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APPLICATION OF DECISION SUPPORT SYSTEM METHOD WITH TOPSIS TO IDENTIFY POVERTY-PRONE AREAS IN BREBES REGENCY

APLICAÇÃO DO MÉTODO DO SISTEMA DE APOIO À DECISÃO COM TOPSIS PARA IDENTIFICAR ÁREAS SUSCEPTÍVEIS À POBREZA NA REGIÃO DE BREBES

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Maulida Arta Sari*
*Bina Nusantara University, Jakarta, Indonesia
Orcid: https://orcid.org/0009-0003-5625-3672
maulida.sari@binus.ac.id

Tuga Mauritsius*
*Bina Nusantara University, Jakarta, Indonesia
Orcid: https://orcid.org/0000-0002-5525-5591
tmauritsus@binus.edu

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Abstract
Poverty is a complex multidimensional problem that requires accurate identification of priority areas for the effectiveness of poverty alleviation programs. Brebes Regency faced a poverty rate of 14.22% in 2021, exceeding the Central Java average of 11.26%, with inaccurate targeting of social assistance leading to misallocation of resources. This study implements a Decision Support System (DSS) based on the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method to identify poverty-prone areas in Brebes Regency systematically and accurately. The methodology employs a quantitative approach with multicriteria analysis, including four variables: average income, malnutrition of toddlers, number of Certificates of Inability (SKTM), and number of recipients of Direct Cash Assistance (BLT). Data was collected from 297 villages via surveys, interviews, and BPS secondary data. The system uses web architecture with data normalization, criterion weighting, and OpenStreetMap-integrated geographic visualization. Results show TOPSIS identified poverty vulnerability hierarchy with 100% accuracy via manual and automated verification. Padakaton Village ranks highest at 0.6000 as a priority area. Alpha and beta testing confirmed perfect functional validity. Decile-based color-coding visualization aids spatial poverty interpretation. The DSS-TOPSIS system provides objective, measurable recommendations for strategic poverty alleviation decisions in Brebes Regency with high calculation transparency.

Resumo
A pobreza é um problema complexo e multidimensional que requer a identificação precisa das áreas prioritárias para a eficácia dos programas de combate à pobreza. O distrito de Brebes enfrentou uma taxa de pobreza de 14,22% em 2021, excedendo a média de Java Central de 11,26%, com uma orientação imprecisa da assistência social, levando a uma má alocação de recursos. Este estudo implementa um Sistema de Apoio à Decisão (DSS) baseado no método Técnica para Ordem de Preferência por Similaridade à Solução Ideal (TOPSIS) para identificar de forma sistemática e precisa as áreas propensas à pobreza na Regência de Brebes. A metodologia emprega uma abordagem quantitativa com análise multicritério, incluindo quatro variáveis: renda média, desnutrição de crianças pequenas, número de Certificados de Incapacidade (SKTM) e número de beneficiários da Assistência Direta em Dinheiro (BLT). Os dados foram coletados em 297 aldeias por meio de pesquisas, entrevistas e dados secundários do BPS. O sistema usa arquitetura web com normalização de dados, ponderação de critérios e visualização geográfica integrada ao OpenStreetMap. Os resultados mostram que o TOPSIS identificou a hierarquia de vulnerabilidade à pobreza com 100% de precisão por meio de verificação manual e automatizada. A aldeia de Padakaton ocupa a primeira posição com 0,6000 como área prioritária. Os testes alfa e beta confirmaram a validade funcional perfeita. A visualização com codificação por cores baseada em decis ajuda na interpretação espacial da pobreza. O sistema

Keywords: Decision Support System. Poverty Identification. Brebes Regency. Decision Making. TOPSIS.

DSS-TOPSIS fornece recomendações objetivas e mensuráveis para decisões estratégicas de redução da pobreza na Regência de Brebes com alta transparência de cálculo.a

Palavras-chave: *Sistema de Apoio à Decisão. Identificação da Pobreza. Regência de Brebes. Tomada de Decisão. TOPSI.*

1 INTRODUCTION

Poverty is a complex socio-economic condition that hinders people from adequately meeting basic needs, becoming a widespread global problem, including in Indonesia with characteristics of lack in various dimensions of life (Roebyantho, 2013). The complexity of the causes of poverty encompasses many interrelated aspects, making it difficult to identify a single factor as the root of the problem. Systemic problems such as limited social safety nets, limited access to health services, education, and employment opportunities are major contributors to poverty. Economic inequality, social exclusion, and discrimination worsen the conditions of disadvantaged communities. The impact of poverty affects not only individuals, but also communities and countries as a whole, perpetuating cycles of inequality through limited access to economic opportunities, health services, and education (Atma Ras, 2013). The multidimensional nature of poverty includes financial deprivation, inadequate housing, limited access to sanitation and clean water, inadequate nutrition, and lack of educational opportunities. Therefore, a comprehensive strategy that addresses the root of the problem and provides direct assistance to affected parties is an urgent need. Governments often intervene through the identification and assistance of underprivileged families as part of development projects, but interventions must be targeted to achieve effective empowerment.

Brebes Regency in Central Java faces significant poverty challenges with the poverty rate reaching 14.22% in 2021, surpassing the provincial average of 11.26%. This region consists of 17 sub-districts, 292 villages, and 5 sub-districts with an agriculture-based economy that produces major commodities such as sugarcane, rice, onions, and chili. Social Service data shows a striking variation in the number of poor people between sub-districts in 2021, with Prohibition and Liability having the highest poor population of 40,857 and 41,555 people, respectively, followed by Bulakamba and Wanasari with 52,319 and 46,577 people. The total poor population in Brebes Regency reached 525,307 people in 2021, a drastic increase from 306,055 people in 2020 (BPS Kabupaten Brebes, 2022). Factors causing high poverty include low levels of education with an average length of only 7.7 years compared to the average in Central Java of 8.3 years, limited employment options, and inadequate infrastructure. Local surveys show that 60% of respondents cited financial constraints as the main reason for not continuing education or skills training (Nuroksi Apipah et al., 2022). The youth unemployment rate reached 18% in 2021, emphasizing the need for focused efforts to address education and employment challenges.

The Brebes Regency Government has implemented various poverty alleviation programs including direct cash assistance to meet the basic needs of low-income families, employment training programs to improve community skills, and infrastructure development such as roads, bridges, and irrigation systems (Saputra, 2021). Despite the various initiatives that have been carried out, the high percentage of poverty indicates the need for a more focused and organized strategy. The main challenge lies in the accurate identification of poor families for assistance programs such as Rastra Social Assistance, Smart Indonesia Card, Healthy Indonesia Card, and Family Hope Program (Komdigi, 2018). Aditiya's research reveals inaccuracies *Targeting* social assistance in Brebes, where some beneficiaries live in decent temporary luxury homes that do not receive assistance and live in substandard housing (Aditiya, 2022). This condition emphasizes the importance of continuous assessment and data collection to ensure a fair and targeted distribution of social assistance. Local government decision-making methodologies currently lack the precision and comprehensiveness needed to target initiatives successfully, often ignoring important socio-economic indicators that result in resource misallocation and inefficient poverty alleviation measures.

Decision Support System (DSS) with the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) offers a solution to systematically identify poverty-prone areas in Brebes Regency. TOPSIS is a multicriteria decision-making technique that selects the best alternative based on geometric concepts where the selected alternative has the closest distance to the positive ideal solution and the farthest from the negative ideal solution (Rahim et al., 2018). DSS as a computer-based information system facilitates complex decision-making by integrating various socio-economic variables to provide a comprehensive picture of the poverty situation (Saifulloh et al., 2019). Atmaja et al.'s research showed an improvement in the accuracy of DSS through comprehensive criteria adjustment and the use of algorithms other than Analytic Hierarchy Process (AHP) (Atmaja et al., 2017). The implementation of the TOPSIS method begins with the determination of relevant criteria such as average income, child malnutrition, number of SKTM, and number of BLT through interviews with district-level decision-makers, followed by data normalization and weighting based on relative importance (Hertyana et al., 2021). Study Munthe et al. prove the TOPSIS system improves the accuracy and speed of information retrieval, overcoming the limitations of the previous time-consuming and inefficient system (Munthe et al., 2018). Efendy et al. confirming TOPSIS-based applications generate Targeting which is more appropriate for low-income families with a user-friendly, error-free interface (Efendy et al., 2023).

Based on the complexity of the poverty problem in Brebes Regency and the limitations of the existing decision-making methodology, this study formulates two main questions. First, how the TOPSIS method can be used to identify poverty-prone areas in Brebes Regency systematically and accurately. Second, how DSS can be designed and developed to assist the government in making decisions related to poverty alleviation in Brebes Regency by utilizing comprehensive data and criteria. This study aims to determine the application of the TOPSIS method to identify poverty-prone areas in Brebes Regency through an objective and systematic multicriteria analysis. In addition, this research also aims to design a DSS that can assist the wider community, academics, and the government in supporting decisions related to poverty alleviation efforts in Brebes Regency by providing comprehensive and easy-to-use analytical tools.

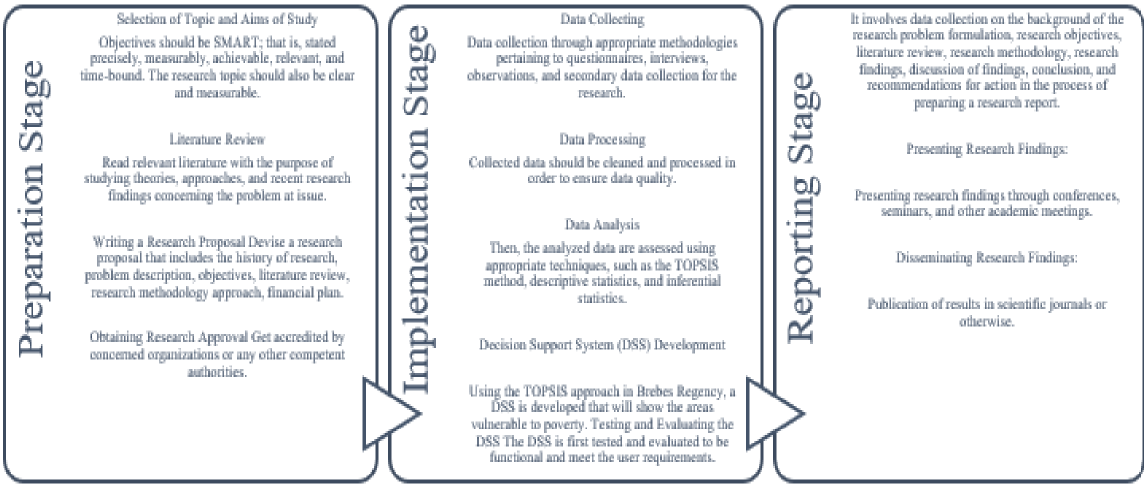
The theoretical benefits of this research include contributing to a comprehensive understanding of the complex nature of poverty and the development of focused solutions for poverty mitigation through the integration of cutting-edge technologies that facilitate thorough data analysis and evidence-based decision-making. This approach encourages efficiency and inclusivity in poverty alleviation efforts, supporting the achievement of sustainable development in Brebes Regency and similar areas. In practical terms, this research is beneficial for governments in identifying vulnerable communities and implementing targeted interventions that allow for the optimization of budget allocation based on the priorities of the greatest impact. For the community, this study provides more focused support to low-income households and easier access to social programs, contributing to improving the welfare and quality of life of the community in Brebes Regency through the effectiveness of better poverty alleviation activities.

2 METHOD

This study develops a conceptual framework that focuses on the identification of poverty-prone areas in Brebes Regency, Central Java, through the implementation of the *Technique for Order of Preference by Similarity to Ideal Solution* (TOPSIS) method integrated with *the Decision Support System* (DSS). The complexity of the problem of poverty as a multidimensional socio-economic phenomenon demands a comprehensive and systematic analytical approach. The integration of the TOPSIS methodology with DSS technology provides a robust analytical foundation for the evaluation of complex data and the determination of priorities based on objective criteria in support of sustainable development and poverty alleviation efforts. This study adopts a multidimensional approach to address the complexity of poverty problems through a combination of the TOPSIS methodology with DSS technology. The TOPSIS method serves as a multi-criteria decision-making process that considers various features and ranks alternatives based on similarities to the ideal solution. DSS serves as a computing platform that supports data analysis, modeling strategies, and user interface capabilities to assist decision-makers in evaluating options and determining optimal actions.

Figure 1

Frame of Mind



The operational stages of the research are arranged methodically and structured to ensure the efficiency of implementation. The process begins with the collection of variable data from various sources, followed by data cleaning and processing to guarantee its quality. The next stage includes data normalization, determination of variable weights based on expert opinions, calculation of TOPSIS values for each village, ranking based on TOPSIS values, and visualization of results using graphs, tables, and maps. The DSS model was developed using a suitable programming language with a user-friendly interface for data access, analysis, and reporting. The model aims to improve the accuracy of the identification of the poorest regions, support the formulation of regional-specific policies, facilitate the evaluation of sustainable programs, and increase transparency and accountability in the implementation of poverty alleviation programs.

Data collection was carried out through mixed methods including surveys with questionnaires (Sugiyono, 2017), semi-structured interviews, participatory and non-participatory field observations. (Sugiyono, 2018), as well as the collection of secondary data from BPS, Bappeda, the Population and Civil Registration Office, scientific articles, and previous research reports (Ardiansyah et al., 2023). Data were collected from the sample villages with a focus on economic, non-economic, demographic, and public service access variables. All data is normalized, weighted, and analyzed using the TOPSIS method before being visualized and integrated in the DSS system.

3 RESULTS AND DISCUSSION

3.1 Research results

3.1.1 Implementation of the technique for order preference by similarity to ideal solution (TOPSIS) method

This study uses the Decision Support System approach with the TOPSIS algorithm to analyze the poverty level in the Brebes Regency area. The implementation of this method consists of several systematic stages which include the determination of evaluation criteria, normalization of datasets, weighting of variables, and ranking of regions based on the level of poverty vulnerability.

3.1.1.1 Determination of criteria and weighting system

The initial stage of implementation involves identifying four main variables that are indicators of regional poverty. The determination of this criterion was carried out through in-depth discussions with stakeholders at the district government level who have competence in understanding local socio-economic conditions. The four criteria include: the average income of the community as a primary indicator of poverty, the prevalence of malnutrition in toddlers which reflects family welfare, the number of recipients of the Certificate of Inability (SKTM) as an indication of official recognition of poverty status, and the quantity of recipients of Direct Cash Assistance (BLT) which shows the level of dependence on government social assistance.

Table 1

Specification, Criteria, And Evaluation Weights

Criterion	Classification	Weight	Justification
Average Income	Cost	5 (Very High)	Fundamental indicators of poverty
Lack of Nutrition News	Benefit	4 (High)	Reflection on family well-being
Number of SKTM	Benefit	2 (Low)	Formal recognition of poverty status
BLT Amount	Benefit	3 (Medium)	Levels of dependency on social assistance

The weighting system applied reflects the level of relative importance of each variable in determining the poverty status of a region. Average income gained the highest weight (5) considering its position as the main determinant of poverty, followed by the nutritional status of toddlers (4) which indicated the long-term well-being of the family.

3.1.1.2 Data normalization and transformation process

The normalization stage is carried out to standardize the measurement scale between variables that have different units. This process uses the vector normalization method with a mathematical formula that calculates the square root of the square sum of all values in each criterion. The divisor values produced for each criterion were: average income (87.7553), undernutrition of toddlers (140.3567), number of SKTM (91.6733), and number of BLT (120.4159).

Table 2

Region Sample Normalized Data Matrix

Region	Income	Nutrition News	SKTM	BLT
Malahayu	0,4558	0,3562	0,0109	0,3322
Bangsri	0,3419	0,3562	0,5454	0,4152
Bulusari	0,114	0,2137	0,3272	0,2491
Padakaton	0,0114	0,0712	0,6545	0,2491
Kuramendala	0,5698	0,285	0,3272	0,4152

3.1.1.3 Calculation of TOPSIS values and determination of optimal solutions

After normalization, weighting is carried out by multiplying the normalized value by the weight of each criterion. The next stage involves determining the ideal positive and negative solutions based on the characteristics of each criterion. For the benefit criteria (malnutrition of toddlers, SKTM, BLT), the ideal positive solution is the maximum value, while for the cost criterion (average income), the ideal positive solution is the minimum value. Euclidean distance calculations are performed to measure the proximity of each alternative to the positive and negative ideal solutions. The final TOPSIS value is obtained through a ratio of negative distance to total positive and negative distance, resulting in a preference score between 0 to 1, where a higher value indicates a higher level of poverty.

3.1.1.4 Results of ranking poverty-prone areas

Analysis using ten sample areas resulted in a ranking that showed variations in poverty vulnerability levels between villages. Padakaton Village ranks at the top with a TOPSIS score of 0.6000, followed by Wanatirta (0.5977) and Bulusari (0.5866). This pattern reflects conditions in which these regions have a combination of low incomes, high prevalence of malnutrition, and heavy reliance on government social assistance programs.

Table 3

Final Ranking of Poverty Vulnerability Level

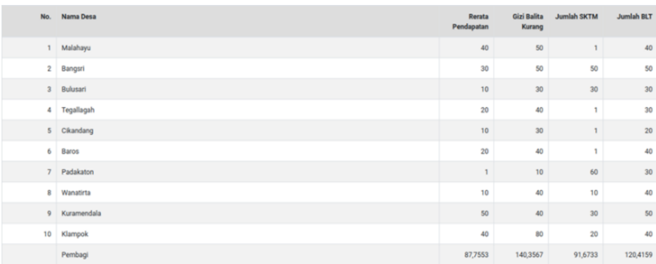
Rank	Region	TOPSIS Value	Poverty Category
1	Padakaton	0,6	Highly Vulnerable
2	Wanatirta	0,5977	Highly Vulnerable
3	Bulusari	0,5866	High Prone
4	Bangsri	0,5254	Moderate Prone
5	Cikandang	0,5252	Moderate Prone

3.1.1.5 Visualization and interpretation of results

The implementation of the system results in two main visualizations that describe the analysis process:

Figure 2

Screenshots of Alternative Data and Divisor Values



No.	Nama Desa	Rerata Pendapatan	Gizi Balita Kurang	Jumlah SKTM	Jumlah BLT
1	Malahayu	40	50	1	40
2	Bangsri	30	50	50	50
3	Bulusari	10	30	30	30
4	Tegallagah	20	40	1	30
5	Cikandang	10	30	1	20
6	Baros	20	40	1	40
7	Padakaton	1	10	60	30
8	Wanatirta	10	40	10	40
9	Kuramendala	50	40	30	50
10	Klampok	40	80	20	40
	Pembagi	87,7553	140,3567	91,6733	120,4159

Figure 3

Screenshot of Alternate Ranking Stages

No.	Nama Desa	Nama Kecamatan	Nilai
1	Padakaton	Ketanggungan	0,6000
2	Wanatirta	Paguyangan	0,5977
3	Bulusari	Bulakamba	0,5866
4	Bangsri	Bulakamba	0,5254
5	Cikandang	Kersana	0,5252
6	Baros	Ketanggungan	0,4911
7	Tegallagah	Bulakamba	0,4795
8	Klampok	Wanasari	0,4752
9	Malahayu	Banjarharjo	0,3349
10	Kuramendala	Tonjong	0,2964

Figure 2 Screenshot of Alternative Data and Divisor Values showing the raw dataset and normalization calculations, and Figure 3 Screenshot of Alternative Ranking Levels presenting the final results of the regional ranking. The results of the analysis show that the TOPSIS method is able to identify multidimensional poverty patterns by considering various socio-economic aspects simultaneously. Padakaton Village, which ranks at the top, has very low-income characteristics (parameter value 1), but is accompanied by a high number of SKTM (parameter value 60), indicating a condition of poverty that has been recognized administratively. In contrast, Kuramendala Village, which ranked the lowest (0.2964), showed a combination of relatively high income (parameter value of 50) with a moderate level of social assistance dependence. This pattern confirms the validity of the TOPSIS method in differentiating poverty levels based on a multi-criteria approach.

The findings of this study provide important insights for decision-making in the allocation of poverty alleviation resources. Areas with high TOPSIS scores require more intensive intervention priorities, especially in programs to increase community income and improve the nutritional status of children under five. The implementation of the Decision Support System with the TOPSIS algorithm has proven to be effective in producing objective and measurable rankings. This method is able to integrate multiple criteria with flexible weighting according to local policy priorities, thereby producing recommendations that are relevant to the regional context of Brebes Regency. The advantage of this approach lies in its ability to process multidimensional data into a single composite index that is easy to interpret, while maintaining the transparency of the decision-making process through the visualization of systematic and structured calculation stages.

3.1.2 Evaluation and validation of decision support system

3.1.2.1 Alpha testing

Initial validation of the *Decision Support System* (DSS) system was carried out through *an alpha testing* approach that involved the system developer as a single tester. The testing methodology used a questionnaire instrument with a 5-point Likert scale, where the value of 1 represents "Strongly Disagree" to a value of 5 for "Strongly Agree".

Table 4

System Functionality Alpha Testing Results Recapitulation

Yes	Functional Aspects	STS	TS	R	S	SS	Percentage
1	Login Authentication	0	0	0	0	1	100%
2	System Navigation	0	0	0	0	1	100%
3	Criteria Management	0	0	0	0	1	100%
4	Parameter Management	0	0	0	0	1	100%
5	District Administration	0	0	0	0	1	100%

Quantitative evaluation shows the achievement of a perfect score with the formula: Score = (5 × 8)/(5 × 8) × 100% = 100%. This result indicates that all functional components of the system operate according to the specifications that have been set.

3.1.2.2 Verify computational accuracy

The validation of the TOPSIS algorithm is carried out through a systematic comparison between the results of automatic computation and manual calculations. The verification process includes seven critical stages in the implementation of the TOPSIS method.

Table 5

TOPSIS Algorithm Accuracy Verification Results

Computational Stage	Validation Status	Accuracy Rate
Determination of Criteria Matrix	Appropriate	100%
Normalization of Input Data	Appropriate	100%
Weighting Applications	Appropriate	100%
Calculation of Positive Ideal Solution (D+)	Appropriate	100%
Calculation of Negative Ideal Solution (D-)	Appropriate	100%
TOPSIS Score Calculation	Appropriate	100%
Alternative Rankings	Appropriate	100%

The convergence of results between manual and automated calculations validates the implementation of accurate and reliable algorithms for the decision-making process.

3.1.2.3 Beta testing

The evaluation of the system by external users was carried out through *beta testing* involving 10 respondents who were selected by *purposive sampling* from Information Systems students. The testing methodology uses an instrument identical to *alpha testing*.

Table 6

Aggregation of Beta Testing Results from a User's Perspective

System Components	Respondents (n=10)	Total Score	Maximum Score	Effectiveness
Authentication System	50	50	50	100%
Interface Navigation	50	50	50	100%
Criteria Module	50	50	50	100%
Parameter Module	50	50	50	100%
Geography Module	50	50	50	100%
Recommendation Generator	50	50	50	100%

Comprehensive calculation: Beta values = 400/400 × 100% = 100%, indicating an optimal level of user satisfaction with system functionality.

3.1.2.4 System utility evaluation

Assessment of the practical utility of the DSS system was carried out through a survey of user perceptions regarding the system's ability to support the identification of poverty-prone areas and the formulation of poverty alleviation strategies.

Table 7

Evaluation of the Utility and Benefits of the DSS System

Utility Aspects	Positive Respondents	Percentage	Significance Levels
Identification of Vulnerable Areas	10/10	100%	Very High
Decision Making Support	10/10	100%	Very High
Effectiveness of Analysis	10/10	100%	Very High

The results of the evaluation demonstrate that the system is able to make a significant contribution in the process of identifying priority areas for poverty alleviation interventions in Brebes Regency.

3.1.3 System needs and specifications analysis

3.1.3.1 Functional needs analysis

Identification of functional needs is carried out through a requirement engineering approach to determine the minimum capabilities that the system must have. The analysis resulted in the specification of five critical functional domains that are the core functionality of the DSS system.

Table 8

DSS System Functional Requirements Specifications

Functional Domains	Capability Description	Priority Levels
Criteria Data Management	CRUD operations for assessment criteria	Critical
Parameter Management	Administration of evaluation parameters	Critical
Geographic Data Management	Sub-district and village data management	Critical
Value Data Management	Alternative data input and validation	Critical
Computing and Visualization	Execution of the TOPSIS algorithm and presentation of results	Critical

Each functional domain has been validated through use case analysis and contributes directly to the system's goal of generating accurate and accountable recommendations.

3.1.3.2 Non-functional needs analysis

Non-functional requirements specifications are formulated to ensure the system can operate optimally under a wide range of deployment conditions. The analysis includes aspects of usability, portability, and accessibility. The system is designed with responsive design characteristics for multi-platform compatibility, supporting a wide range of screen dimensions from mobile devices to desktops. Cross-platform compatibility is ensured through support for Windows and Linux operating systems, as well as compatibility with major browsers such as Microsoft Edge, Mozilla Firefox, and Google Chrome. The system architecture allows deployment on a local network (intranet) to meet the needs of organizations with strict security policies.

3.1.3.3 Software infrastructure specifications

The DSS system software ecosystem is built with an integrated technology stack approach, utilizing a combination of open-source and proprietary software to optimize performance and maintainability. The development environment uses Windows 10 as the main development platform with Mozilla Firefox 133 as the test browser. The server-side architecture is implemented using the XAMPP 7 stack which provides Apache 2 as a web server, PHP 7 as server-side scripting, and MySQL 5 for database management. The development process is facilitated by NetBeans 21 as an Integrated Development Environment (IDE) that supports full-stack web development.

3.1.3.4 Hardware infrastructure specifications

Hardware infrastructure needs are formulated based on system workload analysis and resource utilization projections for development and production environments. Minimum specifications for the development environment include a processor with a speed of 3 GHz to ensure optimal compilation time, 4 GB of system memory to support concurrent development tools, 1 TB of storage for codebases, databases, and version control, and a minimum screen resolution of 1366×768 pixels for optimal user interface development. Production environment configurations can use form factor PCs and laptops with equivalent or higher specifications, providing deployment flexibility according to organizational needs.

3.1.4 System design and implementation

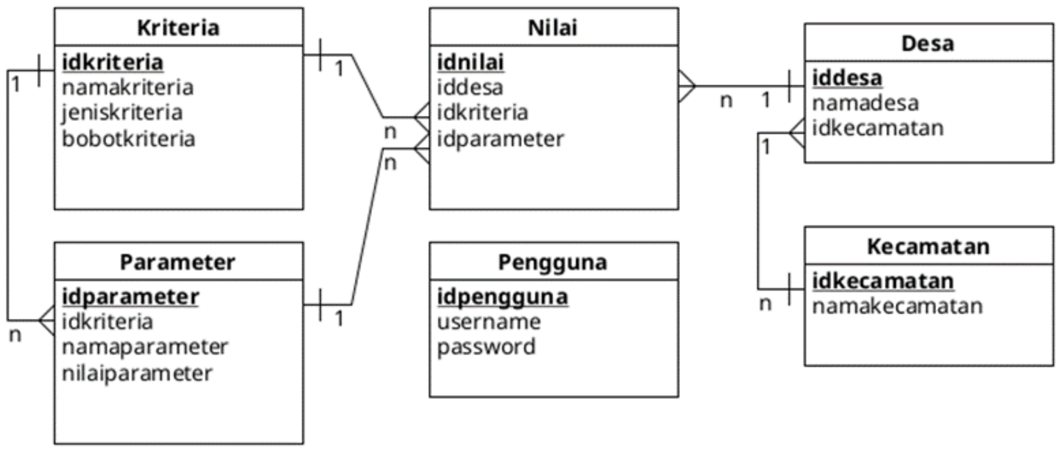
3.1.4.1 Database architecture design

Database design uses *a relational database design* approach with normalization up to *the Third Normal Form* (3NF) to ensure *data integrity* and eliminate *data redundancy*. User Entities: Manage authentication with schemas (*id_pengguna* [BigInt(20), PK], *username* [Varchar(64)], *password* [Varchar(64)]). Criteria Entity: Stores evaluation parameters with structures (*id_kriteria* [BigInt(20), PK], *nama_kriteria* [Varchar(32)], *jenis_kriteria* [Tinyint(4), Enum], *bobot_kriteria* [Tinyint(4)]).

Parameter Entities: Accommodates parameter values with relationships (*id_parameter* [BigInt(20), PK], *id_kriteria* [BigInt(20), FK], *nama_parameter* [Varchar(128)], *nilai_parameter* [Tinyint(4)]). Geographic Entities: Consists of the Sub-district table (*id_kecamatan* [BigInt(20), PK], *nama_kecamatan* [Varchar(32)]) and the Village table (*id_desa* [BigInt(20), PK], *nama_desa* [Varchar(32)], *id_kecamatan* [BigInt(20), FK]). Value Entities: Connects alternatives to criteria through schemas (*id_nilai* [BigInt(20), PK], *id_desa* [BigInt(20), FK], *id_kriteria* [BigInt(20), FK], *id_parameter* [BigInt(20), FK]).

Figure 4

Diagram Design of Relationships Between Tables



3.1.4.2 User interface implementation

User interface development adopts the principle of *User-Centered Design* (UCD) with a focus on *usability* and optimal *user experience*. Authentication Page: Secure *login implementation with* client-side *and* server-side *validation*, displaying username/password input forms with *session management*.

Figure 5

Login Page Interface Design

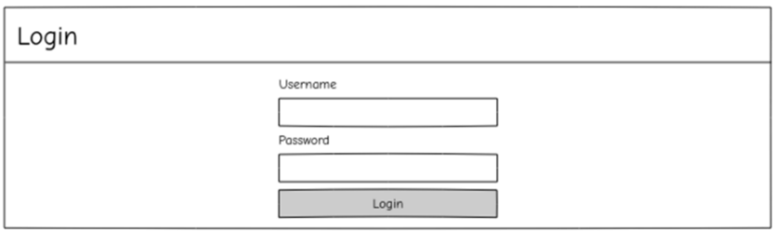


Figure 6

Screenshot of the login page interface

System Navigation: Design *a responsive navigation bar* with a hierarchical structure that includes Home, Criteria, District, Village, Results, Accounts, and Logout modules.

Figure 7

Menu Section Interface Design

Figure 8

Screenshot of Menu Section Interface

Data Management Module: Implementation of *CRUD operations* with a consistent interface for Criteria, Parameters, Districts, and Villages entities, equipped with *search* and *pagination functions*.

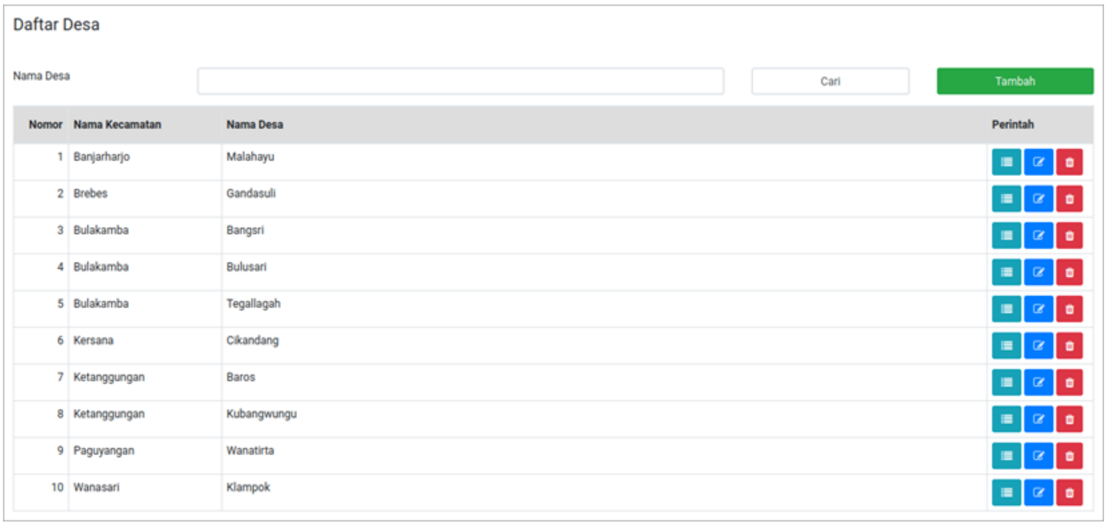
Figure 9

Screenshot of Interface Page List Criteria

Nomor	Nama Kriteria	Jenis Kriteria	Bobot Kriteria	Perintah
1	Rerata Pendapatan	Biaya	Sangat Tinggi	
2	Gizi Balita Kurang	Manfaat	Tinggi	
3	Jumlah SKTM	Manfaat	Rendah	
4	Jumlah BLT	Manfaat	Cukup	

Figure 10

Screenshot of Village List Page Interface



Nomor	Nama Kecamatan	Nama Desa	Perintah
1	Banjarharjo	Malahayu	
2	Brebes	Gandasuli	
3	Bulakamba	Bangsri	
4	Bulakamba	Bulusari	
5	Bulakamba	Tegallagah	
6	Kersana	Cikandang	
7	Ketanggungan	Baros	
8	Ketanggungan	Kubangwungu	
9	Paguyangan	Wanatirta	
10	Wanasari	Klampok	

3.1.4.3 Geographic visualization integration

The system integrates OpenStreetMap for spatial visualization of the results of the TOPSIS analysis, using *a dicil-based color-coding* system for the representation of poverty vulnerability levels. The implementation of *the color mapping* algorithm uses a 10 decile-based spectrum gradation system to visually represent the level of poverty vulnerability. Each decile represents 10% of the data range that has been sorted based on the TOPSIS score value, with the first decile (≤0.1) highlighted in red indicating the region with the highest level of vulnerability, while the tenth decile (>0.9) being highlighted in green indicating the region with the lowest level of vulnerability.

Table 9

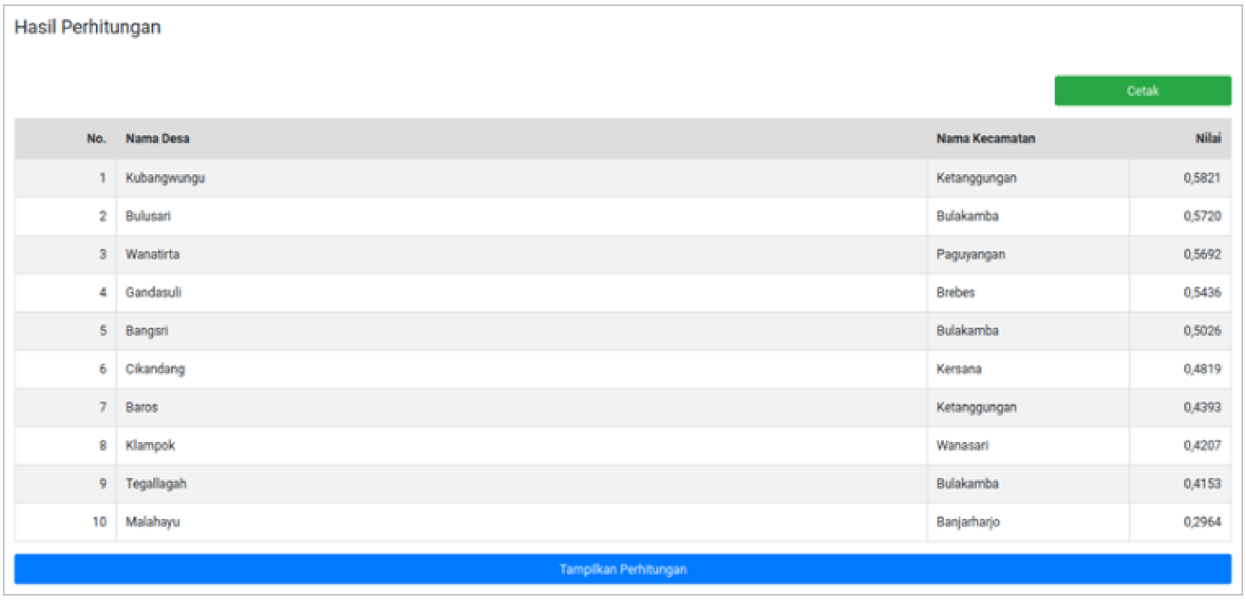
Color Coding System Based on Poverty Vulnerability Decile

Desil	Value Range	Color Coding	Vulnerability Categories	Interpretation
1	≤ 0.1	#ff0000	Highly Vulnerable	Top priority
2	0.1 - 0.2	#ff4400	High Prone	High Priority
3	0.2 - 0.3	#ff8800	Moderate-High Prone	Need Attention
4	0.3 - 0.4	#ffcc00	Moderate Prone	Active Monitoring
5	0.4 - 0.5	#ffff00	Medium Prone	Regular Monitoring
6	0.5 - 0.6	#ccff00	Less Prone	Good Status
7	0.6 - 0.7	#99ff00	Quite Safe	Good Status
8	0.7 - 0.8	#66ff00	Safe	Excellent Status
9	0.8 - 0.9	#33ff00	Highly Secure	Status Optimal
10	> 0.9	#00ff00	Most Secure	Status Ideal

This color classification system facilitates intuitive visual identification of the spatial distribution of poverty. The transition of the color spectrum from red to green provides a representation that is easy for *stakeholders* to understand in determining regional priorities for poverty alleviation policy interventions. This implementation allows decision-makers to quickly identify areas that need immediate intervention (deciles 1-3) and areas that can be used as *best practice models* (deciles 8-10).

Figure 11

Screenshot of the Results Page Interface



Hasil Perhitungan

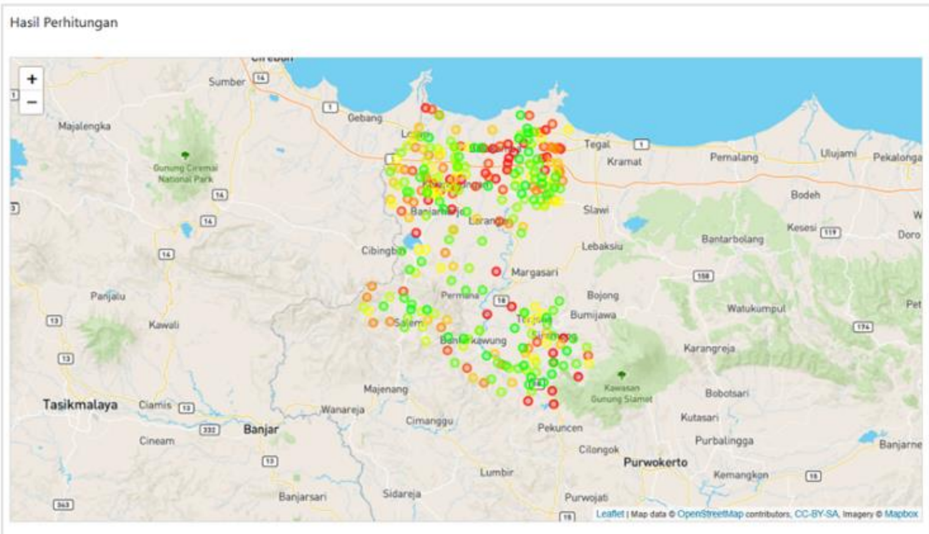
Cetak

No.	Nama Desa	Nama Kecamatan	Nilai
1	Kubangwungu	Ketanggungan	0,5821
2	Bulusari	Bulakamba	0,5720
3	Wanatirta	Paguyangan	0,5692
4	Gandasuli	Brebes	0,5436
5	Bangsri	Bulakamba	0,5026
6	Cikandang	Kersana	0,4819
7	Baros	Ketanggungan	0,4393
8	Klampok	Wanasari	0,4207
9	Tegallagah	Bulakamba	0,4153
10	Malahayu	Banjarharjo	0,2964

Tampilkan Perhitungan

Figure12

OpenStreetMap Results Page Interface Screenshot



This integration allows *stakeholders* to visually understand the spatial distribution of poverty and make geographically location-based policy decisions with high accuracy.

3.1.4.4 System performance validation and evaluation

A comprehensive evaluation of the DSS system shows the achievement *of optimal performance metrics* in all aspects of testing. *Alpha testing* and *beta testing* resulted in a perfect score of 100%, indicating that the system has met all the set functional and non-functional specifications. Verification of the accuracy of the TOPSIS algorithm through manual and automated computational comparisons validates accurate and reliable implementations. The system is able to produce consistent and objective alternative rankings, supporting evidence-based decision-making processes for poverty alleviation.

The integration of geographic visualization using OpenStreetMap provides a rich spatial dimension in the interpretation of the analysis results, facilitates the understanding of the geographical distribution of poverty and supports the formulation of targeted intervention strategies. The results of the study demonstrate that the application of the DSS method with TOPSIS can make a significant contribution in identifying poverty-prone areas in Brebes Regency, with a high level of accuracy and reliability to support *the policy making* process and optimal resource allocation.

3.2 Discussion

3.2.1 Validity and effectiveness of the implementation of the topsis method in decision support systems

The implementation of the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method in the decision support system for the identification of poverty-prone areas in Brebes Regency shows a very high level of accuracy based on the results of computational tests that have been carried out. The verification of the system's calculations shows perfect consistency between the results of automatic computation and manual calculations at every stage of the process, from determining criteria, normalizing data, weighting, to alternative ranking. This is in line with the findings of Zhou et al. who implemented the TOPSIS approach in evaluating energy poverty in the 82 countries participating in the Belt and Road Initiative, where the method was proven to provide an objective framework for policymakers to develop targeted strategies. The consistency of the manual and system calculation results indicates that the TOPSIS algorithm has been implemented correctly in the system architecture, ensuring the reliability and validity of the analysis results (Zhou et al., 2022). This success strengthens the argument of Ali and Khatak that the TOPSIS method is effective in solving the problem of multi-criteria decision-making, especially in the context of identifying beneficiary groups of poverty alleviation programs (Ali & Khatak, 2021). This high level of precision provides confidence that the system can be relied upon as an analytical instrument in the strategic decision-making process at the district level.

Testing the functionality of the system through the alpha testing method resulted in a perfect score of 100%, indicating that all system components are running according to the specifications that have been set. The evaluation includes comprehensive testing of critical functions such as user authentication mechanisms, interface navigation, management of criteria and parameter data, manipulation of geographic data at the sub-district and village levels, and generation of policy recommendations. These results show the maturity of the technology developed, in line with the approach used by Xiao et al. in developing a social vulnerability assessment system using the enhanced TOPSIS method for landslide disaster evaluation (Xiao *et al.*, 2022). The validity of the system is also confirmed through beta testing involving the end user, resulting in identical satisfaction and functionality levels at 100% level. Positive feedback from users shows that the system not only works technically, but also meets practical needs in supporting the process of identifying poverty-prone areas. The success of this implementation reinforces the findings of Rao and Gao who used an enhanced variant of TOPSIS to evaluate the level of urban-rural development integration, where a systematic and structured approach proved effective in producing a comprehensive and accurate analysis (Rao & Gao, 2022).

3.2.2 Analysis of the results of identification and ranking of poor prone areas

The application of the TOPSIS method to a comprehensive dataset covering 297 villages in Brebes Regency succeeded in identifying the hierarchy of poverty vulnerability levels with measurable and objective results. The results of the preliminary analysis showed ten villages with the highest poverty vulnerability level, with Klampok Village in Wanasari District occupying the top position with a score of 0.6876, followed by Bangsri Village in Bulakamba District with a score of 0.6175, and Wanatirta Village in Paguyangan District with a score of 0.5613. The geographical distribution of villages with high levels of vulnerability shows a concentration in certain sub-districts, with Bulakamba sub-district having three villages in the poverty-prone category, namely Bangsri, Tegallagah, and Bulusari. These findings confirm the effectiveness of the TOPSIS approach in identifying priority areas, as demonstrated by Andayani *et al.* in the research on prioritizing Village Fund assistance that uses a similar methodology to ensure optimal resource allocation (Andayani *et al.*, 2021). This distribution pattern provides strategic insight for local governments in designing more focused and efficient intervention programs. The variability of the TOPSIS score from 0.4569 to 0.6876 indicates a clear gradation in the level of vulnerability, allowing differentiation of handling strategies according to the specific characteristics of each region.

The re-ranking process of the ten villages with the highest level of vulnerability resulted in a significant reconfiguration of the priority order, with Padakaton Village in Ketanggungan District rising to first place with a score of 0.6000. This dramatic change illustrates the sensitivity of the TOPSIS method to the composition of the analyzed dataset, in line with the findings of Gambo *et al.* which emphasize the importance of data context in multidimensional analysis for poverty reduction support systems in semi-arid regions (Gambo *et al.*, 2023). The repositioning of Wanatirta Village to second place with a score of 0.5977 and Bulusari Village to third place with a score of 0.5866 shows relative dynamics in the TOPSIS calculation when alternative spaces are narrowed. This phenomenon strengthens the argument Lasaiba that computer-based decision support systems provide superior flexibility and precision in the analysis of people's welfare compared to conventional approaches (Lasaiba, 2023). The significant decrease in Klampok Village's score from first to eighth with a score of 0.4752 and Malahayu Village to ninth place with a score of 0.3349 indicates that the relative characteristics of each village change when compared in a smaller subset. These findings are consistent with Liawan's research using TOPSIS in the selection of recipients of aid from poor students, where the method has been shown to be effective in distinguishing the best candidates through comparison with positive and negative ideal solutions (Liawan, 2019).

A comparative analysis of the system's advantages and limitations reveals that the web-based architecture provides significant operational flexibility, allowing cross-platform and operating system access without the need for the installation of a dedicated application on the client's device. This advantage is in line with the approach adopted by Manutuhu *et al.* in developing a decision support system for the Smart Indonesia program using the Weighted Product method, which emphasizes the importance of system accessibility in increasing transparency and accountability in the distribution of government aid (Manuhutu *et al.*, 2023). Centralization of system maintenance and updates on a single server provides high operational efficiency, reducing technical complexity and long-term maintenance costs. However, the system still has limitations in terms of vertical integration that includes RT and support levels, as well as the lack of a native mobile application for the Android platform. These limitations indicate future development areas that need to be addressed to improve the reach and utilization of the system, as suggested by Truong & Hung that integrates the AHP-TOPSIS approach with ICT indicators for the evaluation of learning quality, emphasizing the importance of technological adaptability to diverse user needs (Truong & Hung, 2023). Nonetheless, the established foundation of the system provides a solid foundation for further development, with an architecture that can be expanded to accommodate the needs of more complex and comprehensive analysis in the future.

4 CONCLUSION

This study successfully implemented a Decision Support System based on the TOPSIS method to identify poverty-prone areas in Brebes Regency with a very high level of accuracy and validity. The system was able to analyze 297 villages using four main criteria (average income, undernutrition of toddlers, number of SKTM, and number of BLT) with weighting that reflects local policy priorities. The test results showed perfect consistency between manual and automatic calculations at all stages of TOPSIS, with alpha testing and beta testing achieving a score of 100%. The regional ranking resulted in an objective identification of priority areas, with Padakaton Village ranking at the top (score of 0.6000) as the area with the highest level of poverty vulnerability. The integration of geographic visualization using OpenStreetMap with a dicil-based color-coding system provides intuitive spatial representations to support strategic decision-making. The system has proven to be effective in integrating multiple criteria into one composite index that is easy to interpret, while maintaining process transparency through systematic and structured visualization of the calculation stages.

Further development is suggested to integrate systems with more detailed administrative levels such as RT and sub-districts to improve the granularity of poverty analysis. The implementation of native mobile applications for the Android platform will expand the accessibility and utilization of the system by stakeholders in the field. It is necessary to develop predictive modules by integrating time-series data for poverty trend analysis and future projections, as well as the implementation of complementary machine learning algorithms such as AHP (Analytical Hierarchy Process) for cross-validation of TOPSIS results. The system can also be enriched with the integration of real-time data from various sources such as CPM and other government information systems to improve the accuracy and relevance of the analysis. It is also recommended to conduct periodic evaluations of the weight of criteria based on local socio-economic dynamics and feedback from policy implementation. The development of a more comprehensive analytics dashboard with drill-down analysis and comparative studies between periods will provide deeper insights for policy makers in designing more effective and targeted poverty alleviation strategies in Brebes Regency.

REFERENCES

Aditiya, D. (2022). *Verifikasi dan Validasi DTKS di Brebes, Mahasiswa KKN MBKM Temukan Fakta Ini!* Kumparan. https://kumparan.com/dimas-aditiya/verifikasi-dan-validasi-dtks-di-brebes-mahasiswa-kkn-mbkm-temukan-fakta-ini-1yUZ4C3ESPg

Ali, R., & Khatak, A. (2021). Multicriteria Decision Making Using TOPSIS Method: An Accurate Selection of Deserving Candidates. *Proceedings of the Future Technologies Conference (FTC) 2021, Volume 3*, 506–517. https://doi.org/10.1007/978-3-030-89912-7_39

Andayani, M., Yanti, N., & Lusiyanti. (2021). Technique for Order Preference Method By Similarity To Ideal Solution (Topsis) for Decision Support System in Determining the Priority for Receiving Village Fund Assistance. *Jurnal Mantik*, *6*(1), 560–567.

Ardiansyah, Risnita, & Jailani, M. S. (2023). Teknik Pengumpulan Data Dan Instrumen Penelitian Ilmiah Pendidikan Pada Pendekatan Kualitatif dan Kuantitatif. *Jurnal IHSAN : Jurnal Pendidikan Islam*, *1*(2), 1–9.

https://doi.org/10.61104/ihsan.v1i2.57

Atma Ras. (2013). Pemberdayaan Masyarakat Sebagai Upaya Pengentasan Kemiskinan. *SOCIUS: Jurnal Sosiologi*, *XIV*, 56–63.

Atmaja, Z., Hasbi, M., & Susyanto, T. (2017). Sistem Pendukung Keputusan Penentu Keluarga Miskin Metode AHP Berbasis Web Dinamis. *TIKomSiN*, *3*(1), 11–19.

BPS Kabupaten Brebes. (2022). *Berita Resmi Statistik*.

Efendy, Z., Rahimullaily, R., & Aini, V. N. (2023). Sistem Pendukung Keputusan Mengunakan Metode TOPSIS Berbasis Aplikasi (Studi kasus Keluarga Miskin di Kelurahan Mata Air Kecamatan Padang Selatan). *Remik*, *7*(1), 142–156. https://doi.org/10.33395/remik.v7i1.11971

Gambo, J., Roslan, S. N. A., Shafri, H., Che'Ya, N., & Yusuf, Y. (2023). Unveiling groundwater potential zones as catalyst for multidimensional poverty reduction using analytical hierarchical process and geospatial decision support systems (S-DSS) approach in the semiarid region, Jigawa, Nigeria. *Groundwater for Sustainable Development*, *24*. https://doi.org/10.1016/j.gsd.2023.101038

Hertyana, H., Mufida, E., & Kaafi, A. (2021). Sistem Pendukung Keputusan Pemilihan Laptop Dengan Menggunakan Metode Topsis. *Jurnal Teknik Informatika UNIKA Santo Thomas*, *5*(1), 36–44. https://doi.org/10.54367/jtiust.v6i1.1216

Komdigi. (2018). *Program Bantuan Sosial untuk Rakyat*. Komdigi. https://www.komdigi.go.id/berita/artikel/detail/program-bantuan-sosial-untuk-rakyat

Lasaiba, M. A. (2023). Pengembangan Wilayah Tertinggal Di Indonesia: Optimalisasi Sumber Daya Alam Dan Teknologi Untuk Kemajuan Yang Berkelanjutan. *Jendela Pengetahuan*, *16*(1), 13–23. https://doi.org/10.30598/jp16iss1pp13-23

Liawan, S. (2019). Decision Support System for Poor Student Aid Admission Selection (BSM) using the Topsis Method. *International Journal of Basic and Applied Science*, *8*(2), 57–63. https://doi.org/10.35335/ijobas.v8i2.38

Manuhutu, M. A., Suripatty, R., Tindage, J., Manurung, T., Tupamahu, M., & Uktolseja, L. J. (2023). Development of Decision Support System in Determining Prospective Student Recipients of the Program Indonesia Pintar Using the Weighted Product Method. *Journal of Theoretical and Applied Information Technology*, *101*(21), 6677–6686.

Munthe, N. R., Sarkum, S., & Nasution, M. (2018). Perancangan Sistem Informasi Pendataan Masyarakat Miskin: Tinajuan Parameter Penghasilan Dan Kondisi Rumah. *Sistemasi*, *7*(3), 273. https://doi.org/10.32520/stmsi.v7i3.382

Nuroksi Apipah, Dumadi Dumadi, & Slamet Bambang Riono. (2022). Edukasi Penetapan Harga Jual bagi Pelaku UMKM Harum Manis Desa Parereja, Brebes.

Jurnal Pengabdian Kepada Masyarakat, *1*(3), 01–10. https://doi.org/10.55606/jpkm.v1i3.13

Rahim, R., Supiyandi, S., Siahaan, A. P. U., Listyorini, T., Utomo, A. P., Triyanto, W. A., Irawan, Y., Aisyah, S., Khairani, M., Sundari, S., & Khairunnisa, K. (2018). TOPSIS Method Application for Decision Support System in Internal Control for Selecting Best Employees. *Journal of Physics: Conference Series*, *1028*(1). https://doi.org/10.1088/1742-6596/1028/1/012052

Rao, C., & Gao, Y. (2022). Evaluation Mechanism Design for the Development Level of Urban-Rural Integration Based on an Improved TOPSIS Method. *Mathematics*, *10*(3). https://doi.org/10.3390/math10030380

Roebyantho, H. (2013). Kebijakan Penanganan Kemiskinan Melalui Kelompok Usaha Bersama (Kube). *Sosio Informa*, *18*(2), 117–132. https://doi.org/10.33007/inf.v18i2.68

Saifulloh, S., Pamungkas, R., & Lenawati, M. (2019). Decision support system with TOPSIS method for lecturer appraisal in Universitas PGRI Madiun. *Journal of Physics: Conference Series*, *1375*, 1–9. https://doi.org/10.1088/1742-6596/1375/1/012009

Saputra, U. R. (2021). Analisis Kebijakan Pengentasan Kemiskinan di Kabupaten Brebes Melalui Pengembangan Industri. *Jurnal Manajemen Publik Dan Kebijakan Publik (JMPKP)*, *3*(2), 22–36.

Sugiyono. (2018). *Metodologi Penelitian Kualitatif, Kuantitatif & RnD.* Alfabeta.

Truong, P., & Hung, N. (2023). *Applied Decision Support System Using TOPSIS – AHP, and ICT Newhouse Indicators for Evaluation of Courses at University of Economics Ho Chi Minh City (UEH), Vietnam* (pp. 39–54). https://doi.org/10.1007/978-3-031-27099-4_4

Xiao, Y., Tang, X., Li, Y., Huang, H., & An, B.-W. (2022). Social vulnerability assessment of landslide disaster based on improved TOPSIS method: Case study of eleven small towns in China. *Ecological Indicators*, *143*, 109316. https://doi.org/10.1016/j.ecolind.2022.109316

Zhou, K., Wang, Y., & Hussain, J. (2022). Energy poverty assessment in the Belt and Road Initiative countries: based on entropy weight-TOPSIS approach. *Energy Efficiency*, *15*, 46. https://doi.org/10.1007/s12053-022-10055-8

Authors' Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study’s findings are fully available within the article.

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