JURNAL STATISTIKA DAN APLIKASINYA

e-ISSN 2620 – 8369
VOLUME 8 (ISSUE 2) DECEMBER 2024: 138-151
https://doi.org/10.21009/JSA.08201

VISUALIZATION AND MAPPING OF HOUSEHOLD HOUSING CONDITIONS IN WEST JAVA USING MULTIDIMENSIONAL SCALING

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ABSTRACT

Article History:

Received: 5, December 2024
Revised: 24, December 2024
Accepted: 27, December 2024
Published: 31, December 2024
Available online.

Keywords:

Multidimensional Scaling (MDS), housing conditions, West Java, infrastructure, spatial analysis

This study aims to map household housing conditions in West Java using the Multidimensional Scaling (MDS) approach. West Java, as the most populous province in Indonesia, faces significant challenges regarding housing inequalities, infrastructure access, and socio-economic disparities between urban and rural areas. These disparities necessitate a comprehensive and systematic approach to identify vulnerable regions and inform targeted policy interventions. Using data from the 2023 National Socio-Economic Survey (Susenas), this study analyzes five main groups of variables: basic needs, housing facilities and ownership, socio-economic status, access to services and infrastructure, and household demographics and welfare. The Multidimensional Scaling (MDS) technique is employed due to its capability to reduce complex, high-dimensional data into a two-dimensional representation, allowing clearer visualization of regional disparities and interrelationships among variables. MDS also facilitates robust model evaluation, ensuring high-quality mapping results. The MDS results reveal significant variations in household conditions, with urban areas such as Bekasi and Depok City showing better infrastructure access and welfare outcomes compared to rural areas like Cirebon and Sukabumi District. Evaluation of the MDS model indicates excellent performance, with STRESS values ranging from 0.042 to 0.083 and RSQ values between 0.993 and 0.999, demonstrating high accuracy. This study addresses a research gap where few studies have comprehensively mapped housing inequalities in large, diverse regions like West Java using advanced multidimensional techniques. The findings emphasize the importance of policies focusing on infrastructure development and equitable distribution of social assistance in underdeveloped regions to reduce regional disparities.

How to cite this article:
S. Hafsah, R.N. Labibah, A. Fitrianto, Erfiani, L.M.R.D Jumansyah, "VISUALIZATION AND MAPPING OF HOUSEHOLD HOUSING CONDITIONS IN WEST JAVA USING MULTIDIMENSIONAL SCALING", Jurnal Statistika dan Aplikasinya, vol. 8, iss. 2, pp. 138 - 151, December 2024

Journal e-mail: jsa@unj.ac.id
Research Article · Open Access

1. INTRODUCTION

The use of appropriate statistical methods in the analysis of residential data is essential, especially in studies involving multiple interconnected variables. Multidimensional Scaling (MDS) is one of the effective statistical techniques to map data into a two- or three-dimensional space, making it easier to visualize and understand the relationship between variables in a dataset [1]. In this study, MDS is used to map household housing conditions in West Java based on several factors such as access to clean water, sanitation, electricity, and the physical condition of the house.

West Java Province, the province with the largest population in Indonesia, faces major challenges in terms of housing planning and equity. Rapid urbanization, accompanied by infrastructure gaps between urban and rural areas, adds to the complexity of providing adequate housing for the entire population. This condition is further exacerbated by high population density, especially in urban areas, which often leads to the formation of slums with limited access to basic services such as clean water, electricity, and adequate sanitation [2]. Therefore, mapping housing conditions using the MDS approach can provide a clearer picture of the most vulnerable areas to housing problems, thus helping to prioritize policy interventions.

The MDS approach has proven effective in analysing various social and economic issues in West Java. For example, a study on the sustainability of the Arabica coffee business in West Java used MDS to assess the social and economic dimensions within the sector [3]. Another study also demonstrated the applicability of MDS in assessing the social, economic, and cultural dimensions of eco-villages in the upstream area of the Citarum watershed, indicating the need for greater support in environmental management [4]. This method has the same potential to be applied in research related to household housing conditions, with the aim of identifying areas in need of improved housing infrastructure in West Java.

In addition to social and economic factors, the housing conditions of households in West Java are also influenced by environmental factors. Some areas are prone to natural disasters, such as floods and landslides, which often contribute to poor housing conditions in the area. Therefore, mapping housing conditions by considering environmental variables using MDS is expected to provide a more accurate picture of areas that require special attention in disaster risk mitigation efforts [5].

MDS can also be used to evaluate the effectiveness of government housing programs. For example, the evaluation of low-cost housing programs can be done by mapping changes in housing conditions before and after program implementation. This method has been proven to be able to visualize changes in the distribution of household welfare, as seen in using MDS in measuring the sustainability of clean water management in South Sulawesi. The results show that the MDS approach can help understand the distribution of resources and infrastructure conditions in different regions [6]. Thus, MDS-based mapping will provide important information on the effectiveness of housing programs and provide a basis for more targeted policy formulation.

This research aims to map household housing conditions in various regions in West Java. The use of MDS as the primary analytical method is critical due to its ability to simplify large datasets, such as the 2023 National Socio-Economic Survey (SUSENAS) data that contains more than 190 variables, into two-dimensional visualizations that are easy to understand. The accuracy of this method is evidenced by its low STRESS values and high RSQ values. By accurately capturing multidimensional relationships, the MDS results can serve as a basis for identifying priority areas requiring targeted policy interventions.

This research resolves the gaps in previous research, such as [2], which did not specifically discuss housing conditions and basic infrastructure like clean water, electricity, and sanitation, as well as [3], which has yet to apply MDS in the context of comprehensively mapping household housing conditions and infrastructure disparities in West Java.

The MDS approach has proven effective in various studies to identify social and economic inequalities in access to adequate housing. For example, Madyaratry [7] used MDS to measure the sustainability index of small and medium enterprises (SMEs) in Lampung Province. The results show how MDS can help map differences in economic distribution among SMEs, which can analogously be applied in the housing context to understand inequalities in access to housing infrastructure and services in West Java.

In addition, [8] showed that MDS can be efficiently used to analyze very large datasets, including spatial data often found in housing studies. In the context of a province with a large area like West Java, this technique helps accelerate the analysis and visualization of complex data, especially when considering various interconnected variables, such as infrastructure and the physical condition of houses. By doing so, MDS can provide a more in-depth picture of the inequality in the distribution of basic facilities between regions.

[9] in their study highlighted the use of MDS to assess regional economic development in Eastern Europe. The study identified significant regional differences in economic development and community welfare, which provide important insights into how MDS can be used to map inequalities in infrastructure development and housing conditions between regions. The findings are relevant for application in West Java in assessing access to adequate housing between urban and rural areas.

[10] developed a Bayesian approach in MDS that allows for more accurate variable selection in the dimensionality reduction process. This technique allows for more precise research, especially in mapping housing data where many social, economic, and environmental variables must be taken into account. With this approach, it is possible to select the most important variables in the analysis of housing in West Java, such as access to clean water and electricity availability, without compromising the precision of the analysis results.

2. METHODS

Material and Data

Data on household housing conditions in West Java were obtained from the 2023 National Socio-Economic Survey (Susenas). This dataset consists of 190 variables, covering various information for each district/city, such as geographical location, food security, housing conditions, access to basic facilities (clean water, electricity, and sanitation), credit usage, government assistance, household size, as well as food expenditure and consumption.

These variables were grouped based on interrelated topics or categories to allow the Multidimensional Scaling (MDS) analysis to produce relevant dimensions. This grouping simplifies the analytical process and ensures that the interpretation of the MDS results focuses on specific dimensions related to household housing conditions. The complete list of variables is provided in Appendix.

Research Method

The analysis in this study was carried out using the R programming language with three structured stages, starting from the data preprocessing stage, data exploration, to the application of MDS to each group of predetermined variables.

Preprocessing Data

The first step in data preprocessing is to check for missing data. This was done because the data from SUSENAS (2023) was suspected to contain missing values when viewed directly in the data table. The identification of missing data is done with the total count method by counting how much data is missing. Missing data handling is done with the imputation method, which is replacing missing data values with the average or median depending on the distribution of the variables.

The second step in data preprocessing is the grouping of variables based on predefined topics. The variables were grouped into topics such as Food Welfare, Access to Facilities and Infrastructure, Physical Condition of Housing, Asset Ownership, Economic Status, and Household Demographics. This grouping not only aims to simplify the analysis process, but also ensures that the interpretation of the MDS results can focus on specific dimensions.

Data Exploration

Data exploration in this study was carried out to see an initial overview of the data to understand the basic characteristics of each variable used. Visualization is used in the form of spatial mapping to display the distribution of housing conditions in various regions in West Java to identify inter-regional differences in terms of the physical condition of housing to household welfare. Heatmaps are used to show areas with certain levels from low to high and utilize a color scale to reflect the intensity of the observed conditions.

Multidimensional Scaling (MDS)

The main goal of MDS is to find a spatial representation of objects (households in the case of this study), where the distance between two objects in low space (MDS output) is as close as possible to the original distance given in the distance matrix. For example, if two objects are very close in the original data (have small Euclidean distance values), then they should also be close in the two-dimensional representation generated by MDS.

MDS works by minimizing an error or stress function that indicates the difference between the original distance and the distance in a two- or three-dimensional representation. The stress function acts as a measure of the quality of the MDS model. This function can be expressed in the formula:

$$S = \sqrt{\frac{\sum_{i<j}\left(d_{ij}-\widehat{d_{ij}}\right)^2}{\sum_{i<j} d_{ij}^2}} \quad (1)$$

Where d_{ij} is the actual distance between objects *i* and *j* in the original data (calculated using Euclidean distance). $\widehat{d_{ij}}$ is the distance between objects *i* and *j* in the two- or three-dimensional space generated by MDS. S is the stress value, which measures how well the MDS configuration represents the distance between objects in a low-dimensional space. The following are the stages of MDS analysis:

1. Distance Matrix: First, MDS requires a distance matrix as input, which stores the distance between each pair of objects. This matrix is calculated based on the original data using Euclidean distance:

$$d_{ij} = \sqrt{\sum_{k=1}^{p}\left(x_{ik}-x_{jk}\right)^2} \quad (2)$$

Where $x_{ik}$and x_{jk} is the value of variable *k* for objects *i and j*, and *p* is the number of variables.

2. Dimensionality Reduction: MDS then reduces the dimensionality of the data. For example, if the original dataset has many variables, MDS tries to represent the data in two dimensions by keeping the distance between objects as much as possible.

3. Coordinates in Low-Dimensional Space: MDS generates new coordinates for each object in two- or three-dimensional space. This is achieved by mapping the original distance into that space by minimizing the stress function previously described. This solution is usually achieved using optimization methods such as Iterative Majorization or Gradient Descent, where the algorithm tries to find coordinates that minimize the stress function.

4. Evaluation with Stress Function: The stress function is used to evaluate the quality of MDS results. A stress value close to zero indicates that the distance between objects in two- or three-dimensional space is very similar to the original distance. Generally, stress values below 0.1 are considered excellent, between 0.1 and 0.2 are considered acceptable, and more than 0.2 indicates poor quality.

3. RESULTS

Data Exploration Results

This data exploration aims to understand the distribution patterns and interrelationships of important variables related to household conditions in West Java. In this process, several key aspects such as access to drinking water sources, lighting sources, house ownership, and correlations between numerical variables are analyzed to get an initial picture of the characteristics and conditions of households in the region.

The visualization illustrates how households are distributed across various factors, ranging from the use of refillable water and rainwater as drinking sources, to the use of electric and non-electric lighting. In addition, the distribution of households by home ownership category and the correlation between infrastructure variables are also mapped. The exploration of this data provides an important basis for understanding the relationships between variables and helps provide a deeper context for the subsequent MDS analysis.

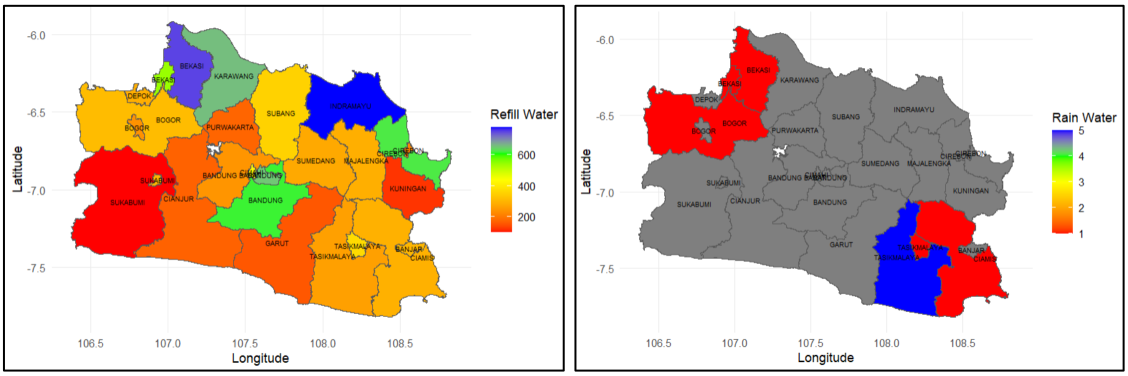

Figure 1. Distribution of Households by the drinking water sources

Figure 1 shows that households using refill water as a source of drinking water are more prevalent in urban areas such as Bekasi, Depok, and Karawang. This suggests that households in these areas have better access to water sources that are treated and distributed through commercial systems. In contrast, the use of rainwater for drinking is very limited, with the highest concentration in Tasikmalaya and Banjar. This indicates that rainwater is only used as an alternative in certain areas that may have limited access to more modern or centralized sources of drinking water.

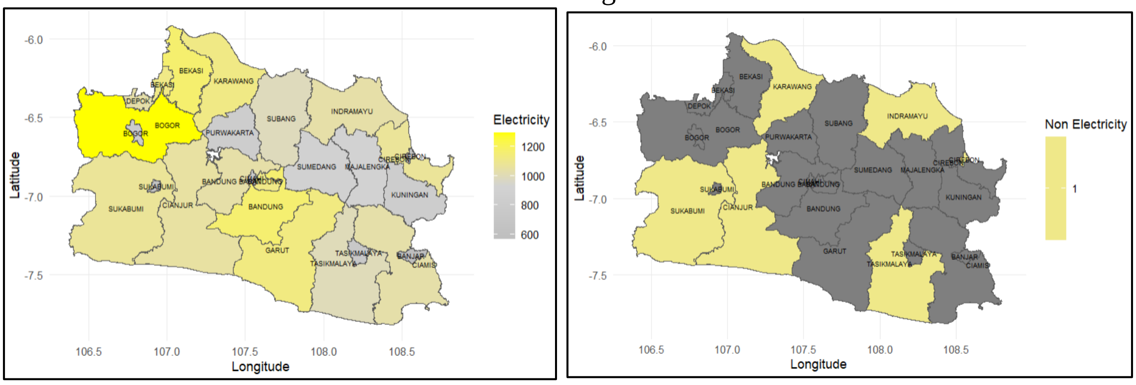

Figure 2. Distribution Based on lighting source

Figure 2 shows that most households in West Java use electricity as a source of lighting, especially in urban areas such as Bogor, Bekasi and Depok. This reflects the existence of more developed infrastructure in urban areas. Meanwhile, the use of non-electric sources of lighting, such as oil or candles, is still present but limited in some rural areas such as Garut, Ciamis, and Indramayu. This suggests that although the majority of households have access to electricity, some rural areas may still face infrastructure limitations.

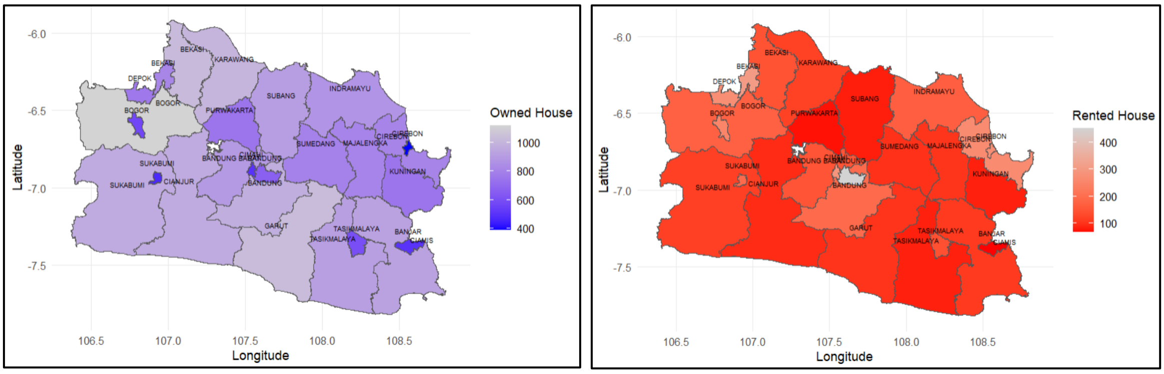

Figure 3. Distribution Based on home ownership

Figure 3 shows that households with a good house category, owned or serviced, are more prevalent in urban areas such as Bogor, Bekasi, and Depok, as well as some rural areas such as Sukabumi and Tasikmalaya. This indicates that home ownership with good physical condition is more common in economically developed areas. In contrast, households living in poor condition houses, such as rented or rented houses, are more common in urban areas such as Bandung and Bogor. This suggests that there is a difference in access to decent housing between households who own their own homes and those who rent or live in non-permanent accommodation.

Multidimensional Scaling Results

The MDS analysis aims to map patterns of similarities and differences between districts and cities in West Java based on several dimensions that represent household welfare. Each MDS group categorizes regions based on various aspects such as basic needs, housing facilities, socio-economic status, access to services and infrastructure, and household demographics.

With the MDS approach, we can see how each region has unique characteristics and how the interrelationships between variables create patterns that describe household welfare levels. The results of this MDS are expected to provide a deeper picture of the disparities between regions and assist in formulating more targeted policies to improve the quality of life of households throughout West Java. Each MDS group will be explained further to explore the differences and patterns that emerge from this analysis.

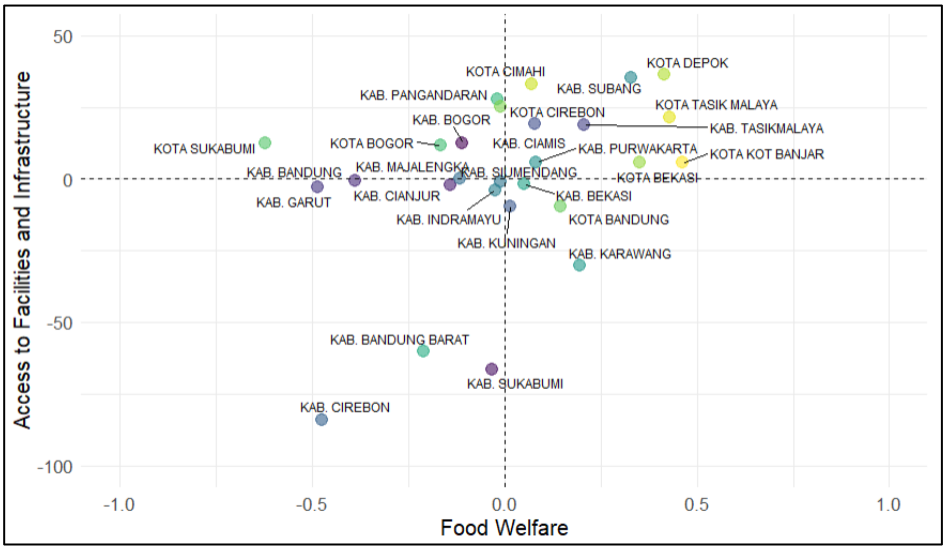

Figure 4. MDS Plot Based on Basic Needs

Figure 4 shows districts that are located closer to each other have similar conditions in both dimensions. For example, Bekasi, Depok and Tasikmalaya City are in the upper right quadrant, indicating that these areas have good infrastructure access and higher food welfare conditions than other areas. In contrast, areas such as Cirebon District and Sukabumi City are located in the lower left quadrant, indicating lower infrastructure access and poorer food welfare. This MDS map illustrates the significant disparities between districts/cities in West Java in terms of access to facilities and infrastructure and food welfare. Regions in the lower left quadrant may require more attention from the government in terms of improving access to infrastructure and improving food welfare. Conversely, regions in the upper right quadrant can serve as examples or benchmarks for other regions in improving household welfare and access to infrastructure. These results can serve as a basis for formulating more targeted policies to reduce inter-regional inequality in West Java.

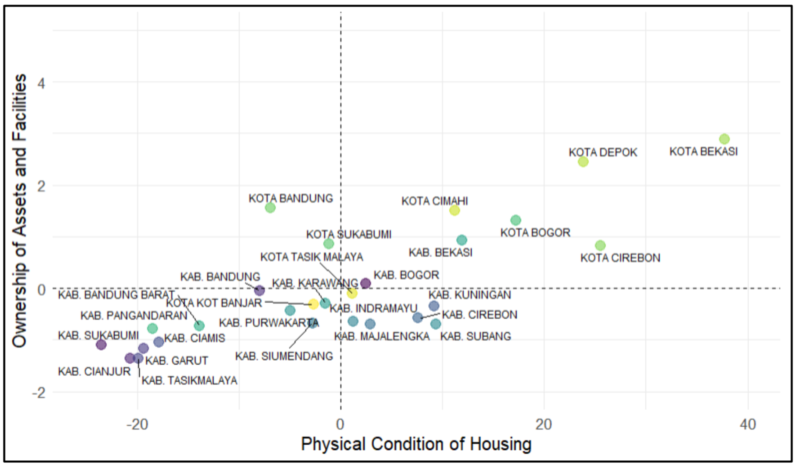

Figure 5. MDS Plot Based on Housing Facility and Ownership

Figure 5 shows the position of districts/cities on this map, illustrating the differences in housing conditions and asset ownership in the West Java region. Some cities, such as Bekasi, Depok, and Cimahi, stand out in terms of good physical housing conditions and high asset ownership, as seen from their position in the upper right quadrant. On the other hand, some areas, such as Cianjur, Sukabumi, and Garut District are in the lower left quadrant, showing lower physical housing conditions and relatively less asset ownership. This interpretation shows that there are significant disparities in terms of housing conditions and asset ownership in the West Java region. Areas in the lower left quadrant may require more intensive policy interventions to improve the physical condition of housing as well as facility ownership, while areas such as Bekasi and Depok City can be considered as examples of areas that are more advanced in this aspect. An understanding of these differences is important in the formulation of a more equitable housing development strategy across the West Java region.

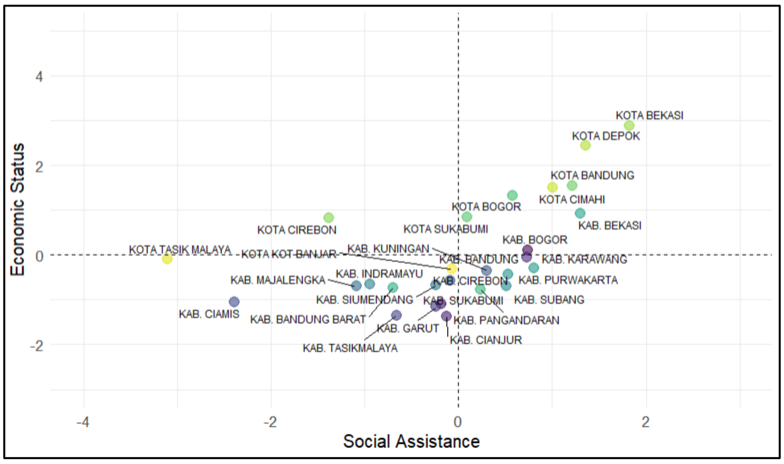

Figure 6. MDS Plot Based on Socio-Economic Status

Figure 6 shows that large cities such as Bekasi, Depok, and Cimahi, are in the upper right quadrant, indicating that these areas have a high economic status and also receive more social assistance. On the other hand, areas such as the Ciamis, Majalengka, and Indramayu Regency are in the lower left quadrant, indicating lower economic status and relatively little social assistance. There are significant differences in the distribution of social assistance and economic status across West Java. Regions in the lower left quadrant may require more attention in the form of increased social assistance to improve the economic status of people in the region. Meanwhile, areas in the upper right quadrant show better economic conditions, despite still receiving social assistance, which may reflect a more equitable assistance policy in these areas.

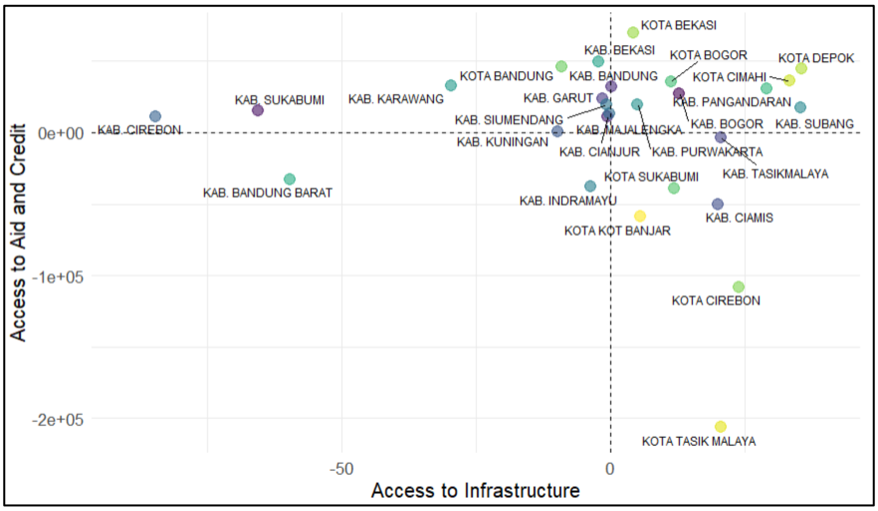

Figure 7. MDS Plot Based on Access to Services and Infrastructure

Figure 7. Shows the variation in access to infrastructure and aid and credit across districts/municipalities in West Java. Regions such as Bekasi, Depok, and Cimahi, have good access to infrastructure and aid/credit, as seen from their position in the upper right quadrant. In contrast, Cirebon District and Tasikmalaya City have lower access to both aspects, as seen in the lower left quadrant. This disparity highlights the need for policies that focus on improving access to infrastructure and financial assistance in areas with limited access, to reduce regional disparities in West Java.

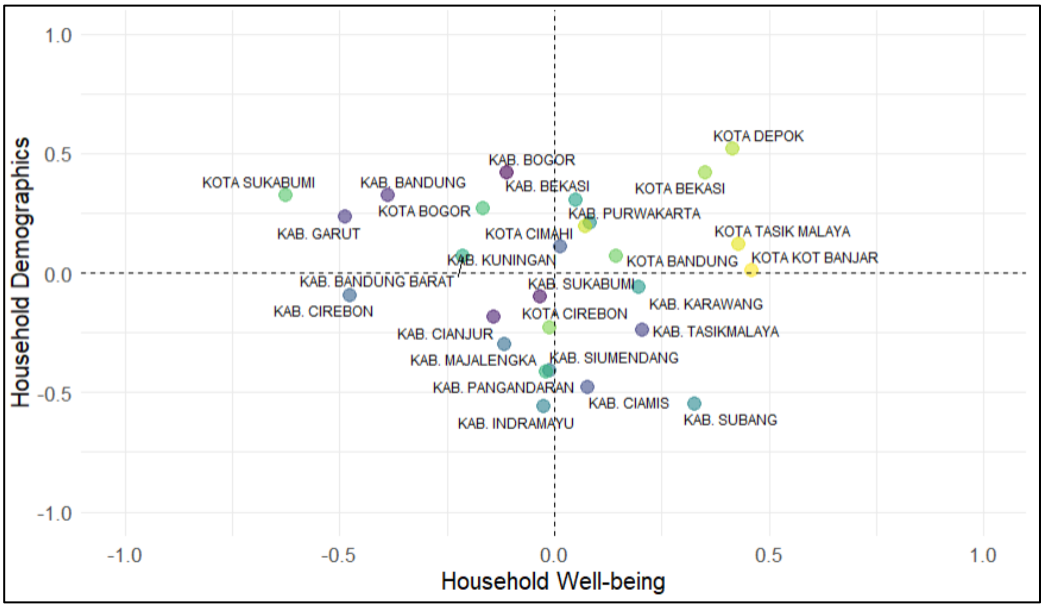

Figure 8. MDS Plot Based on Demographics and Household Welfare

Figure 8 Banjar City and Subang District occupies the top positions with high levels of household welfare and good demographic characteristics. In contrast, Cirebon City, Cirebon District and Sukabumi District show negative values on both dimensions, indicating lower household welfare and demographic conditions. Bekasi and Depok City show fairly high household welfare, although with slightly lower demographic characteristics than some other regions in the upper quadrant. This plot illustrates that there are significant differences in household welfare and demographics across West Java, with urban areas tending to be better positioned than some rural areas.

Table 3. Evaluation of Multidimensional Scaling Results

MDS Group	STRESS Value	RSquare (RSQ)
Group by basic needs	0.055	0.997
Group by Housing Facilities and Ownership	0.083	0.993

MDS Group	STRESS Value	RSquare (RSQ)
Group by Socio-Economic Status	0.042	0.999
Group Based on Access to Services and Infrastructure	0.055	0.997
Group by Demographics and Household Well-being	0.037	0.999

Based on the Multidimensional Scaling (MDS) evaluation results, each variable group has STRESS and RSQ values that indicate excellent data mapping quality. The Basic Needs group has a STRESS value of 0.055 and an RSQ of 0.997, indicating that the model is able to represent the data accurately, with minimal distortion. The Housing Facilities and Ownership group has a slightly higher STRESS value of 0.083, but with an RSQ of 0.993, it still shows that the model is well suited to describe the differences in facilities and asset ownership in the region. Meanwhile, the Socio-Economic Status group had the lowest STRESS value of 0.042 and an almost perfect RSQ of 0.999, indicating that the mapping of this data is very accurate with little distortion. The Access to Services and Infrastructure group showed similar results with a STRESS value of 0.055 and an RSQ of 0.997, indicating that the mapping of access to infrastructure was done very well. Finally, the Demographics and Household Welfare group recorded a STRESS value of 0.037 and an RSQ of 0.999, indicating that the model is very capable of representing demographic and welfare variations with high precision. Overall, the low-STRESS value and RSQ close to 1 indicate that this MDS model is very suitable for mapping household housing data in West Java with a very high level of accuracy.

4. DISCUSSIONS

Multidimensional Scaling (MDS) was used to map multidimensional relationships between households in West Java based on several predefined groups of variables. The MDS process begins by calculating a distance matrix between households using Euclidean distance, which considers variables within each group, such as housing conditions, access to drinking water, electric lighting, and socio-economic status. This process generates a matrix that describes the distance or differences between households based on similarities in these variables.

After the distance matrix is calculated, MDS is used to reduce the data into two dimensions so that the relationship patterns between households can be visualized more simply. In this two-dimensional representation, households with similar conditions will be located closer to each other, while households with different conditions will be located further away. This process helps identify groups of households that share similar characteristics, such as good access to basic infrastructure or households that are still dependent on less viable resources. The MDS results provide important insights into regional differences and disparities between regions, which are further analyzed in this study.

The findings of this study explain that MDS successfully mapped the household hausing in West Java with very high accuracy (STRESS 0.037-0.083; RSQ 0.993-0.999). These findings are linear with previous studies that used MDS to analyze the sustainability of Arabica coffee farming in West Java and revealed that the social dimension had the highest score (62.45%), while the economic and institutional dimensions had lower scored and required further interventions to achieve optimal sustainability [3]. This research confirms the relevance of MDS as an effective method for analyzing and identifying sustainability dimensions and areas that requiring improvement comprehensively.

This research succesfully identified infrastructure disparities between urban and rural areas in West Java. For example, urban areas such as Bekasi and Depok City have better infrastructure conditions compared to rural areas such as Sukabumi Regency and Cirebon Regency. These finding expand on the study by [9], which utilized MDS to map regional economic development disparities in Ukraine and showed that MDS is effective in illustrating the regional hierarchy based on economic indicators.

Furthermore, this research is linear with the work of [6], who used MDS to evaluate the sustainability of clean water infrastructure in South Sulawesi. Their research showed that MDS provides more stab;e results compared to other multivariate analysis methods. Thus, the findings of this study strengten the validity of MDS in revealing patterns of infrastructure disparities and acces to basic services.

Based on the MDS results from the five groups, government policies should focus on improving access to infrastructure and basic services in underdeveloped areas such as Cianjur, Tasikmalaya, Garut, and Sukabumi. Improving the distribution of social assistance, especially in areas with low economic status but limited receipt of assistance, is also a priority. Interventions in the form of economic empowerment programs and the provision of microcredit also need to be focused on areas with limited access to financial services, such as Indramayu Regency and other rural areas.

To sustainably improve household welfare, it is important to integrate social welfare programs with demographic adjustments, especially in areas with high welfare but less than ideal demographic characteristics such as Cirebon City. Policies that combine improved housing quality, infrastructure access, and economic empowerment programs will ensure more equitable growth throughout West Java.

5. CONCLUSION

This study shows that Multidimensional Scaling (MDS) is an effective statistical method in reducing the dimensions of complex data into easy-to-understand visualizations while still maintaining the structure of the distance between households based on welfare variables. MDS allows the identification of patterns of relationships between regions in West Java, especially in terms of disparities in access to basic facilities such as drinking water, electric lighting, and housing conditions. The use of MDS is proven to provide accurate results and help in understanding regional differences that cannot be revealed through traditional analysis. The MDS model evaluation performed showed excellent quality results, with STRESS values ranging from 0.037 to 0.083, which falls into the excellent category, and RSQ values between 0.993 and 0.999, indicating a very high model fit.

Suggestions for future research are to combine MDS with other statistical methods such as Cluster Analysis or Principal Component Analysis (PCA) to strengthen the results and provide a deeper understanding of the data patterns. In addition, the use of various distance methods, such as Mahalanobis Distance or Manhattan Distance can be explored to see if other distance approaches provide more optimal results. Validation of the MDS results through techniques such as cross-validation is also important to ensure the reliability and stability of the results obtained so that the analysis can be used as a basis for more robust and accurate policies.

6. ACKNOWLEDGMENTS

The author expresses gratitude to IPB University for providing the support and assistance needed to complete this research.

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Appendix

Table 1. Variable Names

Variable	Label	Type	Variable	Label	Type
R102	City Code	Scale	R2204C_G	PKH for Other Purposes	Nominal
R105	Urban Classification	Scale	R2205A	Elderly Social Assistance	Nominal
R1701	Food Worry	Nominal	R2206A	Wage Subsidy Assistance	Nominal
R1702	Healthy Food Availability	Nominal	R2207	Received Non-Cash Food Assistance (BPNT)	Nominal
R1703	Limited Food Types	Nominal	R2208A2	Food Aid (Feb 2023)	Nominal
R1704	Skipped Meals	Nominal	R2208B2	Aid Value Known (Feb 2023)	Nominal
R1705	Ate Less	Nominal	R2208BI2	Aid Value (Feb 2023)	Scale
R1706	Food Shortage	Nominal	R2208C2	Months of Aid (Feb 2023)	Nominal
R1707	Hungry Not Eating	Nominal	R2208D2	BPNT Use (Feb 2023)	Nominal
R1708	No Meals All Day	Nominal	R2208EIB2	Rice Spending (Feb 2023)	Scale
R1801	Number of Families	Nominal	R2208EIIB2	Rice Quantity (Feb 2023)	Scale
R1802	Ownership Status	Nominal	R2208EIT2	Other Commodities (Feb 2023)	Scale
R1803	Land Ownership Proof	Nominal	R2208EIIT2	Egg Quantity (Feb 2023)	Scale
R1804	Floor Area	Scale	R2208EK2	Other Commodities (Feb 2023)	Nominal
R1805	Other House Ownership	Nominal	R2208ENU2	Other Commodity No. (Feb 2023)	Scale
R1806	Roof Material	Nominal	R2208EIL2	Other Commodity Spending (Feb 2023)	Scale
R1807	Wall Material	Nominal	R2208EIIL2	Other Commodity Quantity (Feb 2023)	Scale
R1808	Floor Material	Nominal	R2208ES2	Commodity Unit (Feb 23)	Nominal
R1809A	Toilet Facility	Nominal	R2208F2	Rice Quality (Feb 23)	Nominal
R1809B	Type of Toilet	Nominal	R2208G2	Commodity Choice (Feb 23)	Nominal
R1809C	Sewage Disposal	Nominal	R2208H2	Purchase Location (Feb 23)	Nominal
R1809D	Septic Age	Scale	R2208A3	Food Aid (Feb 23)	Nominal
R1809E	Septic Tank Emptying	Nominal	R2208B3	Aid Value Known (Jan 23)	Nominal
R1810A	Main Water Source	Nominal	R2208BI3	Aid Value (Jan 23)	Scale
R1810B	Distance to Waste	Nominal	R2208C3	Months of Aid (Jan 23)	Nominal
R1811A	Water Source Location	Nominal	R2208D3	BPNT Use (Jan 23)	Nominal
R1811B	Time to Collect Water	Scale	R2208EIB3	Rice Spending (Jan 23)	Scale
R1812	Water Shortage Experience	Nominal	R2208EIIB3	Rice Quantity (Jan 23)	Scale
R1813A	Water Turbid	Nominal	R2208EIT3	Egg Spending (Jan 23)	Scale
R1813B	Water Colored	Nominal	R2208EIIT3	Egg Quantity (Jan 23)	Scale
R1813C	Water Tasted	Nominal	R2208EK3	Other Commodities (Jan 23)	Nominal
R1813D	Water Foamy	Nominal	R2208ENU3	Other Commodity No. (Jan 23)	Nominal
R1813E	Water Smelly	Nominal	R2208EIL3	Other Commodity Spending (Jan 23)	Scale
R1814A	Bathing Water Source	Nominal	R2208EIIL3	Other Commodity Quantity (Jan 23)	Scale
R1814B	Distance to Waste Pit	Nominal	R2208ES3	Commodity Unit (Jan 23)	Nominal
R1815A	Handwashing Place	Nominal	R2208F3	Rice Quality (Jan 23)	Nominal
R1815B	Water Availability	Nominal	R2208G3	Commodity Choice (Jan 23)	Nominal
R1815C	Soap Availability	Nominal	R2208H3	Purchase Location (Jan 23)	Nominal
R1816	Lighting Source	Nominal	R2208A4	Food Aid (Dec 22)	Nominal
R1816B1	Meter Capacity 1	Nominal	R2208B4	Aid Value Known (Dec 22)	Nominal
R1816B2	Meter Capacity 2	Nominal	R2208BI4	Aid Value (Dec 22)	Scale

Variable	Label	Type	Variable	Label	Type
R1816B3	Meter Capacity 3	Nominal	R2208C4	Month of Aid (Dec 22)	Nominal
R1817	Cooking Fuel	Nominal	R2208D4	BPNT Use (Dec 22)	Nominal
R1901A	People's Business Credit	Nominal	R2208EIB4	Rice Spending (Dec 22)	Scale
R1901B	Bank Credit	Nominal	R2208EIIB4	Rice Quantity (Dec 22)	Scale
R1901C	Rural Bank Credit	Nominal	R2208EIT4	Egg Spending (Dec 22)	Scale
R1901D	Cooperative Credit	Nominal	R2208EIIT4	Egg Quantity (Dec 22)	Scale
R1901E	Personal Loan	Nominal	R2208EK4	Other Commodities (Dec 22)	Nominal
R1901F	Pawn Credit	Nominal	R2208ENU4	Other Commodity No. (Dec 22)	Scale
R1901G	Leasing Credit	Nominal	R2208EIL4	Other Commodity Spending (Dec 22)	Scale
R1901H	Village Owned Enterprise Credit	Nominal	R2208EIIL4	Other Commodity Quantity (Dec 22)	Scale
R1901I	Online Loan	Nominal	R2208ES4	Commodity Unit (Dec 22)	Nominal
R1901J	Other Credits	Nominal	R2208F4	Rice Quality (Dec 22)	Nominal
R2001A	Gas Cylinder	Nominal	R2208G4	Commodity Choice (Dec 22)	Nominal
R2001B	Refrigerator	Nominal	R2208H4	Purchase Location (Dec 22)	Nominal
R2001C	Air Conditioner	Nominal	R2208A5	Food Aid (Nov 22)	Nominal
R2001D	Water Heater	Nominal	R2208B5	Aid Value Known (Nov 22)	Nominal
R2001E	Landline Phone	Nominal	R2208BI5	Aid Value (Nov 22)	Scale
R2001F	Computer/Laptop	Nominal	R2208C5	Months of Aid (Nov 22)	Nominal
R2001G	Gold/Jewelry	Nominal	R2208D5	BPNT Use (Nov 22)	Nominal
R2001H	Motorcycle	Nominal	R2208EIB5	Rice Spending (Nov 22)	Scale
R2001I	Boat	Nominal	R2208EIIB5	Rice Quality (Nov 22)	Scale
R2001J	Motorboat	Nominal	R2208EIT5	Egg Spending (Nov 22)	Scale
R2001K	Car	Nominal	R2208EIIT5	Egg Quantity (Nov 22)	Scale
R2001L	Television	Nominal	R2208EK5	Other Commodities (Nov 22)	Nominal
R2001M	Land Ownership	Nominal	R2208ENU5	Other Commodity No. (Nov 22)	Scale
R2002_A	Land Owned by Head	Nominal	R2208EIL5	Other Commodity Spending (Nov 22)	Scale
R2002_B	Land Owned by Spouse	Nominal	R2208EIIL5	Other Commodity Quantity (Nov 22)	Scale
R2002_C	Land Owned by Child	Nominal	R2208ES5	Commodity Unit (Nov 22)	Nominal
R2002_D	Land Owned by Others	Nominal	R2208F5	Rice Quality (Nov 22)	Nominal
R2101A	Main Funding Source	Nominal	R2208G5	Commodity Choice (Nov 22)	Nominal
R2101B	Household Member Funding	Nominal	R2208H5	Purchase Location (Nov 22)	Nominal
R2101C	Main Remittance Source	Nominal	R2209A	Fuel Aid (BLT BBM)	Nominal
R2201A2	Pension/Veteran Benefits	Nominal	R2209B	Village Cash Aid (BLT Desa)	Nominal
R2201A3	Household Member Pension	Nominal	R2209C	Cash for Work Program	Nominal
R2201B2	Old Age Insurance	Nominal	R2210A	Micro or Small Business	Nominal
R2201B3	Household Member Insurance	Nominal	R2210B1	PKBL Assistance	Nominal
R2201C2	Work Accident Insurance	Nominal	R2210B2	Ultra-Micro Assistance (Umi)	Nominal
R2201C3	Household Member Work Insurance	Nominal	R2210B3	PNM Mekaar Assistance	Nominal
R2201D2	Death Insurance	Nominal	R2210B4	Micro Waqf Bank Assistance	Nominal

Variable	Label	Type	Variable	Label	Type
R2201D3	Household Member Death Insurance	Nominal	R2210B5	Revolving Fund Assistance	Nominal
R2201E2	Job Loss Insurance	Nominal	R2211A	Routine Cash Aid	Nominal
R2201E3	Household Member Job Loss Insurance	Nominal	R2211A1	Routine Cash for Food	Scale
R2201F2	Severance Payment	Nominal	R2211A2	Routine Cash for Child	Scale
R2201F3	Household Member Severance	Nominal	R2211A3	Routine Cash for Elderly	Scale
R2202	Welfare Card (KKS)	Nominal	R2211A4	Routine Cash for Disabled	Scale
R2203	PKH Recipient History	Nominal	R2211A5	Routine Cash for Other	Scale
R2204A	Still PKH Recipient	Nominal	R2211B	Non-Routine Cash Aid	Nominal
R2204B	PKH Benefit Location	Nominal	R2211B1	Non-Routine Cash Value	Scale
R2204C_A	PKH for Food	Nominal	R301	Number of Household Members	Nominal
R2204C_B	PKH for Housing	Nominal	R302	Household Members 0-4 Years	Scale
R2204C_C	PKH for Healthcare	Nominal	R303	Household Members 5+ Years	Scale
R2204C_D	PKH for Maternity	Nominal	R304	Household Members 10+ Years	Scale
R2204C_E	PKH for Education	Nominal	R305	Female Members Aged 10-54	Nominal
R2204C_F	PKH for Debt Repayment	Nominal	FWT	Weight	Scale

Table 2. Variable Names by Topic Group

Dimension	Topic	Variable Code
1. Group by basic needs		
Dimension	**Topic**	**Variable Code**
Dimension 1	Food Welfare	R1701 – R1708
Dimension 2	Access to Facilities and Infrastructure	R1802 – R1816
2. Group by Housing Facilities and Ownership		
Dimension	**Topic**	**Variable Code**
Dimension 1	Physical Condition of Housing	R1804, R1806 – R1808, R1809A – R1810A
Dimension 2	Ownership of Assets and Facilities	R2001A – R2001M
3. Group by Socio-Economic Status		
Dimension	**Topic**	**Variable Code**
Dimension 1	Social Assistance	R2205A – R2209A
Dimension 2	Economic Status	R2001A – R2001M
4. Group Based on Access to Services and Infrastructure		
Dimension	**Topic**	**Variable Code**
Dimension 1	Access to Infrastructure	R1806 – R1817
Dimension 2	Access to Aid and Credit	R1901A – R2210B3
5. Group by Demographics and Household Well-being		
Dimension	**Topic**	**Variable Code**
Dimension 1	Household Well-being	R1701 – R1708
Dimension 2	Household Demographics	R301 – R305