



# Single Valued Neutrosophic Sets for Analysis Opinions of Customer in Waste Management

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## Abstract

This study presents an analysis of consumer opinions on waste medicine management. The study explores consumers' concerns, preferences, and suggestions regarding correctly disposing unused or expired medications. The analysis shows the key points that emerged from consumer opinions, including environmental impact, public health and safety, accessibility and affordability, education and awareness, pharmaceutical industry responsibility, convenience and ease of disposal, privacy and confidentiality, community engagement, alternatives to disposal, extended producer responsibility, international collaboration, technology solutions, environmental stewardship, and government regulation and support. This study shows the importance of understanding consumer perspectives in developing effective waste medicine management strategies prioritizing environmental sustainability, public health, and consumer satisfaction. We used the multi-criteria decision-making (MCDM) methodology to deal with these criteria. We gathered 15 criteria concerned with waste medicine management. We used the DEMATEL method to show the criteria weights and relationships between criteria. The DEMATEL method is integrated with the single-valued neutrosophic set to deal with uncertain data. The results show the environmental impact has the most significant weight.

**Keywords:** Single Valued Neutrosophic Sets; DEMATEL Method; Waste Management; MCDM.

## 1. Introduction

Medicine waste management is an increasingly critical facet of sustainable healthcare systems, with a multifaceted impact on public health, environmental sustainability, and socio-economic dynamics. While numerous studies have examined pharmaceutical waste disposal practices from institutional and regulatory perspectives, the understanding of consumer behaviours, attitudes, and opinions towards medicine waste disposal still needs to be explored. Consumer behaviour is pivotal in properly disposing of and managing unused or expired medications and medical supplies[1]–[3]. Consumers' behaviours, perceptions, and motivations directly influence the disposal methods adopted, potentially impacting the environment and public health outcomes. Understanding consumer opinions, preferences, and challenges in medicine waste disposal is pivotal for formulating comprehensive waste management policies and effective public awareness campaigns[4]–[6].

This research paper seeks to fill the void in the literature by presenting an in-depth analysis of consumer opinions and behaviours related to medicine waste management. By harnessing sentiment analysis, surveys, and qualitative assessments, this study aims to uncover the underlying factors influencing consumer choices in discarding or retaining

medications, their awareness of proper disposal methods, and the barriers they face in adhering to recommended disposal practices[7]–[9].

The research methodology encompasses various data collection techniques, including surveys distributed across diverse demographic segments, interviews, and social media sentiment analysis. These methodologies aim to comprehensively understand consumer sentiments, attitudes, and behaviours towards medicine waste management practices[10]–[12]. By elucidating consumer perceptions and experiences, this study contributes valuable insights to policymakers, healthcare providers, and waste management authorities. The findings are expected to inform the design of targeted interventions, educational campaigns, and policy initiatives to foster responsible medication disposal practices among consumers[13]–[15]. MCDM used in various real world applications[16].

We used the MCDM methodology to evaluate the criteria related to the consumer opinions of medicine waste management[17]–[19]. The DEMATEL method is used to show the relationships between criteria. Then the DEMATEL method is integrated with the single valued neutrosophic set to deal with uncertainty[20]–[22]. Neutrosophic set was used in various applications to deal with uncertainty[23], [24]. Neutrosophic set is extension of fuzzy set[25], [26]. The idea of a neutrosophic set (NS) was first put out by Smarandache from a philosophical perspective[27]. A NS  $A$  in a universal set  $X$  is defined by its truth-membership function, indeterminacy-membership function, and falsity-membership function separately, according to Smarandache's definition of an NS.

## 2. Methodology

The DEMATEL method is integrated with the single valued neutrosophic sets to deal with uncertainty data[28]. The DEMATEL method is used to compute the relationships between criteria and factors [29]–[31]. Figure 1 shows the framework of this study.



Figure 1: The steps of the proposed method.

- (I) Form the problem between criteria and factors.
- (II) Select a group of decision makers and experts to evaluate the criteria factors.
- (III) Define the single valued neutrosophic scale [20] to evaluate the criteria. We used the single valued neutrosophic numbers to evaluate the criteria and alternatives. Then we replaced these numbers by crisp values through score function[20].
- (IV) Construct the relation matrix between criteria. Then we used the surveys to measure and evaluate the criteria by building the relation matrix.

$$T = \begin{bmatrix} 1 & \cdots & t_{1n} \\ \vdots & \ddots & \vdots \\ t_{n1} & \cdots & 1 \end{bmatrix} \quad (1)$$

(V) Normalize the direct relation matrix.

$$\beta = \frac{1}{\max_{1 \leq i \leq n} (\sum_{j=1}^n t_{ij})}; i, j = 1, 2, \dots, n \quad (2)$$

$$\gamma = \beta T \quad (3)$$

(VI) Compute the total relation matrix.

$$R = \gamma(1 - \gamma)^{-1} \quad (4)$$

(VII) Compute the sum of each row and each column.

$$W_i = \sum_{j=1}^n R_{ij} \quad (5)$$

$$C_i = \sum_{i=1}^n R_{ij} \quad (6)$$

### 3. Results and Discussion

The results of the single-valued neutrosophic set are discussed. The customer and experts obtained the 15 criteria related to waste medicine management. We used the DEMATEL method to analyse these criteria and build the relationships between each other[32]–[35].

- 1) **Environmental Impact:** Many consumers are increasingly aware of the environmental impact of improperly managed waste medicines. They express concerns about the potential contamination of water sources and ecosystems due to the improper disposal or flushing of expired or unused medications. Consumers often advocate for proper disposal practices to minimize the environmental footprint of waste medicines.
- 2) **Public Health and Safety:** Consumers recognize the potential risks associated with the improper management of waste medicines. They express concerns about misusing or accidentally ingesting improperly discarded medications, particularly by children or pets. Consumers value proper waste management practices to ensure public health and safety.
- 3) **Accessibility and Affordability:** Some consumers raise concerns about the accessibility and affordability of medication disposal options. They may express frustration if there are limited or inconvenient disposal locations, leading to difficulties properly disposing of waste medicines. Additionally, the cost of proper disposal methods, such as drop-off programs or mail-back services, can concern consumers.
- 4) **Education and Awareness:** Many consumers believe education and awareness campaigns are essential in promoting proper waste medicine management. They desire clear guidelines and instructions on how to dispose of medications safely. Consumers often call for increased public education initiatives to inform individuals about the potential risks of improper disposal and to emphasize the importance of responsible waste management.
- 5) **Pharmaceutical Industry Responsibility:** Some consumers believe the pharmaceutical industry should take greater responsibility for waste medicine management. They advocate for initiatives encouraging pharmaceutical companies to develop sustainable packaging, provide information on safe disposal practices, and support take-back programs.
- 6) **Convenience and Ease of Disposal:** Consumers often prefer convenient and easily accessible disposal methods. They appreciate initiatives such as take-back programs at pharmacies or community drop-off locations that provide a hassle-free way to dispose of waste medicines.

- 7) **Personal Responsibility:** Many consumers believe that individuals are responsible for properly managing their waste medicines. They emphasize the importance of reading and following medication disposal instructions provided by healthcare professionals or on medication packaging.
- 8) **Privacy and Confidentiality:** Consumers express concerns about privacy and confidentiality when disposing of waste medicines. They may worry about exposing or linking personal information to the medications they dispose of. Ensuring secure and anonymous disposal methods addresses these concerns and encourages proper waste management practices.
- 9) **Community Engagement:** Consumers often emphasize the importance of community involvement in waste medicine management. They believe community-based initiatives, such as local collection events or awareness campaigns, can effectively raise awareness and promote responsible disposal practices. Consumers appreciate collaborative efforts that involve healthcare providers, pharmacies, community organizations, and local governments working together to address the issue.
- 10) **Alternatives to Disposal:** Some consumers advocate exploring alternatives to disposing unused or expired medications. They suggest options such as donation programs, where unopened and unexpired medications can be safely redistributed to individuals in need, particularly those who struggle with access to affordable healthcare.
- 11) **Extended Producer Responsibility:** Consumers increasingly call for extended producer responsibility (EPR) policies in waste medicine management. EPR holds pharmaceutical manufacturers accountable for the lifecycle of their products, including proper disposal. Consumers believe implementing EPR programs would incentivize manufacturers to develop sustainable packaging, support take-back programs, and invest in environmentally friendly disposal methods.
- 12) **International Collaboration:** Waste medicine management is a global issue, and consumers recognize the need for international collaboration and standardization of disposal practices. They highlight the importance of sharing best practices, research, and expertise to develop effective and sustainable waste medicine management strategies on a global scale.
- 13) **Technology Solutions:** Consumers are open to using technology to enhance waste medicine management. They appreciate the convenience of digital platforms or mobile applications that provide information on nearby disposal locations, medication expiration reminders, or guidance on safe disposal methods. Technology-driven solutions can help increase awareness, accessibility, and efficiency in waste medicine management.
- 14) **Environmental Stewardship:** Many consumers view proper waste medicine management as environmental stewardship. They believe that responsible disposal practices contribute to a healthier environment and ecosystem. Consumers appreciate initiatives that prioritize sustainability and encourage the reduction of pharmaceutical waste through measures such as proper dosage management and avoiding unnecessary medication purchases.
- 15) **Government Regulation and Support:** Consumers need regulations and policies to support effective waste medicine management. They believe that clear guidelines, enforcement mechanisms, and financial incentives can encourage individuals and organizations to adopt proper disposal practices. Consumers value government initiatives that promote education, establish collection programs, and invest in research for innovative disposal technologies.
  - (I) Select a group of decision makers and experts to evaluate the criteria factors who have expertise the medicine waste management.
  - (II) Define the single valued neutrosophic scale to evaluate the criteria.
  - (III) Construct the relation matrix between criteria by Eq. (1) as shown in Table 1.  
Then we used the surveys to measure and evaluate the criteria by building the relation matrix.
  - (IV) Normalize the direct relation matrix by Eqs. (2 and 3) as show in Table 2.

Table 1: The direct relation matrix.

	$WMC_1$	$WMC_2$	$WMC_3$	$WMC_4$	$WMC_5$	$WMC_6$	$WMC_7$	$WMC_8$	$WMC_9$	$WMC_{10}$	$WMC_{11}$	$WMC_{12}$	$WMC_{13}$	$WMC_{14}$	$WMC_{15}$
$WMC_1$	(0.60,0.50 .50)	(0.60,0.50 .50)	(0.91,0.01 .01)	(0.60,0.50 .50)	(0.70,0.40 .40)	(0.91,0.01 .01)	(0.60,0.50 .50)	(0.98,0.01 .01)	(0.60,0.50 .50)	(0.91,0.01 .01)	(0.60,0.50 .50)	(0.91,0.01 .01)	(0.70,0.40 .40)	(0.60,0.50 .50)	(0.91,0.01 .01)
$WMC_2$	(0.60,0.50 .50)	(0.40,0.65 .70)	(0.70,0.40 .40)	(0.60,0.50 .50)	(0.75,0.35 .35)	(0.60,0.50 .50)	(0.98,0.01 .01)	(0.91,0.01 .01)	(0.85,0.15 .15)	(0.50,0.50 .55)	(0.98,0.01 .01)	(0.91,0.01 .01)	(0.60,0.50 .50)	(0.40,0.65 .70)	(0.60,0.50 .50)
$WMC_3$	(0.91,0.01 .01)	(0.70,0.40 .40)	(0.60,0.50 .50)	(0.50,0.60 .55)	(0.70,0.40 .35)	(0.60,0.50 .50)	(0.40,0.65 .70)	(0.70,0.40 .40)	(0.30,0.75 .75)	(0.40,0.60 .65)	(0.40,0.60 .65)	(0.40,0.70 .75)	(0.40,0.60 .65)	(0.60,0.50 .50)	(0.60,0.50 .50)
$WMC_4$	(0.60,0.50 .50)	(0.60,0.50 .50)	(0.60,0.50 .50)	(0.50,0.60 .55)	(0.70,0.40 .35)	(0.70,0.40 .40)	(0.70,0.40 .40)	(0.60,0.50 .50)	(0.70,0.40 .35)	(0.60,0.50 .50)	(0.60,0.50 .50)	(0.40,0.70 .75)	(0.30,0.75 .75)	(0.60,0.50 .50)	(0.30,0.75 .75)
$WMC_5$	(0.70,0.40 .40)	(0.75,0.35 .35)	(0.70,0.40 .35)	(0.60,0.50 .55)	(0.60,0.50 .50)	(0.70,0.40 .40)	(0.70,0.40 .40)	(0.60,0.50 .50)	(0.70,0.40 .35)	(0.70,0.40 .40)	(0.70,0.40 .40)	(0.91,0.01 .01)	(0.91,0.01 .01)	(0.70,0.40 .40)	(0.70,0.40 .40)
$WMC_6$	(0.91,0.01 .01)	(0.60,0.50 .50)	(0.60,0.50 .50)	(0.60,0.50 .55)	(0.60,0.50 .50)	(0.70,0.40 .40)	(0.91,0.01 .01)	(0.70,0.40 .40)	(0.60,0.50 .50)	(0.40,0.65 .70)	(0.91,0.01 .01)	(0.60,0.50 .50)	(0.85,0.15 .15)	(0.85,0.15 .15)	(0.60,0.50 .50)
$WMC_7$	(0.60,0.50 .50)	(0.98,0.01 .01)	(0.40,0.65 .70)	(0.60,0.50 .55)	(0.60,0.50 .50)	(0.70,0.40 .40)	(0.70,0.40 .40)	(0.20,0.75 .80)	(0.60,0.50 .50)	(0.60,0.50 .50)	(0.30,0.75 .75)	(0.91,0.01 .01)	(0.91,0.01 .01)	(0.20,0.75 .80)	(0.70,0.40 .40)
$WMC_8$	(0.98,0.01 .01)	(0.91,0.01 .01)	(0.70,0.40 .40)	(0.60,0.50 .55)	(0.60,0.50 .50)	(0.70,0.40 .40)	(0.70,0.40 .40)	(0.20,0.75 .80)	(0.70,0.40 .35)	(0.70,0.40 .40)	(0.20,0.75 .80)	(0.60,0.50 .50)	(0.85,0.15 .20)	(0.60,0.50 .50)	(0.70,0.40 .40)
$WMC_9$	(0.60,0.50 .50)	(0.85,0.15 .15)	(0.30,0.75 .75)	(0.91,0.01 .01)	(0.75,0.35 .35)	(0.40,0.65 .70)	(0.70,0.40 .40)	(0.30,0.75 .75)	(0.70,0.40 .40)	(0.75,0.35 .35)	(0.30,0.75 .75)	(0.40,0.70 .75)	(0.91,0.01 .01)	(0.91,0.01 .01)	(0.91,0.01 .01)
$WMC_{10}$	(0.91,0.01 .01)	(0.50,0.50 .55)	(0.40,0.60 .65)	(0.85,0.15 .15)	(0.60,0.50 .50)	(0.70,0.40 .40)	(0.70,0.40 .40)	(0.70,0.40 .40)	(0.70,0.40 .40)	(0.70,0.40 .40)	(0.40,0.65 .70)	(0.60,0.50 .50)	(0.70,0.40 .40)	(0.70,0.40 .40)	(0.60,0.50 .50)
$WMC_{11}$	(0.60,0.50 .50)	(0.98,0.01 .01)	(0.60,0.50 .50)	(0.70,0.40 .35)	(0.91,0.01 .01)	(0.70,0.40 .40)	(0.70,0.40 .40)	(0.20,0.75 .80)	(0.70,0.40 .40)	(0.60,0.50 .50)	(0.60,0.50 .50)	(0.70,0.40 .40)	(0.60,0.50 .50)	(0.85,0.15 .15)	(0.70,0.40 .40)
$WMC_{12}$	(0.91,0.01 .01)	(0.91,0.01 .01)	(0.40,0.65 .70)	(0.40,0.70 .75)	(0.60,0.50 .50)	(0.70,0.40 .40)	(0.70,0.40 .40)	(0.91,0.01 .01)	(0.70,0.40 .40)	(0.70,0.40 .40)	(0.70,0.40 .35)	(0.70,0.40 .35)	(0.91,0.01 .01)	(0.91,0.01 .01)	(0.85,0.15 .15)
$WMC_{13}$	(0.70,0.40 .40)	(0.60,0.50 .50)	(0.85,0.15 .15)	(0.91,0.01 .01)	(0.60,0.50 .50)	(0.40,0.65 .70)	(0.91,0.01 .01)	(0.91,0.01 .01)	(0.60,0.50 .50)	(0.60,0.50 .50)	(0.91,0.01 .01)	(0.70,0.40 .35)	(0.50,0.60 .55)	(0.70,0.40 .40)	(0.50,0.60 .55)
$WMC_{14}$	(0.60,0.50 .50)	(0.40,0.65 .70)	(0.85,0.15 .15)	(0.91,0.01 .01)	(0.85,0.15 .15)	(0.91,0.01 .01)	(0.85,0.15 .15)	(0.91,0.01 .01)	(0.91,0.01 .01)	(0.85,0.15 .15)	(0.75,0.35 .35)	(0.60,0.50 .50)	(0.30,0.75 .75)	(0.85,0.15 .15)	(0.10,0.85 .90)
$WMC_{15}$	(0.91,0.01 .01)	(0.70,0.40 .40)	(0.60,0.50 .50)	(0.91,0.01 .01)	(0.85,0.15 .15)	(0.40,0.65 .70)	(0.70,0.40 .40)	(0.98,0.01 .01)	(0.91,0.01 .01)	(0.91,0.01 .01)	(0.60,0.50 .50)	(0.91,0.01 .01)	(0.60,0.50 .50)	(0.30,0.75 .75)	(0.60,0.50 .50)

Table 2: The normalized direct relation matrix.

	$WM_1$	$WM_2$	$WM_3$	$WM_4$	$WM_5$	$WM_6$	$WM_7$	$WM_8$	$WM_9$	$WM_{10}$	$WM_{11}$	$WM_{12}$	$WM_{13}$	$WM_{14}$	$WM_{15}$
$WM_1$	0.238866	0.532389	0.974696	0.532389	0.639676	0.974696	0.535425	0.998988	0.532389	0.974696	0.532389	0.974696	0.532389	0.996964	0.974696
$WM_2$	0.532389	0.737482	0.639676	0.532389	0.706478	0.532389	0.998988	0.974696	0.866397	0.490891	0.996964	0.974696	0.532389	0.996964	0.974696
$WM_3$	0.974696	0.639676	0.639676	0.532389	0.659919	0.532389	0.532389	0.639676	0.259109	0.402834	0.5333	0.532389	0.639676	0.532389	0.639676
$WM_4$	0.532389	0.532389	0.532389	0.45749	0.659919	0.642713	0.532389	0.532389	0.974696	0.866397	0.667004	0.532389	0.639676	0.667004	0.974696
$WM_5$	0.639676	0.706478	0.659919	0.532389	0.659919	0.532389	0.639676	0.639676	0.974696	0.532389	0.974696	0.532389	0.639676	0.974696	0.532389
$WM_6$	0.974696	0.532389	0.532389	0.642713	0.532389	0.642713	0.532389	0.532389	0.974696	0.866397	0.667004	0.532389	0.639676	0.667004	0.974696
$WM_7$	0.535425	0.998988	0.532389	0.639676	0.639676	0.974696	0.532389	0.532389	0.667004	0.532389	0.974696	0.532389	0.639676	0.974696	0.532389
$WM_8$	0.998988	0.974696	0.639676	0.532389	0.639676	0.532389	0.532389	0.532389	0.667004	0.532389	0.974696	0.532389	0.639676	0.974696	0.532389
$WM_9$	0.532389	0.866397	0.259109	0.974696	0.974696	0.698381	0.532389	0.532389	0.532389	0.703441	0.639676	0.32996	0.974696	0.974696	0.974696
$WM_{10}$	0.974696	0.490891	0.402834	0.866397	0.532389	0.532389	0.532389	0.532389	0.532389	0.643623	0.532389	0.532389	0.639676	0.532389	0.532389
$WM_{11}$	0.532389	0.996964	0.5333	0.667004	0.974696	0.532389	0.238866	0.532389	0.974696	0.532389	0.974696	0.639676	0.532389	0.532389	0.532389
$WM_{12}$	0.974696	0.974696	0.537482	0.528947	0.532389	0.640182	0.974696	0.532389	0.532389	0.640182	0.639676	0.639676	0.532389	0.639676	0.532389
$WM_{13}$	0.639676	0.532389	0.866397	0.974696	0.532389	0.374482	0.974696	0.532389	0.866397	0.530263	0.974696	0.659919	0.659919	0.974696	0.639676
$WM_{14}$	0.532389	0.374482	0.866397	0.974696	0.866397	0.974696	0.866397	0.974696	0.974696	0.706478	0.706478	0.667004	0.659919	0.532389	0.532389
$WM_{15}$	0.974696	0.639676	0.532389	0.974696	0.532389	0.374482	0.866397	0.532389	0.532389	0.974696	0.974696	0.659919	0.45749	0.866397	0.532389
$WM_{15}$	0.639676	0.532389	0.532389	0.532389	0.532389	0.532389	0.532389	0.532389	0.532389	0.532389	0.532389	0.532389	0.532389	0.532389	0.532389

(V) Compute the total relation matrix by Eq. (4) as shown in Table 3.  
 Table 3. The total relation matrix.

	$WMC_1$	$WMC_2$	$WMC_3$	$WMC_4$	$WMC_5$	$WMC_6$	$WMC_7$	$WMC_8$	$WMC_9$	$WMC_{10}$	$WMC_{11}$	$WMC_{12}$	$WMC_{13}$	$WMC_{14}$	$WMC_{15}$
$WMC_1$	-	-	0.3954	0.1175	-	0.3861	-	0.3018	-	0.2671	-	-	-	0.0331	-
$WMC_2$	0.2362	0.1223	0.395454	0.117543	0.3795	0.386196	0.3995	0.301829	0.4852	0.267113	0.1398	0.3142	0.2438	0.033175	0.236204
$WMC_3$	0.431504	0.5169	0.3855	0.1248	0.202419	0.5481	0.555385	0.0038	0.046464	0.1518	0.0423	0.289146	0.04816	0.7287	0.431504
$WMC_4$	1.0784	0.1426	0.323511	0.197211	0.4422	0.583942	0.7737	0.145338	0.2639	0.1750	0.114956	0.7284	0.028919	0.767115	1.0784
$WMC_5$	0.882527	0.4723	0.8347	0.3946	0.005698	0.8162	0.276386	0.1527	0.714173	0.282703	0.2709	0.045265	0.229543	0.4095	0.882527
$WMC_6$	0.016907	-	-	-	-	-	-	-	0.292394	-	0.190739	-	-	0.108603	0.016907
$WMC_7$	2.8078	0.0920	0.1445	0.0055	0.2138	0.2395	0.2192	0.2387	-	0.1348	0.174597	-1.5349	-	2.135307	2.8078
$WMC_8$	0.407413	0.72275	1.711174	0.748707	1.57174	1.96814	1.9694	0.225493	0.9282	0.1348	0.174597	0.400269	0.7656	0.1204	0.407413
$WMC_9$	-	0.2965	0.3558	0.0035	0.319355	-0.4644	0.041648	0.3812	0.1236	0.052617	0.4320	0.400269	0.045341	0.1204	-
$WMC_{10}$	0.2958	0.016491	0.2314	0.045578	0.345782	0.217681	-0.059	0.006301	0.2139	0.065771	0.142343	0.2034	0.110515	0.2326	0.2958
$WMC_{11}$	1.540017	0.1758	1.1333	0.8448	0.700082	1.5817	1.211057	0.1338	0.362368	0.2280	0.253474	0.918474	0.385951	1.3778	1.540017
$WMC_{12}$	0.738627	-	-	-	0.23131	-0.7292	0.244389	-	0.029384	0.052592	-	0.210777	-	0.2834	0.738627
$WMC_{13}$	1.3600	0.242166	0.796901	0.337558	0.6755	1.113148	1.0872	0.1643	-0.3229	0.2731	0.1078	0.8024	0.1603	0.858925	1.3600
$WMC_{14}$	0.629042	0.3062	0.2061	0.1421	0.515877	0.4548	0.499532	0.3027	0.3201	0.0875	0.2155	0.09205	0.1169	0.5054	0.629042
$WMC_{15}$	0.415809	0.3011	0.4273	0.2993	0.441361	0.3466	0.620342	0.0639	0.0460	0.003117	0.356004	0.360104	0.2675	0.7067	0.415809
	1.350784	0.470249	0.361215	0.063337	0.5869	0.533711	0.9203	-0.1169	0.091169	-0.3112	0.28912	0.392369	0.2573	0.693199	1.350784
	1.047084	-	0.5504	0.4877	0.536234	0.9381	0.891207	-0.0215	0.196128	0.0415	0.2559	0.61931	0.040659	1.4071	1.047084

(VI) Compute the sum of each row and each column by Eqs. (5 and 6) as shown in Figure 2.

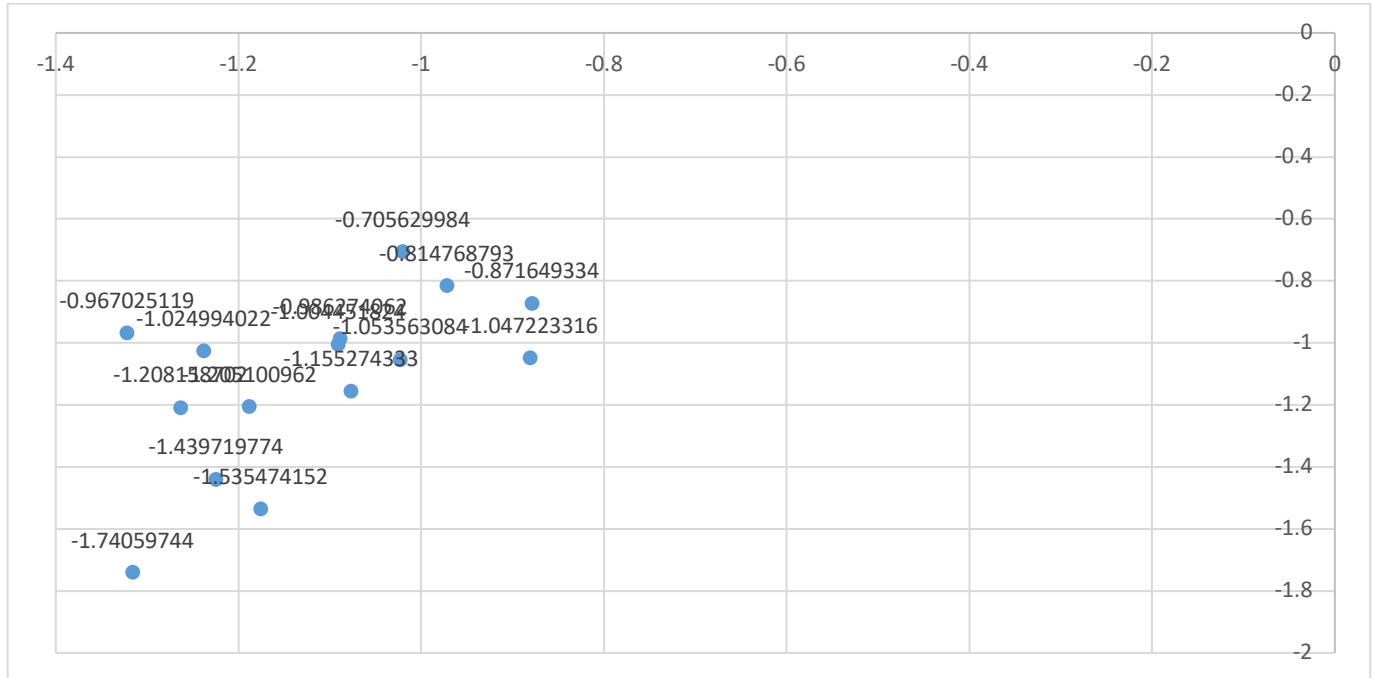


Figure 2: The relationships between criteria.

Then we compute the weights of criteria as shown in Figure 3. We show the government support has least weight and environmental impacts has the largest weight.

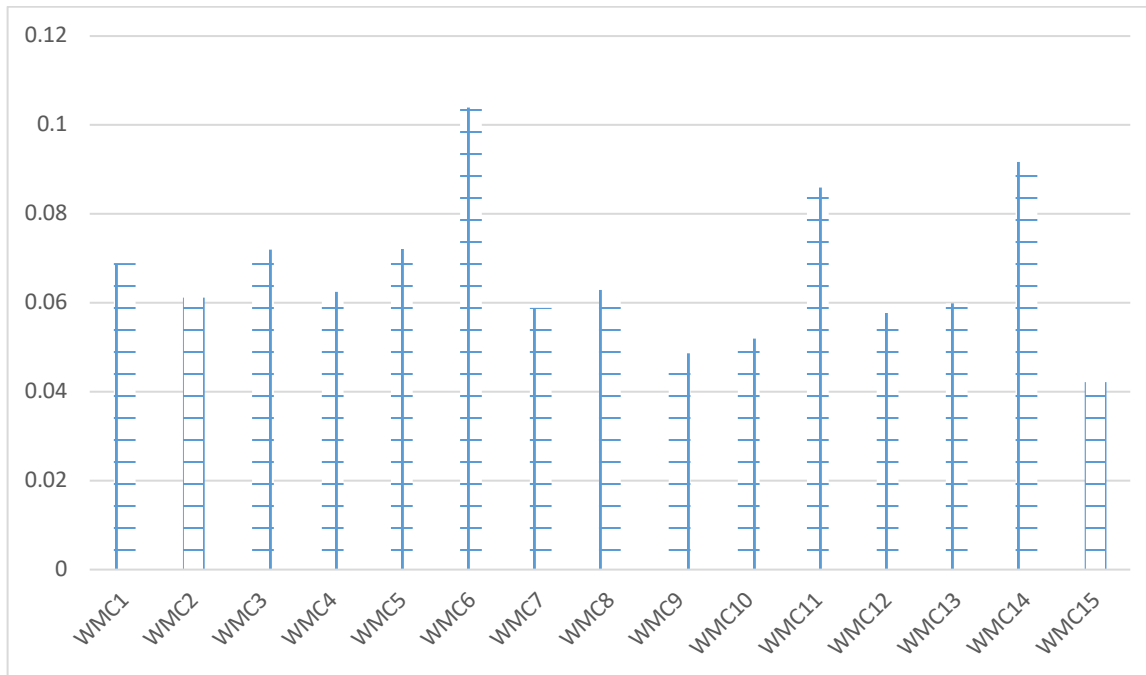


Figure 3: The weights of criteria.

**4. Conclusions**

The analysis of consumer opinions on waste medicine management reveals several essential insights. Consumers are increasingly aware of the environmental impact of improper disposal and express concerns about the contamination of ecosystems and water sources. They prioritize environmental sustainability and advocate for responsible waste management practices to minimize the ecological footprint of waste medicines. Public health and safety are significant concerns for consumers. They emphasize the need for proper disposal methods to prevent the misuse or accidental ingestion of medications, particularly by children or pets. Consumers recognize appropriate waste medicine management is crucial to public health and safety.

Consumer opinions on waste medicine management provide valuable insights for developing effective strategies. By considering consumer concerns, preferences, and suggestions, stakeholders can design waste medicine management systems prioritizing environmental sustainability, public health, and consumer satisfaction. Collaboration among industry, government, and communities is crucial in implementing comprehensive waste medicine management approaches that address the diverse needs of consumers. We used the single valued neutrosophic sets to build the relationships between criteria. We used 15 criteria in this study. We compute the weights of criteria. The environmental impact has the largest weight.

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