

Cooperative Customer Loan Eligibility Assessment System Using The Weighted Product (WP) Method

Mas'ud Hermansyah^{1*}, Nur Andita Prasetyo², M Faiz Firdausi³, Iqbal Sabilirasyad⁴,
Agung Muliawan⁵

¹Politeknik Negeri Jember, Jember, Indonesia

^{2,3,4,5}Institut Teknologi dan Sains Mandala, Jember, Indonesia

Corresponding Author:

Mas'ud Hermansyah, Politeknik Negeri Jember, Jl. Mastrip, Krajan Timur, Sumbersari, Kec. Sumbersari, Kabupaten Jember, Jawa Timur 68121, Indonesia
Email: mas_udhermansyah@polije.ac.id

Abstract

The loan eligibility assessment model is an important aspect in cooperative financial management to ensure that loans are given to customers who truly meet the requirements and are able to fulfill repayment obligations. This research aims to develop a decision support model using the Weighted Product (WP) method in assessing the suitability of cooperative customers. The WP method was chosen because of its ability to integrate various criteria with certain weights, thereby enabling a more objective, transparent and structured assessment process. The criteria used in this research include length of cooperative membership, compliance with paying deposits, loan payment records, savings history, total monthly income, ratio of income to installments, and value of collateral for loans. Alternative customer data is analyzed using the WP method to produce a final score that represents the eligibility level of each customer. The research results show that this model is effective in helping cooperatives identify customers who are worthy of receiving loans based on a combination of predetermined criteria and weights. Implementing the WP method is also able to minimize the risk of bad credit by prioritizing customers with a low risk profile. Thus, it is hoped that this model can become a reliable tool in supporting decision making in cooperatives, as well as increasing efficiency and accuracy in the loan granting process.

Keywords : Cooperative, Weighted Product. Criteria, Alternatives

1 INTRODUCTION

Cooperatives are a financial institution that has an important role in supporting the community's economy, especially in rural areas [1]. In Sumberejo Village, Ambulu District, Jember Regency, the Mekarsari Cooperative is an institution that contributes to providing financial services, including loans to support the needs of the community, the majority of whom work as farmers and traders. With economic conditions that are largely dependent on agricultural products and trade, loan services from cooperatives are one of the main solutions in helping people develop their businesses and meet their financial needs. [2]. However, challenges in providing cooperative loans often arise, especially in terms of assessing customer eligibility. Assessments carried out manually are often ineffective, take a long time, and have the potential to cause bias, thus hindering correct decision making [3]. Therefore, a model is needed that is able to provide recommendations for assessing customer suitability objectively and efficiently, one of which is by implementing a Decision Support System (DSS).

The Decision Support System (DSS) is an approach model designed to support decision making by analyzing data systematically [4]. In its implementation, there are various methods that can be used, including Simple Additive Weighting (SAW), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), and Weighted Product (WP). Simple Additive Weighting (SAW) works by adding up normalized criteria values based on certain weights. This method is known to be simple and easy to apply, but has limitations in handling cases with many criteria or a high level of complexity [5]. Different from SAW, Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) uses a geometric distance calculation approach by measuring the closeness of alternatives to positive and negative ideal solutions. TOPSIS provides more in-

depth and accurate analysis, but requires more calculation steps than other methods [6]. Meanwhile, Weighted Product (WP), which is the focus of this research, offers flexibility and better capabilities in handling cases with many criteria. WP works using the principle of multiplying the weights for each criterion, resulting in a more proportional and structured assessment [7]. In addition, compared to TOPSIS, the WP method has the advantage of a simpler calculation process, making it more efficient to apply in certain contexts.

Previous research shows the success of the Weighted Product (WP) method in various cases and its application in various fields. For example, research conducted by [8] used the WP method to model loan recommendations to cooperative X customers. The results of this research showed that WP was able to provide appropriate results in assessing credit worthiness. Another study by [9] implemented the WP method for providing cooperative loans to residents of Pal 30 Village. This research proves that WP can help the decision-making process become more efficient. Furthermore, research by [10] using the WP method in providing cooperative credit to customers. The results of this research show that the WP method is able to produce models that can increase objectivity and efficiency in decision making, especially in the financial sector. Thus, it is hoped that this research can make a practical contribution in optimizing the loan appraisal process and increase scientific insight in the field of SPK based on the WP method.

2 RESEARCH METHOD

2.1 Framework

The research framework includes several stages designed to achieve the research objectives. This stage is related to feasibility analysis as a basis for decision making in providing credit to cooperative members. The following is a framework that supports the implementation of applications using the Weighted Product (WP) method, which will be presented in Figure 1 below:

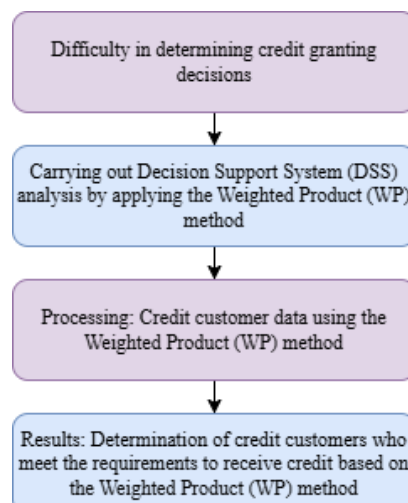


Figure 1. Framework of Thought

- a. The initial stage of research begins with identifying the problems faced by cooperatives in determining customers who are worthy of receiving credit. This difficulty usually arises due to various criteria that must be considered. Without a structured approach, decision making is often less objective and takes longer. Therefore, modeling is needed that can help manage data and provide accurate decisions.
- b. Once the problem is identified, the next step is to choose an appropriate method to support the decision-making process. In this research, the Weighted Product (WP) method is used because it has the advantage of handling many criteria by giving weight to each criterion according to its level of importance. The WP method allows for more structured and proportional analysis, thereby providing more objective results in evaluating credit customers.
- c. At this stage, the credit customer data that has been collected will be processed using the WP method. This process involves normalizing the data to eliminate unit differences between criteria, assigning weights to each criterion based on their level of importance, and calculating the final score for each

customer. The result of this processing is an alternative ranking based on the credit worthiness of each customer.

- d. The final stage is the interpretation of the calculation results. Based on the final score obtained from the WP method, customers with the highest scores are considered the most worthy of receiving credit. This system helps cooperatives make decisions more quickly, accurately and transparently, thereby supporting efficiency in the decision-making process.

2.2 Metode Weighted Product (WP)

The Weighted Product (WP) method is a method in the Decision Support System (DSS) which uses a comparison technique between alternatives based on certain criteria by multiplying the weight of each criterion. WP is one of the methods used to solve Multi Attribute Decision Making (MADM) problems [11]. In this method, each criterion is given a weight according to its level of importance, and alternative values are normalized first. The assessment process is carried out by calculating the product of the criteria values that have been raised to the power by their weights, thus producing a final score for each alternative. The alternative with the highest score is considered the best choice. The WPM method uses multiplication to connect attribute ratings, where the rating of each attribute must first be raised to the power of the weight of the attribute in question. The process here is the same as the normalization process. Preference for alternative A_i , use equation (1).

$$S_i = \prod_j^n = 1X_{ij}^{w_j} \quad (1)$$

Relative preferences for each alternative use equation (2).

$$V_i = \frac{n_j^n = 1X_{ij}^{w_j}}{n_j^n = 1(x_j^*)^{w_j}} \quad (2)$$

The steps in the WP method are as follows:

- a. Determine the criteria that will be used as a reference in decision making in equation (3).

$$C_j, j = 1, 2, 3, \dots, n \quad (3)$$
- b. Determine the initial weight for each criterion. The initial weight value (w) is used to indicate the relative importance of each criterion.
- c. Determine the vector value (S).
- d. Determine the vector value (V).

In the Weighted Product (WP) method, costs and benefits refer to two types of criteria that are often used in decision making, depending on the nature of the criteria faced.

- a. Cost: Criteria included in the "cost" category are criteria where the smaller the value is considered the better. Usually, these criteria are related to costs or things that need to be minimized, such as loan fees, interest, or distance. In WP, criteria with the "cost" property will be calculated using an inverse value, where the smaller the value associated with the criterion, the better the result.
- b. Benefit: On the other hand, criteria included in the "benefit" category are criteria where the greater the value is considered to be the better. Examples of these criteria are income, collateral value, or a higher credit score. In WP, the "benefit" criterion will be calculated directly, without the need for inversion, because the greater the value of the criterion, the better the results.

In general, WP treats the "benefit" and "cost" criteria in different ways in the calculation process, and they are combined to produce a final ranking of alternatives that can be used for decision making.

3 RESULTS AND ANALYSIS

The Weighted Product (WP) method requires criteria and weights as a basis for the calculation process. From the results of the analysis carried out, a number of criteria were obtained along with the value weights for each criterion which will be used to support decision making in determining the appropriate credit grant to members. The criteria based on the assessment attributes used in the calculations can be seen in Table 1 below:

Table 1. Criteria and Attributes

Criteria Code	Criteria	Information
C1	Length of Cooperative Membership	Benefit
C2	Compliance Paying Deposits	Benefit

C3	Loan Payment Records	Benefit
C4	Savings History	Benefit
C5	Total Monthly Income	Cost
C6	Income to Installment Ratio	Benefit
C7	Collateral Value for Loans	Benefit

The following is a brief explanation for each criteria for providing loans to cooperative customers:

- a. Length of Cooperative Membership
Assess how long the customer has been a member of the cooperative. A longer membership period shows customer loyalty and stability in the cooperative.
- b. Compliance Paying Deposits
Assess the extent to which customers are disciplined in paying routine deposits. This compliance shows the customer's responsibility in fulfilling their obligations as members of the cooperative.
- c. Loan Payment Records
Assess the extent to which customers have a good loan payment record. Payment on time or without arrears indicates a customer who can be relied on in managing loans.
- d. Savings History
Assessing customer consistency in saving at the cooperative. A good savings history shows the customer's commitment to utilizing cooperative services wisely.
- e. Total Monthly Income
Assess the customer's income level which can affect their ability to repay the loan. Sufficient income shows financial ability to pay installments.
- f. Income to Installment Ratio
Assess the proportion of income used to pay loan installments. A smaller ratio indicates better financial ability to pay off loans without interfering with other needs.
- g. Collateral Value for Loans
Assess the value of the collateral provided by the customer compared to the loan amount. Higher value collateral provides more security for cooperatives in providing loans.

The importance weight values that will be used for the calculation are in Table 2 below:

Information	Value Weight
Low	1
Enough	2
High	3

The importance weight value refers to the number or value given to indicate the level of importance or priority of a criterion or factor compared to other criteria or factors in the decision making process.

The representation weight values for each criterion are as shown in Table 3 below:

Criteria Code	Criteria	Information
C1	Length of Cooperative Membership	1,0
C2	Compliance Paying Deposits	1,5
C3	Loan Payment Records	1,0
C4	Savings History	0,5
C5	Total Monthly Income	2,5
C6	Income to Installment Ratio	1,5
C7	Collateral Value for Loans	2,0

The distribution of weights is appropriate for the criteria in Table 3, with the total weights adding up to 10. These weights are based on an assessment of the importance of each criterion in providing loans to cooperative customers from the leadership of the cooperative.

Next, determine the importance value of each existing criterion which will be displayed in the following data tables:

Table 4. Weight Values for Criteria for Length of Cooperative Membership (C1)

Information	Weight
< 1 year	1
1 – 3 year	2
> 3 year	3

Table 5. Weight Value of Compliance Criteria for Paying Deposits (C2)

Information	Weight
Never pay	1
Late several times	2
On time	3

Table 6. Criteria Weight Values for Loan Payment Notes (C3)

Information	Weight
There are active arrears	1
Late several times	2
Always on time	3

Table 7. Weight Value of Savings History Criteria (C4)

Information	Weight
Never save	1
Sometimes saving	2
Save regularly	3

Table 8. Criteria Weight Values Amount of Monthly Income (C5)

Information	Weight
< Rp 1 juta	1
Rp 1 juta – Rp 3 juta	2
> Rp 3 juta	3

Table 9. Criteria Weight Values for Income to Installment Ratio (C6)

Information	Bobot
< 30% of income	1
30% – 50% of income	2
> 50% of income	3

Table 10. Criteria Weight Value of Collateral Value for Loans (C7)

Information	Bobot
< 50% of the loan value	1
50% – 100% of the loan value	2
100% of the loan value	3

The value of each criterion and alternative in Table 11 follows:

Table 11. Alternative Values Based on Criteria

Alternative	Criteria						
	C1	C2	C3	C4	C5	C6	C7
A1	< 1 year	On time	Always on time	Sometimes saving	Rp 1 juta – Rp 3 juta	< 30% of income	50% – 100% of the loan value
A2	1 – 3 year	Late several times	There are active arrears	Never save	< Rp 1 juta	> 50% of income	< 50% of the loan value
A3	> 3 year	On time	Always on time	Save regularly	> Rp 3 juta	< 30% of income	100% of the loan value

A4	1 – 3 year	Never pay	Late several times	Sometimes saving	Rp 1 juta – Rp 3 juta	30% – 50% of income	50% – 100% of the loan value
A5	> 3 year	Late several times	Late several times	Save regularly	Rp 1 juta – Rp 3 juta	30% – 50% of income	< 50% of the loan value
A6	< 1 year	Never pay	There are active arrears	Never save	< Rp 1 juta	> 50% of income	< 50% of the loan value
A7	> 3 year	On time	Always on time	Sometimes saving	> Rp 3 juta	< 30% of income	100% of the loan value

Based on the credit grant data listed in Table 11, the following are the values for each data that will be used in the calculation process. The weight values of the criteria and alternatives can be seen in Table 12 below:

Table 12. Alternative Values Based on Criteria Weights

Alternative	Criteria						
	C1	C2	C3	C4	C5	C6	C7
A1	1	3	3	2	2	1	2
A2	2	2	1	1	1	3	1
A3	3	3	3	3	3	1	3
A4	2	1	2	2	2	2	2
A5	3	2	2	3	2	2	1
A6	1	1	1	1	1	3	1
A7	3	3	3	2	3	1	3

That's why the assessment is weighted C1, C2, C3, C4, C5, C6, C7 that is $W = (1,0; 1,5; 1,0; 0,5; 2,5; 1,5; 2,0)$ then it will be repaired $\sum w_j = 1$ in the following way:

$$W_j = \frac{W_j}{\sum W_j}$$

$$W_1 = \frac{1,0}{1,0 + 1,5 + 1,0 + 0,5 + 2,5 + 1,5 + 2,0} = 0,1$$

$$W_2 = \frac{1,0}{1,0 + 1,5 + 1,0 + 0,5 + 2,5 + 1,5 + 2,0} = 0,15$$

$$W_3 = \frac{1,0}{1,0 + 1,5 + 1,0 + 0,5 + 2,5 + 1,5 + 2,0} = 0,1$$

$$W_4 = \frac{1,0}{1,0 + 1,5 + 1,0 + 0,5 + 2,5 + 1,5 + 2,0} = 0,05$$

$$W_5 = \frac{1,0}{1,0 + 1,5 + 1,0 + 0,5 + 2,5 + 1,5 + 2,0} = 0,25$$

$$W_6 = \frac{1,0}{1,0 + 1,5 + 1,0 + 0,5 + 2,5 + 1,5 + 2,0} = 0,15$$

$$W_7 = \frac{1,0}{1,0 + 1,5 + 1,0 + 0,5 + 2,5 + 1,5 + 2,0} = 0,2$$

Next, calculate the value of the vector S. Before calculating the value of the vector S, the weights are corrected first to obtain $\sum w = 1$.

Then the vector S can be calculated as follows:

$$S_1 = (1^{0,1}) + (3^{0,15}) + (3^{0,1}) + (2^{0,05}) + (2^{-0,25}) + (1^{0,15}) + (2^{0,2}) = 7,320$$

$$S_2 = (2^{0,1}) + (2^{0,15}) + (1^{0,1}) + (1^{0,05}) + (1^{-0,25}) + (3^{0,15}) + (1^{0,2}) = 7,360$$

$$S_3 = (3^{0,1}) + (3^{0,15}) + (3^{0,1}) + (3^{0,05}) + (3^{-0,25}) + (1^{0,15}) + (3^{0,2}) = 7,473$$

$$S_4 = (2^{0,1}) + (1^{0,15}) + (2^{0,1}) + (2^{0,05}) + (2^{-0,25}) + (2^{0,15}) + (2^{0,2}) = 7,278$$

$$S_5 = (3^{0,1}) + (2^{0,15}) + (2^{0,1}) + (3^{0,05}) + (2^{-0,25}) + (2^{0,15}) + (1^{0,2}) = 7,304$$

$$S6 = (1^{0,1}) + (1^{0,15}) + (1^{0,1}) + (1^{0,05}) + (1^{-0,25}) + (3^{0,15}) + (1^{0,2}) = 7,179$$

$$S7 = (3^{0,1}) + (3^{0,15}) + (3^{0,1}) + (2^{0,05}) + (3^{-0,25}) + (1^{0,15}) + (3^{0,2}) = 7,452$$

The next step is to calculate the vector V value for the assessment process. The following is a calculation of the value of vector V based on the value data calculated for vector S in the following calculation process:

$$V1 = \frac{7,320}{7,320 + 7,360 + 7,473 + 7,278 + 7,304 + 7,179 + 7,452} = 0,1425$$

$$V2 = \frac{7,360}{7,320 + 7,360 + 7,473 + 7,278 + 7,304 + 7,179 + 7,452} = 0,1433$$

$$V3 = \frac{7,473}{7,320 + 7,360 + 7,473 + 7,278 + 7,304 + 7,179 + 7,452} = 0,1455$$

$$V4 = \frac{7,278}{7,320 + 7,360 + 7,473 + 7,278 + 7,304 + 7,179 + 7,452} = 0,1417$$

$$V5 = \frac{7,304}{7,320 + 7,360 + 7,473 + 7,278 + 7,304 + 7,179 + 7,452} = 0,1422$$

$$V6 = \frac{7,179}{7,320 + 7,360 + 7,473 + 7,278 + 7,304 + 7,179 + 7,452} = 0,1398$$

$$V7 = \frac{7,452}{7,320 + 7,360 + 7,473 + 7,278 + 7,304 + 7,179 + 7,452} = 0,1451$$

The final result of the calculation is a V value using the Weighted Product (WP) method which provides a preference value for each alternative that has been analyzed based on the specified weight criteria. The following are warnings based on the calculations presented in Table 13.

Table 13. Final Customer Ranking Results

Alternative	V value	Ranking
A1	0,1425	4
A2	0,1433	3
A3	0,1455	1
A4	0,1417	6
A5	0,1422	5
A6	0,1398	7
A7	0,1451	2

Based on the results of calculations to determine the feasibility of providing loans to cooperative customers, each alternative is assessed based on predetermined criteria. Alternative A3 managed to rank first with a V value of 0.1455, indicating that this customer has the highest eligibility to receive a loan based on the analysis carried out. Alternative A7 is in second place with a V value of 0.1451, followed by A2 in third place with a V value of 0.1433.

Meanwhile, A1 is in fourth position with a V value of 0.1425, followed by A5 in fifth position with a V value of 0.1422. Alternative A4 is in sixth position with a V value of 0.1417, and alternative A6 is in last place with a V value of 0.1398, indicating that this customer has the lowest eligibility to receive a loan. This ranking provides clear guidance for cooperatives in determining which customers are most worthy of being given a loan based on the analysis of the decision support system that has been implemented.

4 CONCLUSION

The application of the Weighted Product (WP) method in the process of assessing the creditworthiness of Mekarsari Cooperative customers really supports more objective and systematic decision making. This method allows cooperatives to evaluate the suitability of prospective customers fairly and transparently based on predetermined criteria and relevant weights. In addition, the WP method helps optimize the use of resources by distributing loans to customers who have the ability and responsibility to repay loans. This also contributes to minimizing the risk of bad credit by selecting customers who have a lower risk profile based on the results of criteria analysis.

Based on the evaluation results, it can be concluded that the WP method is effective in helping cooperatives determine the suitability of prospective customers to receive loans. This method is able to accommodate various assessment criteria by giving certain weights to each criterion. With this approach, assessment accuracy increases because the WP method provides a clear and transparent structure for decision making. Each prospective customer is assessed based on the final score resulting from a combination of various predetermined criteria and weights, so that the assessment process becomes more objective and accountable. By prioritizing more important criteria, this method also helps reduce the risk of bad credit and ensures that loans are given to customers who truly qualify.

REFERENCES

- [1] N. Ruslana, I. Bintang, F. Dei, E. Kadarisman, and A. Sukarso, "Penguatan Kelembagaan Koperasi Nelayan Minapari Desa Karangjaladri Kecamatan Parigi Kabupaten Pangandaran," *Sricommerce J. Sriwij. Community Serv.*, vol. 5, no. 2, pp. 183–190, 2024.
- [2] A. M. P. Lesmono *et al.*, "Peran Koperasi Simpan Pinjam dalam Menurunkan Tingkat Pinjaman Online di sekitar Masyarakat Kecamatan Gunungpati," *J. Implementasi*, vol. 1, no. 2, pp. 139–145, 2021.
- [3] M. Y. Simargolang, Y. H. Siregar, and H. S. Tamba, "Sistem Pendukung Keputusan Menggunakan Metode Fuzzy Universitas Asahan," *JrTi J. Teknol. Inf.*, vol. 2, no. 2, pp. 122–128, 2018.
- [4] H. D. Yunita and F. Fahurian, "Sistem Pendukung Keputusan Pemilihan Perumahan di Bandar Lampung," *Explor. J. Sist. Inf. dan Telemat.*, vol. 10, no. 1, pp. 1–17, 2019.
- [5] F. Rahmasari, S. Paembonan, and M. Mukhramin, "Sistem Pendukung Keputusan Pemilihan Jenis Smartphone Dengan Simple Additive Weighting (SAW)," *JITET (Jurnal Inform. dan Tek. Elektro Ter.*, vol. 12, no. 3S1, pp. 4616–4634, 2024, doi: 10.30998/jrkt.v4i01.10248.
- [6] S. Puspita and G. Yanto, "Penerapan Metode Technique for Order By Similarity To Ideal Solution (TOPSIS) dalam Pemilihan Unit Kegiatan Mahasiswa (UKM) yang Diminati di STMIK Indonesia Padang," *J. SIMTIKA*, vol. 5, no. 2, pp. 40–46, 2022.
- [7] A. Fitriyani, R. Komarudin, Y. I. Maulana, and A. Haidir, "Penerapan Metode Weighted Product (WP) Pada Pemilihan Supplier Kimia Terbaik PT. Mayer Indah Indonesia Bogor," *Bianglala Inform.*, vol. 8, no. 1, pp. 36–43, 2020, doi: 10.31294/bi.v8i1.8106.
- [8] M. Jannah, K. O. Putra, and J. Azizah, "Implementasi Metode Weighted Product dalam Memberikan Pinjaman kepada Nasabah Koperasi X," *JATI (Jurnal Mhs. Tek. Inform.*, vol. 8, no. 3, pp. 4351–4355, 2024, [Online]. Available: <http://journal.ummat.ac.id/index.php/justek>
- [9] S. E. Rianti and M. Marhalim, "Sistem Pendukung Keputusan Pemberian Pinjaman Koperasi Warga Desa Pal 30 Menggunakan Algoritma Weighted Product," *SAINTIK J. Sain Inform. Sist. dan Teknol. Inf.*, vol. 1, no. 1, pp. 18–23, 2021, [Online]. Available: <https://journals.unihaz.ac.id/index.php/saintik/article/view/1973%0Ahttps://journals.unihaz.ac.id/index.php/saintik/article/download/1973/1195>
- [10] S. Supiyandi, R. N. Fuad, E. Hariyanto, and S. Larasati, "Sistem Pendukung Keputusan Pemberian Kredit Koperasi Menggunakan Metode Weighted Product," *J. Media Inform. Budid.*, vol. 4, no. 4, pp. 1132–1139, 2023, doi: 10.58487/akrabjuara.v8i1.2018.
- [11] B. Sembiring and S. Sulindawaty, "Sistem Pendukung Keputusan Penentuan Kualitas Tempe Siap Jual Dengan Metode Weight Product," *J. Nas. Komputasi dan Teknol. Inf.*, vol. 8, no. 2, pp. 53–58, 2020, doi: 10.32672/jnknti.v3i2.2382.