

## WATER CONSERVATION: BEST PRACTICES AROUND THE WORLD AND WAY FORWARD FOR PAKISTAN

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### Abstract

*Water is the most valuable gift to human race by Mother Nature. On the globe, almost 97 percent of water exists in the form of oceans while three percent is available in the form of fresh water, thus conservation is a requisite. Scarcity of water resources, lack of water storage capability and unsustainable groundwater utilization are the main challenges for international and local communities. Population growth and climate change have enhanced stress on natural water resources. This research highlights best practices from all over the world and evaluates traditional as well as innovative methods by using secondary data to highlight civic responsibility regarding water conservation and provide guidelines for all the concerned authorities in Pakistan. This paper also addresses the challenges in adopting or adapting best practices in Pakistan and concludes that improved water conservation and management practices have monetary gains and assist in protecting the environment.*

**Keywords:** *Water Conservation, Water Scarcity, Urbanization, Industrialization, Innovation*

### Introduction

**W**ater is the most valuable gift to human race by Mother Nature. Water is not only significant for life on earth but also plays a vital role in maintaining equilibrium of the entire ecosystem by absorbing the Sun's heat, by scouring the mountains and carrying the sediments into valleys and rivers, by penetrating into rock crusts and taking part in the development of mineral deposits, and by influencing climatic and biological changes in Polar Regions.<sup>1</sup>

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<sup>1</sup> J. Barbier, *The Water Paradox; Overcoming the Global Crises in Water Management* (Connecticut: Yale University Press, 2019), 71-95.

Water is used in huge quantities in industrial and agricultural sectors. On the globe, almost 97 *percent* of water exists in the form of oceans while three *percent* is available in the form of fresh water. Fresh water comprises water in ice caps and sheets, icebergs, glaciers, bogs, lakes, ponds, streams, rivers, canals, and underground water called groundwater. Fresh water is usually regarded as having small quantities of dissolved salts and completely dissolved solids. However the terminology precisely excludes brackish water and sea water which does consist of mineral-rich waters. Fresh water does not mean only drinking water (or potable water). A large volume of the globe's fresh water (groundwater and surface water) is unsuitable for drinking without some treatment.<sup>2</sup>

Fresh water is a variable and renewable resource, but definitely occurs in limited quantities. It can only be replenished through the natural water cycle, in which water from oceans, ponds, plantations, land, streams, and lakes vaporizes and results in development of clouds and returns as rainfall or precipitation. Nevertheless, if more fresh water is utilized through human practices than is naturally refurbished, this may cause reduction in fresh water availability from underground and surface sources and can become a reason of severe damage to the environment. The growth in world population and the rise in per capita water consumption places more stress on the limited accessibility of clean fresh water. Several parts of the world are currently facing strain on water availability (or water shortage). Due to the faster leap of population growth and an increase in the volume of water slower than individual consumes, it is estimated that this condition will continue to become worse. The scarcity of water in coming years would be harmful to people as it would disturb everything from sanitation, to general wellbeing and grain production. Professionals highlight that population increase and urbanization are the key causes of global water crisis. The problem has also been worsened by global warming, poor water administration, and an absence of political determination to handle this crisis.<sup>3</sup>

Global Warming implies an increase in regular surface temperatures of the globe. An intense scientific agreement upholds that it is happening principally because of human consumption of fossil fuels, which discharges carbon dioxide and other greenhouse gases into the atmosphere. The gases trap warmth within the air, which can have a series of impacts on the environment, such as rising sea levels, extreme meteorological conditions, and famines that make lands more vulnerable to wildfires. Global warming is anticipated to be the reason of about 20 *percent* of the worldwide increase in water shortage during this century. It

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<sup>2</sup> W. M. Denavan, "Evaluating the Impact of Water Conservation on Fate of Outdoor Water Use," *Journal of Environmental Management*, (2011): 02-11.

<sup>3</sup> B. Chellaney, *Water, Peace and War: Confronting the Global Water Crises* (Maryland: Rowman and Littlefield Publishers, 2015), 145-148.

is expected that it will alter rainfall configurations around the globe, melt mountain glaciers, and exacerbate the severity of floods and droughts.<sup>4</sup>

Global water usage increased six-fold in the last century - greater than twice the proportion of population growth. Water and inhabitants are unequally dispersed across the world and our present freshwater resources are facing substantial risk from overexploitation, contamination, and global warming. According to these trends, justifiable provision of sufficient water resources for farming, manufacturing and human use poses one of the extreme trials of this century. Water crisis is equally alarming for rich and poor nations and approximately three billion individuals live in limited water situations, which is more than 40 percent of the world's population.<sup>5</sup>

The indicators of general water deficiency are: increasing number of deaths each year due to starvation and water related illnesses, political clashes over limited water resources, extermination of freshwater species, and dilapidation of marine ecologies. Nearly half of all swamps across the world have already been vanished and dams have completely changed the flow of approximately 60 percent of the world's main water courses.<sup>6</sup>

## Water Crisis in Pakistan

Asia is the world's largest and most populated continent and water is becoming a threatening constraint in this region. Pakistan, an agro-based economy, has monsoon climate in most of its parts. Such type of weather is dependent strongly on yearly glacier-melts and monsoon showers. There might be abundant rain throughout the wet spell and then a very lengthy dry period where crop production relies primarily on irrigation water. Pakistan is among the most water-stressed states and per capita access to surface and groundwater sources is projected to continue to decrease in the years ahead because of urbanization and rapid population growth. As a harsh consequence of global warming, the yearly mean surface temperatures in Pakistan have been gradually rising during the previous century.<sup>7</sup>

Though there is growing awareness about climate change and increase in current water insufficiency in Pakistan, ambiguity rests about the extent to which this change may take place and its probable repercussions for various segments. Global warming is expected to

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<sup>4</sup> F. Pearce, *When the Rivers Run Dry: The Defining Crisis of Twenty-First Century* (Boston: Beacon Press, 2007), 167-175.

<sup>5</sup> A. Kallen, *Running Dry: The Global Water Crisis* (Springfield: 21<sup>st</sup> Century Books, 2015), 36-43.

<sup>6</sup> David Lewis Feldman, *Water* (Cambridge: Polity, 2012), 98-105.

<sup>7</sup> Khurshed. *Water Crisis in Pakistan: A Book on Informatic Material* (Riga: VDM Verlag Dr. Müller, 2010), 111-123.

influence water quality and the occurrence of water-borne ailments. Water quality considerations comprising of acidity, nutrient and oxygen levels, are mostly sensitive to rising water temperatures; which stimulates the growth of numerous planktonic kinds that are directly or indirectly harmful to human health. Therefore, rise in water temperatures indicates an upsurge in water-borne bacteria and dangerous algal pollutants. It can also cause possible intensification in vector-related illnesses such as malaria, dengue, haemorrhagic fever or yellow fever etc.<sup>8</sup>

Global warming has become the reason for change in monsoon rainfall patterns and other deviations in precipitation intensities that could cause more occurrences of heavy rainfall events and riskier happenings like inundations and famines that have a direct effect on water quality and water-related maladies. Flooding and heavy rainfall also lead to great quantities of pollutants entering rivers from municipal industrialized and agrarian zones, further worsening water quality. Whereas drought situations not only decrease water supply, they also damage water quality as toxins become more concentrated in water. Likewise, water scarcity can force citizens to use unclean sources of water for drinking and other practices. Vegetables and crops, irrigated with wastewater, due to the inaccessibility of treated water, become contaminated with pesticides and other pollutants.<sup>9</sup>

Climate change is changing the water dynamics in Pakistan and if not attended to properly, it may have catastrophic effects, causing extensive insufficiency, clashes, and harm to fiscal wellbeing. With new trials and tribulations in trans-boundary water dialogues, comprehensibly much attention is focused towards Pakistan's regional water disputes with India and Afghanistan. But transnational practice indicates that water scarcity can intensify internal pressures. According to the UN Peace Institute, data from Pakistan illustrates that water shortage, famines, overflows and local negligence can prompt strains locally and this can worsen intrastate water differences. Because of the scarcity of water, and global warming; there is an annual increase in desertification of land and the level of underground water is also reducing. Water management must be the highest priority for the country. Merely impugning former governments for the predicament won't resolve anything. According to research, climate change does not pose development challenges only, but it also presents development opportunities.

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<sup>8</sup> Seth M. Seigel, *Let There Be Water: Israel's Solution for a Water Starved World* (New York: St. Martins Press, 2017), 311-327.

<sup>9</sup> H. Gliet, *Water in Crisis: A Guide to the World's Fresh Water Resources* (Oxford: Oxford University Press, 1993), 401-419

## Importance of Water Conservation

Fresh water is the basis for survival of our planet, and freshwater ecologies link water courses with oceans and individuals with the resources they require to prosper. However, when waterways, ponds and lakes are ruined, their capacity to deliver consistent provisions of clean and fresh water and to sustain plant and animal species on which masses of vulnerable societies rely is endangered. Demand for fresh water is outstripping supply and according to an assessment, this need will exceed its consistent supply by 40 percent in 2030.<sup>10</sup> Cultivation, manufacturing practices, degraded areas and untreated waste are primary reasons of contamination in freshwater schemes. Lessened water quality intimidates freshwater species, disturbs fisheries, escalates water treatment expenditures and increases threats for human health. Everywhere on the globe, climate change is already upsetting freshwater mechanisms, as famines and inundations take place with greater intensity and frequency.<sup>11</sup>

Following are some key points that highlight the importance of water conservation:

- **It reduces the impact of famines and water scarcities.** Even though our requirement for fresh water sources is always growing because of population and industrial development, the supply we have remains the same. Though water ultimately returns to Earth through the water cycle, it's not always reverted to the same place or in the same amount and quality. By decreasing the quantity of water we consume, we can better guard us against future drought years.
- **It protects against escalating expenditures and political clashes.** Failing to conserve water can finally lead to an absence of a sufficient water supply, which can have severe consequences. These include increasing outlays, reduced food provisions, health vulnerabilities, and political conflict.
- **It facilitates the preservation of our environment.** Decreasing our water utilization lessens the amount of energy needed to process and deliver it to homes, farms, businesses and societies, which in turn assists to reduce pollution and conserve fuel resources.
- **It makes water available for recreational purposes.** It's not just swimming pools, spas and golf courses that we have to think about. Much of our freshwater resources are also used for improving our environment, watering lawns, flowers and vegetable gardens, as

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<sup>10</sup> Gary Chamberlain, *Because Water is Life* (Wilnona: Amselm Academic, 2018), 89-107.

<sup>11</sup> E. Douglass, *Water Crisis: Day Zero* (Visibility Press, 2018), 46-63.

well as washing cars and filling public fountains at parks. Failing to conserve water now can mean losing out on such issues later on.

- **It forms safe and beautiful communities.** Fire-fighters, hospitals, gas stations, street cleaners, health clubs, gyms and restaurants all require large amounts of water to provide services to the community. Reducing our usage of water now means that these services can continue to be provided.

## Traditional Water Conservation Techniques

People across different regions of the world have to deal with either scarce or excess water due to varying patterns of rainfall and land topography. The traditional water conservation methods, though not much popular, are still in practice and are effective. With the help of primary and secondary data, we will gain knowledge regarding use of these traditional ways in other countries and Pakistan.

### Chinese Water Conservation Techniques:

- **Clay Pot Irrigation Technique:**

A technique first used in China more than 2000 years ago is still used by many farmers in dry lands. The clay pot irrigation system uses a buried, unglazed, porous clay pot filled with water to provide controlled irrigation to the plants, where the consumption of water is influenced by the plant's water usage. According to Rai, the clay pot irrigation consumes as little as 10 percent of total water used otherwise through conventional surface irrigation. Such type of irrigation has proved to be more effective than drip irrigation system. In India, the melon yield through clay pot irrigation was 25 t/ha using only 2 cm water/ha as compared to 33 t/ha using 26cm of water/ha through flood irrigation. This traditional technique not only conserves water but also creates suitable conditions for seeds to germinate in hot and humid weather and gives a steady supply to the seedling.<sup>12</sup>

Buried clay pot irrigation (pitcher irrigation technique) has been used to grow a wide range of annual and perennial plants in China, Pakistan, India, Iran, Mexico and Brazil. In the arid district of Sanghar that is located in Southern Sindh Province, the farmers take benefits by using clay pot irrigation technique. It is impossible for them to harvest vegetables on the dry lands of this area. In an interview conducted with a farmer Hussain Soomro from Rano Junejo village said: "Clay pot method uses less labour and a small amount of water. I have installed 20 clay pots on the land in front of my hut and I live near Chotiari freshwater reservoir. I sow

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<sup>12</sup> S. Amrith, *Unruly Waters: How Rains, Rivers, Coasts, and Seas Have Shaped Asia's History* (New York: Basic Books, 2018), 226-287.

different vegetable seeds such as Okra, Eggplant and Cucumbers and after using some to feed my family, rest is sold at a local market of my town”<sup>13</sup>

## Indian Water Conservation Techniques

Due to climate change, the country's lakes and other water reservoirs are getting exhausted. The country is mostly dependent on rain water and monsoon season to satisfy its water needs. Around 83 percent of total fresh water is used for agriculture purposes. In order to conserve water and save it for future use, India has revived its traditional water conservation techniques which are still prevalent in the city of Jaisalmer of Rajasthan which is water sufficient despite scarce rainfalls. Following are the traditional techniques prevalent in India:

- **Taanka:** A technique specially employed in dry ranges such as deserts where water fetching becomes an ordeal. *Taanka* is a cylindrical underground pit that stores rain water and can fulfill the needs of a family of five over the summer season. In some cases the *taanka* is covered to avoid rapid evaporation of water in intense temperatures.
- **Johads:** The traditional conservation techniques are not only effective in conservation but also work as tool for social cohesion. One example of such technique would be a *Johad*. It is a community owned rain water harvesting technique. The construction site is marked at some elevated position where a deep pit is excavated which is then connected to major channels dug into the depth of the water reservoir.
- **Kund:** *Kund* is mainly used to conserve the drinking water. Historically *Kund* was mainly used for drinking water purposes and religious rituals were also maintained through *Kund*. The history of *Kund* dates back to Raja Sur Singh who built the early versions of *Kund* as early as 1607 AD. The structure of *Kund* is similar to the shape of a saucer which holds rain water to serve people for drinking water use.
- **Jhalara:** In order to secure water wasted as a consequence of seepage from a water reservoir, *Jhalara* is built with rectangular shaped step walls. The stairs are designed with the purpose of collecting the subterranean seepage from an upstream water reservoir of a lake. The main purpose of such sites was to provide essential water supply for the religious rites, royal ceremonies, and community use. Jodhpur, a city in India has eight *Jhalras* in total with the oldest namely *Mahamandir Jhalara* built in 1660 AD.

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<sup>13</sup> Afsheen Zeeshan, "Implementation of Disaster Risk Reduction Policy in Pakistan," *ISSRA Papers* 7, no. 1 (2015): 43-54.

- **Bawari:** Bawaris are mostly located in the state of Rajasthan. These were stepwells designed to store the rain water for consumption during water scarce times. The rain would be diverted to man-made tanks through manmade canals built on the hilly outskirts of the cities. The water would percolate under the ground to increase the ground water table recharging the intricate network of aquifers. The well had steps layered around it to avoid water evaporation.
- **Bhandara Phad:** The make-up of this technique is somewhat closer to the idea of a dam. A *bhandhara* check dam is built across a river leading to *kalvas* (canals). These canals further spread out in the *phads* (agricultural block). To ensure proper irrigation and to manage overflow of water the *sandams* (escape outlets) ensure that the excess water is removed from the canals by *charis* (distributaries) and *sarangs* (field channels). The Phad system is still operational in India. It mainly functions on three rivers in Tapi Basin – Panjhra, Mosam and Aram – in the Dhule and Nasik districts of Maharashtra.<sup>14</sup>

These techniques were used in Pakistan in early 50's and 60's but these days such traditional practices cannot be seen anywhere in the country.

### Water Conservation Techniques in Saudi Arabia

The water conservation tool bags are distributed among approximately 18 million inhabitants on regular basis. The water conservation tools bag consists of water saving showerheads and faucets, leak detection pills and toilet-tank-bank replacement bags. This campaign is included among the largest water conservation campaigns of its kind around the globe in terms of quantity as well as quality. Water conservation tools are also distributed and installed among the public sector institutions such as mosques, government buildings, parks, airports, schools as well as private sector facilities such as furnished apartments, residential compounds and hotels. A number of retail outlets have been opened for distributing the water saving showerheads at a very reasonable price to increase their use by the public.<sup>15</sup>

In Pakistan, awareness campaigns are being run on national and provincial levels to create civic sense among the public regarding usage of water. According to the collected data from a survey about these

<sup>14</sup> Sanchari Pal, "Modern India can Learn a lot from these 20 Traditional Water Conservation Systems," *The Better India*, July 15, 2016, <https://www.thebetterindia.com/61757/traditional-water-conservation-systems-india/>

<sup>15</sup> Chamberlain, *Because Water is Life*.



campaigns, only 15-17 percent of the campaigns have been funded by the concerned federal and provincial agencies whereas the rest of the campaigns have been funded and organized by private educational institutions, civil society and non-governmental organizations.<sup>16</sup>

The above discussion proves that the traditional techniques can improve our practices as well as transform our perceptions and social behaviour towards water conservation. The traditional and conventional practices have proven to be the best strategy for water conservation as well as effective agricultural yields. The traditional agricultural methods are more prone to survive any natural calamities. The traditional modes of production show strong ecological basis and lead to regeneration and preservation of natural resources including water. The sustainability of traditional structure lies on these key principles: species diversity, organic matter accumulation, the enhanced recycling of biomass and nutrients, the minimization of resource losses through soil cover and water harvesting, and the maintenance of high levels of functional biodiversity.

## **Innovative Water Conservation Methods**

“We never know the worth of water till the well is dry” was said by Thomas Fuller. While he made this statement in a symbolic sense, this research emphasizes the importance of water with regards to its management system where the more you manage the better would be the life expectancy of people, which is the most important thing. The idea is to focus on the allocation and distribution of the resources under the influence of effective management system. Water cannot be found as unlimited in any part of the world and therefore, it needs to be used with a great concern of management; otherwise, it leads to scarcity which is a threat for the survival of human life.<sup>17</sup>

Urbanization has devastated the water cycle by overexploiting ground water, reducing the open soil surface, increasing contamination rate and caused a resultant worsening in water quality. Industrial units and apartments face acute water shortages which force them to spend extensive amounts of money to purchase water from metropolitan and private water suppliers. However, the situation in rural areas is equally grim. The population explosion necessitates a proportionate increase in

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<sup>16</sup> A. Ayaz, “Water Resources and Conservation Strategies in Pakistan,” *The Pakistan Development Review*, vol. 6, no. 2 (2017): 997-1009.

<sup>17</sup> L.B. Sukia, “What is the importance of Water Resource Management and its Implication on Future Generations of Man-kind?” *Research Gate*, June 6, 2014. [https://www.researchgate.net/post/What\\_is\\_the\\_importance\\_of\\_Water\\_Resource\\_Management\\_and\\_its\\_implication\\_on\\_future\\_generations\\_of\\_man-kind](https://www.researchgate.net/post/What_is_the_importance_of_Water_Resource_Management_and_its_implication_on_future_generations_of_man-kind).

food production, which in turn demands more land, more fertilizers and pesticides, and more water.<sup>18</sup>

The innovation in water conservation mainly depends upon the management system. The conservation of rainwater is the most useful way to reduce the water scarcity. Climate change also causes a huge challenge for water conservation which makes it essential to have a particular set of strategies to overcome the environmental effects. The innovative methods that are in use around the world, and can be adopted in Pakistan, are discussed below.

### **Rainwater Harvesting**

Modern technology has introduced a new method of water conservation which can be easily practiced by high or low income households. It can be used for the potable and non-potable utilities in the house where the rainwater is a good resource for the non-potable usage like washing clothes, cars, house etc. The idea is successfully being implemented in India so as to manage water scarcity, especially in urban areas.<sup>19</sup>

The mechanism of rainwater conservation varies from the traditional methods to innovative methods. However, the modern innovative method basically emphasizes on roof-top based rain water storage which is used for potable as well as non-potable utilities of household. The second way of using the rainwater in an efficient way is to store water in the ground through the percolation process. Percolation is the process comprised of using pebbles for the refinement of water. So, as the rain water passes through these layers of pebbles, it is filtered and passes into the wells present in the ground. It can be used by the household residents and also commercial urbanized areas.<sup>20</sup>

In Pakistan, utilization of rain water has not been promoted yet and people do not understand the importance of conserving rainwater for domestic and other related activities. There is lack of awareness among the people regarding techniques for rainwater conservation and its importance. A mass awareness campaign in this regard is urgently needed.

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<sup>18</sup> "Harvesting Rainwater," C. P. R, Environmental Education Center, <http://www.cpreec.org/pubbook-harvest.htm#1>.

<sup>19</sup> Judah Samuel, "Pioneers of Rainwater Harvesting in India," Ecoideaz, 2015, <http://www.ecoideaz.com/expert-corner/rainwater-harvesting-movement-india>.

<sup>20</sup> Nelson Da Franca Ribeiro Dos Anjos, "Source Book of Alternative Technologies for Freshwater Augmentation in Latin America and the Caribbean," *International Journal of Water Resources Development*, vol.14, no.3 (1998): 365-398.

## Green House Evaporation Mechanism

Scientists are trying to convert the world's most arid areas into fertile land for vegetable farms, fertile fruits etc. through use of fresh water. This fresh water would be purified through solar energy from the sea water. An Australian expert has suggested that seawater be pumped from the sea, then dripping it through a honeycomb structure inside a greenhouse where it will get evaporated due to solar heat. The evaporated vapours will be condensed on the greenhouse roof which as result will form fresh water.<sup>21</sup> This fresh water is usable for potable and non-potable purposes of households, companies, farms and other areas. Another example of this method is the pilot project launched in Qatar in 2012 where it yielded successful results which led to the application of this method in Tunisia, Jordan and the different areas of Australia itself. Moreover, the tomatoes of Australia are famously recognized as a result of this innovative water usage and storage mechanism.<sup>22</sup>

Research and development regarding modern water conservation strategies has not been encouraged at federal and provincial levels in Pakistan and because of the lack of this expertise, we are not able to deal with water crisis. On the official website of Pakistan Council of Research in Water Resources, we do not find any single project related to this greenhouse evaporation mechanism that is gaining much popularity in developed countries for the supply of fresh water.

## Sensor and Automated Systems

This method has been applied in Australia for preserving water in agrarian practices. In this technique, computers are used to assist in the method of crop sprinkling. These sensors are positioned in farms and study how yields are developing and consequently, choose how much water is required. Adoption of this method will lead to clever utilization of water and also, sustain the wellness of the harvest and the farm. Rajiv Tikoo, Managing Director of One World Foundation in an interview with *The Times of India*, stated that sensor-based technology can be installed in metropolitan zones, too. These can be connected to water pipes and can monitor leakage as well as impurity. He added that Israel has already executed this knowledge effectively.<sup>23</sup>

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<sup>21</sup> H. H. Ozturk, "Evaporative Cooling Efficiency of a Fogging System in a Rose Green House," *Australian Journal of Experimental Agriculture* 46, no. 9 (2006): 1231-1237.

<sup>22</sup> James Wagstaff, "Sundrop Farms: Mixture of Sunlight and Seawater Leading the Way," *The Weekly Times*, March 22, 2017, <https://www.weeklytimesnow.com.au/agribusiness/decisionag/sundrop-farms-mixture-of-sunlight-and-seawater-leading-the-way/news-story/8928aff10d54c5d9a56024e72a6c0377>.

<sup>23</sup> C. Barnett, *Blue Revolution* (Boston: Beacon Press, 2012), 156-173.

Financial as well as technical resources are needed to use this method and in Pakistan, we face challenges in the acquisition of these resources. During an interview with a Senior Executive of Pakistan Council of Research and Water Resources, some details regarding provision of funds and status of current water management projects in Pakistan were discussed. According to the source, we need decades to use such innovative automated systems that use sensors as we don't have required technical expertise and financial means.<sup>24</sup>

### **Sharland Oasis**

The scarcity of a vital resource like water is mainly due to combination of factors like climate change, environmental degradation, increased human demand of water etc. The Australian Government introduced a strategy called 'Water for Future' which tends to secure the water for households via different innovative methods and saves the ground water for future. The government of Australia encouraged builders, real estate dealers and manufacturers to take up water efficient measures. The Deakin University, Australia funded this program which named it as 'Sharland Oasis'. It set the target of 80 percent of water conservation. The mechanism of this storage system is that the houses are designed in a way where there are tankers attached to the house; the rainwater is stored there by each household which is very useful for the non-potable purposes of water usage like washing clothes.

It has also being proved that stored rain water has very minimum level PH scale (salt intensity) which is useful and safer to use than the pipeline water provided to the people in the urban and rural settings. The Sharland Oasis project has adopted a mechanism where it provides the household a system where the rainwater in the tanks situated alongside the house can be used for irrigation of crops, washing clothes and cars and other non-potable uses. Moreover, it has equipped the household with a filtration mechanism where the same rainwater is helpful for the household to be used for drinking purposes and also for other potable uses.<sup>25</sup>

Like all other innovative ways, this technique is not being used in any area of our country and we are not able to reap benefits by utilizing such an important water conservation method.

### **Use of Big Data**

Big data usage is among the most modern water conservation techniques. Modern industrial businesses are utilizing data to regulate what can be

<sup>24</sup> This interview was conducted by the author with Mr. Saad Rehman, senior researcher at an organization, in Islamabad, on January 16, 2019.

<sup>25</sup> J. Barbier, *The Water Paradox : Overcoming the Global Crises in Water Management* (Yale University Press, (2019) :153-178.

practiced to make the future better by delivering predictive and analytical understandings. The US-based company, Pacific Gas and Electric, has an innovative method for residents to study and monitor their water and energy utilization. It also permits the consumer to match their use with other parallel homes. This practice has facilitated families to save energy and utilize water in a more effective way. Big data also performs a vital part in usage of smart meters. In the US, smart meters are now installed to monitor water use. A home can acquire data every fifteen minutes. This lets the family as well as the water administrator to attain knowledge about water consumption and implement suitable water conservation systems.<sup>26</sup> In the case of Pakistan, financial as well as technical expertise is required for installation of these meters and in Pakistan we are facing problems in managing these resources.

### **Current Water Conservation Techniques in Pakistan**

In Pakistan, people are using their indigenous knowledge to conserve water such as in many areas, cropping and fish farming are being run side by side so that no water or piece of land is wasted. Drip irrigation and sprinkler irrigation techniques are also being used for water conservation by the farmers. Some people store rain water on their roofs and use it to harvest the crops in large drums. It is observed that many domestic and commercial set ups have installed water pipes with such taps that only run when they have water in the pipes and rain water flows through these pipes. Various mulches are also being used to minimize the soil evaporation and conserve the water in soil for maximum time spans. Irrigation is properly scheduled according to the accessibility of water and its quantities. Land levelling is being done to save the water and terracing method is used for harvesting in most of the hilly areas of Pakistan to reap maximum benefits from the water availability. Small bunds are also constructed to conserve the water as well as crops are kept covered. In case of less water availability, zero tillage is utilized to harvest the crops and minimum tillage is a very suitable technique for saving the water.

### **Learning from the Best Practices:**

#### **A Way Forward for Pakistan**

On the basis of both traditional and innovative water conservation techniques, we are able to analyse which method is suitable according to the conditions of Pakistan, and where we need to be more resourceful in order to solve the water crises.

#### **Distribution Schemes**

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<sup>26</sup> L. Feldman, *Water*.

The lack of synchronization between water consumers and the Ministry of Water Resources has remained a main challenge since the establishment of irrigation system that has caused maladministration, meager maintenance, unfair and untrustworthy distribution. Under current rotational (*warabandi*) irrigation scheme, the delivery of water to the channels is unjust. The water outlets situated at the head and middle connections of distributaries draw three to six times more water than their allotted share, while exits at the end draw less than the actual allotted share; therefore, the unfortunate tail users are continually facing water scarcity. Those who draw larger segments use more water than the crop's necessity causing unnecessary damp pressures to harvests and disproportionate discharge of nutrients. However, the tail users use a reduced amount of water than requisite, causing dehydration strains on yields. All this proposes the need for appropriate administration and implementation of systematic methods to use the water available at the outlet. This could be practiced at the farm level either by refining the current methods or by launching effective irrigation procedures.

### **Improvement in Traditional Methods to Reduce Water Wastage**

Currently, the farmers are relying more on conventional flood irrigation practices without considering soil texture and land slope. Therefore, more than 20 percent water is wasted at the field level through deep filtration. Likewise, furrows are organized without suitable information on slope consideration. The agriculturalists require appropriate training on the preparation of furrow, border and basin irrigation techniques. These approaches would still contribute in great yields if they are correctly designed and organized according to water and soil conditions. One of the aspects recognized for unproductive usage of irrigation water through these systems is poor levelling. The un-levelled lands are categorized with non-uniform circulation of irrigation water and deep filtration, which disturbs application efficacy as a result. A suitably levelled field with an appropriate design and size decreases application losses, guarantees constant circulation, and increases crop production.

### **Modern Irrigation Methods for Better Water Management**

Resourceful irrigation approaches like sprinkler, trickle, pitcher, and sub-irrigation are vital to be initiated at the tail reaches with water scarcity issue. These systems are verified as efficient ones in terms of water saving but are considered as costly; therefore, agronomists are hesitant to utilize them. But, the approval of these procedures relies upon their achievement in terms of increased harvest returns connected with decreased usage of water. Since these practices have potential to conserve lot of water, therefore, more land could be brought under farming with lesser quantities of water available, predominantly, at the tail reaches of the delivery schemes.

The irrigation techniques so initiated must be suitable as well as economically reasonable for the agriculturalists. Henceforth, the government should adopt practices and fix demonstration areas at fields to make them familiar to the farmers. As soon as the farmers understand the advantages of water conserved and proceeds attained, they will implement such structures using their own means. Among the innovative approaches stated, trickle irrigation has been described as one of the most well-organized ways of water application than any of the traditional surface irrigation methods. It delivers prescribed quantity of water, accomplishes high field application productivity, deals with improved consistency, conserves water, and guarantees superior crops. Similarly, the water is delivered to plants in an accurate amount, thus their instant water necessities are fulfilled.

### **Water Storage Reservoirs**

The idea of water storage reservoirs at the farm level is quite innovative and requires research on how to make it physically and financially feasible. Their usage is a calculated management approach to use water when it is in surplus and use only when required. The storage volume is dependent on the size of the reservoir and obtainability of water to be connected.

The use of other best practices for water conservation needs resources to be implemented according to Pakistan's circumstances. Similarly Pakistan needs to invest more in research and development which is the prerequisite for design and implementation of innovative methods to save water. Initially to solve the water crisis, the provinces should abandon political playoffs and decide on establishing new water reservoirs. According to water experts, the rate at which our population is growing, a Tarbela-sized water storage facility is required to be built every decade.<sup>27</sup> Federal and provincial water commissions are also required to ensure well-organized water resource management at all levels along with national water policies.

The Council of Common Interests (CCI) officially ratified the National Water Policy (NWP) with consent in April 2018. The policy authorizes the provinces to build their own strategies within a national agenda for sustainable development and administration of water resources. It acknowledges that water resource is a state obligation, but irrigation, farming, water supply, and other water-related sub-sectors are provincial issues. The policy also endorses that the federal government can perform an important role in simplifying protocols to guarantee effective and ecological utilization of ground water, industrial usages and waste water supervision.

The legislators in Pakistan need to fight against the water crisis

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<sup>27</sup> M. Khurshed, *Water Crisis In Pakistan: A Book on Informatic Material*.

because it threatens to make arable land dry over the next decade. Long, medium and short term plans need to be articulated in order to reserve water. In a short time span, we may formulate and implement water treatment schemes and inform the stakeholders in order to attain an optimum level of existing water utilization for domestic, industrial and sanitary usage. In the intervening time, tactics for the medium-term may consist of a comprehensive evaluation of national water agreements and constructing dams so that water is distributed in an unbiased and viable way. In the long time, Pakistan can deliberate establishment of desalination plants to make more consumption of sea water possible. Many nations have taken up this plan to alleviate water concerns.

Actually the expenditures of founding such plants in the coastline zones of Pakistan would rely greatly on the kind of fuel that is utilized, though the paybacks of this ingenuity would be greater than the costs. With the launching of coal-based power plants under CPEC, it would appear rational to initiate planning for building desalination plants rather than making ourselves prepared for a waterless future. Attention must be given to the treatment of industrial waste before it is permitted to be discharged into water channels. The environmental regulations and their application need be followed more earnestly and sensibly. The practices that involve use of untreated wastewater for irrigation of crops should be instantly stopped as it is unsafe for the users of those vegetables and crops. Groundwater for drinking purposes must not be pumped near wastewater pipes.

Water from Monsoon rainfalls is one of the largest sources for water in the country because it also assists in cultivation of unfertile lands. By channelizing monsoon rainwater towards deserts like Tharparkar and Cholistan the region could be transformed. A huge amount of water is squandered annually and through appropriate utilization it could aid in electricity generation too. The academic circles, civil society and water research institutions have to collaborate in harmony for the resolution of current water crisis confronted by Pakistan. Water demand can be monitored and regulated with the help of a series of programs that encourage efficient water usage; comprising of awareness campaigns, voluntary acquiescence, legitimate constraints on water consumption, controlling of water or the obligation of water conservation principles in technologies. Words on paper and in promises cannot change the situation; action is the only solution to the problem.

### **Water Filtration from Lakes**

The increase in the use of water in outdoor rather than indoors in the urban areas has created a major dilemma for the equal distribution of water for the households. Corporations and development projects are increasingly expanding which leads to increasing demand for water consumption. As a result, the availability of fresh water for potable and



non-potable uses in the household is drastically affected. Therefore, the study brings some variant solutions from the traditional water conservation methods to develop an innovative water conservation strategy. The strategy entails that there should be reservoirs constructed by the government near the industrial zones that tend to consume more water than other ordinary (household) consumers. This is supposed to store the wastewater of those industries, corporations etc. and process it through filtration plants to make it usable for non-potable uses of households. It will be distributed among the households via pipelines. This service will tend to prevent the wastage of fresh water and will save the use of ground water from overconsumption. This process of filtration will reduce the scarcity of water in the long term. These reservoirs will be beneficial to store rainwater as well, which will augment the water storage rather than being wasted.<sup>28</sup>

There is negligence on the part of concerned authorities at federal as well as provincial level in Pakistan in understanding the significance of water filtration in reservoirs to meet the growing needs of water resources. During interviews conducted with officials of Pakistan Council of Research and Water Resources, it appeared that enough attention is not paid to use of innovative conservation methods in different parts of Pakistan.

## Conclusion

Global and local water challenges must be addressed as soon as possible. We need a new mode of thinking and we must shift our paradigm from old policies to sustainable policies in Pakistan. Smarter usage of innovative tools for obtaining, refining and dispensing water is necessary. It must be acknowledged at all levels that access to safe water and sanitation are fundamental human rights. We have to save water for future generations and a sustainable future is possible if we move all individuals, communities, countries and global course of action in the same direction of saving current water resources. Water conservation involves consideration and determination, but every little bit helps. We must not think that what we do does not matter and should make changes in our lifestyles to reduce our water usage. The trick is making water conservation a way of life, not just something we think about once in a while. As the societies and communities become more conscious and involved in sustainability at cultural, national and local levels, the collective and fiscal advantages of investing in water conservation are becoming more obvious and persuasive internationally.

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<sup>28</sup> D. Wallace, *The Uninhabitable Earth: The Life After Warming* (New York: Tim Duggan Books, 2019), 213-234.

