Scarcity of water resources in rural area of Quetta District; challenges and preparedness

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Abstract: This research was motivated by the statement appearing in the media and in the government reports that Quetta is going to run out of water in the near future. The study aims to explore the causes and impact of water scarcity from a socio-economic perspective. The study is based on both the primary and secondary data. The primary data is collected in the rural area of Quetta district from farmers through a well structure questionnaire, whereas secondary data is collected from the online accessible sources. The results indicate that water level has reached to an alarming level in the selected area, primarily due to a subsidy on electric tube wells, indiscriminate installation of tubewells, violation of tubewells spacing norms, growing of high delta crops, population growth, and poor drought management. This affects the people of the area in terms of decline in Kareze irrigation system, depletion of groundwater level, deteriorating health conditions, and uncalled migration from the area. Based on the results, the study recommends effective strategies for putting a restriction on the installation of new tube wells in the study area. Moreover, there is a need of instantaneous campaigns for educating farmers on the efficient use of water and awareness regarding conservation of water resources.
Keywords: water scarcity, enormity, perception, subsidy, efficient use of water.

1. Introduction

Water is one of the most indispensable of all natural resources, it is essential for a human being, economic development and biodiversity (Walter., *et al* 2011). Water is foundation of life and livelihoods, and is key to sustainable development (Guppy and Anderson, 2017). Water is becoming scarce globally, and water trade is taking an important place in water policy discussion (Lenzen., *et al* 2013). Water shortage is one of the most dangerous risks for society, changing hydro-climate and socio-economic conditions have aggravated water scarcity problem throughout the world (Veldkamp., *et al* 2015). Many countries have to face the challenge of rapidly growing of water demand, driven by an increasing population and economic growth, linked to urbanization, industrialization, and mechanization (King, 2004). Water scarcity is one of the most pervasive natural resource allocating problems faced by development planners. One-third of the developing world will face sever water shortage in the twenty-first century (Keller., *et al* 2000). The emergence of water scarcity recognizes that socio-economic, environmental and political factors can influence the occurrence shortage in the availability of ware relative to demand (Damkjaer and Taylor, 2017). Hence, water resources management seems to have become one of the important political, social, and economic issues of the present century and economists face new challenges of growing water demand and changing laws and institution (Louw, 2002). Shatanawi and Naber (2011) pointed out that demographic change like migration and urbanization have increased the demand for water. Social changes such as improvement

in lifestyle and rise in standards of living have influenced the perception of people and their attitude toward water. Changing in the global economy and the growth of international trade of goods and services has increased water scarcity. Similarly, Yin *et al* (2017) pointed out that increasing population growth and socio-economic development have put greater pressure on the water resources, and anticipated that climate and socio-economic change may further increase water scarcity in some countries of the world.

Pakistan has moved from water-stressed to water scarce country. Pakistan is facing unprecedented water shortage; owing to climate change and poor water management that has resulted in exploitation of water at a rate faster than it is replenished, directly contributing to the growing water scarcity crises (Khair., *et al* 2011). Balochistan province of Pakistan is the most water scarce province of the country. Land in Balochistan means nothing, whereas water is considered everything as it is a resource at a premium and it adds to the value of land from almost no value to a very high priced commodity in areas where ample groundwater or surface waters are available (Ahmad, 2006). Inefficient water use, wastage of surface water and indiscriminate abstraction of groundwater resources coupled with water scarcity have aggravated the current situation making management of water resources a really complex and a difficult task in the Balochistan province of Pakistan (GoB, 2006). Similarly, Khair *et al* (2014) pointed that in Balochistan the groundwater policies and governance arrangements have resulted in a massive decline in the groundwater table, the uncontrolled installation of tubewells, electric subsidy policy on agriculture tubewells and ineffective governance are key causes of groundwater decline in Balochistan.

Quetta, the provincial headquarter of Balochistan is located at an average elevation of l,680 m above mean sea level. It is surrounded by Chiltan, Murdar and Zarghoon Mountains. Quetta is facing many socio-economic problems due to its ever increasing population growth and the influx of Afghan refugees. Among other problems, scarcity of water in Quetta has always remained a problem and water supply position becomes acute during the period of low rainfall.

In Quetta district, the groundwater is the only source to fulfill the requirement for domestic, industrial and agriculture purpose. Forty years back the water supply was through karezes which have been dried up. The tubewells then installed for the supply of water and due to high population growth, the numbers of tubewells have been increasing each year. The indiscriminate installations of tubewells have abstracted a huge quantity of water round the clock. Due to these huge numbers of tubewells the rural area of Quetta district is facing a serious problem of water scarcity. The situation become further deteriorated to the mismanagement of water system and lack of coordination among the department supplying water to the study area of Quetta district.

Thus, this paper initially aims to examine the factors that are responsible for water scarcity in the rural areas of Quetta district. The study then explores the impact of water scarcity in the rural areas of Quetta District. Finally, the study suggests measures and techniques for controlling of water scarcity.

2. Material and methods

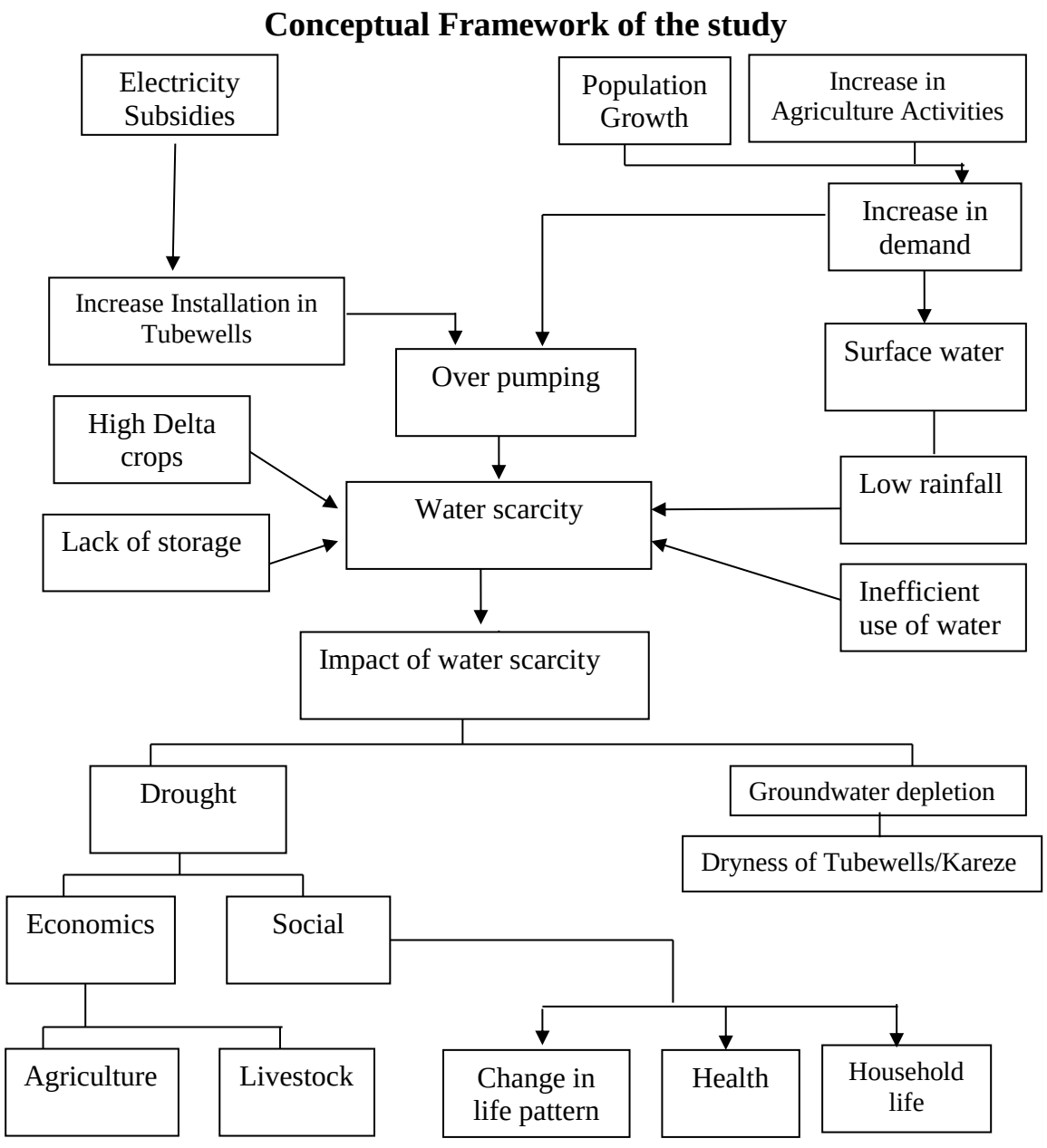
This section presents the research design to achieve the objectives of the research; it presents the conceptual framework of the study and provides information about the source of data, data collection instruments, sampling techniques, and methodology.

3. Questionnaire Designed

The questionnaire was developed and distributed among exports for their comments and suggestion. Following their feedback, the questionnaire was revised. Keeping in view the objectives of the study all the relevant information included in the questionnaire.

4. Data Collection

Primary and secondary data were used for this study. Primary data has been obtained through questionnaire, interviews and group discussion from the respondent (i.e. farmers). The farmers' community of the study area of Quetta District is taken as a target population. A sample of 55 farmers selected randomly from all the rural area of Quetta District. The sample size for the above-mentioned area is based on stratified random sampling method. Moreover, secondary data were collected from the relevant government departments which included Department of Agriculture Research and Extension, Irrigation and Power Department, Planning and Development Department, NGOs and other relevant departments.



5. Result and discussion

This section presents the survey results. The purpose of this section is to present the farmers' perception about the present water situation, factors causing of water scarcity and impact of water scarcity through graphs and charts in the study area of Quetta district. The details are given in the following sections.

5.1 Major Factors Causing of Water Scarcity in the Rural Area of Quetta District

Shortage and mismanagement of water have caused great problems to the community in the rural area of Quetta District. The following factors have emerged as of possible importance in explaining the water shortage in the study area of Quetta District.

5.1.1. Subsidy on electricity

The agriculture sector in Balochistan is getting a subsidy on electricity. It was decided that the farmer will pay a flat rate of Rs. 6,000 per month irrespective of consumption and the remaining amount will be shared by the Federal Government, Provincial Government and Water and Power Development Authority (WAPDA) with a ratio of 40, 30 and 30% respectively. The subsidy helped the farmers in the installation of deep tubewells or converting their deep diesel-operated tubewells to electricity. However, subsidy also resulted in lowering of water table and mining of the scarce groundwater resources. The indiscriminate and unplanned development of deep tubewells in the last two decades, with almost no control over their operation, has resulted in a rapid declining of groundwater table in the study area of Quetta District.

According to Ahmad (2005) subsidized electricity to agriculture tubewells encouraged farmers to use groundwater indiscriminately for increasing agriculture production. The tube well subsidy is perhaps the greatest impediment to efficient utilization of water resources and provides a huge disincentive to farmers to adopt more efficient methods of irrigation. During research study when the farmers asked about other reasons for groundwater depletion, the majority of farmer's responses were over-abstraction and increase in the number of tubewells in the area.

5.1.2. Uncontrolled Installation of Tube wells

The government-led electrification of many of the rural area of Quetta District has improved communication networks and generated promising returns for fruit and vegetables, and the tube well irrigation has gained remarkable growth. During research study, it was observed that farmers are installing additional tubewells to meet the requirement of rural agriculture sub-sectors. Anyone anywhere can install tubewells on his lands and any kind of company or individual can be hired for this purpose. This has resulted in adopting any kind of standards in site selection or technique of drilling, tubewells materials, design and testing. In a study, Ahmad (2006) pointed out that the unchecked installation of tubewells in large numbers, indiscriminate pumping of water and highly subsidized electricity were the main reasons for water scarcity in Balochistan.

During survey, it was fined that majority of the farmers having more than one tubewells in the study area of Quetta District. When the farmers were asked a question about the number of tubewells they are using for their irrigation purpose. The following responses were received from the farmers.

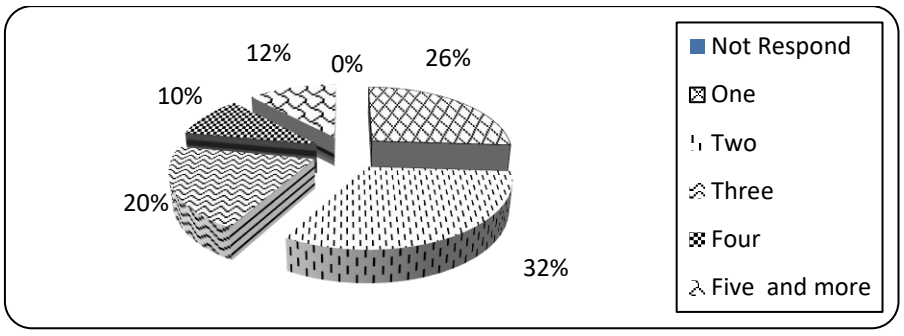


Figure 1. Percentage of Farmers Having Number of Tube wells

Figure 1 showed the responses of the farmers about the number of electric tubewells they are having. About 12% of the respondents were of the view that they have five and more tubewells, 10% mentioned four, and 20% said three, 32% pointed out two, and 26% replied only one. These results clearly show that majority of the farmers having more than one tubewells. This indiscrimination of tubewells is the major cause of over exploitation of groundwater in the rural area of Quetta District. During survey another important thing which was noted that in spite of large number installing of tubewells, the farmers using high Horse Power (HP) motors for running their tubewells. When the farmers were asked about the type of tubewells they were using for their irrigation purpose. The following were the response of the farmers:

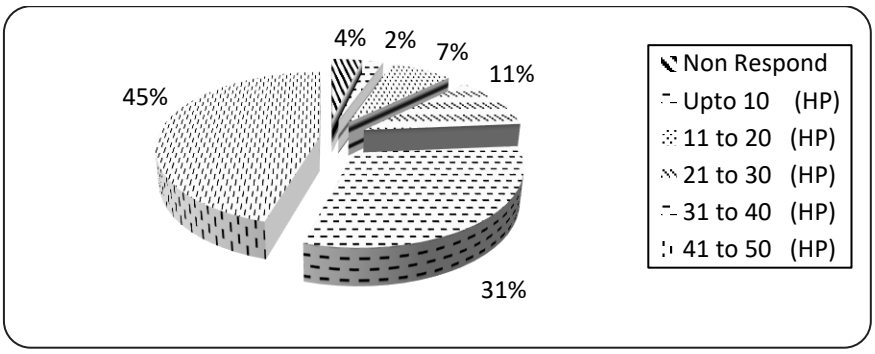


Figure 2. Percentages of Farmers Having Prime Mover Type of T/W

Figure 2 showed a majority of the farmers using high prime mover type of tubewells for irrigation of their fields. 45% of the farmers pointed that they using 41 to 50 HP prime mover types of tubewells. 31% mentioned that 31 to 40 % HP prime mover types of tubewells, 11% were having 21 to 30 HP. These results showed that 87% of the farmers were using the prime mover amongst 31 to 50 HP turned to be an important factor causing water scarcity in Quetta District.

5.1.3 Violation of Tubewells Spacing Norms

There exists a clause that guides regulators about the tubewell to tubewell spacing norms under the Balochistan Groundwater Administration Ordinance 1978 (Halcrow, 2007). Violations of these tubewell spacing norms were often observed during the survey, most of the farmers do not follow the minimum distance regulation between tubewells, which is 750 feet; therefore it also happens to be one of the major contributing factors to the alarming depletion of water table in the study area. During survey when the farmers were asked about the number of tubewells per 1000 square feet the following responses as per figure 3 received.

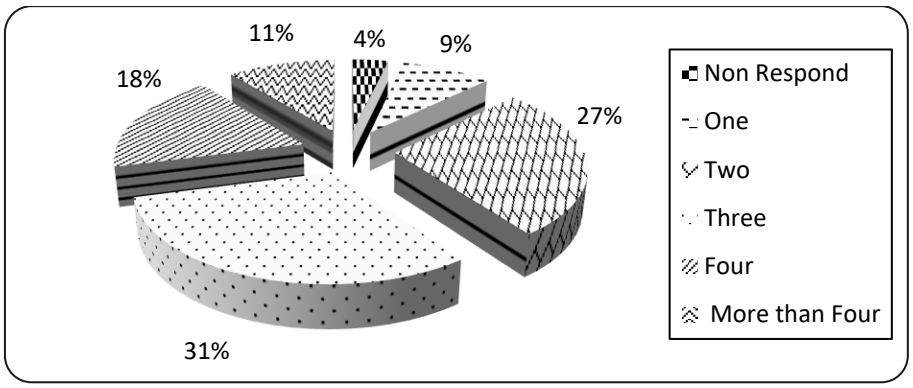


Figure 3. Percentage of T/W Installation within 1000 Square Feet

Figure 3 shows that 11% farmers replied that there are more than 4 tubewells within every 1000 square feet, 18% pointed out that 4, 31% respondent that 3, 27% mentioned that 2. This result clearly shows that the number of installation of the tubewells per 1000 square feet is very high. It has also been noted that no permission is required for the installation of tubewells, because of the lack of proper regularly system both from the federal and provincial government.

5.1.4 Growing of high Delta Crops

After the provision of subsidized electricity to the farmers, the area under high-value crops like apple cultivation steadily increased. It had also become the cash crop so the farmers had cultivated it more than other crops, and the income from apple orchard was more than the other crops. The water requirement of apple was more than other fruits like grapes, pomegranates, peaches, almonds, and plums, but climatically growing apple was not suitable in the area such as Quetta District that has altitude less than 1600m. it may be summed up that apple replaced the traditional crops like pomegranates, grapes plum, peaches and almond which are climatically suited and adapted to that area like Quetta District. Asharaf and Majeed (2006) conducted a study to analyze the water situation in Balochistan. The main finding of the study was that the water resources were scarce both for the domestic and agriculture purposes almost in all parts of the province. The reason for this water scarcity was the growth of high delta crops and lack of crops knowledge among the farmers which led to over irrigation of crops. Similarly, Choudhary *et al* (2008) conducted a comparative study of the cost of production and decision making analysis in case of onion and sunflower crops in Quetta district. This study concluded that water scarcity was the main problem in Balochistan, which caused high delta crops in the study area. During survey when the farmers were asked about the cropping pattern in the study area, the following response as figure 4 was received.

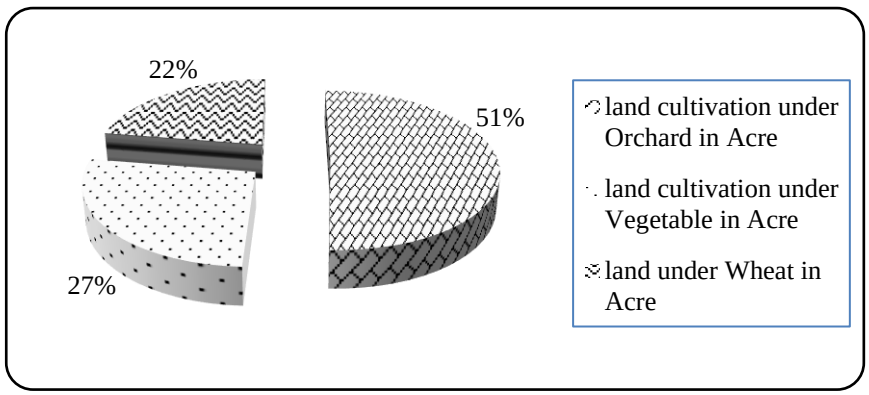


Figure 4. Cropping Patterns of the Farmers in Quetta District

Figure 4 shows the cropping pattern of the farmers in the area. It has been found that 51% of the area is used for orchards, 27% of the area is used for vegetables, and 22% area for wheat. The above figure shows that apples are the major crop in the study area of Quetta District. It is consuming more water than the other crops.

5.1.5 Influx and high Growth Rate of Population

The overall water supply and demand projection for Quetta district show that the water problem will be acute in the future as a result of a rapid increase of population growth. Shah *et al* (2002) pointed that although agriculture sector is highly depended on irrigation water; however overexploitation and overpopulation growth facing sever water shortage in upland of Balochistan. Quetta District will require more water for its population, which is increasing at a rate of 3 to 6 percent per year. The water supply capacity is limited and cannot meet the total demand. Poverty and lack of economic opportunities have pushed labor from the rural areas because of the lack of job opportunities, education, and healthcare facilities. During summer season this problem became acuter with the increase in population due to the influx of seasonal visitors from other parts of provinces of the country due to the harsher climatic condition.

5.1.6 Inefficient use of Irrigation Water

The irrigation system in the study area of Quetta District is inefficient due to poor maintenance of watercourses and channels and traditional methods of irrigation (mainly flooding). During the survey, it has been observed that most of the respondent did not have any information and education about the efficient use of water. In response to the adoption of high-efficiency irrigation system such as sprinkler and trickle, most of the farmers have no information about such irrigation system. Qureshi and Mujeeb (2004) observed that water was scarce in Balochistan because farmers failed to make efficient use of water and that they at times over irrigated crops due to their ignorance. In response to a question asked from farmers about information of high efficiency irrigation system, the following response as per figure 5 received

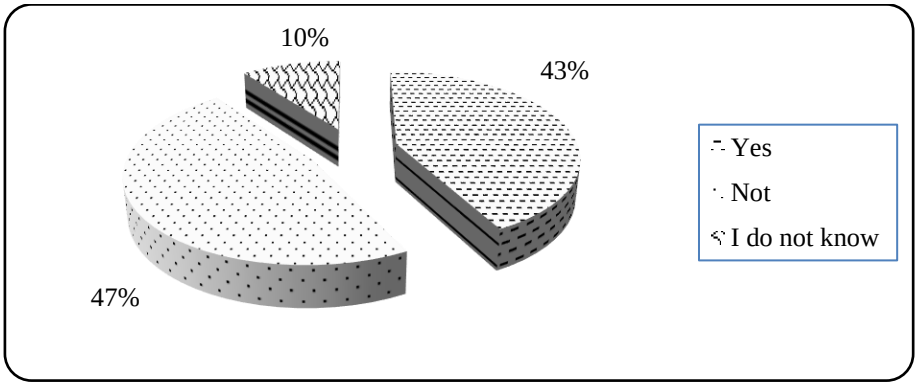


Figure 5. Farmers Perception about High-Efficiency Irrigation System.

Figure 5 shows the information about the farmers' perception of the use of the high efficiency irrigation system. 47% farmers responded that they think high-efficiency irrigation system put no impact on their on their output production. Whereas, 43% of the farmers stated that they have information about the usage of high-efficiency irrigation system and it can result in the increase of their output production. Hence the lack of awareness about the high-efficiency irrigation system was also one the major factors that caused water depletion in the area.

5.1.7. Poor Drought Management

There have been many droughts in the history of Balochistan resulting from erratic rainfall and diminishing precipitation in successive years. The drought of 1998-2006 exhibited a substantial loss of rainfall to a very low level. The average rainfall 50-60% below the average annual rainfall caused reduction of river flows as the recharge declined and the rate of decline of water table further accelerated; further worsened the situation. The impacts of drought were many folds; first it prompted the more abstraction from groundwater in the form of tube well installation as drought mitigation measures, secondly, the annual recharge to groundwater recharge almost touched zero levels. Halcrow, (2008) mentioned in a study Supporting Public Resource Management in Balochistan that in an alluvial aquifer of Quetta District; the decline of water table was around 18-24 meters per year. The production of fruits, crops, and vegetables fell by about one-third of total production.

5.1.8. Impact of Water Scarcity

From the discussion of the respondents, it was revealed that scarcity of the water has a great impact on the inhabitant of Quetta District. Followings are the impact of water scarcity on the people of the rural area of Quetta District.

5.1.9. Falling Water tables

Water scarcity affected the groundwater situation and water tables are falling at an alarming rate in the study area of Quetta District. According to Halcrow (2008), the decline of water table was around 18-24 feet per year in the alluvial aquifer of Quetta Valley. Similarly, Ahmad (2006) studied that the water table in the three main basins-Pishin Lora Basin (PLB), Nari River Basin (NRB), and Zhob River Basin (ZRB) of Balochistan are declining at the rate of more than four to five meters annually. The overall water table decline from 50-100 feet to 200-700 feet in a period of around 30 years is an excellent example of water mining. The falling water tables are not only increasing the cost of pumping but also causing the groundwater quality to deteriorate, and this is a major issue in the groundwater dependent area of Balochistan (Qureshi *et al*., 2008). During survey when the farmers were asked a question to know the rate of annual decline in the water table in the study area of Quetta District, the following responses have been received from all the farmers.

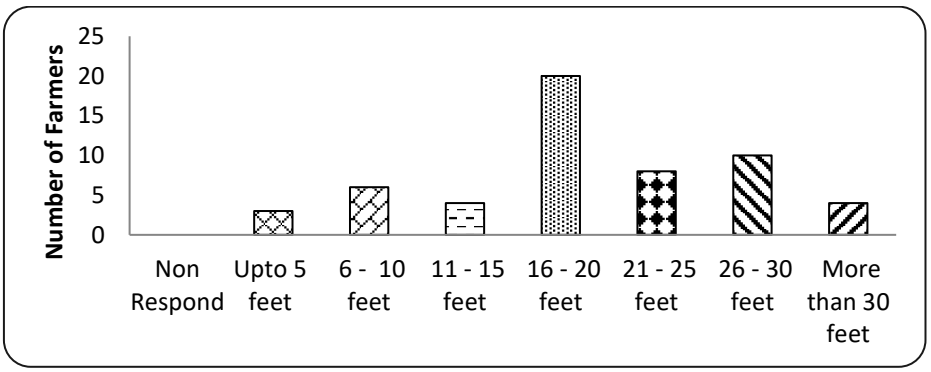


Figure 6. Farmers Perception about Depletion of Ground Water in Quetta District

Figure 6 shows the farmers response about the annual depletion of water table in the study area. It can be seen that majority of the farmers i.e., 20 out of 55 farmers mentioned that that water is declining at an annual rate of 16 to 20 feet per year. Similarly, 10 farmers pointed out that, water is declining at a rate of 26 to 30 feet annually, 8 farmers mentioned that 21 to 25 feet per year and 4 farmers stated that the rate of depletion is even greater than 30 feet annually. 6 farmers mentioned that the rate is 6 to 10 feet, 4 showed 11 to 15 feet and 3 stated 5 feet per year. Overall, out of 55 farmers

42 stated that the groundwater is depleting 25% annually which is a very high rate especially in an arid zone like Quetta.

5.1.10. Decline of Kareze Irrigation System

Kareze irrigation had been the ancient irrigation system prevailing in many districts of Balochistan for many centuries for drinking and irrigation purposes. It had been the main source of irrigation in Quetta, Pishin, Killa Abdullah, Mastung, Kalat and Ziarat districts of Balochistan. About 60% of the area used to be irrigated by kareze/springs in the Quetta and Pishin districts in 1904 with some381 karezes in the Mastung and Kalat districts, 123 in Zhob, 115 in Lorelai, 127 in Panjgure and 23 in Chaghi (Balochistan Gazetteer, 1906 quoted by IUCN, 2000). A survey conducted by the Irrigation and Power department during 1998-2000 revealed that the total number of karezes in the province were some 1,146 in the different districts of Balochistan. Karezes, despite having been the practice for centuries, have fallen prey to electrification and the subsequent mechanized groundwater development, and its decline is concomitant with the introduction of Persian wheels, dug wheels and later on deep tube wells. Mustafa and Qazi (2007) argued that the ecologically sustainable kareze system, which had been the locus of community life, has been under strain due to the excessive groundwater drawdown from electric and diesel tube wells.

Now the century's old system of kareze irrigation is so seriously endangered that it is near to complete collapse and there are only a small number of karezes that are still running. During survey when the farmers asked a question about the number of karezes/tubewells dried in the study area of Quetta District, the following response received from the farmers as per figure.

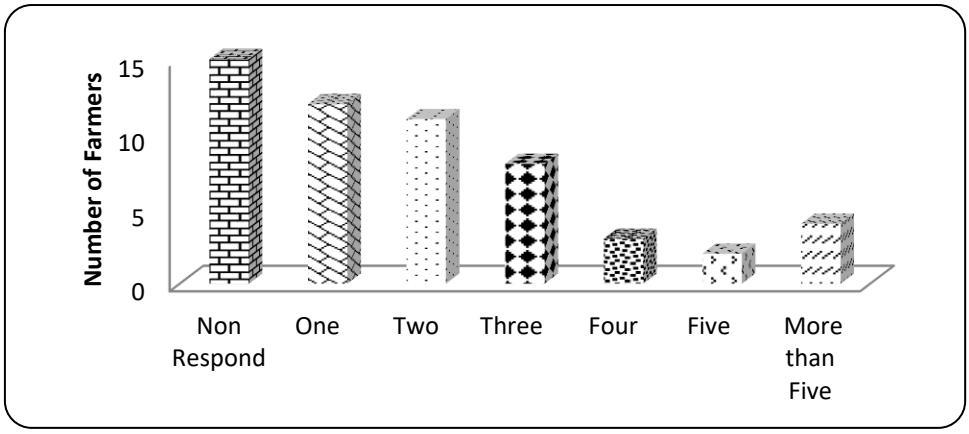


Figure 7. Farmers Perception about the Number of Tubewells/Karezes Dried.

Out of 55 farmers, 40 farmers replied that there tubewells/ karezes have been dried due to water scarcity in the area. 12 pointed one, 11 stated two, 8 showed three, 3 said four, 2 indicated five, and 4 farmers mentioned more than five tube wells/karezes have been dried out due to water scarcity. These results clearly show that water scarcity resulted in the drying of tube wells/ karezes in the study area of Quetta District.

5.1.11. Socio-economic Impact of Water Scarcity

Water scarcity had adversely affected the social and economic condition of the people of study area of Quetta District. Followings are the socio-economic impact of water scarcity, which are discussing below;

5.1.12. Migration of people

According to Ahmad *et al* (2004) that water scarcity has caused widespread migration of people. This has converted a large population of settle villagers into migrants termed as refugees. Similarly,

Nasurullah *et al* (2011) pointed out that water scarcity has a serious socio-economic effect on the population of Tehsil Karezat District Pishin. Majority of people are migrated from the tehsil to the urban centers to get job especially in government services and business in some households few members are left their homes in search of job, the farmers having their own land now working as daily wages in other farmers' fields. During survey as per information received from farmers that, around 30% population migrated from their villages to other area where water and agricultural satisfactory. The competition for local work added to the pressure on the job market and the relation between the local population and the migrants has led the situation of conflict in the area.

5.1.13. Impact on Health Situation

Water scarcity adversely affected human health in the study area. According to Ahmad et al (2006) that water scarcity causes for the poor state of human health. The most common health complains due to water scarcity related to diarrhea, vomiting, and fever among children. During survey information revealed from the farmers in group discussion indicates that spending on health has decreased approximately 50% as compared to the situation before water scarcity. As a guess, the farmers mentioned that they used to spend 20% of their income on health which declined to around 10% at present. The scarcity of water has resulted in the increase in communicable disease, especially waterborne disease and also in nutritional disorder in the study area.

5.1.14. Rise in Conflict

The water scarcity has caused a rise in conflicts among the farmers in the rural area of Quetta District. As everyone abstract groundwater they blame each other for the decreasing discharge capacity of their tube wells. Where ever anyone has to drill a new well it always causes a conflict and badly affected even the relationship of the near relatives there is also a stress and agony which affected the normal life of the society. Due to the over-exploitation of water and down the water table every year a considerable amount of money is being spent on digging deeper their tube wells each or every ultimate year. According to Ahmad (2006) that with the current rate of groundwater depletion, water shortage may cause serious inter-generational issues and inhabitant of different basins may have serious conflict among themselves due to water scarcity.

6. Conclusion and recommendation

The main finding of the study is that the water scarcity issues have been proved as recognized by the respondents as well as by the direct observation by the researcher. The reason for water scarcity is rising population growth, the growth of high delta crops, low rainfall and over-exploitation of groundwater. Similarly, it has also been noted that installation of new tubewells, violation of tubewells spacing norms and subsidy on electric tube wells were also found to be the key factors led to the water shortage of water in the study area of Quetta district. Moreover, the results also showed that most of the farmers were not aware of the modern high-efficiency irrigation system led to the mismanagement of water resources in the study area. Regarding the impact of water scarcity on the dwellers of the study area, this water shortage led to adversely affect the social and economic condition of farmers in the study area. Moreover, this water shortage also led to the migration of farmers from their native place, adversely affected the health of farmers and conflict among farmers rises due to water shortage. On the basis of above finding the followings suggestions are recommended for the solution of water scarcity problem in the rural area of Quetta District.

- The Government should ban on installation of new tubewells in the valley.
- The subsidized flat rate for electricity encourages wastage, charging electric supply for all kind of tube wells should be metered and the flat rate should be linked with high-efficiency irrigation system.

- Incentives should be given to the farmer by subsidizing mechanism, introducing of new high yield crop varieties and improving the irrigation efficiency coordination among the agencies governing the water resources
- The mass awareness campaign is made through electronic and print media for controlling waste of water in households is must and should be undertaken on an urgent basis.

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