

Measure Gender Gaps in Land Ownership Access in Colombia Using the Utilization of Administrative Records

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Key words: Access to Land, Land Distribution, Gender, Machine Learning.

SUMMARY:

Women's access to property and land control is undoubtedly one of the primary factors that determine gender inequalities in rural areas. Its measurement presents limitations in the available sources. Cadastral data sources do not record the owner's gender. Therefore, the study explores a proposal to measure gender disparities in land ownership access in Colombia by utilizing cadastral and administrative records, presenting the methodological considerations for its application, and the formulation of the indicators that can be derived from these sources. Methodologically, a deterministic matching of census data with cadastral sources was conducted through the identity document, allowing the assignment of gender to property owners in the country, and the development of an algorithm with machine learning. Using this information, indicators for the distribution of landowners by gender, the incidence of female and male property owners for each municipality, and the distribution of the value and area of land property by gender were calculated. These indicators are currently not available for Colombia in the FAO's gender database, so their inclusion opens doors to territorial analyses with a gender perspective. Through this practical and comparative study calculating gender gaps in land access and ownership, progress is being made in determining the importance of land registration, not only for control and fiscal revenue purposes but also as a tool for territorial planning and management. The understanding of the indicators measuring the quality and access to property by women confirms the hypothesis of inequality between men and women. First, this is evident in the distribution of land, where women do not reach one-third of property ownership, and second, these gaps widen when measuring the quality of these properties in terms of area and value.

RESUMEN:

El acceso de las mujeres a la propiedad y el control de la tierra es, sin duda, uno de los principales factores que determina las desigualdades de género en las áreas rurales. Su medición presenta limitaciones en las fuentes disponibles. Las fuentes de datos catastrales tradicionales no registran el sexo del propietario. Por lo tanto, el estudio explora una propuesta para medir las disparidades de género en el acceso a la propiedad de la tierra en Colombia mediante el uso de registros catastrales y administrativos, presentando las consideraciones metodológicas para su aplicación y la formulación de los indicadores que se pueden derivar de estas fuentes. Metodológicamente, se llevó a cabo una coincidencia determinista de datos del Censo Nacional de Población y Vivienda con fuentes catastrales a través del documento de identidad, lo que permitió la asignación de género a los propietarios de propiedades en el país, y el desarrollo de

Proposals to measure Gender disparities in Land Ownership Access. Utilizando esta información se calcularon indicadores para la distribución de propietarios de tierras por sexo, la incidencia de propietarios y mujeres y hombres en cada municipio, y la distribución de valor y área de la propiedad de la tierra por género. Estos indicadores no están actualmente disponibles para Colombia en la base de datos de género de la FAO, por lo que su inclusión abre puertas a análisis territoriales con un enfoque de género. A través de este estudio práctico y comparativo que calcula las brechas de género en el acceso a la propiedad de la tierra, se avanza en la determinación de la importancia de la inscripción de tierras, no solo con fines de control y recaudación fiscal, sino

también como una herramienta para la planificación y gestión territorial. La comprensión de los indicadores que miden la calidad y el acceso a la propiedad por parte de las mujeres confirma la hipótesis de la desigualdad entre hombres y mujeres. En primer lugar, esto es evidente en la distribución de la tierra, donde las mujeres no alcanzan un tercio de la propiedad, y en segundo lugar, estas brechas se amplían al medir la calidad de estas propiedades en términos de área y valor.

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1. INTRODUCTION:

The deeply rooted inequality stemming from the imbalanced distribution of land ownership, within a context of historical and cultural disparities between men and women, exacerbates the challenges experienced by women in rural life. These disparities manifest across various levels, encompassing social strata, races, ethnicities, ages, and geographical locations, further intensified by the complexity of these intersections (DANE-MADR, 2021). Gender biases in women's access to and control of land in the country are primarily grounded in women's limited autonomy and participation in the existing economic and social structure (Deere C. D., 2011). Entrenched practices, such as the familist approach in social and agrarian policies, coupled with inadequately inclusive and poorly implemented regulations, have created gaps in land tenure, favoring men's access, control, and enjoyment, especially in dispersed rural areas.

In the quest to advance the recognition, protection, and fulfillment of women's rights regarding access, tenure, and use of land, aligned with the goals of the 2030 Agenda, it is crucial to have statistical information that allows monitoring land ownership from a gender perspective. Despite efforts made in implementing the Multipurpose Cadaster (MC) public policy in the country, we currently face a lack of a baseline that facilitates tracking land ownership by men and women nationwide. These information gaps have been documented in various studies, emphasizing the challenges in reducing inequalities in land tenure when there is no disaggregated information based on the owner's gender (Deere & León, 2003; León, 2010; Marín Salazar & Avendaño Arias, 2018).

The measurement of gender gaps in land ownership poses new challenges in leveraging available information. Although the country currently possesses the traditional cadastre database, the absence of the gender variable for property owners hinders a direct understanding of unequal relations between men and women in land ownership. This proposal initiates with a first phase of database integration, involving the Statistical Population Base Registry (REBP), the National Population and Housing Census (CNPV), and the cadastre database. In this phase, initial exercises were conducted to intensively exploit this information through a methodological proposal for interoperability between the databases. This initiative materializes in a second phase, where IGAC aims to populate the Multipurpose Cadastre (MC) databases through similar exercises. In other words, building on the experience gained in phase

1, phase 2 seeks to empower IGAC to carry out the exercise of populating the MC databases.

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In this context, this document presents, in its first section, a methodological summary for linking the gender variable to property owners found in traditional cadaster databases through interoperability with other administrative records and the implementation of gender prediction algorithms. Having a database of landowners, the second results section

addresses three fundamental aspects developed in the document:

- **Distribution of Land Ownership in Colombia between Men and Women:** Identifying departments with the greatest gender gaps for sole owners and co-owners, translating into pressures on decision-making power over agricultural units.

- **Characteristics of Land According to the Gender of Property Owners in Colombia:** Conditions of these lands, including areas, economic purpose, and other features, allowing examination of particularities in gender gaps in land ownership.
- **Sociodemographic Characteristics of Women and Men Landowners in Rural Colombia:** Describing differences characterizing women landowners compared to male landowners.

Finally, in a third section, the document presents the main conclusions of gender gaps, highlighting those women in Colombia: 1) have less access to land ownership; 2) own smaller plots; 3) exhibit a greater inclination toward residential use due to the small areas they own.

2. METHODOLOGICAL NOTE:

Measuring gender gaps in land ownership has presented limitations in the available data sources. Demographically, the traditional cadastre databases in the country are limited, particularly lacking the gender variable. Hence, it was necessary to explore other sources of information to obtain a comprehensive view of the population characteristics that underpin land tenure in the country. This exercise represents a methodological innovation to derive gender-disaggregated indicators from the cadastral base. Its results, for the first time in the country, bring to light the rural property inequalities between men and women, providing strategic information to advance decision-making in closing these gaps. A brief overview of the consulted and processed databases, along with the interaction and interoperability processes required for their integration and synthesis, is presented below:

- **National Cadaster:** The country maintains a record of private, fiscal, vacant, heritage, and publicly used real estate distributed across its territory. This inventory contains the physical, legal, and economic characteristics of properties. Processes such as formation, updating, and cadastral conservation (Law 148 of 2020) are implemented for data collection and registration. As of January 1, 2019, according to the diagnosis by CONPES 3958, 66.0% of the national territory's area had outdated cadastral information, 28.3% lacked cadastral formation, and only 5.6% of the national territory had updated information (Colombia, 2019). Despite the low level of updating in municipal cadasters, the conservation process contributes to permanently maintaining changes generated in properties, either at the request of stakeholders or in line with the real estate dynamics incorporated by cadastral managers into their databases and inventories.
- **Statistical Population Base Registry (SPBR):** In recent years, DANE has joined international initiatives for using and leveraging data from national and regional administrative records as input for statistical production (DANE, 2020). The REBP allows the construction of sociodemographic indicators, complementing other base records in the country, such as the cadaster information system. The structuring and use of the REBP provide new opportunities in statistical production, reducing the burden and costs of obtaining responses (Wallgreen & Wallgren, 2021). The interaction with REBP records as of 2018 involves incorporating variables associated with demographic characteristics, initially the gender variable, with projections also to kinship and marital status.

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• **National Population and Housing Census (NPHC):** This is the most important national instrument for registering population characteristics, including their distribution in the territory, and the living conditions of households in the country (DANE, 2018). The most recent population census was conducted in 2018. Through this census, the national base records of characteristics about the gender of individuals reported in the cadaster as owners of properties in different territories and regions of Colombia.

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For information processing, first, a purification of the databases was carried out to have

consistent information. Regarding the cadastral databases, records of natural persons were used, and from this base, two subgroups were subsequently defined: 1) records with identification (citizenship card, foreigner identification card, identity card) and 2) people without identification. For each subgroup, a different procedure was used to obtain the gender variable. Thus, the methodological process addressed three main phases that were applied according to the existence or absence of the identification variable in the cadastral base. These phases corresponded to:

- **Deterministic Integration for Records with Identification:** Using the identification document number in the cadastral records as a base, an integration or join was performed with the tables of the National Population Census (DANE, 2018) and the Statistical Population Base Register - REBP (DANE, 2020), which also store the identification document variable. Once the integration between the databases was obtained, the information on the gender type was added to the cadastral base. As a result of this process, four categories or classes of integration were determined, defined by: citizenship card, foreigner identification card, identity card (minors), and without documentation. As mentioned earlier, the NIT category was not included in either of the two phases addressed.
- **Probabilistic Gender Prediction by Name:** Following the first phase for records that did not cross, a machine learning technique known as Random Forest (RF) was employed. The data source to train the model was obtained from the REBP 2019 records, using the full names of individuals and their respective genders. By combining parameters with the best performance metrics, a prediction algorithm was obtained to determine the gender of individuals who did not cross. In this exercise, three classification methods were proposed: 1). Gradient Boosted Regression Trees (GBRT), 2). Random Forest, and 3). Bernoulli Classifier, for which the following procedure was applied: Gender Prediction: For imputing the gender variable in records without information from the cadastral base, the same cleaning and organization considerations were applied to the new database. One of the significant advantages of this method is that it allows filling in missing information by training on over 60 million records where gender and names are available for the country.
- **Estimation of Indicators:** From the database of property owners with the gender variable, indicators for the distribution of landowners by gender, the incidence of women and men as property owners for each municipality, and the distribution of the value and area of land ownership by gender were calculated. To measure the gaps in the distribution of landownership by gender, the following disaggregations were proposed for subsequent analyses:

3. RESULTS:

3.1 Rural Property Distribution between Men and Women:

3.1.1 Distribution by Gender of Sole Property Ownership

For the entire rural national territory, 63.7% of sole-owned properties are titled to men, while the remaining 36.3% have women as owners; with 18 out of the 32 departments falling below

~~this national average. The breakdown by gender of individuals holding sole property ownership~~
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 Shows that women's participation is significantly lower in the rural areas of all departments in the country. In places such as, Vaupés, Bolívar, Guainía, and Caquetá, women do not exceed 30% ownership participation. The widest gap is observed in the department of Vaupés, where the distribution marks 21.5% of sole female owners and 78.5% of sole male owners. This limitation hinders women from making decisions about land, production, and livelihood mechanisms. In contrast, the highest participation of women in ownership occurs in the department of Atlántico, where women hold 45.7% of the legal ownership of properties, while men hold 54.3%. Although the smallest gap is found in the departments of the Archipelago of San Andrés and Providencia, Quindío, Meta, Valle del Cauca, and Atlántico, the proportions

do not reach parity between men and women in any department of the country.

3.1.2 Distribution by Gender of Property Ownership for Co-Owners

In 47.4% of rural properties in the country, ownership is shared (co-ownership). In six out of the 32 departments of Colombia, shared ownership predominates above the national average (47.4%). In the department of Quindío, co-ownership reaches 62.5% of properties, followed by departments such as Guainía (60%), Boyacá (59.7%), and Santander (59.5%). In contrast, in departments such as Vaupés, Chocó, and Putumayo, over 75% of properties are owned by sole owners, meaning these are the departments where fewer individuals are involved in the legal ownership of properties, indicating greater challenges for women to access land.

Regarding shared co-ownership between men and women, significant progress is evident in the departments of Boyacá, Cundinamarca, and Santander (regions with small agricultural and peasant units) where percentages above 90% of this type of arrangement are present. However, the cadastral information does not identify the relationship of kinship; therefore, it is not possible to determine the marital or personal connection between the owners of shared properties, limiting the analysis to determine if there are advances in shared titling between spouses. Concerning the participation of only women as co-owners, their participation is lower than that of only men in 31 out of the 33 departments of the country, being only higher in departments of Cesar and Amazonas, possibly in response to market biases as indicated by the literature.

When comparing the percentage of properties with shared ownership between men and women at the departmental level, it is observed that the largest gaps occur in departments such as Vaupés, where not only does co-ownership represent the lowest participation, but this type of arrangement is predominantly among male co-owners, accounting for 78% of such arrangements. In general, the departments belonging to the former national territories, such as Vaupés, Guainía, Putumayo, Vichada, Guaviare, Arauca, and Amazonas, represent less than 73% of shared co-ownership between men and women. In these departments, Family Agricultural Units (FAU) have larger extensions than in other areas of the country (INCODER, 1996), resulting in less possibility of plot densification and reduced opportunities for both women and shared ownership.

3.2 Characteristics of Land Holdings by Men and Women:

3.2.1 Average Area of Land Holdings Based on Gender of Owners

The distribution of land among the population is mainly within smaller plots, with micro-sized properties accounting for 64.5% of all plots. Meanwhile, medium-sized properties are concentrated in the hands of 10.2% of owners, likely indicating better profitability due to a larger area for exploitation. Additionally, gaps widen when differentiating ownership contexts based on gender. In these cases, women consistently have a higher participation in smaller plots, while their representation in medium and large-sized properties tends to decrease significantly. The following outlines the behavior of land data based on size, both at the national level and differentiated across departmental territories.

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- **Sole Owner:**

Women's participation is more significant in smaller-sized plots, i.e., plots with areas less than three hectares (ha) (micro-sized plots) account for 72.1% of female ownership, compared to a concentration of 62.1% for male ownership. On the other hand, men have a significant dominance in other size categories, for example, in medium-sized properties, where sole male owners represent 11.3% compared to 7.0% for sole female owners in this land size. Properties with areas ranging from three (3) to ten (10) hectares (ha), referred to as smallholdings, show a distribution in favor of men (18.4%) compared to women (12.7%). In the size category known as small properties (10 to 20 ha), the percentage differences favor male ownership by 2.7%. Large estates, in general, correspond to very few properties, with a higher concentration among men (0.7% of the total properties owned solely by men) compared to women (0.4%).

Land tenure by size or extension of the plots is a crucial indicator in gender gaps, as those with the possibility of viable productive development and higher income are men, owning larger farms. This dynamic implies that female landowners have limited opportunities, engaging in subsistence or economically less lucrative agricultural activities due to working on very small plots (Arshad & Coen, 1992), or focusing solely on residential purposes without involving economic activities related to the land. In the country, the trend in land distribution indicates a significant fragmentation of smaller-sized properties (smallholdings and micro-sized plots) and, at the same time, a consolidation of large farms among a small percentage of the population (Machado, 1998).

National territories showing wider gender gaps in the ownership of micro-sized plots are mainly located in some departments of the Caribbean region (Magdalena, Atlántico, La Guajira, Cesar), and the departments of Chocó, Meta, Santander and Norte de Santander. In these regions, differences of 15 to 26 percentage points (pip) are observed, indicating a higher percentage of women's ownership in this type of plots, considering that their overall access is still lower in all cases. In contrast, areas in the periphery of the country exhibit a balance in the distribution of micro-sized plots. In departments such as Caquetá, Vichada, San Andrés, and Guainía, the gap does not exceed five (5) percentage points, and in some cases, like Amazonas, male participation as the titleholder of these smaller plots is higher.

- **Co-property:**

From the perspective of co-property, the distribution of land sizes does not differ much from the previous scenario, especially for smaller plots. On a national scale, women who are co-property owners have a higher participation only in holding micro-sized plots, where they reach 69.3% concentration of total co-property owned solely by women, compared to 62.1% for solely men and 57% for micro-sized plots shared between both sexes. In the remaining size typologies, women always have the smallest representation in the quantity of coproperties, with gaps of up to five percentage points in favor of men or coproperties with ownership for both sexes.

Regarding the differentiation of gaps in coproperties of smaller size (micro-sized plots) in national territories, they follow the previously mentioned trend of a higher concentration of women's ownership in minimal-sized plots in contrast to the low concentration of their ownership in larger plots. Thus, the widest gaps are found in the departments of Cesar

(58 pip.), Chocó (31 pip.), Guainía (30 pip.), Bolívar (22 pip.), Magdalena (20 pip.), and Arauca (18 pip.). Once again, the regions of the Caribbean, Pacific, and Orinoco, along with the Amazon, are included. Almost half of the country's departments have a gap between 5% and 15% where women prevail as co-property owners of small plots.

Finally, in some remote territories, the gap exhibits an inverse behavior, indicating that women have lower representation in micro-land co-ownership. Departments such as La Guajira (-12 pip.), Casanare (-17 pip.), Guaviare (-25 pip.), and Vaupés (-38 pip.) show this trend. In these areas, women participate as co-owners in properties whose owners are of both sexes. However, the lack of ownership, even in micro-lands, is indicative of greater segregation regarding land access. Certain cultural and ethnic patterns in specific territories may determine these conditions of women's absence in land tenure.

3.2.2 Economic Purpose of Land Based on Gender of Owners

The economic purpose of land refers to the classification assigned to each property, including land, structures, and/or buildings, at the time of cadastral identification, based on the predominant activity carried out on it (IGAC, 2007). For the current analysis, a distinction is made between properties that generate some form of income in rural areas due to their current use (agricultural, livestock farming, commercial and industrial livestock) and residential uses designated for housing. Educational, religious, public, recreational, cultural, mining, institutional, forestry, and lot uses were grouped as others. This classification allows for the measurement of differences in the utilization of activities on lands owned by men and women, presenting, like the previous analyses, the gaps for properties owned by a single individual and for co-ownership.

• **Sole Owner:**

In Colombia, according to the cadastral information valid for 2019, the distribution of land uses for properties owned solely by women shows that 21% of these properties are dedicated to residential use, while 71.5% are used for agricultural and livestock purposes. For men, this distribution is significantly higher in agricultural, and livestock uses, with 79.3% of properties designated for such purposes and 14.4% for residential use. The 7.8 percentage point gap between properties owned by women allocated for agricultural and livestock uses and those owned by men demonstrates that not only do women have fewer properties than men, as presented in the previous section, but also that these properties are less utilized for agricultural and livestock activities (compared to those owned by men). This is partly due to the concentration of micro-properties among women, but also because of gender inequalities in access to technical assistance, credit, and institutional programs for training, transfer, assistance, empowerment, and competence-building for agricultural producers to engage in productive activities (DANE-MADR, 2021).

These gaps at the departmental level are wider in Caribbean Coast departments such as Magdalena (30.8 percentage points), Atlántico (21.7 percentage points), La Guajira (20.5 percentage points), Cesar (20.3 percentage points), and in the Pacific Region in the department of Chocó (21.5 percentage points). In these departments, as indicated in the previous section, there is a higher participation of women in rural properties of smaller size (micro-

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properties) and, as evident, predominantly used for residential purposes. This means that these properties, due to their size, do not allow for agricultural exploitation, increasing the income gap that can be perceived from the utilization of the properties.

In contrast, the proportion of properties owned by women allocated for agricultural and livestock uses, exceeding the proportion of properties with the same purpose owned by men, is observed in the departments of Amazonas (-22.2%) and Guainía (-8.4 percentage points). These two departments also have smaller gaps in property sizes, as presented earlier, demonstrating the strong relationship between the size of the property and the possibility of carrying out productive activities. Consequently, this highlights inequalities not only in access to land but also in the profits derived from it.

- **Co-property:**

For jointly-owned properties, the concentration of residential properties is lower than when there is a sole owner of any gender, and conversely, agricultural and livestock uses have a greater share in such shared arrangements. For properties shared by only men, residential use accounts for 6.4% of their total properties, while agricultural and livestock use amounts to 86.8%. On the other hand, for properties owned solely by women, residential use is 13.2% compared to 77.3% for agricultural and livestock use. In the latter group, "other uses" become significant, accounting for 7.7%. For properties shared between men and women, residential use corresponds to 10.1%, and agricultural and livestock use is 83.3%, demonstrating the effect of the change in use when there is male involvement in ownership, possibly involving greater processes of family farming.

Differences at the departmental level in jointly owned properties with an agricultural and livestock economic purpose show that the pattern of greater gaps in the Caribbean and Pacific coast departments remains the same as in the previous analysis. The largest inequalities are observed in the department of Cesar (61.1 percentage points), Chocó (26.6 percentage points), Magdalena (22.8 percentage points), and Bolívar (16.4 percentage points). Conversely, differences where the participation of properties owned solely by women in agricultural use is greater than that of properties owned solely by men are found in the departments of Vaupés (-59.4 percentage points), Guaviare (-40.0 percentage points), Casanare (-18.4 percentage points), and Amazonas (-4.2 percentage points), possibly also related to the size of properties in these departments.

This indicates that agricultural activities are associated with the availability of exploitable land on the properties, showing greater lag in areas where women's properties are smaller. Finally, based on the analysis of property distribution and property characteristics disaggregated by gender, three central findings emerge: 1) women have fewer properties than men in all departments of the country; 2) their properties are smaller; 3) and, in general, women's properties are mostly used for housing, related to their smaller size that limits their capacity for other productive activities.

CONCLUSIONS:

This document contributes in various ways. Firstly, it is a methodological contribution. Through the presented exercise, the importance of administrative records and their intensive use to make

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visible inequalities, which were not measurable in official statistics before, has been determined. In this line, and particularly, advances in available methodologies were utilized in machine learning algorithms for predicting the gender variable. This approach can be applied to other administrative records lacking this basic variable for gender-focused analyses.

Secondly, within the framework of measuring Sustainable Development Goal (SDG) 5.a.1, the indicators on land ownership quality and access in Colombia reveal various situations of inequality between men and women in two ways: i) the distribution of land ownership in rural areas shows that women are the minority of landowners, although they constitute more than half of the total population, and ii) gender gaps in land ownership access widen when measuring the quality of these properties in terms of area and economic purpose. Women predominantly own smaller properties with different non-productive uses.

- Only 36.3% of rural properties with a sole owner belong to women. The remaining 63.7% are owned by men.
- Rural properties owned solely by women are smaller, with 75.1% being micro-plots of less than 3 hectares.
- Properties owned solely by women in rural areas are allocated to residential use in 24.4% of cases, reducing the possibility of exploitation for agricultural purposes.

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