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Water Scarcity Awareness and Its Role in Promoting Water Recycling Systems at Car Wash Stations: A Case Study from Town-I Peshawar

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Abstract: This study aims to investigate the issue of water mismanagement, specifically in the car wash sector. The objective of this study is to identify any substantial connections between water scarcity awareness and the implementation of water recycling systems in car wash stations of Town 1, Peshawar, Pakistan. The quantitative research method is used to achieve the objectives. Twenty people working on different levels in car wash stations were asked to fill out the questionnaire. The findings conclude that increasing the awareness of car wash owners towards water scarcity will enhance the likelihood of investing in water recycling technologies to reduce water use.

Keywords: Water Scarcity, Water Recycling, Carwash, Climate Change, Urbanization

Introduction

Background Study

Water is one of the pertinent ingredients to life. Liu et al. (2017) describe water scarcity as the percentage of freshwater usage in relation to the available freshwater resources. Whether it is the use of water for irrigation, manufacturing, energy-making, industrial processes, or domestic use, the demand for water increases with the growing population. However, water quantity and quality are impacted by climate change-induced increases in the frequency and severity of climatic extremes, such as droughts and floods, as well as by the intensification of agriculture, industrialization, urbanization, and increased water extractions, especially in developing countries (Van Vliet et al., 2021). Lack of water can cause environmental deterioration, health problems, and loss of livelihood (Guppy, 2017). Keeping the global water crisis under consideration, it is integral to understand, amidst such grave circumstances, how water scarcity awareness impacts water-related sectors, such as car wash stations (focused in this study). The ability to utilize water wisely and implement sustainable alternatives, including water recycling systems, heavily relies upon people's knowledge of the problem of water scarcity.

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Recently, the United Nations Water Conference 2023 laid out the Water Action Agenda that included 700 commitments aimed at increasing water security to curb the global water crisis. While the United Nations Development Program (UNDP) is devoted to assisting nations with the creation and execution of water security programs, World Vision pledged to raise and invest $2 billion by 2030 to expand the effectiveness of transformative efforts in the field of water and sanitation services in 50 countries, the United States Agency for International Development (USAID) promised to invest $1 billion on water and sanitation infrastructure, European Union committed to invest €300 million in Africa's water projects, the African Development Bank promised to invest $30 billion in water and sanitation facilities in the next ten years, The Water Supply and Sanitation Collaborative Council (WSSCC) pledged to raise $1.5 billion for programs promoting sanitation and hygiene. And the International Water Management Institute (IWMI) is committed to creating a global water accounting system (Yinuo, 2023).

Similarly, Pakistan has always been portrayed as a land of abundant resources, characterized by ceaseless water streams and lush green plains, seemingly impervious to physical constraints. However, the passage of time has brought forth various stark realities, including pressing issues such as the impending scarcity of water. Reports from the Pakistan Council of Research in Water Resources (PCRWR) emphasize the urgent need for an efficient, effective, and practical approach to address the escalating water crisis in the country, which is likely to lead to a multitude of problems. Climate change further exacerbates the situation, with adverse impacts such as unpredictable rainfall patterns, saltwater intrusion, Glacial Lake Outburst Floods (GLOF), rapid glacier melting, and dwindling water reserves (Faruqui, 2004).

Water, in all its forms, is vital not only for environmental sustenance, natural processes, ecosystems, and biodiversity but also for forming an indispensable foundation for humanity (Biswas and Uitto, 2000). Approximately 70% of Pakistan's population is directly or indirectly associated with agriculture, which contributes 26 per cent of the country's GDP (Khoso et al., 2015). This, in turn, affects living standards in the urban sector, as any decline in agricultural output will correspondingly lower the overall quality of life (Nabi et al., 2019). According to a recent report titled "Water Crisis in Pakistan: Manifestations, Causes and the Way Forward", published by the Pakistan Institute for Development Economics (PIDE) in 2022, some alarming statistics emphasize the gravity of the situation. The report reveals that Pakistan ranks 14th among 17 countries worldwide with an "extremely high-water risk," and the country squanders one-third of its available water.

Water scarcity is a major problem in Peshawar - a city that lies in the north-west of Pakistan and forms the capital of the province of Khyber Pakhtunkhwa. With an average of 40 gallons of water utilized every car wash, the car wash industry uses a lot of water. (Water Scarcity and Its Effects on the Environment, 2020). However, water recycling technologies are not widely used in Peshawar's car wash facilities. The Pakistani government has created a water management strategy to address this issue by reducing water loss and enhancing water quality and several plans calling for managing the sources already on hand and developing reservoirs, but people's awareness regarding the negative effects of water waste is integral for them to understand the need of water conservation.

According to the UN, water scarcity is recognized as the primary global challenge, impacting billions of people worldwide. By 2025, an estimated 3.2 billion individuals will face freshwater shortages.

The planet consumes a staggering 10 billion tons of water daily, with 80% of used water being returned untreated to the environment. Alarmingly, 1.8 billion people lack access to clean drinking water. Although water is an abundant resource in the natural global cycle, certain stages in the cycle are not balanced. Due to a surge in the global population, water intake has increased by approximately 6.5 times, reaching about 6.0 - 6.4 thousand km^3 per year or 7 - 10% of total river flow, referred to as "available water resources" for the modern economy.

Water shortages in Pakistan affecting almost all regions of the country. For instance, Tharparkar (Thar), a rural area in Sindh province, has been experiencing severe drought for the past 4-5 years, resulting in approximately 1,500 child deaths annually due to water scarcity and inadequate sanitation facilities. Shockingly, none of the available water sources meet the minimum standards set by the World Health Organization (Tahir, 2020).

It is evident that most research papers on water scarcity primarily come from Western scholars and international organizations, revealing a significant gap in the literature due to the lack of research by Pakistani scholars. Moreover, credible research focused on the context of Peshawar is nearly non-existent, with existing studies primarily centred on Islamabad or Lahore, particularly when it comes to recycling plants and water usage in car wash stations. This deficiency in the literature indicates a lack of knowledge that allows for further research in this field.

Significance of Study

This study demonstrates considerable effectiveness in both theoretical and practical realms. From a theoretical perspective, the results will contribute to expanding knowledge about water recycling in service stations and the factors influencing it. The research will also provide specific methods for engagement and changing social behavior.

On the other hand, the practical significance of this study is immense. Its conclusions can be used to make effective and well-founded decisions and develop policies at all levels of government and among consumers. The study, grounded in the context of Pakistan, allows for generalizing the results and immediately applying them to future planning of government initiatives and programs.

Objectives

The study aims to expand the field of water scarcity management and explore the evident deficiencies in the current understanding of the subject, which creates opportunities for future investigations. Therefore, this study has a number of objectives.

i. By methodically investigating and correcting the obvious gaps in the present understanding of water scarcity within the setting of Pakistan, with a focus on Town 1, Peshawar.
ii. The main goal of this study is to carefully evaluate the viability and crucial significance of raising awareness about water scarcity as a powerful tool for encouraging the widespread adoption of water-friendly practices, especially the integration of water recycling mechanisms in car wash stations.
iii. The study seeks to explore if and how this could be done how increased awareness of Pakistan's water scarcity could drive the implementation of water recycling mechanisms in car wash stations.

Hypothesis

The study has two hypotheses to be tested.

Hypothesis 1: Water scarcity in Pakistan has a statistically positive significant causal impact on the adoption of water recycling mechanisms in car wash stations.

Hypothesis 2: This causal relationship is particularly significant for car wash stations that have implemented water recycling mechanisms.

Scope of the study

Defining the research parameters is of utmost importance to establish realistic boundaries for the study. Firstly, the research is contextualized within the framework of the Town-I of Peshawar, which encompasses the city circle. To ensure broad applicability, the study aims to generalize its findings on a larger scale. A sample size has been determined using the universally accepted formula proposed by Glenn D. Israel (Israel, 1992). The research adopts a cross-sectional approach, gathering data at a specific point in time. Moreover, it follows a quantitative research design, with the primary objective being hypothesis testing. Each of these parameters is further expounded upon in the subsequent sections of the study.

Theoretical Framework

This research adopts a multivariate theoretical framework to explore the concept of 'Awareness' in the context of water scarcity in Pakistan (Gafoor, 2012). These frameworks provide unique awareness categories and definitions to gauge and comprehend the degree of water scarcity awareness, such as the Information-Motivation-Behavioral Skills (IMB) Model, for starters, places emphasis on the three key components of awareness: knowledge, motivation, and behavioral skills. According to this concept, awareness of water shortage is based on knowledge of the issue, a desire to solve it, and the capacity to carry out water-saving measures (Fisher & Fisher, 1992). Although the information is the starting point, motivation and behavioral skills are also essential components of awareness.

It is also possible to gauge awareness of water scarcity by adapting the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB). These frameworks place a strong emphasis on attitudes, subjective norms, and perceived behavioral control, taking into account awareness as well as a person's attitude toward water scarcity, perceptions of social norms pertaining to water conservation, and the perceived control over engaging in water-saving behavior (Ajzen & Fishbein, 1980; Ajzen, 1991).

It is essential to emphasize that the analysis of water recycling mechanisms encompasses various techniques, designs, instruments, tools, and equipment aimed at reducing water wastage and promoting water-efficient practices in car wash stations. The research thoroughly examines the influence of each independent variable on the dependent variable to effectively test the formulated hypotheses.
Presented below is the comprehensive list of variables integrated into the theoretical framework.

Independent Variables (X):

- X1: National Water Scarcity Awareness
- X2: Water Shortage Awareness
- X3: Water Wastage Awareness

Dependent Variable (Y):

- Y1: Use of Water Recycling Mechanisms

It is essential to acknowledge that certain factors, such as the financial capacity of the car wash station or external influences, may potentially act as mediators or moderators. However, this particular research primarily centers on examining the impact of awareness in driving the adoption of water recycling mechanisms. The methodology for conducting the study is analytical and is based on positivist principles (Taylor, 2006). With this method, impartiality and ambiguity are guaranteed, and the effect of Pakistan's water scarcity awareness is treated as an independent variable. The positivist ontological paradigm upholds the independence of the investigation from subjective goals. The use of a quantitative technique strengthens the research's validity and dependability while improving objectivity (Taylor, 2006). Rejecting qualitative and non-numerical data reduces researcher bias and maintains the validity of the study, further encouraging impartiality and neutrality in the study process, which is the axiological paradigm.

The most effective research strategy is a structured questionnaire because it lowers the margin of error through meticulous planning and a small-scale pilot study (Jeynes, 2015). A localized viewpoint is crucial in the setting of Peshawar Town-I, where distinct norms and cultures predominate. Since the study is presented in quantifiable terms, I did not find qualitative research methodologies necessary. A deeper comprehension of the impact of Pakistan's water scarcity awareness is possible thanks to the explanatory case study design (Qi, 2010). It supports the claim that case study results can be easily generalized and offer useful advantages right away. The structured survey's appropriateness and validity are increased by operationalizing and quantifying social variables like awareness using the Likert scale (Jeynes, 2015).

Population and Sample

As mentioned earlier, this research focuses on a case study of Peshawar Town-I, which confines the investigation to a specific area, and the findings are limited to that context. Peshawar serves as the capital of Khyber Pakhtunkhwa province in Pakistan. The chosen Town-I serves as the city centre. The field survey identified a total of twenty registered car wash stations within the selected area of Town-I. The entire population of twenty units was included in the research. However, a systematic sampling technique was still adopted to ensure the systematic inclusion of all twenty units in the sample, as demonstrated in Table 1. It is crucial to emphasize that all twenty car wash stations in Town-I were encompassed in the study.

Table 1

Total number of respondents

N	
Valid Responses	Missing
20	0

Data Collection

This research adheres to the positivist philosophy, adopting a quantitative research approach. Specifically, it falls under the category of non-experimental design, utilizing survey design as the principal means of

data collection through structured questionnaires. These questionnaires, or surveys, were designed to operationalize the various variables in the theoretical framework, with responses quantified using the Likert scale and subsequently analyzed in SPSS. To ensure clarity for respondents, a translator was present during questionnaire distribution to translate instructions and questions into Urdu and Pashto, their native languages.

Results and Discussion

The main findings are categorized into four key areas. The independent variable, 'awareness of water scarcity,' is further divided into three dimensions: National water scarcity awareness, water shortage awareness, and water wastage awareness. Each dimension consists of several items that were assessed through the structured questionnaire. Likewise, the dependent variable, water recycling awareness, has been operationalized. The first three dimensions assess the respondents' awareness of water scarcity, which is then analyzed in relation to the dependent variable of water recycling awareness. This section provides valuable insights into the relationship between water scarcity awareness and the adoption of water recycling mechanisms in car wash stations in Peshawar Town-I.

Demographics Section

The demographic information can be viewed in Table 2, given below.

Table 2

The designation of the respondents

Designation	Frequency	Percent	Valid Percent	Cumulative Percent
Owner of the Car Wash	3	15.0%	15.0%	15.0%
Manager at the Car Wash	8	40.0%	40.0%	55.0%
Worker in the Car Wash	5	25.0%	25.0%	80.0%
Other	4	20.0%	20.0%	100.0%
Total	20	100.0%	100.0%	100.0%

The descriptive analysis, represented in the Table, presents the distribution of respondents based on their designation in the car wash stations in Peshawar Town-I. A total of 20 respondents participated in the study.

The majority of the respondents, 40.0%, were identified as "Manager at the Car Wash," indicating a significant representation of managerial roles in the surveyed car wash stations. Following that, 25.0% of the respondents were "Worker in the Car Wash," highlighting the involvement of car wash employees in the study.

A smaller proportion, 15.0%, were classified as "Owner of the Car Wash," suggesting that car wash owners also participated in the research. Additionally, 20.0% of the respondents were categorized as "Other," which includes respondents with designations not explicitly specified in the provided categories.

Main Findings

The main findings of this study are presented in this section, divided into four subsections: National Water Scarcity Awareness, Water Shortage Awareness, Water Wastage Awareness, Water Recycling Awareness. The findings from these assessments provide valuable insights into the level of awareness and attitudes towards water scarcity, shortage, wastage, and recycling in car wash stations.

Assessing National Water Scarcity Awareness

Table 3 presents the questions used to assess respondents' awareness of national water scarcity in Pakistan. The table shows that all 20 respondents provided valid responses for each question, indicating their level of understanding of the water scarcity challenges the country is facing.

Table 3

Questions assessing national water scarcity awareness

Questions	Most frequent response (1 - 5)
Pakistan is facing water scarcity	4
Pakistan is a water-stressed country	2
Pakistan, by 2025, will face absolute water scarcity.	2
Pakistan has one of the highest groundwater withdrawal rates in the region.	2
Pakistan needs to take her water crisis seriously	4
Pakistan has a severe water shortage	3

Assessing Water Shortage Awareness

Table 4 displays the questions used to gauge respondents' awareness of water shortage at car wash stations. The table indicates that all 20 respondents provided valid responses to each question, reflecting their awareness of water supply issues during car washing activities.

Table 4

Questions Assessing Water Shortage Awareness

Questions	Most frequent response (1 - 5)
The water supply/flow is satisfactory at the car wash	2
There is a water shortage at the car wash	4
When washing vehicles, there is no water shortage	2
Water supply/flow is consistent when washing cars	2
Sometimes, vehicles cannot be washed due to water shortage	4

Assessing Water Wastage Awareness

Table 4 showcases the questions designed to evaluate respondents' awareness of water wastage in car

wash stations. The table demonstrates that all 20 respondents offered valid responses for each question, showing their perception of water usage efficiency during vehicle washing.

Table 5

Questions assessing water wastage awareness

Questions	Most frequent response (1 - 5)
When washing a car/vehicle, there is no water wastage	2
Water is used in excess when washing a vehicle/car	4
I believe that extra water is used during vehicle/car wash	4
I believe water is wasted during vehicle/car wash	4

Assessing Water Recycling Awareness

Table 5 illustrates the questions used to assess respondents' awareness of water recycling mechanisms. The table indicates that all 20 respondents provided valid responses for each question, revealing their inclination towards using water recycling plants and their understanding of the importance of water recycling in car wash stations, particularly during Pakistan's water crisis.

Table 5

Questions Assessing Water Recycling Awareness

Questions	Most frequent response (1 - 5)
I am willing to install water recycling plants	4
I believe that water recycling is important	4
Water recycling can prevent water wastage in car wash stations	4
I know different tools/techniques/mechanisms, etc. for water recycling	2
Water recycling is important during Pakistan’s water crisis	4

In summary, each table provides a comprehensive overview of respondents' perceptions and awareness regarding various water-related aspects in the context of car wash stations, with no missing responses from the participants.

Correlation Analysis

Correlation analysis assesses the presence and strength of relationships between variables. It is important to note that the hypotheses formulated for this study are based on causal relations rather than purely correlational findings. The correlation table (Table 6) presents the relationship between the variables: 'National Water Scarcity Awareness' (ANWS), 'Water Shortage Awareness' (AWS), 'Water Wastage Awareness' (AWW), 'Water Recycling Awareness' (yAR), and the overall 'Awareness' variable. The latter is a combination of ANWS, AWS, and AWW.

Table 6

Correlation between the variables.

Variables	ANWS	AWS	AWW	yAR	Awareness
ANWS	1.000				
AWS	.588**	1.000			
AWW	.770*	-.497	1.000		
yAR	.773*	.091	.816*	1.000	
Awareness	.908*	.374	.836*	.828*	1.000

*Correlation is significant at the 0.01 level (2-tailed).

**Correlation is significant at the 0.05 level (2-tailed).

N=20

'ANWS' denotes 'National Water Scarcity Awareness'

'AWS' denotes 'Water Shortage Awareness'

'AWW' denotes 'Water Wastage Awareness'

'yAR' denotes 'Water Recycling Awareness'

The correlation values range between +1 and -1, where a positive sign indicates a positive relationship and a negative sign indicates a negative relationship. A value of '1' represents a perfect positive correlation. The starred values in the table indicate significant relationships between the variables, with higher values indicating higher significance.

The results reveal a strong positive relationship of 82.8% between yAR (Water Recycling Mechanisms) and Awareness (Average Awareness Score). As people become more aware of water scarcity and wastage, they tend to embrace water recycling practices, resulting in a significant increase in correlation. There is a substantial positive correlation of 81.6% between AWW (Water Wastage Awareness) and yAR (Water Recycling Mechanisms). Individuals who exhibit a higher awareness of water wastage are also more likely to engage in water recycling mechanisms, resulting in a significant 81.6% correlation between these two variables. There is a noteworthy negative correlation of 49.7% between AWW (Water Wastage Awareness) and AWS (Water Shortage Awareness). Interestingly, there is a negative correlation of 49.7% between awareness of water wastage and awareness of water shortage. This suggests that individuals who are more aware of water wastage might be less aware of water shortage issues, and vice versa.

However, it is essential to emphasize that correlation alone does not establish causation. To test the causal hypotheses, linear regression analysis is necessary (Hu, 2020).

Regression Analysis

To test the generated hypotheses and determine the presence of a cause-and-effect relationship between the dependent and independent variables, a linear regression test was conducted. The table below (Table 7) shows the variables used in the testing, with 'Awareness' regarding water scarcity in Pakistan as the independent variable and the use of water recycling mechanisms as the dependent variable.

Table 7

Variables entered/removed.

Model	Variables Entered	Variables Removed	Method
1	Awareness[b]	-	Enter

a. Dependent Variable: yAR (yAR denotes Water Recycling)

b. All requested variables entered.

The model summary in Table 8 indicates the suitability of the model with the accumulated questionnaire data.

"Model": The model number or iteration.

"R": The Pearson correlation coefficient.

"R Square": The coefficient of determination.

"Adjusted R Square": This value takes into account the number of independent variables in the model and adjusts R Square accordingly.

"Std. Error of the Estimate": This value represents the standard deviation of the residuals, which are the differences between the actual values and the predicted values from the regression model.

Table 8

Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.820[a]	.672	.639	.233

a. Predictors: (Constant), Awareness

Table 8 presents the model summary, shedding light on the model's appropriateness in relation to the data gathered from the questionnaires. It's important to acknowledge that, in the realm of social science research, a threshold of 30% (or .30) is considered a cutoff point. A value below this threshold is deemed unacceptable, indicating potential issues such as flawed model specification, erroneous data, or data mismanagement (Hu, 2020). Furthermore, an 'R-value' surpassing 40% (.4) and an 'R-square' value exceeding 50% (.5) warrant closer examination (Jain and Chetty, 2019). Therefore, as evident from the table, the achieved figures are satisfactory. Of particular significance is the 'R Square' value. In statistical terms, this is referred to as the coefficient of determination. As observed, the value of 67.2% (or .672) demonstrates that the independent variable holds the capacity to exert influence over the dependent variable. Additional analyses have been conducted to substantiate this finding further.

Table 9 reveals the coefficients derived from the regression model. These coefficients are crucial for testing hypotheses. They showcase both the unstandardized and standardized coefficients, along with associated statistical values.

In this table:

"Model" denotes the model number or iteration.

"Unstandardized Coefficients" represent the coefficients for each variable in their original units.

"Standardized Coefficients" present the coefficients standardized to show their relative importance.

"t" represents the t-value, indicating how many standard errors the coefficient is away from zero. "Sig." shows the significance level, denoted by p-values, which determine the statistical significance of the coefficients.

Table 9

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.041	.316		-1.041	.309
	Awareness	.807	.122	.820	5.563	<.001

The coefficient for awareness represents the change in the dependent variable (adoption of water recycling mechanisms) associated with a one-unit increase in the independent variable (awareness) while keeping other variables constant. In this analysis, the coefficient is 0.807, which indicates that for each unit increase in awareness, the adoption of water recycling mechanisms is expected to increase by approximately 0.807 units. This suggests that higher awareness of water scarcity is associated with a significant increase in the likelihood of using water recycling methods in car wash stations. The standardized coefficient (Beta) provides a standardized measure of the strength and direction of the relationship between the independent and dependent variables. In this case, the Beta value for awareness is 0.820, which suggests a strong positive relationship between awareness and the adoption of water recycling methods. The t-statistic measures the ratio of the estimated coefficient to its standard error. It indicates whether the coefficient is significantly different from zero. In this analysis, both the constant and the awareness coefficient have t-statistics with associated significance levels. For awareness, the t-statistic is 5.563, and the significance level is less than 0.001. This indicates that the relationship between awareness and the adoption of water recycling mechanisms is statistically significant.

However, the viability of testing the second hypothesis was hindered by a unanimous response from all respondents, indicating that none of them had access to pre-installed water recycling mechanisms. In response to the query, "Does your car wash station possess a water recycling/treatment/conservation mechanism?" every participant uniformly responded with a 'No.' Therefore, the lack of positive responses did not allow us to test the second hypothesis in this study.

Conclusion

The participation of respondents who are informed about the water scarcity issue and support the implementation of water recycling systems in car wash stations in Peshawar contributes significantly to the sustainable development of the region. These findings outline the prospect of successfully implementing environmentally effective practices and highlight the importance of collective efforts.

In the context of the water crisis, car wash stations play a crucial role in optimizing water resource usage. Irrational water usage at car wash stations can lead to the unjustifiable depletion of this valuable resource. The implementation of water recycling systems in car wash stations represents a responsible approach to water usage and contributes to reducing negative environmental impacts.

The awareness and support of respondents regarding ecological responsibility enable the optimization of water usage at car wash stations in Peshawar. This is a significant step towards more sustainable and efficient water resource utilization, which in turn aids in addressing global and regional water crisis issues.

Pakistan has a statistically significant causal impact on the adoption of water recycling mechanisms in car wash stations. The findings from the study underscore the pivotal role of awareness in influencing the implementation of water-efficient practices, such as water recycling, within the car wash sector in Peshawar Town-I. Informed individuals exhibit a greater propensity to embrace environmentally responsible approaches, thereby contributing to the broader objective of sustainable water resource management. This validation of the initial hypothesis highlights the potential of awareness campaigns in shaping behavior and fostering positive changes in resource utilization patterns.

The second hypothesis faced limitations in its verification due to the absence of positive responses. Despite the robust investigation into the causal relationship between awareness of water scarcity and the adoption of water recycling mechanisms, the study encountered a lack of evidence supporting the significance of this relationship within car wash stations that had already implemented water recycling systems.

While the second hypothesis remains unverified in this study, it highlights the complexity of the interplay between awareness and the adoption of water-efficient practices. This underscores the need for more comprehensive research and nuanced investigations to explore the potential nuances of such relationships within specific contexts.

Recommendation

To ensure the successful implementation of recirculation systems in car wash stations, a multifaceted approach is essential. This approach encompasses various strategies and collaborations that collectively contribute to sustainable water usage and conservation.

Firstly, effective staff training and awareness enhancement play a crucial role. Properly educating the staff and creating awareness about water scarcity are pivotal for the proper functioning of recirculation systems.

Financial incentives also play a pivotal role in driving car wash businesses to adopt recirculation systems. By offering financial incentives, the burden on businesses is reduced, accelerating the integration of environmentally efficient practices (Monney, Donkor & Buamah, 2020).

Interdisciplinary collaboration stands as another critical aspect. Collaborating with experts from diverse fields provides an opportunity to implement innovative solutions and optimize both the technical and organizational aspects of recirculation systems.

Partnering with authorities and environmental organizations is vital for creating an enabling environment. Through tax benefits and awareness campaigns, such partnerships can support the implementation of recirculation systems.

Given the absence of established laws for water-efficient practices in car wash stations, the responsibility falls on the district government. They should take charge to ensure compliance with sustainable water usage practices (Warraich, 2019). This could involve providing financial aid and loans to encourage water treatment, conservation, and recycling mechanisms. Developing a comprehensive framework to limit water wastage and establish standards for car wash stations is crucial.

Training government officials in water conservation is essential, as heightened sensitivity to water scarcity can lead to innovative water-saving techniques. Shifting focus from reservoirs to water treatment and recycling arrangements is imperative.

By implementing these detailed recommendations, the car wash industry in Peshawar can significantly contribute to water conservation efforts, mitigate the water crisis, and create a sustainable approach to water usage in the region.

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