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Traditional Water Conservation Techniques in India

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Abstract: ***Water conservation is a practice needed for survival. In India, various techniques are used to save water, which are practical and climate-responsive. From the age of the Indus valley civilization, till today many practices are seen in different parts of India. The traditional practices used for conserving water and even cooling buildings in ancient times. Forts surrounded water bodies for protection from enemies. Indians continue to build structures to catch and store the monsoon rains. Some unique water conservation techniques are still practiced in India and are efficient. These are sometimes better than the present-day water-saving techniques. The paper summarizes the transformation over the years in the construction and advancements of water conservation practices in India. In dry regions, these practices have helped people survive tough times.***
Keywords: Rain water harvesting, Storage, Tanks, Traditional methods, Water conservation

I. INTRODUCTION

Water conservation is a process that includes policies, strategies, and techniques to sustainably manage natural sources of water, protect the hydrosphere, and meet the current and future demand of water supply for humans. There are many things on which it depends like the population size, contamination, climate change, and how efficiently humans use it. An average of 55 liters/capita/day is the amount of water used by a rural person in India, whereas the same in the urban context is 135 liters/capita/day. This high difference shows how important it is to save water and protect it from contamination. Traditional conservation techniques like katta, sand bores, johads, bawdi, bamboo drip irrigation systems are some very good examples of water conservation practices in India. Some major urban techniques like roof type rainwater harvesting, cycle run water pumps, rainwater syringe, and water wheel technique are once used in today's context. If people in urban areas will start to use these traditional techniques to conserve water for irrigation and other purposes, water will be saved more effectively.

II. TRADITIONAL METHODS

People still use old traditional water harvesting methods which were used by ancient civilizations. The archeological evidence shows that in the Indus valley civilization people used an excellent system of water harvesting and drainage. The stormwater channels of Dholavira settlement is a good example of water channeling and storing for dry seasons. Irrigation and water harvesting are mentioned in Chanakya's Arthashashtra. A water harvesting system that uses the natural slope of the land to store floodwater is seen in Sringaverapura, near Allahabad. While king Bhoj of Bhopal made the largest artificial lake in India to conserve water. Jahaz mahal of Mandu, Madhya Pradesh is a water-saving structure on the top of a hill where the water table is very low. These are great examples that give us a better understanding of traditional techniques and their implementation.

A. Jhalara

They are typical rectangular-shaped step-wells having tiered steps on 3 or all sides, which collect the subterranean seepage of a stream or reservoir. They ensure an easy and regular supply of water for religious rites, community use, and royal ceremonies. They are human-made tanks mostly found in Rajasthan and Gujrat. The steps are built in a series of levels. The water collected is not safe for drinking as it is open to the sky but is mostly used for public bathing and religious rites. The city of Jodhpur has many jhalaras which were constructed to save rain water.

The technique is the step with levels going deeper and storing water. It also has major drawbacks of water contamination, breeding space for mosquitoes, and the non-availability of safe drinking water. A covered system is more preferred for water storage. Even the capacity of water depends on the climate and monsoon seasons. They majorly suit the climatic condition of Rajasthan and Gujrat but due inefficiency of storing pure water and the risk of pollution caused by humans this system is not majorly used.

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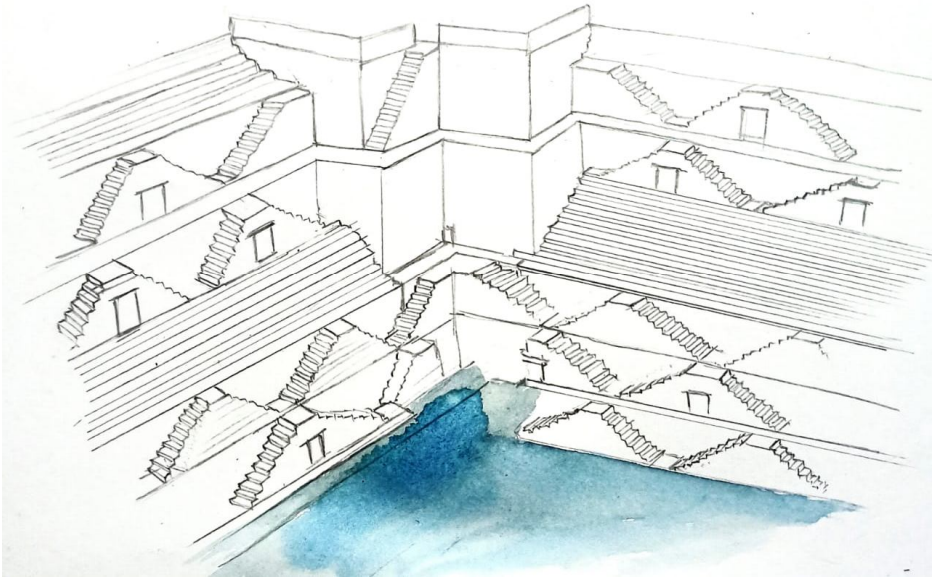

Figure 1: Jhalara

B. Bawari and Step Well

These unique water storage structures once were a part of an ancient network of water storage. The rainwater collected was diverted to tanks through canals built on the outskirts of city to supply water. This resulted in ground water recharge as water seeps into ground, supplying water to deep and intricate network of aquifers. The steps help in centralizing the water flow and minimizing water loss through evaporation. The stepwell concept gives narrow and deep wells as outcomes that are majorly used for rainwater collection. A very good example is Rani ki vav which is a perfect combination of detailed carvings with beautiful aesthetics and a water-conserving structure.

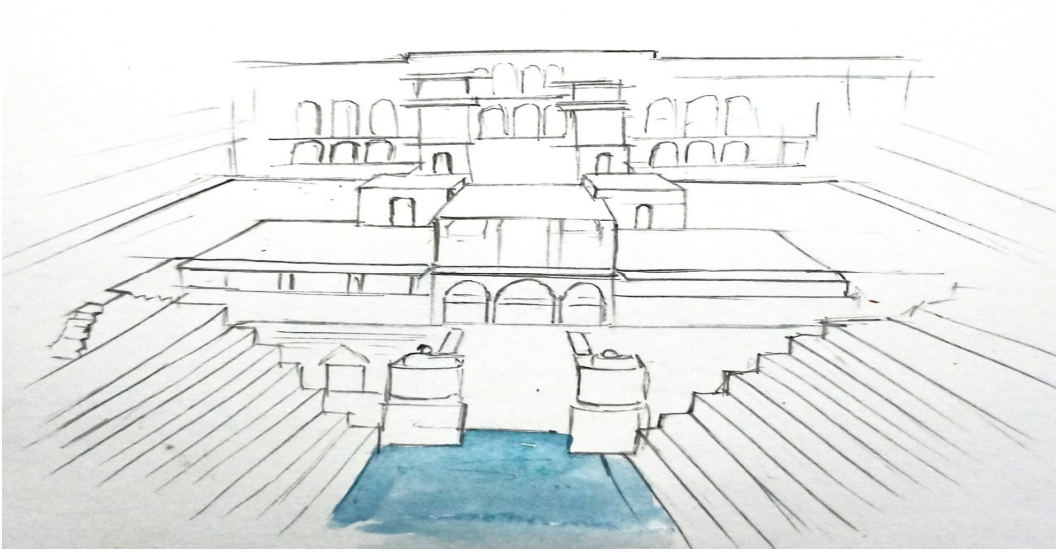

Figure 2: Bawari or step well

The traditional Indian sculpting is also seen in the construction of this step well. The base of these step wells provided relief from the daytime heat and served as a place for a social gathering in old times. Stepwells are divided into two parts which are the vertical steps and the collector at the bottom. A vertical shaft from which water is drawn is designed in the form of columns and the rest of the area is divided into different chambers and zones leading to the steps at the bottom. The galleries and chambers surrounding these wells were often carved with elaborate detail and became quiet and cool retreats during the hot summers. Hence the storage and re-directing of water become an easy process.

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C. Paar System

This is a common water harvesting system practiced in western parts of Rajasthan. From a common place rainwater flows from the agar (catchment) and percolates into the sandy soil. To access the percolated water kuis or beris are dug in the storage area. Kui is a whole normally 5 to 12 meters deep which helps to get stored water. This is a vernacular technique where the structure is constructed through traditional masonry. Paars are seen in Jaisalmer district where more than 20 kuis are still in working condition. This water harvesting system is a basic design for harvest surface runoff water for agriculture. The water received from monsoon rains can be stored for 6 to 7 months.

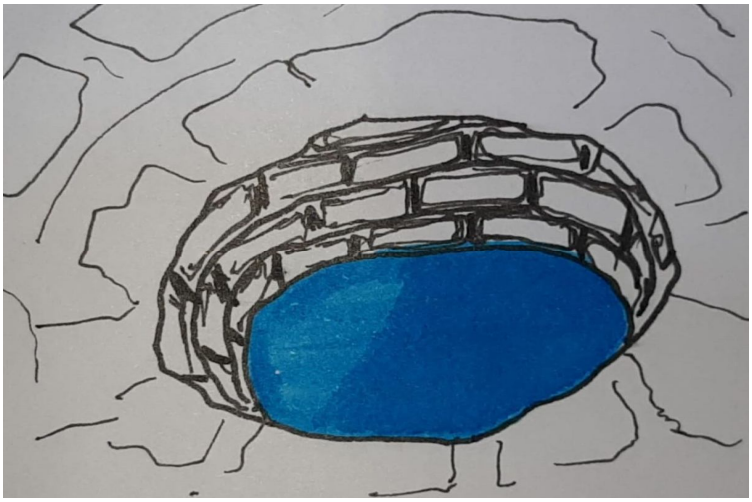

Figure 3: Paar system

This method is a non-polluting, eco-friendly method where there is no problem of water contamination. The conserved water is useful for agriculture and in a place like Rajasthan which is very dry a little saving of water is also important. The part of agar that has some moisture content is also used to grow fodder for animals and some endangered plant species.

D. Taanka

This traditional rainwater harvesting technique is seen in the Thar desert region of Rajasthan. This cylindrically paved underground pit is used to store rainwater from rooftops, courtyards, and artificially prepared catchment flow. If it is filled then it can last till the next dry season. There is no risk of water contamination here.

A taanka is majorly composed of covered, underground, impermeable water-storing area, on the shallow ground for the collection of rainwater. The storage is usually constructed of stone, brick masonry, or concrete, with lime mortar or cement plaster. Surface run-off from rooftops and other areas flow into the tank through filtered inlets in the wall of the pit. In towns of Bikaner every household has a taanka to store water for dry seasons.

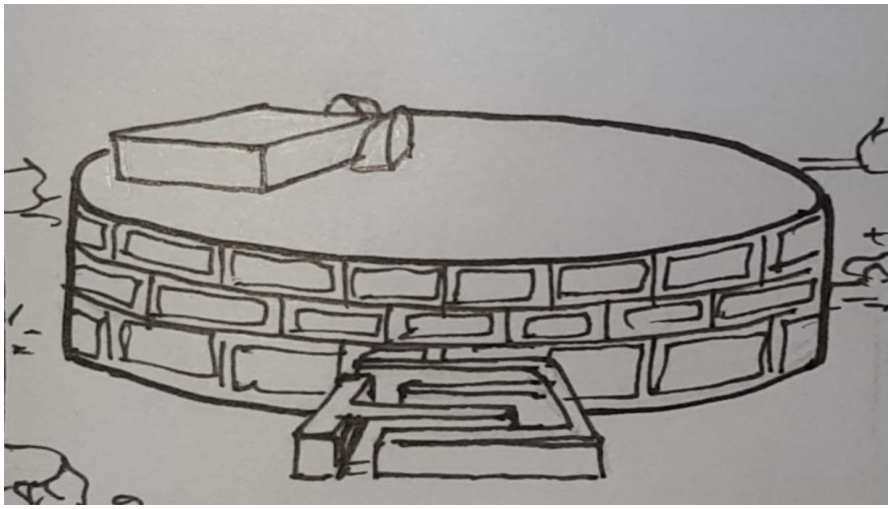

Figure 4: Taanka

E. Zing

Figure 5: Zing

Glaciers are found in the cold regions of Ladakh. A part of the land is dug to construct tanks that help to store water from melting glaciers. This is a freshwater source that is channelized to the tank with the help of a network of guiding channels. The collected water can be used for many purposes but is mainly used for irrigation.

Again, the drawback arises, that being a surface water collection source the contamination of water can easily take place. The water is mostly used for cultivation but as it is a pure water source it can be used for drinking purposes also. This kind of water reservoir can be seen in hilly areas and the channels used for the transportation of water are termed Kuhls. This is the best example of making a freshwater reservoir.

F. Eri

Eri is an old water management system used in India to control floods, prevent soil erosion and stop runoff during heavy rainfall. In states like Tamil Nadu, these are mostly seen. It helps to recharge the groundwater. The collected rainwater with the help of false catchments is also channelized to the eri system where it gets collected in a central water tank. They are constructed at an equal distance to channel water whenever needed to far-off villages. The water collected is used for irrigation and other purposes fulfilling the needs of people in dry seasons.

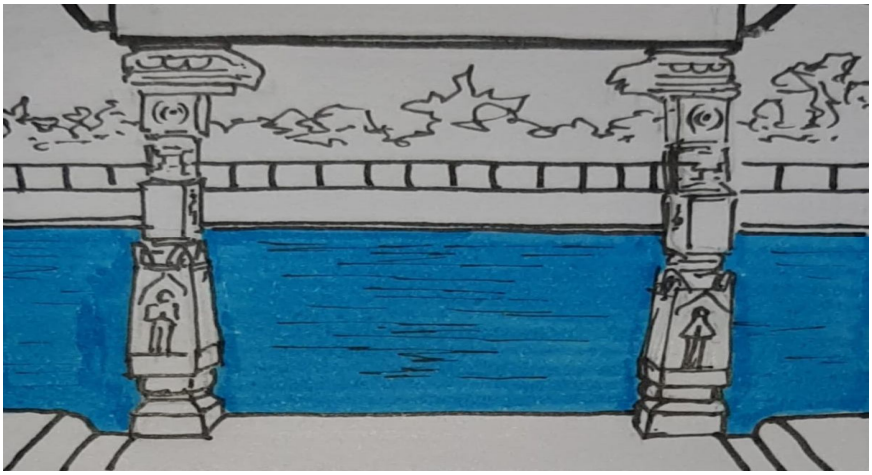

Figure 6: Eri

This ecologically safe traditional system is viable and cost-effective. It helps to rejuvenate the water bodies with the connection of channels. It did set an example to be used to date. The channel allows the flow of water to different distribution points and hence the water is also not kept stagnant. The flow restricts the process of contamination and the water is used for household, agriculture, and many other uses in the nearby areas.

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III. WATER CONSERVATION PRACTICES IN INDIA

A. The arid Regions of Rajasthan

In a hot-dry region of Rajasthan water conservation is not an occasional process but a need for survival. The problem of water scarcity in these areas not only affects land fertility but also targets the life cycle of the people. The range of Aravalli hills makes the soil texture rocky and the water table goes down because of it. Forts and havelies are prominent structures here. Usually, these forts are situated on the topmost level so that they can keep an eye on the enemies from any side. Channelizing water to the fort was a big task hence people were dependent on the rainwater collected on the tanks or water reservoirs near the fort. The water stored on the tanks was distributed with the help of small channels. Every fort has its channel of water supply grid and a reservoir or tank storage to conserve water for dry seasons.

Figure 7: Rain water collecting tanks on fort complex

On the forts of Rajasthan, such examples are prominent. The fort of Jaigarh in Jaipur has a big central courtyard just in front of the entrance which has three large tanks used for storing water. The pucca canals on the hills bring rainwater to the reservoirs. The stored water in the fort was for emergency use. The largest tank is 158 feet long, 138 feet wide, and 40 feet deep. The tank is covered and rests on arches over eighty-one pillars constructed inside the tank. Sixty hundred thousand gallons of water can be stored in the tank. A small tank just behind measures 69 feet in length, 52 feet wide, 52 feet deep, and alongside this tank is a small open tank measuring 61 feet in length, 52 feet wide, and 27 feet deep.

Man-made lakes and water bodies for storing rainwater is common practice to conserve water. The main issue arises during summers when due to evaporation water dries very fast and also the water table depletes. The Thar desert is one of the hottest and driest regions in the world. It rains the least here in the country. There are no perennial rivers and groundwater is saline. Piped water supply from far-off tube wells doesn't help much. A taanka is the most common way of collecting rainwater. Beris is typically made in the bed of a pond. These are extremely narrow wells not more than 10 to 12 feet deep. For most of the year, they remain submerged underwater. During the summer when the pond dries up water seeps from the sub-surface gypsum belt laid in with moisture and gets collected in the beri.

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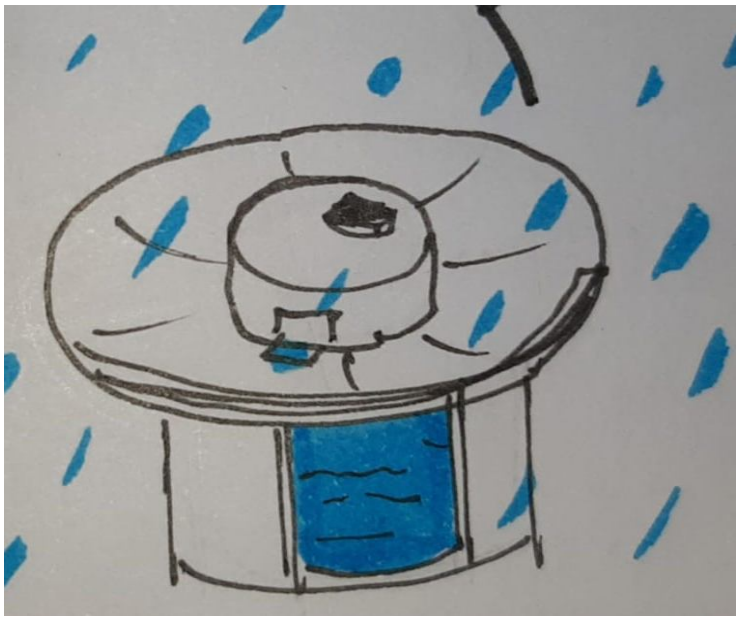

Figure 8: False catchment created for taanka

When piped water reached the desert people gradually moved away from the practice of harvesting water. But when the Indra Gandhi Canal is unable to give a reliable supply of water too far off villages there is no option but to buy water from private tankers at very high prices. When the modern way of life fails to give all the answers, societies do look back to their traditional ways of water conservation. The traditional practices have proved to be more useful than the modern methods of conserving water in the region.

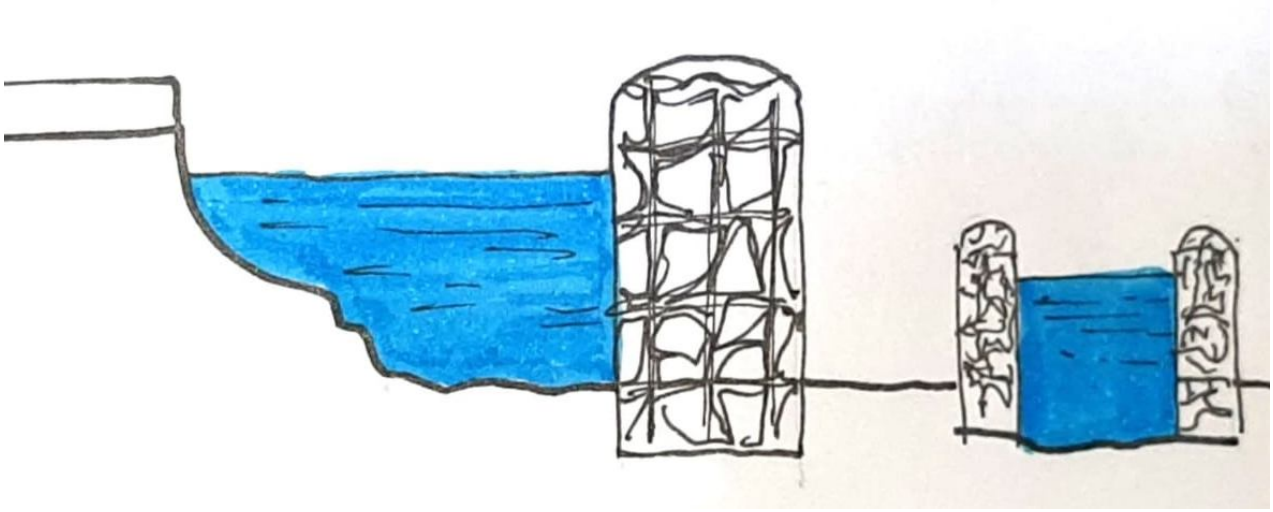

Figure 9: Khadin bund for water conservation

B. The Runn of Kutch in Gujrat

In dry regions of Kutch in Gujrat instead of water conservation practices initiatives like the water-grid project have helped to gain a freshwater supply in dry places. The regions like Kutch and Saurashtra did face issues of freshwater supply but due to the introduction of the water-grid project, the people get ample supply of water now. About 60% of the land area of Kutch contains saline water. Groundwater is saline so borewells are not an option. Rainwater collection and storing it till the next dry month is the only alternative people are left with. Water treatment plants and desalination units have helped people to get fresh water but it cost them a lot. The supply of water to long distances is done with canals and underground pipes which costs a lot to the government. With 6,292 km of bulk pipeline, 1,20,000 km of distribution pipeline, 23,693 water tanks, and 181 treatment plants the whole state of Gujrat creates a network of water pipes to supply 3500 million liters of safe water. The water from the Narmada branch canal is supplied further through pumping stations with the help of pipes.

C. Ancient fort city of Mandu, Madhya Pradesh

On the Vidhya range of Malwa plateau lies the fort city of Mandu located on a hilltop. On the south flows the Narmada River which is too far to nurture the city water. At an elevation of more than 2000 feet, it's quite difficult to take water to the top without any motorized system. Hilly areas simply imply no groundwater. It is difficult to imagine how could have people survived in the old times without any modern method for water supply. Collecting rainwater and storing it is the only way of survival for the people of Mandu. Nowadays due to technological advancements, it is possible to circulate river water through the pipeline. The water management system at Mandu was the need of people back in the old days. The area consists of 1200 tanks of different shapes and sizes used to collect rainwater.

Figure 10: Embankments of Kapoor talab

Jahaz Mahal is a fort that has 2 water bodies on both opposite sides. The 2 manmade lakes enhance the beauty of the fort making it look like floating on the sea during rainy seasons. At every step, the complex has water channels that direct the water to a central reservoir. The Kapoor and Munj lake not only add beauty to the complex but collect a large amount of rainwater. There are 2 swimming pools located at different levels. Even in a place like Mandu because of their water-conserving practices they were able to afford the luxury of pools. On the top-level water, channels were designed in a circular pattern to filter the water and ahead of it to the pool.

Figure 11: Circular water channels

Figure 12: Water in talab during summers

The Champa Baodi is one of a kind. It is a deep well with 4 story living area around it. The rooms close to the well remain cool during the summers. The long corridors allow wind circulation making it a naturally ventilated area. The water channels on the top of the fort walls help to collect the rainwater. The central tank and open courtyard help to cool the place during the hot months. Opposite to Jahaz Mahal lies a twin baori which is a good example of rainwater harvesting. The geometry used in its construction amplifies the surrounding with its beauty.

IV. CONCLUSIONS

India is a country, where still half of the population lives in rural areas. As the modern methods of water conservation are impotent to fulfill the need of people, some traditional water conservation practices are still used to battle water crises. The urban rainwater harvesting techniques may be a context for cities only but in rural India, especially states like Rajasthan, traditional methods are more effective. There are several techniques followed by the people of India but only a few of them are described in the paper. This conservation technique is a revolution, as day by day, it has upgraded itself for the better. The new techniques followed today are somewhat related to the old ones only. The states like Rajasthan and Gujrat still use old traditional methods. The modern conservation practices were inspired by the traditional ones. For example, a combination of taanka and paar systems is used in rainwater harvesting systems, used today. Ponds and man-made lakes are still in use, but due to pollution and heavy discharge of industrial waste into these water bodies, it does not fulfill any purpose. Old practices which were helpful like step wells and jhalara are not relevant today. Studies show that most of the contaminated water is found in lakes and ponds of megacities. Any water body on the outskirts of a town or city is mostly polluted because of the disposal of waste and the presence of landfills near the water bodies. A pond does not help in water conservation instead is a breeding ground for misquotes and algae.

We conclude that for a better living water conservation is very important and in India, several traditional practices have helped to evolve the new conservation techniques. The advancements which took over time are important for an understanding of how to cope up with the flaws and mistakes done in the past.

V. ACKNOWLEDGMENT

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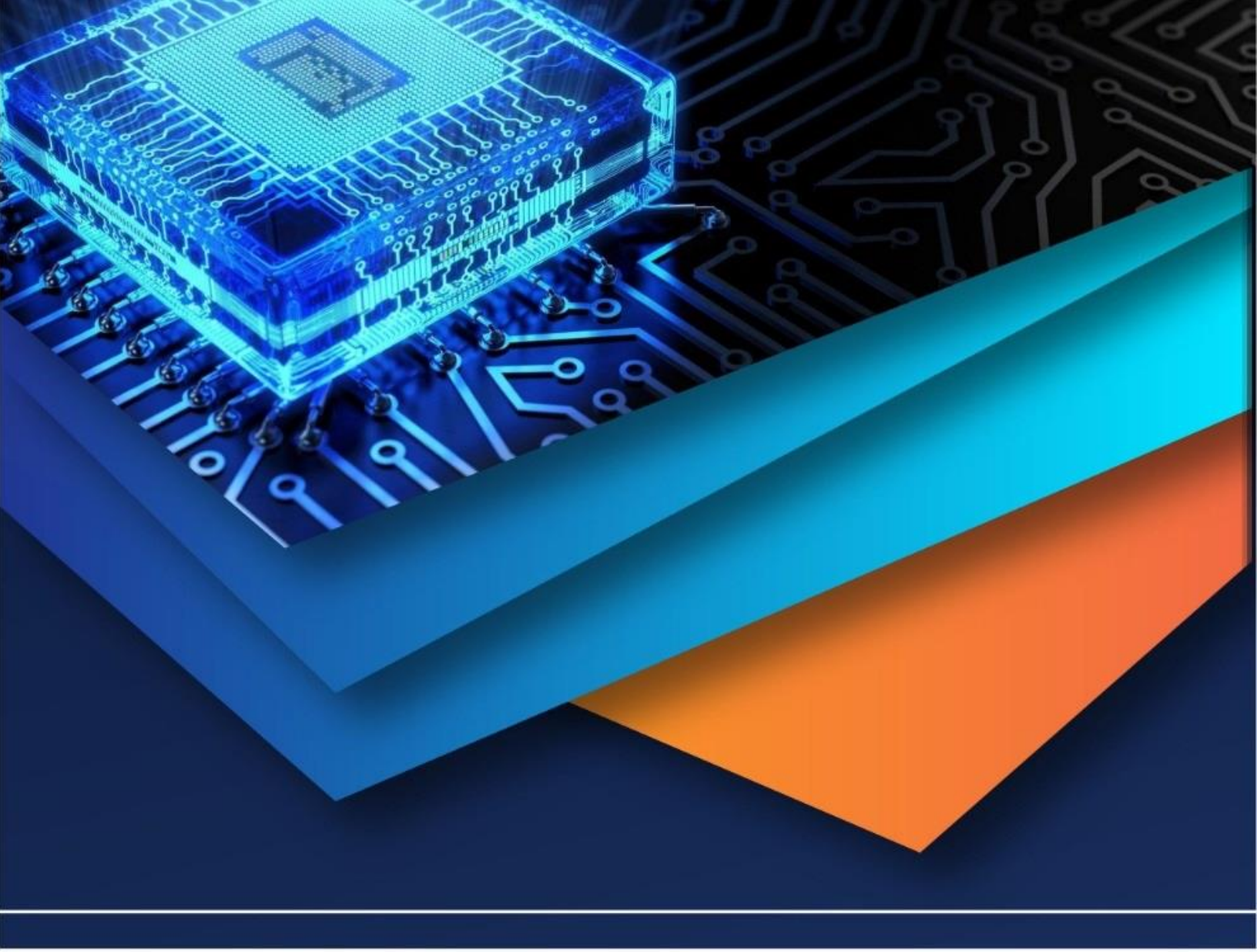

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