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Women's Empowerment in Urban Agriculture: evidence from the Belém Metropolitan Region, Brazil

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Resumo
Diante da necessidade de propor políticas públicas adequadas para mulheres no ambiente da produção agrícola, o objetivo deste artigo consiste em avaliar o nível de empoderamento de mulheres que desenvolvem a Agricultura Urbana (AU) na Região Metropolitana de Belém (BMR) a partir da criação do Índice de Empoderamento Feminino na Agricultura Urbana (IEFAU). O método adotado foi o quanti-qualitativo, por meio de entrevistas semiestruturadas e observações realizadas com sessenta agricultoras em seus sistemas de produções. Para criação do IEFAU utilizou-se da combinação linear dos escores fatoriais e a proporção de variância explicada em cada fator, em seguida foi realizada a padronização dos escores fatoriais (FP), visando à obtenção de valores positivos e permitir a classificação das agricultoras quanto ao seu nível de empoderamento. Os dados da pesquisa quanto ao empoderamento de mulheres na AU, apresentou-se em sua maioria em IEFAU-Alto no formato individual e por categorias, resultado justificado pela promoção de redes de relacionamentos e sólidas regras de reciprocidade e confiança construídas no ambiente da produção organizada, contudo, reitera que, apesar da AU contribuir para seu empoderamento, ainda precisa da ação do Estado para a promoção de maior incentivos de políticas públicas que atendam as respectivas demandas, especialmente para grupos de mulheres agricultoras em suas especificidades.
Palavras–chave: Agricultura urbana. Empoderamento. Região Metropolitana de Belém.

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Abstract
Given the need for public policies tailored to women in agricultural production, this study assesses the level of empowerment among women engaged in urban agriculture (UA) in the Metropolitan Region of Belém (MRB) through the development of the Women's Empowerment in Urban Agriculture Index (WEUAI). A mixed-methods approach was adopted, combining semi-structured interviews and field observations conducted with sixty women farmers in their production systems. The WEUAI was constructed using a linear combination of factor scores (FS) and the proportion of variance explained by each factor. The FS were subsequently standardized to produce positive values and enable the classification of women farmers according to their level of empowerment. The findings showed predominantly high WEUAI scores, both at the individual and category levels, which may be explained by the strengthening of social networks and the strong norms of reciprocity and trust established within organized collective production systems. However, the study emphasizes that, although UA contributes to women's empowerment, government intervention remains necessary to expand incentives through public policies that address the specific needs of women farmers, particularly those in vulnerable contexts.
Keywords: Urban agriculture. Empowerment. Metropolitan Region of Belém**.**

Índice de Empoderamiento Femenino en la Agricultura Urbana (IEFAU): aportaciones del estudio en la Región Metropolitana de Belém (BMR)

Resumen
Dada la necesidad de proponer políticas públicas adecuadas para las mujeres en el entorno de la producción agrícola, el objetivo de este artículo es evaluar el nivel de empoderamiento de las mujeres que desarrollan AU en la BMR a partir de la creación del Índice de Empoderamiento Femenino en la Agricultura Urbana (IEFAU). El método adoptado fue cuantitativo y cualitativo, a través de entrevistas semiestructuradas y observaciones realizadas a sesenta agricultoras en sus sistemas de producción. Para crear el IEFAU, se utilizó la combinación lineal de las puntuaciones factoriales y la proporción de varianza explicada en cada factor, seguida de la normalización de las puntuaciones factoriales (PF), con el fin de obtener valores positivos y permitir la clasificación de las agricultoras según su nivel de empoderamiento. Los datos de la investigación sobre el empoderamiento de las mujeres en la AU se presentaron mayoritariamente en IEFAU-Alta en el formato individual y por categorías, resultado justificado por la promoción de redes de relaciones y reglas sólidas de reciprocidad y confianza construidas en el ambiente de la producción organizada, sin embargo, se reitera que, a pesar de que la AU contribuye a su empoderamiento, aún necesita de la acción del Estado para promover mayores incentivos a las políticas públicas que atiendan las respectivas demandas, especialmente de los grupos de mujeres agricultoras en sus especificidades.
Palabras clave: Agricultura urbana. Empoderamiento. Región Metropolitana de Belém.

1 Introduction

According to a United Nations report (UN, 2021), women account for more than 40% of the agricultural workforce in developing countries. However, achieving gender equality in agriculture requires transforming gender norms and reducing power asymmetries between men and women so that women farmers can participate more fully in decision-making spaces.

In Brazil, approximately 1.7 million women lead agricultural production (UN, 2021). This represents substantial progress, considering that women's participation in agriculture was historically far less visible. Today, women farmers have gained increasing recognition, including within the urban spaces of small, medium-sized, and large cities.

In Brazil, the relationship between urban agriculture (UA) and women farmers extends beyond food production within city boundaries. UA also encompasses economic and social relations and represents an important means of securing family livelihoods. In this context, UA is understood as a key mechanism for asserting the right to the city and promoting women's empowerment (DELGADO, 2017; CARLOS, 2020).

UA can therefore serve as an urban planning strategy that enables residents to identify viable alternatives for combating poverty, increasing income, and producing food to meet daily household needs.

In Brazilian metropolitan areas, UA contributes to food security, health and well-being, poverty reduction, and women's social inclusion. However, evidence suggests that significant challenges remain regarding the integration of this activity into urban and environmental planning (MATA, 2014; FERRARETO, 2015).

Although many cities have lost characteristics traditionally associated with rural areas, these features persist in certain Amazonian sub-regions, including the municipalities that comprise the Belém Metropolitan Region (BMR).

Among the economic activities carried out by women in the BMR, including commerce and services, agriculture remains the oldest and most significant, sustaining a large number of female-headed households. Within the context of UA, agricultural activity also constitutes a space of resistance and a means of defending the right to food.

In the BMR, UA is practiced in productive backyards as well as in community and private spaces and is largely driven by socially vulnerable populations, particularly women. It constitutes a form of popular economy deeply embedded local realities. However, UA continues to face important challenges, including the lack of adequate public incentives. Furthermore, women continue to experience gender-based barriers, such as violence, restricted access to economic and educational resources, and exclusion from decision-making spaces.

Ensuring women's full participation across all economic sectors and levels of economic activity is therefore essential for building strong economies and more stable and equitable societies. This process is already evident in the experiences of women farmers in the BMR.

Analyzing women's work, particularly within agricultural decision-making spaces, provides important insights for the formulation of public policies aimed at overcoming the reproduction of socially assigned gender roles. In the case of the urban women farmers in the BMR, agricultural practice is intrinsically connected to local culture, since these activities are predominantly carried out by women born and raised in the region. Culture encompasses not only material aspects and values but

also the meanings embedded in practices that sustain and animate this way of life (BRANDÃO, 1986).

Within this context, agricultural associations play a central role. Established in 1988, these associations emerged to participate in institutional markets through the National School Feeding Program (PNAE) and, later, the Food Acquisition Program (PAA) implemented through municipal governments. They also formed partnerships with private companies in the cosmetics sector.

The success of associations is reflected in their participation in courses and training programs focused on strengthening social capital and promoting the empowerment of their members. Empowerment is a multidimensional process that affects different aspects of life, including family relations, social status, economic power, and physical and emotional well-being (Alkire et al., 2013a). Given women's substantial involvement in the development of these associations, empowerment emerges as a key mechanism enabling them to act as effective agents of local socioeconomic development.

Despite the recognized importance of women's empowerment in agriculture and the growing body of research on this topic in Brazil, relatively few have examined women's participation in decision-making processes related to production, income generation, access to resources, participation in social groups, and time allocation. Considering the increasing role of women in the regional agricultural economy and the relevance of research in this field, this study aims to assess the level of empowerment among women engaged in urban agriculture in the BMR through the development of the Women's Empowerment in Urban Agriculture Index (WEUAI).

In this context, the study also aligns with the fifth Sustainable Development Goal (SDG), "Gender Equality", established by the United Nations (UN, 2019). According to the UN, eliminating all forms of discrimination against women and girls is not only a fundamental human right but also essential for accelerating sustainable development. Evidence indicates that promoting the empowerment of women and girls generates multiplier effects that contribute to economic growth and development.

The remainder of this paper is organized as follows: Section 2 presents a brief theoretical framework addressing the core concepts of urban agriculture and women's empowerment. Section 3 describes the study area and the methodology employed, Section 4 presents the results and discussion, and Section 5 presents the final considerations.

2 Theoretical framework

2.1 Urban Agriculture: brief concept and contributions

Urban agriculture (UA) is practiced within urban areas (intra-urban) or on their peripheries (peri-urban), encompassing settings that range from small towns to large metropolitan centers. It involves the cultivation, production, processing, and distribution of food and non-food products. UA relies heavily on human, material and

institutional resources available in and around cities while simultaneously supplying products, services, and resources back to urban populations (Mougeot, 2000).

UA generates multiple social, economic and environmental benefits for cities and their inhabitants. Although political support for this activity has expanded in recent years, additional investment and research remain necessary to strengthen its contribution to sustainable urban development. The economic and social dimensions of UA therefore constitute an important field of investigation. According to Moustier (2001), the economic impacts of UA can be assessed through indicators such as: (a) employment generation; (b) income generation and distribution; (c) financial availability; (d) contributions to household food supply; (e) value added; (f) contributions to urban food supply; and (g) market participation.

The benefits associated with UA can also be analyzed across different scales: (a) at the household level, UA contributes to employment, supplementary income generation, and savings on food and health expenditures; (b) at the municipal level, it improves nutritional conditions and public health while promoting waste recycling, pollution reduction, and landscape enhancement, thereby increasing overall urban quality; and (c) at the national level, UA can improve the efficiency of food systems by supplying perishable products that may otherwise be inaccessible to certain population groups. In some countries, it also contributes to import substitution and increases in Gross Domestic Product (Van Veenhuizen & Danso, 2007).

Studies examining the relationship between UA, food security, poverty reduction, and women's inclusion indicate that the activity is primarily oriented toward household consumption. Within this sphere, women play a central role in preserving culinary traditions and gastronomic culture (Arruda, 2011; Mata, 2014; Garcia, 2016; Sousa, 2019).

A major challenge in implementing UA projects as community-based interventions lies in integrating them with local development initiatives and social services. This process includes ensuring that the multiple benefits generated by UA effectively reach project participants while also considering the diverse social roles traditionally assigned to women.

2.2 Women's empowerment in agriculture and socioeconomic development

Sustainable development cannot be achieved without effective empowerment processes capable of strengthening the assets and capacities of poor and marginalized populations. These processes enable individuals and communities to participate, negotiate, articulate interests, and transform both their living conditions and their surrounding environments in ways that improve quality of life (Villacorta & Rodrigues, 2002).

Empowerment, however, does not occur spontaneously. It is driven by external actors and mechanisms, including development programs, social projects, activists, and public policies that facilitate women's individual and collective transformation. In democratic societies, public policies play a central role in promoting equal opportunity and social justice among different social groups.

Amartya Sen's work provides substantial evidence linking women's empowerment to broader development outcomes. According to Sen, women's education is a fundamental condition for improving female agency.

"The increase in women's power is one of the central aspects of the development process in many countries today. Among the factors involved are women's education, their patterns of property ownership, their employment opportunities, and the functioning of the labor market. [...] Women's agency is one of the mediators of economic and social change, and its determinants and consequences are closely related to many of the central features of the development process" (Sen, 2000, pp. 234–235).

Historically, ownership of productive resources such as land and capital in developing countries has remained concentrated among male household members, who are traditionally viewed as responsible for household social reproduction (Sen, 2000). As a result, women frequently encounter barriers to establishing small or large-scale enterprises because they often lack assets that can be used as collateral for credit access. This constraint limits women's participation across multiple economic sectors, particularly agriculture.

Women's empowerment therefore plays a fundamental role in generating both direct and indirect impacts on socioeconomic development. Petesch, Smulovitz, and Walton (2005) argue that ownership of economic resources and human capital[1] is essential for strengthening agency because it reduces dependency and expands individuals' capacity to make strategic life choices.

Staduto (2015) further argues that the work performed by women farmers remains widely underrecognized and is frequently associated with reproductive activities perceived as having little or no economic value. As a result, women's contributions to income generation and market-oriented production are often overshadowed by men's roles, especially because men tend to dominate market negotiations and public economic spaces.

According to Staduto (2015), market-oriented and remunerated productive activities have traditionally been associated with men. By contrast, women are generally assigned "reproductive work" linked to the private sphere, including domestic labor, childcare, care for older adults, and backyard management. However, the author emphasizes that women's work in the household backyard production systems generates two forms of income: (1) production for household self-consumption and (2) income derived from the sale of surplus production. Although the former cannot be directly monetized, it should still be considered in household budget assessments.

[1]The concept of human capital refers to the capacity to work (Sandroni, 1994, p. 41). The term also designates the skills and abilities that enable individuals to generate income. Human capital derives both from natural aptitudes and from competencies acquired through learning processes.

The difficulty in distinguishing productive from reproductive activities, combined with women's limited access to land and productive capital, reflects social arrangements that historically favor the transfer of inheritance to men. These conditions reinforce women's subordinate position, particularly in agriculture, where their participation in the management of rural and urban agricultural establishments often remains invisible.

In recent years, socioeconomic analyses comparing women's and men's participation in agriculture, especially in decision-making processes, have expanded considerably worldwide (Gupta, Pingali, & Pinstrup-Andersen, 2017).

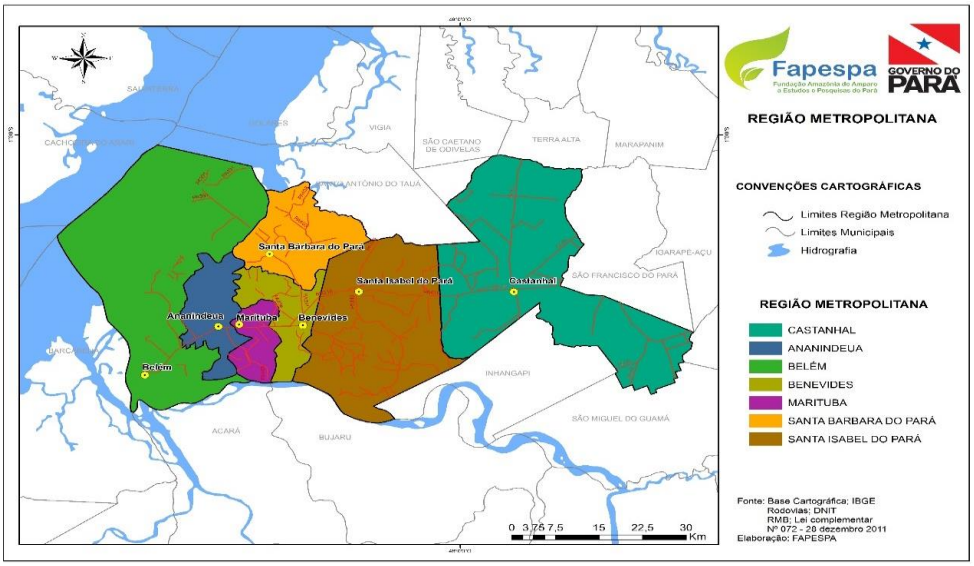
Among these studies, those based on primary data collection are particularly relevant because field-based evidence provides a more comprehensive understanding of women's roles in socioeconomic development within specific territorial contexts, such as UA in the study area. Thus, examining the evolution of agricultural work carried out by women in the BMR is essential for understanding its implications for women's empowerment.

3 Study area and methodological approach

The current territorial configuration of the MRB originated in the 1970s through Federal Complementary Law No. 14/1973. Initially, the metropolitan region comprised only the municipalities of Belém and Ananindeua. In 1995, the municipalities of Marituba, Benevides, and Santa Bárbara do Pará were incorporated through State Complementary Law No. 27/1995. Santa Izabel do Pará was subsequently added in 2010 through State Complementary Law No. 72/2010, followed by the incorporation of Castanhal in 2011 through State Complementary Law No. 76/2011.

The MRB currently comprises the municipalities of Belém (the state capital), Ananindeua, Marituba, Benevides, Santa Bárbara do Pará, Santa Izabel do Pará, and Castanhal, as shown in Figure 1.

Figure 1 – Municipalities comprising the Belém Metropolitan Region (MRB).



Source: FAPESPA, 2015.

The MRB has an estimated population of 2,529,178 inhabitants, corresponding to nearly one-third of the population of Pará state (8,690,745 inhabitants). This population is concentrated within an area of 3,565.8 km², equivalent to approximately 1% of the state's total area of 1,245,870.707 km² (IBGE, 2020). The region's Gross Domestic Product (GDP) is approximately R$ 43 billion, with a per capita GDP of R$ 17,577.96 (IBGE, 2015). Population distribution is predominantly concentrated in the metropolitan core.

The study was conducted with urban women farmers working in organized groups within the MRB. The associations included in the research were selected based on reports produced in 2021 by the Technical Assistance and Rural Extension Agency of the State of Pará (EMATER) for the municipalities of Belém, Ananindeua, Marituba, and Benevides. According to these reports, the associations comprised 245 members, including 92 men and 153 women. A total of sixty women farmers were interviewed, representing 39% of all female members.

In Belém, the selected association was the Chico Mendes Agroextractive Rural Producers Association (AMPRACM), located in the Mosqueiro District. In Ananindeua, the study included the Gleba Guajará Horticultural Producers Association (APHA), in the Corunçambá neighborhood. In Marituba, the selected groups were the Bela Vista Agricultural and Residents Association (AAMBV), located at Km 18 of BR-316, and the Horticultural Producers Association, in the Uriboca neighborhood. In Benevides, the selected groups were the Taiassuí Sons and Friends Association on Taiassuí road, and the AMPARA Association, located along the São José Road.

The methodological approach combined qualitative and quantitative strategies. The qualitative component consisted of perceptions obtained through semi-structured interviews and systematic observations conducted with the women farmers in their production systems. The quantitative component involved the application of multivariate analysis techniques to data collected through sixty structured questionnaires aimed at characterizing the social profile of women engaged in UA.

The research was conducted in two phases: (1) a bibliographic, documentary, and exploratory review, and (ii) fieldwork.

The first stage took place between January 2021 and July 2022 and focused on the relationship between UA, women, and the sexual division of labor. During this period, literature related to the theoretical framework was reviewed, particularly studies addressing social capital and women's empowerment. Secondary data were also collected, especially those produced by the Brazilian Institute of Geography and Statistics (IBGE), in addition to documents available on municipal government websites within the MRB and complementary sources such as books, academic journals, and master's theses.

The second stage, corresponding to fieldwork, was conducted between August and September 2022. During this period, sixty questionnaires were

administered and systematic observations were carried out with urban women farmers who agreed to participate in the study.

To assess women's level of empowerment in UA, the questionnaire incorporated the Women's Empowerment in Agriculture Index (WEAI) proposed by Alkire (2013b), encompassing the following dimensions: 1) decision-making related to production and income generation; 2) access to and decision-making power over productive resources; and 3) participation in social organization and community leadership. These dimensions were adapted to the context of the present study and incorporated into the questionnaire.

To achieve the study objective, the adapted variables analyzed included: a) community action and leadership; b) participation in social organizations; and c) decision-making related to production and domestic systems. These variables were considered associated with the promotion of political, economic, and social equity between men and women, as well as women's autonomy and empowerment.

The WEUAI was constructed using a linear combination of factor scores (FS) and the proportion of variance explained by each factor, according to the following equation:

$$\text{WEUAI}_i = \sum_{j=1}^{q} \frac{\lambda_j}{\Sigma\lambda_j} FS_{ij}, (i = 1,2, \dots, n) \quad (1)$$

Where:

- λ = variance explained by each factor
- $\Sigma\lambda$ = total variance explained by the set of common factors

The estimation of the WEUAI involved several stages. First, factors were extracted using the principal components method, which Matos and Rodrigues (2019) identify as one of the most widely used multivariate techniques. This method uses the original variables to generate independent linear combinations capable of explaining the maximum proportion of variance. To facilitate data interpretation and reduce factor indeterminacy, orthogonal varimax rotation was applied. Factor retention was based on three criteria: (i) eigenvalue criterion; (ii) the Scree test criterion; and (iii) the cumulative percentage of explained variance (MATOS: RODRIGUES, 2019).

Factor scores (FS) were subsequently standardized to produce positive values and enable the classification of women farmers according to their level of empowerment. To ensure that WEUAI values ranged between 0 and 1, the following equation was applied:

$$FS = \frac{F_i - F_{\min}}{F_{\max} - F_{\min}} \quad (2)$$

After standardization, the urban women farmers were ranked and classified into high, medium, and low empowerment levels, as presented in Table 1.

TABLE 1 – Categorization of the Women's Empowerment in Urban Agriculture Index (WEUAI)

High	≥ 0.70
Medium	0.50–0.69
Low	< 0.50

Source: Research data.

To evaluate the suitability of the data for factor analysis, Bartlett's test of sphericity was performed. Rejection of the null hypothesis confirmed the existence of significant correlations among the variables, indicating that they could jointly represent one or more latent constructs ($p < 0.05$). The Kaiser–Meyer–Olkin (KMO) test was also applied; according to Matos and Rodrigues (2019), values equal to or below 0.5 indicate inadequate sample size. In this study, the sample was considered adequate for factor analysis.

4 Results and Discussion

4.1 Urban women farmers in the Metropolitan Region of Belém: brief characterization

The urban women farmers interviewed were categorized according to characteristics identified during fieldwork, as follows: CAURD: agricultural activity as the primary source of income combined with domestic work; CAUTI: UA associated with informal employment; CAUART: UA combined with handicraft production; CAUTS: UA associated with solidarity-based initiatives; and CAUM: urban women farmers classified as individual microentrepreneurs (MEI in Portuguese).

Women classified as CAURD accounted for 63% of the total sample of sixty interviewees engaged in UA in MRB. CAUTI represented 22% of the sample, followed by CAUART (7%), CAUTS (3%), and CAUM (5%). Table 2 presents the distribution of these categories in absolute and relative terms.

Table 2 – Distribution of women farmers in the MRB by category.

	CATEGORIES	No.	%
1	CAURD	38	63
2	CAUTI	13	22
3	CAUART	04	7
4	CAUM	03	5
5	CAUTS	02	3
	TOTAL	**60**	**100**

Source: Research data, 2022.

The predominance of CAURD among urban women farmers in the MRB indicates that agricultural activity extends beyond subsistence and constitutes an important source of income for these women and their families. Additionally,

domestic labor continues to be socially assigned almost exclusively to women, regardless of marital status.

Federici (2004) and Beauvoir (2016) argue that women's confinement to domestic labor and childcare reflects historically constructed control over women's bodies and labor. This dynamic has enabled men's participation in paid employment while relegating women to activities considered unproductive and therefore unpaid. The present findings indicate that this pattern remains evident among women classified as CAURD.

The second most representative category was CAUTI, in which UA functions primarily as a complementary source of income and food provision. Because agricultural activity alone is insufficient to sustain household income, these women also engage in informal activities, including the sale of cakes, sweets, and snacks.

The CAUART category comprises women for whom agricultural production plays a central role in income generation, while handicraft production carries both economic and symbolic value. The collective nature of handicraft activities also contributes to social interaction and improved quality of life.

Consistent with previous studies, the role of UA as a supplementary income source has also been documented by Sequeira (2014), Dourado (2015), and Sousa (2019). However, the low financial returns obtained from agricultural production remain insufficient to guarantee household subsistence, reinforcing the need for complementary income-generating activities.

In the CAUM category, agricultural production primarily supplements household food provision alongside activities performed as Individual Microentrepreneur (MEI), particularly in the beauty and food sectors. Beauty-related activities include hair straightening, coloring, and hairstyling services provided in small salons, whereas food-related activities include meal preparation and sales in small restaurants.

Finally, the study identified the CAUTS category, in which agricultural activity serves as a complementary source of income while women simultaneously engage in solidarity-based initiatives. These activities include campaigns to collect clothing, shoes, and other items for donation to socioeconomically vulnerable families living in peripheral urban areas.

4.1 Analysis of the Women's Empowerment in Urban Agriculture Index in the MRB

The statistical indicators demonstrated that the dataset was suitable for factor analysis and, consequently, for the construction of the WEUAI. The Kaiser-Meyer-Olkin (KMO) index was 0.610, indicating adequate intercorrelations among the variables and supporting the application of principal component analysis. Bartlett's test of sphericity yielded a value of 376.354, significant at the 1% level (Table 3), leading to rejection of the null hypothesis that the correlation matrix was an identity matrix. These results confirm the adequacy of the sample for factor analysis.

Factor analysis generated independent linear factors, and the estimated model identified three factors that together explained more than 60% of the total

variance. According to Hair et al. (2005), cumulative explained variance above 60% is considered acceptable in the Humanities and Social Sciences. Factor 1 explained 29.44% of the total variance, Factor 2 accounted for 20.99%, and Factor 3 explained 20.48%. Table 3 presents the rotated factor loading matrix and the communalities associated with each variable.

Table 3 – Factor loading matrix after orthogonal Varimax rotation and communalities

Participation in social movements	**0.876779275**	**0.00591**	**-0.01435**	**0.768983**
Political participation	**0.837374435**	0.287255	-0.09825	0.793364
Public speaking	**0.793612867**	-0.04332	-0.00402	0.631714
Participation in other social movements	**0.729867476**	0.495354	-0.06839	0.782759
Women's Inspirational Leadership	**0.602896499**	0.177775	-0.063	0.399057
Participation in courses within the association	-0.11633737	**0.838416**	0.116738	0.730104
Participation in production decisions within the association	0.280645743	**0.790085**	0.032093	0.704027
Participation in credit acquisition decisions within the association	0.358887858	**0.763064**	-0.05513	0.714107
Decisions regarding household expenditures	-0.12439189	0.189822	**0.885252**	0.835176
Decisions regarding major household expenditures	-0.07084136	-0.03764	**0.880027**	0.780882
Decision-making within the production system	0.03088393	-0.0397	**0.812105**	0.662045
Explained Variance (%)	29.44084102	20.99887	20.48954	
Accumulated Variance (%)	29.44084102	50.43971	70.92925	

Source: research data, 2022.
Note: KMO=0.610, Bartlett's tests = 376.354, significant at the 1% probability level.

Table 3 presents the factor loadings and communalities associated with each variable. Most communality values ranged between 0.6 and 0.7 except for the variable "Women's Inspirational Leadership" (0.39). This variable was intended to assess the extent to which the work performed by women farmers serves as a source of inspiration for other women, thereby encouraging their participation in social organizations. Despite its lower communality, the variable was retained because of its theoretical relevance to the measurement of women's empowerment.

Factor 1 comprised the variables Participation in Social Movements, Political Participation, Public Speaking, Participation in Other Social Movements, and Women's Inspirational Leadership. This factor was labeled "Social Capital and Political Action." Collectively, these variables reflect the women farmers' engagement in social organizations, highlighting their capacity for mobilization and their ability to expand labor and income opportunities.

The "Social Capital and Political Action" factor encompasses elements of social organization that facilitate political mobilization and coordinated collective action, enabling women farmers to pursue common goals. Organized participation promotes collective interests through values such as equality, solidarity, trust,

tolerance, persistence, respect, and dignity, all of which contribute to successful cooperation (PUTNAM, 2006).

Factor 2 grouped the variables Participation in Courses within the Association, Participation in Production Decisions, and Participation in Credit Acquisition Decisions within the Association. This factor was designated "Capacity Building and Collective Action." It reflects the way in which participation in social organizations influences women's access to education, technical skills, and empowerment processes. A higher level of education not only improves individual productivity but also enhances the productivity of other production factors. Furthermore, education plays a central role in overcoming women's economic subordination by enabling their participation in productive activities associated with income generation, autonomy, and empowerment.

Empowerment involves both individual transformation and collective action aimed at changing the economic and social structures that sustain women's subordination. In practical terms, this process includes actions that enable women to overcome poverty through access to income, healthcare, housing, and education for their children. At a deeper level, however, empowerment requires fundamental shifts in unequal gender power relations (LEÓN, 1997; SARDENBERG, 2009).

Factor 3 included the variables Decisions Regarding Household Expenditures, Decisions Regarding Major Household Expenditures, and Decision-Making within the Production System, and was labeled "Household and Productive Decision-Making." These variables address women farmers' participation in decision-making processes both within the domestic sphere, commonly associated with unpaid labor, and within the production system, regarded as a space of work and income generation. Recognizing women's central role in decision-making across both domains highlights the socioeconomic importance of UA for their self-development and empowerment.

Historically, opportunities for decision-making have been concentrated primarily among men. Within this context, empowerment involves gaining greater control over one's life and making choices according to one's own interests and priorities, while also advancing women's pursuit of economic, social, and political power (DEERE and LEÓN, 2002).

Based on the factor loadings presented in Table 3, the variables contributing to each latent dimension were identified and grouped according to the designated factor names. Standardized scores were subsequently used to construct the WEUAI.

4.2 Factor scores and the Women's Empowerment in Urban Agriculture Index (WEUAI)

The WEUAI was classified according to the three categories. Values greater than or equal to 0.7 were considered high and reflected stronger performance across the dimensions analyzed, indicating that these women farmers could serve as leadership references within their communities. Values between 0.50 and 0.69 were classified as medium, suggesting the need for measures aimed at strengthening intermediate empowerment outcomes. Values below 0.50 were classified as low and reflected lower levels of empowerment, greater marginalization, and limited

participation in the family production system. Table 4 presents the factor scores and the overall WEUAI.

Table 4 – Factor Scores and the Women's Empowerment in Urban Agriculture Index (WEUAI)

Woman farmer	F1	F2	F3	FS1	FS2	FS3	INDEX	Categorization
1	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
2	0.27004	0.5959	0.33811	0.672848	0.896307	0.948396	0.818602	High
3	1.09937	-2.3924	0.5003	0.901877	0.24448	0.986959	0.73183	High
4	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
5	0.27004	0.5959	0.33811	0.672848	0.896307	0.948396	0.818602	High
6	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
7	0.27004	0.5959	0.33811	0.672848	0.896307	0.948396	0.818602	High
8	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
9	0.27004	0.5959	0.33811	0.672848	0.896307	0.948396	0.818602	High
10	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
11	0.27004	0.5959	0.33811	0.672848	0.896307	0.948396	0.818602	High
12	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
13	0.27004	0.5959	0.33811	0.672848	0.896307	0.948396	0.818602	High
14	0.27004	0.5959	0.33811	0.672848	0.896307	0.948396	0.818602	High
15	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
16	-1.69253	0.3793	0.21721	0.130862	0.849061	0.91965	0.571347	Medium
17	-0.10139	-0.10773	0.47267	0.570273	0.742827	0.980389	0.73983	High
18	-0.70841	-0.71332	0.4848	0.402638	0.610732	0.983273	0.631975	Medium
19	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
20	-2.16639	0.89806	0.14958	0	0.962216	0.90357	0.545885	Medium
21	-1.67007	-1.00423	0.30764	0.137064	0.547277	0.941151	0.490788	Low
22	-0.8504	0.97265	0.20834	0.363426	0.978486	0.917541	0.705586	High
23	-1.69253	0.3793	0.21721	0.130862	0.849061	0.91965	0.571347	Medium
24	-0.10139	-0.10773	0.47267	0.570273	0.742827	0.980389	0.73983	High
25	-0.70841	-0.71332	0.4848	0.402638	0.610732	0.983273	0.631975	Medium
26	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
27	-2.16639	0.89806	0.14958	0	0.962216	0.90357	0.545885	Medium
28	-1.67007	-1.00423	0.30764	0.137064	0.547277	0.941151	0.490788	Low
29	-0.8504	0.97265	0.20834	0.363426	0.978486	0.917541	0.705586	High
30	-1.69253	0.3793	0.21721	0.130862	0.849061	0.91965	0.571347	Medium
31	-0.10139	-0.10773	0.47267	0.570273	0.742827	0.980389	0.73983	High
32	-0.27291	-0.91235	0.55515	0.522906	0.567318	1	0.673874	Medium
33	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
34	-2.16639	0.89806	0.14958	0	0.962216	0.90357	0.545885	Medium
35	-1.67007	-1.00423	0.30764	0.137064	0.547277	0.941151	0.490788	Low
36	-0.8504	0.97265	0.20834	0.363426	0.978486	0.917541	0.705586	High
37	-0.90535	0.29423	0.35998	0.348251	0.830505	0.953596	0.665892	Medium
38	-1.17692	1.07128	-1.21996	0.273253	1	0.577943	0.576426	Medium
39	-0.39089	-3.07982	0.43937	0.490325	0.094536	0.972472	0.512429	Medium
40	0.64945	-2.04548	0.42505	0.777627	0.320153	0.969067	0.697492	Medium
41	-0.04741	-2.34865	0.41931	0.585181	0.254023	0.967702	0.59764	Medium

42	-0.17175	-3.51322	-0.77052	0.550843	0	0.684803	0.426461	Low
43	0.36883	-0.13221	0.4792	0.70013	0.737487	0.981942	0.792598	High
44	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
45	1.45468	-0.99891	0.40746	1	0.548437	0.964885	0.856169	High
46	-0.37138	-1.63542	-3.6507	0.495713	0.409598	0	0.327020	Low
47	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
48	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
49	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
50	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
51	0.54497	0.5767	-3.59105	0.748773	0.892119	0.014183	0.579008	Medium
52	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
53	0.83675	0.30351	-2.09893	0.829352	0.832529	0.368955	0.697296	Medium
54	-0.51949	0.29693	-0.889	0.45481	0.831094	0.656633	0.624512	Medium
55	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
56	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
57	0.54497	0.5767	-3.59105	0.748773	0.892119	0.014183	0.579008	Medium
58	0.8952	0.37789	0.41108	0.845493	0.848753	0.965745	0.881196	High
59	0.83675	0.30351	-2.09893	0.829352	0.832529	0.368955	0.697296	Medium
60	-0.51949	0.29693	-0.889	0.45481	0.831094	0.656633	0.624512	Medium

Source: Research data, 2022.

Among the 60 urban women farmers in the MRB, 35 presented high WEUAI values (58.33%), 20 medium values (33.33%), and 5 a low WEUAI (8.34%).

Among the respondents classified with high WEUAI values, respondent 45 stood out (WEUAI = 0.856169). Her strongest performance was observed in the "Social Capital and Political Action" factor, composed of the variables Participation in Social Movements, Political Participation, Public Speaking, Participation in Other Social Movements, and Women's Inspirational Leadership.

This result highlights the importance of social organization in strengthening women's participation in UA and expanding their engagement in collective mobilization processes. These elements directly contributed to the respondent's high empowerment level.

The findings further indicate that women engaged in UA in the MRB benefit from the typical advantages associated with collective organizational processes. Participation in these groups strengthens trust, reciprocity, and collective commitment, which increases both efficiency and individual and collective empowerment.

In this regard, a study by Machado (2021) on women's work in family farming in Paraíso do Sul Rio Grande do Sul state, demonstrated that social organization functioned as an important tool for resistance and recognition of women's labor. By organizing groups across different localities in the municipality, the women gained visibility and voice, enabling them to move beyond the domestic sphere, discuss issues of shared interest, and achieve greater autonomy while recognizing their relevance to agricultural development. In this case, social capital also operates as a form of security, since women who lack financial assets to offer as collateral rely heavily on personal and collective social relationships.

Similarly, Coleman (1988/1990) and Putnam (2006) define social capital as a set of social bonds, trust-based norms, and reciprocal relations that facilitate coordinated action for mutual benefit, thereby increasing societal efficiency. For these authors, trust constitutes the central element underlying social capital and cooperation.

Among the women farmers classified with medium WEUAI values, respondent 38 was particularly noteworthy (WEUAI = 0.576426). Her intermediate performance was associated mainly with the "Capacity Building and Collective Action" factor, composed of the variables Participation in Courses within the Association, Participation in Production Decisions within the Association, and Participation in Credit Acquisition Decisions within the Association. Nevertheless, these women still require public policies specifically designed to strengthen their current levels of empowerment.

The findings also reinforce that the political and social dynamics of traditional societies historically positioned men in leadership roles and public spaces while confining women to domestic activities. In this sense, the social roles attributed to men and women can be understood as cultural constructions consolidated through "a regime of domination–exploitation of women by men," known as patriarchy[2], "a term that refers to the power of the father" (Saffioti, 2004, p. 44).

Among the women farmers classified with low WEUAI values, respondent 46 (WEUAI = 0.327020) was particularly notable because of her negative performance in the factor "Strategies and Decision-Making in Productive and Domestic Domains". This factor comprises the variables Decisions Regarding Household Expenditures, Decisions Regarding Major Household Expenditures, and Decision-Making within the Production System. These findings indicate that women classified with low WEUAI experience lower levels of empowerment, greater marginalization, and reduced participation in family production systems.

Under these conditions, women's empowerment emerges as a collective challenge involving women, men, and society as a whole, requiring actions that promote equal opportunities, and the absence of discrimination.

From this perspective, Beauvoir (2016) argues that if girls were raised from childhood under the same expectations, opportunities, freedoms, and constraints as boys, receiving the same education, participating in the same activities, and envisioning the same future, social relations between men and women would no longer reproduce a system of hypocrisy. Instead, beyond biological differences, men and women would recognize one another as equals.

The findings also demonstrated that participation in agricultural associations within the MRB contributed to the expansion of women farmers' social capital as well as their cognitive, psychological, economic, and political empowerment. This process

[2] Addressing this issue, Pateman (1993) argues that "political right originates in sexual or conjugal right," emphasizing that paternal right constitutes only one dimension of patriarchal power rather than its primary foundation. According to the author, the power exercised by men as fathers is derived from the patriarchal right exercised by husband over women.

was strengthened through the consolidation of social ties among the women themselves and external institutional actors.

Nevertheless, social capital, understood as a socio-structural resource embedded in social relations that strengthens collective action and public policies while facilitating coordinated and cooperative practices, has not yet reached all urban women farmers in the MRB. In this regard, the study reinforces the need for public policies grounded in women's specific realities so that empowerment processes can effectively reach all women farmers.

4.3 Analysis of the Women's Empowerment in Urban Agriculture Index (WEUAI) in the MRB, by category

Women's participation in economic activities related to UA represents a pathway toward empowerment and the redefinition of gender roles in both domestic and public spheres. From this perspective, it is important to examine how the WEUAI is distributed across the social categories identified during the research, as presented in Table 5.

Table 5 – WEUAI of urban women farmers in the MRB, by category (%)

CATEGORY	LOW WEUAI	MEDIUM WEUAI	HIGH WEUAI
CAURD	10.53	34.21	55.26
CAUTI	0.00	23.08	76.92
CAUART	0.00	75.00	25.00
CAUM	33.33	33.34	33.33
CAUTS	0.00	0.00	100.0

Source: Research data, 2022.

Table 5 shows that high WEUAI values predominated in the CAURD (55.26%), CAUTI (76.92%), and CAUTS (100%) categories, whereas medium WEAUI values predominated in the CAUART (75%) and CAUM (33.34%). Low WEUAI were identified only in CAURD and CAUM, although at relatively low frequencies. Overall, the categorical analysis indicates that participation in organized UA activities contributes to women's empowerment by expanding their knowledge, strengthening their capacities, and fostering greater autonomy and decision-making in both productive and domestic environments.

Empowerment is inherently relational. It is both a process and an outcome of social action depends on interaction among individuals. Effective empowerment therefore requires participation in decision-making spaces shaped by political, economic, and social contexts. Such participation enables the construction of social structures capable of challenging the naturalized forms of economic, political, cultural, and social domination (Ckagnazaroff & Machado, 2008; Baquero, 2012).

The findings further demonstrates that the empowerment outcomes achieved by participating women farmers were strongly facilitated by social networks that promoted norms of reciprocity and trust.

From this perspective, participation in organized women's groups strengthened social bonds and enabled the formation of new social relationships, thereby contributing substantially to the expansion of social capital among women farmers.

6 Final considerations

The study found that the social profile of urban women farmers in the MRB can be classified into five categories (CAURD, CAUTI, CAUART, CAUM, and CAUTS), each characterized by distinct objectives and socioeconomic perspectives integrated into the urban ecological system.

With regard to the methodological proposal used to construct the WEUAI through multivariate analysis, the dataset proved suitable for factor analysis. The Kaiser-Meyer-Olkin (KMO) index reached 0.610, indicating sufficient intercorrelation among the variables to justify the application of principal component analysis. Bartlett's test of sphericity yielded a value of 376.354, significant at the 1% level. Consequently, the null hypothesis was rejected, confirming the adequacy of the sample for factor analysis.

Given the validation of the proposed model, the WEUAI may serve as a methodological reference for future studies on UA while also contributing to the strengthening of public and private institutions responsible for implementing policies aimed at promoting gender equality for women and girls.

With respect to women's empowerment, the study confirmed that agricultural activity developed through organized collectives functions not only a mechanism for market expansion but also as a driver of social mobilization, enabling women to attain high levels of empowerment.

The predominance of high WEUAI values, both at the individual and categorical levels, indicates that empowerment among women engaged in UA in the MRB is strongly associated with the expansion of social networks and with the consolidation of norms of reciprocity and trust within organized production environments. These findings reinforce the importance of investing in cooperative and associative organizational structures.

Nevertheless, while UA contributes to complementary income generation and women's empowerment, the activities carried out by women farmers in the MRB remain embedded within broader structural challenges, including violence in production environments and public spaces, as well as threats faced by women who assume leadership roles in social organizations.

Under these conditions, the finding that 58.33% of urban women farmers in the MRB were classified as empowered, both within production systems and domestic environments, demonstrates that UA contributes to social reproduction, employment, income generation, and livelihood maintenance. However, persistent social vulnerability, including latent poverty among farming families, remains evident. Thus, UA continues to require state support through public policies specifically designed to address the needs of women farmers.

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