P-ISSN: 2790-6795	Annals of Human and Social Sciences	Jan-Mar 2023, Vol. 4, No. 1
O-ISSN:2790-6809	http://doi.org/10.35484/ahss.2023(4-I)41	[443-452]

Annals of Human and Social Sciences
www.ahss.org.pk

RESEARCH PAPER

Water Scarcity in Desert Belts in Pakistan: A Case of Thar Region

[1]Jhaman Das Hirani* and [2] Muhammad Ali

1. Researcher, Department of Economics, University of Sindh Jamshoro, Sindh, Pakistan
2. Assistant Professor, US Pakistan Center for Advanced Studies in Water MEHRAN UET, Jamshoro, Sindh, Pakistan

***Corresponding Author** jrhirani@yahoo.com

ABSTRACT

This study aims to assess the status of water scarcity in Thar Desert of Pakistan and find pragmatic remedial measures. This desert belt is the most water scare region in the country. The Research used both quantitative and qualitative data, considering both primary and secondary data collection, analysis and interpretation. This study summarized that groundwater is the major water source for 91% households in Thar desert. Barrage water supplied through pipeline system has been capable of quenching water needs of about 6%. Whereas 03% don't have any permanent water source, coerced to purchase it. Per capita water availability is 10 liters per day for 85% households. Women and school children (girls and boys) are responsible to fetch water which affects both productive working hours and education. Hence, this study recommends adopting innovative approaches including promoting rainwater harvesting and revamping the existing water sources in the Thar desert.

Keywords: Water Scarcity, Water Shortage in Thar Desert, Water Crisis Solutions

Introduction

Water scarcity is a global menace which is affecting almost every continent of the World. Today, all the major water sources are under pressure due to increased water needs (including drinking, domestic, agricultural, industrial and environmental needs). Population growth, industrial development and urbanization have increased water demand globally. Water scarcity is a shortage of water below the minimum required level of water needed for aggregate human consumptions. The international water agencies including UN Water have ranked many regions in the World as water stress and water scare regions. There are various causes of water shortage including physical dearth of water, inadequate water management (due to poor infrastructures and dormant institutions), climate change affects and natural hazards. All the major water sources are extinguishing at an alarming rate. The glaciers are melting due to global warming causing floods and wastage of fresh water sources in some regions of the world (Afzal, et. al., 2020).

United Nations Water (2019) defined that water scarcity is shortage of water availability due to physical dearth of water, or shortage in access due to non-functionality of institutions for regular supply or because of inadequate infrastructure. Hence, it focuses on water availability in terms of its quantity either because of the non-provision of water resources in real time or due to inefficiency of responsible institutions to deliver water supply (p.4).

Nairizi (2017) suggested that water scarcity means an excessive water demand against available water supply. He further explains that the concept of water scarcity is relative and dynamic at same time. This may appear at any level of supply or demand. Water scarcity is also a social concept, where the causes of human meddling with the water cycle are concerned. The status of water scarcity is directly related to existing economic policies,

planning cum management approaches, more than hydrological viability and natural changes in water availability over time (p.6). Gleick & Cooley (2021) defines water scarcity as growing mismatch between availability of freshwater and human demands (p.1).

White (2012) elaborated that water scarcity can well be understood as inadequate access to sufficient water quantities needed for human and environmental consumption, seems as a stringent and growing concern for many regions in the world. Hence, when it comes to water scarcity it means available water resources are under pressure. Thus, all the concerned stakeholders including international organizations, non-government organizations, government departments, academia and others, when expressing water scarcity, they indicate that water resources are under stress. The scarcity of water means increasing demand of water to create comparing limited available water sources, which ultimately causes stress on water resources (p.1).

Steduto, et al (2012) defined water scarcity as a gap of freshwater availability, in specified area, between prevailing supply and quantity of water demanded under existing arrangements of the institutions and condition of infrastructure. The arrangements also include pricing and retail charging (p.5).

The blue water demand has increased since 1950s in in the agricultural and industrial, along with continuous population growth have amplified water scarcity as well. One of the prime determinants of water scarcity is the overconsumption of water as well (Unfried, K. et al 2022).

Pakistan is at the verge of water stress to water scare with an estimated per capita water availability of around 1000^{m3} which is alarming (Sharif et al. 2016). The global aggregate water demands are rising due to higher water needs in both agriculture and industrial sectors (Amarasinghe, U. A., & Smakhtin, V. (2014). Population growth with rapid urbanization is putting intense pressure on existing water sources (Benna & Garba 2016) the same is the situation in Pakistan as well. Climate change is provoking water scarcity in Pakistan by making rainfall pattern very erratic (Ahmad, A. et al. 2020). The southern arid zone and Thar desert belt are most vulnerable to water shortage on an average it receives a rainwater in between 500-100 mm/year (Garg & Choudhary 2021) and it is one the main of seasonal migration in the area as well (TORRES, 2015).

Tharparkar is regarded as the most water scare region in the country. It is desert district in southern region of the Sindh province of Pakistan. By land area this district comes under the largest district of the province. With a total estimated human population of 1.65 million, the district is also home to more than 5 million livestock. According to UNDP (2016) among all district of Sindh province, Tharparkar has lowest human development index. The livelihood of people depends on rain-fed agriculture, since, Tharparkar has a fertile desert. The district has an area of 19638 km^2 with its headquartered at Mithi. The district has seven administrative setups namely, Mithi, Chachro, Nangarparkar, Diplo, Islamkot, Kaloi and Dahli

According to Multidimensional Poverty Index, Tharparkar is one among poorest district in Pakistan. The district falls at lowest level for human development in the country with a ranking of 121 out of 151 in education. The status of education has worsened further compared to last year during which the district was ranked at 112. Around 96% of people dwell in far flung rural areas. The district has more than 2500 small and large rural setups known as villages. An estimated 1.593 million people reside in the district, spread over the area of 19638 km2 (Khan, 2022). The district has seven Taluks including Mithi, Islamkot, Diplo, Chachhro, Dahli, Kaloi and Nangarparkar. The district is regarded as the most water scare region in the country. Groundwater is the only major drinking water source, which is also brackish to saline ranging from 100 ppm to 6000 ppm level of TDS (Total Dissolved

Salts) (Kumar, et al. 2022). The water fetching responsibility lies to women, who carry earthen water-pot on their heads to fetch water necessary of survival.

The researchers also intimated that various state and non-state actors have tried to cope with this water shortage issue. In this connection, number reverse osmosis plants are installed by Government of Sindh, along with other small-scale water abstraction schemes by other actors. However, drinking water is still one of the major challenges for the people of Tharparkar. Water shortage has dilapidated the agriculture sector in the region. Only 17% are being cultivated out of the total cultivable land. Hardly, 2.29% of the area is irrigated (Ahmad & Sarfraz, 2017, p.3).

Hagler Bailly Pakistan (2012) stated that Tharparkar has a tropical desert climate. It is extremely hot in summer during daytime; however, nights are cooler. The hottest months during the day are April – June each year. Whereas December – February are the coldest months. The average minimum cum maximum temperate during the mentioned periods are 9°C and 28°C, respectively. It categorically defined.

1) Summer (March - June), very hot temperatures, moderate wind from the southwest, dry conditions, and low humidity.

2) Monsoons (June - September), high rainfall, temperatures rise, high humidity (Figure-3), and strong winds from southwest. The temperatures are milder compared to summer with high humidity.

3) Post-monsoon summer (September - November) no rains, low wind speed. Temperature hike and humid decreases; and

4) Winters (November - March), moderate temperature, low humidity, dry conditions, and low winds from the north and northeast (p.4).

Material and Methods

This study employed a descriptive survey design. The descriptive study is useful to present the situation as they prevail, where researcher can easily report what happened or is happening, along with discovering the causes of it (Creswell, 2021). Similarly, Mugenda & Mugenda (2003) confirms that descriptive study is used to collect data for evaluating present condition and provide basis for decision. Hence, the current situation can be determined through descriptive study. Descriptive research is effective for analyzing non-quantified topics and issues (Siedlecki, 2020). The study has applied both qualitative and quantitative methods for data collection and data has been triangulated accordingly.

Under this study 10% of randomly selected households from 120 selected villages amongst all ecological zones of Thar. Separate FGDs (Focal Groups Discussions) and KIIs (Key Informant Interviews) were also undertaken in 16 randomly selected villages. Primary data is collected at different tiers i-e from random selected households, focal group discussions, key informant interviews and personal observation from the 16 different rural villages of all eight ecological zones of Tharparkar. Secondary data is collected from various published and unpublished material, data collected by independent researchers, corporates / firms, NGOs, INGOs, UN Agencies and prevailing Government record. The similar nature other studies and reports were also reviewed which are ever conducted in various other similar regions of the world.

Results and Discussion

The data collected at household level suggest that ground water is only major water source for around 91% people of Tharparkar. The major ground water sources are reported as 72% dug wells, 17% Reverse Osmosis Plants, and 2% either handpumps or solar power submersible pumps. Moreover, the distant and physical proximity of existing water sources in the village is another dilemma. It is pertinent to mention that most of the water sources in not at doorstep. Even village wells within proximity of one kilometer is considered as blessing in Tharparkar. Some the of the villagers don't have wells in their own village, hence compelled to travel for kilometers to fetch the water necessary of daily consumptions (including drinking and cooking etc).

The primary data collected at household level suggests that out of 72% households, who are having dug wells as major water source, 63% households have access to village wells, which are generally available within 01-kilometer circumference. It was also found that there are 11% highly water vulnerable households for even not having wells within their villages. Ironically, the household members of such households (including women, girls and children) have to travel daily from 2 – 5 kilometers to nearby villages to get necessary water.

The water collection mechanism in Tharparkar from the wells is an arduous one. Usually, a rope is tangled with bucket which is used to abstract water from wells deep down ranging from 30 feet in Diplo belt up to 500 feet in the areas of Chachhro and Dahli, since water table varies in Tharparkar.

Table 1
Major Water Sources

#	Water Sources	%age of Hhs
1	Dug wells	72%
2	RO Plants	17%
3	Hand pumps	02%
4	Pipe Water Supply	06%
5	No permanent source	03%

Moreover, household level data assessment suggests that at present only 06% households have direct access to pipeline water. These households reside in the villages which luckily fall along the route of only pipe water supply from Naukot town, to Mithi and finally reaching at Islamkot. It is pertinent to mention that only 06% households of Tharparkar have access to fresh water (surface water) supply from barrage water through a single line pipe water supply. However, an independent assessment regarding RO plants functionality in Tharparkar (Jhaman and Asif, 2017) suggest that barrage water is supplied through pipeline system only twice a month. This pipeline supply system usually in towns is used to provide available saline ground water to households, to enable them to meet daily water needs. This is another area of concerns that how high TDS cum chemically contaminated ground water left residual in pipelines mixes with freshwater and worsen the quality of drinking water.

A similar assessment suggests that 78% of households who consume pipeline water don't treat supplied water in any way. Only 12% filter with cloth, 07% boiling and 03% slow-sand filtration methods were observed. Therefore, the quality of supplied "fresh water' is yet another unaddressed area. 03% people shared they don't have any water source nearby and they have to purchase it at varying cost from PKR 3000 to PKR 5000 per month per household.

Water shortage is another issue in Tharparkar. Data suggests that up to 70% households hardly collect 50 liters of water per day and 20% collect up to 100 liters to meet

drinking and domestic water needs. Whereas, only 10% have reported their daily water stocks are more than 100 liters per household. Per capita water consumption suggests that 85% of people consume up to 10 liters of water and 13% consume maximum 15 liters (per person per daily). Only 02% reported their water consumption is more than 20 liters per person per day.

Table 2
Daily Water Collection Practices in Study Area

#	Daily water collected per Hhs in ltrs	%age of Hhs
1	50 Liters	70%
2	100 Liters	20%
3	>100 Liters	10%

The water consumption at present shows a grim water shortage and much below the recommended range of water consumption even in emergencies. WHO (World Health Organization) recommends even in worst emergencies the average water availability per person per day should be 15 liters to 20 liters. WHO (World Health Organization) in its technical note on WASH in emergencies 2013, suggests that water is essential for life, health and human dignity. In extreme emergency situations, there may not be sufficient water available to meet basic needs and in these cases, supplying a minimum level of safe drinking water for survival is of critical importance. Insufficient water and the consumption of contaminated water are usually the first and main causes of ill health.

This study, through its primary data collection, also tried to grasp the overall understanding of local people regarding water availability. 55% of people shared that available water is not sufficient for drinking, 32% don't consider is sufficient for cooking and 27% don't find it sufficient for washing and other household consumptions. On probing the reasons for non-sufficient water, it was found that for 47% of the population water sources run dry and for 53% the existing water sources are too far to fetch water.

The overall time consumed to collect necessary water for drinking and other household consumptions make people coerce to fetch only minimum required water. Households shared that their family members, mostly women and young girls who usually are responsible to collect water, have to walk several kilometers daily to extract water from wells with arduous methods and bring it back home through carrying heavy containers filled with water on their head. It adds fuel to the fire since most of the villages are settled on sand dunes and village wells are situated in lower basins of the village usually 500 – 1500 feet down the dunes.

Study suggests that women, in study area, have to carry back water filled in earthenware climbing back the dunes, which makes water fetching very difficult. People shared that water shortage in village wells (since people have to wait for hours to fill back aquifers once water is abstracted) and arduous water collection methods coerce them to collect only minimum possible water for basic survival. This is also one of the major contributing factors for insufficient water in Tharparkar.

Table 3
Water Availability Status in Study Area

#	Water Availability	%age of Hhs
1	Not Sufficient for drinking	55%
2	Not Sufficient for cooking	32%
3	Not Sufficient for washing	27%

This study tried to find out the impacts of water scarcity on the economy of Tharparkar. Therefore, study tried to collect primary data on various parameters including if the available water sufficient for drinking and other household consumptions, what is direct cost involved on collection of necessary water and how much time including

productive working hours are spent over collection of daily needed water. For the efficacy of data, the primary data was directly collected at three different tiers i-e at household level through household assessment tool, at village level through FGDs and from key informants through KII. All the data collection tools used indicators to collect data regarding how dearth of water is affecting human health, food availability, livestock health and fodder and current education practices in rural setups of Tharparkar. Besides, personal observations were undertaken, and available secondary information was also reviewed.

The overall feedback from primary data summaries that 98% people assume water shortage affects economy in various ways including direct cost involved on water fetching, consumption of productive working hours, aggravating educational status, water scarcity provoking health issues, water shortage causing food insecurity, water scarcity depleting agriculture activities and water scarcity affecting livestock based economic activities etc, in Tharparkar.

Primary data collected at household level summarizes that 80% households are paying some direct cost to collect water necessary of drinking and other daily household consumptions. Most of them pay up to Rs.4000. 02% of households even have to pay more than 4000 per month. In response to question, does the fetching water involves additional time which could either had contributed to income generation? all of them responded affirmatively. Enquiring what else could have been done if additional available water is ensured, 36% preferred handicraft, 39% preferred labour and 04% shared of doing trade as additional income generation options. 21% shared they could have been doing domestic work in additional time if could have saved, now consumed on water fetching.

Data further suggest that 58% households are paying monthly up to 3000, due to water shortage, 33% pay from 3000 to 5000 per month. 05% also pay more than 5000 per month. Only 04% pay no cost.

Table 4
Monthly Cost on Water Collection in Study Area

#	Monthly cost paid for water collection	%age of Hhs
1	3000	58%
2	3000 – 5000	33%
3	>5000	05%
4	No cost paid	04%

Daily time consumed to fetch water necessary for drinking and other household usage is another dilemma for people of Tharparkar. 73% of households have shared they consume more than one hour to fetch water necessary for drinking and other household's consumptions. However, these responses are mainly from the areas of Dahli, Chhachhro, Islamkot, Mithi and few villages of Nagarparkar. Access to water in these areas is generally considered the greatest challenge.

The bar chart depicting the depth of wells for all ecological zones of Tharparkar presents a similar situation. The wells in the above-mentioned areas are not only deep but water availability in aquifers is also limited. Even in some cases people of these villages have to wait for hours to reach their water fetching turn from communal wells. People shared that usually in hot season (April – September) these wells become frequently dry, hence inciting water scarcity. Besides, 26% households consume from 30 minutes to 01 hour and only 01% consume less than 15 minutes. Survey results found that 46% of households have to pay five round trips a day to collect daily needed water. Whereas 28% undertake 04 trips, 12% undertake three trips and 14% undertake one to two trips.

Data collected from various ecological zones of Tharparkar suggest that 61% of people rank pipeline water as the most appropriate water solution in Tharparkar. Whereas,

17% rank RO plants, 12% rank rainwater harvesting structures. This is proved that rainwater harvesting may help in mitigating water crisis as initially hypothesized in no. 4 hypothesis "Rainwater harvesting practices may significantly contribute to coping with water scarcity in the region". However, this hypothesis will stand true subject to availability of rainwater. While 06% rank additional hand pump as the most appropriate water solution in Tharparkar and 04% suggest additional water wells as the most appropriate water solution for Tharparkar.

Consultation with communities for who could play vital role for water security in Tharparkar, 43% people think influential people and politician could play vital role. NGOs/Aid agencies vital role is endorsed by 20% people, and 13% people think local Government might play vital role. However, 24% were not aware who could play pivotal role for water security in Tharparkar.

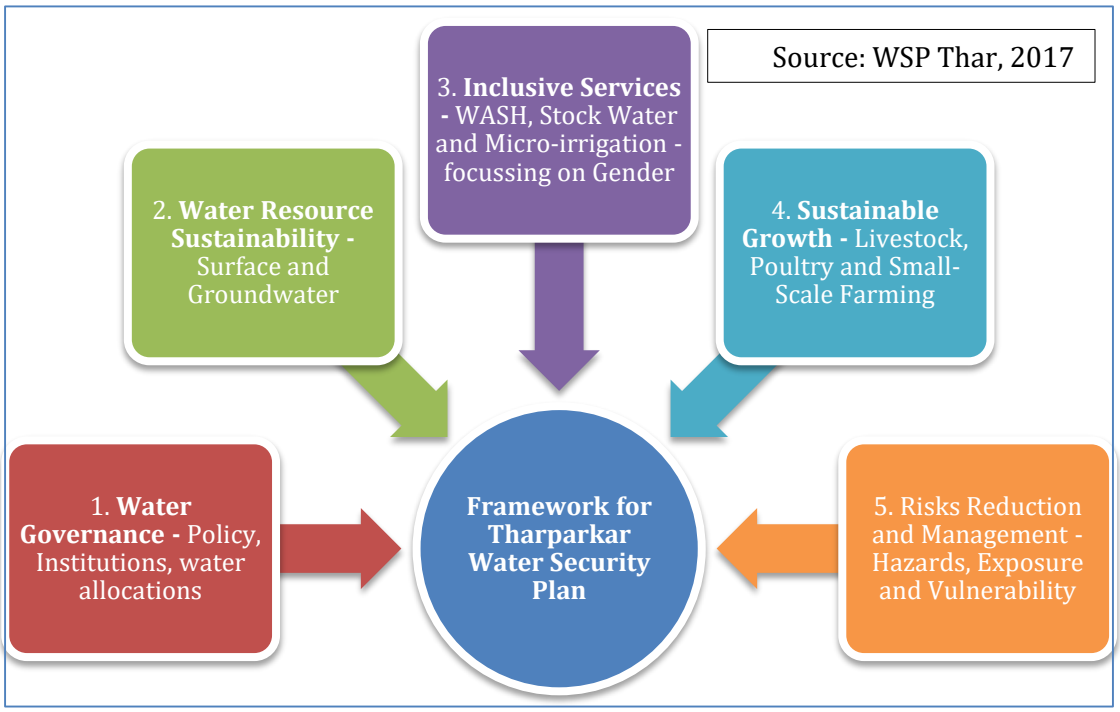

Figure 1

FGDs with communities for probing possible water solution 36% rank additional dug wells. 30% bring water from nearby villages, and 26% think waiting for long time to collect water from wells is possible solution to cope water shortage in Tharparkar. However, 08% prefer buying additional water to cater water shortage.

Conclusion

This research concludes that the study area (District Tharparkar) is semi-arid desert belt which is water scare district in the country (Pakistan). The results and discussion summarized through primary data collection, at both household level and village level, intimate that water shortage is most acute problem faced by people of Tharparkar. Ground water is the only major water source which does not fulfil the water needs of local communities.

The results suggest that water shortage affects the economy of the studied population in various ways including direct cost involved and daily time consumed for water fetching, and health expenditures incur due to insufficient and unsafe water in Tharparkar. In rural villages of Tharparkar, the school going children (both boys and girls) are engaged in water collection activity with their parents, which also affects regular attendance in

schools. In the worst cases water collection provokes drop-out of school children in water scare villages.

Supply of surface water / canal water through pipe water supply is ranked as the most appropriate water solution for Tharparkar by people interviewed through household level data collection, focal group discussions and key informant interviews. Besides, rainwater harvesting is also considered as an added advantage subject to availability of rain showers. The increased access of ground water supply through RO plants, solar powered submersible pumps and hand pumps, coupled with prevailing dug wells is ranked as last resort to cope water scarcity

Recommendations

The recommendation to address the water scarcity problem of Tharparkar focusses on promoting rainwater storage with innovative approaches including rainwater harvesting and sand dams. Besides, it also suggests revamping existing water supply sources to resolve concurrent water shortage issue.

References

Ahmad, A., Hayat, U., Ali, S., Bilal, H., Ali, N., & Khan, K. (2020). Descriptive analysis of water resources in Pakistan: A perspective of climate change. *Journal of Innovative Sciences*, *6*(2), 77-89

Ahmad, S., H. S. (2017). Water Security Planning Tharparkar. Islamabad: - SF Tharparkar.

Amarasinghe, U. A., & Smakhtin, V. (2014). *Global water demand projections: past, present and future* (Vol. 156). IWMI.

Afzal, N., Yaseen, Z., & Muzaffar, M. (2020). China and India: On the Edge of Water Dispute and Cooperation, *Journal of Arts and Social Sciences*, 7 (2), 231-244

Benna, U. G., & Garba, S. B. (Eds.). (2016). *Population growth and rapid urbanization in the developing world*. IGI Global.

Briscoe, J., Qamar, U., Contijoch, M., Amir, P., & Blackmore, D. (2005). *Pakistan's water economy: Running dry*. World Bank, Washington, DC, 3540.

Creswell, J. W. (2021). *A concise introduction to mixed methods research*. SAGE publications.

De Fraiture, C., Molden, D., & Wichelns, D. (2010). Investing in water for food, ecosystems, and livelihoods: An overview of the comprehensive assessment of water management in agriculture. *Agricultural Water Management*, *97*(4), 495-501.

Garg, S. K., & Choudhary, D. (2021). Emerging Challenges In Thar Desert With Climate Change. *International Journal of Pharmacology & Biological Sciences*, *15*.

Gleick, P. H., & Cooley, H. (2021). Freshwater scarcity. *Annual Review of Environment and Resources*, *46*(1), 319-348.

Hassan, M. (2016). Water Security in Pakistan: Issues and Challenges: United Nations Development Programme.

Iqbal, A. R. (2010). Water Shortage in Pakistan-A Crisis around the Corner. *ISSRA papers*, *2*(2), 1-13

Khan, R., Muzaffar, M., & Mustafa, M. (2022). Pakistan-India Water Conflict: A Causal Analysis, *Annals of Social Sciences and Perspective*, 3(1),43-51

Kumar, L., Deitch, M. J., Tunio, I. A., Kumar, A., Memon, S. A., Williams, L., ... & Basheer, S. (2022). Assessment of physicochemical parameters in groundwater quality of desert area (Tharparkar) of Pakistan. *Case Studies in Chemical and Environmental Engineering*, *6*, 100232.

Steduto, P., Faurès, J. M., Hoogeveen, J., Winpenny, J., & Burke, J. (2012). Coping with water scarcity: an action framework for agriculture and food security. *Rome: Food and Agriculture Organization of the United Nations*.

TORRES, C. A. Q. (2015). Drought in Tharparkar: From seasonal to forced migration. *State Environ. Migr*, *19*, 64.

Nairizi, S. (2017). Drought and Water Scarcity. *International Commission on Irrigation and Drainage: New Delhi, India*.

Pakistan, H, B. (2012). *Environmental and Social Impact* Assessment Thar Coal Block II Mining Project - Final Report

Khoso, S., Wagan, F. H., Tunio, A. H., & Ansari, A. A. (2015). An overview on emerging water scarcity in Pakistan, its causes, impacts and remedial measures. *Journal of Applied Engineering Science*, *13*(1).

Shaikh, M. A. (2003, April). Water scarcity in Tharparkar. In *Proceedings from Seventh International Water Technology Conference Cairo* (pp. 1-3).

Sharif, M., Jabbar, A., Niazi, M. A., & Mahr, A. B. (2016). Managing Water Availability and Requirements In Pakistan: Challenges And Way Forward. *Journal of Agricultural Research (03681157)*, *54*(1).

Siedlecki, S. L. (2020). Understanding descriptive research designs and methods. *Clinical Nurse Specialist*, *34*(1), 8-12.

Unfried, K., Kis-Katos, K., & Poser, T. (2022). Water scarcity and social conflict. *Journal of Environmental Economics and Management*, *113*, 102633.

UN Water. (2019). *Water Facts*. UN Water - Coordinating the UN's work on water and sanitation

White, C. (2012). Understanding water scarcity: Definitions and measurements. Global Water Forum. *Australian National University, Australia*.

Wolfe, S., & Brooks, D. B. (2003, May). Water scarcity: An alternative view and its implications for policy and capacity building. In *Natural Resources Forum* (Vol. 27, No. 2, pp. 99-107). Oxford, UK: Blackwell Publishing Ltd.