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Research paper

Evaluation of Water Resources Management in Construction Industry – A Model Study

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Abstract

Construction projects need to be executed to a prefixed time schedule and with the estimated cost according to the plan among all these before starting the project all we need to see was water resources if the resources are not available we cannot start the project. The research was developed in water resources management the techniques, limitations, the future purpose work the overview of all the methods need to be covered. Business have increased now a days to get the additional advantage to the construction project all we need to do was select the area which have surrounding water supplies, underground water level, occurrence of the rainfall all these conditions need to be considered before the construction of the project. While the construction of the project water treatment plants has to be constructed the water used for the household purpose can be reuse by fallowing the treatment techniques. Ground water recharge techniques also have to be implementing to increase the level. The water resource management gives extra benefit to the project the initial cost of these treatment plants will be more but in the future there will be more benefited. This paper describes and finds issues in the water resource management in construction projects and also taken many options of engineers, project managers, people who are living in the local area, site engineers, and irrigation officers. The gathered information from the questionnaire survey is analyzed in AHP Model and developed the importance of the alternatives derives from the issues. This will be helpful for the employees of construction project managers and also to the people who are wasting more water the techniques need to fallow and how to use them and how to treat them how to save water will be considered.

Keywords: *Construction Project Management; Water Resources; Resource Management; AHP Model.*

1. Introduction

The basic important resource for the construction of any project was water resource management. Day by day increase in the population leads to usage of the resources to manage the resources all we should do was to save the resources for the future generations so the reuse of the treated waste water has to implement in each and every construction projects. From since 10 years the attention towards the treatment of the waste water has been increased. The treated water can be used further for irrigation purpose, fire control facilities, ground water recharge, industrial reuse, etc. At the time of the construction of projects huge amount of water will be get wasted so the ground level water get decreased so each and every house need to built their own rain water harvesting to revitalize the ground level water. Water covers extra than two-thirds of earth surface but fresh water stand for less than 0.5% of the total water on earth. 97% of all water is in the seas and oceans and the rest of 3% of fresh water which can be use for drinking and agriculture purposes.

There are four main sources of water

1. Surface water
2. Underground water
3. Atmospheric water
4. Oceanic water

Surface water: India's average yearly surface run-off generated by rainfall and snowmelt is predictable to be about 1869 billion cubic meters. However, it is predictable that only about 690 billion cubic meters or thirty-seven percent of the surface water resources can in reality be mobilized. This is because 1. Over 90 per cent of the yearly flow of the Himalayas Rivers occurs over a four month phase and 2. Probable to imprison such resources is difficult by imperfect appropriate storage reservoir sites.

The average yearly rainfall over the complete surface of the earth is predictable to be about hundred centimeters. Amounting to a total volume of about $5x105km^3$.This is about 39 times the total quantity of all water in the atmosphere, implying that the standard dwelling time of water in the atmosphere is about 9.4 days. Yet, this atmospheric movement is energetically related to the much larger time scales of transmission of surface water and ground water and has predisposed the earth's evolution over billions of years.

Underground Water: The term underground water refers to all water below the water table to enormous depths. In the soil, both water and air coexist in the aperture seats. A reflective corollary is that the passageway water in the soil can only be extracted by plant roots, within confident range of situation. Ground water, on the other hand can be extracted by humans through wells. Ground water

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and soil water together represent the lower part of the hydrological cycle.

The yearly probable ordinary of ground water recharge from rainfall in India is about 342.43 km^3, which is 8.56% of total annual rainfall of the country. The yearly probable ground water recharge intensification from canal irrigation system is about 89.46km^3. Thus, total fill up able ground water supply of the country is assessed as 43.89%. After allotting 15 percentages of this measure for drinking and six km^3 for industrial purposes, the remaining can be utilized for irrigation purposes. Thus the accessible ground water resource for irrigation in India is 361km^3, of which purposeful quantity (ninety percentages) is 325km^3.The estimates by the central Groundwater Board of total refill able ground water resource, requirement for domestic, industrial and irrigation uses and pragmatic ground water resources for opening use are given in.

Atmospheric Water: The Earth is a really exceptional in its plenty of water. Water is essential to underneath life on the Earth, and helps tie mutually the Earth's lands, oceans, and atmosphere into an integrated system. Precipitation, evaporation, freezing and melting and attentiveness are all part of the hydrological cycle - a boundless global practice of water circulation from smoke to land, to the ocean, and back to the vapors. This cycling of water is confidentially linked with energy interactions amongst the atmosphere, ocean, and land that determine the Earth's climate and cause much of natural climate variability. The impacts of climate change and unpredictability on the excellence of human life occur primarily through changes in the water cycle. The hydrological cycle is mostly ambitious by solar energy. Of the total solar energy conventional on the Earth's surface, about forty percentages is returned to the atmosphere as latent heat of evaporation, and another 18% as sagacious warm. Within the atmosphere, water plays a momentous role in the redeployment of energy through meridional or longitudinal convection cells, as well as through zonal or latitudinal circulation patterns. The average annual precipitation over the complete surface of the Earth is predictable to be about hundred centimeters, amounting to a total volume of about 5, 105 km^3. This is about thirty-nine times the total quantity of all water in the atmosphere, implying that the average dwelling time of water in the atmosphere is about 9.4 days. Yet, this atmospheric movement is energetically associated to the much larger time-scales of movement of surface water and groundwater, and has prejudiced the Earth's development over billions of years.

The Oceanic Water: The Ocean plays a key role in this fundamental cycle of water. The ocean holds ninety-seven percentage of the total water on the planet; 78% of global precipitation occurs over the ocean, and it is the source of eighty six percentage of global vanishing. In accumulation disquieting the amount of atmospheric water vapors and hence rainfall, evaporation from the sea surface is important in the movement of heat in the climate organization. Water evaporates from the surface of the ocean, mostly in warm, cloud-free subtropical seas. This cools the surface of the ocean, and the large quantity of heat immersed the ocean reasonably buffers the greenhouse effect from increasing carbon dioxide and other gases. Water vapor conventional by the atmosphere condenses as clouds and falls as rain, mostly in the ITCZ, far from where it evaporated, Condensing water vapor releases latent heat and this drives much of the atmospheric swap over in the tropics. This latent heat release is a noteworthy part of the Earth's heat balance, and it couples the planet's liveliness and water cycles.

1.1. Recycle and Reuse of water

According to Gupta et al. Recycling of water is not practiced in India and there is considerable scope and incentive to use this alternative. They estimated that recyclable water is between 103 and 177km3/year for low and high population projections.

1.2. Reduction of water demand and management of resources

Due to population pressure demand of water is gradually increasing in India. The water demand could be reduced through the practices which require less water and reduce wastage of water and misuse of water. First of all there should be a balance between water demand and water supply. For ideal water management, economic incentives or penalties to be applicable to the users. Water rationing system may also be introduced. These may be based on strategies that include legal restrictions, economic incentives and issuance of public appeals.

1.3. Desalinization of water

About 70% of the earth's water resources are saline water. Since 1970, different desalinization technologies have been developed including distillation, reverse osmosis and electrolysis. Especially these technologies are suitable in coastal areas where less drinking water is available and more saline water is available

2. Objectives

The objective of study as follows:

1. The data collection through questionnaire survey from different construction companies and also to identify the issues involved in water resources management in the construction projects.
2. Data analysis with a software or technique and recommended solutions for the issues involved in the water resource management in construction projects.

3. Methodology

In the initial stage of the project firstly we need to gain knowledge about the project so the literature review has to be done. The different journals have to be collected from different journals regarding water resources management in construction project. The research done finds out the limitations and drawbacks involved in the water resources management. The research work is carried out by reading the various journals, research papers, books, previous projects. The main knowledge we can gain from reading the various journals after gaining knowledge we have to think about how to find the solutions and gaining knowledge about the water resources management and we need to plan for the future work to be done and also to find the solutions for those issues.

3.1. Data collection

Data has to be collected from the project managers, civil engineers, contractors, construction managers from different live projects. As already discussed in the objective the data has to be collected from the different journals and qualitative research has to be done.

In the literature review the research was focused on:

- The different methods/models used mainly to analyze the issues and to find out some alternatives for the completion on project in construction project
- The problems regarding management of resources and also the loss & profit of the construction companies.

The main motto and aim of the collection of data is to gather the information regarding the machinery management and how they will be used wisely in the construction projects to decrease the cost and time.

The data was collected in three major ways:

1. Questionnaire survey
2. Literature survey
3. Journal paper.

Questionnaire survey

This is very valuable information that was gathered from the officials of the construction projects this was considered as the main aspect. The gathered opinions of the people are honest and genuine while answering the questionnaire survey and their responses are anonymous. The questionnaire was distributed to the officials of some construction managers in Vijayawada. This includes questions about the machinery management. In this section they are asked about their background. The basic questions asked were:

- Number of projects you are involved in.
- Years of experience in construction industry.

3.2. Data Analysis

AHP model

This is a technique used to take multi criteria decision on various problems in which lots of variables are involved in the resource management issues. The data which was collected regarding resource management was observed in some construction companies.

The officials of construction projects mainly use this AHP model for collecting the opinions. We can solve the problem by using the different criteria's and each one of them has different alternatives. AHP Method mainly used to find out the perfect alternative that can be imposed to solve the various issues of the resource management construction projects. AHP Model undergoes five steps to find the best alternatives.

AHP Model calculations for problems in construction projects

- The first step was to decomposition of problems to criteria, sub criteria, goal and alternatives in the form of the questionnaire survey.
- Then the comparison's was done pair wise to the alternatives and we find the most important in tends to too strong to equal. This was done officially in the construction projects to gather the opinions for our questions.

Finally I made in to the pair wise comparisons for alternatives and also to find the most important one and to see which alternative one has weighs more.

- AHP is a two-stage process:
- Decomposing the complexity
- Synthesizing the relations

There are five basic elements involved in this AHP Model they are

- Hierarchy construction
- Relative weight calculation
- Pair wise comparisons
- Aggregation of relative weights
- Consistent ratio

$$CR = \frac{CI}{RI} \quad (1)$$

$$CI = \frac{\lambda max - n}{n - 1} \quad (2)$$

Whereas CR= Consistency Ratio
CI=Consistency Index
RI=Relative Index.

4. Results and Discussion

The questionnaire survey which was prepared on three resources such as Space & Facilities, Water resources, Machinery management responses taken from the various levels of students, employees and different construction companies was taken. I got 52 responses from the respondents the minimum qualification for the respondents was diploma to answer the questionnaire. The main motto to do this survey was to have quality work. The result regarding Space & Facilities, Water resources, Machinery management with respect to quality, quantity and time as below.

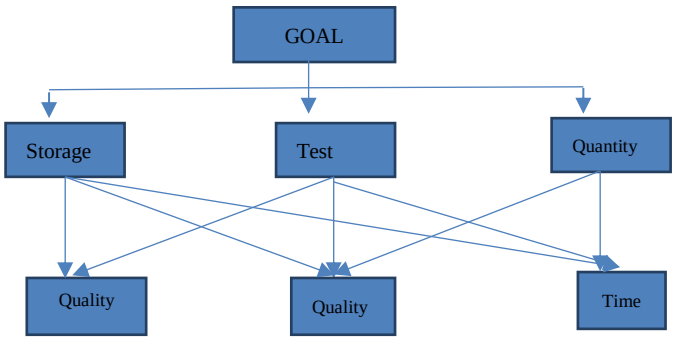


Fig. 1: Hierarchy Tree

Table 1: ranking of criteria

	Storage	Test	Quantity reliability
storage	1	3	4
test	1/3	1	2
Quantity reliability	1/5	1/2	1

Ranking of priorities

To find the ranking of priorities, namely the Eigen vector X:

- Normalize the column entries by dividing each entry by the sum of the column.
- Take the overall row averages.

$$A = \begin{bmatrix} 1 & 3 & 4 \\ 0.33 & 1 & 2 \\ 0.2 & 0.5 & 1 \end{bmatrix}$$

Sum = 1.534.337.00

Normalized column sums

$$\begin{bmatrix} 0.65 & 0.69 & 0.57 \\ 0.21 & 0.23 & 0.28 \\ 0.13 & 0.11 & 0.14 \end{bmatrix}$$

Row Averages

$$X=\begin{bmatrix}0.65\\0.32\\0.14\end{bmatrix}$$ (Priority Vector)

Criteria weights

1. Storage = 0.32
2. Test = 0.56
3. Quantity reliability = 0.12

Calculation of Consistency Ratio:

To calculate λ_{max} so as to lead to the consistency index and the Consistency Ratio:

A			X	AX	X
1	3	5	0.65	2.17	0.65
0.33	1	2	0.32	0.81	0.32
0.2	0.5	1	0.14	0.43	0.14

λ_{max}= 2.97, By averaging of Ax and X

CI= (2.97-3)/(3-1) = -0.015, n=3, R.I. = 0.58 (from Table)

C.R. = -0.015/0.58 = -0.02

C.R. $\leq$0.1 it indicates consistency for decision.

Hence we can move further to do AHP Analysis.

Ranking Alternatives

Storage	Quality	Quantity	Time
Quality	1	1/2	3
Quantity	4	1	3
Time	1/3	1/4	1

Priority Vector

$$\begin{bmatrix}0.29\\0.58\\0.11\end{bmatrix}$$

The priority vector is obtained by doing Normalization as done above.

Test	Quality	Quantity	Time
Quality	1	4	2
Quantity	1/4	1	3
Time	1/2	1/5	1

Priority Vector

$$\begin{bmatrix}0.55\\0.27\\0.15\end{bmatrix}$$

The priority vector is obtained by doing Normalization as done above.

Quantity reliability	Quality	Quantity	Time
Cost	1	3	5
Time	1/3	1	2
Quality	¼	½	1

Priority Vector

$$\begin{bmatrix}0.63\\0.22\\0.12\end{bmatrix}$$

The priority vector is obtained by doing Normalization as done above.

Ranking of Alternatives

Criteria	Storage	Test	QR
Quality	0.29	0.55	0.63
Quantity	0.58	0.27	0.22
Time	0.11	0.15	0.12

X =.

$$\begin{bmatrix}0.65\\0.32\\0.14\end{bmatrix}=\begin{bmatrix}0.45\\0.42\\0.13\end{bmatrix}$$

5. Recommendations

The response I had got from the people has some knowledge about the resource management in construction projects. The final conclusion was that the resources are utilized based on quantity of the items. From this we can know that id quantity of the items we buy and they has or be utilized in a perfect manner then the all other factor are managed and work will be completed in time. Due to the low quantity the work will be stopped and work will not be completed in time this leads to loss in the money and time.

- The final result will be concluded that while buying and utilizing they have to be more in quantity and check list prepared by the government of the respective state or country.
- The quality of materials and tests to be done for each and every incoming material
- The PMBOK guidelines has to be followed
- Skilled labor should be procured in order to decrease the project cost and to increase the quality of construction
- Water should be used wisely in order to save the water and or reuse the water for daily household works
- To complete the work quickly and accurately machinery should be used and also cost of the labor also decreases by using this machinery.

Many improvements have to be done in order to ensure the effectiveness. The response considered that the common issues to be mainly concentrated specially manpower, material, land resources, water resources in construction project. The rank which was given will be helped in the future projects. The survey was answered by the people who have the total knowledge about them and also experienced in the construction industry.

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