Land Governance for Land Markets

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Key words: land governance, land markets, valuation, land prices

SUMMARY

How land markets, land prices and their respective dynamics are organized, is very much determined by how land tenure historically evolved and how the country's land administration system is organized. But as known, all interventions linked to land, whether through land reform, land consolidation, expropriation, protected areas, or road construction, will affect the land and their land rights. Consequently, land interventions will also influence – to a larger or lesser extent – the land market and its land prices. For a well-functioning land market, the valuation of land is an important condition to determine the land price. It supports negotiations about the land price between buyer and seller, obtaining a mortgage, levying of taxes, and determining compensation in case of land interventions.

For most developing countries the lack of a good and affordable valuation system is a big challenge for taxation, for expropriation, for land consolidation and for other policies. The lack of a systematic valuation methodology leads to inconsistent valuation practices, leading to lawsuits and requires sufficient resources. For most developing countries, the lack of a good and affordable valuation system is a big challenge for public interventions like taxation, for expropriation, for land consolidation and for other policies.

This article aims to show the importance of land markets for land administration and will elaborate on some cost-effective methodologies enabling land valuation in various contexts. After a short introduction providing background information about the relation between land administration, land prices, and land valuation, three different cases will be discussed. First, a land price monitoring system will be presented that was developed based on advanced land administration information combined with information from other data sets. Second, a Brazilian example for obtaining land prices based on a local survey and using hedonic prices, will be presented. Third, a mass valuation methodology based on banded valuation with relative values for a land consolidation project in the Netherlands will be explained. Together these three examples provide a good overview of variations in land valuation, ranging from high-end land administration context to a developing context where such information is absent or not completely available.

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1. INTRODUCTION

The performance of the different land markets in any place, in any country, is directly and indirectly related to the economy, the environment, the wellbeing of the people, and natural resources for example. Operational characteristics of land markets and land prices are very much determined by their legacy; how the land tenure system evolved over time, how the land administration system functions, and to what extent land transactions are formalized. For a well-functioning land market, the valuation of land is an important condition to determine the land price. It supports negotiations about the land price between buyer and seller, obtaining a mortgage, levying of taxes, and determining compensation in case of land interventions.

But as known, all interventions linked to land, whether through land reform, land consolidation, expropriation, protected areas, or road construction, affect the land and their land rights. Land speculation also plays an important role. All these issues are strongly linked to how land administration is set up in a country. Mostly, in such countries people are not aware that these issues get complicated, because the country lacks an organized and reliable land administration system. The lack of a systematic valuation methodology leads to inconsistent valuation practices, leading to lawsuits and requires sufficient resources. For most developing countries, the lack of a good and affordable valuation system is a big challenge for taxation, for expropriation, for land consolidation and for other policies.

This article aims to address the importance of land prices and the valuation of land in the context of different cases and show that simpler methods of obtaining prices for the different aims is possible. The focus is on rural land markets, although the mechanisms are similar for the urban context. The next chapter provides some background information about the relation between land markets, land administration, and valuation. In this section besides emphasizing that land prices are always volatile, and thus valuations are always questionable, it proposes the banded system for valuation as a simplified solution. The third item shows the Dutch evaluation method as an important benchmark for the issue. The land price monitor in the Netherlands shows the other end of the spectrum where all needed data is digitally available in standardized and interoperable data sets. The fourth describes a case about land valuation in Brazil, where hedonic prices method was used to estimate equations that can be used for estimation of different types of properties. The case of Brazil provides information on how valuation can be organized without access to a nationwide standardized land administration system or other data sets. The fifth chapter monitoring land prices in the Netherlands a banded valuation method applied in land consolidation in the Netherlands. It shows an example of a banded valuation system, where similar land is grouped into several classes according to their relative value.

2. LAND ADMINISTRATION AND LAND MARKETS

2.1 Role of land administration in land markets

Society has always been related to the land in some way and this relationship always tends to become more organized as society evolves and gets organized. The so-called Land Management Systems, known worldwide as LAS - Land administration systems are understood as:

> *"An infrastructure for the implementation of land policies and land management strategies to support sustainable development. Such infrastructure includes institutional arrangements and a legal procedural framework, with a view to information on land management and dissemination of systems and technologies necessary for allocation and support to land markets, assessment, use control and development of soil interests"* (Williamson et al., 2010, p.453).

In Western countries, concepts and ideas about the soil are integrated in the creation of land management systems, corroborating land management as a physical asset. Such land concepts demonstrate the understanding of each community. However, the adequacy between the physical and cognitive aspects of the land is essential for such systems to be able to perform their fundamental task, which is the translation of how people think about the land and the management of the land based on these understandings.

Such institutions develop principles to assist land issues around the world, and given the proposed barriers and solutions, the character of land governance in a given territory is defined. Figure 1 shows the prospects for the functioning of an efficient and land administration system. Both the land register and the cadastral map are at the heart of the land administration system. To achieve a sustainable development, four other aspects of the land administration system have to be in place: land tenure, land value, land use, and land development. The two first will, together with the cadaster create efficient land markets. The other two also with the cadaster will guarantee a good land use. So, for good functioning land markets the land rights should be clearly established as well as a good system of assessment and land prices has to be organized, all based on the mapped land cadaster.

Within this focus, interventions related to land governance can have direct impacts on economic development, for better or for worse. Based on analyzes of a collection of these interventions in various parts of the world, Deininger and Feder (2009), if the conditions are right, noticed that good land administration will result in:

a. improved institutional performance and governance
b. reduced costs for protecting property rights
c. investment in land improvements

Deininger (2003) specifically, paid much attention to the links between good land administration and land markets and showed that its main impacts are:

a. creating efficient renting markets
b. selling markets development - where prices are similar to expected economic gains with land

c. better use of land reducing erosion and using better conservation techniques
d. increase in land value
e. expanding access to credit.

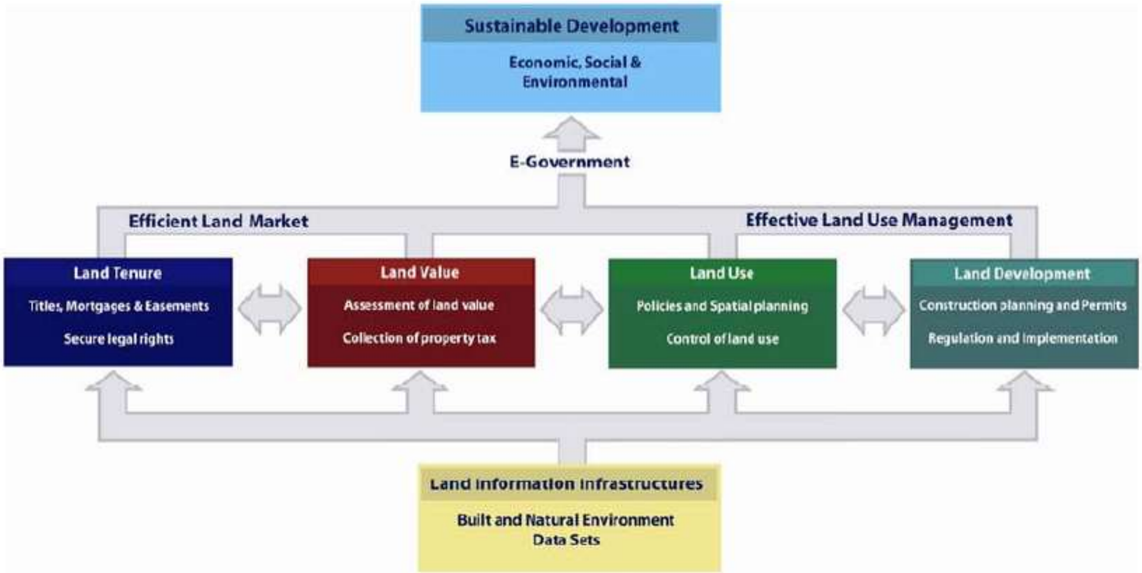

Figure 1 – A Global Land Administration Perspective (Enemark, 2004)

2.2 Land valuation

As was indicated previously, good land administration systems require good information about land markets and land prices. This information is considered important for different purposes, such as for transactions, monitor the trends on the (agricultural) land market, housing market, taxation, expropriation, or land consolidation.

But land trade dynamics and so its prices are determined by the markets. As Telles et al. (2018) have shown, in the economic theory literature exists a long theoretical discussion on the main determinants of land prices that has been going on for centuries. Reydon et al (2014) proposed a modern institutional approach to understand the land price formation. They showed that land prices have always two components: the productive and the speculative expectation on the land use and thereby its value. Besides that, land prices are in general locally determined, but can be profoundly affected by regional and national dynamics. So, land prices are always quite volatile and unpredictable. In Reydon et al(2014:393) words:

> *"In summary, rural land can be characterized as being, simultaneously, a capital and a liquid asset, negotiated at flexible prices – established by the capacity of the owners to accumulate the asset. The main reason for this is that the supply of land is fixed, and the market price will be determined by the dynamics of demand. The expectations of the owners can determine the quantity of land to be negotiated, but the purchasers' expectations of future gains with the use of the land is what will establish the price."*

What is clear from the literature is that there is no objective value, since value can always be discussed based on changes in time, location, and people's personal expectations and judgement. So as the land administration authority has to determinate land values, the process must be systematic and careful, because the estimated land value will always be discussed and questioned. The best general solution is that citizens must be confident on the way valuation is done. This relates to long term consistency in evaluation, good land value estimations and transparency, as valuation is always an approximation of the real value. Valuation of land and properties practice are based on the following main principles[1]:

a. *Market value* - the most probable price of a property on the open market and is used in most cases
b. *Net income value* - the present value of future yearly net income and is mostly used for investment decisions
c. *Cost value* – calculated by the replacement costs minus depreciation and it is used mostly for insurance compensation

To obtain good estimations of land prices based on the market value, is a rather complex process as RICS (2016:20) states:

> *"Valuation using the market approach based on comparable is normally the preferred method of estimating market value. Indeed, it is used as the primary approach in many valuations. Valuation by comparison requires a depth of information of similar assets normally in a similar type of location or geographical area. (...) This includes all types of relevant transactional comparable evidence, including:*
> - *recently completed transactions of identical properties for which full and accurate information is available; occasionally, this may include the subject property itself;*
> - *recently completed transactions of other, similar properties for which full and accurate information is available and*
> - *recently completed transactions of similar properties for which full data may not be available but sufficient reliable data can be obtained."*

The other methods, net income value and cost value, even though sometimes used, bring up other problems, mostly related to the difficulty to have adequate parameters. Part of the literature[2] is working, for the same aims, with mass appraisal using artificial intelligence, but is also mostly dependent on existing information. So, at the end, the best is still to provide good estimation to market value, but when proper information is unavailable, there are simpler ways to obtain good estimations.
One of them is the banded that needs some information on the land values, and as works with bands it does not require a very high level of precision.

[1] For more detailed information on valuation there is the classical book from Shapiro et al (2019), an important reviews from and McCluskey et al (2016) and Rics (2016) .
[2] Wang, D., & Li, V. J. (2019) has done an literature review on this issue.

2.3 Banded system for valuation

The banded system distinguishes bands that entail land of similar value. Grouping land with similar characteristics into a band of similar value, simplifies the procedure compared to individual ‘ad valorem’ based valuation. The bands and its ranges are determined with the aim of valuation in mind (which should reflect the range of ‘*values’* of the real estate within the jurisdiction).
As most of the extensive valuation systems are quite costly, many countries are using the banded system to conduct valuation mostly for tax purposes, but also for land consolidation, where massive valuation of all land within a designated area is needed. The banded system can be used when up-to-date sales data is absent, and therefore becoming impossible to produce ‘ad valorem´ values for individual objects. This methodology is also applied in absence of a complete register of landowners that is needed for an adequate valuation system. The number of value bands is linked to the band widths: the fewer the bands, the wider the ‘*value’* ranges and the more tolerant they are too rough estimates of property ‘*values’*.
As Plimmer, F. A. S. & McCluskey, W. J. (2016) show in the study for FIG, the banded system has been used with good results for the purpose of charging property taxes in Great Britain, after the failure of a new system (Tax Pool) that was used during the 90’s. In Ireland the banded system was introduced in the year of 2010, as a temporary method for collecting property taxes.

3. MONITORING LAND PRICES IN THE NETHERLANDS

3.1. The land monitor

Various stakeholders, such as real estate agents and financial institutes, showed interest in information about the rural land market, in particular about the number of transactions and land prices for arable land, grassland, and silage maize in the Netherlands. Based on the captured information in the land administration system as provided by the Dutch Cadaster, land registry and mapping agency, and other country-wide registrations about land use and land lease, it is possible to monitor the land market based on a set of standardized criteria (Kadaster, 2020). It provides information on the number of transactions (Figure 2), the land price for different types of agricultural land (Figure 3), and leased or unleased land. The number of transactions is an indicator for the land mobility in the area, providing information on the volatility of the land market in terms of supply and demand. Low land mobility indicates that little land comes available on the land market or there is a mismatch between supply and demand, while high land mobility typically indicates the opposite.
The results are presented by region and over time (Figure 4). The geographical division into regions shows the diversity between regional land markets. The monitor is produced on a quarterly basis in a standardized way to allow for comparison over time and between regions.

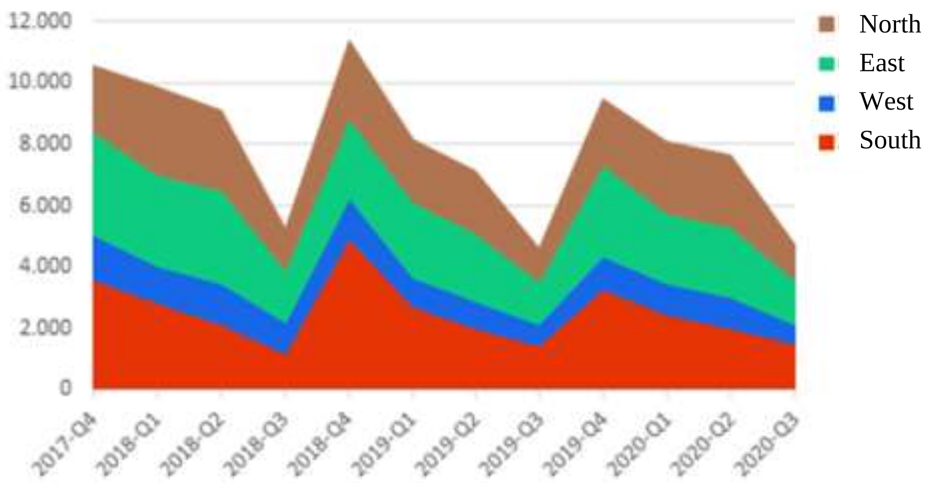

Figure 2 – Land mobility of agricultural land (in ha) per region between 2017 – 2020 (source: Kadaster/RVO/Wageningen Economic Research)

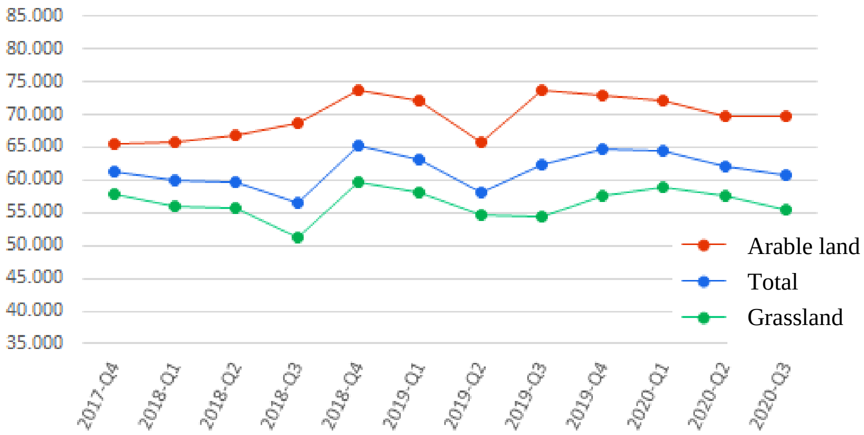

Figure 3 – Price (in €/ha) of unleased land for arable land, grassland, and total (arable, grass, silage maize) between 2017 – 2020 (source: Kadaster/RVO/Wageningen Economic Research)

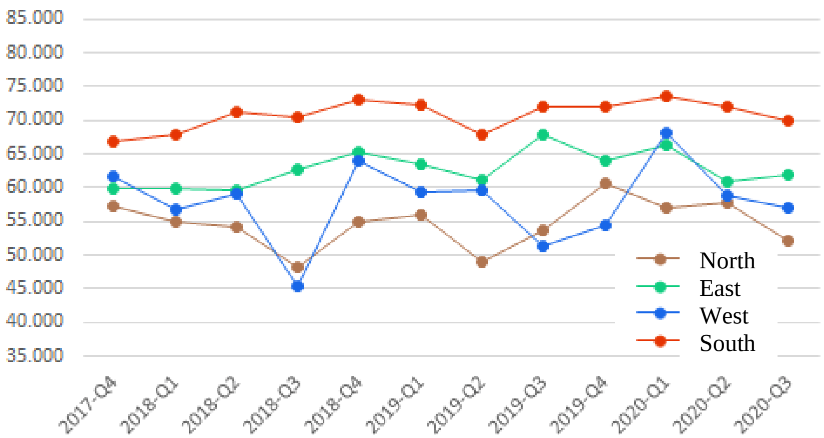

Figure 4 – Price (in €/ha) of unleased agricultural land per region between 2017 – 2020 (source: Kadaster/RVO /Wageningen Economic Research)

3.2. Methodology

3.2.1. Land price

The agricultural land price is defined as the market price for available land on the land market as paid by the buyer. To determine the land price, a number of variables are used to select land transaction over the selected period of time (in this case based on quarterly updates):

- The buyer has a farm, i.e. it is a farmer
- The sold land consists of grassland, arable land, or silage maize
- The type of transaction is a regular transaction of buying and selling (excluding inheritance or auctions for example)
- It is freehold property rights
- The parcel holds no buildings
- The parcel holds no regular lease or ground lease
- It is not a transaction between family members
- The parcel is larger than 0.25 ha
- The purchase price is greater than €1

Furthermore, all transactions with extremely high or low prices are excluded from the selection as these are not considered representative. The selected variables are suitable for the Dutch context but could be adapted to other contexts providing that the information is available.

3.2.2. Land mobility

Land mobility refers to the amount of agricultural land (in ha) that was bought / sold on the land market. This information is based on land transactions as registered in the land administration system and complemented by other data sources about the agricultural sector. The following transactions were selected to determine land mobility:

- The sold land consists of grassland, arable land, or silage maize
- The type of transaction is a regular transaction of buying and selling (excluding inheritance or auctions for example)
- It is freehold property rights
- It is not a transaction between family members
- The parcel is larger than 0.25 ha
- The purchase price is greater than €1

3.2.3. Geographical regions

The four regions, north (in Dutch: Noord), east (in Dutch: Oost), south (in Dutch: Zuid), and west (in Dutch: West) are based on the standardized subdivision of the country into agricultural areas (Figure 5). These so-called statistical units are used to present the geographical distribution of phenomena related to the agricultural sector. Region north consists of the three agricultural areas named “Bouwhoek en Hogeland”, “Veenkoloniën en Oldambt” and “Noordelijk Weidegebied”. Region east consists of the four agricultural areas “Oostelijk Veehouderijgebied”, “Centraal Veehouderijgebied”, “IJsselmeerpolders” and “Rivierengebied”. Region west consists of the three agricultural areas “Westelijk Holland”, "Waterland en Droogmakerijen", "Hollands/Utrechts Weidegebied". Region south consists of the four agricultural areas "Zuidwestelijk Akkerbouwgebied", "Zuidwest-Brabant", "Zuidelijk Veehouderijgebied" and "Zuid-Limburg".

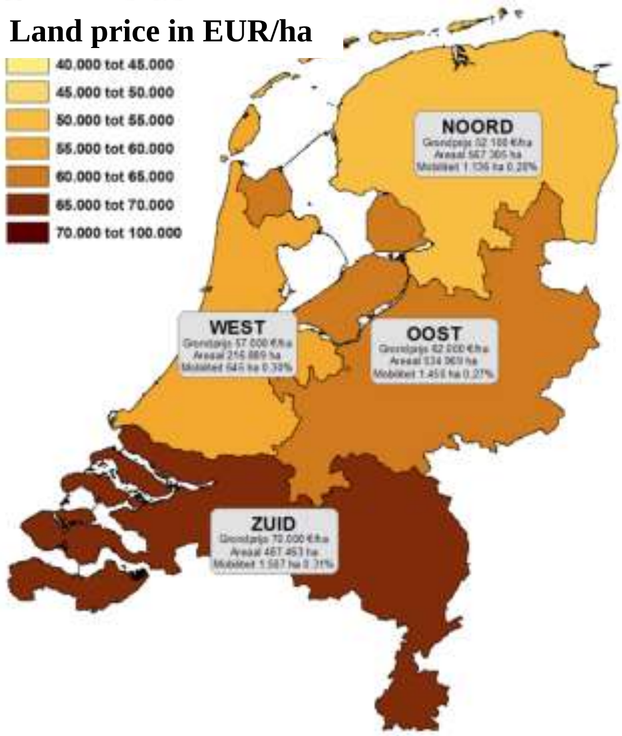

Figure 5 – Land price monitor for the Netherlands in Q3 2021 (Source: Kadaster/RVO/Wageningen Economic Research)

4. HEDONIC PRICES EQUATIONS TO DETERMINE LAND PRICES

This item presents an example of hedonics price determination, that is a methodology to determine rural land prices in specific markets, but it can be used in many ways. Its principle is quite simple, and it does not need a complete register of landowners or transaction prices. A questionary is applied to a statistic significant sample of rural properties acquired in recently in a specific market. The questionnaire has questions about the price paid and property characteristics such as: size, location, soils quality, access to water, access to commercial infrastructure, predominant crops, expected price and others. Using hedonic price determination, based on the most prevalence characteristics, an equation is established. With this equation is possible to estimate prices for different properties using the same characteristics.

4.1. Hedonic regression: an introduction

In economics, hedonic regression is a method of estimating the demand for a good, or equivalently its value to consumers. It breaks down the item being researched into its constituent characteristics and obtains estimates of the contributory value of each

characteristic. This requires that the composite good being valued can be reduced to its constituent parts and the market values of those constituent parts. Hedonic models are most commonly using regression analysis, although more generalized models exist, such as sales adjustment grids. An attribute vector, which may be a dummy or panel variable, is assigned to each characteristic or group of characteristics. Hedonic models can accommodate non-linearity, variable interaction, or other complex valuation situations.
Hedonic models are commonly used in real estate appraisal and real estate economics, as houses have a variety of easily measured traits (such as the number of rooms, overall size, or distance from certain amenities) which make them more amenable to hedonic regression models than most other goods. Land prices are determined by two kinds of variables: productive, related to land as a production factor and speculative, related to the land as an asset that maintains value. To study the variable effects on land prices in specific markets, from the information collected in the fieldwork the following equations will be estimated:

$$PRICEt = a0 + a1X1t + a2X2t + ... + anXnt \qquad I = 1, 2, ...k. \quad t = 1,2,\ldots n \tag{2}$$

Where:
PRICEt = Negotiated price per hectare. This variable can refer to the current price (PCTE) or the real market price (PREAL).
Xi: represents the relevant variables that explain the variation of rural land price in the specific market.

The methodology used to study rural land prices in specific or local markets follows the next stages:

i) creation of a primary database with application of a questionnaire to the purchasers of rural properties by stratified samples to find real land prices and its explanatory variables,
ii) statistical analysis of the database of primary information to exclude incomplete or incorrect data such as extreme values and getting of the responses coming back equations of the market price and
iii) create a computer program (off-line) and structure of database (web) to estimate land prices from information obtained from people that access the system.
iv) Establishing the hedonic equation for land price determination.

4.2. Application to the Maranhão State case[3][4]

This item presents the application of the hedonic land prices model to a homogeneous zone in the state of Maranhão in the Northeast of Brazil. It is needed to calculate estimated land

[3] This part is largely based on the results of Reydon et al (2014).
[4] This methodology was developed for all states of Brazil except for the North region. It calculates estimated land prices needed for land acquisition within the Cedula da Terra Program, a Land Acquisition Credit Policy from the Brazilian Federal Government (see Reydon et al (2014))

prices, because landowners tend to declare lower property values at the registry offices to reduce the billed property transfer tax. Using cluster analysis, four major homogeneous zones were identified, each consisting of a group of municipalities with similarities in their land markets (Figure 6). Out of these four homogeneous zones, number 211 has been selected as case study and will be presented and discussed in this paper. Homogeneous zone 211 consists of 35 municipalities. 75 questionnaires were collected in 8 sampled municipalities.

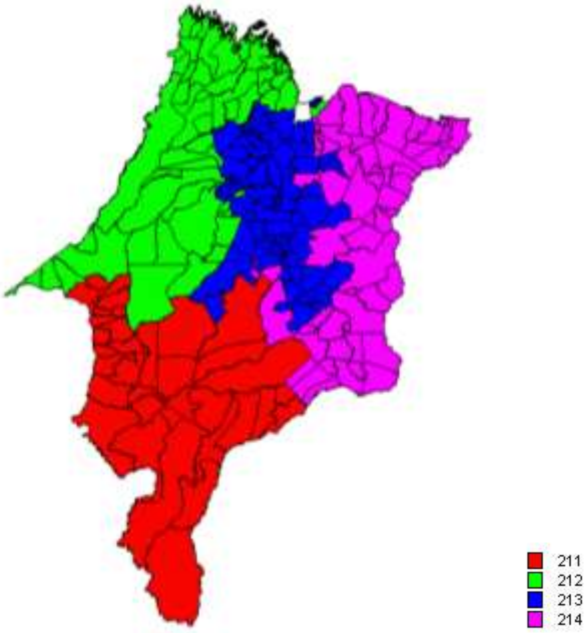

Figure 6 – Maranhão homogeneous zone 211: Geographic distribution of sampled municipalities

4.2.1. Multiple regression model

The multiple regression model to explain and predict the land price in the HZ 211, starting from a group of about 250 variables using the forward stepwise technique selected 5 explanatory variables, according to Table 1. Logarithm of land price per hectare (LNR$/ha) was the dependent variable. Seven cases were eliminated based as outliers on Mahanalobis Distance, Cook Distance or Standardized residuals, leaving 61 observations in the final model.

Table 1 - Maranhão homogeneous zone 211: Results of the regression model

Results regression model for homogeneous zone 211

Dependent: LNR$HAAT	Multiple R = .83907609	F = 26.16827	
	R^2 = .70404868	df = 5,55	
No. of cases: 61	adjusted R^2 = .67714401	p = .000000	
	Standard error of estimate: .303109987		

The regression model explains approximately 70 % of the variance of the natural logarithm of land price per hectare. Above are some global indicators of the econometric model to predict the price of natural logarithm of the price of hectare of rural land in homogeneous zone 211.

4.2.2. Variables of the model

In homogeneous zone 211, the variables that best explained the land price are the ones described in Table 2.
Table *3* presents the standard coefficients, coefficients, standard error, value of the t test and p-value of the estimated coefficients5. All the variables are significant at less than 1%, so all the coefficients present the correct signal, as defined in Table 2.

Table 2 – Maranhão homogeneous zone 211: Description of model variables

Variable	Description	Expected signal of the estimated coefficient
Electric Power	Dummy variable which indicates the access to electric power. It takes value 1 when the farm has accessible electric power and 0 otherwise.	Positive, as besides representing benefits from electric power itself, this variable may be a proxy of other characteristics of infra-structure which usually come together with electric power.
Improvements	Dummy variable that indicates the existence of improvements in the farm, such as barns. It takes value 1 if there are improvements in the farm and 0 otherwise.	Positive, since improvements increase production alternatives.
Rock Fragments	Dummy variable which indicates the presence of rock fragments is considered good (1) soils with no restrictions due to rocks to mechanization and bad (0) the soil with rock fragments that makes mechanization impossible.	Positive, since it is expected that the property where rocks do not interfere in the use of mechanization has higher prices. Those in which the rock fragments make mechanization impossible have lower prices.
Soil	Composite index which considers soil's physical properties, such as depth, texture. This index varies in a range from 10 to 100.	Positive, as soil with better physical properties allow greater land productivity and rent.
Subsistence	Dummy variable value 1 when the system of production of the property is agricultural and cattle rising related to subsistence and trade of surplus and 0 in the opposite situation.	The signal depends on the group of production system of HZ referred.

Table 3 – Maranhão homogeneous zone 211: Estimated coefficients

	Beta	Std.Err.	B	Std.Err.	t(55)	p-level
Intercept			2.831	0.434	6.531	0.000

[5] The column **Beta** would indicate the coefficients of regression if all the independent variables had been standardized with the average zero and standard deviation one, which permits the comparison of the influence of each independent variable on the price forecasted. The following column **(Std. Error)** represents the standard error of the standard coefficients. The column B indicates the estimated coefficients and the following column (Std. Error), its standard error.

Rock_Fragments	0.374	0.087	0.450	0.104	4.317	0.000
Improvements	0.370	0.075	0.455	0.092	4.943	0.000
Subsistance	-0.216	0.076	-0.254	0.089	-2.852	0.006
Electric_Power	0.271	0.079	0.293	0.085	3.442	0.001
Soil	0.277	0.084	0.019	0.006	3.292	0.002

The regression intercept indicates that, when the value of all the dependent variables is zero, the price forecasted by the model is R$ 16.96 R$/ha (antilog of 2.831). Because the dependent variable is the natural logarithm of rural land area, the value of B has different interpretations, which varies according to the functional forms of the explanatory variable refereed (Table 4).

Table 4 – Maranhão homogeneous zone 211: Interpretation of parameters of the variables

Functional form of the explanatory variables	**Interpretation of estimated coefficient**
Logarithm	Elasticity – percentile change in the dependent variable for a one percent change in the explanatory variable
Continuous variable	Logarithm of the rate of variation – the predicted value is multiplied by e^{β} for each unit change in the explanatory variable.
Dummy variable	Logarithm of the price variation factor – the predicted value is multiplied by e^{β} when such a variable equals 1.

The B coefficient of the dummy variable Rock Fragments (0.450) indicates that when they do not interfere with the mechanization of the land, the predicted price of the property is multiplied by factor e0,450, or that it increases in 56.8%.
The B coefficient of the dummy variable Improvements (0.455) indicates that, when there are adequate improvements, the predicted price of the property is multiplied by the factor e0,46, or that it increases in 57.6%.
The B coefficient of the dummy variable Subsistence (-0.254) indicates that, when the property is used mainly for subsistence purposes, the predicted price is multiplied by the factor e-0,254, or that it is reduced in 22.4%.
The B coefficient of the dummy variable Electric Power (0.293) indicates that, when the property has access to electric power, the predicted price is multiplied by the factor e0.293, or that it increases in 34%.
The B coefficient of the variable Soil (0,019) indicates that the increase of a point in the soil index raises the predicted price of the property in 1,92%.

Figure 7 indicates the predicted values by the model and real values of the property, ordered by the last and show the adequate adjustment of the model with all prediction lying on a 95% confidence interval. So, this means that having the basic information from the property it is possible to estimate the land prices with 95 % of confidence.

Finally, it is important to highlight that this model can be used for prediction purposes only in the range of values of the dependent variable of the database from which was estimated.

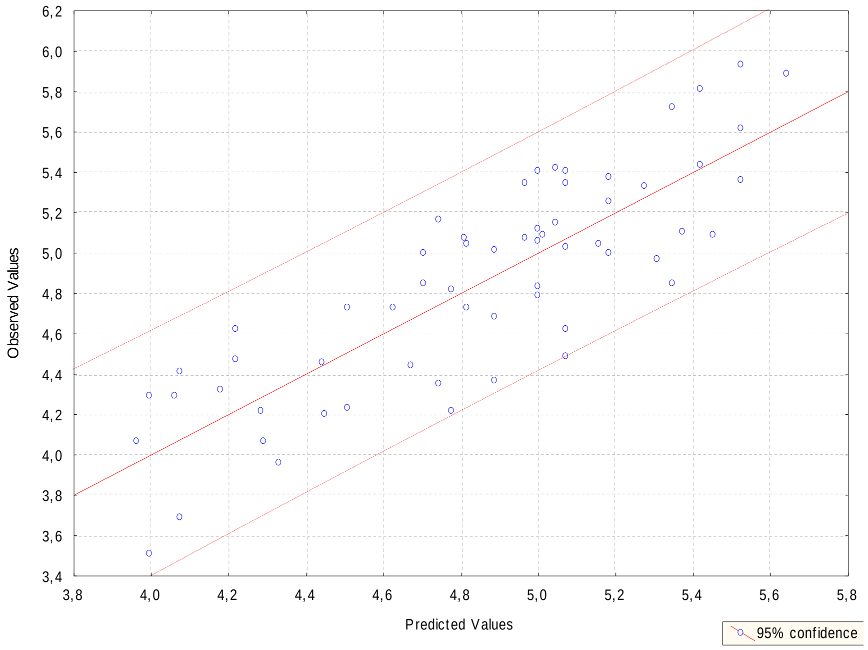

Figure 7 – Maranhão homogeneous zone 211: Predicted versus observed price of rural land hectare

4.2.3. Reflections from the case

This part of the paper discussed and applied a methodology to explain and predict rural land prices per hectare in specific markets. This methodology is based on a multiple regression model, with the logarithm of the rural land price per hectare as dependent variable and, as explanatory variables, a group of variables related to the physical aspects **(**soil, climate, landscape), production (systems of production, localization, approach) infrastructure of the property and expectations (regional situation, local investments). The stepwise technique was used to select the variables included in the model: existence of Rock Fragments, Improvements, Subsistence as the main use of the property, access to Electric Power and Soil characteristics.

This model permitted the explanation of 70% of the variance of price per hectare of rural land. The assumptions of the multiple regression model were respected, in terms of the normality and homoskedasticity of the residuals. Multicollinearity was kept in acceptable levels. In general terms, the statistic, economical and econometric evaluation of the models showed to be satisfactory for the prediction of rural land price per hectare in the Homogeneous Zone in question. The model has been used by the Brazilian Ministry of Agrarian Issues to establish limits for buying land trough the different land credit programs all around the country.

5. BANDED VALUATION FOR LAND CONSOLIDATION IN NETHERLANDS

A banded valuation system particularly pays off in a situation where mass valuation of land is needed. In this chapter we show an example of a banded valuation methodology based on relative land values. Land consolidation is applied to optimize the allocation of land for spatial developments, such as reducing land defragmentation for agriculture, improve nature conservation, measures for climate adaptation, or village renewal. The exchange of land rights between landowners underpins the optimization process. Like normal transactions, any differences in land value due to size, quality or other assets, are settled between landowners. Since in a land consolidation project many parcels are exchanged, new parcels are formed, or parcel boundaries are adjusted, a systematic approach for land valuation is chosen. The value of all land within the project area is determined based on its agronomic value, which is based on the soil type and groundwater levels (Figure 8). Soil types and groundwater levels of similar agronomic value are grouped together according to the determined classification. Each class represents a value, first expressed in points per hectare and later related to the market value based on reference transactions. With the relative values landowners can verify whether the newly allocated land holds similar agronomic value as the original allocation. Figure 8 shows an example of banded mass valuation based on relative value for the project Franekeradeel-Harlingen.

The advantage of such a systematic banded mass valuation is that it is easy to calculate the value for individual parcels in an automated way, even in a situation where one single parcel has heterogeneous characteristics. Figure 9 shows an example of one parcel with large variations in agronomic value (5 different classes, i.e. relative values) due to different soil types present in combination with the groundwater level. First, the relative value in each class is calculated based on the area of that class within the parcel. Second, these values are summed up to generate the total value of the parcel. This is done for all parcels in the same way. One can see that the boundaries of the relative value classes do not need to align with the cadastral parcel boundaries to calculate the relative value of individual parcels.

This example of banded valuation shows that, with reliable and complete geo-information about the variables available, it is relatively easy to calculate the relative values for individual parcels. For this specific application, soil type and groundwater level are choses as variables determining the agronomic land value. With additional, reliable information about land prices, one can also calculate the market value of parcels by converting the relative value to the market value using land transactions with land prices as reference.

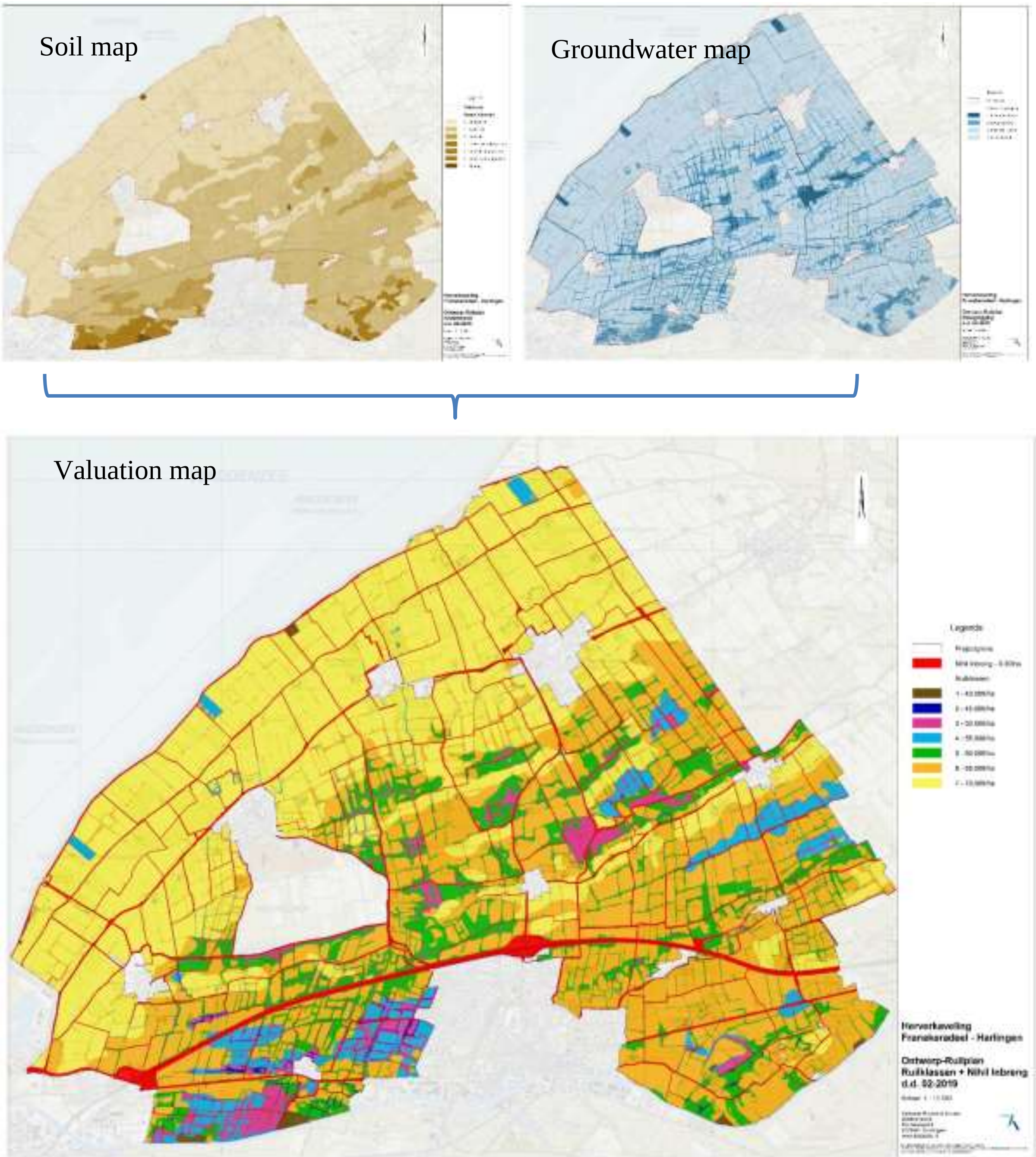

Figure 8 – Mass valuation with relative value in land consolidation (Franekeradeel-Harlingen) based on banded valuation methodology (source: Kadaster)

Figure 9 – Example of one parcel having assigned multiple value bands / classes / relative values (source: Kadaster)

6. DISCUSSION AND CONCLUSION

In this paper we have emphasized that monitoring land markets and land prices is very important. It is after the properties cadaster one of the four pillars for a land administration system. But as land prices are very volatile, land value estimations are very much criticized. So, an appropriate valuation methodology is very important to derive land prices in a systematic manner. In this paper we showed several methods for evaluating land prices to address the broad range of valuation practice, ranging from valuation methods based on high-end land administration systems to methods built around available resources. The most extensive *ad valorum* valuation method is based on market prices, which requires a complete and accurate land information system with purchase prices and object characteristics of all land transactions. As this is not available in all countries, in this paper we advocate for the banded system as an alternative for countries in need of a proper land valuation system, which lack the resources for a complete land administration system capturing land prices. The reasons to opt for a more simple and cost-effective valuation system are similar as described in the FIG publication 'Property taxation for developing economies' (Plimmer & McCluskey, 2016).

First, we described the Dutch price monitor that is a benchmark of a high-end land administration system, by providing insight in land prices over time and by region based on registered transaction combined with additional information from other data sets. In this situation, the role of land administration goes beyond its traditional purpose of describing people's land rights and moves towards a broader role for the land market.

Void of a land administration system with information about the price of land, the example in Brazil shows how land prices can be determined based on a set of relevant parameters and perceived values using a questionnaire to retrieve this information. This demonstrates that alternative land valuation methods can be used to determine land prices in a context where no standardized and reliable 'ready-to-use' data is not available.

At last, an example of mass valuation in land consolidation was presented, to show how a banded valuation of land based on relative values can be at a later stage converted to land prices. It is a specific example of a specific context, but the methodology might be equally useful in a situation where no actual land prices are available, but the value of land can be expressed in relative values.

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