Solar Energy Deployment for the Sustainable Future of Vietnam: Hybrid SWOC-FAHP-WASPAS Analysis

Nguyen Van Thanh 1,* and Nguyen Thi Kim Lan 2

1 Faculty of Commerce, Van Lang University, Ho Chi Minh City 70000, Vietnam
2 International Education Institute, Van Lang University, Ho Chi Minh City 70000, Vietnam; lan.ntk@vlu.edu.vn
* Correspondence: thanh.nguyenvan@vlu.edu.vn

Abstract: In recent years, solar power has developed significantly in Vietnam, making an important contribution to ensuring energy conservation and decreasing greenhouse gas exposure. Recently, Vietnam has experienced impressive growth in the solar and wind energy sectors, showing the high potential of using renewable electricity in addressing energy needs. The target of this study was to construct a fuzzy multicriteria decision-making model including strengths-weaknesses-opportunities-challenges (SWOC) analysis, the fuzzy analytic hierarchy process (F-AHP) model, and the weighted aggregates sum product assessment (WASPAS) model, to select the location of a solar power plant in south Vietnam. The proposed fuzzy multicriteria decision-making model (MCDM) model is the first solar power plant location selection in southern Vietnam that utilizes literature reviews and expert interviews. Moreover, this is the first study to provide a case study on evaluating locations during solar power plant location selection that utilizes a combination of the SWOC, FAHP, and WASPAS models. The findings of this study provide valuable knowledge for the assessment and selection of suitable locations for renewable energy projects, including both solar power energy projects and other renewable energy projects.

Keywords: fuzzy theory; MCDM model; solar energy; SFAHP; WASPAS

1. Introduction

Mekong Delta, Vietnam is facing significant increases in the demand for electricity because the demand for electricity for economic development is increasing more rapidly than the economic growth rate. Considering the problems of identifying appropriate electricity sources for the development of the country and the pressure to manage the environment, the Mekong Delta has recently placed environment-friendly power plants in continuous operation, typically solar power [1].

Located in the monsoon tropics, with the potential for massive solar energy, the Mekong Delta is entering a changing era of solar energy growth and utilization. Solar power plants and projects in the Mekong Delta are mostly concentrated in hot, dry, and high areas along the southwestern border, between Vietnam and Cambodia. This area has a stable climate and weather, and the number of hours of sunshine is much higher than in the wider region [1].

With the advantage of a region with mild weather and climate, a stable rainy season, and an average number of sunny hours a year of over 2600, the average daily solar radiation intensity in the north is nearly 6 kWh/m². Along with large-scale factory construction projects, various applications of technology to utilize solar energy to generate electricity have been encouraged and widely disseminated by the authorities for use in daily life and production throughout the provinces in the Mekong Delta region [2,3]. Map of the annual average daily global horizontal irradiation is shown in Figure 1.
The selection of locations for solar power plants that are sustainable and satisfy the strengths-weaknesses-opportunities-challenges (SWOC) analysis concepts is vital for the development of the country’s energy supply and to reduce environmental harm. Therefore, decision makers must consider both quantitative and qualitative factors.

In this study, two key processes were used to measure the performance level of each potential location. The weight of each criterion was initially computed by the fuzzy analytic hierarchy process (FAHP) approach. The relationships between the characteristics were explored in this manner to offer more realistic weights. The weighted aggregates sum product assessment (WASPAS) approach was deployed to determine the performance of each potential location in terms of the strengths-weaknesses-opportunities-challenges (SWOC) model.

An overview of the research contents and research goals is presented in the introduction section, and the basis for the formation of the research method is presented in the literature review section. The FAHP and WASPAS methods and case studies are introduced in Sections 3 and 4 of this article, respectively. The results and findings of this study are described in detail in the conclusion.

2. Literature Review

Researchers consider MCDM to be one of the most popular treaties in the literature. The term “MCDM” refers to the process of selecting the best option from a set of options. Many models have been used to show the decision-making procedure, some of which have used MCDM methods, which have been used separately or in combination with other MCDM methods and other strategies. Various studies have used MCDM models to solve complicated decision-making problems that involve multiple criteria. These models have been applied in various fields and sectors. In the field of supply chain management, MCDM models are regularly applied to solve problems, such as facility location selection [4–8], supplier performance evaluation [9–12], distribution channel development [13–15], etc. Among

Figure 1. Map of the annual average daily global horizontal irradiation.
these, supplier evaluation and selection processes, which involve multiple qualitative and quantitative criteria, are frequently supported by MCDM models.

Juan M. Sánchez-Lozano et al. [16] combined geographical information systems (GISs) and multi-criteria decision-making (MCDM) methods to assess the optimal photovoltaic solar power plant locations in southeast Spain. Devika Kannan et al. [17] introduced a hybrid model utilizing Monte Carlo simulation with MCDM procedures to choose solar power plant locations in east Iran.

Yeliz Simsek et al. [18] proposed a study that provides decision makers with a method for evaluating the sustainability of clean growth energy projects. Mehdi Jahangiri et al. [19] applied the fuzzy MCDM technique to determine the optimal location in Qatar for solar and wind energy plants to produce hydrogen and electricity power. Aleksandra Baczkiewicz et al. [20] present an approachable study based on two recently discovered multi-criteria decision-making (MCDM) methods: the characteristic objects method (COMET) combined with technique for order performance by similarity to ideal solution (TOPSIS) and stable preference ordering towards ideal solution (SPOTIS), which works as the baseline of a decision support system (DSS).

Chao-Rong Chen et al. [21] used a hybrid MCDM model, including decision-making trial and evaluation laboratory (DEMATEL) and DEMATEL-based analytic network process (DANP) based on geographical information systems (GISs), to improve the performance of solar farms. Pilar Díaz-Cuevas et al. [22] developed an integrated methodology using multi-criteria decision-making methods and geographical information systems to construct a renewable energy spatial planning model. Chia-Nan Wang et al. [23] used data envelopment analysis (DEA) and grey-based multiple criteria decision-making (G-MCDM) for site selection for solar energy. Murugaperumal Krishnamoorthy et al. [24] used two concepts to determine answers to questions related to micro-grid systems. As a result, the economic factor includes the total net present cost, and the cost of energy was found to be the lowest.

From this literature review, MCDM is the optimal technique for applications in complex situations that include multiple criteria and conflicting goals. This tool has received attention in the renewable energy industry because of its flexibility for decision-makers in multiple problems, such as project and location selection. Thus, in this study, we propose a fuzzy MCDM model for solar plant location selection.

3. Methodology

3.1. Fuzzy Analytic Hierarchy Process

The fuzzy AHP model implementation is divided into four steps, which are as follows [25–30]:

Step 1: Constructing the fuzzy AHP model.
Step 2: Constructing the pairwise comparison matrix.

Using fuzzy numbers, a pairwise comparison matrix is produced. The matrix is as follows:

\[
\tilde{A}^k = \begin{bmatrix}
\tilde{a}_{11} & \tilde{a}_{12} & \cdots & \tilde{a}_{1n} \\
\tilde{a}_{21} & \tilde{a}_{22} & \cdots & \tilde{a}_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
\tilde{a}_{n1} & \tilde{a}_{n2} & \cdots & \tilde{a}_{nn}
\end{bmatrix}
\]  

(1)

where:

- \( \tilde{A}^k \) is the fuzzy element pairwise comparison matrix.
- \( \tilde{a}_{kn} \) is the triangular fuzzy mean value when comparing the pair of priority between the items.

To convert fuzzy numbers to real numbers, the triangular fuzzy trigonometric technique is used as follows [31]:

\[
t_{a,\beta}(\tilde{x}_{ij}) = [\beta \cdot f_{\alpha}(L_{ij}) + (1 - \beta) \cdot f_{\alpha}(U_{ij})]
\]

(2)
With: $0 \leq \beta \leq 1$, $0 \leq \alpha \leq 1$

where:

$$f_\alpha (L_{ij}) = (M_{ij} - L_{ij}) + L_{ij}$$  \hspace{1cm} (3)

$$f_\alpha (U_{ij}) = U_{ij} - (U_{ij} - M_{ij}) \cdot \alpha$$  \hspace{1cm} (4)

When the diagonal matrix is matched, we obtain:

$$t_{\alpha, \beta} (\pi_{ij}) = \frac{1}{t_{\alpha, \beta} (\pi_{ij})}$$  \hspace{1cm} (5)

With: $0 \leq \beta \leq 1$, $0 \leq \alpha \leq 1$, $i > j$.

We obtain a comparison matrix with the elements as real numbers after performing the conversion method to obtain the fuzzy comparison matrix. This matrix is made up of $n$ lines and $n$ columns ($n$ is the number of indicators). The matrix’s components represent the relative relevance of the indicator I vs. the column criteria:

$$A = (m_{ij})_{n \times n} = \begin{bmatrix} 1 & m_{12} & \ldots & m_{1n} \\ m_{21} & 1 & \ldots & m_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ m_{n1} & m_{n2} & \ldots & 1 \end{bmatrix}$$  \hspace{1cm} (6)

The scale fuzzy conversion scale established by Kuswandati [32] is used to evaluate the priority in the FAHP model.

**Step 3:** Determine the highest possible individual value.

The Lambda Max technique, developed by Saaty [33], is used to compute the maximum particular value of the indicator:

$$|A - \lambda_{\text{max}} I| = 0$$  \hspace{1cm} (7)

where:

$\lambda_{\text{max}}$ as the matrix’s maximum value.

$A$ as the matrix of pairwise comparisons.

$I$ is the same level unit matrix as matrix $A$.

**Step 4:** Check for consistency.

Saaty utilized the consistency ratio (CR) after computing the maximum individual value of the consistency index (CI). This ratio balances the degree of consistency with the data’s (random) objectivity:

$$CR = \frac{CI}{RI}$$  \hspace{1cm} (8)

where CI represents the CI and RI represents the random index.

If $CR \leq 0.1$, the fuzzy AHP model is adequate; otherwise, the pairwise comparison matrix must be re-evaluated:

$$CI = \frac{\lambda_{\text{max}} - n}{n - 1}$$  \hspace{1cm} (9)

where:

$\lambda_{\text{max}}$ is the matrix’s maximum value

$n$ is the proportion to the number of indicators.

Saaty examined the production of random matrices for each n-level comparison matrix and determined the RI according to the number of indications.

### 3.2. The Weighted Aggregates Sum Product Assessment (WASPAS)

When faced with a decision-making challenge, MCDM approaches, such as the weighted product model (WPM) and the weighted sum model (WSM), are commonly used to determine the optimal choice. WASPAS, a mixture of the aforementioned methods,
is one of the most recent methods that can improve the accuracy in selecting the best alternative [34]. According to the study, the WASPAS approach is more accurate than the WPM and WSM methods.

In recent years, the WASPAS approach has been used in a variety of applications. Bagocius et al. [35] examined the WASPAS approach in conjunction with entropy methods in order to establish an ideal site for a deep-water port in Europe. Turkis et al. [36] used a combination technique of fuzzy WASPAS and fuzzy AHP to identify a site for a retail center location owing to the intricacy of the problem. As a result of the preceding investigations, the WASPAS approach and its accuracy are employed for this study of risk qualitative analysis (RQA), as indicated below [36]:

1. \( X = [x_{ij}]_{q \times r} \) is used to create a decision matrix, where \( x_{ij} \) is the performance of the \( i \)th option with regard to the \( j \)th criterion, \( q \) denotes the number of alternatives, and \( r \) denotes the number of criteria.

2. The following two equations are used to normalize the decision matrix:
   Criteria for maximizing:
   \[
   \overline{x}_{ij} = \frac{x_{ij}}{\max_i x_{ij}}
   \]  
   (10)

   Criteria for minimizing:
   \[
   \overline{x}_{ij} = \frac{\min_i x_{ij}}{x_{ij}}
   \]  
   (11)

3. The following equation is used to determine the significance of the \( i \)th alternative:
   \[
   Q_i^{(1)} = \sum_{j=1}^{n} \overline{x}_{ij} w_j
   \]  
   (12)

   where \( W_j \) represents the weight (relative significance) of the \( j \)th criteria.

4. The overall significance of the \( i \)th choice is then determined using the following equation:
   \[
   Q_i^{(2)} = \prod_{j=1}^{n} \left( \overline{x}_{ij} \right)^{w_j}
   \]  
   (13)

5. The two WSM and WPM approaches are then blended using the joint additive based on the following equation:
   \[
   Q_i = 0.5 Q_i^{(1)} + 0.5 Q_i^{(2)}
   \]  
   (14)

6. The following equation defines a more generalized equation for estimating the importance using the WASPAS method:
   \[
   Q_i = \lambda \sum_{j=1}^{n} \overline{x}_{ij} w_j + (1 - \lambda) \prod_{j=1}^{n} \left( \overline{x}_{ij} \right)^{w_j}, \ \lambda = 0, \ldots, 1
   \]  
   (15)

7. The following equation is used to obtain the optimum values:
   \[
   \lambda = \frac{\sigma^2 \left( Q_i^{(2)} \right)}{\sigma^2 \left( Q_i^{(1)} \right) + \sigma^2 \left( Q_i^{(2)} \right)}
   \]  
   (16)

   The variances \( \sigma^2 \left( Q_i^{(1)} \right) \) and \( \sigma^2 \left( Q_i^{(2)} \right) \) are calculated by the following equations:
   \[
   \sigma^2 \left( Q_i^{(1)} \right) = \sum_{j=1}^{n} W_j \sigma^2 \left( \overline{x}_{ij} \right) \overline{x}_{ij}
   \]  
   (17)
8. The normalized variance estimates for the first criterion values are derived as follows:

\[ \sigma^2(Q_i^{(1)}) = \sum_{j=1}^{n} \left( \frac{\prod_{j=1}^{n} (X_{ij})^{w_j}}{X_{ij}^{w_j}} \right)^2 \sigma^2(X_{ij}) \]  

(18)

4. Case Study

With a lot of potential for renewable energy development, the Mekong Delta region is witnessing strong development of renewable power sources, especially wind and solar energy [37].

In this study, an F-MCDM model was utilized, including strengths-weaknesses-opportunities-challenges (SWOC) analysis, the fuzzy analytic hierarchy process (F-AHP) model, and the weighted aggregates sum product assessment (WASPAS) model, for plant location selection to provide solar energy in the south of Vietnam. In the initial stage of this study, all criteria were defined using SWOC analysis, experts, and a literature review. The fuzzy AHP structure of this study is shown in Figure 2.

The Mekong Delta has a monsoon climate with two seasons: hot and rainy seasons. Every year, the region receives an average of 2200–2500 sunshine hours, with an average daily solar radiation energy of 4.3–4.9 kWh/m². This clearly indicates the potential for light energy conversion. It is estimated that for every 1m² of solar panels, 5 kWh can be converted each day. This light source is very consistent, with more than 90% of the days of each year receiving an adequate amount of sunlight for the solar panels to maintain operations [38]. According to experts, there are eight locations (SP) with many favorable conditions for the development of solar energy. Information about these locations is presented in Figure 3 and Table 1.

Figure 2. Fuzzy AHP structure of the study.
Table 1. Eight potential locations for solar power plant investment.

| No. | Name                        | Symbol |
|-----|-----------------------------|--------|
| 1   | Long Xuyen, An Giang        | SP01   |
| 2   | Can Tho                     | SP02   |
| 3   | My Tho, Tien Giang          | SP03   |
| 4   | Rach Gia, Kien Giang        | SP04   |
| 5   | Vi Thanh, Hau Giang         | SP05   |
| 6   | Soc Trang                   | SP06   |
| 7   | Bac Lieu                    | SP07   |
| 8   | Ca Mau                      | SP08   |

In the multi-criteria decision-making model, the weight of the criteria significantly affects the model’s results. In this study, the FAHP model was applied to determine the weights of the criteria, all input data were evaluated by experts, and the result of the FAHP model was checked using the consistency ratio (CR) and consistency index (CI). The results are shown in Table 2.

In the final stage, the weighted aggregates sum product assessment (WASPAS) approach was employed to calculate the performance of each potential location in terms of the strengths-weaknesses-opportunities-challenges (SWOC) model. A result of WASPAS model is shown in Tables 3–6.

In this study, an MCDM-based approach was developed for the selection of locations for solar power plants in an uncertain decision-making environment. The selection criteria were ensured to satisfy the SWOC framework, where strengths, weaknesses, opportunities, and challenges criteria were considered. The proposed method employed FAHP to calculate the criteria weights and the WASPAS method to determine the performance score and ranking of potential locations in Mekong Delta Vietnam. As shown in Figure 4, SP01 (Long Xuyen, An Giang) is the optimal location in this study.
### Table 2. The weight of all criteria.

| Criteria | Fuzzy Sum of Each Row | Fuzzy Synthetic Extent | Degree of Possibility (Mi) | Normalization |
|----------|-----------------------|------------------------|-----------------------------|---------------|
| PP01     | 7.71623               | 10.35757               | 13.91593                    | 0.03624       |
| PP02     | 12.57650              | 17.28859               | 23.04919                    | 0.05906       |
| PP03     | 13.33665              | 18.45393               | 24.78691                    | 0.06263       |
| PP04     | 10.21413              | 13.82923               | 18.11561                    | 0.04797       |
| PP05     | 13.59007              | 17.57221               | 22.04919                    | 0.06263       |
| PP06     | 7.16564               | 9.43127                | 12.91733                    | 0.03365       |
| PP07     | 7.85250               | 10.27648               | 13.71735                    | 0.03688       |
| PP08     | 9.63003               | 12.86083               | 16.87061                    | 0.04522       |
| PP09     | 10.20564              | 13.18943               | 18.50159                    | 0.04793       |
| PP10     | 8.39975               | 11.30355               | 15.47744                    | 0.03945       |
| PP11     | 8.04400               | 10.68611               | 14.53630                    | 0.03778       |
| PP12     | 10.12401              | 13.99897               | 19.01034                    | 0.04754       |

### Table 3. Normalized matrix.

|       | SP01 | SP02 | SP03 | SP04 | SP05 | SP06 | SP07 | SP08 |
|-------|------|------|------|------|------|------|------|------|
| PP01  | 1.0000 | 0.9000 | 0.8000 | 0.7000 | 0.6000 | 0.9000 | 1.0000 | 0.6000 |
| PP02  | 1.0000 | 0.9000 | 0.8000 | 0.8000 | 0.6000 | 0.8000 | 0.7000 | 0.8000 |
| PP03  | 0.8889 | 0.7778 | 1.0000 | 0.8889 | 0.8889 | 0.8889 | 1.0000 | 0.8889 |
| PP04  | 0.7000 | 0.9000 | 0.9000 | 0.9000 | 0.9000 | 0.9000 | 0.9000 | 0.9000 |
| PP05  | 1.0000 | 0.7778 | 0.6667 | 1.0000 | 0.8889 | 1.0000 | 0.8889 | 1.0000 |
| PP06  | 0.8889 | 0.7778 | 0.7778 | 0.8889 | 0.8889 | 0.8889 | 1.0000 | 0.8889 |
| PP07  | 1.0000 | 0.6667 | 0.7778 | 0.7778 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| PP08  | 0.7778 | 0.8889 | 0.8889 | 1.0000 | 0.8889 | 0.7778 | 0.7778 | 0.7778 |
| PP09  | 1.0000 | 0.7778 | 0.6667 | 0.8889 | 0.8889 | 0.8889 | 0.7778 | 0.7778 |
| PP10  | 0.8889 | 0.6667 | 0.7778 | 0.6667 | 0.8889 | 0.6667 | 0.7778 | 0.7778 |
| PP11  | 1.0000 | 0.6667 | 0.7778 | 0.6667 | 0.8889 | 0.6667 | 0.7778 | 0.6667 |
| PP12  | 0.6667 | 0.7778 | 0.8889 | 1.0000 | 0.8889 | 0.7778 | 1.0000 | 1.0000 |

### Table 4. Weighted normalized matrix.

|       | SP01 | SP02 | SP03 | SP04 | SP05 | SP06 | SP07 | SP08 |
|-------|------|------|------|------|------|------|------|------|
| PP01  | 0.0605 | 0.0545 | 0.0484 | 0.0424 | 0.0363 | 0.0545 | 0.0605 | 0.0363 |
| PP02  | 0.1112 | 0.1001 | 0.0889 | 0.0889 | 0.0889 | 0.0667 | 0.0778 | 0.0889 |
| PP03  | 0.1061 | 0.0929 | 0.1194 | 0.1061 | 0.1061 | 0.1194 | 0.0929 | 0.0976 |
| PP04  | 0.0620 | 0.0797 | 0.0797 | 0.0708 | 0.0797 | 0.0797 | 0.0708 | 0.0797 |
| PP05  | 0.1122 | 0.0872 | 0.0748 | 0.1122 | 0.0997 | 0.1122 | 0.0997 | 0.1122 |
| PP06  | 0.0466 | 0.0408 | 0.0408 | 0.0466 | 0.0466 | 0.0525 | 0.0466 | 0.0466 |
| PP07  | 0.0593 | 0.0396 | 0.0461 | 0.0461 | 0.0593 | 0.0593 | 0.0593 | 0.0593 |
| PP08  | 0.0631 | 0.0722 | 0.0722 | 0.0812 | 0.0812 | 0.0722 | 0.0631 | 0.0812 |
| PP09  | 0.0893 | 0.0695 | 0.0595 | 0.0794 | 0.0794 | 0.0794 | 0.0695 | 0.0893 |
| PP10  | 0.0626 | 0.0469 | 0.0548 | 0.0626 | 0.0704 | 0.0548 | 0.0626 | 0.0548 |
| PP11  | 0.0644 | 0.0429 | 0.0501 | 0.0429 | 0.0573 | 0.0501 | 0.0644 | 0.0573 |
| PP12  | 0.0607 | 0.0709 | 0.0810 | 0.0911 | 0.0810 | 0.0709 | 0.0911 | 0.0911 |

### Table 5. Exponentially weighted matrix.

|       | SP01 | SP02 | SP03 | SP04 | SP05 | SP06 | SP07 | SP08 |
|-------|------|------|------|------|------|------|------|------|
| PP01  | 1.0000 | 0.9936 | 0.9866 | 0.9786 | 0.9696 | 0.9936 | 1.0000 | 0.9936 |
| PP02  | 1.0000 | 0.9884 | 0.9755 | 0.9755 | 0.9448 | 0.9611 | 0.9755 | 0.9884 |
| PP03  | 0.9860 | 0.9704 | 1.0000 | 0.9860 | 0.9860 | 1.0000 | 0.9704 | 0.9527 |
| PP04  | 0.9689 | 0.9907 | 0.9907 | 0.9804 | 0.9907 | 0.9804 | 1.0000 | 0.9907 |
Table 5. Cont.

|    | SP01   | SP02   | SP03   | SP04   | SP05   | SP06   | SP07   | SP08   |
|----|--------|--------|--------|--------|--------|--------|--------|--------|
| PP05| 1.0000 | 0.9722 | 0.9555 | 1.0000 | 0.9869 | 1.0000 | 0.9869 | 1.0000 |
| PP06| 0.9938 | 0.9869 | 0.9869 | 0.9938 | 1.0000 | 1.0000 | 0.9938 | 0.9938 |
| PP07| 1.0000 | 0.9762 | 0.9852 | 0.9852 | 1.0000 | 1.0000 | 0.9895 | 0.9895 |
| PP08| 0.9798 | 0.9905 | 0.9825 | 0.9917 | 1.0000 | 0.9825 | 0.9924 | 0.9825 |
| PP09| 1.0000 | 0.9778 | 0.9644 | 0.9895 | 0.9895 | 0.9778 | 1.0000 | 0.9924 |
| PP10| 0.9917 | 0.9719 | 0.9825 | 0.9917 | 1.0000 | 0.9825 | 0.9917 | 0.9825 |
| PP11| 1.0000 | 0.9742 | 0.9839 | 0.9742 | 1.0000 | 0.9839 | 1.0000 | 0.9924 |
| PP12| 0.9637 | 0.9774 | 0.9893 | 1.0000 | 0.9893 | 0.9774 | 1.0000 | 1.0000 |

Table 6. Final ranking score.

| Alternatives | Qi1   | Qi2   | Qi   | Ranking |
|--------------|-------|-------|------|---------|
| SP01         | 0.8981| 0.8892| 0.8937| 1       |
| SP02         | 0.7970| 0.7926| 0.7948| 8       |
| SP03         | 0.8157| 0.8093| 0.8125| 7       |
| SP04         | 0.8704| 0.8640| 0.8672| 5       |
| SP05         | 0.8637| 0.8637| 0.8637| 6       |
| SP06         | 0.8737| 0.8737| 0.8737| 4       |
| SP07         | 0.8806| 0.8806| 0.8806| 3       |
| SP08         | 0.8874| 0.8874| 0.8874| 2       |

Figure 4. Ranking list from the WASPAS model.

5. Conclusions

The Mekong Delta is a very favorable place for the development of an energy industry cluster, especially solar energy, with an average radiation of 1387–1534 Kwh/KWp/year. The solar energy sector plays an important role in the development of the country’s energy power and mitigation of environmental harms. In addition to the advantage of being one of the countries that experiences the most sunshine hours each year on the world solar radiation map, the government’s preferential policies have created creating an impetus for solar power in Vietnam.

The MCDM model has been applied in many fields of engineering and science, but few works have used it for solar plant location selection under fuzzy environment conditions. In this study, two key processes were used to measure the performance level of each potential location.
location. The weight of each criterion was computed in the first stage using the fuzzy analytic hierarchy process (FAHP) approach. The relationships between the characteristics were explored in this manner to offer more realistic weights. The weighted aggregates sum product assessment (WASPAS) approach was employed to calculate the performance of each potential location in terms of the strengths-weaknesses-opportunities-challenges (SWOC) model. The findings suggest that Long Xuyen, An Giang (SP01) is the most suitable location with a ranking score of 0.8937. The significant findings are explained as follows:

✓ The first hybrid framework for location evaluation and selection in Vietnam that uses SWOC analysis.
✓ The first study with the assistance of a case study that utilizes SWOC analysis, FAHP, and WASPAS together.
✓ The results of this study serve as a suitable calculation method for evaluating and selecting optimal locations for solar power plants, for both solar energy projects in Mekong Delta and globally.

For future research, the proposed model can be combined with other decision-making support model, such as TOFSIS and DEA, to determine the optimal locations for renewable energy projects.

Author Contributions: Conceptualization, N.V.T. and N.T.K.L.; Data curation, N.V.T. and N.T.K.L.; Formal analysis, N.V.T. and N.T.K.L.; Funding acquisition, N.V.T.; Investigation, N.T.K.L.; Methodology, N.V.T. and N.T.K.L.; Project administration, N.V.T.; Resources, N.V.T. and N.T.K.L.; Supervision, N.V.T.; Validation, N.V.T.; Writing—original draft, N.V.T.; Writing—review and editing, N.T.K.L. All authors have read and agreed to the published version of the manuscript.

Funding: The authors wish to express their gratitude to Van Lang University, Vietnam for financial support for this research.

Acknowledgments: The authors wish to express their gratitude to Van Lang University, Vietnam for support for this research.

Conflicts of Interest: The authors declare no conflict of interest.

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