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Environmental Impact of the Rainwater Catchment Systems in the ITSSNP

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Abstract: ***We have as a general objective to evaluate the viability of the RCS (Rainwater Catchment Systems) in the ITSSNP (Instituto Tecnológico Superior of the Sierra Norte of Puebla) through the measurement of the degree of environmental impact, based on its own research methodology, which is divided into 3 stages; Theoretical, Practice and Analysis. The following impacts are obtained as a result of the compilation of data on the supply of drinking water and rainwater inside of the facilities of the ITSSNP carried in a field logbook: Social, it makes the population aware of the benefits of collecting rainwater towards the environment;Environmental, it is based on reducing the consumption of drinking water obtained from the emanation of aquifers damaged by over exploitation.Implementing the RCS, a sustainable solution is provided, which generates a new alternative of water supply in quantity and quality for the population. The implementation of a RCS is an excellent alternative to supply basic needs, thanks to the fact that rainwater is a natural resource that the population does not take advantage of in its entirety, being an option to have a better quality of life in the future.***

Keywords: Catchment, Impact, Rain, Systems, Water

1. Introduction

All human beings are responsible for maintaining and conserving the natural resources of our planet since they are of vital importance for the development of any species, including humans [1], however, there is a natural resource that becomes more important than others, because as well as being indispensable for the existence of living entities, it is used for the development of the Mexican nation, because it is needed as for domestic work as in the industrial use, especially in large industrialized cities. The resource we are talking about is Water, water is a basic resource: without water, there would be no life.

The reality of these resourcesis another, over time, these are depleting in a large proportion despite being renewable resources, this is because the human population is growing year by year, and to satisfy the needs of this, more resources are required, in addition the population does not know how to take advantage of these resources to the maximum and does not use each of them appropriately, which leads to overexploitation and the extinction of them.

Our ancestors knew how to take advantage of resources such as water, an example of this were the artificial systems that captured and retained the rainwater to divert it to the fields, there is evidence that they existed in Prehispanic Mexico, the evidence of this are the aqueducts that they are still standing, but the reality of modern society is that it does not have a culture and awareness about the use of water, which it leads us to depleteit.

2. Problem Statement

In recent years, in the municipality of Zacatlán, it has not been seen that the Rainwater Catchment Systems are used as an alternative to obtain drinking water, since the water shortage is already presented, it is because the aquifers that supply this city have been damaged due to the deterioration of the ecosystem of the place and the soil erosion, which have been affected by several factors. The aspects that are considered decisive for this waste are:

- The lack of interest in the implementation of Rainwater Catchment Systems by the population and the government.
- There is not a good dissemination on this subject; conferences, workshops and others have not been given to the society, and if there are,a few people know about it and those who are promoting these Catchment Systems.
- The lack of information from society about the viability, profitability, benefits and impacts generated by the Rainwater Catchment Systems.
- The ideology of the population on the Rainwater Catchment Systems to think that these are very expensive, they are not profitable or not necessary.
- It has not become necessary to implement Rainwater Catchment Systems in a large part of the region since there is an access to streams, aquifers, wells and to the supply of drinking water by SOSAPAZ.
- The lack of support for projects to implement Rainwater Catchment Systems, by the government with economic resources, and experts in the field to carry out the correct implementation.

3. Establishment of the Hypothesis

Ho: It will be possible to determine that the RCS (Rainwater Catchment Systems) have a high degree of environmental impact in ITSSNP facilities.

HI: It is not possible to determine that the RCS (Rainwater Catchment Systems) have a high degree of environmental impact in ITSSNP facilities.

4. General Objective

Evaluate the viability of the RCS (Rainwater Catchment Systems) in the ITSSNP through the measurement the degree

of environmental impact to make it known to the society and take advantage of their operation.

5. Methodology

The methodology of the research implemented [2] is divided into 3 stages which are:

Theoretical Stage.
1) Conceive the Idea to Investigate and its Background.
2) Elaborate the Problem Statement.
3) Define the General and Specific Objectives.
4) Elaborate the Justification.
5) Elaborate the Theoretical Framework and State of Art.
6) Define the Research and Scope.
7) Formulate the Hypothesis.
8) Select the Appropriate Sample for Research.
9) Determination of the Study Type.

Practical Stage.
10) Selection, Design and Test of the Measurement and Data Collection Instruments.
11) Application of the Measurement Instrument (Surveys).
12) Field Data Collection.

Stage of Analysis.
13) Processing and Analysis of Information.
14) Elaboration of the Results Report and Graphic Representation.
15) Elaboration of the Budget or Financing.
16) Testing of the hypothesis.
17) Synthesis and Conclusions.

6. Investigation Development.

Process of Data Collection [2]:

The logbook, or field diary that was implemented, consisted in taking weekly control of drinking water and pluvial water consumption of the cisterns of the ITSSNP, through a table where the amount in cubic meters of drinking water and the amount of pluvial water was registered weekly which it was supplied to the water tanks of different buildings, to then calculate the total weekly water consumption and thus determine the percentage of potable water supplied during that week, as well as the percentage of pluvial water.After obtaining these data, they were used for the realization of statistics with which planted hypotheses are proved on whether there is saving of drinking water in a large percentage, also these data helped us to determine the months in which there is greater demand for rainwater, among other things.

7. Results

The data presented in the field logbook, on the total supply of drinking water and pluvial water within the ITSSNP, to whichitwas applied a linear regression analysis [2] in the Excel software, applying a scatter plot to the data to obtain the regression equation and the coefficient of determination (r2) (Figure 1), and thus compare it with the data previously calculated, subsequently a data analysis was applied within the same software in order to obtain the data to prove our hypothesis (Table 1), establishing as:

H0: The RCS (Rainwater Catchment Systems) generate a high saving of drinking water in ITSSNP facilities.

H1: The RCS (Rainwater Catchment Systems) do not generate a high saving of drinking water in ITSSNP facilities.

Therefore, it is established that there is a significant evidence that the RCS (Rainwater Catchment Systems) generate a high saving of drinking water in the facilities of the ITSSNP, since with a confidence level of 95% and an error of 5%, the result of the test t is of 0.6397 and the value of tables is of 1.981, reason why the criterion of rejection of H0 is represented of the following way: t calculated> t α represented by the value of table t [3]. Which is expressed 0.6397 <1.981, so the calculated test statistic (t) is acceptable, accepting the null hypothesis and rejecting the alternative hypothesis (Figure 2), also performing the analysis with the testf, with a confidence level of95% and an error of 5%, the result of the test f is of 0.4092 and the value of tables is of 3.924, reason why the criterion of rejection of H0 is represented of the following way: f calculated> f α represented by the value of table f [3]. Which is expressed 0.4092 <3.924 so the calculated test statistic (f) is acceptable, accepting the null hypothesis and rejecting the alternative hypothesis (Figure 3).

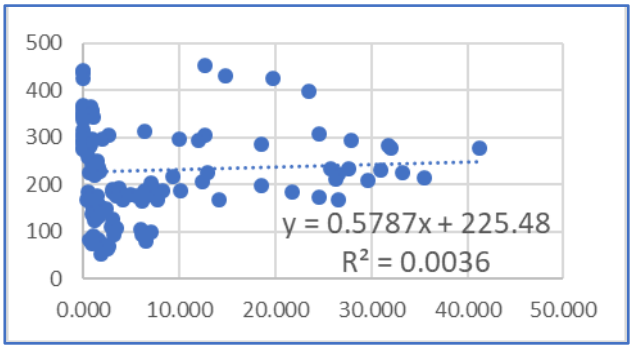

Figure 1: Linear Regression of General Consumption

Table 1: Results of the Linear Regression Analysis of General Consumption

Resumen								
Estadísticas de la regresión								
Coeficiente de correlación múltiple	0.059811918							
Coeficiente de determinación R^2	0.003577466							
R^2 ajustado	-0.005163083							
Error típico	97.70231303							
Observaciones	116							
ANÁLISIS DE VARIANZA								
	Grados de libertad	*Suma de cuadrados*	*Promedio de los cuadrados*	*F*	*Valor crítico de F*			
Regresión	1	3907.027424	3907.027424	0.409295311	0.523611016			
Residuos	114	1088214.585	9545.741971					
Total	115	1092121.612						
	Coeficientes	*Error típico*	*Estadístico t*	*Probabilidad*	*Inferior 95%*	*Superior 95%*	*Inferior 95.0%*	*Superior 95.0%*
Intercepción	225.4839916	11.22669924	20.08462032	3.02959E-39	203.2439869	247.7239964	203.2439869	247.7239964
Variable X 1	0.578703052	0.90456002	0.639761917	0.523611016	-1.21322338	2.370629485	-1.21322338	2.370629485

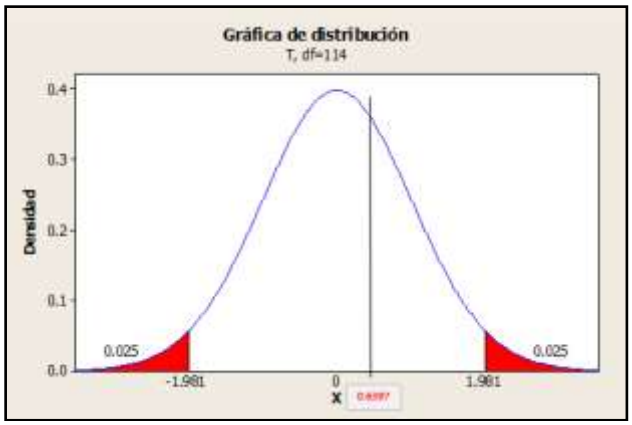

Figure 2: Checking the Hypothesis Through the "t" Distribution

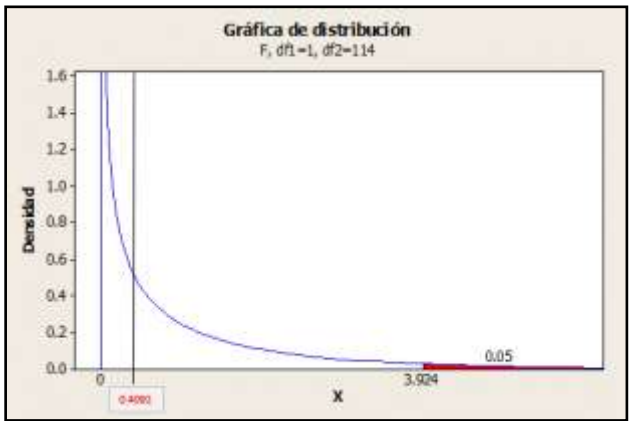

Figure 3: Checking the Hypothesis Through the "f" Distribution

8. Conclusions

Based on all the analyses that have been carried out throughout this project, the following points can be concluded:

- According to the data obtained in the field logbook on the supply of drinking water and rainwater within the ITSSNP, it is concluded that the saving of drinking water and / or rainwater supply is 848.2018m^3 equal to 3.08% of the total water consumption during the period from July 2015 to November 2017.

- The RCS (Rainwater Catchment Systems) are generating a high saving of drinking water in the facilities of the ITSSNP, but they could generate even more saving if it hadinstalled a RCS (Rainwater Catchment Systems) in each building, since based on the linear regression analysis that was done on the system installed in building A, the coefficient of determination r2 showed us that the results of our variable X (Rainwater Consumption) are better than the results of our variable Y (Drinking Water Consumption), that is, the Rainwater Catchment System installed in this building is better since we can use the water obtained from it for many things, however the drinking water does not, this means that the RCS helps to reduce drinking water consumption in the ITSSNP.
- It is worth mentioning that in some way the waste of water is linked to consumption, ensuring that when it is used without control, this vital liquid is susceptible to waste it, also, sustainability is related to Rainwater Catchment Systems andthe real interest that people have in implementing these systems for their benefit and of the environment.
- It can be accepted internally and externally that the Rainwater Catchment Systems in the Institute are generating a high impact on society.
- The social, sustainable and economic factors exert a very strong impact in the region in such a way that it is demonstrated in the drinking water consumption of the same.
- In general, these Rainwater Catchment Systems are a viable alternative to supply in quantity and quality of water, the different activities generated in the Institute, the implementation of a Rainwater Catchment System in an Institution, hospital, home , among others, is an excellent alternative to supply basic needs, thanks to the fact that rainwater is a natural resource that human beings do not take advantage of in its entirety, being an option to have a better quality of life in the future.

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