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Biplot Analysis on Mapping the Characteristics of The Human Development Indeks in West Nusa Tenggara

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Abstract

This study aims to map the characteristics of the Human Development Index for districts and cities in West Nusa Tenggara Province in 2024 using biplot analysis. This study employs a quantitative descriptive research design. The data used in this study are secondary data, namely the 2024 Human Development Index data. The analysis was conducted using biplot analysis. Based on the analysis carried out, the results show that the clustering map obtained explains 95.42% of the total variance in the data. Four regional groups with similar characteristics were identified: Quadrant I comprises three regencies/cities—East Lombok Regency, Sumbawa Regency, and Bima Regency—based on Infant Mortality Rate. Group 2 comprises two regencies/cities—Central Lombok Regency, Dompu Regency, and Bima City—based on Average Years of Schooling. Group 3 comprises 3 regencies/cities: West Lombok Regency, West Sumbawa Regency, and Mataram City, based on life expectancy, expected years of schooling, the open unemployment rate, and real per capita expenditure. Group 4 comprises one regency/city: North Lombok Regency, based on the poverty rate.

Key Word: Mapping, Human Development Index, Biplot Analysis

INTRODUCTION

Development can be understood as an endeavour or process aimed at bringing about positive change. The process of development occurs across all aspects of society, including economic, political, social and cultural spheres. Economic development, meanwhile, is a process of transforming a situation for the better, thereby enhancing welfare, development and prosperity. In the discourse of development economics, economic development is synonymous with creating, maintaining and increasing national income (Suriadi, 2019).

According to Todaro (cited in Husodo, 2020), there are three core objectives in the development process, namely: an increase in the availability and wider distribution of various basic necessities for daily life, such as food, clothing, shelter, healthcare and security; An improvement in living standards, encompassing increased job creation, enhanced educational quality, and the elevation of cultural and humanitarian values. All of which not only improve material well-being but also foster the personal and national identity of the people concerned; and The expansion of economic and social choices for every individual and the nation as a whole, namely freeing them from a mindset of dependence not only on other people or nations but also on any power that has the potential to undermine human values.

The Human Development Index (HDI) is one of the indicators used to measure the level of social and economic development of a country or region. The Human Development Index (HDI) is a key indicator for gauging the success of efforts to improve the quality of human life. Presenting the HDI by region enables each province and district/city to understand the landscape of human development, including achievements, rankings and disparities between regions.

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In 1990, the United Nations Development Programme (UNDP) established this index to highlight the importance of people and their resources in development. The index is derived from the average of indicators across three key dimensions of human development: a long and healthy life, knowledge, and a decent standard of living. The dimension of a long and healthy life is measured by life expectancy at birth. The dimension of knowledge is measured by the average years of schooling for the population aged 25 and over and the expected years of schooling for the population aged 7. Meanwhile, the dimension of a decent standard of living is measured by real per capita expenditure adjusted for inflation (Central Statistics Agency, 2020).

According to data from the Central Statistics Agency of West Nusa Tenggara (NTB), the Human Development Index in West Nusa Tenggara Province for the period 2020–2024 shows an upward trend each year. In 2020, NTB's HDI stood at 70.46, rising to 70.86 in 2021. A significant increase occurred in 2022, reaching 71.65, followed by 72.37 in 2023, and finally 73.10 in 2024. This improvement indicates sustained progress in the areas of education, health, and living standards for the people of NTB during this period. Overall, this upward trend in the HDI suggests that NTB is moving closer to a higher category of human development year on year.

Based on the Human Development Status Classification sourced from Satu Data NTB, it can be seen that, according to the 2024 HDI value, West Nusa Tenggara Province falls into the high human development status category, with a value ranging from $70 \leq HDI < 80$. Nevertheless, when compared with other provinces in Indonesia, NTB's position at 27th out of 38 provinces indicates that its HDI achievement remains relatively behind that of provinces with very high HDI values, such as Jakarta and Yogyakarta, which have on average achieved an HDI above 80.

The province of West Nusa Tenggara (NTB) comprises 10 regencies and municipalities, each with distinct development characteristics. Each region has distinct geographical conditions, resource potentials and development challenges, which directly influence Human Development Index (HDI) outcomes. Consequently, an analysis is required that can simultaneously map and describe the differences and relationships between HDI variables across each regency and city in the province.

Biplot analysis is a method used to represent data from a summary table in a two-dimensional graph. The information provided by a biplot encompasses both objects and variables within a single image. Biplot analysis is a two-dimensional descriptive technique that can be visually presented as a set of objects and variables in a flat graph (Kurniawati & Miranda, 2018). This method facilitates the visualisation of the characteristics of each regency/city based on the complex dimensions of the HDI, presenting the information in an easily understandable manner. By using biplot analysis, a better understanding can be gained of the similarities between regencies/cities, as well as which variables dominate human development characteristics in the NTB region. Based on the biplot display obtained, four key points can be identified: the proximity between objects, the diversity among variables, the correlations between variables, and the variable values associated with the objects (Saputri et al., 2024).

Research on the Human Development Index using the biplot method was previously conducted by Leleury & Wokanubun (2015), which showed that the results of the biplot analysis of districts and cities in Maluku Province with similar HDI characteristics were divided into four groups. Group I comprises Buru and South Buru districts; Group II comprises SBB and SBT districts; Group III comprises Southeast Maluku, Aru Islands, MTB and MBD districts; whilst Group IV comprises Central Maluku district, Tual city and Ambon city.

Research by Kurniawati et al., 2022, shows the results of a biplot analysis of districts and cities in West Kalimantan Province, with life expectancy being the indicator with the highest level of variation. The cities of Pontianak and Singkawang are areas with a relatively high HDI compared to other regions. The results of the biplot analysis for districts/cities in West Java Province show that Group 1 comprises areas with characteristics of the variables 'Expected Years of Schooling' and 'Per Capita Expenditure' with values below the average (Salma et al., 2022).

Group 2 comprises regions with above-average values for life expectancy and average years of schooling. Group 3 comprises regions with above-average values for expected years of schooling and per capita expenditure. Group 4 comprises regions with above-average values for life expectancy and average years of schooling.

Based on the data and analysis presented, the author is interested in conducting a study entitled

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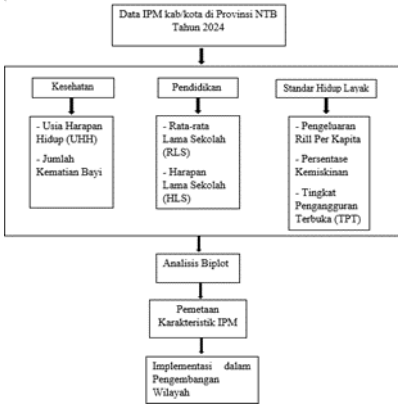
"Biplot Analysis of the Mapping of Human Development Index (HDI) Characteristics in Districts and Cities of West Nusa Tenggara Province in 2024". This study is intended to serve as a reference for the planning and evaluation of human development in the districts and cities of West Nusa Tenggara Province.

RESEARCH METHODS

This study employs a descriptive quantitative approach. The aim of the descriptive analysis is to identify and explain the issues present in the study, presenting them clearly and accurately, and structuring them systematically based on field data. The study is situated in West Nusa Tenggara Province and utilises secondary data, specifically the 2024 Human Development Index. The variables in this study are Life Expectancy (LE), Infant Mortality Rate, Expected Years of Schooling (EYS), Average Years of Schooling (AYS), Real Per Capita Expenditure, Poverty Rate, and Open Unemployment Rate.

Figure 1. Biplot-based data analysis workflow



Source: Author's own work

The 2024 Human Development Index (HDI) data for districts and cities in West Nusa Tenggara Province provides a comprehensive overview of the quality of human development in each region. The HDI itself is a composite index that measures the average achievement across the three fundamental dimensions of human development: health, education and a decent standard of living. In West Nusa Tenggara, this data is sourced from the Central Statistics Agency (BPS). A biplot analysis was then conducted; this is a statistical technique used to present complex data in the form of a two-dimensional graph, thereby facilitating the interpretation of relationships between regions and their interconnections.

Using this method, each region is represented as a point whose position reflects the similarities or differences in characteristics compared to other regions. Regions that are close together on the graph share similar characteristics, whilst those that are far apart indicate significant differences. The results of this clustering can serve as a crucial basis for more targeted regional development planning, as the government can formulate strategies tailored to the specific needs and challenges of each group of regions.

RESULTS AND DISCUSSION

Biplot Analysis of the Human Development Index for Districts and Municipalities in West Nusa Tenggara

The analysis reveals three interlinked layers of issues. A biplot is an attempt to represent a multi-dimensional space as a two-dimensional plot. This dimensional reduction results in a loss of information contained within the biplot. A biplot capable of conveying 70% of the total information is considered sufficient.

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Table 1: Results of the Biplot Analysis

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Biplot of 10 observations and 7 variables

     Explained variance by component 1 = 0.8324
     Explained variance by component 2 = 0.1218
              Total explained variance = 0.9542

Biplot coordinates
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Observations	dim1	dim2
1	-0.0538	-0.3080
2	-0.0606	0.2594
3	0.5235	0.2232
4	0.0684	0.5185
5	-0.2141	0.9469
6	0.4303	0.8241
7	-0.3301	-0.3590
8	2.9178	-0.9332
9	-1.8368	-1.5456
10	-1.4446	0.3737

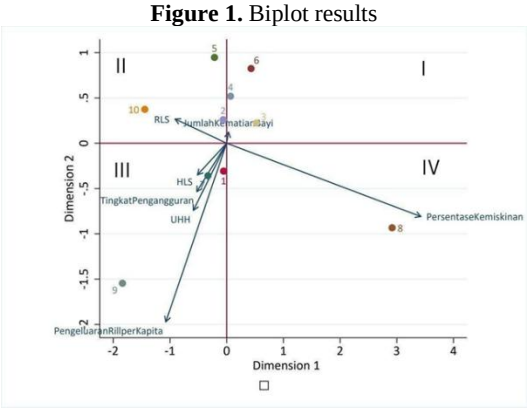
Variables	dim1	dim2
UHH	-0.5870	-0.7410
HLS	-0.5146	-0.3487
RLS	-0.9110	0.2672
Pengeluara~a	-1.0731	-1.9713
Persentase~n	3.4250	-0.8094
TingkatPen~n	-0.5266	-0.5351
JumlahKema~i	0.0326	0.1230

Source: Data processed using Stata 17

The variance explained by the first principal axis is 83.24% and by the second principal axis is 12.18%, meaning that the total variance explained by both axes is 95.42%. As the total variance obtained is close to 1, this indicates that the resulting biplot is excellent; the information provided by the biplot accounts for 95.42% of the total information contained in the data.

Interpretation of Biplot Results

Figure 1. Biplot results



Source: Data processed using Stata 17

1. Based on the proximity of the object

   The proximity between objects is used to identify districts/cities that share similar characteristics with other districts/cities. Districts/cities located in the same quadrant exhibit Human Development Index characteristics that are quite similar, when compared with districts/cities in different quadrants. Based on the results of the biplot, information can be obtained regarding the districts/cities located in the same quadrant.

   Quadrant I comprises three regencies/cities: East Lombok Regency, Sumbawa Regency and Bima Regency, which means they share the same HDI characteristics in terms of the infant mortality rate.Quadrant II comprises three regencies/cities, namely Central Lombok Regency, Dompu Regency and Bima City, which means they share the same HDI characteristics, specifically regarding the variable 'Average Years of Schooling'.

   Quadrant III comprises three regencies/cities, namely West Lombok Regency, West Sumbawa

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Regency, and Mataram City, which means they share the same HDI characteristics, specifically regarding the variables of Expected Years of Schooling, Open Unemployment Rate, Life Expectancy, and Real Per Capita Expenditure.

Quadrant IV comprises North Lombok Regency, based on the Poverty Rate variable.

2. Variability

The variability of the variables can be seen from the length of each variable's vector. According to the graph, the variable with the longest vector among the others is the poverty rate. This means that the poverty rate is the variable with the highest variability in West Nusa Tenggara Province.

3. Relationships between Variables

A linear relationship between variables can be seen from the size of the angle formed by the two variable vectors. The smaller the angle, the stronger the positive correlation between the two variables, as seen in the case of Life Expectancy and Real per capita Expenditure. If the two vectors point in opposite directions or form an obtuse angle, then the two variables have a negative correlation, as seen in the relationship between the Poverty Rate and Real Per Capita Expenditure, and between the Average Years of Schooling and the Poverty Rate.

4. Variable Values in an Object

The values of variables for a given area are used to identify the characteristics of the Human Development Index for each regency/city. If a regency/city aligns with the characteristic vector of the analysed variables, this indicates that the area has high characteristic values or is better than the average for all regencies/cities. Conversely, if a regency or city lies in the opposite direction to the characteristic vector, its characteristic value is low or below the average of other regencies and cities. For example, North Lombok Regency lies in the same direction as the poverty rate variable vector, indicating that the region has a higher characteristic value than the average of all regencies and cities.

The five key elements of Proálcool's success that can be replicated: (1) a statutory mandatory blending mandate; (2) demand pull through a flex-fuel mandate; (3) capital subsidies via the BNDES; (4) parallel distribution infrastructure; and (5) a transition from subsidies to carbon market instruments (RenovaBio, 2017). Indonesia's B40 programme, which is projected to save Rp130.21 trillion in foreign exchange by 2025 (Ministry of Energy and Mineral Resources, 2026b), is on the right track, but requires a legal framework at the level of a law to ensure its sustainability.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Based on the analysis conducted, the results of clustering according to the similarity of characteristics between objects have identified four groups of regencies/cities in West Nusa Tenggara Province. The analysis results show that the resulting clustering map accounts for 95.42% of the total variation in the data. Four regional groups with similar characteristics were identified: Quadrant I comprises three districts/cities—East Lombok District, Sumbawa District, and Bima District—based on Infant Mortality Rate. Group 2 comprises two districts/cities—Central Lombok District, Dompu District, and Bima City—based on Average Years of Schooling. Group 3 comprises three regencies/cities: West Lombok Regency, West Sumbawa Regency, and Mataram City, based on life expectancy, expected years of schooling, the open unemployment rate, and real per capita expenditure. Group 4 comprises one regency/city: North Lombok Regency, based on the poverty rate.

RECOMMENDATIONS

The biplot results reveal several regional clusters that share similarities in terms of the Human Development Index (HDI). These clusters facilitate the formulation of appropriate policies based on the specific needs of each region, which is ultimately expected to drive an increase in the HDI across all

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regions. By identifying common characteristics within these groups—such as levels of education, health, and decent living standards—policy-makers can design more focused and effective interventions. This enables more efficient resource allocation, as well as the development of programmes tailored to local conditions, such as healthcare infrastructure, educational quality, economic access, and other social support systems.

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