An analysis of the use of mass appraisal methods for agricultural properties

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Abstract

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 increases the possibility of large differences in the estimated market value determined and the actual selling price.

This article reports the results of a study that analysed the unique and distinctive attributes of farms, in order to determine whether it is possible to develop a linear multiple regression model for the valuation of farms (which satisfies accuracy requirements) with reasonably available data. The improvement of accuracy levels of Multiple Regression Analysis (MRA) models as well as the limitations of using these MRA models during farm evaluations was also studied.

By following a stepwise regression approach, 60 farms, primarily located in the eco-zone "mixed bushveld" western area of the Limpopo province, were analysed using ten independent variables. Three models have been developed. The results showed that a fairly accurate regression model could be developed. However, a model that achieves a high level of accuracy could not be developed, due to multifaceted reasons, including non-farm factors and the size of the geographical areas.

Accurate MRA valuation estimates will be to the advantage of individual farm owners regarding their municipal tax assessments. It will lead to a wider use of MRAs for the valuation of farms, but great circumspect should be taken when using MRA models in farm valuations. This is due to the possibility that the MRA models do not satisfy minimum accuracy requirements.

It is difficult, but possible, to develop a fairly accurate MRA model for the valuation of farms. Therefore, if currently used MRA models are not fairly accurate for municipal valuation purposes, it should be possible to improve the accuracy. Further research is recommended in the use of other regression techniques such as non-linear, geographic weighted regression and quantile regression. These other techniques would, however, require a larger data sample, in order to provide meaningful results.

Keywords: Agricultural property, Automated Valuation Methodology (AVM), farm valuation, mass appraisal, valuation methodology

Abstrak

Daar is veelvuldige faktore wat die prys van 'n plaas beïnvloed, wat nie noodwendig suiwer finansieël van aard is nie. Dit maak die taak van die waardeerder moeilik en kompleks, wat weer veroorsaak dat die moontlikheid bestaan dat daar groot verskille tussen die gewaardeerde waardes en die verkooppryse van plase voorkom.

Hierdie artikel rapporteer die resultate van 'n studie wat die unieke en onderskeidende eienskappe van plase ontleed ten einde te bepaal of dit moontlik is om 'n liniêre regressie-analiese model te ontwikkel (wat aan minimum akkuraatheidsvlakke voldoen) met redelik beskikbare inligting, vir die waardasie van plase. Die verbetering van die akkuraatheidsvlakke van MRA-modelle sowel as die beperkings van hierdie MRA-modelle, vir gebruik in plaas waardasies, is ook nagevors.

Deur middel van 'n stapsgewyse regressie-analiese metode, is 60 plase wat hoofsaaklik in die "gemengde bosveld" ekosone, in die westelike gedeelte van die Limpopo-provinsie geleë is, ontleed deur van 10 onafhanklike veranderlikes gebruik te maak. Drie modelle is ontwikkel. Die resultate het aangetoon dat 'n regressiemodel ontwikkel kan word wat redelik akkuraat is, maar 'n model met 'n hoë mate van akkuraatheid kon nie ontwikkel word nie as gevolg van veelvuldige redes, insluitend redes wat nie direk verwant is aan plaasfaktore nie en die grootte van die geografiese gebiede.

Alhoewel akkurate MRA-waardasies tot voordeel sal wees van plaas eienaars vir die bepaling van munisipale belastingwaardes en dit sal lei tot 'n wyer en meer algemene gebruik van MRA's vir plaaswaardasies, moet groot versigtigheid aan die dag gelê word met die gebruik van MRA-modelle in plaaswaardasies omdat dit waarskynlik is dat die MRA-modelle nie aan minimum akkuraatheidvereistes voldoen nie.

Dit is moeilik, tog moontlik, om 'n MRA-model vir plaaswaardasies te ontwikkel wat redelik akkuraat is. Dus, waar MRA-modelle vir munisipale waardasies gebruik word, wat nie redelik akkuraat is nie, behoort die akkuraatheid verhoog te kan word. 'n MRA-modelwaardasie sal egter nooit die waardasie van 'n ervare en kundige professionele waardeerder kan vervang, wanneer 'n maksimale akkurate waardasie benodig word nie.

Sleutelwoorde: Landbou-eiendom, waardasie metodologie, massa waardasie, plaaswaardasie, ge-outomatiseerde waardasie metodologie (AVM)

1. Introduction

The value of a specific agricultural property is determined by a wide variety of factors.

Barry, Ellinger, Hopkin & Baker (1995: 344) pointed out that land values are 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.

No two farms are ever the same or entirely homogeneous. 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 (iii) in terms of the amounts of various crops and livestock produced.

Suter (1992: 39-41) stated that a professional valuer who values farms has specialised knowledge and skills regarding farms. The valuer has acquired skills regarding agronomy, engineering, animal and crop science, economics, law and psychology. As a valuer walks a given subject property, he develops an overall comprehension of factors such as soils, topography, drainage, irrigation facilities and the practices influencing the crops raised in the area. The valuer understands the contribution of various buildings and improvements and whether the farm's resources, as an operating unit, are balanced. An understanding of 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 is evident.

Factors such as the number of years of farming experience of the buyer, and if the buyer owns the adjoining farm, have an impact on the price the buyer is willing to pay (Bourhill, 1998: 80).

Van Schalkwyk (1992: 62) determined that the correlation between the debt per hectare, the population density and farm values is significant. Farm values are also highly correlated with the gross farm income.

When valuing an agricultural property, an important part of the valuation process 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 primary objectives of this article are:

- To determine if it is possible to develop a linear multiple regression model for the valuation of farms (which satisfies accuracy requirements) with data of an acceptable quality that is readily available, given the fact that farms are very heterogeneous and that a professional valuer of farms must have very specific skills and knowledge;

- To contribute to the knowledge regarding the improvement of the accuracy levels of MRA models in farm valuations, and
- To determine the limitations that these MRA models might have regarding their applicability to farm valuations.

Accurate MRA valuation estimates will be to the advantage of individual farm owners regarding their municipal tax assessments. 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.

2. Factors influencing the value of farms

Farms have numerous unique factors and attributes that influence their value.

A MRA model, which is inclined to satisfy accuracy requirements, will have to successfully take into account these value-influencing factors and distinctive attributes.

2.1 Market value and the characteristics of agricultural property

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

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

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

Bourhill (1998: 92) mentioned that the most important determinant of land value (within a relatively homogeneous area) is the size of the farm. 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 concludes by stating that, in South Africa, land prices are driven by factors that are difficult to predict and to quantify (Bourhill, 1998: 94).

Pienaar (2015: 71-84) discussed 12 factors that influence a specific farm's value in addition to the factors that influence the farm values of an area:

- The unique combination of natural resources on a farm, namely the land type, soil form, and grazing capacity;
- The topography of the specific farm;
- The presence of rights, servitudes and endorsements;
- The level of infrastructure development has a direct influence on the value;
- The utility of the land;
- Location in relation to markets and input suppliers;
- Access to the farm;
- Farm shape and outlay;
- Farm extent;
- Condition of the veld;
- Labour versus capital intensity, and
- The potential of the specific farm.

2.1.1 Highest and best use principle

The highest and best use principle is important to the potential value of farm properties.

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. There are usually various alternative enterprises as well as various alternative improvements that could be considered. 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.

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

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".

2.1.2 Irrigation

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

It is not easy to determine if the irrigation on a subject farm is legal. The valuer must have specific knowledge regarding the legality requirements of the irrigation as well as technical knowledge regarding the type of irrigation system that is used.

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

- Irrigation land;
- Equipped land;
- Potentially irrigable dry land, and
- Potential irrigable veld.

Each of the above possibilities has a different effect on the market value of the farm.

Furthermore, the efficiency to which water is used also leads to different values per hectare for different irrigation systems.

2.1.3 The use of different valuation methods

With farm valuations, due to the heterogeneity of farms, a combination of all valuation methods is required to account for all components of the farm such as land only, income-production capabilities, and improvements not otherwise accounted for. A MRA model, which endeavours to satisfy accuracy requirements, will have to reflect the fact that all the various valuation methods are used to develop credible farm valuations.

i. Comparable market transaction method (direct sales comparison)

According to Gildenhuys (2001: 216), the comparable market transaction method is not reliable when not enough comparable market transactions have taken place, or when too many adjustments are needed. The prerequisite to use this method is the data availability of sufficient comparable transactions. The lack of farm transactions in a specific area leads to limited comparable transactions, resulting in the adjustment of the criteria in the valuation of the property.

Ratterman (2007: 53) made the point that the valuer should try to replicate the market conditions at the time of the transaction. Thus, the valuer must assess which attributes of the farm influenced the buyer to pursue the sale transaction. These attributes must be taken into account when adjustments are made to estimate a market value of the subject property. The adjustment process requires considerable in-depth agricultural knowledge as well as the ability to skilfully evaluate and correctly interpret the relevant attribute(s) of each comparable transaction. The adjustments needed are part of the valuation process, which cannot be done by a person who does not possess this knowledge and skill regarding agriculture properties, in particular. This is also the part of the process where mistakes are easily made and thus lead to a wrong valuation of the subject farm.

ii. Productive value (income capitalisation) method

Reliable comparable transactions are not always available, hence often the productive value method becomes the preferred method to use. With climate playing a large role in the income-production possibilities of a farm, annual variances in the local climate can influence yields from year to year. 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.

This is further complicated by the abilities of the farmer or manager. An average farmer’s abilities should be used in the measurement of returns not that of an above average performer. It is not correct to value a farm based on yields that are achieved by an outstanding farm manager, but, according to Murray (1969: 381-382), yields must be used that will be achieved by a typical manager.

Furthermore, farming income and costs can vary substantially from year to year, making it difficult to implement the productive value approach.

According to Van Schalkwyk (1995: 124), one of the major concerns of using the income approach in the valuation of farmland relates to the use of the appropriate capitalisation rate. Pienaar (2015: 103) mentions that, in order to determine the capitalisation rate, 21 (meaning a large number) assumptions have to be made. It is often not possible, due to a lack of farm transactions, to determine the correct capitalisation rate in the market.

iii. Depreciated replacement cost method

Many farm valuers find this to be a vital approach, because, in numerous cases, no comparable properties (with similar buildings and improvements in terms of extent and quality) are 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 that can be used (Pienaar, 2015: 91, 100).

iv. Proactive comparable method

Pienaar (2015: 106) explained that this method could be used when there is a lack of reliable comparable transactions. Guidelines for an area are developed proactively (annually). The 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, among others, value/ha for a specific soil type where dry land crop production is done, value/ha for each of a specific veld type, and value/ha for centre pivot irrigation.

It is important for relevant stakeholders such as valuers, financial institutions, agricultural cooperatives and land-reform offices to participate in the preparation of guideline values.

v. Land residual method

This method is used to determine the value of the land only. The value of the land, considered as vacant, is calculated by deducting the value of the improvements from the total value. The land residual method may not be a preferred method but, at times, it prevails as the only alternative method available to value unimproved land (Jonker, 2014: 87).

vi. Partial takings

Farmland is often subjected to the taking of a limited property right such as the requirement to erect high-voltage power lines or a road on the farm, with subsequent registration of a *power-line servitude* or *right-of-way servitude*. This 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.

Pienaar (2015: 74) described the influence of power-line servitudes on the value of a farm in three ways. First, 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.

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 alludes to the comment in the "Uniform Eminent Domain Code", where it is spelled out that the before-and-after valuation method is usually the most equitable.

The before-and-after method is complex and only a valuer with specific knowledge and skill regarding farms can apply this method.

2.2 Automated Valuation Models

There is a paucity of literature regarding mass valuations and the use of Automated Valuation Methods (AVMs), specifically for the valuation of agricultural property.

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

Thompson (2008: 1) argued that quantitative methods are undergoing a massive renaissance, specifically pointing out that a homogeneous valuation method is required worldwide, due to economic globalisation.

2.2.1 Mass valuations

Valuation of properties is, by nature, an estimation of the value of a property as of a given date, and the precision demanded needs to be weighed against the cost of producing value (Bond & Dent, 1998: 373).

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

The SAIV (2014: 14-2) mentioned that, in a mass appraisal environment, valuation models must be developed that replicate the forces of supply and demand over an entire area.

Des Rosiers and Thériault (2008: 111) wrote that hedonic price modelling is popular for 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."

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 as such.

Tretton (2007: 488, 505) wrote that AVMs are in use across the world with varying degrees of sophistication. Most of these AVMs value residential property.

2.2.2 Advantages and shortcomings of AVMs

Tretton (2007: 505-508) mentioned and described the advantages of AVMs:

- Full transparency and public access facilitated;
- Low cost;
- Consistency;
- Speed, and
- Annual revisions are possible.

He also stated that considerable criticism, in the US, can be found of AVMs used by commercial companies for loans:

- Concern that the public does not appreciate/understand the difference between an automated valuation and a conventional valuation, which involves a physical inspection, understanding of the market condition, and a careful examination of comparable evidence close to the property;
- The use of outdated or very limited data. A recurring theme being the lack of data available outside the public sector;
- Failure to take account of all the variables affecting value – a lack of individual inspection of the property, and
- There is greater confidence in a "real person" undertaking the valuation.

Gilbertson and Preston (2005: 127-129) commented that the fact that a valuer has hardly, if any, input to an AVM has the advantage of eliminating human error and bias, and the disadvantage that it could also eliminate the physical property inspection, the skill, judgement and experience of the valuer.

Robson and Downie (2008: 6) referred to specific constraints on AVM use:

- 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 homogeneous neighbourhoods at prices close to the median for the locality. Subsequently, these models are 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 is mentioned.
- 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.

Thompson (2008) 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 analysed and used to produce the property value estimates.

2.2.3 Municipal taxation

One of the major problems that municipalities face is the extraordinary high administration cost to determine the values of agricultural properties (Fisher, 1996: 314). Therefore, there is a very real cost benefit for municipalities to use AVMs for agricultural valuations.

2.2.4 Trends and opportunities in the use of AVMs

Robson and Downie (2008: 4) found that AVMs are in use throughout the world. This includes India, Russia, South America, and many smaller countries. Some countries are "early-stage" users, while others such as Sweden, the US and Canada are "established" users. The established users have confidence in its use for second mortgage purposes and have also started to use it for first mortgage purposes.

They also found that a successful AVM model in one country would not necessarily be applicable in another country. It has to be adapted to local market conditions that drive values.

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).

In a survey undertaken by Robson and Downie (2008), with the participation of 473 valuers across the world, 44% of the respondents believe that they can benefit by using AVM data.

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

Gilbertson and Preston (2005: 127) indicated that there is not enough access to highly comparable data, which makes the application of mass valuation technology much more complex in the commercial property sector than in the residential property sector.

Tretton (2007: 488 & 505) 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 and quantity of data, the less feasible automation becomes.

Boshoff and 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.

2.2.5 Accuracy requirements

According to Pienaar (2015: 55), there is a general belief in the valuation industry that it is acceptable to have different valuations of the same property. These can differ by 10% in the value estimates. From personal communications with a number of valuers, who specialise in valuing farms, the common opinion is that, since farms are much more difficult to value than a residential property, the tolerable accuracy should preferably be within 15%. If it exceeds 20%, the valuation is not considered credible.

Crosby, Lavers and Murdoch (1998: 305) mentioned 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 important to determine the extent to which that valuation departs from the "true value" [selling price] of the property. Crosby (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 each other. Furthermore, they refer to a study by Hutchison (1996) where the valuation estimates were compared with the actual selling price. The results of the research were 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 was the matter of contention. "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".

According to the IAAO (2013: 13), the most generally useful measure for uniformity is the Coefficient of Dispersion (COD). However, it is important to take cognisance of the fact that ratio studies cannot be used to judge the level of appraisal of an individual property (IAAO, 2013: 7).

Rossini and Kershaw (2008: 1) conducted 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. Their research focused on establishing a set of standards for the accuracy of individual valuation. Rossini and 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 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 major advantage of Rossini and Kershaw's (2008) study is that they established guidelines for the accuracy of individual properties', within a group of properties, appraisal accuracy.

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

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

However, there is no maximum COD level specified for a developed farm. However, 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.

2.2.6 The use of regression analysis in the valuation of agricultural properties

Murray (1969: 276-285) described nine different studies done in the U.S.A. In the first study, the sale prices of 160 farms from 1916 to 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 such as 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 level of variance that was not explained by statistical analysis. There are similar complexities in the characteristics of both farmland and commercial property, which make the application of AVMs in the valuation of agricultural property more challenging. Arguably, even more difficult than in the case of commercial property.

- Farms are highly heterogeneous, and
- The quality and availability of data to develop successful AVM models to use in the valuation of agricultural property are often poor and scarce.

3. Methodology

The stepwise regression method was used to develop three MRA models. In this process, all the candidate independent variables in the model are checked to determine if their significance has been reduced below the specified tolerance level. If a non-significant variable is found, it is removed from the model (NCSS, 2015: online). By following this process, the regression model has been improved by removing the independent variables that have a non-significant influence on the dependent variable.

3.1 Sampling method and size

The aim of the researcher was to use data, as far as possible, from a homogeneous area regarding its natural habitat. Sixty eco-zone farms ("mixed bushveld") (South African National Biodiversity Institute, 2005: 26) in the JR, KR, KQ, LR, LS and MT registration divisions in the western area of the Limpopo Province were used. 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 (see Figure 1). The only exception is four farms that are close to Letsitele in the eastern part of the Limpopo Province. 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.

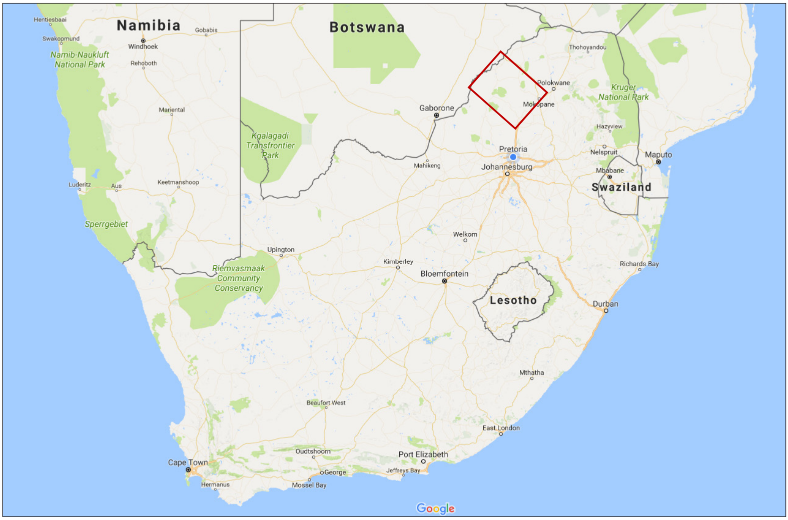

Figure 1: Study area
Source: Google Maps

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.

3.2 Data acquisition

The data used for empirical analysis 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).

3.3 Data analysis and interpretation of findings

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(s).

3.3.1 Pearson *r* correlation coefficient

Correlation coefficients measure the strength of linear association between two variables (Gujarati & 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 any relationship.

3.3.2 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 in the dependant variable is accounted for by the independent variables in the model. It also implies that 35% of the value of the dependent variable is not accounted for by the model (Gujarati & Porter, 2009: 493).

3.3.3 Adjusted R^2

For comparative purposes, the adjusted R^2 is a better measure than the R^2. The adjusted R^2 value is a calculated value that adjusts the analysis model if independent variables are added to increase the R^2 (Gujarati & Porter, 2009: 493). When a variable is added to a model and the adjusted R^2 does not increase, the new variable indicates no additional influence than would be explained by adding any totally irrelevant random variable (Wolverton, 2009: 296).

3.3.4 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 (SPSS, [n.d.]: online). 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)

3.3.5 Coefficient of Dispersion (COD)

According to the IAAO (2013: 13), the most generally useful measure of variability or uniformity is the COD. It is also the most important measurement for uniformity. 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 using equation 1.

$$COD = \frac{100}{Rm}\left[\frac{\sum_{1}^{N} | Ri - Rm |}{N}\right] \qquad (1)$$

Where:

COD = coefficient of dispersion, i.e., the average per cent of dispersion around the median assessment ratio;

Rm = median assessment ratio;

Ri = observed assessment ratio for each parcel;

N = number of properties sampled.

According to Wolverton (2009: 86), the COD is often used as a measure of uniformity in tax assessment studies to reflect the relationship between assessed value and actual value, or price.

3.3.6 t-value (Significant Testing)

The t-value is a statistical test indicating the significance in the difference between the mean of the actual selling prices and the mean of the estimated values, calculated by the regression analysis model (Gujarati & Porter, 2009: 4).

A t-value of 0 indicates that the value of the dependent variable is not dependent on the independent variable (Wolverton, 2009: 255). In a regression equation with 17 independent variables (as in Model 1), a t-value of 1.740 and higher indicates a p-value of .05 and lower.

3.3.7 *p*-value (exact level of significance)

In statistics, the term 'significant' means it is 'probably true'. The *p*-value indicates how likely it is that something is not true. A *p*-value of 0.05 means that there is a 5% probability that something is not true. Thus, it has a 95% probability of being true, and the null hypothesis can be rejected with 95% certainty. The p-value is defined as the lowest significance level at which the null hypothesis can be rejected (Gujarati & Porter, 2009: 835).

3.3.8 *F*-test

The *F*-test is a test to determine the overall significance of the estimated regression analysis. It indicates significance of the coefficients in the model for the number of independent variables used in the analysis (Gujarati & Porter, 2009: 240-242).

3.3.9 Durbin-Watson

Autocorrelation is the measure of a correlation between the error terms (Gujarati & Porter, 2009: 412). Autocorrelation 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 (Gujarati & Porter, 2009: 434-435).

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

3.3.10 Multicollinearity

Multicollinearity 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 interrelated (Australian Property Institute, 2015: 487).

3.3.11 Variance-Inflatory Factor (VIF)

The speed with which variances of a variable increase can be seen with the VIF. It shows how the variance of a variable is inflated by the presence of multicollinearity. The extent of collinearity increases as the variance of a variable increases (Gujarati & Porter, 2009: 328).

A common rule applied is, if the value of the VIF index exceeds 10, that variable is highly collinear (Gujarati & Porter, 2009: 340).

3.3.12 Heteroscedasticity

This tests the variance of errors over a sample. If the variance of error is unequal, the sample is heteroscedastic (Gujarati & 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).

3.4 Model descriptions

3.4.1 Dependent variable used in the model

This study aims to develop a regression model that calculates the total market value of the subject property, with the required accuracy. In model 1, the dependent variable is estimated value.

In models 2 and 3, the dependent variable is vacant land value. The reason for using vacant land value as the dependent variable rather than the total value is that the Depreciated Value of Improvements (DVI), which is to be added to the vacant land in order to calculate total value, depends on how accurate the valuer estimated these values. DVI has a very high probability of significance ($p = .000$ and $t = 4.085$) on the dependent variable. The value of the DVI variable, therefore, has a high significance on the dependent variable. The risk of a wrong DVI estimate is eliminated by using Vacant Land Value as the dependent variable.

3.4.2 Independent variables used in the model

A number of authors (Woolford & Cassin,1983: 214, 216; Bourhill, 1998: 81; Pienaar, 2015: 71-84) have identified independent variables that have a significant influence on a farm’s value.

The following variables, which were identified by the abovementioned authors, are used in this study:

- Date of sale;
- Size of the farm;
- DVI;
- Quality of the grazing;
- The number of hectares per livestock unit needed;
- The number of hectares legally under irrigation;
- Distance from the farm to the nearest town;
- Tourism infrastructure on the farm;
- Topography of the terrain, and
- Security in terms of game fence.

3.5 Accuracy requirement

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

4. Results and discussion

4.1 Model 1

Dependent variable: Total value.

Independent variables: All 10 of the abovementioned independent variables.

Table 1: Summary of statistical indicators, Model 1

Model	*R*	*R^2*	*Adjusted R^2*	*Std. Error of the Estimate*	*Durbin-Watson*	*COD*
1	0.945	0.893	0.850	R1 748 826	1.915	14%

The R^2 value of 0.893 is fairly high. This 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 that 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*1,748,826 from the real value (if the data is normally distributed), indicating a questionable accuracy of the model. The COD is 14%. This is lower than the maximum COD of 15%, which is the requirement for fair accuracy. However, out of the sample of 60 farms, 23 individual farm estimates 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 sufficiently accurate. The Durbin-Watson value of 1.915 indicates that there is no autocorrelation present.

Table 2: Model 1 ANOVA test results

Model 1	*df*	*F*	*p-Significance*
Regression	17	0.642	.000
Residual	42		
Total	59		

The calculated *F*-value of 20.6 is more than eight times the critical *F*-value of 2.52; 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 ($F = 20.6$, $p = .000$).

Table 3: Model 1 regression correlations and coefficients

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

Independent variable	*VIF*	*Pearson correlation*	*t-Value*	*p-Significance*
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 values are all well below 10, indicating that there is little or no multicollinearity present. The Ha/LSU variable is the highest, with a VIF value of 9.161, which is still below 10.

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 has the lowest correlation. The date variable has a negative correlation, because the older the transaction, the lower the impact on the dependent variable. Thus, it indicates that the price of the farms increased over time. Although it would be beneficial for the dependent variable to be time adjusted, a lack of accurate information for this purpose precludes this option. The use of a date variable as independent partly solves the difference in dates of sale, although it assumes a linear relationship between time and price. The date variable should be replaced by various date categories, if more data is available, in order to be more accurate, but would have to be considered in future research. 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 demonstrates that the price of the farms decreases when the carrying capacity decreases, which confirms the market value expectation.

The independent variables size, DVI and irrigation ha have p-values of .000, which indicates 100% probability of significance that the dependent variable is dependent on these independent variables. The t-values of all three 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 indicate statistical significance at the p = 0.025 level.

Town distance with p = 0.910 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.

Visual inspection of the model indicated homoscedasticity (not shown). 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 sufficiently accurate. There is a possibility that the model is sufficiently 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.

4.2 Model 2

Dependent variable: Vacant Land Value..

Independent variables: DVI and grazing were excluded in this model. This is advocated, as the value of the DVI is not included in the Vacant Land Value and the DVI was also excluded as an independent variable.

Table 4: Summary of statistical indicators, Model 2

Model	*R*	*R^2*	*Adjusted R^2*	*Std. Error of the Estimate*	*Durbin-Watson*	*COD*
4	0.931	0.867	0.822	*R*1 713 133	1.910	20 %

The R^2 value of 0.867 is marginally lower than in Model 1. This 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 1. This implies that 17.8% of the variation is not explained by the model.

The standard deviation of the error term of R1 713 133 is very similar to the number in Model 1.

The COD is 20%, which is higher than Model 1. It is higher than the maximum COD of 15% for fair accuracy. Furthermore, out of the sample of 60 farms, 28 individual farm estimates 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 Durbin-Watson value of 1.910 indicates that there is no auto-correlation present.

Table 5: Model 2 ANOVA test results

Model 2	*df*	*F*	*p-Significance*
Regression	15	19.134	.000
Residual	44		
Total	59		

The *F*-value is marginally lower than in Model 1. The calculated *F*-value of 19.134 is more than seven times the critical *F*-value of 2.52; 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)

Table 6: Model 2 regression correlations and coefficients

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	2.539	0.304	.568	.573
Game fence	2.202	0.137	.399	.692
Topography	2.346	0.183	2.151	.037
Vaalwater	1.479	-0.035	-.813	.421
Mookgopong	4.773	0.104	-1.458	.152
Alldays	2.742	-0.255	-1.596	.118
Letsitele	1.563	-0.108	-1.144	.259
Bela-Bela	3.869	0.213	.724	.473
Makhado	3.389	0.090	-2.369	.022
Lephalale	2.567	-0.117	-1.048	.300
Town Distance	1.597	0.218	-.119	.906

The VIF values are all well below 10, indicating that there is hardly any 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 2. The independent variables size and irrigation ha have p-values of .000, which indicates 100% probability of significance. Both the t-values are statistically significant at the p = 0.001 level.

Date with .084, game fence with .037, and Makhado with .022 have values with a higher than 90% probability of significance. Their t-values indicate statistical 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.

A visual inspection of the actual versus the predicted values revealed that no severe heteroscedasticity is evident. All the statistical indicators show that model 1 is more accurate than model 2. There is a possibility that model 2 is sufficiently 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.

4.3 Model 3

Dependent variable: Vacant Land Value.

Independent variables: reduced to only five, namely topography, irrigation ha, tourism, date, and size. These variables have the lowest p-values and the highest t-values, as indicated in Models 1-3.

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 nearest town were used. This implies that the geographic area is as homogeneous as possible (with the data available to the researcher). The aim of model 3 is to do a regression analysis regarding an area that is as homogeneous as possible, where the most significant independent variables are used, and which is not influenced by the DVI.

Table 7: Summary of statistical indicators, Model 3

Model	*R*	*R²*	*Adjusted R²*	*Std. Error of the Estimate*	*Durbin-Watson*	*COD*
7	.971	.943	.927	R1 055 333	1.889	14%

The R^2 of 0.943 and the adjusted R^2 value of 0.927 imply a high correlation between the dependent and the independent variables. The fact that the adjusted R^2 is higher and 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. This 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. Out of the sample of 24 farms, four individual farm estimates have an error term of more than 20%. Thus, 83% of the individual farm estimates is within 20% of the actual selling price. Therefore, this model is fairly accurate, but it still does not satisfy a high degree of accuracy or a "reasonable level of acceptance". The Durbin-Watson value of 1.889 indicates that it is undecided whether any autocorrelation is present or not.

Table 8: Model 3 ANOVA test results

Model 3	*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 calculated *F*-value of 59.614 is more than 13 times the critical F-value of 2.80; 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.

Table 9: Model 3 regression correlations and coefficients

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, indicating that there is hardly any or no multicollinearity 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.

Topography with .004 has a p-value with a higher than 95% probability of significance. The t-value indicates statistical significance at the $p = 0.025$ level.

Tourism with $p = 0.677$ has the lowest probability of significance. The t-value indicates statistical insignificance at a $p = 0.25$ level.

The independent variables size, irrigation ha and topography have $p \leq .05$ 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 irrigation ha variable with a value of 0.756 has the highest correlation. This indicates how valuable the presence of irrigation is 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, with the result that a log transformation on the data in this variable should be considered.

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 the *a priori* market value expectation.

A visual inspection of the model output indicated homoscedasticity (not shown) and, therefore, satisfies one of the underlying assumptions of regression analysis. The COD of 14% and the 83% individual estimates that are within the 20% accuracy requirement indicate that this model is fairly accurate.

Limitations of model 3 are that it covers only a relatively small geographic area, namely the area around Thabazimbi. One of the biggest limitations of model 3 is that the dependent variable is the value of the vacant land; it is thus 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. This, therefore, 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.

Table 10: 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	VLV	As in model 1, without grazing and DVI
3	24	VLV	Date, size, irrigation ha, tourism and topography and with only the Thabazimbi farms.

Legend

TV = Total Value

VLV = Vacant Land Value

VLV/ha = Vacant Land Value/ha

DVI = Depreciated Value of Investment

Table 11: Summary of the most important 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	R1 748 826	20.6	14	62
2	0.822	R1 713 133	19.1	20	53
3	.927	R1 055 333	59.6	14	83

The R^2 of 0.943 and the adjusted R^2 value of 0.927 is the highest of all the models.

The COD of 14% and the 83% individual estimates that are within the 20% accuracy requirement are also the highest of all the models and indicates that model 3 is the only model that 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. It should, however, be noted that these international benchmarks were initially designed for the US market, and for homogeneous property type. Although, they are the only standards set, they may not necessarily be applicable in the South African context, or specifically to agricultural property.

5. Limitations of the study

There is a paucity of literature available regarding the application of MRA models in the valuation of farms, other than some literature in the quarterly publications of the International Association of Assessing Officers (IAAO), which is only accessible by members at the cost of an expensive membership fee. The latter is not available to scholars. It is, however, suggested that the findings of this study be compared to those of the IAAO.

The availability of sufficient relevant and accurate data to develop MRA models for farm valuations is a severe limitation.

6. Conclusions

A valuer has hardly, if any, input when using a MRA and this is deemed a double-edged sword. It eliminates human error and bias and substitutes the physical property inspection as well as the valuer's skill, judgement and experience.

It is important to understand the factors that influence farm prices and the various unique and distinctive attributes that are inherently part of farms. These should be taken into consideration when valuing agricultural property. These value-influencing factors and distinctive attributes cause farm valuations to be complex and make it relatively difficult to satisfy accuracy requirements.

The accuracy of a MRA relies heavily on the quality and accuracy of the data 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 results of this stepwise regression analysis showed that it is difficult to access appropriate and accurate data to develop a regression model for agricultural property, which satisfies accuracy requirements.

Model 3 does satisfy the accuracy requirements for fairly accurate estimates, but it is not sufficiently accurate to satisfy high accuracy requirements. The reasons for the difficulty to acquire sufficient accurate data in order to be able to develop a MRA model that is sufficiently accurate to satisfy accuracy requirements, are multifaceted. Some of these reasons are non-farm factors that are difficult to translate into appropriate and accurate quantitative data in a MRA model.

An alternative approach to developing a MRA model (which is as accurate as possible) is to ensure that the geographic area is as homogeneous as possible; the geographic area must be very small, in order to avoid the inclusion of too many changes in the inherent characteristics of data points due to location. This will imply that multiple MRA models have to be developed for each municipal area. This will be a costly exercise and, therefore, contradict the cost efficiency of MRA. To eliminate the negative impact of too much heterogeneity, further research should be done on more advanced models such as geographic weighted regression and quantile regression techniques.

7. Recommendations

All the models, except one, that were developed during the stepwise regression process are not fairly accurate. No model has a high degree of accuracy.

It is difficult, yet possible, to develop MRA models that are sufficiently accurate. Therefore, if the MRA models that are currently used are not sufficiently accurate for municipal valuation purposes, it should be possible to improve the accuracy. Valuers should be cautious when using MRA models in municipal farm valuations, because it is possible that the MRA models do not satisfy minimum accuracy requirements. Under the methods applied in this research, a MRA valuation cannot replace a valuation done by a skilled and knowledgeable professional valuer, when high accuracy is required. This does, however, not preclude further research in the application of more advanced methods.

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