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LEVERAGING THE SAW METHOD IN A DECISION SUPPORT SYSTEM TO IMPROVE ELDERLY NUTRITION AT LAWEYAN HOME FOR THE ELDERLY

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ABSTRAK

Program pengabdian masyarakat ini bertujuan untuk mengatasi permasalahan gizi pada lansia di Panti Wreda Dharma Bhakti Laweyan, Surakarta, melalui pengembangan Sistem Pendukung Keputusan (SPK) dengan Simple Additive Weighting (SAW). Sistem ini dirancang untuk membantu pengasuh dalam memilih menu makanan yang sesuai berdasarkan profil kesehatan individu, termasuk data demografis, riwayat penyakit, dan alergi. Aplikasi dikembangkan dalam bentuk web yang memungkinkan pengguna memasukkan data penghuni dan memperoleh rekomendasi makanan yang diprioritaskan sesuai kriteria gizi yang telah ditentukan. Algoritma SAW digunakan untuk memproses data multikriteria dan menghasilkan peringkat alternatif makanan secara efektif. Validasi empiris menunjukkan bahwa sistem mampu memberikan rekomendasi yang akurat dan personal, mendukung peningkatan kualitas gizi lansia. Pelatihan bagi pengasuh dan pendekatan partisipatif memastikan keberlanjutan penggunaan sistem. Kegiatan ini menunjukkan potensi integrasi teknologi pengambilan keputusan dengan layanan berbasis komunitas dalam meningkatkan manajemen gizi lansia di lingkungan institusional.

Kata kunci: Sistem Pendukung Keputusan, Simple Additive Weighting, Nutrisi Lansia, Pengabdian Masyarakat, Sistem Rekomendasi Makanan

ABSTRACT

This community engagement initiative addresses nutritional challenges among elderly residents at the Laweyan Home for the Elderly in Surakarta by developing a Decision Support System (DSS) utilizing the Simple Additive Weighting (SAW) method. The DSS was designed to assist caregivers in making informed meal selections based on individualized health profiles, including demographic data, medical conditions, and allergy history. Implemented as a web-based application, the system enables users to input resident data and receive prioritized dietary recommendations aligned with established nutritional criteria. The SAW algorithm processes multi-criteria input to rank food alternatives effectively. Empirical validation using real-world data demonstrated the system's capacity to generate accurate, personalized suggestions that support improved nutritional outcomes. Additionally, caregiver training and participatory implementation ensured practical usability and sustainability. This project highlights the potential of integrating algorithmic decision-making with community-based care to enhance the quality of elderly nutrition management in institutional settings.

Keywords: *Decision Support System, Simple Additive Weighting, Elderly Nutrition, Community Service, Meal Recommendation System*

INTRODUCTION

The global elderly population is steadily increasing, bringing numerous health and social challenges. One of the most pressing concerns in elderly care is the issue of proper nutrition [1]. As individuals age, their dietary needs change significantly, requiring careful attention to ensure optimal health and well-being. Malnutrition in older adults can lead to weakened immune systems, reduced muscle mass, cognitive decline, and increased susceptibility to disease.

In many nursing homes and elderly care facilities, maintaining an appropriate nutritional balance for residents is a continual challenge [2]. Factors such as dietary restrictions, loss of appetite, medication interactions, and individual preferences further complicate the meal planning process. Caregivers often face difficulties in selecting meals that meet both the nutritional and personal needs of elderly individuals, especially when working without systematic tools or structured guidance [3]; [4].

Technology offers promising solutions to these challenges. Decision Support Systems (DSS) have been widely adopted in various fields to facilitate complex decision-making processes by evaluating multiple criteria simultaneously [5];[6];[7]. DSS has proven particularly effective in improving the healthcare sector's diagnosis, treatment planning, and patient management. However, its application in elderly nutrition planning remains limited and underexplored, especially in community-based care.

The implementation of a DSS tailored for elderly nutrition has the potential to bridge the gap between dietary guidelines and practical meal planning in care facilities. By integrating algorithms that evaluate multiple food options against established nutritional standards, such systems can assist caregivers in selecting the most suitable meals for residents. This approach promotes healthier eating habits and enhances the overall quality of care in elderly institutions.

One of the most accessible and efficient decision-making methods is the Simple Additive Weighting (SAW) method. The SAW method assigns weights to criteria and ranks alternatives based on their performance [8]; [9]; [10] . In food selection, SAW can evaluate meal options based on nutritional value, taste preferences, availability, and cost. Its simplicity and effectiveness make it a practical choice for implementation in community-level interventions.

This community service project was initiated to address the nutritional challenges faced by residents at Laweyan Home for the Elderly in Surakarta, Central Java. The facility, officially known as Panti Wreda Dharma Bhakti Surakarta, has served as a vital care institution for the elderly, many of whom require specialized attention and consistent nutritional support. Observations and initial discussions with caregivers at the home revealed a need for structured assistance in daily meal planning.

This initiative introduced a Decision Support System utilizing the SAW method as a practical tool to support the food selection process at the Laweyan facility. The goal was to create a system that could identify the most appropriate meals for elderly residents based on weighted criteria aligned with their specific health and dietary needs. The project was designed not merely as a technological intervention, but as a participatory effort involving staff, caregivers, and community volunteers.

Data on everyday food items, nutritional content, and resident preferences were collected and analyzed early. Based on these data, the DSS was developed with a user-friendly interface and a logical flow that non-technical users could easily adopt. The SAW algorithm was embedded in the system to process input data and generate prioritized food options for each resident or meal plan [11]; [12]; [13] .

The intervention aimed to provide a technical solution and empower caregivers through training and engagement. As part of the community service framework, workshops and hands-on sessions were conducted with staff members to ensure the effective adoption and use of the system. This collaborative approach fostered a sense of ownership among caregivers and improved their confidence in using the system as part of their daily routine.

The Laweyan case exemplifies how technology and community participation can result in sustainable and impactful change in elderly care. Beyond immediate nutritional benefits, the DSS introduced a culture of informed decision-making and evidence-based practice at the facility. The residents benefited from more consistent and tailored meal options, while caregivers gained new skills in using digital tools to enhance service quality.

METHODOLOGY

This community service initiative employed a structured and academically grounded methodology to design and implement a Decision Support System (DSS) that enhances elderly nutrition at the Laweyan Home for the Elderly. The methodology comprised five key phases: requirement analysis, criteria formulation, data collection, system development using the Simple Additive Weighting (SAW) method, and empirical validation.

The requirement analysis phase began with field observations and interviews with caregivers and kitchen staff at Laweyan Home. These consultations revealed the absence of a systematic mechanism to personalize food choices according to each resident's health conditions, allergies, and age-related requirements. Caregivers often relied on general dietary practices, lacking structured tools to optimize nutrition. These findings underscore the need for a digital decision-making system grounded in health data.

The second phase involved formulating relevant criteria to guide food selection. These criteria were derived from established nutritional guidelines and contextual factors specific to the elderly. They included demographic attributes such as age and gender, medical considerations such as chronic illnesses (e.g., heart disease, stroke, hypertension), and common food allergies (e.g., shellfish, fish, duck). Table 1 presents the complete list of criteria and their corresponding weights, categorized by benefit and cost attributes.

The assigned weights in Table 1 were normalized to construct a consistent decision matrix for the SAW method. This normalization involved summing the total weights and computing proportional values for each criterion, forming the priority weight vector [14]; .

Table 1: Nutritional Selection Criteria and Weights

Criteria	Weight	Description
C1	3	Age 60–75
C2	3	Age 75–90
C3	2	Age >90
C4	4	Male
C5	3	Female
C6	5	Heart Disease
C7	4	Uric Acid
C8	4	Stroke
C9	3	Hypertension
C10	2	Shrimp Allergy
C11	3	Fish Allergy
C12	3	Shellfish Allergy
C13	3	Duck Allergy

The weight values assigned to each nutritional selection criterion are designed to reflect their relative importance in dietary decision-making for elderly care. These values guide the prioritization process in methods such as Simple Additive Weighting (SAW), ensuring that each factor is appropriately considered in relation to health and demographic needs.

A weight of 1 indicates very low relevance, meaning the criterion has minimal influence on dietary decisions. A weight of 2 reflects low relevance, with limited impact except in specific cases. A weight of 3 represents moderate relevance, where the factor is considered equal to others in the context of meal planning. A weight of 4 signifies high relevance, requiring careful attention due to its substantial impact on nutritional choices. Finally, a weight of 5 indicates critical relevance, meaning the criterion is essential and directly determines dietary restrictions or needs, especially in cases involving serious medical risks.

Data collection focused on identifying food alternatives commonly served at the facility and evaluating them against predetermined criteria. Each food item was rated based on expert input and institutional knowledge. Table 2 illustrates a sample of this rating process.

Table 2: Sample Rating Matrix of Food Alternatives

Criteria	White Rice	Red Rice	Corn	Mashed Rice
C1	3	3	2	2
C4	3	3	2	2
C6	2	3	3	2
C7	2	3	1	2
C11	2	2	2	2
C12	2	2	2	2

In the context of evaluating food alternatives for elderly residents, each item is assessed against a set of nutritional and health-related criteria using a rating scale of 1 to 3. These ratings represent how well a food alternative meets each criterion based on expert judgment and the institution's dietary priorities. A value of 1 indicates low suitability, meaning the food item poorly meets the nutritional or health-related requirement in question. This may include cases where the food contributes negatively to a resident's condition (e.g., a high glycemic index for diabetics or high purine content for individuals with uric acid sensitivity). A rating of 2 denotes moderate suitability, suggesting the food is generally acceptable but not optimal in addressing the criterion—it may be used occasionally or in moderation depending on individual needs.

A value of 3, on the other hand, indicates high suitability, where the food alternative strongly aligns with the desired nutritional or health-related criterion. Foods rated three are typically recommended due to their beneficial properties, such as being high in fiber, low in sugar, or appropriate for residents with specific health concerns. This rating system provides a structured basis for comparing and selecting food options, allowing caregivers and dietitians to make informed, individualized decisions while ensuring consistency across the evaluation process. It also supports the integration of multi-criteria decision-making methods, such as the SAW technique, by transforming qualitative judgments into quantitative scores.

The decision matrix was normalized using the SAW method based on the attribute type. For benefit criteria, normalization was achieved by dividing each value by the maximum in its column; for cost criteria, normalization involved dividing the minimum value by each entry. The resulting normalized matrix was then multiplied by the normalized weights, and the total scores were computed by summing the weighted values [15].

The following equations govern the normalization procedures:

- For benefit attributes: $r_{ij} = \frac{x_{ij}}{Max_i . x_{ij}}$
- For cost attributes: $r_{ij} = \frac{Min_i . x_{ij}}{. x_{ij}}$

The final score for each food alternative was computed as: $V_i = \sum_{j=1}^{n} W_j * r_{ij}$

Where:

- V_i denotes the final preference score for the alternative,
- W_j is the normalized weight of the criterion,
- r_{ij} is the normalized score of the alternative on the criterion.

The full operational flow of the SAW-based DSS is depicted in Figure 1, which outlines the stages from data entry and criteria selection through normalization, weighted aggregation, and ranked recommendation output.

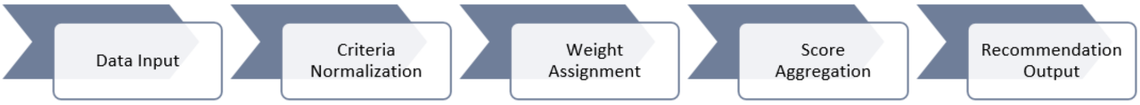

Figure 1: Flowchart of SAW-Based DSS Process

The system was implemented as a web-based application using PHP for server-side logic and MySQL for data storage. It incorporated user authentication, dynamic form interfaces, and an automated SAW computation engine. Admin users were authorized to modify criteria and food databases, while caregivers could input resident profiles and receive personalized nutritional recommendations.

To support end-user engagement and maintain system adaptability, the application included intuitive modules for updating weights, adding new food items, and revising allergy filters. The interaction flow followed a logical progression illustrated in Figure 2, which outlines the system's activity from user login to recommendation delivery.

Figure 2: Activity Diagram of User Interaction

Validation of the system was conducted using real data from the Laweyan Home. The analysis revealed that food alternatives, such as red rice and sweet potatoes, consistently ranked higher among residents with heart and metabolic conditions. Furthermore, allergy-based filtering successfully prevented unsuitable recommendations, enhancing the system's reliability and practical relevance.

RESULTS AND DISCUSSION.

The application offers an interactive interface that facilitates user input, supporting the generation of personalized recommendations. Figure 3 illustrates a page where users are prompted to fill out a calculation form. The form includes age, gender, medical history, and allergy history. Users must also specify the desired quantities for each relevant category. After completing all required inputs, they can click the "Display Results" button. The application will then automatically process the data and generate the corresponding output.

Figure 3. Form Interface for Inputting Personal and Preference Data

Table 3 presents a detailed profile of 46 elderly individuals residing in a faith-based nursing home in Surakarta. The age distribution shows that the largest group of residents falls within the 70–79 age range, accounting for 43.5% of the total population. This is followed by those aged 80 years and above, representing 30.4%, and the 60–69 age group, comprising 26.1%. In terms of gender, the population is predominantly female, making up 60.9%, while males account for the remaining 39.1%. This gender imbalance is consistent with broader demographic trends, as women generally have a longer life expectancy and are more likely to require long-term care in later life. The age and gender distribution provide essential context for understanding the specific needs and vulnerabilities of the residents.

Table 3. Demographic and Health Characteristics of Elderly Residents

Criteria	Category	Number (persons)	Percentage (%)
Age	60–69 years	12	26.1%
	70–79 years	20	43.5%
	≥80 years	14	30.4%
Gender	Male	18	39.1%
	Female	28	60.9%
Medical History	Hypertension	22	47.8%
	Diabetes Mellitus	10	21.7%
	Mild Stroke	5	10.9%
	No Serious Medical History	9	19.6%
Allergy History	Food Allergy (e.g., seafood)	3	6.5%
	Drug Allergy	2	4.3%
	Unknown	7	15.2%
	No Known Allergies	34	73.9%

Health-related data reveal that chronic conditions are prevalent among the elderly in this care setting. Nearly half of the residents (47.8%) are living with hypertension, while 21.7% have diabetes mellitus, and 10.9% have experienced mild stroke incidents. Interestingly, about 19.6% of the population report no significant medical history, suggesting a segment of relatively healthy older adults who may benefit from preventive care and active aging programs. In terms of allergies, the majority (73.9%) have no known allergies, while a small number report food allergies (6.5%) or drug allergies (4.3%), with 15.2% having unclear or unreported allergy information. This data highlights the importance of personalized health monitoring, medication management, and nutritional care to ensure the well-being of elderly residents in institutional care environments.

The evaluation focused on 14 food alternatives, which were rated across six prioritized criteria selected from the broader set defined in the methodology section: C1 (Age 60–75), C4 (Gender: Male), C6 (Heart Disease), C7 (Uric Acid), C11 (Fish Allergy), and C12 (Shellfish Allergy). These criteria were chosen based on their high normalized weights and relevance to dietary planning for elderly individuals with chronic conditions and allergy risks. The raw performance scores of all 14 food alternatives were compiled in a decision matrix. These values reflect the degree to which each food item satisfies each of the selected criteria. The matrix was directly extracted from the data shown in Table 2 of the methodology section and is reproduced here in Table 4.

Table 4: Raw Evaluation Matrix of 14 Food Alternatives

Alternative	C1	C4	C6	C7	C11	C12
A1 (White Rice)	3	3	2	2	2	2
A2 (Red Rice)	3	3	3	3	2	2
A3 (Corn)	2	2	3	1	2	2
A4 (Mashed Rice)	2	2	2	2	2	2
A5 (Potato)	3	2	3	3	2	2
A6 (Cassava)	3	3	3	3	2	2
A7 (Wheat)	2	3	3	3	2	2
A8 (Rice Porridge)	2	2	2	2	2	2
A9 (Steamed Bread)	3	3	2	2	2	2
A10 (Sweet Potato)	3	3	2	3	2	2
A11 (Sago)	2	2	2	2	2	2
A12 (Instant Noodle)	1	2	1	1	2	2
A13 (Sticky Rice)	3	2	2	2	2	2
A14 (Dry Bread)	2	2	1	1	2	2

The evaluation matrix was transformed using the normalization process prescribed by the Simple Additive Weighting (SAW) method. This step was essential to ensure that each criterion could be compared consistently regardless of its original unit or range. For the benefit-type criteria, such as C1 (Age 60–75), C6 (Heart Disease), and C7 (Uric Acid), normalization was performed by dividing each entry by the highest value found within its respective column. This approach emphasized the most favorable attributes by assigning higher scores to alternatives that were closer to the optimal value.

In contrast, for cost-type criteria—specifically C4 (Gender: Male), C11 (Fish Allergy), and C12 (Shellfish Allergy)—the normalization was done by dividing the lowest value in the column by each entry. This method helps prioritize alternatives with lower, more desirable scores for those criteria. The resulting normalized values from both groups were compiled and displayed in Table 5.

Table 5: Normalized Decision Matrix

Alternative	C1	C4	C6	C7	C11	C12
A1 (White Rice)	1.00	1.00	0.67	0.67	1.00	1.00
A2 (Red Rice)	1.00	1.00	1.00	1.00	1.00	1.00
A3 (Corn)	0.67	1.50	1.00	0.33	1.00	1.00
A4 (Mashed Rice)	0.67	1.50	0.67	0.67	1.00	1.00
A5 (Potato)	1.00	1.50	1.00	1.00	1.00	1.00
A6 (Cassava)	1.00	1.00	1.00	1.00	1.00	1.00
A7 (Wheat)	0.67	1.00	1.00	1.00	1.00	1.00
A8 (Rice Porridge)	0.67	1.50	0.67	0.67	1.00	1.00
A9 (Steamed Bread)	1.00	1.00	0.67	0.67	1.00	1.00
A10 (Sweet Potato)	1.00	1.00	0.67	1.00	1.00	1.00
A11 (Sago)	0.67	1.50	0.67	0.67	1.00	1.00
A12 (Instant Noodle)	0.33	1.50	0.33	0.33	1.00	1.00
A13 (Sticky Rice)	1.00	1.50	0.67	0.67	1.00	1.00
A14 (Dry Bread)	0.67	1.50	0.33	0.33	1.00	1.00

After obtaining the normalized matrix, the final scores for each food alternative were calculated by applying a set of predetermined weights: W = {0.1875, 0.125, 0.3125, 0.25, 0.065, 0.065}. These weights represent the relative importance of each criterion in the decision-making process.

Each alternative's normalized values were multiplied by the corresponding weights, and the results were summed to produce a total score for each option. This weighted summation method enabled the system to rank the food alternatives effectively based on their overall suitability. The complete ranking and scores are presented in Table 6.

Table 6: Final SAW Scores and Rankings

Alternative	Score	Rank
A5 (Potato)	1.000	1
A2 (Red Rice)	0.940	2
A6 (Cassava)	0.940	2
A13 (Sticky Rice)	0.860	4
A10 (Sweet Potato)	0.860	4
A7 (Wheat)	0.890	6
A3 (Corn)	0.830	7
A11 (Sago)	0.820	8
A4 (Mashed Rice)	0.820	8
A9 (Steamed Bread)	0.800	10
A1 (White Rice)	0.800	10
A8 (Rice Porridge)	0.820	12
A14 (Dry Bread)	0.680	13
A12 (Instant Noodle)	0.640	14

These results reflect the DSS's accuracy in ranking food alternatives based on their health suitability. The computation steps, from raw evaluation to final ranking, align with SAW methodology and confirm system validity. The outcomes also validate the application's alignment with nutritional priorities in elderly care.

CONCLUSION

The community service initiative conducted at Laweyan Home for the Elderly successfully demonstrated the practical benefits of integrating the Simple Additive Weighting (SAW) method within a Decision Support System (DSS) to address the complex issue of elderly nutrition. By developing a web-based application that considers individual health profiles, including age, medical conditions, and allergies, the system significantly enhanced the caregivers' ability to make informed, personalized dietary decisions. Empirical validation demonstrated that the DSS generated accurate and contextually relevant meal recommendations, leading to improved health outcomes for elderly residents.

This program addressed the immediate nutritional challenges and empowered caregivers through training and participatory involvement, ensuring sustainability and local ownership of the technology. The approach provides a replicable model for other elderly care facilities, highlighting the value of integrating algorithmic decision-making with community-based services. Future development may include expanding the food database, incorporating dynamic health monitoring, and evaluating long-term impacts on resident well-being.

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