THE CRITICAL FACTOR FOR THE IMPLEMENTATION OF WASTEWATER RECLAMATION, EXPLANATORY FINDING FOR AGRO-INDUSTRIAL ANALYSIS IN THAILAND

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ABSTRACT

This study aimed to explore the current perspective of the Thailand industry on wastewater reclamation technologies. The research focused on identifying the criteria that influence the decision-making process for implementing these technologies. Quantitative research was conducted using non-probability purposive sampling techniques to select a specific sample group consisting of individuals with knowledge and/or experience in wastewater reclamation technologies. The researchers collected at least 100 questionnaires from the selected respondents to ensure effective data gathering. The AHP-OS (Analytical Hierarchy Process-Online Survey) was utilized to evaluate the importance weight of each criterion based on the collected data. Pearson correlation analysis was also performed to examine the relationships between variables. The evaluation results showed a strong consensus among participants. Pairwise comparison values indicated the relative importance and preference of each criterion within their respective categories, aiding in decision assessment and prioritization. The Pearson correlation coefficients revealed trade-offs or conflicts between certain criteria. Further analysis demonstrated that water quality had a moderate negative correlation with reliability, ease of construction and deployment, ease of operation and maintenance, and capacity. Reliability exhibited a weak negative correlation with water quality, ease of operation and maintenance, and capacity. Ease of construction and deployment, ease of operation and maintenance, and capacity displayed weak correlations with other criteria. Corporate responsibility did not show significant correlations with any other criteria. In terms of environmental sub-criteria, the consolidated decision matrix indicated that "Environmental impacts" was slightly more important than "Safety Risk".

KEY WORDS: Wastewater Reclamation Technologies/ AHP-OS, Data Analysis/ Water Quality, Reliability/ Agro-Industry.

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CHAPTER I
INTRODUCTION

1.1 Background and rationale

Many countries around the world recognize the water scarcity problem as a critical problem that impacts our humanity's quality of life, economy, and ecosystem. About 30% of the world's population will live with freshwater scarcity resources for basic sanitation systems, and 60–70% of the world's population will live in regions with complete water scarcity or high water stress (Macedonio et al. 2012). As reported from the AQUASTAT database, 70% of the global freshwater was used by the agricultural, followed by 19% in the industry and 11% in domestic. (FAO, 2010) The global water demand has increased dramatically due to the continuous growth of the population, agriculture, and industry are causing increased water demand and contamination. (Hess et al., 2014) It was forecasted that more than 160% of the world's water would be needed to satisfy global water demand in 2030. (Lavrnić et al., 2017) The world industrialization is beginning to understand the critical role of water, especially agro-industry.

Agro-industry is an industry whose main activities focus on the preservation, preparation, and processing of harvested agricultural production. Agro-industry product has classification into both non-food and food following the International Standard Industrial Classification (ISIC) (John and Rudi, 2008). The continuous growth of agro-industry has the incentive from increasing interest in value-added food and agricultural products in the context of economic growth, food security, and opportunities for solving people's poverty. (Silva et al., 2019) The process requires large amounts of freshwater for various types of production processes, such as cleaning, cooling, and sterilizing. Especially the food industry, the quality of water is a significant concern in the production processes related to water. In addition to the enormous use of water, wastewater, and large amounts of contamination have generated throughout those processes. (Román et al., 2011)

Wastewater reclamation is considered an alternative to freshwater in areas with water availability problems. Many regions of the world are exploring the reuse as alternative water supplies in response to emerging water scarcity challenges. (Lazarova and Bahri, 2008; Aleisa and Al-Zubari, 2017) Multiple factors have driven the global expansion of water reclamation to get along with water scarcity and contaminated problems as a result of climate change, population growth, and growth of human civilization (Gulamussen et al., 2018) The water of wastewater reclamation has become an environmentally and economically viable alternative for the industry. water reclamation and reuse are already practiced in many countries around the world, but when compared to the amount of wastewater generated from municipal and industrial, it is a small fraction. (Miller, 2016) According to Sustainable Development goals six from the United Nations, they are considered the wastewater reclamation technology as one of a crucial solution for ensuring availability and sustainable management of water (UN, 2015).

Thailand has an agro-industry as one of the important industries that drive the economy, where water quantity and quality are crucial factors in almost every activity. At present, Thailand has initiated the use of wastewater reclamation systems in many industries, but still at a small number. The wastewater reclamation system is the new opportunity for the production facilities or company in agro-industry that normally requires a massive amount of water, including concerned in water quality as well, using the wastewater reclamation technologies is a great alternative to purify drain water that has been treated by the wastewater treatment system to reuse in the system. Reduce the amount of raw water or tap water that needs to be bought into the system, solve the problem of water shortage, and reclaimed water can be used in a different application, all of this is a benefit from the implementation the wastewater reclamation system.

To identify the weight of each criterion for the implementation of wastewater reclamation in Thailand agro-industry is very challenging. Several criteria influence the decision-making process. One of the most critical points in decision-making is determining essential criteria that affect the decisions both in terms of positive and negative (Saaty, 1990). In this paper, two analysis methodology consists of two analysis methodology, using content analysis to identify the current perspective to the wastewater reclamation technologies in a different context from Thailand agro-industry and using analytical Hierarchy Process to analyze the collected data by questionnaire to find the weight on each criterion and critical criteria that promote and obstruct the decision to use wastewater reclamation technology in Thailand. The research was designed to collect both qualitative data and quantitative data from 2 groups consist of the business owners, or high-level employees of the company used a high amount of water in the Thailand industries and Senior employees in the water contractor company or Specialist in water treatment systems. The research results beneficial to wastewater reclamation providers or nearby allows designing products and services to satisfy the needs of Thailand customers, encourage the industrial sector to use of wastewater reclamation instead of releasing treated water.

1.2 Research objectives and research questions

The objective (OBJ): To identify how each criterion affects the decision for implementation of wastewater reclamation technologies in the Thailand industry.

Research questions (RQ)

RQ2: How can the adoption of wastewater reclamation technology be effectively promoted within Thailand's industrial sectors?

Table 1.1 Research questions, objectives and data collection

Research Questions (RQ)	**Objectives (OBJ)**	**Data collection**
RQ1	OBJ	Collect data through 100 questionnaires from: 1. The business owners or high-level employees of the company used a high amount of water in the Thailand industries. 2. Senior employees in the water contractor company or Specialist in water treatment systems.
RQ2		

1.3 Scope of study

This study focuses on understanding the current perspective of wastewater reclamation technologies and identify how each criterion affects the decision to implementation of wastewater reclamation technologies in the Thailand industry. 100 questionnaires from the business owners or high-level employees of the company used a high amount of water in the Thailand industries and Senior employees in the Thai water contractor company or Thai specialist in water treatment systems. Use the Analytical Hierarchy Process method for the evaluation weight of each criterion to the implementation of wastewater reclamation technologies in Thailand industry.

1.4 Conceptual framework

General Information

- Interviewee information
- Company or industry information

Questionnaire

The criterion for implementation of wastewater reclamation technologies

- Technical
- Social
- Economic
- Environmental

→

- How each criterion affects the decision for implementation of wastewater reclamation technologies

Figure 1.1 Conceptual framework

1.5 The expected outcome of the study

1. Recognize how each criterion affects the decision for implementation of wastewater reclamation technologies in Thailand industry.
2. The result can be used to guideline the products or services of companies that provide services related to the wastewater reclamation technologies so that the products or services more satisfy with the Thailand industry.

CHAPTER II
LITERATURE REVIEW

This chapter involves three sections including Section 2.1 provides An overview of the Agro-industry and Wastewater reclamation technologies, Section 2.2 Concepts, and theories used in analyzing quantitative data and Section 2.3 contains the previous research papers relevant to the topic and discuss the concern criterion and alternative technologies of wastewater reclamation that will apply in this research, as outlined each section and sub-section below:

2.1 An overview of the Agro-industry and Wastewater reclamation technologies

2.1.1 The Agro-industry

2.1.2 The Wastewater reclamation technologies

2.2 Concepts and theories used in analyzing quantitative data

2.2.2 The Analytic Hierarchy Process for analyzing quantitative data

2.2.3 The BPMSG's AHP Online System – AHP-OS

2.3 The relevant research papers

2.1 An overview of the Agro-industry and Wastewater reclamation technologies

2.1.1 Agro-industry

Thailand Agro-industry is one of the most successful industries sectors. In B.E. 2560, Forward-looking expectations that the value of exports of processed agricultural industry Thai food section is expected to increase to 2 trillion baht. Thai food is exported to 6 continents, a total of 222 countries. Thailand is the number one food exporter in the world on many items. (Department of Industrial Promotion, 2015)

The agro-industrial sector has been defined as the subset of the manufacturing sector that added value to harvested agricultural products thought process, which includes transformation, preservation, and preparation of agricultural production toward intermediaries or final consumption. An important characteristic of the agro-industrial sector is the perishable nature of raw materials, the quantity and quality can change significantly over time. According to the International Standard Industrial Classification (ISIC) agro-industry taken to include manufacturers consists of: i) food and beverages; ii) tobacco products; iii) paper and wood products; iv) textiles, footwear, and apparel; v) leather products; and vi) rubber products. (Silva et al., 2009; Wilkinson and Rocha, 2008) The agro-industry is needed large amounts of water and high-quality water during the process operation. Table 2.1 represents the typical rates of water use in different Agro-Industries.

Table 2.1 Typical rates of water use for selected agroindustry

Industry	Range of water use (m^3/ton)
Canneries	
▪ Green beans	50-71
▪ Peaches and pears	15-20
▪ Other fruits and vegetables	4-35
Food and beverages	
▪ Beer	10-16
▪ Bread	2-4
▪ Meatpacking	15-20
▪ Milk products	10-20
Pulp and paper	
▪ Pulp	250-800
▪ paper	120-160
Textiles	
▪ Bleaching	200-300
▪ Dyeing	30-60

Source: Silva et al. (2009)

2.1.2 Water reclamation technologies

2.1.2.1 The definition and concept of the wastewater reclamation

The wastewater reclamation is the treatment process to make treated wastewater reusable for several beneficial purposes The water reuse concept is developed on three principles: (1) Providing reliable wastewater treatment to meet strict water quality requirements for reuse application, (2) Protecting public health, and (3) Achieving public acceptance. (Asano and Bahri, 2011). The implementation of wastewater reclamation in many countries has experienced water scarcity and water pollution problems as a result of the continuous increase in population and industrialization. The global implementation of water reclamation in the world is increasing, and the global reclamation capacity was expected to increase to 0.545 million m3/day in 2015 (Eslasmain, 2016). The treated wastewater effluents have been reused as an alternative water source (Jimenez and Asano, 2008).

Now, water reclamation technologies exist to provide water of almost any quality desired to the water is used for a variety of applications, as shown in Table 2.2 (Levine and Asano, 2004), the water quality requirements will vary depending on the usage purpose. The comparison of concepts about the extent to which water quality changes through municipal-level applications are shown as a graph in Figure 2.2 (Asano and Bahri, 2011)

Table 2.2 Applications of reclaimed water

Type of reuse	Example of application
Agricultural irrigation	Plants were grown for human consumption
Non-potable use	Landscape irrigation (parks, schoolyards, golf courses), fire protection, construction, and in-building use (toilets and cleaning)
Potable use	Direct pipe to pipe water supply, blending with municipal water supply
Industrial uses	Cooling water, boiler feed, process water, construction activities, and washdown water
Environmental uses	Groundwater replenishment, controlling saltwater intrusion, Artificial wetlands, and enhanced natural wetlands

Source: Levine and Asano (2004)

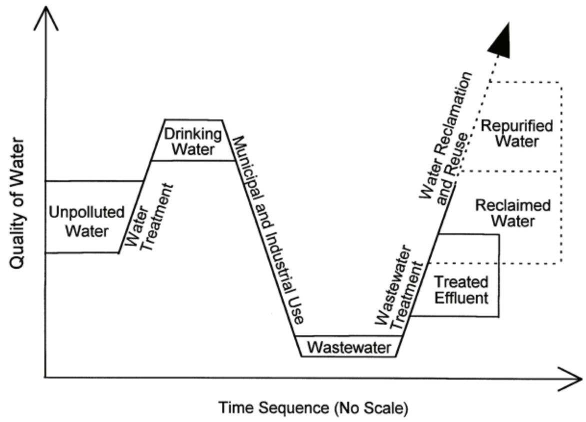

Figure 2.1 Water quality changes during public uses of water in a time sequence.
Source: Asano and Bahri (2011)

The wastewater reclamation technology plays an essential role in sustainable water resource management. The wastewater reclamation plant has designed based on several advanced technologies that have many different advantages, such as membrane bioreactors, ultraviolet disinfection, ozonation, and advanced oxidation.

2.1.2.2 Important of water reclamation technologies to industry.

Water reclamation for industries is mainly driven by the low availability of water, the contamination as a result of effluent released from industries, and high industrial water tariffs (Asano, 2002; Jiménez-Cisneros, 2014). However, a critical factor that limiting the use of reclaimed water in the industry is to ensure continuous operations without causing water shortages, reaching quality standards, acceptable costs, and acceptability of the use of reclaimed water by industries (Toze, 2006; Ordóñez et al., 2014). The water reclamation for industrial use is also influenced by factors such as environmental and climatic factors, social acceptance, and availability of financial support (Lautze et al., 2014). The drivers and reuse applications of water reclamation for industrial use in different regions are shown in Table 2.3.

Table 2.3 The drivers and reuse applications of industrial water reclamation in each region.

Region	Reuse Application	Driving factors of water reuse	References
Asia	▪ Cooling ▪ Washing ▪ Process water	▪ Water scarcity ▪ Political pressure	(Asano and Jimenez, 2008; USEPA, 1992)
Australia	▪ Cooling ▪ Boiler ▪ Firefighter ▪ Dust suppression	▪ Water scarcity ▪ Environmental concerns	(Asano and Jimenez, 2008; USEPA, 1992; Apostolidis et al., 2011)
Northern Europe	▪ Cooling	▪ High industrial water demand ▪ Resource efficiency ▪ Environmental concerns	(Asano and Jimenez, 2008; USEPA, 1992; Ryan, 2016; Marecos do Monte, 2007; Angelakis and Gikas, 2014)
North America	▪ Process water ▪ Cooling ▪ Condensing and steam generation	▪ Water scarcity ▪ Cost-effectiveness of reclaimed water ▪ Resource efficiency ▪ Environmental concerns	(Asano and Jimenez, 2008; USEPA, 1992; Schaefer et al., 2004; C. Smith, 2015)
Southern Africa	▪ Cooling ▪ Mining ▪ Process water	▪ Water scarcity	(Indian Institute of Technology, 2011)

Water use in the industry can be classified into cooling, boiler feed, and process water. The use of application water is for several purposes, such as cleaning, facilities operation, manufacturing, and construction activities. The cooling process is the most water use in industrial activity, which uses two-thirds of all industrial water (EUROSTAT, 2014). Many industrial processes depend on the availability of large quantities of reliable water sources. The reuse of wastewater has become an environmentally friendly and economic opportunity for the industry. (Gündoğdu et al., 2019) The industrial water reclamation practices are implemented mostly focus on water use reduction strategy. Besides, it is to reduce water pollution (Wang et al. 2008). Despite the water reclamation, have great potential in terms of sustainability and alternative water resource, at the present market for reclaimed water for the industry is still awaiting a wider implementation.

2.2 Concepts and theories used in analyzing quantitative data

2.2.1 The Analytic Hierarchy Process for analyzing quantitative data

The AHP is a multiple criteria decision-making tool that has been widely used in many decision-making applications that can be used with quantitative and qualitative data. This technique was developed at the Wharton School of Business by Saaty (Saaty, 1980). It supports the decision-makers to explore all possible alternatives in order to entirely understand the problems before making a decision (Estoque and Murayama, 2010; Yalcin, 2008). AHP has been generally used to solve problems of multi-criteria decision making in academic research and industry practice. AHP is widely used for diverse purposes, such as complex planning, resource allocation, and priority-setting problems in business, energy, health, marketing, transportation, natural resources, and environmental sciences (Schmoldt,et al., 2001). Its fundamental objective is to judge the most suitable choice according to a specific goal by evaluating priorities to all alternatives and the criterion (Saaty, 2001). A pairwise comparison technique is used to determine the priority of each criterion and alternatives for achieving the goal objective.

They consist of three principles of the AHP used for problem-solving are as mention below (Malczewski, 1999; Saaty 1980, 2008a): (1) Decomposition—Organize the elements of the problem into a hierarchical structure, (2) Comparative judgments—Generate a pair-wise comparison matrix of all elements at the same level compare each related element in the level and, (3) Synthesis of priorities—Calculate the global priority of an element at the lowest level of the hierarchy. The AHP steps for evaluating criteria weight consists of five steps, as presented below (Teknomo, 2006; Coyle, 2004; Aşchileana et al., 2017)

- Step 1: Modeling the Problem

Define the problem and identification of decision elements such as alternatives and criteria by analyzing all participants, objectives, and related things. Set up all elements, including the goal, criteria, sub-criteria, and alternatives in order into a hierarchy (Johnson, 1980; Vaidya and Kumar, 2006). At the first level of the hierarchy is the overall goal. The second level of the hierarchy is the decision rules or criteria. This level can be extended to sub-element below the main criteria above, depending on how much detail. The lowest level contains the alternative from the decision-maker—a simplified structure of the AHP shown in figure 2.3.

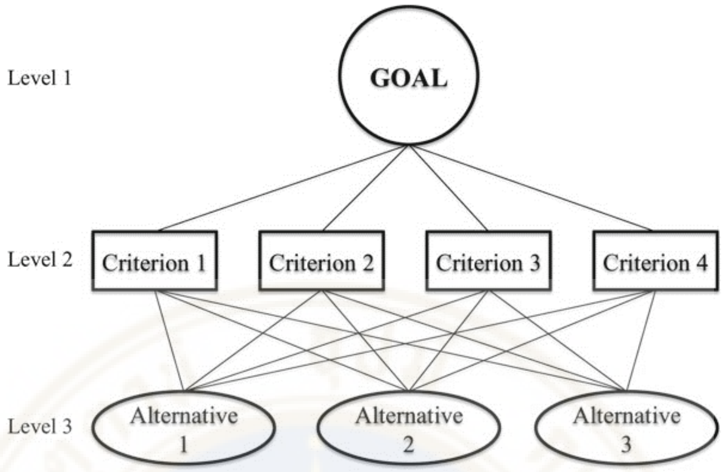

Figure 2.2 The general structure of AHP for multi-criteria decision making
Source: Zahedi (1986)

- Step 2: Determining Priorities Among the Decision Elements of the Hierarchy

Evaluate ratings for each of the criteria and alternatives using a pair-wise comparison technique from the participation of experts and/or stakeholders by comparing the relative importance of one decision element over another at the same level by using the rating scale developed by Saaty represents in Table 2.4 The number of comparisons for the decision elements at a particular level is determined by using equation (1) (Teknomo, 2006; Vaidya and Kumar, 2006). The comparison value will arrange through a pair-wise comparison matrix, as shown in Table 2.5 as c= [cij] (Saaty, 2008a). Moreover, all matrix shall contain the total value below each column, which is calculated following on the equation (2)

Table 2.4 The fundamental scale of absolute numbers

Importance	Definition	Explanation
1	Equal importance	Two activities (elements) contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgment slightly favor one activity (element) over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor one activity (element) over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity (element) is favored very strongly over another; its dominance is demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity (element) over another is of the highest possible order of affirmation

Source: Saaty (2008b)

Table 2.5 The Example of the pairwise comparison matrix for the criteria adaptation from Bangweon and Seokjoong (2016)

Topic	Criterion 1	Criterion 2	Criterion 3	Weight
Criterion 1	1	A	C	W_1
Criterion 2	1/A	1	B	W_2
Criterion 3	1/C	1/B	1	W_3

$$\text{Numberofcomparison} = \frac{n(n-1)}{2} \quad (1)$$

where n is the number of elements.

$$Sj = \sum_{j=1}^{m} cji \tag{2}$$

where Sj is the total sum value of the column

m is the number of decisional criteria

Before going to the next step, all pair-wise comparison matrix for the criteria and the alternatives have been prepared.

- Step 3: Calculating the normalized values for each criterion

The normalized values "nij" are acquired by dividing the value obtained as a result of comparison with the total value of their column "Sj", a calculation based on the following on the equation (3)

$$nij = \frac{cij}{Sj} \tag{3}$$

Then, converted the pairwise comparison between criteria into weights, those weights are an average of the normalized values on each row, based on the equation (4), as follows:

$$kj = \frac{\sum_{j=1}^{m} nji}{m} \tag{4}$$

Where kj is the importance coefficients (weights) of the decision criteria.

- Step 4: Determining the normalized principal eigenvectors (priority vectors)

The vector of priorities is calculated as an average of multiplication between the matrix of relative weights of decision criteria and the average weight of decision criteria, based on the following on the equation (5)

$$\lambda max = \sum_{j=1}^{m} \frac{(c \cdot k)j}{m \cdot kj} \qquad (5)$$

where (c·k)j is the elements of the matrix-vector determined as a result of multiplying the "c" matrix with "k" vector

- Step 5: Verifying the Consistency of Judgments and Making Conclusions.

Determine the consistency of the evaluation by calculating the consistency ratio (CR) before making Conclusions. The CR for a particular matrix is calculated by the uniformity coefficient (CI) divided by the random consistency index (RI) following equation (6) (Saaty, 1980) The results from the sum of the multiplications between the weight of each criterion will present the importance of each criterion. The criteria that get the highest score indicates the most significant impact on the decision

$$CR = \frac{CI}{RI} \qquad (6)$$

Where the uniformity coefficient "CI" is calculated based on equation (7) and the random consistency index "RI" values presented in Table 2.6 below

$$CI = \frac{\lambda max\text{-}m}{m\text{-}1} \qquad (6)$$

Table 2.6 The random consistency index (RI) values

n	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
RI	0.00	0.00	0.58	0.90	1.12	124	1.32	1.41	1.45	1.49	1.51	1.48

Source: Saaty (1980)

However, the Analytic Hierarchy Process in this study, there will be hierarchies to level 3, consisting of the overall goal, criterion, Sub-criterion, not include the final level of alternative because the purpose of this research is to evaluate the weight of the criteria that affect the decision to implement wastewater reclamation in industrial.

2.2.3 The BPMSG's AHP Online System – AHP-OS

AHP-OS is web-based software for non-commercial users developed by Klaus D. Goepel, accessible through this URL link: https://bpmsg.com/ahp/. The software is an implementation based on an open-source scripting language named Hypertext Preprocessor (PHP), and database functions are using Structured Query Language (SQL). It contains various tools and features based on the Analytic Hierarchy Process (AHP) principles following Prof. Thomas L. Saaty has developed to support rational decision-making. The software can calculate priorities and evaluate a set of decision alternatives against those criteria from simple to complex decision-making problems. These are the functions and features that AHP-OS has, as shown below

- Flexible definition of decision hierarchies.
- Weight calculation and alternative evaluation.
- Pairwise comparison input, highlighting the top-3 most inconsistent judgments.
- A posteriori application of different AHP judgment scales.
- Group decision making using weighted geometric mean aggregation of individual judgments.
- Group consensus calculation.
- Weight uncertainty estimation.
- Sensitivity analysis.
- Weighted sum model and weighted product model for the aggregation of alternatives.
- Export input and result data as comma-separated value (CSV) files for further processing or presentation in a spreadsheet program.

2.3 The relevant research papers

Conducted a review of the research that uses an analytical hierarchy process (AHP) or other decision-making methods to select the appropriate wastewater reclamation. The objective is to find the suitable criteria to be applied in this research. Summarize the content of the research studied as follows and summarized the criteria of each research under four main topics consist of Technical, Social, Economic, and Environmental as represent in table 2.7.

Sadr et al. (2015), use a fuzzy logic-based multi-criteria group decision-making tool in the paper to facilitate the selection of the best membrane assisted experts from academia and industry undertook treatment technologies for different water reuse scenarios by evaluation. This study ranks wastewater treatment technology based on 10 different criteria as shown in table x with 10 membranes assisted in 4 different wastewater reuse scenarios. The results show that in the scenarios considering potable water reuse applications, Water quality, and community acceptance were the most important criteria in these scenarios. The results of scenarios associated with non-potable water reuse show that cost-related criteria and energy consumption were weighed higher than other criteria.

Curiel-Esparza et al. (2014), using a hybrid method combining the AHP with the Delphi method and the VIKOR technique to select a sustainable disinfection technology for wastewater reuse projects. The research focused on implementing sustainability criteria in decision making consist of technical performance, economic profit, and sustainability criteria. The results show that the main criteria for selecting the best technique for expert judgment are capital cost (24.42%), reliability of the system (22.68%), and operation and maintenance costs (20.92%). The technologies of ultraviolet radiation and natural systems have a good rank. The ultraviolet radiation technology is the best alternative from evaluating weight in overall criteria by experts (28.38%), followed by natural systems alternative (25.07%). The Delphi-AHP-VIKOR expert system proposed in this paper is a reliable method in selecting a sustainable disinfection technique for wastewater reuse projects.

Hadipour et al. (2015), applied an MCDM model based on the analytic hierarchy process structure with four criteria, sixteen sub-criteria, and five alternatives as having been implemented in order to find the best alternative for wastewater reuse application in Iran. The five alternatives, including agricultural irrigation, landscape irrigation, industrial use, environmental uses, and groundwater recharge. From the result, the best alternative for wastewater reuse is groundwater recharge, and environmental use is the second alternative. The analytic hierarchy process is an effective approach for sustainable wastewater reuse management and can be applied to other sectors.

Jing et al. (2013), using a hybrid stochastic-interval analytic hierarchy process (SIAHP) to prioritizing the strategies of reusing treated wastewater from a WWTP in the city of Shuangcheng, China, among four alternatives consist of city moat landscaping, municipal reuse, industrial reuse, and agricultural irrigation. The experts have investigated and evaluated the alternatives base on the three main criteria and their sub-criteria. Based on the concluding overall scores, industrial reuse (0.18–0.3) is more preferred than municipal reuse (0.16–0.25) or agricultural irrigation (0.17–0.26). It can be concluded that choosing industrial reuse seems to give the best overall account of technical, economic, and environmental concerns.

The researchers have summarized the criteria which have adopted fromreviewed the literatureina table formfor easy understanding, in which all criteriaweredivided, matchingto four main categories consists of Technical, Social, Economic, and Environmentalare represented in table 2.7.All of these criteria will be chosen for further consideration as appropriate for use in this research.

Table 2.7 Summarize the criteria from the research review.

No	Research topics	Assessment tools	Criteria			
			Technical	**Social**	**Economic**	**Environmental**
1	A group decision making tool for the application of membrane technologies in different water reuse scenarios	MCMEDM	• Adaptability • Ease of construction and deployment • Land requirement • Level of complexity • Water quality and reliability	• Community acceptance	• Capital cost • Operation & maintenance Cost • Energy consumption	• Impact on the environment
2	Selecting a Sustainable Disinfection Technique for Wastewater Reuse Projects	AHP-Delphi; VIKOR	• Reliability of the system • Operational simplicity • Efficiency in reducing pathogenic micro organisms • Level of complexity	-	• Capital cost • Operation & Maintenance cost • Additional treatments	• Environmental impacts • Use of natural resources • Safety Risk
3	Multi-criteria decision-making model for wastewater reuse application: a case study from Iran	AHP	• Applicability • Quality of effluent • Quantity of effluent • Simple operation and maintenance • Institutional cooperation	• Public acceptant • Health risks • Social benefits • Governmental support	• Capital cost • Operational cost • Income generation • Financial opportunities	• Ecological risks • Water reservation • Environmental

Table 2.7 Summarize the criteria from the research review (cont.)

No	Research topics	Assessment tools	Criteria			
			Technical	Social	Economic	Environmental
4	A Hybrid Stochastic-Interval Analytic Hierarchy Process Approach for Prioritizing the Strategies of Reusing Treated Wastewater	SIAHP	• Applicability • Water quality requirements • Capacity • Convenience • Reliability • Simple operation and maintenance	-	• Capital cost • Operational cost • Benefits	• Ecological Risk • Human Risk • Water Reservation • GHG Reduction • Aesthetics

CHAPTER III
RESEARCH METHODS

This research study use research methodology, which is quantitative research using questionnaires for data collection and analysis through the Analytic Hierarchy Process. The researcher studied from research papers and documents that are related to the research objectives and reviewed the research literature with research methods using similar concepts and theories. Summarize the important criteria for use with analysis tools in this research—the research procedure, as shown in Figure 3.1.

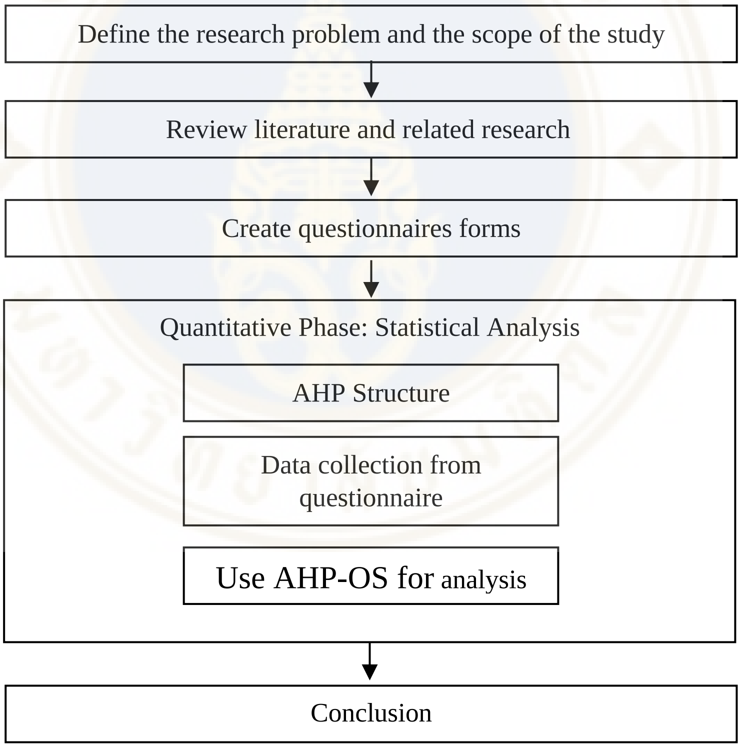

Figure 3.1 Summarize the important criteria for use with analysis tools in this research

3.1 Sample

The quantitative research in this study using Non probability purposive sampling techniques to select a specific sample group from people who have knowledge or/and experience in wastewater reclamation technologies according to researcher requirement because of the data gathering from the answer of this group will give the most effective for this research.

The researcher's requirement quantitative research needs to be consistent with the purpose of the study. Research data collection require to collected from the specific person or sample group who have knowledge or/and experience in the wastewater reclamation technologies in the context of users or service providers, which have divided in detail into two groups as follows:

Group 1: The business owners or high-level employees involved in the water management of companies that operate in the agricultural processing industry because most of the activities have water involved. The water reclamation technologies are an alternative to achieve sustainable water management of this sample group

Group 2: High-level employees from companies that provide a major role in the water business market, such as water system contractors, water machinery and equipment dealers, and water system consultants, including water system experts. The sample group has the knowledge and experience that can explain the current market feedback to the water reclamation technologies, as well as understand customer perception.

The researchers determined the number of questionnaires collected for the quantitative research phase at least 100 sets from the respondents selected according to sample group requirements

3.2 Research tools: AHP

AHP methodology is used to analyze data in the quantitative research phase to determine the weight of each criterion that affects the decision to implement the wastewater reclamation technologies. The Data were collected using questionnaires developed hierarchical structure based on the criteria reviewed in chapter 2.3, which can classify each element in each level as in Figure 3.1. The questionnaire was developed to be consistent with the above hierarchical structure by using the pair-wise comparison method to evaluate the weight between each criterion. There are consist of three parts consist of (1) General information of respondents, (2) Evaluate the weight between each of criterion following of the analytical hierarchy process theory, and (3) recommendations

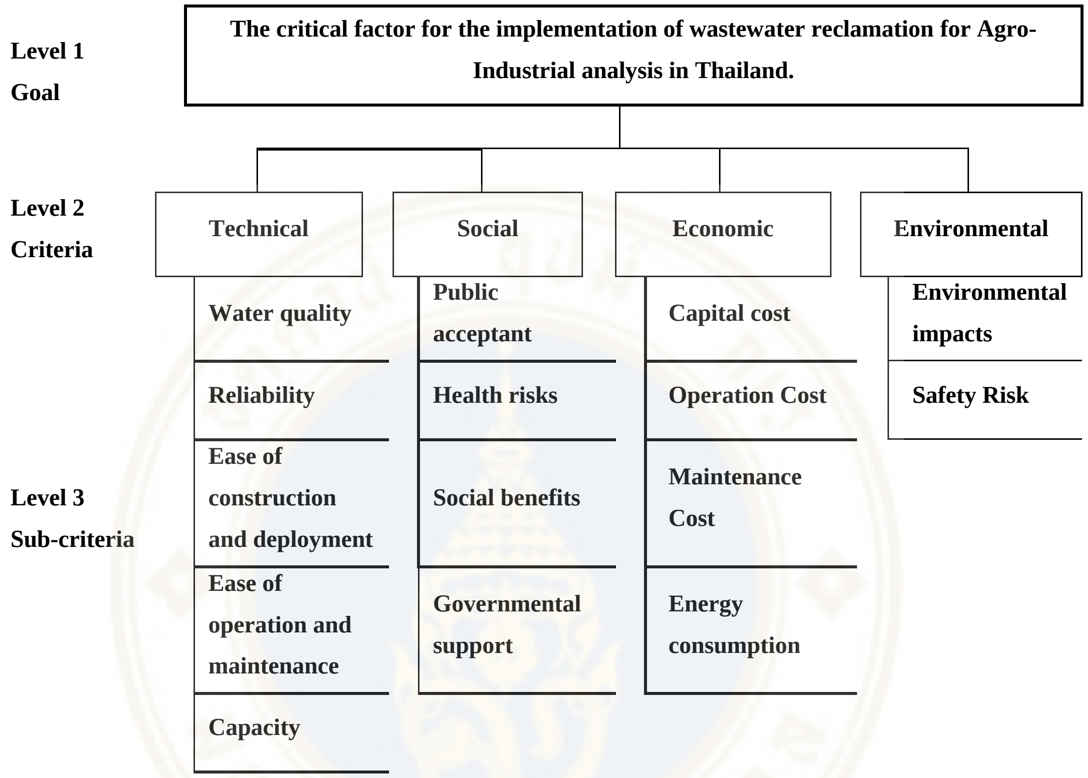

Figure 3.2 Summary of hierarchy structure for the importance of the decision to implement the wastewater reclamation technologies

The way how to rate the importance between each criterion pair put the checkmark in the score box on the side that the respondent's value more. For example, as shown in Table 3.1, the respondent's checkmark in score box number 6 on the technical criteria side it means the technical criteria is strong plus important than the social level in the respondent's aspect.

Table 3.1 The Example of filling out a questionnaire

Technical																**Social**
9	8	7	6√	5	4	3	2	1	2	3	4	5	6	7	8	9
Extreme importance							Equal importance						Extreme importance			

3.3 Data collection methods

The researcher has collected the data by following the steps

1. Create a letter requesting permission to collect data for research sent via email to the selected company or person. The content in the request letter contains the purpose of the research, details, and benefits of the research.

2. After receiving permission from the company or the person who sent the letter

- For those who have been selected to conduct in the quantitative research phase, the questionnaire is sent via email, and the internal data consists of the research objectives and the brief information of the research. The early content of the questionnaire is a policy to keep confidentiality and prevent data risk. Google Forms are set up to allow respondents to submit answers only once, and respondents will not be able to see other people's answers.

3. Collecting all the data from questionnaires checking the correctness of the obtained data. Prepare the data to be ready for further analysis.

3.4 Data analysis

The researcher uses the AHP-OS to evaluate each criterion's importance weight based on the data collected from the questionnaire, resulting in faster and more accurate data analysis than manual calculations. Besides, the AHP-OS has the function to check the data collection's consistency to ensure that the information collected is consistent with AHP's calculation principles. Pearson Correlation was analysis the relationship between variables.

CHAPTER IV
RESEARCH RESULTS AND DISCUSSION

To provide the most accurate research results, the researcher will prioritize the analysis results from the analysis hierarchy process method and strengthen the reliability of the findings by the analyzed conclusions.

4.1 Data collection from the AHP questionnaire

The research data was collected from questionnaires submitted to the participants who have power or get involved in making decisions related to internal water resource management within the company or organization, and the participant's work position are shown in Table 4.1.

Table 4.1 Summary of the participants who submitted the questionnaire

No.	Participants group	Participants Number	Position
1	Water business company	65	- CEO/Owner - Managing Director - Purchasing Manager - Project Manager - Operation Manager - Design Engineering - Environmental Engineering - Water System Expert
2	Argo-industry company	35	- CEO/Owner - Production Manager - Quality Control Director - Quality Control Manager - General Manager - Utility manager - Purchasing Manager - Research Assistance

4.2 Data processing from collected questionnaire

The collected questionnaire data from 100 participants were entered into the AHP Online system to analyze and illustrate the results using the pair-wise comparison method to evaluate the weight between each criterion. The results are represented in consolidated global priorities and breakdown by nodes.

- The breakdown by nodes section analysis of consolidated priorities, consolidated decision matrix and AHP group consensus.
- The consolidated global priorities analysis of group consensus and global weights.

4.2.1 Breakdown by nodes of goal criteria level

Table 4.2 the minimum, maximum, mean, and standard deviation values for Global weights by nodes and participants

	Minimum	Maximum	Mean	Std. Deviation
Technical	0.05	0.59	0.31	0.12
Social	0.04	0.35	0.13	0.08
Economic	0.07	0.72	0.37	0.14
Environmental	0.04	0.57	0.20	0.11
Corporate Responsibility	0.00	0.11	0.04	0.03

The table 4.2 provided shows the minimum, maximum, mean, and standard deviation values for different categories: Technical, Social, Economic, Environmental, and Corporate responsibility. For each category, the minimum value represents the lowest score observed, while the maximum value represents the highest score. The mean value represents the average score across all observations, and the standard deviation indicates the variability or spread of the scores within each category.

Based on the data you provided, here are some observations:

Technical: The scores range from 0.05 to 0.59, with an average score of 0.31 and a relatively low standard deviation of 0.12.

Social: The scores range from 0.04 to 0.35, with an average score of 0.13 and a standard deviation of 0.08.

Economic: The scores range from 0.07 to 0.72, with an average score of 0.37 and a standard deviation of 0.14.

Environmental: The scores range from 0.04 to 0.57, with an average score of 0.20 and a standard deviation of 0.11.

Corporate Responsibility: The scores range from 0.00 to 0.11, with an average score of 0.04 and a relatively low standard deviation of 0.03.

These statistics provide insights into the range and distribution of scores within each category, allowing for a better understanding of the performance or impact in each area.

4.2.1.1 Consolidated Priorities

The breakdown of the goal criteria level represented in Table 4.3 provides valuable insights into the priorities and ranks among criteria. Among the four criteria, the Economic criterion takes precedence with a significant priority of 37.20% (Rank 1), signifying its paramount importance in the decision-making process. The Technical criterion secures the second position with a priority of 31.30% (Rank 2), highlighting its substantial role. Environmental follows closely, obtaining a priority of 19.50% (Rank 3), emphasizing its significance. The Social criterion takes the fourth place with a priority of 12.00%. The high AHP group consensus of 77.3% indicates strong agreement among the participants in this evaluation.

Table 4.3 shows the priorities of the goal criteria level, calculated from the data in Table 4.3 using the AHP online tool.

Table 4.3 Breakdown by nodes consolidated priorities of goal criteria level

No.	Criteria	Priority	Rank
1	Technical	31.30%	2
2	Social	12.00%	4
3	Economic	37.20%	1
4	Environmental	19.50%	3
AHP group consensus: 77.3% high			

4.2.1.2 Consolidated Decision Matrix

Table 4.4 Breakdown by nodes consolidated decision matrix of goal criteria level

Criteria	Technical	Social	Economic	Environmental
Technical	1.00	2.65	0.83	1.61
Social	0.38	1.00	0.33	0.60
Economic	1.21	2.99	1.00	1.93
Environmental	0.62	1.66	0.52	1.00

The table 4.4 provided is a breakdown of a consolidated decision matrix for goal criteria at different levels. The criteria are divided into four categories: Technical, Social, Economic, and Environmental. The values in the table represent the pairwise comparisons between the criteria.

Technical: The diagonal value of 1.00 indicates that the Technical criteria are compared to themselves, resulting in a perfect match. The other values in the row represent the relative importance or preference of the Technical criteria compared to the other criteria. For example, the value of 2.65 suggests that the Technical criteria are considered 2.65 times more important than the Social criteria.

Social: The diagonal value of 1.00 indicates a perfect match when comparing the Social criteria to themselves. The other values in the row represent the relative importance or preference of the Social criteria compared to the other criteria. For example, the value of 0.33 suggests that the Social criteria are considered 0.33 times less important than the Economic criteria.

Economic: The diagonal value of 1.00 indicates a perfect match when comparing the Economic criteria to themselves. The other values in the row represent the relative importance or preference of the Economic criteria compared to the other criteria. For example, the value of 1.93 suggests that the Economic criteria are considered 1.93 times more important than the Environmental criteria.

Environmental: The diagonal value of 1.00 indicates a perfect match when comparing the Environmental criteria to themselves. The other values in the row represent the relative importance or preference of the Environmental criteria compared to the other criteria. For example, the value of 0.62 suggests that the

Environmental criteria are considered 0.62 times less important than the Technical criteria.

These pairwise comparison values provide insights into the relative importance or preference of each criterion within each category. They can be used to assess and prioritize different criteria when making decisions or evaluating alternatives.

Table 4.5 correlation analysis of Technical, Social, Economic, Environmental, and Corporate responsibility

		Technical	**Social**	**Economic**	**Environmental**	**CR**
Technical	Pearson Correlation	1	-.255*	-.561**	-0.146	-0.008
	Sig. (2-tailed)		0.011	0.000	0.148	0.935
Social	Pearson Correlation	-.255*	1	-.230*	-0.111	-0.003
	Sig. (2-tailed)	0.011		0.022	0.273	0.974
Economic	Pearson Correlation	-.561**	-.230*	1	-.574**	0.035
	Sig. (2-tailed)	0.000	0.022		0.000	0.729
Environmental	Pearson Correlation	-0.146	-0.111	-.574**	1	-0.036
	Sig. (2-tailed)	0.148	0.273	0.000		0.726
Corporate responsibility	Pearson Correlation	-0.008	-0.003	0.035	-0.036	1
	Sig. (2-tailed)	0.935	0.974	0.729	0.726	

*Significant level 0.05

**Significant level 0.05

The Pearson correlation coefficient measures the strength and direction of the linear relationship between two variables. A value of 1 indicates a perfect positive correlation, -1 indicates a perfect negative correlation, and 0 indicates no correlation.

- Technical:

The coefficient between Technical and Social is -0.255, indicating a negative correlation (although relatively weak) between these two criteria.

The coefficient between Technical and Economic is -0.561, indicating a moderate negative correlation between these two criteria.

The coefficient between Technical and Environmental is -0.146, indicating a weak negative correlation between these two criteria.

The coefficient between Technical and CR is -0.008, indicating almost no correlation between these two criteria.

- Social:

The coefficient between Social and Technical is -0.255, indicating a negative correlation (although relatively weak) between these two criteria.

The coefficient between Social and Economic is -0.230, indicating a negative correlation (although relatively weak) between these two criteria.

The coefficient between Social and Environmental is -0.111, indicating a weak negative correlation between these two criteria.

The coefficient between Social and CR is -0.003, indicating almost no correlation between these two criteria.

- Economic:

The coefficient between Economic and Technical is -0.561, indicating a moderate negative correlation between these two criteria.

The coefficient between Economic and Social is -0.230, indicating a negative correlation (although relatively weak) between these two criteria.

The coefficient between Economic and Environmental is -0.574, indicating a moderate negative correlation between these two criteria.

The coefficient between Economic and CR is 0.035, indicating almost no correlation between these two criteria.

- Environmental:

The coefficient between Environmental and Technical is -0.146, indicating a weak negative correlation between these two criteria.

The coefficient between Environmental and Social is -0.111, indicating a weak negative correlation between these two criteria.

The coefficient between Environmental and Economic is -0.574, indicating a moderate negative correlation between these two criteria.

The coefficient between Environmental and CR is -0.036, indicating almost no correlation between these two criteria.

- Corporate responsibility:

The coefficient between Corporate responsibility and Technical is -0.008, indicating almost no correlation between these two criteria.

The coefficient between Corporate responsibility and Social is -0.003, indicating almost no correlation between these two criteria.

The coefficient between Corporate responsibility and Economic is 0.035, indicating almost no correlation between these two criteria.

The coefficient between Corporate responsibility and Environmental is -0.036, indicating almost no correlation between these two criteria.

The p-values associated with each correlation coefficient indicate the statistical significance of the correlations. A p-value less than 0.05 suggests that the observed correlations are unlikely to occur by chance.

The correlation analysis reveals interesting relationships between the different criteria. The Technical criteria show a moderate negative correlation with the Economic criteria, suggesting that as the importance of Technical factors increases, the importance of Economic factors tends to decrease. There is also a weak negative correlation between Technical and Social criteria, indicating a slight trade-off between these two areas. Similarly, there is a weak negative correlation between Technical and Environmental criteria, suggesting some conflicting priorities. The Social criteria exhibit a weak negative correlation with both Economic and Environmental criteria, implying that as the importance of Social factors increases, the importance of Economic and Environmental factors may slightly decrease. The Economic criteria show a moderate negative correlation with both Technical and Environmental criteria, indicating potential trade-offs between these areas. On the other hand, the Environmental criteria show weak negative correlations with Technical and Social criteria, suggesting some misalignment in priorities. The Corporate responsibility criterion shows almost no correlation with any of the other criteria, indicating its independence from the other factors. These correlation results provide valuable insights into the relationships between different criteria and can assist in decision-making processes by highlighting potential trade-offs or conflicts among them.

4.2.2 Breakdown by nodes of technical sub-criteria level

Table 4.6 the minimum, maximum, mean, and standard deviation values for technical sub-criteria level

	Minimum	Maximum	Mean	Std. Deviation
Water quality	0.05	0.60	0.31	0.12
Reliability	0.05	0.53	0.24	0.12
Ease of construction and deployment	0.03	0.44	0.10	0.06
Ease of operation and maintenance	0.03	0.49	0.15	0.10
Capacity	0.03	0.46	0.20	0.09
Corporate responsibility	0.00	0.10	0.05	0.02

In terms of the data provided, the table 4.6 shows the water quality criterion ranges from a minimum score of 0.05 to a maximum score of 0.60, with a mean score of 0.31 and a standard deviation of 0.12. Similarly, the reliability criterion ranges from 0.05 to 0.53, with a mean score of 0.24 and a standard deviation of 0.12. The ease of construction and deployment criterion ranges from 0.03 to 0.44, with a mean score of 0.10 and a standard deviation of 0.06. The ease of operation and maintenance criterion ranges from 0.03 to 0.49, with a mean score of 0.15 and a standard deviation of 0.10. The capacity criterion ranges from 0.03 to 0.46, with a mean score of 0.20 and a standard deviation of 0.09. Lastly, the corporate responsibility criterion ranges from 0.00 to 0.10, with a mean score of 0.05 and a standard deviation of 0.02.

- Consolidated Priorities

The breakdown by nodes of the technical sub-criteria level represented in Table 4.7, reveals the priorities and ranks assigned to each criterion. Water Quality emerges as the most crucial sub-criterion with the highest priority of 32.20% (Rank 1), signifying its utmost importance. Reliability follows closely at 24.00% (Rank 2), underscoring its critical role. Capacity secures the third position with a priority of 20.20% (Rank 3), highlighting its significance. Ease of Operation and Maintenance (14.20%) and Ease of Construction and Deployment (9.50%) obtain Ranks 4 and 5, respectively. The AHP group consensus for this level is 75.2%, indicating a high level of agreement among the evaluators.

Table 4.7 shows the priorities of the technical sub-criteria level criteria level, calculated from the data in Table 4.5. using the AHP online tool.

Table 4.7 Breakdown by nodes consolidated priorities of technical sub-criteria level

No.	Criteria	Priority	Rank
1	Water quality	32.20%	1
2	Reliability	24.00%	2
3	Ease of construction and deployment	9.50%	5
4	Ease of operation and maintenance	14.20%	4
5	Capacity	20.20%	3
AHP group consensus: 75.2% high			

- Consolidated Decision Matrix

Table 4.8 Breakdown by nodes consolidated decision matrix of technical sub-criteria level

Sub-Criteria	Water quality	Reliability	Ease of construction and deployment	Ease of operation and maintenance	Capacity
Water quality	1.00	1.43	3.07	2.25	1.66
Reliability	0.7	1.00	2.53	1.67	1.29
Ease of construction and deployment	0.33	0.4	1.00	0.64	0.44
Ease of operation and maintenance	0.44	0.6	1.57	1.00	0.66
Capacity	0.6	0.78	2.25	1.51	1.00

The values in the table 4.8 are filled using a scale where 1 represents equal importance, and other values indicate the relative importance between the sub-criteria. For example, a value of 1.43 in the cell where "Water quality" intersects with "Reliability" indicates that "Reliability" is considered to be approximately 1.43 times more important than "Water quality" based on the judgment of the decision-makers.

The interpretations for each cell in the matrix:

Water quality: The sub-criteria are compared to themselves, resulting in a value of 1.00, indicating equal importance.

Reliability: The importance of "Reliability" compared to "Water quality" is 1.43, indicating that "Reliability" is considered more important than "Water quality".

Ease of construction and deployment: The importance of "Ease of construction and deployment" compared to "Water quality" is 3.07, indicating that "Ease of construction and deployment" is considered significantly more important than "Water quality".

Ease of operation and maintenance: The importance of "Ease of operation and maintenance" compared to "Water quality" is 2.25, indicating that "Ease of operation and maintenance" is considered more important than "Water quality".

Capacity: The importance of "Capacity" compared to "Water quality" is 1.66, indicating that "Capacity" is considered more important than "Water quality".

Table 4.9 The correlation analysis of technical sub-criteria level

		Water quality	**Reliability**	**Ease of construction and deployment**	**Ease of operation and maintenance**	**Capacity**	**corporate responsibility**
Water quality	Pearson Correlation	1	-.330**	-.334**	-.306**	-.293**	0.017
	Sig. (2-tailed)		0.001	0.001	0.002	0.003	0.866
Reliability	Pearson Correlation	-.330**	1	-0.058	-.447**	-.368**	-0.104
	Sig. (2-tailed)	0.001		0.569	0.000	0.000	0.304
Ease of construction and deployment	Pearson Correlation	-.334**	-0.058	1	-0.045	-0.146	0.094
	Sig. (2-tailed)	0.001	0.569		0.657	0.149	0.356
Ease of operation and maintenance	Pearson Correlation	-.306**	-.447**	-0.045	1	-0.048	0.084
	Sig. (2-tailed)	0.002	0.000	0.657		0.639	0.409
Capacity	Pearson Correlation	-.293**	-.368**	-0.146	-0.048	1	-0.040
	Sig. (2-tailed)	0.003	0.000	0.149	0.639		0.698
corporate responsibility	Pearson Correlation	0.017	-0.104	0.094	0.084	-0.040	1
	Sig. (2-tailed)	0.866	0.304	0.356	0.409	0.698	

The correlation analysis you provided shows the Pearson correlation coefficients between water quality, reliability, ease of construction and deployment, ease of operation and maintenance, capacity, and corporate responsibility. The coefficients indicate the strength and direction of the linear relationship between the criteria.

Based on the results, there are some interesting findings. Water quality has a moderate negative correlation with reliability, ease of construction and deployment, ease of operation and maintenance, and capacity. This suggests that as water quality improves, there tends to be a decrease in the importance or performance of these criteria. There is also a weak positive correlation between water quality and corporate responsibility, indicating a slight association between these two factors.

Reliability shows a weak negative correlation with water quality, ease of operation and maintenance, and capacity. This suggests that as reliability improves, there may be a slight decrease in the importance or performance of these criteria.

Ease of construction and deployment, ease of operation and maintenance, and capacity show weak correlations with the other criteria. These correlations suggest that there may be some minor associations between these criteria, but the relationships are not particularly strong.

Corporate responsibility shows no significant correlations with any of the other criteria. This indicates that corporate responsibility is relatively independent of the other factors considered in the analysis.

4.2.3 Breakdown by nodes of social sub-criteria level

Table 4.10 the minimum, maximum, mean, and standard deviation values for social sub-criteria level

	Minimum	Maximum	Mean	Std. Deviation
Public acceptant	0.04	0.47	0.20	0.11
Health risks	0.04	0.59	0.17	0.09
Social benefits	0.04	0.48	0.17	0.10
Governmental support	0.06	0.74	0.47	0.13
Corporate responsibility	0.00	0.09	0.04	0.03

The table 4.10 provided includes the minimum, maximum, mean, and standard deviation values for several criteria: public acceptance, health risks, social benefits, governmental support, and Corporate responsibility.

For public acceptance, the criterion ranges from a minimum score of 0.04 to a maximum score of 0.47. The mean score is 0.20, and the standard deviation is 0.11. This indicates that the scores for public acceptance vary between 0.04 and 0.47, with an average score of 0.20 and a moderate level of variability.

Similarly, for health risks, the criterion ranges from 0.04 to 0.59, with a mean score of 0.17 and a standard deviation of 0.09. This suggests that the scores for health risks vary between 0.04 and 0.59, with an average score of 0.17 and a relatively low level of variability.

The social benefits criterion ranges from 0.04 to 0.48, with a mean score of 0.17 and a standard deviation of 0.10. This indicates that the scores for social benefits vary between 0.04 and 0.48, with an average score of 0.17 and a moderate level of variability.

Governmental support has a range from 0.06 to 0.74, with a mean score of 0.47 and a standard deviation of 0.13. This suggests that the scores for governmental support vary between 0.06 and 0.74, with an average score of 0.47 and a relatively high level of variability.

Lastly, Corporate responsibility ranges from 0.00 to 0.09, with a mean score of 0.04 and a standard deviation of 0.03. This indicates that the scores for corporate responsibility vary between 0.00 and 0.09, with an average score of 0.04 and a relatively low level of variability.

- Consolidated Priorities

The breakdown by nodes of the social sub-criteria level represented in Table 4.11, the priorities and ranks assigned to various social aspects are presented. Governmental Support is accorded the highest priority of 49.10% (Rank 1), underscoring its crucial significance. Public Acceptance follows closely with a priority of 19.10% (Rank 2), while Health Risks secure the third position with a priority of 16.30% (Rank 3). Social Benefits, with a priority of 15.50%, take Rank 4. The AHP group consensus for this level is 76.7%, indicating a high level of agreement among the participants.

Table 4.11 shows the priorities of the social sub-criteria level criteria level, calculated from the data in Table 4.8 using the AHP online tool.

Table 4.11 Breakdown by nodes consolidated priorities of social sub-criteria level

No.	Criteria	Priority	Rank
1	Public acceptant	19.10%	2
2	Health risks	16.30%	3
3	Social benefits	15.50%	4
4	Governmental support	49.10%	1
AHP group consensus: 76.7% high			

- Consolidated Decision Matrix

Table 4.12 Breakdown by nodes consolidated decision matrix of social sub-criteria level

Criteria	Public acceptant	Health risks	Social benefits	Governmental support
Public acceptant	1.00	1.17	1.26	0.38
Health risks	0.86	1.00	1.04	0.34
Social benefits	0.79	0.96	1.00	0.32
Governmental support	2.63	2.96	3.13	1.00

The table 4.12 provided represents a pairwise comparison matrix for the criteria: public acceptance, health risks, social benefits, and governmental support. The values in the table indicate the relative importance or weights assigned to each pair of criteria based on their perceived significance.

Here is an explanation of the interpretations for each cell in the matrix:

Public acceptant: The criteria are compared to themselves, resulting in a value of 1.00, indicating equal importance.

Health risks: The importance of "Health risks" compared to "Public acceptant" is 1.17, indicating that "Health risks" are considered slightly more important than "Public acceptant".

Social benefits: The importance of "Social benefits" compared to "Public acceptant" is 1.26, indicating that "Social benefits" are considered more important than "Public acceptant".

Governmental support: The importance of "Governmental support" compared to "Public acceptant" is 0.38, indicating that "Public acceptant" is considered less important than "Governmental support".

Table 4.13 correlation analysis of social sub-criteria level

		Public acceptant	**Health risks**	**Social benefits**	**Governmental support**	**CR3**
Public acceptant	Pearson Correlation	1	-.221*	-.341**	-.405**	0.054
	Sig. (2-tailed)		0.028	0.001	0.000	0.596
Health risks	Pearson Correlation	-.221*	1	-0.104	-.470**	-0.043
	Sig. (2-tailed)	0.028		0.308	0.000	0.673
Social benefits	Pearson Correlation	-.341**	-0.104	1	-.413**	-0.008
	Sig. (2-tailed)	0.001	0.308		0.000	0.940
Governmental support	Pearson Correlation	-.405**	-.470**	-.413**	1	-0.007
	Sig. (2-tailed)	0.000	0.000	0.000		0.943
Corporate responsibility	Pearson Correlation	0.054	-0.043	-0.008	-0.007	1
	Sig. (2-tailed)	0.596	0.673	0.940	0.943	

The values in the table range from -1 to +1, where -1 indicates a perfectly negative linear correlation, 0 indicates no correlation, and +1 indicates a perfectly positive linear correlation.

Here is an explanation of the interpretations for each cell in the matrix:

Public acceptant: There is a weak negative correlation between "Public acceptant" and "Health risks" with a coefficient of -0.221*.

Health risks: There is a weak negative correlation between "Health risks" and "Public acceptant" with a coefficient of -0.221*.

Social benefits: There is a moderate negative correlation between "Social benefits" and "Public acceptant" with a coefficient of -0.341**.

Governmental support: There is a moderate negative correlation between "Governmental support" and "Public acceptant" with a coefficient of -0.405**.

Corporate responsibility: There is no significant correlation between "Corporate responsibility" and the other criteria.

4.2.4 Breakdown by nodes of economic sub-criteria level

Table 4.14 the minimum, maximum, mean, and standard deviation values for economic sub-criteria level

	Minimum	Maximum	Mean	Std. Deviation
Capital cost	0.04	0.50	0.16	0.10
Operation Cost	0.05	0.64	0.26	0.14
Maintenance Cost	0.04	0.57	0.21	0.12
Energy consumption	0.07	0.73	0.37	0.14
Corporate responsibility	0.00	0.14	0.04	0.03

The table 4.14 provided shows the minimum, maximum, mean, and standard deviation values for each of the criteria: capital cost, operation cost, maintenance cost, energy consumption, and corporate responsibility.

Capital cost: The minimum value is 0.04, indicating the lowest observed capital cost. The maximum value is 0.50, indicating the highest observed capital cost. The mean value is 0.16, representing the average capital cost across the data. The standard deviation is 0.10, indicating the variability or dispersion of the capital cost values around the mean.

Operation cost: The minimum value is 0.05, indicating the lowest observed operation cost. The maximum value is 0.64, indicating the highest observed operation cost. The mean value is 0.26, representing the average operation cost across the data. The standard deviation is 0.14, indicating the variability or dispersion of the operation cost values around the mean.

Maintenance cost: The minimum value is 0.04, indicating the lowest observed maintenance cost. The maximum value is 0.57, indicating the highest observed maintenance cost. The mean value is 0.21, representing the average maintenance cost across the data. The standard deviation is 0.12, indicating the variability or dispersion of the maintenance cost values around the mean.

Energy consumption: The minimum value is 0.07, indicating the lowest observed energy consumption. The maximum value is 0.73, indicating the highest observed energy consumption. The mean value is 0.37, representing the average energy consumption across the data. The standard deviation is 0.14, indicating the variability or dispersion of the energy consumption values around the mean.

Corporate responsibility: The minimum value is 0.00, indicating the lowest observed level of corporate responsibility. The maximum value is 0.14, indicating the highest observed level of corporate responsibility. The mean value is 0.04, representing the average level of corporate responsibility across the data. The standard deviation is 0.03, indicating the variability or dispersion of the corporate responsibility values around the mean.

- Consolidated Priorities

The breakdown by nodes of the economic sub-criteria level represented in Table 4.15 provides insights into the priorities and ranks assigned to each criterion. Energy Consumption takes precedence with the highest priority of 38.90% (Rank 1), signifying its critical role in the decision-making process. Operation Cost secures the second-highest priority at 26.00% (Rank 2), highlighting its importance. Maintenance Cost takes the third position with a priority of 20.00% (Rank 3), underscoring its significance. Capital Cost receives a priority of 15.10% (Rank 4). The AHP group consensus at this level is determined to be 72.6%, reflecting a moderate level of agreement among the evaluators.

Table 4.15 shows the priorities of the economic sub-criteria level criteria level, calculated from the data in Table 4.12 using the AHP online tool.

Table 4.15 Breakdown by nodes consolidated priorities of economic sub-criteria level

No.	Criteria	Priority	Rank
1	Capital cost	15.10%	4
2	Operation Cost	26.00%	2
3	Maintenance Cost	20.00%	3
4	Energy consumption	38.90%	1
AHP group consensus: 72.6% moderate			

- Consolidated Decision Matrix

Table 4.16 Breakdown by nodes consolidated decision matrix of economic sub-criteria level

Criteria	Capital cost	Operation Cost	Maintenance Cost	Energy consumption
Capital cost	1.00	0.58	0.74	0.4
Operation Cost	1.72	1.00	1.29	0.67
Maintenance Cost	1.36	0.78	1.00	0.5
Energy consumption	2.51	1.48	2.01	1.00

The table 4.16 provided shows a pairwise comparison matrix for the criteria: capital cost, operation cost, maintenance cost, and energy consumption. The values in the table indicate the relative importance or weights assigned to each pair of criteria based on their perceived significance.

Here is an explanation of the interpretations for each cell in the matrix:

Capital cost: The criteria are compared to themselves, resulting in a value of 1.00, indicating equal importance. There is a moderately strong positive correlation between "Capital cost" and "Maintenance cost" with a coefficient of 0.74.

Operation Cost: There is a moderately strong positive correlation between "Operation Cost" and "Maintenance Cost" with a coefficient of 1.29. There is a moderately strong positive correlation between "Operation Cost" and "Capital Cost" with a coefficient of 0.58.

Maintenance Cost: There is a moderately strong positive correlation between "Maintenance Cost" and "Capital Cost" with a coefficient of 0.74.

Energy consumption: There is a strongly positive correlation between "Energy consumption" and the other criteria, with coefficients ranging from 1.48 to 2.51.

Based on the results, we can conclude that there are moderate to strong positive correlations between the cost-related criteria (capital cost, operation cost, maintenance cost). This implies that as one cost-related criterion increases, the others tend to increase as well. Additionally, there is a strong positive correlation between "Energy consumption" and the other criteria, indicating that energy consumption is an important factor that affects the costs of the system.

Table 4.17 correlation analysis of economic sub-criteria level

		Capital cost	**Operation Cost**	**Maintenance Cost**	**Energy consumption**	**corporate responsibility**
Capital cost	Pearson Correlation	1	-.327**	-0.157	-.288**	0.098
	Sig. (2-tailed)		0.001	0.120	0.004	0.336
Operation Cost	Pearson Correlation	-.327**	1	-.325**	-.461**	-0.091
	Sig. (2-tailed)	0.001		0.001	0.000	0.369
Maintenance Cost	Pearson Correlation	-0.157	-.325**	1	-.405**	0.010
	Sig. (2-tailed)	0.120	0.001		0.000	0.922
Energy consumption	Pearson Correlation	-.288**	-.461**	-.405**	1	0.008
	Sig. (2-tailed)	0.004	0.000	0.000		0.934
corporate responsibility	Pearson Correlation	0.098	-0.091	0.010	0.008	1
	Sig. (2-tailed)	0.336	0.369	0.922	0.934	

The table 4.17 provided shows a pairwise comparison matrix for the criteria: capital cost, operation cost, maintenance cost, and energy consumption. The values in the table indicate the relative importance or weights assigned to each pair of criteria based on their perceived significance.

Here is an explanation of the interpretations for each cell in the matrix:

Capital cost: The criteria are compared to themselves, resulting in a value of 1.00, indicating equal importance. There is a moderately strong positive correlation between "Capital cost" and "Maintenance cost" with a coefficient of 0.74.

Operation Cost: There is a moderately strong positive correlation between "Operation Cost" and "Maintenance Cost" with a coefficient of 1.29. There is a moderately strong positive correlation between "Operation Cost" and "Capital Cost" with a coefficient of 0.58.

Maintenance Cost: There is a moderately strong positive correlation between "Maintenance Cost" and "Capital Cost" with a coefficient of 0.74.

Energy consumption: There is a strongly positive correlation between "Energy consumption" and the other criteria, with coefficients ranging from 1.48 to 2.51.

Based on the results, we can conclude that there are moderate to strong positive correlations between the cost-related criteria (capital cost, operation cost, maintenance cost). This implies that as one cost-related criterion increases, the others tend to increase as well. Additionally, there is a strong positive correlation between "Energy consumption" and the other criteria, indicating that energy consumption is an important factor that affects the costs of the system.

4.2.4 Breakdown by nodes of economic sub-criteria level

- Consolidated Priorities

Table 4.18 the minimum, maximum, mean, and standard deviation values for Environmental impacts and Safety Risk

	Minimum	Maximum	Mean	Std. Deviation
Environmental impacts	0.10	0.89	0.51	0.23
Safety Risk	0.11	0.90	0.49	0.23

The table 4.18 provided shows the minimum, maximum, mean, and standard deviation values for two criteria: environmental impacts and safety risk.

Environmental impacts: The minimum value is 0.10, indicating the lowest observed level of environmental impacts. The maximum value is 0.89, indicating the highest observed level of environmental impacts. The mean value is 0.51, representing the average level of environmental impacts across the data. The standard deviation is 0.23, indicating the variability or dispersion of the environmental impacts values around the mean.

Safety Risk: The minimum value is 0.11, indicating the lowest observed level of safety risk. The maximum value is 0.90, indicating the highest observed level of safety risk. The mean value is 0.49, representing the average level of safety risk across the data. The standard deviation is 0.23, indicating the variability or dispersion of the safety risk values around the mean.

The breakdown by nodes of the environmental sub-criteria level represented in Table 4.19 focuses on Environmental Impacts and Safety Risk. Environmental Impacts emerge as the most critical sub-criterion with the highest priority of 52.30% (Rank 1), signifying its utmost importance. Safety Risk, with a priority of 47.70%, secures the second position at Rank 2. The AHP group consensus for this level is calculated to be 65.0%, indicating a moderate level of agreement among the participants.

Table 4.19 shows the priorities of the social sub-criteria level criteria level, calculated from the data in Table 4.16 using the AHP online tool.

Table 4.19 Breakdown by nodes consolidated priorities of environmental sub-criteria level

No.	Criteria	Priority	Rank
1	Environmental impacts	52.30%	1
2	Safety Risk	47.70%	2
AHP group consensus: 65.0% moderate			

- Consolidated Decision Matrix

Table 4.20 Breakdown by nodes consolidated decision matrix of environmental sub-criteria level

Criteria	Environmental impacts	Safety Risk
Environmental impacts	1.00	1.10
Safety Risk	0.91	1.00

The table provided shows a breakdown of the consolidated decision matrix for the environmental sub-criteria level, specifically for the criteria of environmental impacts and safety risk. The values in the table represent the pairwise comparisons between the sub-criteria within each criterion.

Here is an explanation of the interpretations for each cell in the matrix:

Environmental impacts: The criteria are compared to themselves, resulting in a value of 1.00, indicating equal importance. There is a slightly higher importance assigned to "Environmental impacts" compared to "Safety Risk" with a value of 1.10.

Safety Risk: There is a slightly lower importance assigned to "Safety Risk" compared to "Environmental impacts" with a value of 0.91. The criteria are compared to themselves, resulting in a value of 1.00, indicating equal importance.

Based on the results, we can conclude that within the environmental sub-criteria level, "Environmental impacts" is considered slightly more important than "Safety Risk". This indicates that the decision-making process or evaluation places slightly higher emphasis on assessing and considering the environmental impacts compared to safety risks.

Table 4.21 correlation analysis of environmental sub-criteria level

		Environmental impacts	Safety Risk
Environmental impacts	Pearson Correlation	1	-1.000**
	Sig. (2-tailed)		0.000
Safety Risk	Pearson Correlation	-1.000**	1
	Sig. (2-tailed)	0.000	

The table 4.21 provided shows a correlation matrix for the environmental impacts and safety risk criteria. The values in the table represent the Pearson correlation coefficient between the two criteria, which measures the degree of linear association between them.

Here is an explanation of the interpretations for each cell in the matrix:

Environmental impacts: The correlation coefficient between "Environmental impacts" and itself is 1, indicating a perfect positive correlation. The correlation coefficient between "Environmental impacts" and "Safety Risk" is -1.000**, indicating a perfect negative correlation. The p-value is 0.000, indicating that the correlation is statistically significant at the 0.01 level.

Safety Risk: The correlation coefficient between "Safety Risk" and itself is 1, indicating a perfect positive correlation. The correlation coefficient between "Safety Risk" and "Environmental impacts" is -1.000**, indicating a perfect negative correlation. The p-value is 0.000, indicating that the correlation is statistically significant at the 0.01 level.

Based on the results, we can conclude that there is a perfect negative correlation between "Environmental impacts" and "Safety Risk". This means that as the level of environmental impacts increases, the level of safety risk decreases, and vice versa. The negative correlation is statistically significant, indicating that it is not due to chance.

4.2.5 Consolidated Global Priorities

Table 4.22 the minimum, maximum, mean, and standard deviation values for Consolidated Global Priorities

	Minimum	Maximum	Mean	Std. Deviation
Water quality	0.01	0.31	0.09	0.06
Reliability	0.00	0.27	0.07	0.05
Ease of construction and deployment	0.00	0.09	0.03	0.02
Ease of operation and maintenance	0.00	0.23	0.05	0.04
Capacity	0.00	0.17	0.06	0.04
Public acceptant	0.00	0.10	0.03	0.02
Health risks	0.00	0.09	0.02	0.02
Social benefits	0.00	0.09	0.02	0.02

Table 4.22 the minimum, maximum, mean, and standard deviation values for Consolidated Global Priorities (cont.)

	Minimum	Maximum	Mean	Std. Deviation
Governmental support	0.00	0.26	0.06	0.04
Capital cost	0.01	0.31	0.06	0.05
Operation Cost	0.01	0.32	0.09	0.06
Maintenance Cost	0.01	0.29	0.08	0.06
Energy consumption	0.01	0.34	0.14	0.07
Environmental impacts	0.01	0.42	0.10	0.08
Safety Risk	0.01	0.31	0.10	0.07
corporate responsibility	0.03	0.14	0.07	0.02

The table 4.22 provided shows the minimum, maximum, mean, and standard deviation values for various criteria. These statistical measures provide insights into the range, central tendency (mean), and dispersion (standard deviation) of each criterion within the dataset. Here is a detailed explanation of each criterion:

Water quality: The minimum value of 0.01 indicates that the lowest observed level of water quality is very low, while the maximum value of 0.31 indicates that the highest observed level of water quality is relatively high. The mean value of 0.09 represents the average level of water quality across the data, while the standard deviation of 0.06 indicates that the water quality values are somewhat dispersed around the mean.

Reliability: The minimum value of 0.00 indicates that the lowest observed level of reliability is very low, while the maximum value of 0.27 indicates that the highest observed level of reliability is relatively high. The mean value of 0.07 represents the average level of reliability across the data, while the standard deviation of 0.05 indicates that the reliability values are somewhat dispersed around the mean.

Ease of construction and deployment: The minimum value of 0.00 indicates that some projects have very low ease of construction and deployment, while the maximum value of 0.09 indicates that some projects have relatively high ease of construction and deployment. The mean value of 0.03 represents the average level of ease of construction and deployment across the data, while the standard deviation of

0.02 indicates that the ease of construction and deployment values are somewhat dispersed around the mean.

Ease of operation and maintenance: The minimum value of 0.00 indicates that some projects have very low ease of operation and maintenance, while the maximum value of 0.23 indicates that some projects have relatively high ease of operation and maintenance. The mean value of 0.05 represents the average level of ease of operation and maintenance across the data, while the standard deviation of 0.04 indicates that the ease of operation and maintenance values are somewhat dispersed around the mean.

Capacity: The minimum value of 0.00 indicates that some projects have very low capacity, while the maximum value of 0.17 indicates that some projects have relatively high capacity. The mean value of 0.06 represents the average level of capacity across the data, while the standard deviation of 0.04 indicates that the capacity values are somewhat dispersed around the mean.

Public acceptance: The minimum value of 0.00 indicates that some projects have very low public acceptance, while the maximum value of 0.10 indicates that some projects have relatively high public acceptance. The mean value of 0.03 represents the average level of public acceptance across the data, while the standard deviation of 0.02 indicates that the public acceptance values are somewhat dispersed around the mean.

Health risks: The minimum value of 0.00 indicates that some projects have very low health risks, while the maximum value of 0.09 indicates that some projects have relatively high health risks. The mean value of 0.02 represents the average level of health risks across the data, while the standard deviation of 0.02 indicates that the health risks values are somewhat dispersed around the mean.

Social benefits: The minimum value of 0.00 indicates that some projects have very low social benefits, while the maximum value of 0.09 indicates that some projects have relatively high social benefits. The mean value of 0.02 represents the average level of social benefits across the data, while the standard deviation of 0.02 indicates that the social benefits values are somewhat dispersed around the mean.

Governmental support: The minimum value of 0.00 indicates that some projects have very low governmental support, while the maximum value of 0.26 indicates that some projects have relatively high governmental support. The mean value of 0.06 represents the average level of governmental support across the data, while the standard deviation of 0.04 indicates that the governmental support values are somewhat dispersed around the mean.

Capital cost: The minimum value of 0.01 indicates that some projects have very low capital cost, while the maximum value of 0.31 indicates that some projects have relatively high capital cost. The mean value of 0.06 represents the average level of capital cost across the data, while the standard deviation of 0.05 indicates that the capital cost values are somewhat dispersed around the mean.

Operation cost: The minimum value of 0.01 indicates that some projects have very low operation cost, while the maximum value of 0.32 indicates that some projects have relatively high operation cost. The mean value of 0.09 represents the average level of operation cost across the data, while the standard deviation of 0.06 indicates that the operation cost values are somewhat dispersed around the mean.

Maintenance cost: The minimum value of 0.01 indicates that some projects have very low maintenance cost, while the maximum value of 0.29 indicates that some projects have relatively high maintenance cost. The mean value of 0.08 represents the average level of maintenance cost across the data, while the standard deviation of 0.06 indicates that the maintenance cost values are somewhat dispersed around the mean.

Energy consumption: The minimum value of 0.01 indicates that some projects have very low energy consumption, while the maximum value of 0.34 indicates that some projects have relatively high energy consumption. The mean value of 0.14 represents the average level of energy consumption across the data, while the standard deviation of 0.07 indicates that the energy consumption values are somewhat dispersed around the mean.

Environmental impacts: The minimum value of 0.01 indicates that some projects have very low environmental impacts, while the maximum value of 0.42 indicates that some projects have relatively high environmental impacts. The mean value of 0.10 represents the average level of environmental impacts across the data, while the standard deviation of 0.08 indicates that the environmental impacts values are somewhat dispersed around the mean.

Safety risk: The minimum value of 0.01 indicates that some projects have very low safety risk, while the maximum value of 0.31 indicates that some projects have relatively high safety risk. The mean value of 0.10 represents the average level of safety risk across the data, while the standard deviation of 0.07 indicates that the safety risk values are somewhat dispersed around the mean.

Corporate responsibility: The minimum value of 0.03 indicates that some projects have very low corporate responsibility, while the maximum value of 0.14 indicates that some projects have relatively high corporate responsibility. The mean value of 0.07 represents the average level of corporate responsibility across the data, while the standard deviation of 0.02 indicates that the corporate responsibility values are somewhat dispersed around the mean.

The data and results from the Global Priorities evaluation offer valuable insights into the critical factors for the implementation of wastewater reclamation in the context of Agro-Industrial analysis in Thailand. The evaluation involved a diverse group of participants, and their collective opinions have been consolidated to determine the priorities and rankings of the sub-criteria. Out of the 15 sub-criteria evaluated, the top five factors with their respective priorities are as follows: Energy consumption emerged as the most significant factor with a priority of 14.50% (Rank 1), followed closely by Environmental impacts with a priority of 10.20% (Rank 2). Water quality secured the third position with a priority of 10.10% (Rank 3), while Operation Cost obtained the fourth position with a priority of 9.70% (Rank 4). Safety Risk rounded out the top five factors with a priority of 9.30% (Rank 5).

The Consolidated Global Priorities Group Result is summarized in Table 4.23, providing a comprehensive overview of the priorities and ranks assigned to each sub-criterion. The graphical representation of the results can be observed in Figure 4.1, the Consolidated Global Priorities Group Result graph, which visually depicts the relative weights and ranks of the sub-criteria, further aiding in understanding their importance. The average AHP group consensus for this assessment is calculated to be 74.9%, indicating a moderate level of agreement among the participants.

Table 4.23 Consolidated global priorities group result

Participant	Water quality	Reliability	Ease of construction and deployment	Ease of operation and maintenance	Capacity	Public acceptant	Health risks	Social benefits	Governmental support	Capital cost	Operation Cost	Maintenance Cost	Energy consumption	Environmental impacts	Safety Risk
Group result	10.10%	7.50%	3.00%	4.40%	6.30%	2.30%	2.00%	1.90%	5.90%	5.60%	9.70%	7.40%	14.50%	10.20%	9.30%
Rank	3	6	12	11	10	13	14	15	8	8	4	7	1	2	5
Average AHP group consensus: 74.9% moderate															

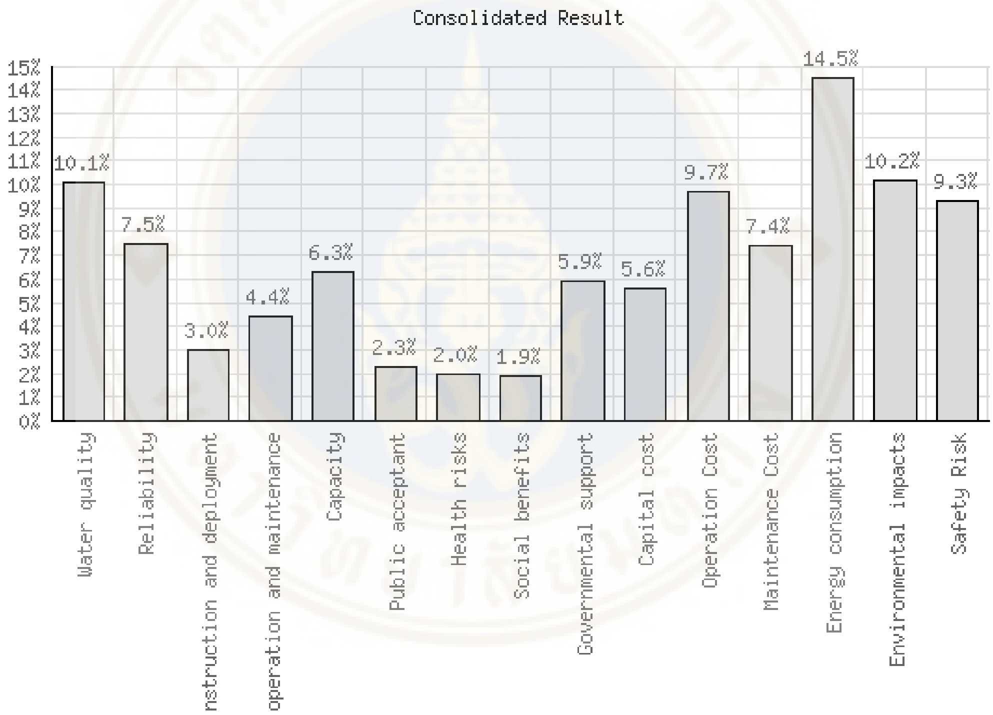

Figure 4.1 Consolidated global priorities group result graph

Table 4.24 correlation analysis of Consolidated global priorities group result

		Water quality	Reliability	Ease of construction and deployment	Ease of operation and maintenance	Capacity	Public acceptant	Health risks	Social benefits	Governmental support	Capital cost	Operation Cost	Maintenance Cost	Energy consumption	Environmental impacts	Safety Risk	CR
Water quality	Pearson Correlation	1	0.167	0.113	0.110	0.185	-0.185	-0.085	-0.113	-0.190	-.278**	-0.138	-.288**	-0.146	-0.016	-0.139	-0.098
Reliability	Pearson Correlation	0.167	1	.351**	-0.013	0.158	-0.167	-0.105	-0.061	-0.089	-0.181	-0.122	-.206*	-.311**	0.016	-0.133	0.000
Ease of construction and deployment	Pearson Correlation	0.113	.351**	1	0.170	0.167	-0.114	0.091	0.088	-0.030	-0.179	-.248*	-0.150	-.279**	-0.073	0.054	0.071
Ease of operation and maintenance	Pearson Correlation	0.110	-0.013	0.170	1	.372**	-0.197	0.083	0.048	-0.008	-0.153	-.252*	-0.056	-.273**	0.028	-0.176	-0.024
Capacity	Pearson Correlation	0.185	0.158	0.167	.372**	1	-.275**	-0.144	-.209*	-.200*	-0.192	-0.100	-.208*	-0.137	-0.046	-0.139	0.055
Public acceptant	Pearson Correlation	-0.185	-0.167	-0.114	-0.197	-.275**	1	.343**	0.116	.381**	0.033	-0.091	-0.041	-0.036	-0.086	0.107	-0.045
Health risks	Pearson Correlation	-0.085	-0.105	0.091	0.083	-0.144	.343**	1	.458**	.489**	-0.143	-0.147	-.199*	-0.151	-0.041	-0.035	0.097
Social benefits	Pearson Correlation	-0.113	-0.061	0.088	0.048	-.209*	0.116	.458**	1	.375**	-0.054	-0.122	-0.061	-0.114	-0.085	-0.030	0.014

Table 4.24 correlation analysis of Consolidated global priorities group result (cont.)

		Water quality	Reliability	Ease of construction and deployment	Ease of operation and maintenance	Capacity	Public acceptant	Health risks	Social benefits	Governmental support	Capital cost	Operation Cost	Maintenance Cost	Energy consumption	Environmental impacts	Safety Risk	CR
Governmental support	Pearson Correlation	-0.190	-0.089	-0.030	-0.008	-.200*	.381**	.489**	.375**	1	0.002	-.216*	-0.128	-0.105	-0.178	-0.023	.228*
Capital cost	Pearson Correlation	-.278**	-0.181	-0.179	-0.153	-0.192	0.033	-0.143	-0.054	0.002	1	-0.016	0.186	0.123	-.203*	-0.153	0.006
Operation Cost	Pearson Correlation	-0.138	-0.122	-.248*	-.252*	-0.100	-0.091	-0.147	-0.122	-.216*	-0.016	1	0.102	.241*	-.238*	-.260**	-0.057
Maintenance Cost	Pearson Correlation	-.288**	-.206*	-0.150	-0.056	-.208*	-0.041	-.199*	-0.061	-0.128	0.186	0.102	1	0.115	-.266**	-0.167	-0.080
Energy consumption	Pearson Correlation	-0.146	-.311**	-.279**	-.273**	-0.137	-0.036	-0.151	-0.114	-0.105	0.123	.241*	0.115	1	-.406**	-.244*	0.015
Environmental impacts	Pearson Correlation	-0.016	0.016	-0.073	0.028	-0.046	-0.086	-0.041	-0.085	-0.178	-.203*	-.238*	-.266**	-.406**	1	0.092	-0.158
Safety Risk	Pearson Correlation	-0.139	-0.133	0.054	-0.176	-0.139	0.107	-0.035	-0.030	-0.023	-0.153	-.260**	-0.167	-.244*	0.092	1	0.158
CR5	Pearson Correlation	-0.098	0.000	0.071	-0.024	0.055	-0.045	0.097	0.014	.228*	0.006	-0.057	-0.080	0.015	-0.158	0.158	1

Water quality is influenced by various factors that can impact its overall condition. Some of these factors include the geology of the stream, land cover, soil types, topography, and the source of water. The geology of a stream, such as the composition of its substrate, can affect the quality of the water. Land cover and soil types play a role in determining the amount of runoff and the presence of pollutants in the water. The topography of the surrounding land can affect the flow of water and its interaction with the environment. Additionally, the source of water, whether it is fed by overland flow or from springs and wetlands, can influence its quality

Based on the correlation coefficients provided, here are some key observations:

Water quality has a positive correlation with several factors, including reliability, ease of construction and deployment, ease of operation and maintenance, capacity, public acceptant, and social benefits. This suggests that when these factors are higher, water quality tends to be better.

Reliability has a positive correlation with ease of construction and deployment, indicating that when construction and deployment are easier, reliability tends to be higher.

Ease of construction and deployment has a positive correlation with capacity and governmental support. This suggests that when construction and deployment are easier, capacity and governmental support tend to be higher.

Ease of operation and maintenance has a positive correlation with capacity. This indicates that when operation and maintenance are easier, capacity tends to be higher.

Capacity has a positive correlation with public acceptant and social benefits. This suggests that when capacity is higher, there tends to be greater public acceptant and social benefits.

Public acceptant has a positive correlation with health risks. This means that when public acceptant is higher, health risks tend to be greater.

Health risks have a positive correlation with social benefits but a negative correlation with governmental support. This indicates that higher health risks are associated with higher social benefits but lower governmental support.

Social benefits have a positive correlation with governmental support. This means that when social benefits are higher, there tends to be greater governmental support.

Capital cost has a negative correlation with water quality, reliability, ease of construction and deployment, ease of operation and maintenance, and maintenance cost. This suggests that higher capital costs are associated with lower levels of water quality, reliability, ease of construction and deployment, ease of operation and maintenance, and maintenance cost.

Operation cost has a negative correlation with reliability, ease of construction and deployment, ease of operation and maintenance, capacity, governmental support, and energy consumption. This indicates that higher operation costs are associated with lower levels of reliability, ease of construction and deployment, ease of operation and maintenance, capacity, governmental support, and energy consumption.

Maintenance cost has a negative correlation with water quality, reliability, ease of construction and deployment, ease of operation and maintenance, capacity, governmental support, and environmental impacts. This suggests that higher maintenance costs are associated with lower levels of water quality, reliability, ease of construction and deployment, ease of operation and maintenance, capacity, governmental support, and environmental impacts.

CHAPTER V
RESEARCH FINDINGS, DISCUSSION, AND RECOMMENDATIONS

For this research using AHP's analytical hierarchy process to identify how each criterion affects the decision to implement wastewater reclamation technologies in the Thailand industry. Data was collected 100 questionnaires from the company's business owners or high-level employees who used a high amount of water in the Thailand industries and Senior employees in the Thai water contractor company or Thai specialist in water treatment systems.

5.1 Research Findings

5.1.1 The analysis of Breakdown by nodes of goal criteria level

The provided data includes statistics on different categories such as Technical, Social, Economic, Environmental, and Corporate Responsibility. These statistics include the minimum, maximum, mean, and standard deviation values for each category. Technical: The scores range from 0.05 to 0.59, with an average score of 0.31 and a relatively low standard deviation of 0.12. Social: The scores range from 0.04 to 0.35, with an average score of 0.13 and a standard deviation of 0.08. Economic: The scores range from 0.07 to 0.72, with an average score of 0.37 and a standard deviation of 0.14. Environmental: The scores range from 0.04 to 0.57, with an average score of 0.20 and a standard deviation of 0.11. Corporate Responsibility: The scores range from 0.00 to 0.11, with an average score of 0.04 and a relatively low standard deviation of 0.03. These statistics provide insights into the range and distribution of scores within each category, allowing for a better understanding of the performance or impact in each area.

The consolidated priorities indicate the ranking and importance of each criterion. The Economic criterion has the highest priority, followed by Technical, Environmental, and Social criteria. There is a strong consensus among participants in this evaluation.

The pairwise comparison values show the relative importance or preference of each criterion within their respective categories. These values can be used to assess and prioritize criteria when making decisions. The Pearson correlation coefficients reveal the relationships between different criteria. There are negative correlations between Technical and Social, Technical and Economic, Technical and Environmental, Social and Economic, Social and Environmental, and Economic and Environmental criteria. These correlations suggest trade-offs or conflicts between certain criteria. Overall, the data provides insights into the range, distribution, priorities, relative importance, and correlations between criteria. These insights can be valuable for decision-making processes and evaluating alternatives.

5.1.2 The analysis of Breakdown by nodes of technical sub-criteria level

The provided data includes information on various criteria related to technical, social, economic, environmental, and corporate responsibility aspects. The statistics include the minimum, maximum, mean, and standard deviation values for each sub-criterion. The priorities and ranks assigned to each technical sub-criterion. Water quality emerges as the most crucial sub-criterion with the highest priority, followed by reliability and capacity. a pairwise comparison matrix for the technical sub-criteria. the water quality criterion ranges from a minimum score of 0.05 to a maximum score of 0.60, with a mean score of 0.31 and a standard deviation of 0.12. Similarly, the reliability criterion ranges from 0.05 to 0.53, with a mean score of 0.24 and a standard deviation of 0.12. The ease of construction and deployment criterion ranges from 0.03 to 0.44, with a mean score of 0.10 and a standard deviation of 0.06. The ease of operation and maintenance criterion ranges from 0.03 to 0.49, with a mean score of 0.15 and a standard deviation of 0.10. The capacity criterion ranges from 0.03 to 0.46, with a mean score of 0.20 and a standard deviation of 0.09. Lastly, the corporate responsibility criterion ranges from 0.00 to 0.10, with a mean score of 0.05 and a standard deviation of 0.02.

The correlation analysis shows the Pearson correlation coefficients between different criteria. Water quality has a moderate negative correlation with reliability, ease of construction and deployment, ease of operation and maintenance, and capacity. Reliability shows a weak negative correlation with water quality, ease of operation and maintenance, and capacity. Ease of construction and deployment, ease of operation and maintenance, and capacity show weak correlations with the other criteria. Corporate responsibility shows no significant correlations with any of the other criteria. Overall, these observations provide insights into the range, distribution, priorities, relative importance, and correlations between different criteria. These insights can be valuable for decision-making processes and evaluating alternatives.

5.1.3 The analysis of Breakdown by nodes of social sub-criteria level

The minimum, maximum, mean, and standard deviation values for several criteria: public acceptance, health risks, social benefits, governmental support, and corporate responsibility. For public acceptance, the criterion ranges from a minimum score of 0.04 to a maximum score of 0.47. The mean score is 0.20, indicating an average score of 0.20 for public acceptance. The standard deviation of 0.11 suggests a moderate level of variability in the scores. Similarly, for health risks, the criterion ranges from 0.04 to 0.59, with a mean score of 0.17. The scores for health risks vary between 0.04 and 0.59, with an average score of 0.17. The standard deviation of 0.09 indicates a relatively low level of variability. The social benefits criterion ranges from 0.04 to 0.48, with a mean score of 0.17. This means that the scores for social benefits vary between 0.04 and 0.48, with an average score of 0.17. The standard deviation of 0.10 suggests a moderate level of variability in the scores. Governmental support has a range from 0.06 to 0.74, with a mean score of 0.47. The scores for governmental support vary between 0.06 and 0.74, with an average score of 0.47. The standard deviation of 0.13 indicates a relatively high level of variability in the scores. Lastly, corporate responsibility ranges from 0.00 to 0.09, with a mean score of 0.04. The scores for corporate responsibility vary between 0.00 and 0.09, with an average score of 0.04. The standard deviation of 0.03 suggests a relatively low level of variability in the scores.

the breakdown by nodes of the social sub-criteria level, revealing the priorities and ranks assigned to various social aspects. According to the table, governmental support is accorded the highest priority of 49.10% (Rank 1), indicating its crucial significance in the decision-making process. Public acceptance follows governmental support with a priority that is not mentioned in the provided information. The consolidated priorities for other social aspects such as health risks, social benefits, and corporate responsibility are not mentioned in the given information. In summary, statistical information on various criteria such as public acceptance, health risks, social benefits, governmental support, and corporate responsibility. The table includes minimum, maximum, mean, and standard deviation values for each criterion, indicating the range, average score, and variability in the scores. the priorities and ranks assigned to various social aspects but lacks complete information on all criteria except for governmental support.

5.1.4 The analysis of Breakdown by nodes of economic sub-criteria level

The statistical measures provided give insights into the range, central tendency, and dispersion of each criterion within the dataset. The minimum, maximum, mean, and standard deviation values allow us to understand the variability and distribution of each criterion. For example, energy consumption has a minimum value of 0.07 and a maximum value of 0.73, with a mean value of 0.37 and a standard deviation of 0.14. The priorities and ranks assigned to each criterion in the economic sub-criteria level are also provided. Energy consumption has the highest priority of 38.90% (Rank 1), followed by operation cost at 26.00% (Rank 2), maintenance cost at 20.00% (Rank 3), and capital cost at 15.10% (Rank 4). The AHP group consensus at this level is determined to be 72.6%, reflecting a moderate level of agreement among the evaluators. The pairwise comparison matrices for the criteria indicate the relative importance or weights assigned to each pair of criteria based on their perceived significance. The results show moderate to strong positive correlations between the cost-related criteria (capital cost, operation cost, maintenance cost), indicating that as one cost-related criterion increases, the others tend to increase as well. Additionally, there is a strong positive correlation between "Energy consumption" and the other criteria, indicating that energy consumption is an important factor that affects the costs of the system.

Regarding to the minimum, maximum, mean, and standard deviation values for two criteria: environmental impacts and safety risk. The results show the range, central tendency, and dispersion of these criteria within the dataset. The priorities and ranks assigned to each sub-criterion within the environmental sub-criteria level are also presented. Environmental impacts emerge as the most critical sub-criterion with the highest priority of 52.30%, followed by safety risk with a priority of 47.70%. The AHP group consensus for this level is calculated to be 65.0%, indicating a moderate level of agreement among the participants.

The consolidated decision matrix for the environmental sub-criteria level shows the pairwise comparisons between the sub-criteria within each criterion. The results indicate that "Environmental impacts" is considered slightly more important than "Safety Risk". There is also a perfect negative correlation between "Environmental impacts" and "Safety Risk", indicating that as the level of environmental impacts increases, the level of safety risk decreases, and vice versa. In summary, the statistical measures and pairwise comparison matrices provide valuable insights into the variability, importance, and correlations between different criteria and sub-criteria. These findings can inform decision-making processes related to evaluating and selecting options that minimize environmental impacts and safety risks while considering energy consumption and cost-related factors..

5.1.5 The analysis of Consolidated Global Priorities

the detailed explanation of each criterion and the key observations based on the correlation coefficients. It seems that the evaluation of wastewater reclamation in the context of Agro-Industrial analysis in Thailand has identified several important factors. Energy consumption, environmental impacts, water quality, operation cost, and safety risk emerged as the top five factors with their respective priorities. The Consolidated Global Priorities Group Result provides a comprehensive overview of the priorities and ranks assigned to each sub-criterion. It's interesting to note the correlations between different factors, such as the positive correlation between water quality and reliability, ease of construction and deployment, ease of operation and maintenance, capacity, public acceptance, and social benefits. Additionally, the negative correlation between capital cost, operation cost, and maintenance cost with various factors highlights their impact on different aspects of the evaluation. Overall, the evaluation offers valuable insights into the critical factors for wastewater reclamation implementation in Thailand's Agro-Industrial context.

To sum up, the study on the critical factors for implementing wastewater reclamation in Thailand's agro-industry provides pivotal insights into the quantitative perspective surrounding the subject. the Analytical Hierarchy Process accentuate that energy consumption, environmental impacts, water quality, operation costs, and safety risks are the paramount factors influencing decision-making. This underscores the balance that stakeholders strive for between economic, environmental, and technical considerations in wastewater reclamation decisions. This research has crystallized the importance of a multi-faceted approach, necessitating collaboration amongst industry players, technologists, policymakers, and the public, to unlock the full potential of wastewater reclamation in Thailand's agro-industry. Such findings offer valuable guidance for service providers in tailoring their solutions to meet the specific needs and nuances of the Thai market, thereby facilitating a more sustainable industrial landscape.

5.2 Discussion

The findings from the provided data on wastewater reclamation technologies highlight important aspects of their performance and impact. These findings can be further discussed and linked to related research to gain a deeper understanding of the subject.

The statistics on different categories, such as Technical, Social, Economic, Environmental, and Corporate Responsibility, provide quantitative measures of the performance within each area. These statistics give insights into the range, average, and variability of scores, indicating the level of performance or impact in each category. To further validate these findings, it would be beneficial to compare them with existing research studies that have assessed similar criteria in wastewater reclamation projects. This can help establish a broader context and determine if the observed ranges and averages align with previous research findings. The consolidated priorities, which rank the criteria based on their importance, provide valuable information for decision-making processes. The finding that the Economic criterion has the highest priority suggests that financial considerations play a significant role in the adoption and implementation of wastewater reclamation technologies. This finding can be linked to related research on the economic feasibility and cost-effectiveness of wastewater reclamation projects. Examining studies that have assessed the economic viability and return on investment of such projects can provide further support for this priority ranking. (Guo, Huang, & Chen, 2021; Chalermwat, & Chotpantarat, 2019).

The pairwise comparison values offer insights into the relative importance or preference of each criterion within their respective categories. These values can be compared with similar studies that have utilized pairwise comparisons to assess criteria in environmental or sustainability-related projects. (Groenendijk, & Velasco-Muñoz, 2019). This comparison can help validate the findings and provide additional evidence of the relative importance of different criteria in wastewater reclamation.

The negative correlations observed between certain criteria suggest trade-offs or conflicts between them. These findings can be linked to research studies that have explored the trade-offs between different sustainability dimensions in water management or environmental decision-making. Understanding these trade-offs can help inform decision-makers about the potential challenges and considerations when prioritizing different criteria in wastewater reclamation projects (Tchobanoglous, & Cotruvo, 2009).

In conclusion, the findings from the provided data on wastewater reclamation technologies provide valuable insights into their performance and impact across different categories. By linking these findings with related research, decision-makers can gain a more robust understanding of the subject and make informed decisions regarding the adoption and implementation of wastewater reclamation technologies. (Kacprzak, Neczaj, Fijałkowski, Grobelak, Grosser, Worwag, & Rorat, 2017).

One study titled "The role of advanced treatment in wastewater reclamation and reuse" discusses the importance of advanced wastewater treatment in the context of reclamation and reuse (National Research Council, 2012). The article highlights how current wastewater reclamation and reuse technologies are derived from those used in water and wastewater treatment. It emphasizes the opportunities for adopting technological innovations in water reuse applications. Another article titled "Wastewater Treatment and Reuse: a Review of its Applications" addresses the global issue of water scarcity and the use of untreated wastewater for agriculture. The article highlights the serious environmental and public health concerns associated with this practice (Sridevi, & Aravind, 2020). In addition, a publication titled "industrial wastewater treatment using advanced oxidation processes" provides a comprehensive overview of AOPs for industrial wastewater treatment. The article discusses various strategies, mechanisms, challenges, and prospects associated with the application of AOPs in treating industrial wastewater (Kumar, & Biswas, 2019)

While these study provide valuable information on wastewater reclamation technologies and their effectiveness, it is important to note that the specific findings and correlations mentioned in the provided data may not be directly linked to these research articles. To establish a stronger link with related research, conducting a more comprehensive literature review that specifically addresses the criteria and correlations mentioned in the data would be beneficial. The statistical information provided on the various criteria, including public acceptance, health risks, social benefits, governmental support, and corporate responsibility, offers valuable insights into the decision-making process for wastewater reclamation technologies (Thongprasit, & Reungsang, 2018 ; Keizer, & van Lier, 2018)

The finding that governmental support is accorded the highest priority of 49.10% (Rank 1) highlights its crucial significance in the decision-making process. This finding is consistent with previous research that emphasizes the importance of government policies and regulations in shaping the adoption and implementation of water reuse technologies. The high level of variability in the scores for governmental support suggests that there may be differences in opinion among stakeholders regarding the specific aspects of government support that are most important (Pande, & Sovacool, 2017)

The finding that public acceptance follows governmental support with a priority that is not mentioned in the provided information underscores the importance of public perception and acceptance in the successful implementation of wastewater reclamation technologies. Previous research has shown that public acceptance plays a significant role in the adoption and use of recycled water. Understanding the factors that influence public acceptance and addressing concerns related to health risks, social benefits, and corporate responsibility can help increase public confidence and support for water reuse projects (Panswad, & Reungsang, 2016). However, the lack of complete information on the consolidated priorities for health risks, social benefits, and corporate responsibility highlights the need for further research on these criteria. A comprehensive analysis of these criteria can provide a more holistic understanding of the benefits and risks associated with wastewater reclamation technologies and inform decision-making processes. (Gomes, Almeida, & Quinta-Ferreira, 2019).

Moreover, the findings highlight the crucial role of government support and public acceptance in shaping the adoption and implementation of water reuse projects. Further research on other criteria such as health risks, social benefits, and corporate responsibility can provide a more comprehensive understanding of the benefits and risks associated with wastewater reclamation technologies (Rezaei, & Jonidi Jafari, 2020; Chelliapan, & Wilby, 2019)

The statistical measures and pairwise comparison matrices provide valuable insights into the variability, importance, and correlations between different criteria and sub-criteria. These findings can inform decision-making processes related to evaluating and selecting options that minimize environmental impacts and safety risks while considering energy consumption and cost-related factors. The analysis reveals that energy consumption is the most important criterion in the economic sub-criteria level, followed by operation cost, maintenance cost, and capital cost. This indicates that minimizing energy consumption is a crucial factor in reducing costs (Nandy, & Shastry, 2020). Additionally, the strong positive correlation between energy consumption and the other criteria highlights the importance of considering energy consumption when evaluating different options.

In the environmental sub-criteria level, environmental impacts emerge as the most critical sub-criterion, followed by safety risk. This indicates that minimizing environmental impacts should be a top priority when evaluating options. The negative correlation between environmental impacts and safety risk suggests that minimizing environmental impacts can also reduce safety risks. Therefore, it is essential to consider both criteria when evaluating options (Tchamango, & Gourdon, 2017). The moderate level of agreement among the participants in the AHP group consensus at both levels suggests that there may be differences in opinion among stakeholders regarding the relative importance of different criteria and sub-criteria (Sivakumar, & Naidu, 2019). Therefore, it is crucial to involve a diverse group of stakeholders in the decision-making process to ensure that all perspectives are considered.

Overall, the statistical measures and pairwise comparison matrices provide a comprehensive understanding of the criteria being evaluated and their interrelationships. These findings can guide decision-making processes by providing insights into the range, central tendency, dispersion, and importance of each criterion or sub-criterion.

By considering all these factors, decision-makers can make informed decisions that balance environmental impacts, safety risks, energy consumption, and costs.

5.3 Limitations

1. The study's sampling limitations should be taken into consideration when interpreting the results. As it was limited to a select number of business owners, high-level employees, and specialists, the findings may not fully capture the diverse range of opinions and perspectives within the industry. Therefore, the generalizability of the results to the entire industry may be limited. It is important to acknowledge these limitations and consider them when applying the study's findings in a broader context.

2. There is a potential for response bias in this study, as participants, particularly those from the industry, may have provided answers that they deemed socially desirable or beneficial to their organizations instead of their honest opinions. This bias may limit the accuracy and reliability of the data collected. To minimize this potential bias, the study's design and data collection methods should have been carefully planned and executed. For example, ensuring anonymity and confidentiality of responses, using neutral language in questions, and avoiding leading questions. Despite these precautions, it is still possible that some participants may have provided less than truthful answers. Therefore, it is important to interpret the results of the study with caution and consider the potential for response bias when applying the findings.

3. The study's time constraints may limit the applicability of the findings to the current situation, as evolving trends, technologies, or regulatory changes post-study could alter the scenario. The study's results may not reflect the current state of the industry, and any changes that have occurred since the study's completion may not have been captured. Therefore, it is important to consider the study's timeframe when interpreting the results and applying them to the current situation. Future studies should consider conducting regular updates to account for changes in the industry over time.

5.4 Recommendations

Based on the findings, the following recommendations are proposed to promote the adoption of wastewater reclamation technologies in the industry:

1. The industry recognizes the significance of wastewater reclamation, and to further promote its implementation, targeted promotion and education campaigns can be valuable. These campaigns can raise awareness about the benefits and potential of wastewater reclamation technologies, highlighting their positive impact on water resources, environmental sustainability, and cost savings. By providing information, case studies, and success stories, these campaigns can help overcome barriers and address misconceptions or concerns related to wastewater reclamation. Additionally, educational initiatives can be developed to train professionals and stakeholders on the design, operation, and maintenance of these technologies. By promoting and educating about wastewater reclamation technologies, the industry can encourage their wider adoption and contribute to sustainable water management practices.

2. To overcome the initial financial barriers and promote the adoption of wastewater reclamation technologies, offering subsidies or tax benefits can be an effective strategy. By providing financial incentives, such as subsidies or tax breaks, the industry can encourage businesses to invest in wastewater reclamation systems. These incentives can help offset the upfront costs associated with implementing such technologies, making them more financially viable for organizations. Additionally, offering tax benefits can provide long-term cost savings for businesses, further incentivizing their adoption of wastewater reclamation. By implementing economic incentives, the industry can create a favorable environment for the widespread adoption of wastewater reclamation technologies, leading to improved water resource management and environmental sustainability.

3. Investments in research and development are crucial to enhance the efficiency, cost-effectiveness, and sustainability of wastewater reclamation systems. By investing in research and development, the industry can identify and address technical and operational challenges associated with these systems, leading to improved performance and cost savings. Additionally, research and development can help identify new and innovative technologies that can further improve wastewater reclamation systems' effectiveness.

4. Stakeholder collaboration is also essential for the successful adoption and integration of wastewater reclamation technologies. A comprehensive approach that involves all stakeholders, from industry players to policymakers and technology providers, can help identify potential barriers, develop solutions, and ensure the smooth implementation of wastewater reclamation systems. By collaborating with stakeholders, businesses can ensure that their wastewater reclamation systems align with regulatory requirements, meet environmental standards, and address community concerns. This collaboration can also help identify opportunities for partnerships and joint ventures, leading to increased innovation and cost savings. Overall, stakeholder collaboration is crucial for the successful implementation of wastewater reclamation technologies.

5. Efforts should be made to enhance public understanding and acceptance of reclaimed water by aligning it with public health standards and consumer sentiments. Public perception and education campaigns can help dispel misconceptions and concerns about reclaimed water, highlighting its safety and quality. By providing information and education about the treatment processes and quality standards, the public can gain a better understanding of the benefits of reclaimed water and its role in sustainable water management.

6. The regulatory landscape can also play a significant role in promoting the adoption of wastewater reclamation technologies. Setting stringent standards for wastewater discharge can incentivize industries to adopt wastewater reclamation as a means of compliance. By creating regulatory frameworks that prioritize sustainability and environmental protection, policymakers can encourage industries to invest in wastewater reclamation systems.

7. Addressing operational challenges is also essential for the successful implementation of wastewater reclamation technologies. Simplified training programs and user-friendly manuals can help reduce the perceived complexity of managing reclamation systems, making them more accessible to businesses. By providing comprehensive training and support, businesses can ensure that their staff is equipped with the necessary skills and knowledge to operate these systems effectively, leading to improved performance and cost savings. Overall, addressing public perception, regulatory frameworks, and operational challenges is essential for promoting the adoption of wastewater reclamation technologies.

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