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Correlation between physical characteristics and plant composition of home gardens in Bandung City, West Java, Indonesia

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Abstract. *Laraswari S, Wulandari I, Husodo T, Abdoellah OS, Amalia CA, Fawwaz MR, Azadi SM, Farhaniah SS. 2024. Correlation between physical characteristics and plant composition of home gardens in Bandung City, West Java, Indonesia. Biodiversitas 25: 3051-3060.* Green open space in urban settings provides various benefits to city residents, yet the increase in urban population indirectly results in a decrease in urban green space. Home gardens can expand urban green space to complement public areas but are often overlooked. This research examines the physical characteristics (area size, shape, and zoning) and plant composition of home gardens in Bandung City, West Java, Indonesia, as well as the correlation between both aspects. This research examined extensive data collection from a densely populated urban area, a context rarely explored but highly relevant in recent urban development. Data was collected in five housing complexes in the Rancasari Sub-district, with 514 home gardens, and correlation analysis was performed using Canonical Correspondence Analysis (CCA). The result showed that 92.2% of the home gardens had very narrow areas with 2-53m^2. The shape of the home garden was dominated by strips, with 66% and 94% of home gardens having front zoning. Across the sampled home gardens, there were 1054 species from 141 families, with a total of 32,967 individuals. Araceae was the most commonly found family with 100 species and *Sri Rejeki* (*Aglaonema commutatum* Schott) had the largest number of individuals. Most of the home garden plants were ornamental plants due to their attractive morphology, making them relatively homogeneous within 95% of the home gardens. The presence of ornamental plants was the least influenced by physical characteristics, while medicinal and spice plants can be grouped together as they were more affected by the area size and less by the zone and shape. Edible plants were the most influenced by all physical characteristics, particularly the zone. This study provides new insights into urban ecology, offering valuable information for homeowners, developers, and policymakers to enhance the role of home gardens as private green spaces.

Keywords: Bandung City, Canonical correspondence analysis, home garden, open green space, plant composition

Abbreviations: CCA: Canonical Correspondence Analysis

INTRODUCTION

The world's population is growing rapidly, impacting our environment and quality of life. As the global population continues to increase, more people are living in urban areas than before, which is a trend that continues to persist in the future. The United Nations (UN) Population Division reported that the percentage of the world's urban population was 55% in 2018, and it is projected to reach more than 68% in 2050. The increase in global urban population is estimated to reach 57% in 2021 (United Nations Population Division 2019). It is also reported that the population of cities in Indonesia in 2018 reached 55% of the total population in Indonesia. Urbanization in Indonesia is predicted to continue, triggering social, economic, governance, and ecological problems (Mardiansjah et al. 2021).

The increase in urban population might cause ecological problems, including reducing urban green space. This problem happens worldwide, including in Bandung City, Indonesia. According to Mukhoriyah et al. (2021), in 2015-2020, there was a very significant decline in the area of open green spaces in the city of Bandung due to the conversion of land into built-up areas as the implication of the high rate of urbanization and other commercial activities.

According to Wang et al. (2020), the expansion of built-up areas puts pressure on urban infrastructures, including urban green spaces. East Bandung area has been significantly affected not only by urbanization but also by the government's plan. The government's plan to develop East Bandung into a technopolis causes rapid growth and challenges the city in maintaining open green spaces. Sarah et al. (2023) reported that the East Bandung area has recently experienced rapid development. While new business centers and infrastructures are being established, the city must balance progress with sustainable development to ensure residents' good quality of life, one of which is by maintaining open green spaces.

Green space delivers two types of benefits, namely direct benefits (which are quick and tangible), such as creating beauty and comfort and obtaining materials for sale, and indirect benefits (which are long-term and intangible), including very effective air purification, maintaining continuity of groundwater supplies, preservation of environmental functions along with flora and fauna (Regulation of the Minister of Public Works Number 05/PRT/M/2008 2008). The Minister of Public Works Regulation No. 05 of 2008 stipulates that urban areas should have a minimum of 30% green open space, consisting of 20% public green open space and 10% private green open space. Considering the potential reduction in the area of urban green open space and ensuring local communities have access to green spaces, it is essential to facilitate the creation and preservation of private green open spaces, including in the form of home gardens. Home gardens are crucial for urban communities to connect them to green open spaces.

Despite its importance as a private green open space, there is no assessment of home gardens in Bandung City. The characteristics of the home garden as a representative of private green open space maintained and managed by urban communities need to be studied. Therefore, this research aims to study the physical characteristics (area size, shape, and zoning), plant composition, and the correlation between physical characteristics and plant composition of home gardens in Bandung City. The results of this study are important to enhance our understanding of the contribution of home gardens in extending green open space in urban settings and its potential to conserve plant diversity.

MATERIALS AND METHODS

Study period and area

The study was conducted between January and March 2024 at five housing complexes in Rancasari Sub-district, Bandung City, West Java Province, Indonesia, namely the Bandung Indah Raya (BIR), Baturaden, Pasir Pogor, Banyu Biru, and Margahayu Raya (Figure 1). Rancasari Sub-district is located at 6°56'50.34"S 107°40'34.30"E with area extent of 7.60 km^2 and an altitude of 685-705 meters above sea level.

Data collection procedures

The housing complexes were selected based on the presence of home gardens with various types of plants, representing heterogeneous structures and functions of green open space. Based on information from the Rancasari Sub-district Office, each housing complex used as a sampling location had more than 100 houses. Hence, this research took a 10% sample from the total houses in each housing complex, resulting in a total of 514 home gardens as the sample. This sampling design refers to Arikunto's (2002) statement that if the population is more than 100, a 10%-15% or 20%-25% or more sample should be taken. Technically, selecting home gardens as a sample depends on the homeowner's willingness. Thus, sample selection was done using a purposive sampling method, a method used to target certain individuals with characteristics of interest in the study (Turner 2020).

Data was collected by observing the home garden's physical characteristics and plant species composition. The physical characteristics data included the length, width, and position of the garden relative to the house, while the plant species composition data included species names, the number of species, and the number of individuals of each species.

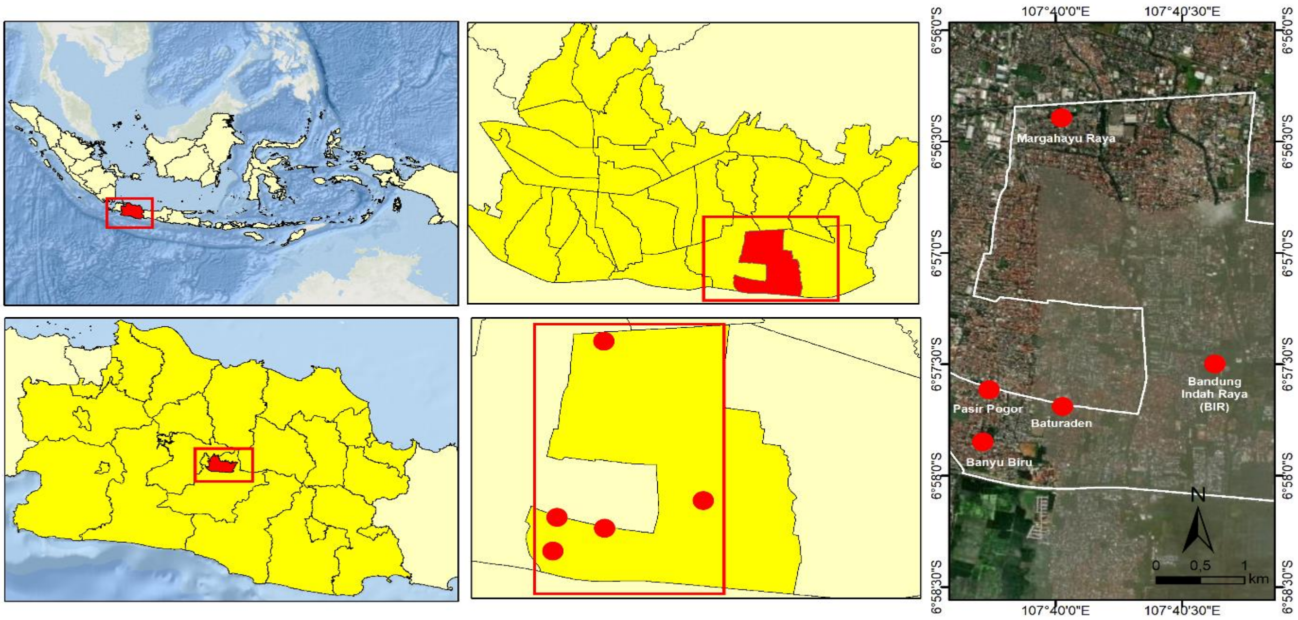

Figure 1. Map of study area in Rancasari Sub-district, Bandung City, West Java, Indonesia, showing five sampling sites: Bandung Indah Raya (BIR) (6°57'40.71"S, 107°40'31.35"E), Baturaden (6°57'43.50"S, 107°40'1.64"E), Pasir Pogor (6°57'36.50"S, 107°39'44.33"E), Banyu Biru (6°57'55.06"S, 107°39'43.18"E), and Margahayu Raya (6°56'22.83"S, 107°40'1.26"E)

Data analysis

The main aspects studied in the research are the physical characteristics of the home garden (area, shape, and zoning), the composition of plant species (species and number of individuals), and the correlation between them. First, the physical characteristic of the home garden was analyzed, which are categorized into five categories, namely very narrow, narrow, medium, wide, and very wide, referring to similar research conducted by Iskandar et al. (2018). Second, the shape of the home gardens was analyzed by calculating the ratio between the length and width of the home gardens, referring to Arifin et al. (1998). A ratio of more than two is considered a strip shape, while a ratio between one and two is considered a block. Ratios outside this category are classified as irregular shapes. Third, a zoning analysis was carried out on the position of the home garden relative to the house building. Home garden zoning includes front, side, and back zoning and its combinations, as reported by Wakhidah et al. (2020), based on the typical Indonesian home garden zoning.

The plant composition was studied by identifying the taxonomic information, function, and number of individuals, which were then analyzed for frequency to determine the plant composition at the research location. The correlation analysis of the physical characteristic and plant composition of the home garden is carried out using Canonical Correlation Analysis (CCA), which is a standard multivariate statistical analysis tool to find and calculate the association between two sets of variables, in this case, the plant composition variable and the physical characteristics variable of the home garden. The CCA analysis outputs are eigenvalue and scores illustrated on the ordination diagram (Parikesit et al. 2018).

1) Eigenvalue: The eigenvalue ranges from 0 to 1, which describes the distribution level of types or plots in the ordination diagram. If the eigenvalue approaches 1, then the distribution of plants in the gradient of the measured variable is more even.

2) Ordination diagram: The ordination diagram consists of points depicting the plot and plants, while arrows depict the physical characteristic of the home garden. The direction of the arrow shows the relationship between physical characteristic variables with home garden points and the presence of plant species.

RESULTS AND DISCUSSION

Physical condition

The area of the home gardens observed in the Rancasari Sub-district varied between 2 and 256.6 m^2. In a normal distribution, the maximum area of home garden was 64.5 m^2, while the minimum area was 2 m^2. The average home garden area in Rancasari Sub-district was 28.8 m^2. Very narrow home gardens dominated the categories (Table 1). There were 13 outlier data recorded; all had an extent of more than 64.5 m^2. The shape of home gardens in Rancasari Sub-district is divided into three categories: strip, block, and irregular. The strip shape dominated the categories with 66%. Most of the house gardens were parallel to the road around the house. Meanwhile, block and irregular home gardens had the same percentage, at 17% (Table 2). Home garden zoning in Rancasari Sub-district was found not only on the front, back, and side of the house but also on the combination of them. Therefore, home garden zoning is divided into six zones: front, back, side, front-side, right-left sides, and front-back. The front zoning was the dominant zone with 94% or 485 houses, while front-back and right-left side zoning were only found in one home garden (Table 3).

Plant composition

We identified 1054 plant species from 141 families, with Araceae, Asparagaceae, and Orchidaceae as the plant families with the largest number of species, with 100 species, 56 species, and 42 species, respectively. Other families comprised of under 40 species. Overall, 32,967 individual plants were found in home gardens in the Rancasari Sub-district, with an average of about 64 plants in every garden. *Sri Rejeki* (*Aglaonema commutatum* Schott) is a species with the largest number of individuals (2095 individuals). Homeowners mostly used these plant as decorative plants to enhance their home garden aesthetics.

Table 1. The extent and categorization of home garden's area in Rancasari Sub-district, Bandung City, West Java Province, Indonesia

Home garden area category		Number of home garden	Percentage (%)
Very narrow	2-53 m^2	474	92.2
Narrow	53-104 m^2	30	5.8
Medium	104-155 m^2	5	1
Wide	155-206 m^2	3	0.6
Very wide	206-257 m^2	2	0.4

Table 2. The shape of home garden in Rancasari Sub-district, Bandung City, West Java Province, Indonesia

Shape	Number of home garden	Percentage (%)
Strip	340	66
Block	85	17
Irregular	89	17

Table 3. The zoning of home garden in Rancasari Sub-district, Bandung City, West Java Province, Indonesia

Zone	Number of home garden	Percentage (%)
Front	485	94.4
Side	12	2.3
Back	2	0.4
Front-side	13	2.5
Left-right sides	1	0.2
Front-back	1	0.2

Based on its utilization, plant species found in home gardens in Rancasari Sub-district have several functions, namely medicinal, edible, spice, and ornamental (Table 4). Some plant species in a home garden can have two functions with the combinations of medicinal-edible, medicinal-spice, medicinal-ornamental, and edible-spice. Edible-ornamental and spice-ornamental combinations did not appear in our identification. Based on area extent, ornamental plants dominated in all categories (Table 5). The total ornamental plant species for very narrow, narrow, medium, wide, and very wide are 838 species, 239 species, 76 species, 49 species, and 45 species. Ornamental plants were dominant in all categories of shape (Table 6), with the highest number in strip-shaped gardens. Based on the zone, ornamental plants dominated all categories and were mostly planted in front-zoning home gardens (Table 7).

Correlation between physical condition and plant composition

The relationship between plant composition and the physical characteristic of the home garden was analyzed using CCA (Canonical Correspondence Analysis) with the Past 4.03 for Windows software. CCA was run twice to represent two types of plant composition variables, namely plant species and plant function. The outputs from the CCA analysis are the eigenvalue and scores illustrated on ordination diagram.

Plant species as the variable of plant composition

The eigenvalues obtained in this study were 0.180 for axis 1 and 0.138 for axis 2. The low eigenvalues for these two axes indicate uneven distribution of garden plants across varying physical characteristics. The species distribution is considered even if the eigenvalue is > 0.5 (Parikesit et al. 2018). As much as 55.78% of the variation is associated with axis 1, and 42.72% is associated with axis 2 (Table 8).

Home garden distribution across physical characteristics shows that home gardens were spread across the four quadrants, most of which are in quadrants 2 and 3. However, the distribution is not even but grouped at the center axis (Figure 2). The closer to the center of the axis, the smaller the area, the shape in the strip or block category, and the zoning is simple (front, side, or back).

Table 4. The function of plants in home garden in Rancasari Sub-district, Bandung City, West Java Province, Indonesia

Function	Medicinal	Edible	Spice	Ornamental	M-E	M-S	M-O	E-S
Number of species	20	67	24	887	21	9	16	10

Notes: M: Medicinal, E: Edible, S: Spices, O: Ornamental

Table 5. Plant function on each area category in home garden in Rancasari Sub-district, Bandung City, West Java Province, Indonesia

	Medicinal	Edible	Spice	Ornamental	M-E	M-S	M-O	E-S
Very Narrow	16	59	24	838	21	9	16	10
Narrow	5	23	6	239	14	6	12	3
Medium	1	12	3	76	6	4	4	5
Wide	0	6	1	49	5	1	6	2
Very Wide	1	15	5	45	3	2	3	6

Notes: M: Medicinal, E: Edible, S: Spices, O: Ornamental

Table 6. Plant function on each shape category in home garden in Rancasari Sub-district, Bandung City, West Java Province, Indonesia

	Medicinal	Edible	Spice	Ornamental	M-E	M-S	M-O	E-S
Strip	27	65	19	700	11	10	16	10
Block	4	29	11	360	13	9	14	7
Irregular	9	37	16	374	15	7	13	7

Notes: M: Medicinal, E: Edible, S: Spices, O: Ornamental

Table 7. Plant function on each zoning category in home garden in Rancasari Sub-district, Bandung City, West Java Province, Indonesia

	Medicinal	Edible	Spice	Ornamental	M-E	M-S	M-O	E-S
Front	11	62	22	859	21	9	16	10
Side	2	15	6	1	12	7	9	6
Back	0	15	6	45	3	1	2	4
Front-side	1	16	5	162	12	5	5	6
Left-right sides	0	1	1	19	1	0	0	0
Front-back	0	1	0	29	0	1	1	0

Notes: M: Medicinal, E: Edible, S: Spices, O: Ornamental

The distance between the arrows and the points showing plant species shows the strength of the relationship between physical characteristics and plant species (Figure 3). This ordination diagram does not show the existence of several groups of plant types, but garden plants form one large group centered on the central of the axes. This ordination diagram does not show any certain tendencies of plant species in particular physical characteristics of the home garden.

Scores show where each data point is plotted among the ordination diagram. Scores on the axis 1 column show the data points' position on the horizontal axis, and scores on axis 2 show the data points' position on the vertical axis. Scores on axis 3 indicate the data point's position in the third dimension of the ordination space. This third axis can only be visualized using 3D plots. The scores of the physical variables, namely area, shape, and zone, are shown in Table 9. Area has a high positive score on axis 1, indicating its strong correlation with the first canonical axis and its significant role in defining a plant composition along axis 1. The shape of a home garden can positively or negatively influence plant composition across different axes, with values of -0.25, -0.05, and 0.61 on each axis, respectively. Zone shows a positive correlation on axes 2 and 3 with 0.42 and 0.44 scores, respectively, implying that zone management consistently positively influences plant composition along this axis.

Plant function as variable of plant composition

The eigenvalues obtained in this study were very low: 0.008 for axis 1 and 0.00008 for axis 2. The very low eigenvalues also show an uneven distribution of garden plant functions across physical characteristics. As much as 98.93% of the variation is associated with axis 1, which is very dominant. Meanwhile, only 0.955% of the variation is associated with axis 2 (Table 10).

The result of the ordination diagram shows that the distribution based on plant function across physical characteristics is spread across the four quadrants, most of which were in quadrants 2 and 3. The distribution is not even but grouped at the center axis (Figure 4). The ordination diagram shows that most of the plots were distributed around ornamental functions, indicating that most of the home gardens were cultivated with ornamental plants.

Table 8. Eigenvalues of the correlation between physical condition and plant species composition

	Correlation		
	Axis 1	**Axis 2**	**Axis 3**
Eigenvalue	0.18064	0.13835	0.0048718
% variance	55.78	42.72	1.504

Table 9. Scores for physical condition as plotted in the ordination diagram

Category	Scores		
	Axis 1	**Axis 2**	**Axis 3**
Physical characteristic			
Area	0.62	-0.11	0.11
Shape	-0.25	-0.50	0.61
Zone	0.05	0.42	0.44

Table 10. Eigenvalues of the correlation between physical characteristics and plant function

	Correlation		
	Axis 1	**Axis 2**	**Axis 3**
Eigenvalue	0.00830	0.00008	0.00001
% variance	98.93	0.955	0.1187

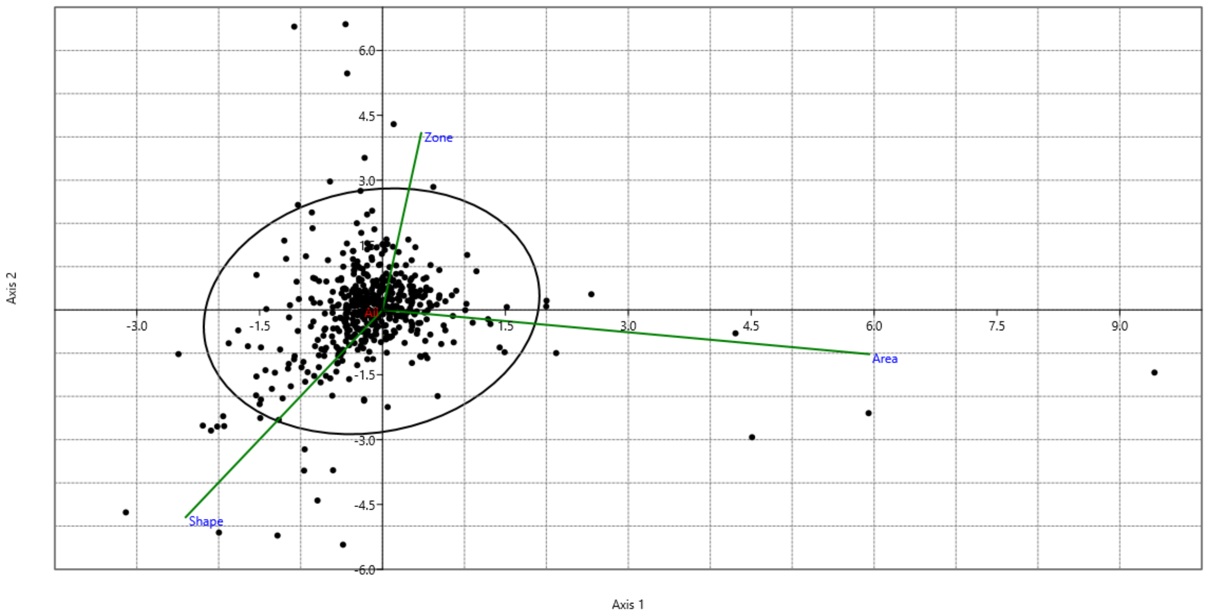

Figure 2. The distribution and ordination of home gardens based on the correlation between physical characteristics and plant species composition

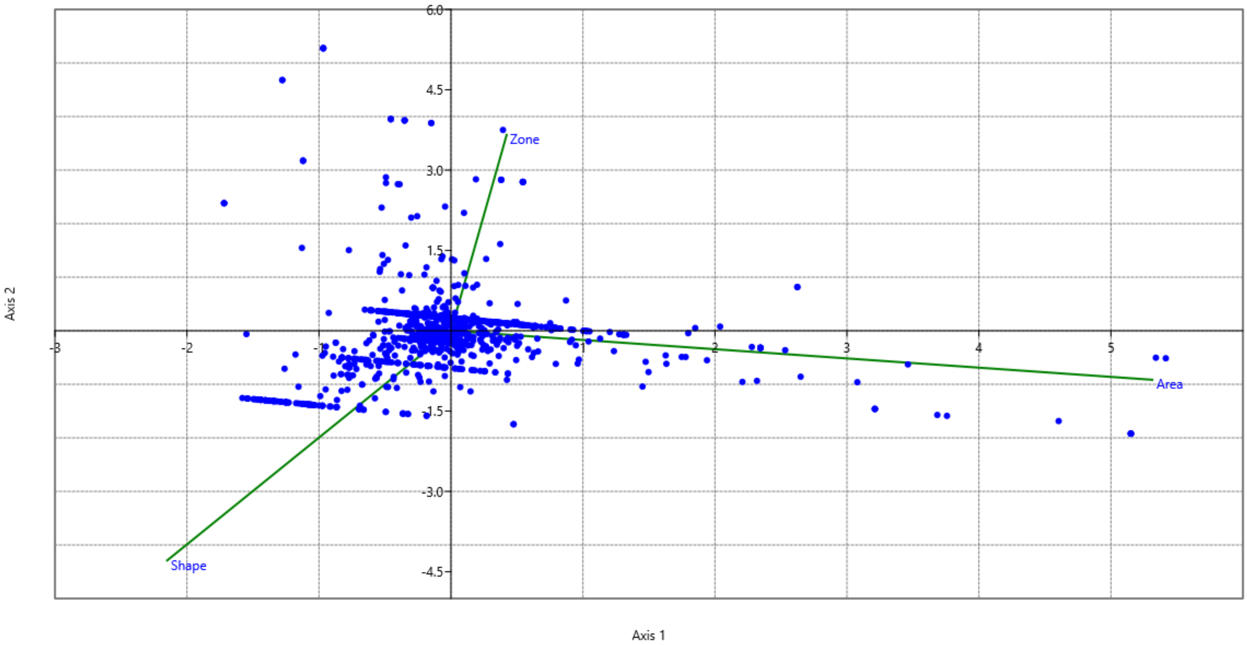

Figure 3. The distribution of plant species across varying physical characteristics

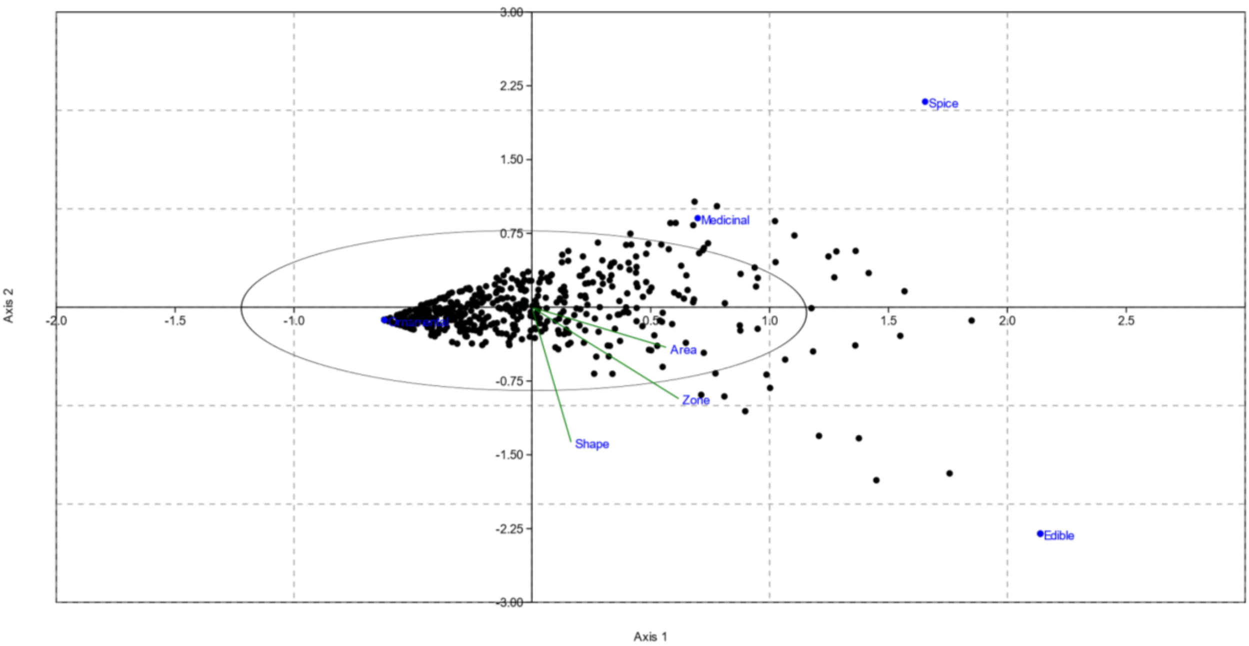

Figure 4. The distribution and ordination of home gardens based on the correlation between physical condition and plant function

The ordination diagram shows that plant function was distributed in three quadrants: medicinal and spice in quadrant 1, ornamental in quadrant 3, and edible plants in quadrant 4. Ornamental plants had a stronger relationship with shape and less with zone and area. Medicinals and spices had a stronger relationship with the area than with zone and shape. Meanwhile, edible plants have the strongest relationship with all physical characteristic parameters, especially zones (Figure 5). However, ornamental plants were opposite of the physical characteristic arrows direction, thus showing the lowest to no correlation with the physical characteristics.

The scores of the physical characteristics (i.e., area, shape, and zone) and the plant function (i.e., medicinal, edible, spice, and ornamental) are shown in Table 11. The area scores indicate a slight positive influence on axis 1 (0.06), a slight negative influence on axis 2 (-0.04), and no impact on axis 3 (0.00). This suggests that the size of the area has minimal influence on the overall plant composition across these three axes. Shape scores indicate a negligible positive correlation with axis 1 (0.02) and a weak negative correlation with axis 2 (-0.14) and axis 3 (-0.04), suggesting that shape has a minor influence on plant composition. Similar to shape scores, zone scores indicate a weak positive correlation with axis 1 (0.02) and weak negative correlations with axes 2 (-0.10) and 3 (-0.06), implying that zone characteristics have a slight impact on plant composition, particularly on axis 1. As for the plant function scores, medicinal plant scores indicate that medicinal plant has a strong positive correlation with all three axes, especially axis 3 (2.48), suggesting that medicinal plant composition is strongly influenced by all garden characteristics measured. The scores for edible plants show a strong positive correlation with axis 1 (2.14), a strong negative correlation with axis 2 (-2.30), and a slight negative correlation with axis 3 (-0.16). This indicates that edible plant composition is heavily influenced by axis 1 and inversely related to axis 2. Spice plant scores indicate a strong positive correlation with axes 1 (1.65) and 2 (2.09) and a strong negative correlation with axis 3 (-1.63), suggesting that spice plant composition is significantly influenced by factors associated with axes 1 and 2, but inversely by axis 3. Ornamental plant scores indicate a negative correlation across all three axes (-0.62 on Axis 1, -0.13 on axis 2, and -0.18 on axis 3), indicating that ornamental plant composition is generally negatively related to the measured factors.

Discussion

Home gardens in Rancasari Sub-district were mostly categorized as very narrow. The results revealed that approximately 98% of the home gardens do not meet the minimum size requirement to be classified as ecological gardens (Kharisma and Kaswanto 2021), with a critical minimum of 100 m² necessary to sustain plant diversity and productivity. The small extent of home gardens in most urban areas is mostly caused by high human population density and high land prices (Arifin et al. 1998). This research observed that the home garden space provided by housing developers is usually used as a built-up space by homeowners, such as terraces and garages, reducing space for plants. This happened because homeowners tried to maximize the use of their land since it is harder for them to afford houses with relatively bigger spaces. This also happened in Yogyakarta, where Irwan and Sarwadi (2017) reported that local settlements changed to urbanized settlements, which were indicated by increasing prices, followed by smaller and smaller places for home gardens. As urban development becomes denser than before, the space available for home gardens will become increasingly limited. New housing complex developments should consider carefully to incorporate garden space in areas receiving adequate sunlight, such as rooftops (Sharma et al. 2022). Therefore, people can maximize their narrow home garden space by planting plants in sitting pots, hanging pots, and polybags.

Table 11. Scores for physical condition and plant function as plotted in the ordination diagram

Category	Scores		
	Axis 1	**Axis 2**	**Axis 3**
Physical characteristic			
Area	0.06	-0.04	0.00
Shape	0.02	-0.14	-0.04
Zone	0.07	-0.10	-0.06
Plant function			
Medicinal	0.70	0.91	2.48
Edible	2.14	-2.30	-0.16
Spice	1.65	2.09	-1.63
Ornamental	-0.62	-0.13	-0.18

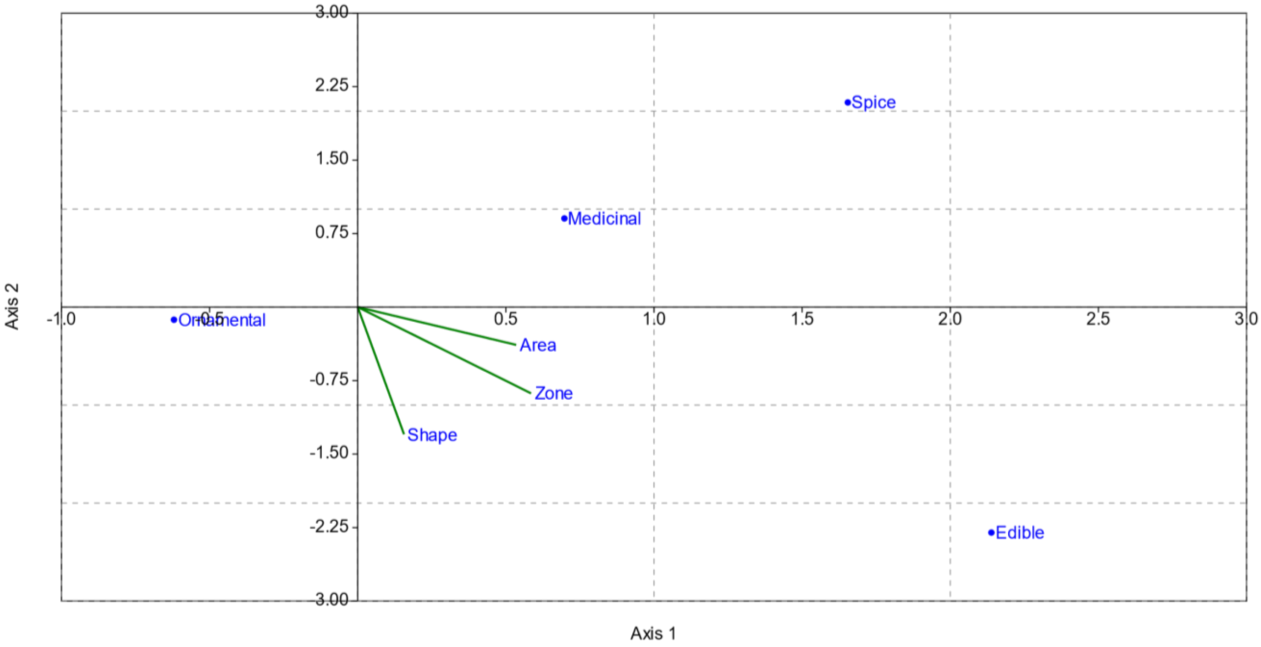

Figure 5. The distribution of plant function across varying physical characteristics

This research found that most home gardens had strip shapes. Arifin et al. (1998) stated that block and strip home garden forms are often found in most urban areas, while irregular home gardens are rarely found in most urban locations. Zoning is the position of the home garden relative to the house building. Home gardens in the Rancasari Sub-district mostly had front zoning. This zoning layout is generally designed by the housing complex developer and maintained by homeowners. Home garden zoning is an important aspect of garden sustainability because the position of the home garden around the house determines the sunlight captured for plant photosynthesis. Sunlight is crucial for a sustainable home garden because plants use spectral cues to regulate their growth and reproduction (Kotilainen et al. 2020).

We found a significant number of species across the home gardens sampled. Home gardens can contribute to urban plant diversity. This is also what happened in Los Angeles, where urban plant diversity significantly increased due to exotic plants that were cultivated by the city residents (Avolio et al. 2020). Among all the plant utilization categories, ornamental plants had the biggest number of species. Across all the physical characteristics, ornamental plants dominated the number of species. This result showed that urban homeowners preferred ornamental plants to decorate their home gardens. This argument is supported by Wulandari et al. (2023), who found that urban homeowners tend to select ornamental plants rather than medicinal, edible, and spice plants. Homeowners tend to plant ornamental plants to provide beauty and greenery and to create their own aesthetics in their home gardens.

The Araceae family was the most commonly found family, with 100 species. Araceae are widely planted because they are cosmopolitan and have wide distribution globally; it is by far the most diverse family in the wet tropics, especially in South and Central America and Southeast Asia (Haigh et al. 2023), including Bandung. The uses of plants in the Araceae family also varied, including producing carbohydrates (*Colocasia esculenta* (L.) Schott, *Xanthosoma sagittifolia* (L.) Schott), bearing fruit (*Monstera deliciosa* Liebm.), medicinal plants (*Typhonium flagelliforme* (G.Lodd.) Blume), and ornamental plants (*Alocasia* spp., *Anthurium* spp., *Dieffenbachia* spp., *Philodendron* spp., and *Spathiphyllum* spp.). However, Araceae is primarily popular as an ornamental plant because this family has a broad spectrum of leaf shape, blade size, texture, and coloration. Moreover, it is relatively easy to cultivate; even small pieces of the stem can potentially produce new growth. This is especially true for *Monstera*, *Dieffenbachia*, and *Spathiphyllum*. Most aroid stems can be cut into pieces repeatedly to create new plants. This makes them popular and easy to share with other residents, a feature many plant families do not have. Aroids are among the most popular ornamental plants (Croat and Ortiz 2020).

Another family often found was the Asparagaceae with 56 species including *Asparagus densiflorus* (Kunth) Jessop, *Dracaena surculose* Lindl., *Sansevieria trifasciata* Prain, *Yucca aloifolia* L., and *Agave* spp. The distinctive morphological characteristics of Aspargaceae family are the densely alternate leaf arrangement and the varying leaf colors. Therefore, people predominantly plant plants from the Asparagaceae family as ornamental plants (Flores et al. 2020). These plants are mostly used by homeowners as decorative plants to enhance their home garden aesthetics.

The Orchidaceae family is also commonly found in the research location with 42 species, including *Dendrobium* spp., *Oncidium* spp., *Phalaenopsis* spp., *Epiphyllum anguliger* (Lem.) G. Don ex Loudon, and *Vanilla planifolia* Andrews. The global community has long known the Orchidaceae family as ornamental plants and flowers. The Orchidaceae family, found in Indonesia, is characterized by the unique shape and color of the flowers, which attract people to grow them. Indonesia has more than 5000 species of orchids (Hariyanto et al. 2020). People are attracted to orchids because of their diverse flower color, scent, and morphology (Li et al. 2021). In addition, the Orchidaceae plants are relatively easy to maintain because they have several adaptive mechanisms. Epiphytic orchids have cuticles that contain polysaccharides, flavonoids, and cutin matrix. The cuticle helps orchids adapt to the environment by reducing absorbed solar radiation and temperature and reducing transpiration (Rindyastuti et al. 2018) and protects against unsuitable environmental conditions (De and Biswas 2022) so that species from the Orchidaceae family are more resistant to these disturbances. Epiphytic orchids have adequate root systems to help them grow in a poor nutrient environment when they grow at a slow rate. In those cases, the orchid's velamen help absorb water and nutrients from rainfall (De and Biswas 2022).

Most of the plants identified had ornamental traits; this is predicted to relate to homeowners' preferences. Urban residents use home garden plants mainly for ornamental purposes (González-Ball et al. 2022). According to Wulandari et al. (2023), urban residents prefers ornamental plants rather than food-producing plants, medicines, and spices since these plants provide beauty, more green, and aesthetic to their homes. Avolio et al. (2020) found in their study in the Los Angeles urban area that residents' preferences for their plants are beautiful and easy-to-maintain plants. There is a strong relationship between homeowner preferences and plant traits. Non-woody ornamental plants with showy flowers are also dominant in Los Angeles home gardens. Urban home gardens are generally small, yet they serve as abundant representations of ecosystems close to human-environment interactions, with each home garden influenced by individual resident preferences and actions (Blanchette et al. 2021).

The Canonical Correspondence Analysis (CCA) to understand the correlation between physical characteristics and plant species composition resulted in low eigenvalues (0.049-0.18) and even far lower for the correlation between physical characteristics and plant function (0.00001-0.0083). This result showed that plant function is distributed way more unevenly across physical characteristics. This result also indicates that there might be several other environmental factors, other than physical characteristics, that play a more significant role in the distribution of the species but were not measured in this study, as explained by Parikesit et al. (2018). However, the ordination diagram to depict the correlation between physical characteristics and plant function provides a better picture. The ordination diagram of both correlation analyses shows uneven, grouped plot dots in the center of the diagram, suggesting that the home gardens observed generally had a low area, strip or block shape, and front zoning (Figures 2 and 4). Home gardens with areas classified as wide and very wide, irregularly shaped, and combined zoning (front-side, right-left side, and front-back) were outside the distribution of 95% of the data. Specifically, analysis to see the correlation between physical characteristics and plant function showed that dots were distributed mostly around plants with ornamental functions (Figure 2).

The ordination diagram showing the correlation between physical characteristics and plant species composition does not show any certain plant tendencies in particular physical characteristics, implying that plant distribution in home gardens in Rancasari Sub-district is known to be homogeneous. This means that the physical characteristics of home gardens do not determine plant species distribution. This is likely caused by human intervention when planting in the home garden where physical characteristics do not become a limitation for any species planting. For example, fruit-producing plants that naturally require a large space of land, such as *Durio zibethinus* Murray, *Mangifera indica* L., *Dimocarpus longan* Lour., and *Nephelium lappaceum* L., were often found planted on large pots or polybags, locally known as *tabulampot* (*tanaman buah dalam pot*). Pots can be a solution for urban communities with limited space but would like to effectively and efficiently plant fruit plants around their house (Gürsu 2024). Apart from that, verticulture techniques are widely used by home garden owners. Verticulture is a stratified plant cultivation system carried out vertically, outdoors, or indoors. This technique is ideal for narrow land as it occupies less space (Putri et al. 2022). Verticultural cultivation of plants is an efficient way of land use by applying the main principle of abundant sunlight utilization where plants are arranged in containers or multi-story structures. The verticulture planting method is very suitable for those with narrow land in urban areas (Hidayat et al. 2022). Verticulture is usually used on ornamental plants such as *Chlorophytum comosum* (Thunb.) Jacques, *Epiphyllum anguliger*, and *Epipremnum pinnatum* (L.) Engl. Planting using this technique can involve using sitting pots, hanging pots, and attaching them to walls.

On the other hand, the ordination diagram and scores showing the correlation between physical characteristics and plant function (Figure 5 and Table 11) suggests that ornamental plants had the least correlation with physical characteristics. This result is supported by Wulandari et al. (2023), who states that there is a negative correlation between utilization categories, namely between the ornamental plant and others (medicinal, spice, and food/edible). It was assumed that the negative correlation is due to the relatively different objectives in growing plants. This result is also supported by Ali et al. (2021), who found that home gardens due to urbanization have increased the composition of non-ornamental plants. This result implies that planting ornamental plants is generally not influenced by physical characteristics but is more influenced by other factors. As reported by Philpott et al. (2020), the presence of ornamental plants can be influenced by gender, with women growing more ornamental plant species than men. However, between the three physical characteristics, the ornamental plant had the strongest relationship with shape and less with zone and area. Medicinal and spice plants can be categorized into one group, having a stronger relationship with the area and less with zone and shape. Edible plants had the strongest correlation with all physical characteristic variables, especially with zone. This result differs from the findings of Ali et al. (2021), who found that decreased areas of home gardens due to urbanization increased fruit plants.

Many studies provide evidence of the benefits of home gardens in rural areas, often focusing on livelihood or food security issues. This study is a step forward as it widens the perspective of broader urban sustainability issues. For this study, we applied an analytical method that connects the home garden's physical characteristics with plant composition in terms of species and function. Due to the purposeful selection of heterogenous home gardens in middle-class inner-city housing complexes, the results are limited to this specific type of urban area. However, the general applicability of the chosen approach allows for future studies to confirm the results for other types of urban agriculture and other urban open green spaces. Our study revealed that 92.2% of home gardens in the Rancasari Sub-district are categorized as very narrow (2-53 m^2), they were dominated by strips by 66% and 94% of the home gardens had front zoning. Home gardens in Rancasari Sub-district consisted of 1054 species from 141 families with a total number of 32,967 individual plants, yet the gardens were homogeneous, where plant species were similar in 95% of home gardens. Based on their function, ornamental plants were the least influenced by physical characteristics, while medicinal and spice plants can be grouped together as they were more affected by the area and less by the zone and shape. Edible plants were the most influenced by all physical characteristic variables, particularly the zone.

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