

KNOWLEDGE OF WATER CONSERVATION IN COMPANIES IN THE STATE OF VERACRUZ, MEXICO

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Melgarejo Galindo Loida¹, Melgarejo Galindo Doreidy², Castro Lara Rosalía Janeth³, Jiménez Sánchez

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¹ National Technological Institute of Mexico/Úrsulo Galván Technological Institute, loida.mg@ugalvan.tecnm.mx , <https://orcid.org/0000-0002-1552-5999>.

² National Technological Institute of Mexico/Úrsulo Galván Technological Institute, doreidy.mg@ugalvan.tecnm.mx , <https://orcid.org/0000-0002-8885-4769>.

³ National Technological Institute of Mexico/Úrsulo Galván Technological Institute, rjaneth.cl@ugalvan.tecnm.mx , <https://orcid.org/0000-0003-1662-7812>.

⁴ National Technological Institute of Mexico/Úrsulo Galván Technological Institute, L21885061@ugalvan.tecnm.mx .

Summary -- Water conservation is essential because water is a fundamental resource in all areas and sectors, from its necessity for the existence of various natural species to its indispensability for the production of goods and services.

Water, like other natural resources, deserves preservation due to its unquestionable necessity. It is important to take care of it, since even though it has been characterized as a renewable resource, its quality and use can be compromised due to its inadequate use and exploitation.

It is now necessary to establish activities for the care of this vital liquid in different areas, from the individual, social, and business levels, as well as from the different levels of government and economies, where the social and business sectors are not exempt. Strategies for the protection and preservation of water must be implemented in order to continue using it efficiently.

However, the first step is to identify strategies that can help promote the efficient and responsible use of water resources. To do this, it is necessary to determine how well informed people are about water conservation and use activities and strategies. Likewise, companies need to be aware of conservation strategies so that they can use the resource appropriately in the performance of their activities. Given this, it is relevant to carry out this study, which aimed to evaluate the knowledge of water conservation among employees and managers of companies in the state of Veracruz, Mexico.

The results identified that there is still a need to strengthen a culture of knowledge about water reuse in companies, methods for purifying water, and wastewater treatment, as well as

identify the impact of technology on the care and preservation of the resource.

Keywords: Business development, preservation, natural resources.

Abstract -- Water care becomes indispensable as it is an essential resource in all areas and sectors, from its necessity for the existence of the various existing natural species, to its indispensability for the production of goods and services.

Water, like other natural resources, deserves preservation due to its unquestionable need. Its care is important, since even though it has been characterized as a renewable resource, its quality and use can be compromised due to its inadequate use and exploitation.

Nowadays, it is necessary to establish activities for the care of this vital liquid, in different areas, from the individual, social, and business sectors, as well as from the different levels of government and economies, where the social and business sectors are not exempt. Strategies for the protection and preservation of water must be implemented in order to continue using it efficiently.

However, the first step is to identify which strategies can help promote the efficient and responsible use of water resources. It is necessary to determine how informed people are about the activities and strategies for caring for and using water. Likewise, companies must be aware of care strategies and be able to take advantage of the resource in an appropriate manner in the performance of their activities. Given this, it is pertinent to carry out the present study, which is presented as an objective to evaluate the knowledge of water care by employees and managers of companies in the state of Veracruz, Mexico. As part of the results, it was identified that it is still

necessary to strengthen a culture of knowledge of water reuse in companies, methods for purifying water, and wastewater treatment, and to identify the impact of technology on the care and preservation of the resource.

Key words – – Business development, preservation, natural resources.

INTRODUCTION

The scarcity of natural resources is becoming increasingly evident, with no distinction between renewable and non-renewable resources. Inappropriate use has caused increasing damage, and the need to care for and preserve these resources has become clear. Among these resources is water, a fundamental element for existence and subsistence; indispensable for the performance of primary and secondary activities, ranging from the preservation of life to its use as a necessary resource for the production of goods and services in various economic activities across different sectors.

In the early 1970s, the environmental consequences of industrial society began to emerge, prompting reflection on the environment and available resources. In the 1980s, within the framework of the United Nations, the concept of "sustainable development" emerged, which today is a mandatory reference point in all economic development policies. [1]

Today, water scarcity is a reality, with many homes and organizations affected by the lack of this resource. "Approximately 97% of water is found in the oceans, 3% is fresh water, but of this amount, 75% is found in polar ice caps, in the ground, in rock formations, and in the atmosphere, leaving less than 25% of fresh water as surface and groundwater." Due to the effects of global warming and pollution, the day when water, a vital resource, will run out is fast approaching. [2]

According to various data, the outlook for access to water by the world's population is not encouraging. This is because it is estimated that around 884 million people worldwide do not have access to water, and that approximately 1.5 million children die each year from water-related causes. It is also estimated that this year (2025) and by 2025, two-thirds of the human population will suffer from shortages of this vital liquid. [3]

In this regard, it is currently estimated that 20% of the world's population (representing one in five people) does not have access to drinking water to meet their needs, and that in the current year, whereas previously

According to current estimates, two-thirds of the world's population, representing 66.6%, faces problems of water scarcity and/or insufficiency. Likewise, it is estimated that one-third of the world's population, equivalent to 33.3% of inhabitants, will live in absolute scarcity. By 2030, it is estimated that one in five countries in the world will face water shortages. Furthermore, according to sources, by the current year, 2025, water shortages will generate problems related to food scarcity or insufficiency of approximately 350 million tons of food worldwide [4]. This situation must be addressed by the economic sectors in general, due to the impact it has on society and businesses.

In this regard, we consider Alvarado, cited by Gonzales, who states that comprehensive and integrated water resource management must be based on the perception of water as an integral part of the ecosystem, a natural resource, an economic and social asset, whose quantity and quality are directly determined by the nature of its use. Thus, it is considered that water resources must be protected and preserved, and in the development of this aquatic resource, priority must be given not only to satisfying human economic needs through the production of goods and services, but also to safeguarding ecosystems and other social needs that are not directly or particularly economic. [5]

Considering the above, strategies have been planned and implemented to care for this vital resource. For example, the main contribution of Mexico's 2030 Water Agenda, in its vision and underlying principles, is to prioritize society's intention to follow the path of sustainable development. The above, considered as a common activity, as a collective product in the generalization of responsibility for its implementation and monitoring of its progress, is also an action that commits all actors involved in the water sector to support, with the performance of their various capacities and efforts, the achievement of sustainability of Mexico's water resources. [6]

In accordance with the above, given the evident water scarcity and the unquestionable need to implement strategies for water use and conservation in all sectors, including the business sector, it is necessary to conduct initial studies on the knowledge of water conservation strategies in companies in the state of Veracruz, particularly in the central coastal area of the state. In this case, information is considered regarding the municipalities of La Antigua, Veracruz, Actopan, Puente Nacional, Alto Lucero, Xalapa, Paso de Ovejas, Boca del Río, and Úrsulo Galván, all in the state of Veracruz; places with a large influx of water bodies and commercial activity.

business. This study is being conducted with the aim of evaluating the knowledge of water conservation among employees and managers of companies in the state of Veracruz, Mexico. and specifically seeks to identify the frequency of water reuse in companies, determine the frequency of information they have regarding methods for purifying water and treating wastewater in companies, and finally establish the frequency with which it is thought that technology will solve water scarcity.

DEVELOPMENT

This research project is carried out in accordance with the objectives of the project entitled Evaluation of water use and management in organizations and society. The methodology used establishes a descriptive approach, as one of its primary purposes is to identify and describe in detail the use and management of water in organizations and homes in society in the central coastal area of the state of Veracruz.

In addition, the methodology is complemented by qualitative and quantitative studies, which provide relevant information for the purpose of identifying the actions implemented for water conservation by the inhabitants of various municipalities in the state of Veracruz, which are the subject of this study. In this case, we refer specifically to the central coastal zone in the aforementioned municipalities.

The research, carried out over a specific period of time and in a specific population, is considered to have a cross-sectional approach, where the object of study is companies in the central coastal area of the state of Veracruz, specifically in the municipalities of Actopan, Alto Lucero, Boca del Río, La Antigua, Paso de Ovejas, Puente Nacional, Úrsulo Galván, Veracruz, and Xalapa, primarily, and the members or employees of these companies as the subjects of study. To this end, the interview technique was mainly used, applying a structured questionnaire, Likert scale type with a rating scale and multiple choice, to a sample obtained from a finite population, which was established according to the reports and information from the Mexican Business Information System (SIEM) [7], where, as indicated, information was obtained from registered companies. The survey technique was also applied to the inhabitants of the area, for which the universe or population of the information obtained from the National Institute of Statistics and Geography was considered [8].

The samples were calculated using a statistical formula for finite populations, for which a 95% confidence level and a 10% error rate were established. Once the sample was exhausted,

the data analysis was continued using Excel spreadsheets and the Minitab program.

The following are the results of the research progress, which aims to fulfill the objective of evaluating the knowledge of water conservation among employees and managers of companies in the state of Veracruz. The results for the main municipalities or those with the highest frequency are presented, in this case, Úrsulo Galván, La Antigua, Veracruz, Actopan, Puente Nacional, Alto Lucero, Xalapa, Paso de Ovejas, and Boca del Río. (Table 1). The different locations where data collection took place are also indicated.

Table 1. Location of respondents from different companies.

Place of residence	No	%
Úrsulo Galván, Ver.	375	28
La Antigua, Veracruz	331	25
Actopan, Ver.	234	18
Veracruz, Ver.	109	8
Puente Nacional, Ver.	83	6
Alto Lucero, Ver	29	2
Xalapa, Veracruz	27	2
Paso de Ovejas, Ver.	26	2
Boca del Río, Ver.	23	2
Others, State of Veracruz	21	2
Mexico City	8	1
Emiliano Zapata, Veracruz	7	1
Ciudad Juárez, Chihuahua	6	0.4
Foreign	6	0.4
Soledad de Doblado, Veracruz	6	0.4
Camarón de Tejeda, Ver	5	0.4
Puebla, Puebla	5	0.4
Juchique de Ferrer, Ver.	4	0.3
La Gloria, Ver.	3	0.2
Apazapan, Ver.	2	0.1
State of Mexico	2	0.1
Monterrey	2	0.1
Oaxaca de Juárez	2	0.1
Tijuana, B.C.	2	0.1
Vega de Alatorre, Ver.	2	0.1
Cancún	1	0.1
Cd. Del Carmen	1	0.1
Chiapas	1	0.1
Hidalgo	1	0.1
La Paz, Baja California	1	0.1
Morelia, Michoacán	1	0.1
Obregón, Sonora	1	0.1
Querétaro	1	0.1
Reynosa, Tamaulipas	1	0.1
San Luis Potosí	1	0.1

Place of residence	No	%
Sinaloa, El Dorado	1	0.1
Sinaloa, Mazatlán	1	0.1
Tlaquepaque, Jalisco	1	0.1
Tlaxcala	1	0.1
Valladolid, Yucatán	1	0.1
Grand total	1335	100

Employees or managers of companies in the area under study were surveyed, for a total of 1,335 employees, distributed as follows:

Table 2. Percentage distribution of respondents by gender and age range.

Age range	Number	%
Between 18 and 24 years old	666	50
Between 25 and 40 years old	337	25
Between 41 and 65 years old	164	12
Under 18 years old	152	11
Over 65 years old	16	1
Total	1335	100

Source: Own creation.

With regard to the respondents, Figure 1 shows that women in all age groups are higher in percentage terms than men. However, in the case of 18- to 24-year-olds, men have a higher percentage share (53%) than women (Figure 1).

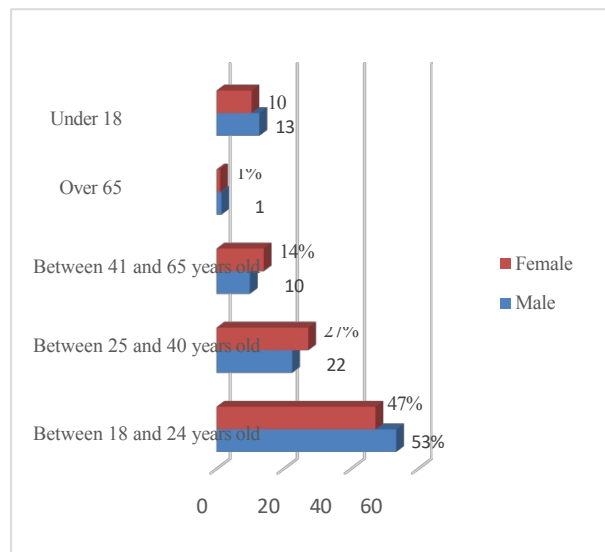


Figure 1. Distribution of sample members by gender and age range.

Source: Own creation.

The first variable considered in water conservation is water reuse. To this end, a question was asked about the culture of reuse: Is water reused?

at home? And is the water used by the company reused?, with the answer options Never, Almost never, Occasionally, Frequently, and Very frequently. A more pronounced culture of reuse is identified at home than at work, with 52% responding frequently to very frequently.

Table 3. Frequency of reuse at home and at work.

Question	Never	Almost never	Occasionally	Frequently	Very frequently
Reused water	2%	9%	36%	32	20
The water used for by the company is reused	13%	11	15	12	8

Source: Own creation.

The first variable considered in terms of water conservation by companies in the area under study is water reuse in companies. As can be seen, the option *Occasionally* was chosen by most respondents; however, in the office, the second most selected alternative was *Never*, *Frequently*, and *Very frequently*, which had significant percentages of selection.

Table 4. Distribution of the frequency with which water is reused in the company.

Frequency	Number	%
Occasionally	196	25
Never	178	23
Frequently	156	20
Almost never	148	19
Very often	111	14
Grand total	789	100%

Source: Own creation.

Likewise, with regard to user knowledge, three questions were used to find out what information they had and to provide them with knowledge about water conservation in companies.

The first question was: *The information you have about methods for purifying water and making it suitable for human consumption is:* in this case, the answers are shown in Table 3, where most respondents mentioned having *Medium* information, followed in order of importance by *High* and *Very High*.

Table 5. Frequency distribution of information on methods for purifying water.

Information	Number	%
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Average	582	43.60%
High	385	28.84
Very high	192	14.38
Low	151	11.31
None	24	1.80
Fair	1	0.07%
Grand total	1335	100.00%

Source: Own creation.

Another question refers to *the information they have regarding how a wastewater treatment plant works*, requesting responses on a Likert ordinal scale of *Poor, Fair, Good, and Excellent*.

Table 4 shows that the same proportion of respondents said the information was *Good* or *Fair* (38%). Therefore, based on both responses to the question, it appears that users have sufficient knowledge.

Table 6. Frequency distribution of the information they have about wastewater treatment.

Information	Number	%
Good	511	38
Fair	502	38
Excellent	176	13
Poor	146	11
Grand total	1335	100

Source: Own creation

Finally, they were asked about how often they think technology will solve water scarcity. The responses are shown in Table 5, in which 34% of the sample said *occasionally*.

Table 7. Frequency distribution of the belief that technology will solve water scarcity.

Frequency	Number	%
Occasionally	45	34
Almost never	276	21
Frequently	269	20
Never	193	14%
Very often	145	11
Grand total	1335	100

Source: Own creation.

In order to identify possible relationships between the variables, the data obtained in the research was analyzed using the Chi-square statistical program (χ^2). This section presents the results relating to the questions posed in this study.

The analysis was carried out between the control variables of: Gender; Age Ranges; and Whether they worked, crossing them with the indicators of each dimension.

The following table presents only those indicators whose Chi-square (χ^2) value allowed us to consider that they are not independent and therefore there is a relationship between them. When the indicator does not appear, it means that there is independence between the variables and indicators, so they are not presented in the table.

Table 8. χ^2 analysis.

Dimension	Indicator (Question)	Gender	Age range Age	Employment	Chi2	Value p
Water reuse	The information that has about the methods for purifying the water and consider it suitable for consumption is:	X		x	9.661	0.047
	The information that has about the functioning of a treatment plant waste is:	X		x	20.724	0.000
			X	x	35.894	0.000
	Frequency with which they think that technology will resolve the water of	X		x	25.934	0.000
			X	x	55.435	0.000
				X		0.050

Source: Own creation.

DISCUSSION AND ANALYSIS OF RESULTS

Employees or managers of companies in the area under study were surveyed, for a total of 1,335 employees, 75% of whom are between 18 and 40 years of age. It can be seen that women in the different age groups are greater in percentage terms than men. However, in the 18-24 age group, men had a higher percentage (53%) than women.

Water reuse is an occasional activity, and it was never the other option, which means that 48% never or almost never reuse water. The lack of implementation of water reuse strategies in the municipalities under study is evident, and it is important to strengthen the culture of resource conservation. This is in agreement with Tovar, Jiménez, & Quiroz [9], who state that it is becoming increasingly essential to change the way

of thinking and acting among people who believe that water is an inexhaustible resource, a situation that is reflected in its irrational and careless use. It is necessary that all of us, without exception, begin to care for, protect, and rationalize the use of this coveted, prestigious, and indispensable mineral, which is becoming increasingly scarce, so that life on our planet can continue.

With regard to user knowledge, three questions were used to find out what information they have and to provide them with knowledge about water conservation in all companies. With regard to the information they have, the methods for purifying water and considering it fit for human consumption are rated as Medium, High, and Very High. (86.7%), which differs from the conclusion that 76% of respondents have low knowledge about safe water consumption, as found in a descriptive cross-sectional project on water consumption by families in the Los Angeles community, Peru, with the aim of carrying out an educational intervention on safe water consumption in 2018-2019. [10]

Regarding the question about how well-informed respondents were about how a wastewater treatment plant works, answers were requested on a Likert scale ranging from Poor, Fair, Good, and Excellent, with 76% considered to be Good. Therefore, based on both responses to the question, it appears that users have sufficient knowledge, which is consistent with Roldán's study, which found that 65.1% of the population is familiar with some type of wastewater treatment system. They mentioned that they were familiar with artificial wetlands, the phytoremediation process, municipal treatment plants, and wastewater treatment plants that use microorganisms. It is determined that the number of people reflected in the high percentage of the population that has information and knowledge about water activities and/or treatments is significant. Likewise, it should be a general activity where it is a priority to expand this knowledge and transmit it to others and to future generations, not only for the purpose of generating knowledge, but also so that it can become a habit to want to have and implement some type of water treatment at home. It is necessary for this to be a social practice, carried out on a daily basis and involved in different types of education (formal, informal, non-formal, and community), where values of respect for the environment and natural resources in general are promoted and recovered [11].

In this regard, it is important to mention, quoting Ramón, that in Mexico, the treatment of wastewater for reuse, reincorporation into surface water bodies, or reinfiltration into aquifers is not a widespread option

unfortunately, existing treatment plants use polluting technologies, consume high amounts of energy, and, unfortunately, produce toxic waste as a result of their operation. Therefore, in order to build a sustainable urban infrastructure, it is necessary to opt for alternative technology that allows for the reuse of water flows and/or their return to nature in good quality, without intensive energy use and without producing pollutants. [12]

Finally, regarding the frequency with which technology will solve water scarcity, 34% of the sample said occasionally. Given this, a technological methodology must be chosen that is more suitable for wastewater treatment and that contributes to adequate and efficient decision-making in the investment of economic resources to decontaminate water bodies. [13] This methodology must be based on sustainability factors, life cycle analysis, and the costs associated with investment, operation, and adequate and effective maintenance. It is important to identify the appropriate use of technologies and their importance in water conservation; however, they should not be considered the only viable alternative. [14]

With the above, we agree with Custodio & Cabrera that water scarcity is not an absolute value but rather relative to human activity, which generates demand, but its capacity to support human activity varies greatly and under very different circumstances. Human ingenuity plays an essential role here, using scientific knowledge to generate technology to solve problems of subsistence, growth, economic development, and well-being. [15]

CONCLUSIONS

We were able to evaluate 1,335 employees from different companies in the area under study, of which the largest percentage of the sample is between 18 and 24 years old (50%), and 25% are between 25 and 40 years old, with the majority being female, except for the 18 to 24 age range, where men have a higher participation.

The study and its results identified the frequency of water reuse in companies, with respondents indicating that they only do so occasionally. The second most popular response was never, followed by almost never (19%), representing a total of 67% who do not reuse water in the companies where they work or represent.

The second objective is to determine the frequency of information they have regarding methods for purifying water and treating wastewater in

companies. Three questions were used to assess users' knowledge and find out what information they have and what they know about water conservation in companies. The first question was: What information do you have about methods for purifying water and making it suitable for human consumption? Most respondents said they had average information, followed in order of importance by high and very high. This accounted for a total of 86.7% of the responses.

The other question refers to the information they have about the working method or process of a wastewater treatment plant, where responses were requested on a Likert ordinal scale of Poor, Fair, Good, and Excellent, with 38% of respondents saying it was Good or Fair.

Based on the information analyzed for both questions, it can be concluded that company employees have significant knowledge about water purification and the use of water treatment plants.

The third specific objective was to establish the frequency with which it is thought that technology will solve water scarcity, where occasionally was the most frequent response, followed by almost never, making a total of 55% who believe that technology will not solve the problem of water shortages.

Finally, a Chi2 value was identified, which demonstrates the relationship between the variables of control: gender; age ranges; and whether they worked, crossing them with the indicators of each dimension. In this case, information on water purification methods, information on the operation of a wastewater treatment plant, and the frequency with which they think technology will solve water scarcity allowed us to consider that they are not independent and therefore there is a relationship between them.

With the information obtained, it is necessary to establish a proposal to follow up on the subject of study, with the aim of addressing other variables such as care, savings, among others, related to water use and care in companies.

The above results serve as a follow-up and reference to the research entitled Environmental culture in companies in the central region of the state of Veracruz, which established its objective as evaluating the environmental culture in companies in the municipality of La Antigua [16], where the need to strengthen policy implementation activities in water management was identified. This research served as a reference for another study on the preservation, care, and use of resources, entitled Evaluation of

waste management in organizations as a benchmark for circular economy for sustainability, which is currently being developed by the group of researchers who subscribe to this study, where the aim is to identify the activities implemented in this area by companies in the Úrsulo Galván, La Antigua, and Veracruz corridor in the state of Veracruz.

It is also important to mention the relationship between this research and the Diagnosis of knowledge about drinking water and sanitation services in Palmas de Abajo, Actopan, Veracruz, which aimed to investigate the conditions of the inhabitants of the area in terms of water issues and the treatment system for cleaning water [17].

Finally, according to the various studies and results, there is a clear need for people to make good use of water resources and to be informed about strategies that support water conservation [18].

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Table of Contribution Roles

Role	Author(s)
Conceptualization	Loida Melgarejo Galindo Rosalía Janeth Castro Lara "supports"
Resources	Loida Melgarejo Galindo
Funding acquisition	Loida Melgarejo Galindo
Methodology	Doreidy Melgarejo Galindo
Project administration	Loida Melgarejo Galindo
Data curation	Yair Jiménez Sánchez
Writing – original draft	Rosalía Janeth Castro Lara
Formal analysis	Doreidy Melgarejo Galindo
Supervision	Loida Melgarejo Galindo
Validation	Doreidy Melgarejo Galindo
Visualization	Rosalía Janeth Castro Lara
Writing, revision, and editing	Loida Melgarejo Galindo



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