

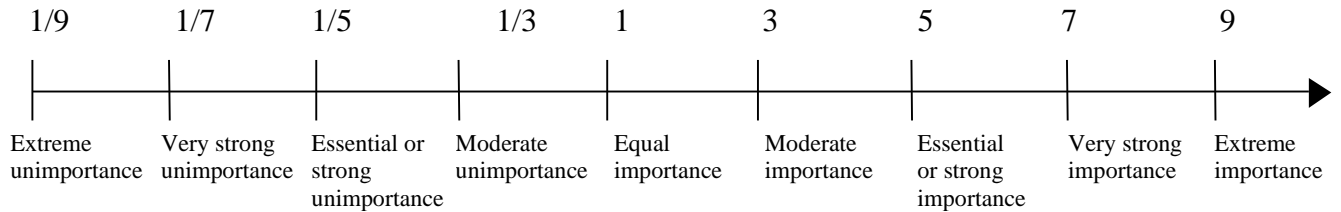
Supplementary Materials S1

Determining the weight in the Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) process consists of four main steps.

Step 1: Determine the priority for the criteria

Table S1. Score comparison of indicators



Source: [1]

Carry out the comparison of the criteria in pairs—the importance of the pairs of criteria. Considering the priorities (a_{ij} values, with i running in rows, j running in columns) in pairs of criteria with positive integer values from 1 to 9 or the reciprocal of these numbers, we obtain a matrix square ($n \times n$) like Table S2.

Table S2. Priority matrix of criteria

Criteria	C1	C2	C3	...	Cn
C1	a_{11}	a_{12}	a_{13}		a_{1n}
C2	a_{21}	a_{22}	a_{23}		a_{2n}
C3	a_{31}	a_{32}	a_{33}		a_{3n}
...					
Cn	a_{n1}	a_{n2}	a_{n3}		a_{nn}

Step 2: Calculate the weight of the criteria

After completing the above matrix, we proceed to calculate the weights for the criteria by summing the values of the matrix by column, then take each value of the matrix divided by the sum of the corresponding column. The weight of each criterion $C1, C2, C3, \dots, Cn$ will be equal to the average of the values in each horizontal row. As a result, we have a matrix of 1 column and n rows.

	C1	C2	C3	...	Cn	Trọng số
C1	w11	w13	w13		w1n	w1
C2	w21	w23	w23		w2n	w2
C3	w31	w32	w33		w3n	w3
...						...
Cn	wn1	wn1	wn1		wnn	wn

Next, before obtaining the weighted values ($w_1, w_2, \dots w_n$), it is necessary to validate the consistency of the experts' assessment through consistency ratio (CR). The CR less than or equal to 10% is acceptable [1]. In other words, there is a 10% chance that the experts answer the questions completely at random.

$$CR = \frac{CI}{RI}$$

CR—Consistency ratio; CI—Consistency index; RI—Random index

- Determine the consistency index CI:

$$CI = \frac{\lambda_{\max} - n}{n-1}$$

λ_{\max} is the maximum eigenvalue of a pairwise comparison matrix ($n \times n$); λ_{\max} is always greater than or equal to the number of rows or columns n . The more consistent the statement, the closer λ_{\max} to n .

$$\lambda_{\max} = \frac{1}{n} \left(\frac{\sum_{i=1}^n a_{ij} \cdot w_i}{w_i} \right)$$

- Random Index RI:

Table S3. Average random consistency index value

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.54	1.56	1.57

Step 3: Calculate the priority of the alternatives according to each criterion

In this step, the calculation procedure is as same as that in Step 1 and Step 2, but the data included in this step are the result of comparing the priority of the alternatives, which are based on each criterion from experts' assessment. Thus, the evaluation must perform n matrices for n different criteria. As a result, we have n matrices 1 column m rows (m alternatives). Consistency ratio should also be tested to ensure the obtained results adequately.

Step 4: Evaluate the alternatives and make decisions

Multiplying weight matrix of the alternatives, which are obtained from Step 3, by the criteria weight matrix, which are obtained from Step 2, result in a matrix of m rows (m alternatives) \times 1 column (weighted values). The resulting matrix will indicate the best option to choose—the one with the highest weight value.

Supplementary Materials S2

Weights calculation of criteria groups and MSW treatment technologies using the AHP method

Table S4. Matrix calculation for comparing the level of importance among criteria groups

Comparison		Result of expert's assessment											A _{ij}
i	j	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	
Economic	Social	0.11	3.00	4.00	1.00	0.14	0.33	3.00	0.20	6.00	7.00	8.00	1.257
	Environmental	0.20	0.50	5.00	1.00	0.20	0.20	2.00	0.11	7.00	5.00	5.00	0.977
Social	Environmental	7.00	0.33	0.50	1.00	3.00	1.00	0.50	0.33	0.50	0.50	0.20	0.725
CR (%)		4.6	4.6	8.2	0.0	5.7	2.5	0.8	2.5	7.0	1.2	3.8	3.7

	Eco.	Soc.	Env.
Eco.	1.00	1.26	0.98
Soc.	0.79	1.00	0.73
Env.	1.02	1.37	1.00

	Eco.	Soc.	Env.	Total	Weight (W)	Vector sum of weights	Vector consistency	λ_{\max}	CI	CR	CR (%)
Eco.	0.36	0.35	0.36	1.06	0.355	1.064	2.999	2.999	0.00	-0.001	-0.1
Soc.	0.28	0.28	0.27	0.83	0.275	0.826	2.999				
Env.	0.36	0.38	0.37	1.11	0.370	1.109	2.999				

Table S5. Matrix calculation for comparing the importance level of economic criteria

Comparison		Result of expert's assessment											A _{ij}
i	j	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	
Investment cost	Operation and maintenance costs	3.00	0.33	3.00	3.00	0.33	4.00	5.00	4.00	0.33	5.00	5.00	1.996
	Treatment cost	7.00	5.00	7.00	5.00	3.00	3.00	3.00	5.00	5.00	6.00	7.00	4.847
	Revenue/Benefit	5.00	7.00	5.00	3.00	5.00	4.00	7.00	3.00	3.00	3.00	9.00	4.563
Operation and maintenance costs	Treatment Cost	5.00	6.00	4.00	3.00	5.00	3.00	2.00	4.00	5.00	2.00	3.00	3.595
	Revenue/Benefit	7.00	7.00	2.00	3.00	3.00	3.00	4.00	2.00	3.00	3.00	4.00	3.426
Treatment cost	Revenue/Benefit	0.50	2.00	1.00	2.00	1.00	2.00	2.00	0.33	0.33	1.00	3.00	1.093
CR (%)		9.34	5.84	2.16	8.37	8.44	9.09	6.18	6.70	7.37	8.58	6.25	7.44

Indicator	Investment cost	Operation and maintenance costs	Treatment cost	Revenue/Benefit
Investment cost	1	2	4.85	4.56
Operation and maintenance costs	0.5	1	3.59	3.43
Treatment cost	0.21	0.28	1	1.09
Revenue/Benefit	0.22	0.29	0.92	1

	Investment cost	Operation and maintenance costs	Treatment cost	Revenue/Benefit	Total	Weight (W)	Vector sum of weights	CI	CR	CR (%)
Investment cost	0.52	0.56	0.47	0.45	2.00	0.500	2.02	0.010	0.011	1.07
Operation and maintenance costs	0.26	0.28	0.35	0.34	1.23	0.306	1.24			
Treatment cost	0.11	0.08	0.10	0.11	0.39	0.098	0.39			
Revenue/Benefit	0.11	0.08	0.09	0.10	0.38	0.096	0.38			

Table S6. Matrix calculation for comparing the importance level of social criteria

Comparison		Result of expert's assessment											A _{ij}
i	j	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	
Community health	Job creation	2.00	0.20	0.50	0.20	5.00	3.00	3.00	5.00	5.00	0.20	5.00	1.413
	Support policy	0.50	1.00	4.00	2.00	2.00	7.00	7.00	0.33	7.00	0.50	6.00	2.054
	Community consensus	1.00	0.33	0.20	0.20	4.00	5.00	4.00	0.33	6.00	0.33	7.00	1.157
Job creation	Support policy	0.50	5.00	2.00	3.00	0.33	3.00	3.00	0.20	3.00	3.00	3.00	1.648
	Community consensus	0.50	2.00	0.33	1.00	1.00	3.00	3.00	0.25	0.50	0.50	6.00	1.011
Support policy	Community consensus	1.00	0.33	0.17	0.25	5.00	0.25	2.00	1.00	0.33	0.33	3.00	0.667
CR (%)		2.24	0.15	8.41	5.79	2.80	8.45	6.73	7.37	6.51	5.79	9.72	5.81

Indicator	Community health	Job creation	Support policy	Community consensus
Community health	1	1.41	2.05	1.16
Job creation	0.71	1	1.65	1.01
Support policy	0.49	0.61	1	0.67
Community consensus	0.86	0.99	1.49	1

	Community health	Job creation	Support policy	Community consensus	Total	Weight (W)	Vector sum of weights	Vector consistency	λ_{\max}	CI	CR	CR (%)
Community health	0.33	0.35	0.33	0.30	1.31	0.328	1.31	4.01	4.008	0.003	0.003	0.29
Job creation	0.23	0.25	0.27	0.26	1.01	0.253	1.01	4.01				
Support policy	0.16	0.15	0.16	0.17	0.65	0.162	0.65	4.01				
Community consensus	0.28	0.25	0.24	0.26	1.03	0.257	1.03	4.01				

Table S7.Matrix calculation for comparing the importance level of environmental criteria

Comparison		Result of expert's assessment											A _{ij}
i	j	1	2	3	4	5	6	7	8	9	10	11	
Air pollution	Greenhouse gas emission	2.00	2.00	2.00	3.00	4.00	7.00	5.00	4.00	3.00	1.00	1.00	2.622
	Water pollution	5.00	3.00	3.00	5.00	5.00	5.00	3.00	3.00	5.00	2.00	3.00	3.647
	Land quota	5.00	4.00	4.00	4.00	8.00	3.00	6.00	4.00	4.00	3.00	3.00	4.170
Greenhouse gas emission	Water pollution	4.00	3.00	2.00	2.00	3.00	3.00	0.50	3.00	4.00	3.00	3.00	2.495
	Land quota	4.00	2.00	2.00	3.00	2.00	0.50	4.00	3.00	5.00	4.00	1.00	2.340
Water pollution	Land quota	1.00	1.00	3.00	1.00	3.00	0.33	3.00	2.00	1.00	4.00	0.33	1.335
CR (%)		1.03	1.70	4.65	2.13	8.32	7.18	6.38	9.09	6.24	5.81	5.72	5.30

Indicator	Air pollution	Greenhouse gas emission	Water pollution	Land quota
Air pollution	1.00	2.62	3.65	4.17
Greenhouse gas emission	0.38	1.00	2.5	2.34
Water pollution	0.27	0.40	1.00	1.34
Land quota	0.24	0.43	0.75	1.00

	Air pollution	Greenhouse gas emission	Water pollution	Land quota	Total	Weight (W)	Vector sum of weights	Vector consistency	λ_{\max}	CI	CR	CR (%)
Air pollution	0.53	0.59	0.46	0.47	2.05	0.513	2.09	4.07	4.04	0.01	0.01	1.43
Greenhouse gas emission	0.20	0.22	0.32	0.26	1.01	0.252	1.02	4.05	3.02			
Water pollution	0.14	0.09	0.13	0.15	0.51	0.128	0.51	4.00	2.01			
Land quota	0.13	0.10	0.09	0.11	0.43	0.108	0.43	4.03	1.01			

Table S8. Matrix calculation for comparing MSW treatment technologies based on sustainability criteria

- Environmental criteria

	Landfilling	Composting	Incineration
Landfilling	1.00	0.33	0.20
Composting	3.00	1.00	0.50
Incineration	5.00	2.00	1.00

	Landfilling	Composting	Incineration	Total	Weight (W)
Landfilling	0.111	0.100	0.118	0.329	0.110
Composting	0.333	0.300	0.294	0.927	0.309
Incineration	0.556	0.600	0.588	1.744	0.581

- Social criteria

	Landfilling	Composting	Incineration
Landfilling	1.00	0.33	0.20
Composting	3.00	1.00	2.00
Incineration	5.00	0.50	1.00

	Landfilling	Composting	Incineration	Total	Weight (W)
Landfilling	0.111	0.104	0.063	0.278	0.095
Composting	0.333	0.545	0.625	1.504	0.515
Incineration	0.556	0.273	0.313	1.141	0.390

- Economic criteria

	Landfilling	Composting	Incineration
Landfilling	1.00	2.00	0.50
Composting	0.50	1.00	0.33
Incineration	2.00	3.00	1.00

	Landfilling	Composting	Incineration	Total	Weight (W)
Landfilling	0.286	0.333	0.273	0.892	0.297
Composting	0.143	0.167	0.180	0.490	0.163
Incineration	0.571	0.500	0.546	1.618	0.539

Table S9. Matrix calculation for pair-wise comparison of MSW treatment technologies based on sustainability criteria

	Environmental	Social	Economic
Landfilling	0.110	0.095	0.297
Composting	0.309	0.515	0.163
Incineration	0.581	0.390	0.539

1. Saaty, T.L., *The Analytic Hierarchy Process*. McGraw-Hill, New York, 1980.