However, Model 7 was developed that does satisfy the accuracy requirements for fairly accurate estimates, but it is not accurate enough to satisfy high accuracy requirements.

In the opinion of the researcher, the Bourhill study and the Steyn study most probably did not develop models that satisfied fairly accurate requirements.

The reasons for the difficulty to acquire sufficient accurate data to be able to develop a MRA (multiple regression analysis) model that is accurate enough to satisfy accuracy requirements, are multifaceted. Many of these reasons are human skills related which are difficult to translate into appropriate and accurate quantitative data in a MRA model:

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1. No two farms are ever exactly the same or entirely homogenous. Suter (1980: 3) commented: "no two farms are ever alike in terms of (1) the basic resources (land, labour, or capital) that are available, (2) the way these resources or factors of production are combined, or (3) in terms of the amounts of various crops and livestock produced".

    This can only be valued with a physical inspection by a professional valuer and will be extremely difficult to translate into appropriate and accurate quantitative data  for use in a MRA model.

2. Suter (1992: 39-41) describes the knowledge and experience a professional farm valuer should have:

    a. He should have considerable technical knowledge about many agricultural things.

    b. Usually, to have been born and reared on a farm.

    c. Usually, he has an agricultural college degree or diploma.

    d. He has acquired skills from agronomy, engineering, animal science, economics, law and psychology.

    e. As he walks a given subject property he has a feel for the soils, topography, drainage, irrigation facilities and the practices influencing the crops raised in the area.

    f. He has a feel for the contribution of various buildings and improvements and whether the farm's resources, as an operating unit, are balanced.

    g. He has a feel for the farm real estate market and for factors such as product prices, costs, earnings, rental rates, government regulations and the idiosyncrasies of both buyers and sellers of farms in his area.

3. There are other reasons that influence farm prices, such as the existence of power line servitudes, water pipeline or canal servitudes and right-of-way servitudes (Pienaar, 2015: 74). The impact that these servitudes can have on

the value of the farm can only be estimated with a physical inspection, by a skilled professional valuer.

4. Bourhill (1998: 80) identified factors such as the number of years of farming experience the buyer has and if the buyer owns the adjoining farm have an impact on the price the buyer is willing to pay.

5. Van Schalkwyk (1992: 62) determined that the correlation between the debt per hectare, the population density and the farm values are so significant that farm values are not a good indicator of farm resource quality. Farm values are highly correlated with the gross farm income. Again these factors are difficult to translate into appropriate and quantitative data for use in a MRA model.

6. As indicated in this study, the depreciated values of improvements have a large and direct correlated influence on the total value of the farm. To acquire sufficient accurate data to substitute a physical inspection, with the associated skill of a professional valuer to determine the correct depreciation percentages to be applied for each individual building, will be difficult and costly.

One way to develop a MRA model (which is as accurate as possible) is to ensure the geographic area is as homogenous as possible thus; the geographic area has to be very small.

This will imply that a multitude of MRA models will have to be developed for every municipal area.

It will be a costly exercise and will therefore be contradictory to one of the supposed advantages of the use of MRA models, namely to be more cost effective than the normal valuation procedure of inspecting the property.

If a MRA model for a larger area has to be developed, the amount of appropriate and accurate data needed will be very large. This will make it even more difficult and costly to acquire such a large volume of data.

All the models except one that were developed during the stepwise regression process are not fairly accurate. Thus, great circumspect should be taken when using MRA models in farm valuations.

The final conclusion is that it is possible to develop MRA models that are fairly accurate. Therefore, if MRA models are currently being used for the municipal valuation of farms, which are not fairly accurate, it should be possible to improve the accuracy. However, maximum accuracy cannot be achieved with MRA models. Thus it cannot replace a valuation done by a skilled and knowledgeable professional valuer, when maximum accuracy is required.

In Chapter 5 the study will be concluded by summarising the complexities of farm valuations, answering the research questions, listing the findings, stating the shortcomings of the developed MRA model and discussing the requirements for further research.

# CHAPTER 5

# CONCLUSION AND RECOMMENDATIONS

## 5.1 INTRODUCTION

Mass valuation is a term which is used when a large number of properties have to be valued, using some kind of computer assistance in order to do the valuation quicker and more cost effectively. It uses common data, standardised models and statistical testing.

The method used is to analyse as many as possible transactions, within a specific homogenous area, and then use this information on the rest of the homogenous area.

**The application of valuation theory in farm valuations**

Agricultural properties are heterogenous in their make-up. Two farms can be adjacent to each other and be of similar size, but they can differ regarding the type of farming practiced, the soil type, terrain, water rights, existence of servitudes and the value of the fixed improvements that enhances the farm's profitability. Thus, the two farms' value will differ substantially.

An important part of the valuation process when valuing an agricultural property is to do a thorough property inspection, in order to verify first hand all the relevant factors and data, which can influence the value of the property. This physical inspection has the distinct advantage that the heterogeneous factors applicable to a specific agricultural property, are taken into proper account.

It is important to understand the factors that influence farm prices and to understand the various unique and distinctive attributes that are inherently part of farms, which should be taken into consideration when valuing agricultural property. It is these

value-influencing factors and distinctive attributes, which cause farm valuations to be complex and make it relatively difficult to satisfy accuracy requirements.

To be a successful professional valuer of a specific agriculture property, one needs very specific valuation knowledge and expertise regarding farms and the farming industry:

1. The valuer has skills regarding agronomy, engineering, animal and crop science, economics, law and psychology.
2. As he walks a given subject property he has a feel for the soils, topography, drainage, irrigation facilities and the practices influencing the crops raised in the area.
3. He has a feel for the contribution of various buildings and improvements and whether the farm's resources, as an operating unit, are balanced.
4. He has a feel for the farm real estate market and for factors such as product prices, costs, earnings, rental rates, government regulations and the idiosyncrasies of both buyers and sellers of farms in his area.

   Furthermore, there are other reasons that influence farm prices, such as the existence of power line servitudes, water pipeline or canal servitudes and right-of-way servitudes. The number of years of farming experience the buyer has and if the buyer owns the adjoining farm have an impact on the price the buyer is willing to pay. The correlation between the debt per hectare, the population density and the farm values are significant. Farm values are also highly correlated with the gross farm income.

The valuer who does not have the above-mentioned knowledge regarding all the factors that influence farm values, will when he submits a written report generally display a naive understanding, if not gross ignorance, of many agricultural matters.

To develop an AVM (which satisfies accuracy requirements) for use in farm valuations, the model will have to successfully take into account the above-mentioned unique farm attributes.

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**The use of AVMs (Automated Valuation Methods)**

The development and use of AVMs in the valuation of especially residential property, is a worldwide phenomenon. AVMs are in use around the world. This includes India, Russia, South America and many smaller countries. Some countries are "early stage" users and some (like Sweden, U.S.A. and Canada) are "established" users. The established users have confidence in its use for second mortgage purposes and are beginning to use it also for first mortgage purposes.

A successful AVM model in one country cannot be duplicated in another country. It has to be adapted to a specific country's factors that drive values.

The majority of AVM models use MRA (Multiple Regression Analysis) as a basis.

With the advancement of computer technology and subsequent appropriate software programs, the use of MRA became popular and relative easy to perform.

One of the important reasons for the development and use of AVM models in the valuation of residential property is to avoid the physical property inspection that is part of the traditional valuation process. The benefits of avoiding the physical inspection are amongst others, lower cost and greater speed to do the valuation.

The fact that a valuer has little if any input when using a MRA, is seen as a double-edged sword. It eliminates human error and bias but takes out of the equation not only the physical property inspection but also the skill, judgement and experience of the valuer.

The accuracy of a MRA relies heavily on the quality and accuracy of the data that are used. Thus, the availability of quality and accurate data has a significant impact on the potential accuracy of a MRA. The use of AVMs in the South African residential property market is common.

The majority of valuers believe that AVM models cannot be employed in the South African commercial property market. In their opinion, commercial property is a much more involved valuation exercise than the valuation of residential property and the

risks associated with this type of property need to be balanced and managed. A commercial valuation involves an analysis of the various value-forming factors applicable to commercial property that need to be taken into account. This includes adjustments to the value calculations. They doubted whether an automated valuation process would be able to perform all these functions and incorporate all these factors.

## 5.2    ANSWERING THE RESEARCH QUESTIONS

The research questions were summarised in paragraph 1.4:

1.  Determine if it is possible to develop a linear multiple regression model for the valuation of farms, which satisfies accuracy requirements, with data that is reasonably available?

2.  How does the development of an accurate MRA model contribute to the knowledge regarding the improvement of the accuracy levels of MRA models in farm valuations?

3.  What are the limitations that these MRA models might have regarding their applicability to farm valuations?

It is now possible to answer these questions as follows:

1.  Model 7 does satisfy the accuracy requirements for fairly accurate estimates. but it does not satisfy high accuracy requirements.

    A high adjusted $R^2$ value of 0.927 was reached. The COD of the error term is 14%. This is lower than the maximum COD of 15%, which is the requirement for fair accuracy. In addition, 83% of the individual estimates are within 20% accuracy. Both these indicators do not satisfy high accuracy requirements, which are a COD of less than 10% and at least 90% of individual estimates, and must be within 20% accuracy.

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However, the results of the process involved in the stepwise regression analysis, indicated that it is extremely difficult to have enough appropriate and accurate date available, to develop a regression analysis for agricultural property, which satisfies accuracy requirements.

Although it is difficult, it is possible to develop MRA models that are fairly accurate. Therefore, if MRA models are currently being used for the municipal valuation of farms, which are not fairly accurate, it should be possible to improve the accuracy. However, maximum accuracy cannot be achieved with MRA models. Thus, it cannot replace a valuation done by a skilled and knowledgeable professional valuer, when maximum accuracy is required.

2. The development of a fairly accurate MRA model contributed to the knowledge regarding the difficulty to improve the accuracy levels of MRA models in farm valuations.

The reasons for the difficulty to acquire sufficient appropriate and accurate data to be able to develop a MRA model that is accurate enough to satisfy accuracy requirements are identified:

a. No two farms are ever exactly the same or entirely homogenous. No two farms are ever alike in terms of (i) the basic resources (land, labour, or capital) that are available, (ii) the way these resources or factors of production are combined, or (iii) in terms of the amounts of various crops and livestock produced.

It is extremely difficult to have appropriate and accurate quantitative data that reflect the above, which can result in an accurate MRA model.

b. The professional valuer who values farms has specialised knowledge and skills regarding farms:

He has acquired skills regarding agronomy, engineering, animal and crop science, economics, law and psychology. As he walks a given subject property he has a feel for the soils, topography, drainage, irrigation facilities and the practices influencing the crops raised in the

area. He has a feel for the contribution of various buildings and improvements and whether the farm's resources, as an operating unit, are balanced. He has a feel for the farm real estate market and for factors such as product prices, costs, earnings, rental rates, government regulations and the idiosyncrasies of both buyers and sellers of farms in his area.

Again, it is extremely difficult to have appropriate and accurate quantitative data that reflect the above, which can result in an accurate MRA model.

c. There are other reasons that influence farm prices, such as the existence of power line servitudes, water pipeline or canal servitudes and right-of-way servitudes.

d. Factors such as the number of years of farming experience the buyer has and if the buyer owns the adjoining farm, have an impact on the price the buyer is willing to pay.

e. The correlation between the debt per hectare, the population density and farm values are significant. Farm values are also highly correlated with the gross farm income.

f. The depreciated value of improvements has a large and direct correlated influence on the total value of the farm. To acquire sufficient appropriate and accurate data to substitute a physical inspection will be difficult and costly.

3. The limitations these MRA models are:

a. The biggest limitation, specifically of Model 7, is that the dependent variable is the value of the vacant land. Thus, it is not the total value of the farm. It is the value without the depreciated value of the buildings. In practise, it seldom happens that a farm has no buildings as improvements, therefore it implies that further research will have to be done to develop a model, that will accurately use variables for the depreciated value of the buildings, to enable the model to estimate the total value of a farm.

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b. Model 7 satisfies accuracy requirements for fairly accurate valuations, but it still did not achieve a high level of accuracy. The stepwise regression process was a lengthy process that eventually lead to Model 7. These two facts indicate that to develop models that have a

c. reasonable level of acceptance of accuracy, one needs much more appropriate and accurate data than the data that were available to the researcher.

c. All the models, except one, that were developed during the stepwise regression process were not fairly accurate. Thus, great circumspect should be taken when using MRA models in farm valuations.

## 5.3    LIMITATIONS OF THE RESEARCH

There is very little literature available regarding the application of MRA models in the valuation of farms. Thus, the researcher focused primarily on the literature available as it is applied in the mass valuation of residential property.

The availability of sufficient appropriate and accurate data to develop MRA models, were a severe limitation. Therefore further MRA models, which included the depreciated value of improvements, could not be developed.

This study was not meant to be an all inclusive and detailed study on the use of mass appraisal methods for agricultural properties. However, it is meant to give a general view of:

1. the uniqueness of agricultural property and how this uniqueness makes accurate farm valuations complex and difficult,
2. mass valuation methods; their advantages, limitations and possibilities for use in the valuation of farms,
3. how to develop MRA models for farms, the difficulty to develop models that satisfy accuracy requirements and the limitations these models have.

## 5.4 RECOMMENDATIONS

To be able to do successful in-depth research regarding the possible development of accurate MRA models for use in mass valuations of farms, both a large financial budget as well as researchers who are skilled professional farm valuers will be required.

To acquire sufficient appropriate and accurate data is the major obstacle. The financial budget required to address this limiting factor, is well beyond the means of a student.

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## ANNEXURE "A": INFORMATION OF 60 DATA SETS

**(i)**

| Farm No. | Date | Size ha | Total Value | DVI | Vac LV | Vacant LV / ha | Grazing | ha/ LSU | Irrigation ha | Irr value / ha |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 684 | 10,700,000 | 3,970,000 | 6,723,000 | 10,000 | 3 | 8 | 0 | 0 |
| 2 | 3 | 559 | 5,750,000 | 596,000 | 5,153,000 | 9,210 | 3 | 8 | 0 | 0 |
| 3 | 3 | 561 | 4,000,000 | 357,000 | 3,642,000 | 6,483 | 2 | 8 | 0 | 0 |
| 4 | 3 | 369 | 4,425,000 | 425,000 | 4,000,000 | 10,831 | 2 | 8 | 0 | 0 |
| 5 | 4 | 302 | 3,170,000 | 1,468,000 | 1,704,000 | 5,639 | 1 | 12 | 0 | 0 |
| 6 | 5 | 256 | 2,850,000 | 850,000 | 2,000,000 | 7,783 | 2 | 8 | 0 | 0 |
| 7 | 5 | 158 | 2,650,000 | 1,250,000 | 1,400,000 | 8,814 | 2 | 8 | 0 | 0 |
| 8 | 5 | 182 | 1,700,000 | 300,000 | 1,400,000 | 7,659 | 2 | 8 | 0 | 0 |
| 9 | 5 | 402 | 2,750,000 | 100,000 | 2,650,000 | 6,500 | 3 | 12 | 0 | 0 |
| 10 | 7 | 765 | 5,400,000 | 150,000 | 5,250,000 | 6,857 | 2 | 12 | 0 | 0 |
| 11 | 5 | 1,108 | 7,050,000 | 150,000 | 6,900,000 | 6,223 | 2 | 12 | 0 | 0 |
| 12 | 7 | 878 | 6,500,000 | 500,000 | 6,000,000 | 6,832 | 3 | 12 | 0 | 0 |
| 13 | 4 | 522 | 22,900,000 | 3,330,000 | 19,570,000 | 43,870 | 2 | 12 | 260 | 65,000 |
| 14 | 5 | 147 | 4,000,000 | 1,812,000 | 2,187,000 | 14,858 | 2 | 12 | 12 | 70,000 |
| 15 | 6 | 35 | 2,300,000 | 445,000 | 1,855,000 | 52,306 | 2 | 12 | 25 | 70,000 |
| 16 | 5 | 65 | 2,000,000 | 184,000 | 1,816,000 | 27,589 | 2 | 12 | 22 | 65,000 |
| 17 | 5 | 803 | 4,170,000 | 957,000 | 3,211,000 | 3,995 | 3 | 12 | 0 | 0 |
| 18 | 6 | 712 | 2,500,000 | 0 | 2,500,000 | 3,509 | 2 | 12 | 0 | 0 |
| 19 | 7 | 865 | 4,200,000 | 600,000 | 3,600,000 | 4,159 | 2 | 12 | 0 | 0 |
| 20 | 6 | 562 | 4,300,000 | 1,100,000 | 3,200,000 | 7,648 | 2 | 12 | 0 | 0 |
| 21 | 2 | 576 | 13,000,000 | 6,754,000 | 6,246,000 | 10,844 | 2 | 8 | 0 | 0 |
| 22 | 2 | 709 | 6,500,000 | 500,000 | 6,000,000 | 8,454 | 2 | 8 | 0 | 0 |
| 23 | 3 | 2,004 | 13,150,000 | 650,000 | 12,500,000 | 6,237 | 2 | 8 | 0 | 0 |
| 24 | 3 | 904 | 10,250,000 | 250,000 | 10,000,000 | 11,057 | 2 | 8 | 0 | 0 |
| 25 | 2 | 254 | 3,900,000 | 1,116,000 | 2,784,000 | 10,894 | 2 | 12 | 0 | 0 |
| 26 | 3 | 63 | 2,250,000 | 1,042,000 | 1,208,000 | 18,946 | 2 | 12 | 0 | 0 |
| 27 | 4 | 169 | 2,028,000 | 169,000 | 1,859,000 | 10,988 | 2 | 12 | 0 | 0 |
| 28 | 4 | 444 | 3,900,000 | 352,000 | 3,548,000 | 7,991 | 2 | 12 | 0 | 0 |
| 29 | 4 | 1526 | 10,300,000 | 369,000 | 9,931,000 | 6,508 | 3 | 12 | 0 | 0 |
| 30 | 6 | 735 | 4,500,000 | 384,000 | 4,116,000 | 5,600 | 2 | 12 | 0 | 0 |
| 31 | 6 | 1,211 | 9,690,000 | 2,441,000 | 7,249,000 | 5,986 | 3 | 12 | 0 | 0 |
| 32 | 6 | 767 | 5,700,000 | 1,484,000 | 4,216,000 | 5,497 | 2 | 12 | 0 | 0 |
| 33 | 4 | 1,213 | 18,590,000 | 1,647,000 | 16,943,000 | 13,968 | 3 | 8 | 0 | 0 |
| 34 | 5 | 770 | 7,000,000 | 400,000 | 6,600,000 | 8,571 | 2 | 8 | 0 | 0 |
| 35 | 6 | 132 | 3,606,000 | 1,500,000 | 2,106,000 | 15,955 | 2 | 8 | 0 | 0 |
| 36 | 6 | 120 | 2,432,000 | 800,000 | 1,632,000 | 13,600 | 2 | 8 | 0 | 0 |
| 37 | 6 | 1,368 | 6,880,000 | 1,439,000 | 5,441,000 | 3,977 | 2 | 10 | 0 | 0 |
| 38 | 7 | 513 | 2,600,000 | 500,000 | 2,100,000 | 4,094 | 2 | 10 | 0 | 0 |
| 39 | 7 | 1,038 | 5,000,000 | 700,000 | 4,300,000 | 4,143 | 2 | 10 | 0 | 0 |

| Farm No. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 40 | 7 | 856 | 3,502,000 | 500,000 | 3,002,000 | 3,507 | 2 | 10 | 0 | 0 |
| 41 | 2 | 91 | 3,300,000 | 1,116,000 | 2,184,000 | 24,000 | 3 | 10 | 0 | 0 |
| 42 | 3 | 63 | 2,250,000 | 1,042,000 | 1,208,000 | 18,946 | 2 | 12 | 0 | 0 |
| 43 | 3 | 184 | 7,800,000 | 0 | 7,800,000 | 42,391 | 2 | 12 | 0 | 0 |
| 44 | 4 | 199 | 6,100,000 | 1,313,000 | 4,787,000 | 24,055 | 2 | 12 | 40 | 60,000 |
| 45 | 4 | 548 | 5,400,000 | 1,819,000 | 3,581,000 | 6,535 | 2 | 12 | 0 | 0 |
| 46 | 5 | 974 | 7,800,000 | 1,467,000 | 6,333,000 | 6,502 | 2 | 12 | 0 | 0 |
| 47 | 6 | 1,211 | 9,690,000 | 2,441,000 | 7,249,000 | 5,986 | 3 | 12 | 0 | 0 |
| 48 | 6 | 767 | 5,700,000 | 1,484,000 | 4,216,000 | 5,497 | 2 | 12 | 0 | 0 |
| 49 | 4 | 1,739 | 12,200,000 | 942,000 | 11,258,000 | 6,474 | 2 | 12 | 0 | 0 |
| 50 | 5 | 1,329 | 9,690,000 | 1,006,000 | 8,684,000 | 6,534 | 2 | 12 | 0 | 0 |
| 51 | 5 | 1,026 | 7,500,000 | 797,000 | 6,703,000 | 6,533 | 2 | 12 | 0 | 0 |
| 52 | 5 | 1,108 | 7,050,000 | 150,000 | 6,900,000 | 6,223 | 1 | 12 | 0 | 0 |
| 53 | 4 | 888 | 5,800,000 | 0 | 5,800,000 | 6,532 | 1 | 12 | 0 | 0 |
| 54 | 5 | 1,329 | 9,690,000 | 1,006,000 | 8,684,000 | 6,534 | 2 | 12 | 0 | 0 |
| 55 | 5 | 1,026 | 7,500,000 | 797,000 | 6,703,000 | 6,533 | 2 | 12 | 0 | 0 |
| 56 | 5 | 1,108 | 7,050,000 | 150,000 | 6,900,000 | 6,223 | 2 | 12 | 0 | 0 |
| 57 | 3 | 1,479 | 21,900,000 | 2,691,000 | 19,209,000 | 12,988 | 2 | 8 | 0 | 0 |
| 58 | 4 | 444 | 3,900,000 | 352,000 | 3,548,000 | 7,991 | 2 | 12 | 0 | 0 |
| 59 | 4 | 171 | 1,800,000 | 0 | 1,800,000 | 10,526 | 2 | 8 | 0 | 0 |
| 60 | 4 | 387 | 8,800,000 | 572,000 | 8,228,000 | 21,261 | 2 | 8 | 50 | 50,000 |

(ii)

| Farm No. | Town distance | Tourism | Game fence | Topo-graphy | Vaal-water | Mookgo-pong | Thaba-zimbi | All-days | Letsi-tele | Bela-Bela | Makha-do | Lepha-lale |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | |
| 2 | 1 | 0 | 1 | 2 | 1 | | | | | | | |
| 3 | 3 | 0 | 0 | 1 | 1 | | | | | | | |
| 4 | 4 | 0 | 1 | 3 | 1 | | | | | | | |
| 5 | 1 | 1 | 1 | 3 | | 1 | | | | | | |
| 6 | 3 | 0 | 0 | 1 | | 1 | | | | | | |
| 7 | 1 | 1 | 1 | 1 | | 1 | | | | | | |
| 8 | 3 | 0 | 0 | 1 | | 1 | | | | | | |
| 9 | 5 | 0 | 1 | 1 | | | 1 | | | | | |
| 10 | 5 | 0 | 0 | 1 | | | 1 | | | | | |
| 11 | 5 | 0 | 0 | 1 | | | 1 | | | | | |
| 12 | 5 | 1 | 1 | 1 | | | 1 | | | | | |
| 13 | 3 | 0 | 0 | 1 | | | 1 | | | | | |
| 14 | 2 | 0 | 0 | 3 | | | 1 | | | | | |
| 15 | 2 | 0 | 0 | 1 | | | 1 | | | | | |
| 16 | 3 | 0 | 0 | 1 | | | 1 | | | | | |
| 17 | 4 | 1 | 1 | 1 | | | | | 1 | | | |
| 18 | 4 | 0 | 1 | 1 | | | | | 1 | | | |
| 19 | 2 | 1 | 1 | 1 | | | | | 1 | | | |
| 20 | 3 | 1 | 1 | 1 | | | | | 1 | | | |

| 21 | 4 | 1 | 1 | 1 | | | 1 | | | |
| 22 | 4 | 0 | 1 | 1 | | | 1 | | | |
| 23 | 4 | 0 | 1 | 1 | | | 1 | | | |
| 24 | 4 | 0 | 1 | 1 | | | 1 | | | |
| 25 | 2 | 0 | 0 | 1 | | 1 | | | | |
| 26 | 2 | 0 | 0 | 1 | | 1 | | | | |
| 27 | 5 | 0 | 1 | 1 | | 1 | | | | |
| 28 | 5 | 0 | 1 | 2 | | 1 | | | | |
| 29 | 5 | 1 | 1 | 1 | | 1 | | | | |
| 30 | 5 | 0 | 0 | 1 | | 1 | | | | |
| 31 | 5 | 0 | 0 | 1 | | 1 | | | | |
| 32 | 4 | 0 | 1 | 1 | | 1 | | | | |
| 33 | 4 | 0 | 1 | 1 | | | | 1 | | |
| 34 | 4 | 0 | 0 | 1 | | | | 1 | | |
| 35 | 4 | 0 | 0 | 1 | | | | 1 | | |
| 36 | 3 | 0 | 0 | 1 | | | | 1 | | |
| 37 | 4 | 1 | 1 | 1 | | | | | 1 | |
| 38 | 3 | 1 | 1 | 1 | | | | | 1 | |
| 39 | 2 | 1 | 1 | 1 | | | | | 1 | |
| 40 | 2 | 0 | 0 | 1 | | | | | 1 | |
| 41 | 2 | 0 | 0 | 2 | | 1 | | | | |
| 42 | 2 | 0 | 0 | 1 | | 1 | | | | |
| 43 | 2 | 0 | 0 | 3 | | 1 | | | | |
| 44 | 3 | 0 | 0 | 1 | | 1 | | | | |
| 45 | 5 | 1 | 1 | 1 | | 1 | | | | |
| 46 | 5 | 1 | 1 | 1 | | 1 | | | | |
| 47 | 5 | 0 | 0 | 1 | | 1 | | | | |
| 48 | 4 | 0 | 1 | 1 | | 1 | | | | |
| 49 | 5 | 1 | 1 | 1 | | | | | | 1 |
| 50 | 5 | 1 | 1 | 1 | | | | | | 1 |
| 51 | 5 | 1 | 1 | 1 | | | | | | 1 |
| 52 | 5 | 0 | 0 | 1 | | | | | | 1 |
| 53 | 5 | 0 | 1 | 1 | | | | | | 1 |
| 54 | 5 | 1 | 1 | 1 | | | | | | 1 |
| 55 | 5 | 1 | 1 | 1 | | | | | | 1 |
| 56 | 5 | 0 | 0 | 1 | | | | | | 1 |
| 57 | 4 | 1 | 1 | 2 | 1 | | | | | |
| 58 | 5 | 0 | 1 | 2 | 1 | | | | | |
| 59 | 3 | 0 | 0 | 1 | 1 | | | | | |
| 60 | 3 | 0 | 0 | 1 | 1 | | | | | |

## ANNEXURE "B": PRICES VERSUS ESTIMATE VALUES

### Models 1, 2 & 3

| Farm no. | Total Farm Price | Model 1 Estimate Values | Model 2 Estimate Values | Model 3 Estimate Values |
|---|---|---|---|---|
| 1 | 10,700,000 | 11,560,188.34 | 11,510,637.54 | 11,597,492.06 |
| 2 | 5,750,000 | 7,263,884.71 | 7,198,612.71 | 7,352,297.30 |
| 3 | 4,000,000 | 5,847,522.01 | 5,854,147.90 | 5,795,411.38 |
| 4 | 4,425,000 | 6,869,361.38 | 6,911,117.24 | 6,847,051.63 |
| 5 | 3,170,000 | 4,298,297.92 | 4,265,017.20 | 4,207,131.27 |
| 6 | 2,850,000 | 2,261,655.66 | 2,294,510.08 | 2,323,065.34 |
| 7 | 2,650,000 | 2,679,998.59 | 2,646,125.86 | 2,635,232.77 |
| 8 | 1,700,000 | 1,130,047.84 | 1,164,346.86 | 1,204,570.62 |
| 9 | 2,750,000 | 2,521,580.62 | 2,544,457.31 | 2,725,291.90 |
| 10 | 5,400,000 | 4,195,912.28 | 4,205,804.18 | 4,158,903.44 |
| 11 | 7,050,000 | 7,563,612.73 | 7,580,756.39 | 7,503,146.88 |
| 12 | 6,500,000 | 5,771,060.87 | 5,774,117.81 | 5,914,348.80 |
| 13 | 22,900,000 | 23,357,562.26 | 23,363,737.37 | 23,371,353.12 |
| 14 | 4,000,000 | 5,312,481.99 | 5,285,622.57 | 5,277,044.65 |
| 15 | 2,300,000 | 1,348,110.02 | 1,297,414.34 | 1,304,345.62 |
| 16 | 2,000,000 | 1,512,055.25 | 1,500,795.26 | 1,504,575.23 |
| 17 | 4,170,000 | 4,910,537.54 | 4,947,506.59 | 5,115,064.71 |
| 18 | 2,500,000 | 2,723,441.58 | 2,736,322.69 | 2,691,401.95 |
| 19 | 4,200,000 | 4,378,012.45 | 4,327,219.32 | 4,259,467.13 |
| 20 | 4,300,000 | 3,158,008.44 | 3,158,951.41 | 3,104,066.21 |
| 21 | 13,000,000 | 12,897,215.17 | 12,935,114.33 | 12,906,870.13 |
| 22 | 6,500,000 | 6,760,679.33 | 6,770,276.05 | 6,812,859.42 |
| 23 | 13,150,000 | 15,798,722.14 | 15,757,536.12 | 15,708,633.30 |
| 24 | 10,250,000 | 7,443,383.37 | 7,437,073.50 | 7,471,637.16 |

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| | | | | |
|---|---|---|---|---|
| 25 | 3,900,000 | 3,909,633.89 | 3,887,846.88 | 3,851,076.18 |
| 26 | 2,250,000 | 2,004,818.23 | 1,979,908.28 | 1,960,745.90 |
| 27 | 2,028,000 | 1,612,327.42 | 1,649,040.30 | 1,601,588.76 |
| 28 | 3,900,000 | 4,802,764.77 | 4,839,348.04 | 4,777,846.81 |
| 29 | 10,300,000 | 11,641,163.61 | 11,650,556.02 | 11,736,671.86 |
| 30 | 4,500,000 | 4,683,763.16 | 4,704,199.24 | 4,653,677.74 |
| 31 | 9,690,000 | 10,106,363.37 | 10,117,941.77 | 10,250,624.43 |
| 32 | 5,700,000 | 6,483,313.48 | 6,452,709.69 | 6,353,307.19 |
| 33 | 18,590,000 | 13,852,473.14 | 13,838,970.05 | 13,937,217.15 |
| 34 | 7,000,000 | 8,760,678.45 | 8,767,185.80 | 8,707,410.58 |
| 35 | 3,606,000 | 4,915,736.57 | 4,935,597.06 | 4,911,880.72 |
| 36 | 2,432,000 | 4,099,111.84 | 4,086,247.08 | 4,071,491.54 |
| 37 | 6,880,000 | 8,715,434.58 | 8,747,913.87 | 8,697,178.43 |
| 38 | 2,600,000 | 1,120,046.86 | 1,137,474.25 | 1,161,946.52 |
| 39 | 5,000,000 | 5,149,626.73 | 5,118,517.64 | 5,103,048.43 |
| 40 | 3,502,000 | 2,996,891.83 | 2,978,094.24 | 3,019,826.61 |
| 41 | 3,300,000 | 4,688,926.39 | 4,692,945.21 | 4,819,516.94 |
| 42 | 2,250,000 | 2,004,818.23 | 1,979,908.28 | 1,960,745.90 |
| 43 | 7,800,000 | 3,763,981.05 | 3,750,255.61 | 3,750,034.56 |
| 44 | 6,100,000 | 5,265,439.98 | 5,262,296.71 | 5,246,096.95 |
| 45 | 5,400,000 | 6,422,526.74 | 6,463,052.38 | 6,361,357.83 |
| 46 | 7,800,000 | 8,657,342.23 | 8,674,316.69 | 8,549,226.96 |
| 47 | 9,690,000 | 10,106,363.37 | 10,117,941.77 | 10,250,624.43 |
| 48 | 5,700,000 | 5,472,078.05 | 5,433,027.90 | 5,325,847.95 |
| 49 | 12,200,000 | 13,066,398.53 | 13,056,945.41 | 13,060,530.50 |
| 50 | 9,690,000 | 9,735,065.04 | 9,729,807.62 | 9,765,099.85 |
| 51 | 7,500,000 | 7,325,959.54 | 7,330,138.58 | 7,389,565.61 |

| 52 | 7,050,000 |  |  |  |
|---|---|---|---|---|
|  |  | 6,831,419.28 | 6,835,616.56 | 6,697,373.16 |
| 53 | 5,800,000 |  |  |  |
|  |  | 5,872,824.75 | 5,873,053.01 | 5,715,392.28 |
| 54 | 9,690,000 |  |  |  |
|  |  | 9,735,065.04 | 9,729,807.62 | 9,765,099.85 |
|  | 7,500,000 | 7,325,959.54 |  |  |
| 55 |  |  |  |  |
|  | 7,050,000 | 6,587,308.29 | 7,330,138.58 | 7,389,565.61 |
| 56 |  |  |  |  |
|  | 21,900,000 | 16,602,092.26 | 6,594,492.63 | 6,697,373.16 |
| 57 |  |  |  |  |
|  | 3,900,000 | 3,466,165.27 | 16,616,641.30 | 16,431,035.48 |
| 58 |  |  |  |  |
|  | 1,800,000 | 2,201,816.79 | 3,501,455.40 | 3,622,627.20 |
| 59 |  |  |  |  |
|  | 8,800,000 | 7,463,969.24 | 2,211,266.09 | 2,187,675.33 |
| 60 |  |  |  |  |
|  |  |  | 7,471,121.83 | 7,441,409.61 |

**Model 4**

| Farm no. | Vacant Land Price | Model 4 Estimate values |
|---|---|---|
| 1 | 10,700,000 | 7,549,617.73 |
| 2 | 5,750,000 | 6,817,925.46 |
| 3 | 4,000,000 | 5,482,673.17 |
| 4 | 4,425,000 | 6,377,483.77 |
| 5 | 3,170,000 | 2,774,515.01 |
| 6 | 2,850,000 | 1,407,895.62 |
| 7 | 2,650,000 | 1,441,518.00 |
| 8 | 1,700,000 | 880,071.36 |
| 9 | 2,750,000 | 2,622,361.33 |
| 10 | 5,400,000 | 4,025,154.51 |
| 11 | 7,050,000 | 7,385,655.61 |
| 12 | 6,500,000 | 5,498,869.05 |
| 13 | 22,900,000 | 20,021,573.11 |
| 14 | 4,000,000 | 3,404,801.81 |

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| | | |
|---|---|---|
| 15 | 2,300,000 | 939,314.86 |
| 16 | 2,000,000 | 1,389,814.18 |
| 17 | 4,170,000 | 4,140,667.94 |
| 18 | 2,500,000 | 2,639,326.39 |
| 19 | 4,200,000 | 3,733,854.98 |
| 20 | 4,300,000 | 1,997,150.69 |
| 21 | 13,000,000 | 5,843,003.73 |
| 22 | 6,500,000 | 6,396,382.63 |
| 23 | 13,150,000 | 15,176,324.93 |
| 24 | 10,250,000 | 7,330,288.70 |
| 25 | 3,900,000 | 2,762,605.29 |
| 26 | 2,250,000 | 943,265.91 |
| 27 | 2,028,000 | 1,417,410.37 |
| 28 | 3,900,000 | 4,391,082.56 |
| 29 | 10,300,000 | 11,491,844.18 |
| 30 | 4,500,000 | 4,268,153.88 |
| 31 | 9,690,000 | 7,663,347.74 |
| 32 | 5,700,000 | 4,801,296.76 |
| 33 | 18,590,000 | 12,254,296.87 |
| 34 | 7,000,000 | 8,365,067.50 |
| 35 | 3,606,000 | 3,357,384.31 |
| 36 | 2,432,000 | 3,304,251.32 |
| 37 | 6,880,000 | 7,205,913.15 |
| 38 | 2,600,000 | 682,881.12 |
| 39 | 5,000,000 | 4,460,040.36 |
| 40 | 3,502,000 | 2,494,165.37 |
| 41 | 3,300,000 | 3,699,842.95 |
| 42 | | |

| | | |
|---|---|---|
| 43 | 2,250,000 | 943,265.91 |
| 44 | 7,800,000 | 3,830,656.16 |
| 45 | 6,100,000 | 3,930,619.40 |
| 46 | 5,400,000 | 4,516,004.70 |
| 47 | 7,800,000 | 7,097,578.37 |
| 48 | 9,690,000 | 7,663,347.74 |
| 49 | 5,700,000 | 3,789,133.63 |
| 50 | 12,200,000 | 12,149,537.28 |
| 51 | 9,690,000 | 8,768,123.42 |
| 52 | 7,500,000 | 6,606,897.08 |
| 53 | 7,050,000 | 6,524,070.79 |
| 54 | 5,800,000 | 5,684,280.14 |
| 55 | 9,690,000 | 8,768,123.42 |
| 56 | 7,500,000 | 6,606,897.08 |
| 57 | 7,050,000 | 6,524,070.79 |
| 58 | 21,900,000 | 13,677,962.68 |
| 59 | 3,900,000 | 3,235,406.46 |
| 60 | 1,800,000 | 2,243,914.51 |
| | 8,800,000 | 6,918,016.21 |

## Model 5

| Farm no. | Vacant Land Price | Model 5 Estimate Values |
|---|---|---|
| 9 | 2,650,000 | 2,952,308 |
| 10 | 5,250,000 | 6,823,181 |
| 11 | 6,900,000 | 1,708,550 |
| 12 | 6,000,000 | 11,327,525 |

| | | |
|---|---|---|
| 13 | 19,570,000 | |
| | | 2,613,939 |
| 14 | 2,187,000 | |
| | | 13,389,493 |
| 15 | 1,855,000 | |
| | | 5,281,387 |
| 16 | 1,816,000 | |
| | | 8,234,581 |
| 25 | 2,784,000 | |
| | | 15,619,838 |
| 26 | 1,208,000 | |
| | | 6,808,068 |
| 27 | 1,859,000 | |
| | | 8,234,581 |
| 28 | 3,548,000 | |
| | | 4,600,729 |
| 29 | 9,931,000 | |
| | | 6,192,923 |
| 30 | 4,116,000 | |
| | | 1,368,098 |
| 31 | 7,249,000 | |
| | | 5,347,688 |
| 32 | 4,216,000 | |
| | | 4,251,461 |
| 41 | 2,184,000 | |
| | | 4,081,399 |
| 42 | 1,208,000 | |
| | | 4,303,547 |
| 43 | 7,800,000 | |
| | | 4,512,670 |
| 44 | 4,787,000 | |
| | | 6,817,130 |
| 45 | 3,581,000 | |
| | | 7,199,431 |
| 46 | 6,333,000 | |
| | | 2,664,363 |
| 47 | 7,249,000 | |
| | | 4,002,704 |
| 48 | 4,216,000 | |
| | | 20,007,687 |

**Model 6**

| Farm no. | Price / ha | Model 6 Estimate Values |
|---|---|---|
| 9 | 6,500 | 4,485.10 |
| 10 | 6,857 | 8,018.67 |
| 11 | 6,223 | 11,291.47 |

| | | |
|---|---|---|
| 12 | 6,832 | 7,203.44 |
| 13 | 43,870 | 12,181.15 |
| 14 | 14,858 | 7,213.56 |
| 15 | 52,306 | 6,303.57 |
| 16 | 27,589 | 2,774.57 |
| 25 | 10,894 | 3,176.61 |
| 26 | 18,946 | 9,545.82 |
| 27 | 10,988 | 2,774.57 |
| 28 | 7,991 | 5,725.31 |
| 29 | 6,508 | 3,802.62 |
| 30 | 5,600 | 11,289.32 |
| 31 | 5,986 | 4,787.52 |
| 32 | 5,497 | 10,168.97 |
| 41 | 24,000 | 9,232.67 |
| 42 | 18,946 | 8,338.11 |
| 43 | 42,391 | 10,496.87 |
| 44 | 24,055 | 12,627.95 |
| 45 | 6,535 | 18,852.24 |
| 46 | 6,502 | 20,490.60 |
| 47 | 5,986 | 22,336.50 |
| 48 | 5,497 | 48,004.60 |

## Model 7

| Farm no. | Vacant Land Price | Model 7 Estimate Values |
|---|---|---|
| 9 | 2,650,000 | 2,666,160.16 |
| 10 | 5,250,000 | 4,224,759.27 |
| 11 | 6,900,000 | 6,948,056.99 |

| | | |
|---|---|---|
| 12 | 6,000,000 | 5,190,522.10 |
| 13 | 19,570,000 | 19,564,174.55 |
| 14 | 2,187,000 | 4,459,675.78 |
| 15 | 1,855,000 | 1,642,716.67 |
| 16 | 1,816,000 | 1,963,296.89 |
| 25 | 2,784,000 | 2,733,037.82 |
| 26 | 1,208,000 | 1,253,121.28 |
| 27 | 1,859,000 | 1,574,512.60 |
| 28 | 3,548,000 | 4,546,697.27 |
| 29 | 9,931,000 | 10,085,147.47 |
| 30 | 4,116,000 | 4,364,308.68 |
| 31 | 7,249,000 | 7,251,253.29 |
| 32 | 4,216,000 | 4,558,388.99 |
| 41 | 2,184,000 | 3,048,748.25 |
| 42 | 1,208,000 | 1,253,121.28 |
| 43 | 7,800,000 | 4,595,601.46 |
| 44 | 4,787,000 | 4,194,726.51 |
| 45 | 3,581,000 | 4,153,568.01 |
| 46 | 6,333,000 | 6,415,762.43 |
| 47 | 7,249,000 | 7,251,253.29 |
| 48 | 4,216,000 | 4,558,388.99 |