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Physico-Chemical Analysis of Groundwater of Industrial Affected Areas of Pali District, Rajasthan

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ABSTRACT: Pali is a city of 187,571 inhabitants in India, the capital of Pali district in the state of Rajasthan . Based on the number of inhabitants, the city falls into class I (from 100,000 people upwards) [4] . The city is located at 25° 46' 0 N and 73° 19' 60 E and has an altitude of 213 m asl [1] At the 2001 census, the population of Pali amounted to 187,571 people, of whom 99,258 were male and 88,313 were female. Children aged six years or less totaled 29,716, of whom 15,494 were boys and 14,222 were girls. Finally, those who were able to at least know how to read and write were 115,907, of whom 72,663 were male and 43,244 were female. [5] Pali is a city and capital division in Rajasthan state of India. It is the administrative headquarters of Pali District. It is on the bank of the river Bandi and is 70 km (43 mi) south east of West Jodhpur. It is known as "The Industrial City"

In Rajasthan state particularly, textile mills represent an important economic sector. Pali district in Rajasthan has got largest number of textile industries in the State i.e.989 units, mostly engaged in cotton and synthetic textile printing and dyeing. These industries liberate a variety of chemicals, dyes, acids and alkalis besides other toxic compounds like heavy metals, which are known for their hazardous properties. However, excessive and indiscriminate use of dyestuffs has become increasingly a subject of environmental concern. These dyes can enter the environment through the industrial effluents of dye manufacturing plants and from textile dyeing and printing operations, as wastewater effluents. Assessment of genotoxicity of dyes is therefore of utmost importance. Short-term genetic bioassays have proved to be an important tool in such studies because of their simplicity, sensitivity to genetic damage, speed, low cost of experimentation and small amount of sample required. A total of 7 dyes were tested for their mutagenicity, by Ames assay, using strain TA 100 of Salmonella typhimurium. Only 1 dye, Violet showed absence of mutagenic activity. The remaining 6 dyes were all positively mutagenic.

KEYWORDS-Pali,Rajasthan,ground,water,industrial,textile,wastewater,effluents,genotoxicity,Mewar

I. INTRODUCTION

Pali (formerly known as Pallika and Palli) was a trade centre. In the 11th century AD, Pali was ruled by the Guhilas of Mewar.

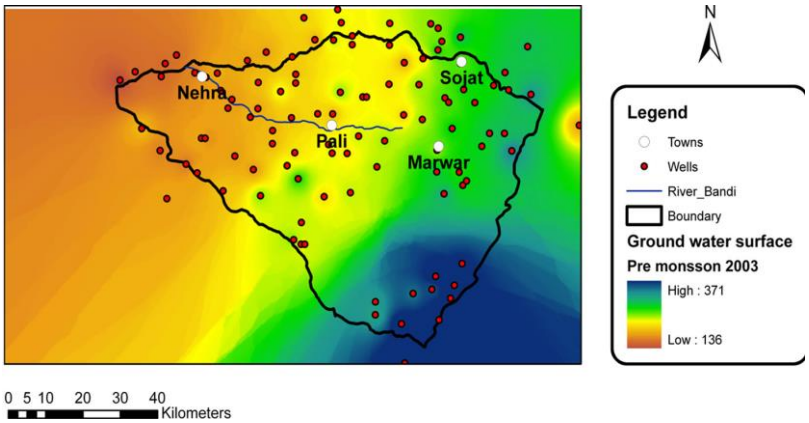

Fig.1.Groundwater estimation in Pali

In the 12th century it became a part of the Nadol kingdom and was ruled by the Chauhans. In 1153 AD it was ruled by Kumarapala and his feudatory Vahadadeva. Then it came under possession of Songara Chauhans of Jalore.

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The Rathore dynasty chronicles relate that Siyaji or Sheoji, grandson of Chandra, the last Gahadvala Rathore king of Kannauj, came to Marwar on a pilgrimage to Dwarka in Gujarat, and on halting at the town of Pali he and his followers settled there to fight alongside the Brahmin community from the raids of marauding bands and foreign invaders. rajputs and paliwal brahmins fought bravely against feroz shah in 13th century but couldn't resist its large army cenopath of brahmin warrior is still in pali known as dhola chabutra . His devali with the inscription of 1273 AD was discovered 21 km north west of Pali.

Rao Chunda, tenth in succession from Siyaji Rathore, finally wrested control of Marwar from the Pratiharas. His brother's son and successor, Rao Jodha, moved the capital to the city of Jodhpur, which he founded in 1459. Pali remained a part of the Marwar kingdom until 1949, when the last ruling Maharaja acceded to newly independent India. The oldest temple in Pali is the temple of Somanatha. Maharana Pratap was born in Pali. His birthplace is known as Dhanmandi Pali. Maharan Pratap's Statue inaugurated on 4 June 2011 by District Collector Mr. Neeraj Kumar Pawan.

Geologists trace the existence of Pali to pre-historic age and maintain that it has emerged from the vast western sea spread over a large part of the present day Rajasthan.

Historical relics depict the existence of this area during the Kushana Age, when King Kannishka had conquered Rohat and Jaitaran area, parts of today's Pali district, in 120 AD. Till the end of seventh century A. D., this area was reigned by the Chalukya King Harshavardhana who also conquered Bhinmal and most of the present area of Rajasthan.

After the Arab invasions of India this area was concentrated by Rajput rulers from all over India. During the period from 10th to 15th century, boundaries of Pali extended to adjoining Mewar, Godwad and Marwar. All Rajput rulers resisted the foreign invaders but individually fought for each other's land and leadership.

After the defeat of PrithviRaj Chauhan, the great warrior against Mohd. Gauri, the Rajput power of the area was disintegrated and Mewar and Godwad area of Pali become the subjects of then ruler of Mewar, Maharana Kumbha. But Pali city which was ruled by its Brahmin rulers known as Paliwal Brahmins now, remained peaceful and progressive.

16th and 17th century saw a number of battles in the surrounding areas of Pali. Shershah suri was defeated by Rajput rulers in the battle of Gini, Mughal emperor Akbar's army had constant battles with Maharana Pratap in Godwad area. Again after the Mughals had conquered almost all of Rajputana, Veer Durga Das Rathore of Marwar made organized efforts to redeem the Marwar area from Aurangzeb, the last Mughal emperor. By then Pali had become subservient to Rathores of Marwar state. Pali was rehabilitated by Maharaja Vijay Singh and soon it became an important commercial center.

Role in struggle for freedom: Under British rule pali played an important role by pioneering the freedom struggle in Marwar. Various Thakurs of pali under the stewardship of Thakur of Auwa, who was the most powerful of all, confronted with the British rule. Auwa fort was surrounded by the British army and then conflicts lasted by 5 days, when at last the fort was possessed by the British army. But this heroic action of Auwa paved the way for continued and organised struggle for freedom.

Pali is located at 25.77°N 73.33°E.[1] It has an average elevation of 214 metres (702 feet). As of 2011 India census,[2] Pali had a population of 229,956. Males constitute 52.2% of the population and females 47.8%. Pali has an average literacy rate of 68.2%, lower than the national average of 74.04%: male literacy is 77.24%, and female literacy is 59%. In Pali, 13% of the population is under 6 years of age. Pin Code of Pali city is 306401 which comes under pali postal division (Jodhpur Region).[3] Pali is famous for its sweet named Gulab Halwa made from milk and rose . Pali is also famous for its Mehendi (henna),which is mainly produced in Sojat city which is 39.5 km (24.5 mi) away from pali) production in India.It is also known as textile hub of Rajasthan. It is also well known for Papad. Pali is famous for Mahraja Shree Umaid Mill which was established in 1942, a textile mill managed by L.N. Bangur group.[4] It is named after Maharaja Umaid Singh of Jodhpur, grandfather of current Maharaja Gaj Singh of Jodhpur. He provided land of the construction of the mill.

Pali has been famous for its textile industries. Cotton and Synthetic clothes, and yarn are exported to other states of India at a very cheap price. Some new industries have also been developed such as those of Bangles, Marble cutting, marble finishing, etc. There is a cotton mill named Maharaja Shree Umaid Mills which is the biggest cotton mill of Rajasthan, employing nearly 3000 workers.

One of the biggest composite textile mill of India 'Maharaja Shri Umaid mills' (Estt. in the year 1940) is also situated at pali. Main production of this mill are cotton, Hank yarn etc. which are used to prepare different clothes. Main cloth production are cotton, 2* 2 rubia etc.

There are three industrial areas in Pali, namely, Mandia road industrial area, Industrial area phase 1 & 2, and Punayata industrial area. Mandia Road Industrial Area is the biggest and the oldest of all. Industries such as Jai Mahaveer Textiles, Shankheshwar Corporation, Dhan Shree Fabrics, Keshariyaji Tex Print, Mahamantra Mills India, Maa Ambe

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Texofine, Mahotsav Fabrics, D.Pawan Fab Tex, sunlight industries, Kundan Tex, K.B Shah, Nakoda Prints, Tulsi Cotton Mills, Mayank Process, Aadeshwar Process, Shree Ganesh Fab Tex, B.B. shah, Shri Arihant Cloth Mills, Shree Rajaram Group of Industries, Kohinoor, Kamal Agencies, Manidhari Impex, Sidhi Vinnayak Petro Chem, Shree Roopmuni Industries, Vam India Organics, Vidhya mills (India), Vidhya industries pvt ltd., Metro industries, Vijaya Fabrics, Manoj textiles, minerwa industries, Sikhwal fabrics, Mohini Process, Jov(Tex) Link, Sonu Group of Industries, Lodha Fabrics, Mega Tex Print, Vinod Group of Industries, M.B finishing, Mahaveer fab tex, Bajrang textiles etc. are among well known and reputed Textile Industries situated at Mandia Road, Pali. Punayata industrial area has been always a question mark on local administration and RIICO because of its setup and evolution. But in the last few years, Punayata Area has turned out to be a major landmark for Industrialist to set up their new business.

Besides this, many more industries are situated in different areas of Pali district i.e. leather-based industries, agriculture instruments, Chemical Industries, cement industry, minerals-based units like stone crushers etc. Among these, granite industries have recently flourished due to the easy availability of raw material and favorable geographical location.

However, the problem of pollution is imminent. Common Effluent Treatment Plants (CETP) have been established in the last few years to treat the discharged water from various industries. Groundwater is the water present beneath Earth's surface in rock and soil pore spaces and in the fractures of rock formations. About 30 percent of all readily available freshwater in the world is groundwater.[1] A unit of rock or an unconsolidated deposit is called an aquifer when it can yield a usable quantity of water. The depth at which soil pore spaces or fractures and voids in rock become completely saturated with water is called the water table. Groundwater is recharged from the surface; it may discharge from the surface naturally at springs and seeps, and can form oases or wetlands. Groundwater is also often withdrawn for agricultural, municipal, and industrial use by constructing and operating extraction wells. The study of the distribution and movement of groundwater is hydrogeology, also called groundwater hydrology.

Typically, groundwater is thought of as water flowing through shallow aquifers, but, in the technical sense, it can also contain soil moisture, permafrost (frozen soil), immobile water in very low permeability bedrock, and deep geothermal or oil formation water. Groundwater is hypothesized to provide lubrication that can possibly influence the movement of faults. It is likely that much of Earth's subsurface contains some water, which may be mixed with other fluids in some instances.

Groundwater is often cheaper, more convenient and less vulnerable to pollution than surface water. Therefore, it is commonly used for public water supplies.

Use of groundwater has related environmental issues. For example, polluted groundwater is less visible and more difficult to clean up than pollution in rivers and lakes. Groundwater pollution most often results from improper disposal of wastes on land. Major sources include industrial and household chemicals and garbage landfills, excessive fertilizers and pesticides used in agriculture, industrial waste lagoons, tailings and process wastewater from mines, industrial fracking, oil field brine pits, leaking underground oil storage tanks and pipelines, sewage sludge and septic systems.

The high specific heat capacity of water and the insulating effect of soil and rock can mitigate the effects of climate and maintain groundwater at a relatively steady temperature. In some places where groundwater temperatures are maintained by this effect at about 10 °C (50 °F), groundwater can be used for controlling the temperature inside structures at the surface. For example, during hot weather relatively cool groundwater can be pumped through radiators in a home and then returned to the ground in another well. During cold seasons, because it is relatively warm, the water can be used in the same way as a source of heat for heat pumps that is much more efficient than using air.

After rendering the agricultural land infertile, the huge amount of ground water being used for dyeing industry on the banks of river Bandi in Pali is fast depleting the groundwater and adversely affecting the dwindling forest resources of the area.

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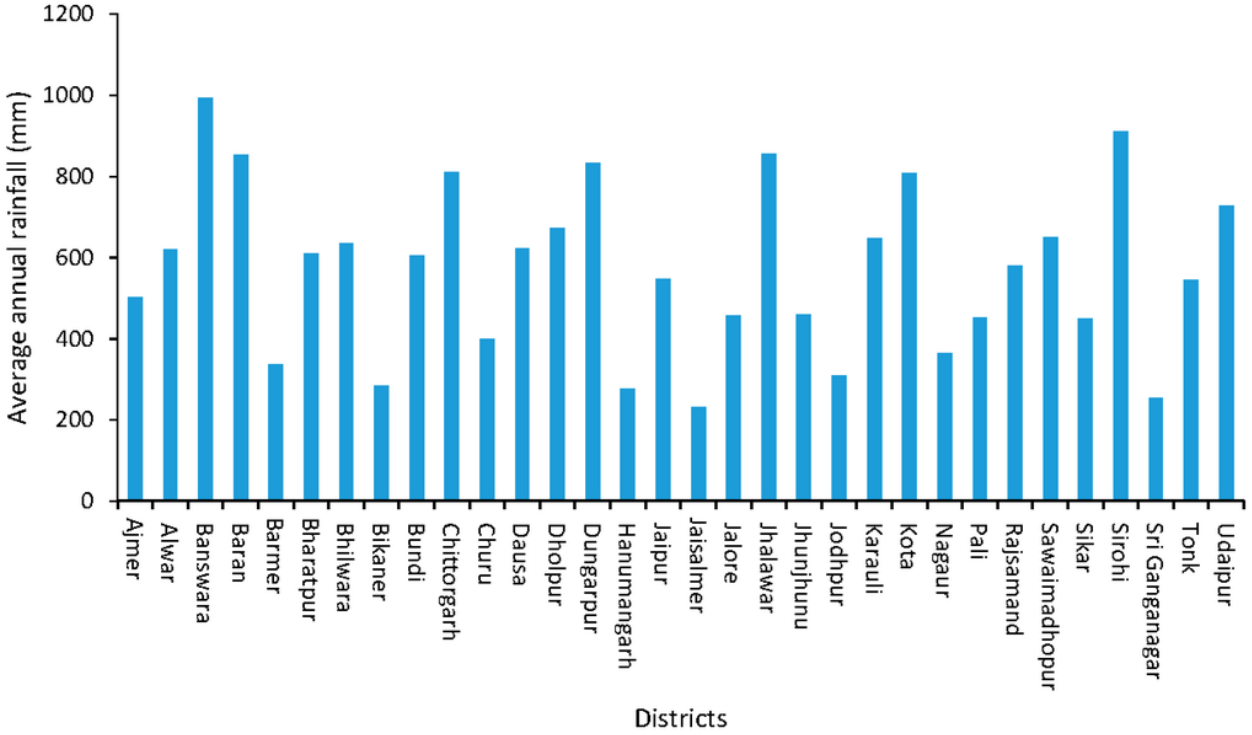

Fig.2. Groundwater Storage Changes and Recharge in districts in Rajasthan including Pali

In Pali, "For cloth dyeing, huge amount of water is required by the industries. Water is supplied from the local dug wells in the agriculture fields. High rate of withdrawal of water has deteriorated the quality of groundwater as reported by the local people. Wood and charcoal made from wood is used for boilers in the factories. This has adversely affected the dwindling forest resource of the area," says a report by the Geological Survey of India. According to the report, dyeing industries located on both the banks of Bandi river near Pali town have been discharging foul-smelling, coloured, liquid effluent into the river. During this study, emphasis was given on the nature and spatial extent of the pollution caused by these dyeing industries. Priority was given to identify the nature of effluent discharged by polluting industries and its effect on the natural resources, namely, water and soil in the vicinity of the dyeing industries. In Pali,Samples of polluted water, flowing through the river, were collected from different locations by GSI. Water samples were also collected from dug wells located either on the banks of Bandi river or away from it in order to assess the spatial extension of pollution in these areas. The foul-smelling liquid effluent discharged by these dyeing industries was seen flowing up to Dholeria village. It was observed that these dyeing industries are causing irreparable damage to agriculture and groundwater to an alarming extent.

"Downstream of Bandi river, near Nera village, a dam has been constructed. The reservoir of the dam is affected by polluted water. If the dyeing industries are not shifted to other locality, irrigation by this polluted water is going to spoil the agriculture fields further downstream. The analyses of industrial effluent and dug well water samples collected from the area show high concentration of TDS, chloride and sulphate and high conductivity. Lead content in some of the samples is above permissible limit of 0.1 mg/l," reads the report.

In Pali,At the moment, there are only five treatment plants, which are not sufficient to treat the total volume of wastewater generated by industries. "Probably all the dyeing units are not linked with the drains which carry industrial waste water to treatment plants in order to avoid direct disposal of untreated effluent to the Bandi river. The BOD & COD of untreated wastewater has been recorded as 43 to 140 mg/l (permissible limit 30 mg/l) & 464 to 1320 mg/l(permissible limit250 mg/l) respectively. Effluent treatment was not able to make the water colourless and reduce TDS. Treated water is not fit for irrigation due to high content of TDS and can only be reused in dyeing industries," reports GSI.

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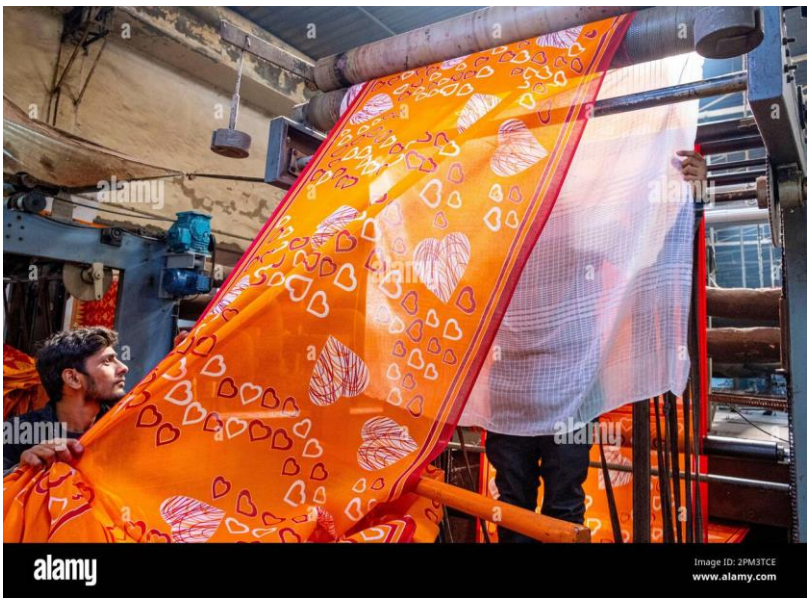

Fig.3. Dyeing Industries in Pali, Rajasthan

Besides, that industrial wastewater flowing through Bandi river generates foul smell causing vomiting sensation to the people in the affected areas. Irrigation by polluted water has rendered agricultural fields infertile. There is an irrigation dam constructed downstream of Bandi but that too has been found to be polluted by the effluents and may spread pollution further downstream of the dam. Firewood provided to boilers of the dyeing industries is collected from local forests causing largescale deforestation, reports GSI

II. DISCUSSION

In Pali, The volume of groundwater in an aquifer can be estimated by measuring water levels in local wells and by examining geologic records from well-drilling to determine the extent, depth and thickness of water-bearing sediments and rocks. Before an investment is made in production wells, test wells may be drilled to measure the depths at which water is encountered and collect samples of soils, rock and water for laboratory analyses. Pumping tests can be performed in test wells to determine flow characteristics of the aquifer.[3] Municipal and industrial water supplies are provided through large wells. Multiple wells for one water supply source are termed "wellfields", which may withdraw water from confined or unconfined aquifers. Using groundwater from deep, confined aquifers provides more protection from surface water contamination. Some wells, termed "collector wells", are specifically designed to induce infiltration of surface (usually river) water. Groundwater pollution (also called groundwater contamination) occurs when pollutants are released to the ground and make their way into groundwater. This type of water pollution can also occur naturally due to the presence of a minor and unwanted constituent, contaminant, or impurity in the groundwater, in which case it is more likely referred to as contamination rather than pollution. Groundwater pollution can occur from on-site sanitation systems, landfill leachate, effluent from wastewater treatment plants, leaking sewers, petrol filling stations, hydraulic fracturing (fracking) or from over application of fertilizers in agriculture. Pollution (or contamination) can also occur from naturally occurring contaminants, such as arsenic or fluoride.[58] Using polluted groundwater causes hazards to public health through poisoning or the spread of disease (water-borne diseases).

The pollutant often creates a contaminant plume within an aquifer. Movement of water and dispersion within the aquifer spreads the pollutant over a wider area. Its advancing boundary, often called a plume edge, can intersect with groundwater wells and surface water, such as seeps and springs, making the water supplies unsafe for humans and wildlife. The movement of the plume, called a plume front, may be analyzed through a hydrological transport model or groundwater model. Analysis of groundwater pollution may focus on soil characteristics and site geology, hydrogeology, hydrology, and the nature of the contaminants. Different mechanisms have influence on the transport of pollutants, e.g. diffusion, adsorption, precipitation, decay, in the groundwater. Groundwater pollution may also increase indirectly due to climate change: More frequent and intense storms can pollute groundwater by mobilizing contaminants, for example fertilizers, wastewater or human excreta from pit latrines.[59]:611 Droughts reduce river dilution capacities and groundwater levels, increasing the risk of groundwater contamination. Domestic laws and regulations regulate access to groundwater as well as human activities that impact the quality of groundwater. Legal frameworks also need to include protection of discharge and recharge zones and of the area surrounding water supply wells,

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as well as sustainable yield norms and abstraction controls, and conjunctive use regulations. In some jurisdictions, groundwater is regulated in conjunction with surface water, including rivers

III. RESULTS

Textile industrial effluent is the most effected factor for river water pollution in Pali. It can be observed that the pH of ground water is more than the permissible limit while most of the parameter as well a BOD, Salinity, alkalinity as HCO3 and Co3 total hardness (as Ca andMg) are found much higher. This study shows that textile effluents are highly, toxic in nature and effect on these ground water parameters in Pali.Industrial waste is the waste produced by industrial activity which includes any material that is rendered useless during a manufacturing process such as that of factories, mills, and mining operations. Types of industrial waste include dirt and gravel, masonry and concrete, scrap metal, oil, solvents, chemicals, scrap lumber, even vegetable matter from restaurants. Industrial waste may be solid, semi-solid or liquid in form. It may be hazardous waste (some types of which are toxic) or non-hazardous waste. Industrial waste may pollute the nearby soil or adjacent water bodies, and can contaminate groundwater, lakes, streams, rivers or coastal waters. One of the most devastating effects of industrial waste is water pollution. For many industrial processes, water is used which comes in contact with harmful chemicals. These chemicals may include organic compounds (such as solvents), metals, nutrients or radioactive material. If the wastewater is discharged without treatment, groundwater and surface water bodies—lakes, streams, rivers and coastal waters—can become polluted, with serious impacts on human health and the environment. Drinking water sources and irrigation water used for farming may be affected. The pollutants may degrade or destroy habitat for animals and plants. In coastal areas, fish and other aquatic life can be contaminated by untreated waste; beaches and other recreational areas can be damaged or closed. The central government is responsible for stimulating regulation, policies, and standards. The regional governments are responsible for coordinating the central and local governments. The local governments are responsible for waste management in their governed area.[14] However, the local governments do not dispose of the waste by themselves but instead hire private companies that have been granted the right from the Pollution Control Department (PCD) . . Groundwater recharge is an important process for sustainable groundwater management, since the volume-rate abstracted from an aquifer in the long term should be less than or equal to the volume-rate that is recharged.

In Pali,Recharge can help move excess salts that accumulate in the root zone to deeper soil layers, or into the groundwater system. Tree roots increase water saturation into groundwater reducing water runoff.[3] Flooding temporarily increases river bed permeability by moving clay soils downstream, and this increases aquifer recharge.[4] Wetlands help maintain the level of the water table and exert control on the hydraulic head.[5] This provides force for groundwater recharge and discharge to other waters as well. The extent of groundwater recharge by a wetland is dependent upon soil, vegetation, site, perimeter to volume ratio, and water table gradient.[6] Groundwater recharge occurs through mineral soils found primarily around the edges of wetlands.[7] The soil under most wetlands is relatively impermeable. A high perimeter to volume ratio, such as in small wetlands, means that the surface area through which water can infiltrate into the groundwater is high.[8] Groundwater recharge is typical in small wetlands such as prairie potholes, which can contribute significantly to recharge of regional groundwater resources.[8] Researchers have discovered groundwater recharge of up to 20% of wetland volume per season.[8] Climate change causes changes to the water cycle which in turn affect groundwater in several ways: There can be a decline in groundwater storage, and reduction in groundwater recharge and water quality deterioration due to extreme weather events.[17]:558 In the tropics intense precipitation and flooding events appear to lead to more groundwater recharge. Road networks and infrastructure within cities prevents surface water from percolating into the soil, resulting in most surface runoff entering storm drains for local water supply. As urban development continues to spread across various regions, rates of groundwater recharge will increase relative to the existing rates of the previous rural region. A consequence of sudden influxes in groundwater recharge includes flash flooding.[20] The ecosystem will have to adjust to the elevated groundwater surplus due to groundwater recharge rates. Additionally, road networks are less permeable compared to soil, resulting in higher amounts of surface runoff. Therefore, urbanization increases the rate of groundwater recharge and reduces infiltration,[20] resulting in flash floods as the local ecosystem accommodates changes to the surrounding environment.

IV. CONCLUSIONS

In Pali, Managing water is a grand challenge problem and has become one of humanity's foremost priorities. Surface water resources are typically societally managed and relatively well understood; groundwater resources, however, are often hidden and more difficult to conceptualize. Replenishment rates of groundwater cannot match past and current rates of depletion in many parts of Pali.

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