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Determinants of Agricultural Land Valuation in the Province of Huambo, Angola: A Quantitative Analysis

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Abstract: This work aims at presenting a review of the literature on agricultural land valuation, highlighting the elements of real estate valuation and the factors that determine the price of an agricultural land in the province of Huambo in Angola. A quantitative methodology was used, based on the collection of data from 612 agricultural properties that were up for negotiation in the province of Huambo in Angola. The valuation of an agricultural land is of great importance for development and economic growth in Africa. In the assumed methodology, multiple linear regression was employed. The results allow us to conclude that variables such as the land being legal, having electricity, being located on the urban fringe with possible future urbanization, being a location close to the urban center, facing a busy road, and allowing for the easy use of machines have a significant impact on the value of the land in question. This study contributes to the development and appreciation of the agricultural world, which are aspects that can greatly help in improving the environment and sustainability of the rural world.

Keywords: plural land values; urban pressure; farmland price determinants; hedonic variables of agricultural land; real estate

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1. Introduction

In the process of evaluating agricultural lands for commercial purposes, institutions are involved, which, in their analysis, try to combine various elements of land research, from land for distribution purposes to land for mineral extraction. Knowing the value of a land is a fundamental element in guaranteeing the continuity of the production cycles of consumer goods for the population [1].

In the evaluation of agricultural land, the concepts of market value and use value are essential for estimating the value of a property. Market value is more objective, reflecting transaction values and depending on external forces, such as supply and demand. It is the most relevant value in commercial transactions [1]. On the other hand, use value is more subjective, focusing on the land's potential for a specific owner. It relates to the income that the agricultural property can generate. This value may be higher or lower than the market value, depending on the owner's ability to extract utility from the land [2]. While the market value is more relevant in commercial transactions, the use value is crucial for assessing the productive potential of an agricultural land [3].

In a study on agricultural lands, ref. [4] considers that their prices result from two aspects: agricultural factors and non-agricultural factors. In a study on the agricultural lands of the Czech Republic, ref. [4] concludes that factors increasing the demand for agricultural lands include a proximity to already built-up areas (within 100 m), a proximity to a large municipality (more than 5000 inhabitants), a short travel time to the capital city (within 1 h), and access to the land parcel via a transportation network.

Ref. [5] concludes that within urban perimeters, there is a higher predisposition to pay near urbanized areas. Ref. [6] argues that land and housing form the economic foundation of a country. Urban land plays a crucial role in providing residential spaces for city inhabitants. According to [6], the prices of agricultural lands are influenced by socioeconomic factors, such as location, income levels, housing demands, and characteristics of the natural environment.

The elements that increase the value of agricultural lands are fruit trees, which raise the price of farms, as opposed to those with only forests. Likewise, lands far from urban areas have a less considerable value compared to those closer to the city. When it comes to evaluating agricultural lands, as long as all the information is available, the use of a linear regression method is an instrument capable of providing excellent conclusions for decision making [7].

Due to the degree of poverty, some rural communities have rural lands as their only asset. From the perspective of protecting farmlands and, at the same time, families, the implementation of a set of laws regulating the use and management of farmlands has been practiced in many countries. In this context, the European Union has regulated the land management process [7]. Regarding the characteristics of agricultural lands, a more relevant set is listed, namely, the types of soil and the diversity of the types of land areas, as well as others that are less considered, such as the distance to buildings, the distance to roads, and the quality of the soil [1].

There are notable differences when comparing the determinants of the agricultural land market and those of the real estate market. While both markets involve the buying and selling of land, the determinants of the agricultural land market are more closely linked to productive capacity and environmental factors, whereas the determinants of the real estate market are primarily associated with location, infrastructure, and urban regulation. The demand in each market also differs: in the agricultural sector, it is driven by the production of food and commodities, whereas in the real estate sector, demand is more related to urban development and housing needs [8,9].

As for determining the value of agricultural lands, elements such as productivity and soil fertility are fundamental. In this process, owners must consider the allocation of the value of the land, either for commercial purposes or for another purpose of social interest [8,10].

There is a greater demand for lands in rural areas and an increase in individuals with very well-defined objectives regarding the acquisition of land for housing purposes, which means that rural areas are increasingly populated. This phenomenon is due to an increase in people's awareness of aspects related to one's quality of life [7]. Agriculture is dependent on certain factors, such as rainfall conditions and soil quality, that are independent of human actions, which are quite influential due to the management of the generational process when it comes to agricultural practices.

The precariousness of jobs located in rural areas is reason enough in some locations for this population to emigrate to large cities in search of better living conditions, especially in the industrial sector. The conversion of an agricultural land for housing purposes on the one hand enhances the value of the land in question; however, on the other hand, this certainly has a negative effect, reducing production on the former land, which ceases to produce in order to make way for housing estates [11,12].

Ref. [13] concludes that the price of an agricultural land is influenced by several factors, with the size of the land area being one of the most significant. According to [14], although an agricultural land is primarily valued for its capacity to generate agricultural production returns, sometimes, the market value of an agricultural land exceeds its value for agricultural production. Ref. [14] argues that agricultural land prices are influenced by a combination of agricultural and non-agricultural factors, highlighting the importance of considering non-agricultural attributes and natural amenities in the valuation of an agricultural land.

Amenities are a key element in driving up the price of an agricultural land, as a result of people's constant demand for an increasingly adequate standard of living. The factors identified in the various authors' approaches are the basis for guiding the choice of and interest in an agricultural land. The elements that affect the productivity of an agricultural land are as follows: the fertility of the soil and the physical characteristics of the land, which harmoniously form the basis for the development of a given area. Furthermore, the fact that there is a range of infrastructures around an agricultural land that makes it possible to transport produced goods, especially access roads, industrial parks, and other facilities that support the preservation of products, results in an additional value over the desirable area [7,8,15].

According to [16], the development of agricultural land prices is based on four main components: (1) the productive component, which includes factors related to the capacity to generate income , depending on crop productivity, government payments, credit policies, among other factors; (2) the intrinsic component, which recognizes the intrinsic value of the land to the owner, taking into account factors such as income levels, population levels, location, urbanization levels, and site characteristics; (3) the speculative component, which arises from market expectations, anticipating that land prices will trend upwards in the long term and with the expectation that the land will be converted for it to be used for purposes other than agriculture; (4) the transactional component, which includes special considerations given to the buyer and seller; the nature of the sale (such as special financing, forced sales, and sales to relatives); the lot size; and the value of improvements.

Ref. [17] argues that according to traditional theory, the values of agricultural lands are determined by discounted future income flows. However, the authors of this work acknowledge that there are factors influencing agricultural land values, such as the possibility of converting a land to alternative uses.

This work aims at presenting a literature review on the subject of agricultural land valuation, highlighting the elements of real estate valuation and the factors that determine the price of agricultural lands in the province of Huambo in Angola. To achieve the proposed objective, this work, in addition to this introductory section, presents a literature review which characterizes the Province of Huambo and the hedonic factors determining the appreciation and devaluation of agricultural lands. Subsequently, the assumed methodology is presented, and formerly, the results are presented and discussed. At the end of this article, a conclusion is presented.

2. Survey of Relevant Literature

2.1. Characterization of the Province of Huambo

The agricultural area of Huambo is one of the most productive, as it is home to most of Angola's rural population, whose idiosyncrasy is predominantly the Umbundu culture, which is one of the most populous in Angola [18]. On 21 September 1912, in the city of Huambo and in the presence of high-ranking individuals from the Government and Administration, Norton de Matos created the Provincial Ordinance of 8 August 1912, in which a document of the foundation of the city of Huambo was drawn up [18]. Norton de Matos had a great passion for the city of Huambo and believed it should be the future capital of Angola.

The province of Huambo (Figure 1) has an average relative humidity that varies between a low average of 60% and a maximum average of 70% [19]. As for precipitation, the busiest months are from October to April, with 95% of precipitation (rain). For [19], the months with the highest rainfall are December and March.

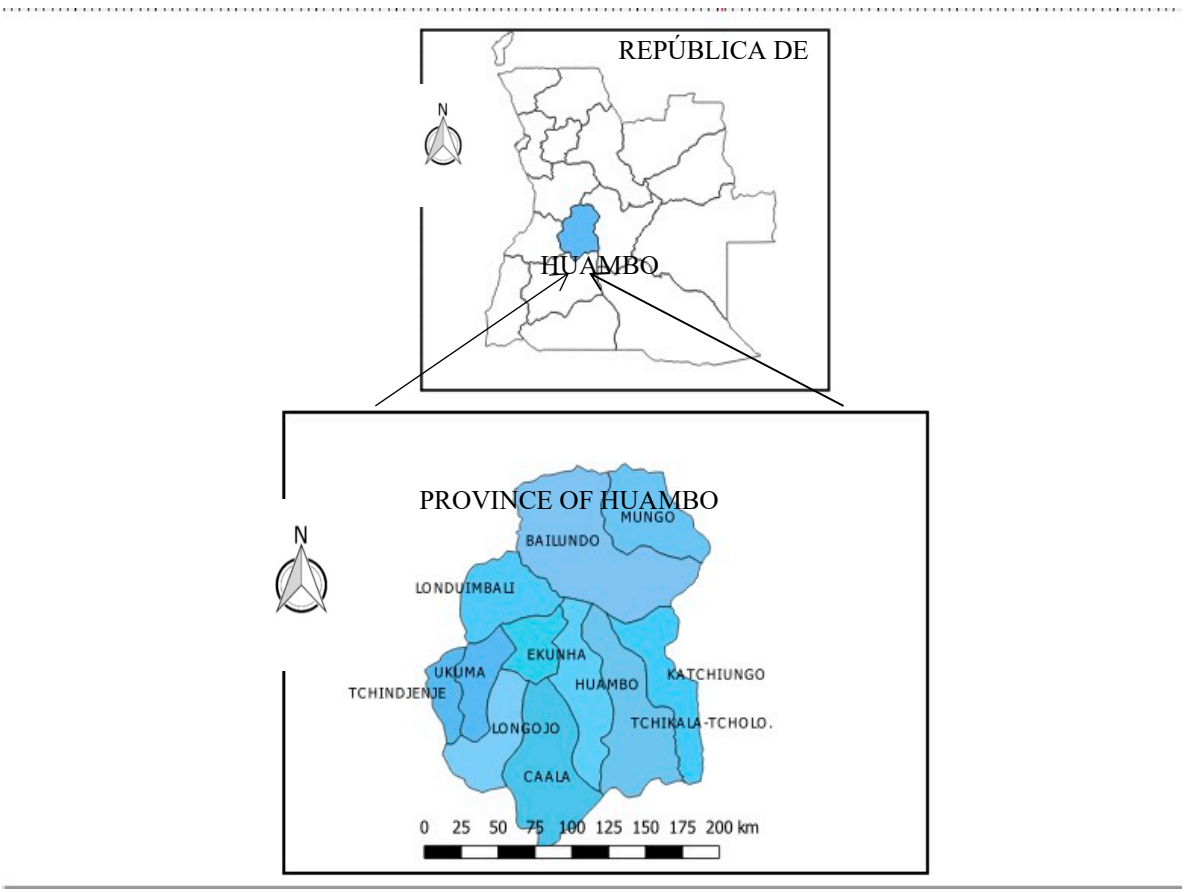


Figure 1. Presentation of the municipalities of the province of Huambo.

For [19], the province of Huambo, being located in the Central Highlands, has a very different climate compared to other provinces of Angola. The amount of rain that the province of Huambo receives, as well as the low temperatures that are recorded in this region, is a condition that makes its climate, at certain times of the year, a very cool climate [19,20]. There is a dispersion of the rural population. This population is located in the agricultural regions of the province of Huambo with higher productivity and fewer slopes, meaning that in the mountainous areas in regions such as Bimbi, Cumbira, and Lepi, there is a smaller concentration of the population [18].

Farmers have difficulties acquiring fertilizers, and the quantities of products harvested per hectare are low due to the soil not being very fertile [19,20]. Most of the population of Huambo is dedicated to vegetable production and has little dedication to corn cultivation, as corn is produced on a small scale, only for internal consumption by families [21].

Most families in Huambo own a plot of land around their homes, where they grow small crops, and this is very noticeable in the neighborhoods surrounding cities [19]. In more recent decades, the city and the province of Huambo have also had a growth impact driven by the growth and expansion of its airport [22].

Families residing in rural areas normally own land. Due to poverty, the amount of land owned by native residents in these areas is becoming increasingly small, passing it on to residents of urban areas with financial resources, who increasingly penetrate the villages, building farms and medium- and high-end homes [19,21]. The population's inability to purchase fertilizers due to their price relegates cultivation to an increasingly smaller space. On the other hand, the lack of land registration makes the natives increasingly prone to clashes with both government policies and land-usurping groups [21].

The province of Huambo has good hydrographic capacity, with much of it still to be studied and explored, especially in the Cunene plateau and in the Govi reservoir,

which together provide sufficient conditions for irrigated agriculture all year round along these water resources [23]. Forests in the province of Huambo are characterized by open woodlands, which, due to successive conflicts and pressures on the surrounding urban areas, have come under pressure in terms of soil, water, aggregates, and fauna [23].

Most of the population of Huambo, despite already owning some land in their area of residence, also farm in the lower reaches of the rivers, commonly known as 'olonacas'. Due to their poor soil, a majority of the crops produced here are corn and cassava [19].

The population of Huambo stands out in its insertion in the various sectors of the economy, namely, in the agricultural sectors, small industries, and the transformation sector [23]. The productivity resulting from small agricultural companies constitute a source of raw materials for large companies outside Huambo, as well as those abroad.

In Huambo, land obtained formally and informally (both) has the same purpose, which is the construction of a family residence or for agricultural purposes. Another form of acquiring land, predominantly in the province of Huambo, is by heritage, wherein land is transferred from generation to generation, and there is also the acquisition of land by a donation through marriage [23].

Since the owners of large lands are, at the same time, individuals with some financial resources, they are the only ones who have a majority of the lands registered, leaving the natives, mostly residing in rural areas, at the mercy of their principles of cultural tradition [19].

2.2. Variables of Valuation and Devaluation of Agricultural Lands

Regarding the price of agricultural lands, there are elements that must be disregarded, such as the skills gained over time by the owner during agricultural practices, which, in a certain way, constitute an added value, despite being a subjective element. The expectation that forms around the return of a determinant piece of agricultural land constitutes an element that leads to price variations, which can either trend downwards or upwards in relation to the market value and depending on the purpose for which the speculation was created [24].

There are several reasons why agricultural lands have received a great deal of trust when it comes to property investments, which stem from the degree of uncertainty of other assets in the face of economic fluctuations. In South Africa, an agricultural land is a privileged element for the acquisition of credit and is, in a way, the means of guaranteeing its granting. In turn, it constitutes the object of evaluating the mechanisms to guarantee the process of obtaining financial resources.

Table 1 presents factors that determine the productivity of an agricultural land, as well as the authors who refer to them.

Table 1. Factors affecting the productivity of agricultural lands.

References	Factors Affecting the Productivity of Agricultural Lands
[15,24–26]	Soil fertility and physical characteristics of the soil.
[1,12,27]	Data on the history of cultivation, local knowledge, and worldwide data.
[28]	Physical size of the land.
[2,7,29]	When families move from urban to rural areas, they are sometimes responsible for the increase in value of an agricultural land.
[8,30–33]	Soil fertility, soil quality, land quality, and land size.
[2,15,34,35]	Physical conditions of the land, the capacity of the land in terms of soil fertility, environmental characteristics of the land, and the function or activity to be assigned to the available land.

Source: own elaboration.

Some elements of importance attributed to agricultural lands are the store of value [36], the means of guarantee [37], family life [38], and the well-being of the population [15,25].

Some elements considered to increase the value of agricultural land prices are presented in Table 2. It can be concluded that the elements related to the appreciation of a land are positive, which, in turn, raise prices, and others tend to reduce the appreciation of agricultural land prices.

Table 2. Elements that increase the value of an agricultural land in terms of price.

References	Elements That Increase the Value of an Agricultural Land in Terms of Price
[15,39]	Productive capital, expectations, and subsidies.
[35,40]	Availability of labor, capital available for investments, profitability of the farm, future expectations, among other variables, and irrigated land.
[17,41]	Farm size, climatic variables (temperature or rainfall), infrastructure, and irrigation.
[27,37,42]	Production capacity of the agricultural land and ownership of the agricultural land.
[9,36]	Expectations and productivity capacity in relation to returns on investments.
[17,42–44]	Urban developments in the region, demographic evolutions, transport networks, and trade networks.
[2,17,43,45]	Land income; land productivity: rainfed or irrigated, forestry or herbaceous, average farm size, and soil productivity; non-agricultural factors: average wage in the local industry; average rainfall, average temperature, and population density; erosion and environmental contamination; and location: population density, soil quality, risks of waterlogging, wind speeds, hours of sunshine, and relative humidity.
[12,14,17,29,30,46–48]	Amenities, increased leisure, attractiveness to retirees, better road links between rural and urban areas, built infrastructures, sustainable rural developments, efficient land management, natural landscapes, tranquility, nature, a clean environment, beach/river pools, and churches and chapels.

Source: own elaboration.

There are influential aspects that stand out in the appreciation of agricultural land prices, such as the presence of natural landscapes and attractive conditions, such as churches and chapels, a clean environment, sustainable developments, urban developments, etc. Others are considered negative elements that, in turn, culminate in the devaluation of agricultural land prices, namely, erosion, soil contamination, inflation, a lack of security in rural areas, the lack of road networks, the lack of the efficient management of soils, and the lack of electricity. The fact is that in Angola, there is no proper land market, although there is the actual buying and selling of land, both formally and informally.

As presented in Table 3, agricultural land prices are influenced by a variety of interrelated factors. Firstly, soil fertility is a crucial determinant, where soils that are more fertile tend to increase the land value. Location is equally important, including the land's proximity to urban centers, infrastructure, market access, and soil quality. The current and potential use of a land, such as the type of crop in practice, agricultural production potential, and land-use history, also play a significant role. The availability of water for irrigation and access to reliable water sources are critical factors.

Table 3. Factors affecting the price of agricultural lands.

References	Factors Affecting the Price of Agricultural Lands
[2,4]	The higher the soil fertility, the higher the price of the agricultural land.
[3,5,6,13,14,16,17]	Location—proximity to urban centers, infrastructure, access to markets, and soil quality.
[5,17,26]	Current and potential use: the current type of cultivation, agricultural production potential, and historical land use.
[5,16,49]	The availability of water for irrigation and access to reliable water sources.
[5,6,14,17]	Regulations and government policies are crucial factors in the evaluation of agricultural lands. This includes environmental regulations, agricultural policies, subsidies, and government incentives.
[2,5,17]	Market conditions: the demand for agricultural lands, trends and prices of agricultural commodities, and general economic conditions.
[5,6,14,39]	Income levels of farmers and the general population in a given region.
[6,13,14]	The demand for housing, population density, and urban development impact land values, particularly in areas near expanding urban centers.
[6,16,17]	The commodity market (commodity prices) and the demand for agricultural products can also affect the values of agricultural lands.
[3,13,14]	Land size; the larger the area, the higher the price of the land.
[16,27]	Family and personal relationships, social norms, and networks of relationships.

Source: own elaboration.

Government regulations and policies, such as environmental regulations, agricultural policies, subsidies, and incentives, can directly influence prices. Market conditions, including the demand for agricultural lands, trends and prices of agricultural commodities, and the general economic situation, affect land values. The income levels of farmers and the local population influence the capacity to acquire and invest in agricultural lands.

Housing demands, population densities, and urban developments impact land values, especially in areas close to growing urban centers. The commodity market, reflected in the prices and demands for agricultural products, also has a direct influence. The size of the land is another factor, where larger plots generally have a higher absolute value. Additionally, family and personal relationships, social norms, and networks of relationships can affect transactions and the perceived value of an agricultural land.

Therefore, we can summarize the unavoidable aspects when working with hedonic models in the valuation of agricultural lands in the following five points:

a. Legalized lands and the existence of electricity

A land being legalized and having electricity have a positive impact, as recommended by the authors of [41,43,50,51]. For [52], one of the obstacles leading to a decline in large-scale productivity in agricultural production in rural areas is the absence of an electricity network in these areas, which could facilitate the use of intensive means for better quality and greater quantity production.

b. Land on the urban edge with possible future urbanization

In refs. [5,17], the authors included the following characteristics of agricultural lands: the diversity of the type of soil area, the type of soil, the diversity of soil types on the property, the shape of the land, its distance to roads and the quality of these roads, its distance to urban buildings, the area of the farm, and the price per hectare. Refs. [6,13,31] state that certain factors attributed by rural landowners add value to a rural land, in the sense that it is reflected in the demand for it.

c. Distance to the urban center of Huambo (in Km)

Refs. [6,33] suggest that the quality of a land and its proximity to the urban center positively influence the value of an agricultural land, and the authors of these works observe that the price of an urbanized land is affected by non-agricultural factors, such as its distance from central areas, shopping centers, and schools.

Refs. [13,14,41] also observe that the population's distance from urban centers has a negative effect on the value of a land, which translates into higher costs, among other factors, while urban density growth rates have a positive effect on the value of agricultural land, due to the scarcity of land for urban growth.

d. It faces a busy road

For [11], a good road network system results in an increase in the price of an agricultural land, as it is considered an incentive that aims to encourage individuals to carry out various activities. Ref. [11] also considers that improving a road is closely related to price distortion. Ref. [8] attributes less significance to its distance from buildings and its distance to roads and their quality. Refs. [14,16] take into account factors such as the land's capacity to produce income; its income production potential; its ease of cultivation; the available natural water resources (riverbanks, lands with several perennial and intermittent springs, ponds, etc.) and artificial water resources (cisterns, artesian wells, dams, water tanks, drinking fountains, etc.); access to the property (asphalt or dirt road); and the presence of water and electricity, provided by public companies.

e. Allows for the easy use of machines

Refs. [13,14,41] observe that the presence of infrastructure and the possibility of irrigation have a positive and significant impact on a land's value. Ref. [41] concludes that the larger the property size, the lower the value per m^2. The authors of [13,15] understand that the value of an agricultural land is closely related to the growth of the public and private structures, as well as the development of the transport system in a given State.

2.3. Study Hypotheses

The research hypotheses of this study are a part of the theoretical logic of the research problem, based on the literature reviewed, and the logic of testing the variables that have an impact on the values per m^2 of agricultural land, in its different aspects. The following sections list the research hypotheses based on the literature review and resulting from the articulation of the methods used to build the model for the variables to be tested in order to verify the following hypotheses:

Hypothesis 1. *Legalized land has a positive impact on the value per m^2 of the agricultural land, ceteris paribus.*

In the province of Huambo, there is legalized land and land to be legalized, which people pass on from generation to generation. Even so, these lands that are not legally owned are traded. Legalized land is expected to have a higher value than non-legalized land. This is in line with [37,42].

Hypothesis 2. *The existence of electricity has a positive impact on the value per m^2 of the agricultural land, ceteris paribus.*

The existence of basic infrastructures, such as communication routes and electricity (among others), are elements that increase the value of agricultural lands. This hypothesis is in line with the literature expressed by the authors of [1,8,15,24,25].

Hypothesis 3. *The location of the land on the urban edge, with possible future urbanization, has a positive impact on the value per m^2 of the agricultural land, ceteris paribus.*

Land on urban edges is more valued. This hypothesis is in line with [1,8,15,31].

Hypothesis 4. *The greater the distance of an agricultural land from its provincial capital, the greater its negative impact on the value per m^2 of the agricultural land, ceteris paribus.*

This hypothesis appears in opposition to hypothesis 3. The authors who refer to it are [1,8,15,31].

3. Methodology

In order to study the factors with an impact on the valuation of an agricultural land, which were mentioned in the literature review, this study was carried out. A database was designed, where numerical and qualitative information about agricultural lands that were for sale in the province of Huambo in the periods of May, June, July, and August 2022, was collected.

To test the survey model on the preference of properties for agricultural lands in the province of Huambo at the level of the host municipality, 30 records were made in order to assess the inaccuracies that could be found in the model to be proposed for data collection. Once the analysis was complete, data on the properties (agricultural lands) that were for sale in the province of Huambo were collected.

The province of Huambo was selected to collect data on agricultural land property preferences. The province of Huambo, the municipality with the largest population among other municipalities, was the target of the database model test, in the initial phase of its approval for application. In the opinions of [53,54], the t-Student test also serves to test whether or not the means of two populations are statistically different.

The present study essentially aims to verify the items that have an impact on the value per m^2 of agricultural lands, in the province of Huambo in Angola, against the backdrop of the reviewed literature, thus supporting scientific knowledge on this subject.

In the first phase, the sample is presented and described, referencing the sources of the information used; the data processing process; and the operational definition of the variables, dependent and independent; included in this study.

Next, the research methodology used is described, that is, the model created that allows the dependent variables to be related to the independent variables, in order to obtain empirical results, we used the multiple linear regression model (MRLM).

3.1. Operational Definition of Empirical Variables

According to [55], for a hypothesis to be seen as a scientific hypothesis, it must be capable of empirical refutation. To meet this requirement, empirical variables or attributes were defined.

In this way, and in the search for answers to the research hypotheses, the value per square meter (m^2) was considered as the dependent variable, which was calculated by dividing the sale value (offer value) of the agricultural land in the sample by its area in m^2.

Regarding the independent variables, the indicators associated with the study hypotheses led us to consider several independent variables.

- The morphology of the terrain (flat, slight slope, steep slope);
- Allows easy use of machines (yes/no);
- Legalized land (yes/no);
- Land with normal configuration (yes/no);
- Has infrastructure (yes/no);
- Soil productivity (bad/good/reasonable);
- Type of land (irrigated/dry);
- Land on the urban edge, with possible future urbanization (yes/no);
- Distance to the urban center of Huambo (in km);
- Nearest urban center (Huambo/Caála/Bailundo);
- Distance to the nearest urban center (in km);

- Distance to the nearest agricultural product market (in km);
- Has amenities (tourist, river, monument, landscapes or others) (yes/no);
- Does a river/stream/lagoon pass through the property (yes/no);
- There is a history of flooding on the property (yes/no);
- Type of land (with abundant water/with fruit trees/forest/dry);
- Has electric light (yes/no);
- Land faces a busy road (yes/no);
- Land fenced with a wall (yes/no).

The functional relationship shown in MRLM between the dependent variable and the independent variables is of the following type:

$$Y_i = \beta_0 + \beta_1 X_{1,i} + \beta_2 X_{2,i} + \beta_3 X_{3,i} + \ldots + \beta_k X_{k,i} + \varepsilon_i \quad (i = 1, \ldots n) \tag{1}$$

Y_i—the dependent variable, i.e., the value per square foot;
β—coefficients of the regression to the estimate;
X_i—the independent or explanatory variables;
ε_i—the error or random variable.

In this context, the explanatory power of the independent variables over the dependent variable was tested.

3.2. Sample

To identify the population and consequently select the sample to be studied, the population density of Huambo's municipalities was taken into account, as shown in Table 4, with the selection of the Huambo Municipality; Bailundo Municipality, located in the north of the province; and finally, Caála Municipality, located in the north of the province, as having the highest probability of marketable agricultural properties. Also, because these three municipalities have been awarded centralized housing, consisting of apartments, ground-floor villas and simple villas, 3200 homes have been built in the municipality of Bailundo, 4200 homes in the municipality of Caála and 2200 homes in the municipality of Huambo over the last 10 years. Several power substations have also been erected in the three municipalities in order to provide cheaper and more available energy to promote the agro-industry. Data collection regarding marketable properties began in May and ended in July 2022.

Table 4. Projected population by municipality at the level of the province of Huambo, 2022.

Population	Population by Municipality	Percentage of Population (%)
Huambo	934,127	35.3
Chicala Cholohanga	135,743	5.1
Catchiungo	158,050	6.0
Bailundo	385,674	14.6
Caála	366,480	13.9
Ekunha	108,103	4.1
Ukuma	72,104	2.7
Longonjo	120,625	4.6
Mungo	148,518	5.6
Londuimbali	175,790	6.6
Chinjenje	39,866	1.5
Total	2,645,080	100.0

Source: INE 2022.

Population selection was limited to municipalities with a higher population density, according to data published by INE 2022. The initial sample consisted of 612 rural properties that were for sale in the province of Huambo. An agricultural land with a value per m^2

of less than AOA 1 and more than AOA 500 was removed, leaving the database with a sample of 553 rural properties.

The database contains information on 553 agricultural plots, which were subsequently analyzed. The agricultural plots have an average value of AOA 26.99 per square meter and an average area of 1,524,183.00 square meters (equivalent to 152.42 hectares). Additional data on the plots are presented in Table 5.

Table 5. Some sample data.

	Yes	No
Legalized land	167	386
Has infrastructure	405	148
Has a residential dwelling	99	454
It possesses irrigation infrastructure	20	533
It has infrastructure for livestock farming	29	524
Irrigated land	163	390
Land on the urban edge, with possible future ubranization	185	368
Has amenities (tourist, river, monument, landscapes or others)	257	296
Does a river/stream/lagoon pass through the property	316	237
There is a history of flooding on the property	148	405
Land with abundant water resources	162	391
The property contains fruit trees	111	442
Has electric light	22	531
Land faces a busy road	295	258
The area is easily accessible	396	157
Land fenced with a wall	29	524

Source: own elaboration.

Thus, from Table 5, it can be highlighted that a significant portion of agricultural lands for sale in the province of Huambo, Angola, is not legally registered and lacks infrastructure. Very few properties have access to electricity.

3.3. Multiple Linear Regression Model Methodology

To test the relationship between the value per m^2 of an agricultural land and its different characteristics, it becomes inevitable to proceed with the estimation of an econometric model. In this way, we seek to conclude what types of relationship the independent variables present in explaining the dependent variable, that is, the relationship between the value per m^2 of an agricultural land and its hedonic characteristics.

A quantitative and correlational research was preferred. Quantitative, because it uses numerical data, in obtaining information, descriptions, and testing of the relationships between the various variables. Correlational, because it aims to explore and determine the existence of relationships between the variables in the hypergeometric plane. In the opinion of [56], regression models verify the "relationships between a set of metric explanatory variables or dummies and a metric dependent variable, that is, it seeks to evaluate the impact of each explanatory variable and how effective the model is suggested".

The research methodology used in building the model to test the hypotheses of the object of study to achieve our research objectives was similar to [55], in assuming the multiple linear regression model (MRLM). MRLM is a data analysis technique that assumes that there is a linear relationship between the dependent variable and a set of explanatory, or independent, variables [57].

The statistical software Statistical Package for the Social Sciences (SPSS) version 26 was used to estimate the regression model. In the regression, the *p*-value was considered for a significance level of 5%. The selection of variables with discriminative power was carried out using the Stepwise method, in order to obtain the best possible model. This method consists of the combination of two other methods, Standard Regression and Hierarchical or sequential Regression, that is, it is a mixture of Forward and Backward which, according to [53], allows the analysis to automatically add or remove variables to the analysis process,

depending on their discriminatory capacity and compliance with the assumptions. After obtaining the best model, the MRLM assumptions were tested by analyzing the correlation coefficient (R), the coefficient of determination (R2), the Durbin–Watson residual tests and the Kolmogorov–Smirnov normality.

4. Estimation Analysis and Validation of Model Assumptions

In the initial exploratory phase of linear regression, the variables that were statistically significant in explaining the dependent variable and those that met the assumptions for model validation were tested to identify the best model. In Multiple Linear Regression (MLR), the Stepwise method was applied, where all variables were statistically significant at a 5%-significance level.

In the current investigation, the model presents an explanatory capacity of 36.4% for the value per m^2 of agricultural land. Thus, we intend to demonstrate the statistical inference of the regression model that we consider to be the most explanatory and robust, and we begin with an approach to the analysis of variance of the model, by looking at the Anova table of the regression, which allows us to test the hypotheses H0: $\beta 1 = \beta 2 = \ldots = \beta k = 0$ vs. H1: $\exists i \neq \beta i \neq 0$; (i = 1, . . ., k). This statistic is associated with a *p*-value = 0.00, for both regressions, which means that it is statistically significant at a significance level of 5%, rejecting H0 to the detriment of H1, from which it can be concluded that the models are significant.

The presence of multicollinearity was verified through the VIF for the regressions that presented a value lower than 5. If the variables presented a value greater than 5, according to [53], the presence of multicollinearity was verified. This verifies the assumption of multicollinearity, concluding that there is no correlation between the variables.

Regarding the Durbin–Watson statistic, as our sample is slightly small, when consulting the Durbin–Watson value table, we concluded for the three regressions that d [dU;4-dU]; therefore, H0 cannot be rejected.

According to the Kolmogorov–Smirnov test used to conclude whether the errors follow a normal distribution, the models present a *p*-value higher than the significance level of 0.05; therefore, H0 is not rejected; that is, the data present a normal distribution, and we can conclude that in the models, there is no apparent violation of the assumptions.

Below is a table (Table 6) of the best model of the various models tested, showing the multiple correlation coefficients, the coefficients of determination, the adjusted coefficients of determination, the Durbin–Watson statistic and the F-statistic.

Table 6. Summary of statistically significant outputs.

	Value per m^2	**Sign**
(Constant)	13.804 *	
Legalized land	36.392 ***	+
Has an electric light	32.672 *	+
Land on the urban fringe with possible future urbanization	10.710 *	+
Land in Caala	24.034 **	+
Distance to the urban center of Huambo in Km	−0.142 *	−
It faces a busy road	13.685 *	+
Allows easy use of machines	12.685 *	+
R	0.364	
R^2	0.132	
R^2a	0.122	
D W	1.226	
F	3.909 *	

Dependent variable: * significance $p < 0.05$; ** significance $p < 0.01$; *** significance $p < 0.001$.

When analyzing the results, it is important to consider that Angola experienced years of civil war, leaving its population with unmet basic needs and making rural living conditions difficult. Therefore, several items that are a part of the literature review and are

included in the database do not appear in the linear regression results due to their lack of statistical significance.

Hence, we can observe that a land being legalized and having electricity has a positive impact, as recommended by the authors of [41,43,50,52].

The agricultural lands in Caála have a positive impact on their value per square meter due to several attractive features. Notably, the presence of the Gove Dam provides a reliable energy source and includes a reservoir named after the dam itself. Another element that also influences the price per m^2 of lands is the presence, in this location, of an industrial park. Finally, another element that, in turn, affects the price of land in this municipality is the passage of the Benguela Railway, an international line that crosses the Republic of Angola and connects the country of Lobito–Benguela, a province on the south coast of Angola, to the province of Luau–Moxico, which borders the Republic of Zambia to the east.

The distance to the capital of the province of Huambo, the city of Huambo, has a negative impact on the value per m^2. Thusly, the greater the distance in kilometers, the lower its value by AOA −0.142 per square meter. This result is in line with those of [31,33,41,51].

Other hedonic characteristics of an agricultural land with a positive impact on its value per m^2 are that it faces a very busy road and that the agricultural land allows for the easy use of agricultural machinery. This conclusion is in agreement with the authors of [11,15,41,51,52].

The presence of energy close to an agricultural land stimulates local development through the growth of small businesses, both those related to the agricultural sector and those unrelated to it. The presence of electricity, whether located in rural or urban areas, not only increases the value of a land located nearby but also encourages the creation of benefits in the economy through the payment of energy consumption costs due to positive externalities. Therefore, the appreciation of these lands is related to the expectation of reduced energy costs on the part of rural entrepreneurs and others.

5. Conclusions

This work aimed at presenting a literature review on the subject of agricultural land valuations, highlighting the elements of real estate valuation and the factors that determine the price of agricultural lands in the province of Huambo in Angola. Through multiple linear regression, we observed that if the land is legalized, and if there is electricity, its value per m^2 increases. These are idiosyncrasies typical of a region that was plagued by war and that is still looking to enter a level of development and economic growth. Although much has been done in recent decades, since peace was achieved, much remains to be done, which is a cause of motivation for present and future generations.

Further, an expected fact is that lands on the urban edge, with the possible development for future urbanization, have greater value. In the present case, in addition to the city of Huambo (the capital of this province), there is another large city that is undergoing rapid development, which is Caala. This city also has an industrial area of some size, which is why agricultural lands in this area have seen a positive increase in value. A negative sign, also expected, is the increase in the land's distance to the provincial capital. The greater the distance to the economic and social center of the province, the lower the value of the land per m^2. Other items that add value to agricultural lands include facing busy roads and allowing the easy use of agricultural machinery.

This work allows us to indicate some paths for political decision makers in the province of Huambo in Angola. Therefore, the opening of roads, electrification, and construction of infrastructures is important for the valorization of the agricultural world. Another important and pressing aspect is to support the legalization of agricultural lands for those who own them. Given that there are lands that are not registered, there is the risk of illegal land appropriation, or there could be problems in the future with their possession. Naturally, there is a greater business risk, which is why the market value is lower. These

are aspects can greatly contribute to increasing rural wealth and, consequently, improving the lives of people.

As a limitation of this study, it should be noted that it was conducted in a region that has been affected by war for over forty years. The area where the study was carried out lacks electric power, potable water, sanitation, and other basic living conditions. Additionally, most properties in the region are not officially registered. These factors may constrain the model obtained compared to other countries.

As future work, it would be important to understand other variables that may have an influence on the value of agricultural lands, typical of the region's idiosyncrasies, and what is the impact on the value per m^2 of an agricultural land, due to its proximity to rural markets selling agricultural products.

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