



RESEARCH PAPER

Impact of Water Scarcity on Rice Production caused Scio-Economic Deprivation in Taluka Kamber, Pakistan

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ABSTRACT

The water scarcity impacting the agriculture productivity and caused socio-economic deprivation in developing countries including Pakistan. Mostly in rural areas, a majority of the households engage in primary economic activities for their livelihood, including agriculture and animal husbandry. This research is based on three objectives: to monitor the water scarcity and agriculture productivity from 2010 to 2021, to analyze the impact of water scarcity on agriculture productivity, and to find out the socio-economic impacts. The study was conducted in Taluka Kamber, to explore small farmer's perspective on water scarcity and its impacts on agriculture. During this research primary and secondary data were collected. The primary data was collected from the different localities of the research area in September and October 2022. Secondary data was collected from different sources like the irrigation Department, Bureau of statistics etc. The results show that the average water scarcity in Rice Canal was measured as 23.6%, and the average water scarcity in Ghar-Wah Canal was measured as 13.2%. Apart from this, 12% agricultural land has been converted to barren land and the production of agriculture is also reduced which has negative impacts on crops producers.

Keywords: Agriculture, Socio-Economic, Taluka Kamber, Water Scarcity

Introduction

Water scarcity is considered a threat to sustainable development around the world (Yohannes et al. 2017). It is estimated that, presently, 2.8 billion people are living in water-stressed areas and approximately half of the world population will face this issue by 2030 (Badawi 2019). The water scarcity can be attributed to climate change, coupled with improper governance and rapid growth in population. Pakistan, being a developing country, is prone to severe water crunch. Its rank is 14th among the 17 high water risk countries of the world. Over 80% of the total population in the country has been facing with severe water scarcity for at least one month of the year. Per person share in water is declining each year but demand for food productions is increasing (Afzal, et al. 2020; Maqbool, 2022).

In addition to surface water, groundwater resources are also severely overdrawn in Pakistan, mainly to supply water for irrigation, which resulted in serious concerns for future food insecurity (Khan, et al. 2022).

The Indus River Irrigation System is characterized by large inefficiencies at the canal, watercourse and field levels; only about 30% of water flowing through the system is delivered to farms. Farmers at the tail end of the system rarely get water (Parry et al., 2016).

Water scarcity has a significant impact on agriculture as it affects the availability of water for irrigation, a critical component of crop production. In regions with limited water

resources, farmers face the challenge of deciding which crops to grow, how much water to use, and when to irrigate. As a result, crop yields may be reduced, and some crops may become unviable (Hatibu e t, al. 2006). Water scarcity is also a significant problem for livestock and dairy farming. Animals require a reliable supply of clean water, and water scarcity can lead to dehydration, decreased milk production, and even death. In addition, water scarcity may also affect the quality of crops and livestock, as well as the availability of food for consumers (Theodora et, al, 2008). Taluka Kamber is part of this system which gets its irrigation water from Indus River through Ghar -Wah canal, a branch of Rice canal taken from River Indus at Sukkur Barrage. The required amount of water is not received in the Rice canal as well as in the subsequent canals. Thus due to inadequate water availability, agricultural practices are suffered from acute water shortage.

Literature Review

The global demand for food is increasing, with the passage of time, due to increasing demands of population. But in the light of Malthus's theory of Population, the physical area of the planet is not increasable to cultivate more crops (Odorico, et, al 2018). Water scarcity has a significant impact on agriculture globally, affecting food production and security. The agricultural sector is among the largest users of freshwater globally, accounting for 70% of water withdrawals (Anwar, 2016). The present fresh water resources are limited and cannot fulfill the global demand of conventional crops cultivation (Odorico, et, al 2018). Discrepancy between agriculture water availability and demand for cultivation, where agriculture water demand exceeds available water resources. Water shortage denotes a multi-dimensional social deficiency of humankind, water shortage may impact whole areas, it is the susceptible and growers that suffer the severe costs. This plays a vital role in the economic development of any country, especially in an agricultural country. So, water shortage in both terms, generally in perspectives of physical requirement and economic growth of a country (Angelo, et, al 2018).

Sindh Province has its own century-old world-famous irrigation system, the irrigation system of Sindh depends on 14 main canals originating from the Gudu, Sukkur, and Kotri barrages. Since the last decade, the Sukkur barrage is facing water shortage. In 2021, 21 to 26% water shortage were recorded at Sukkur Barrage (GoS 2021). But in November, 2022, 38 to 40% of water shortage was recorded at the Guddu and the Sukkur barrages (GoS 2021).

Study Area

District Kamber-Shahdadkot is located on the northwestern border of Sindh with Balochistan Province. The Geographical area of the district is 5475 square kilometers and according to the 2017 census, total population of the district was 1.33 million. More than 70% area is plain, but owing to high salinity only 48.5% area is under cultivation and the rest of 21.5% is laying barren. Around 30% of the land is covered by the Khirthar mountains range (Chandio, N.H 2009). Geographically District Kamber-Shahdadkot is located between longitude 27.34° 30, 94 72.36° 17, 92 North and latitude 67.58° 53.50 to 68.01° 39.39 East (Chandio, N. H., et, al, 2017). (Taluka Kamber covers an area of 970 Km² having a population size of 393,374 (GoP, 2017). The western border of Kamber Taluka is connected with the Khirthar Mountain range. A group of limestone hills and mountains known as the "Halar" range, but more commonly referred to as the Khirthar range, the length of this belt is 19 to 21 kilometers wide. The Khirthar Mountain covers 15% of the district and the rest 85% of the land is plain with several ponds and lakes. The well-known lakes include Lake Hamal, lake Saroh, lake Chagro, and Lake Drigh (Anwar & Chandio, (2012). The population of Taluka is 0.39 million (GoP 2017).

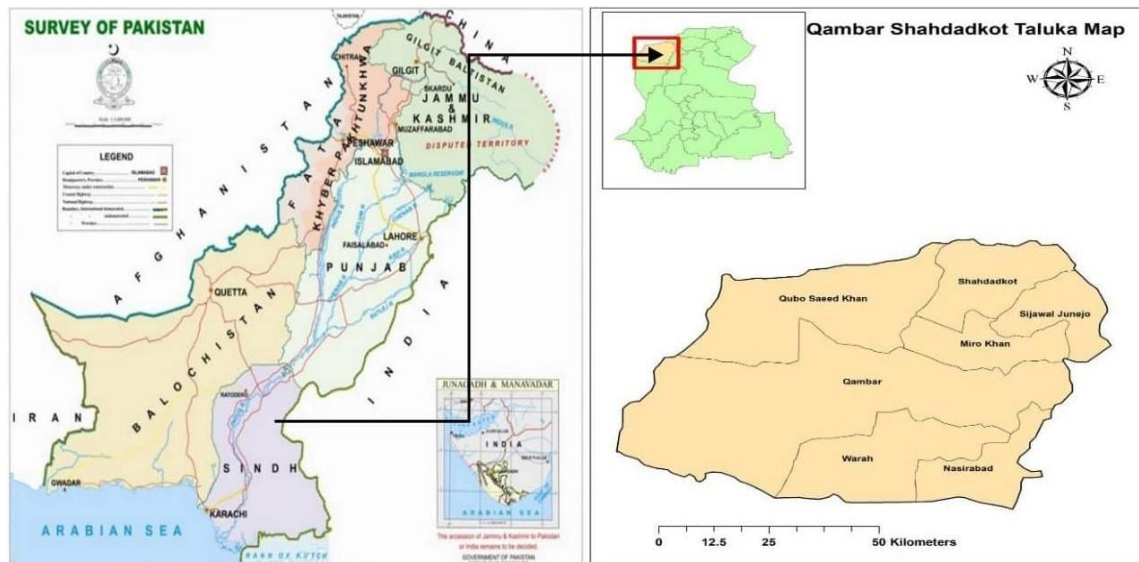


Fig.1. Geographical location of Study area in Pakistan

Material and Methods

Primary Data Collection:

In different visits, 162 interviews were conducted. Out of (162) interviews (150) were conducted with small growers while (12) interviews were held with big growers. All interviews were conducted with male growers because it was so difficult to conduct interviews with female growers due to cultural barriers. But, the woman also found to work in agricultural lands with their males. A questionnaire was prepared before the interview, and a dozen of questions were asked of farmers. All questions were relevant to water scarcity, agriculture productivity, and socioeconomic status. Almost growers were disappointed with this profession. But due to the non-availability of financial sources, they could not change their profession.

Secondary Data Collection

The Irrigation water data from Rice Canal, Ghar Canal, and Noor Wah canal was collected from for 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, and 2021 from the irrigation department Government of Sindh (GoS, 2021). A few pieces of data were collected from an online source of the Pakistan Bureau of Statistics, and a few data were also downloaded from the Agriculture Department, Government of Sindh, relevant to the District Kamber-Shahdadkot and Taluka Kamber.

The statistical tools were used to analyze the collected data and find the quality of the results. Descriptive statistics like frequency and percentage were obtained through MS Excel and SPSS for exploring and summarization of the data.

Results and Discussion

Water Scarcity in Rice Canal (2010 to 2021)

As the rice canal has been designed for 10658 cusecs of water, no required water was released in the Rice canal from 2010 to 2021. In two cropping years (2015 and 2018) water scarcity was more severe. These two years were very harmful for agricultural productivity, which caused socio-economic deprivation. In 2015 and 2018, an average, 31.60% less water was received to the rice canal. In 2010, 12.27% water scarcity was measured, which was the year of minimum water availability among the years of study period. Similarly, an average water scarcity in the last 12 years was recorded as 23.64%.

Table 1
Water Scarcity in Rice canal (2010-2021)

S. No	Year	Required water (cusecs)	Availability of water (cusecs)	Shortage (cusecs)	Shortage %
1	2010	10658	9350	1308	12.27
2	2011		7920	2738	25.68
3	2012		8040	2618	24.56
4	2013		9310	1348	12.64
5	2014		7950	2708	25.40
6	2015		7290	3368	31.60
7	2016		7870	2788	26.15
8	2017		8312	2346	22.01
9	2018		7290	3368	31.60
10	2019		7870	2788	26.15
11	2020		7625	3033	28.45
12	2021		8820	1838	17.24
Average		10658	8138	2521	23.64

Source: District Irrigation Department Kamber-Shahdadkot 2021

Water Scarcity in Ghar-Wah canal (2010 to 2021)

Water scarcity remained observed in the Ghar-wah Canal over the entire study period. The total capacity and the required amount of water 4150 cusecs, but, an average, only 3600 cusecs of water were released. An average 550 cusecs or 13.2%. Water scarcity was measured. A part from this, in 2014, water scarcity was measured as 20%, this ratio is high rest of the study period.

Table 2
Water scarcity in Ghar Wah canal (2010 to 2021)

S. No.	Year	Required water (cusecs)	Availability of water(cusecs)	Shortage (cusecs)	Shortage %
1	2010	4150	3780	370	08.9
2	2011		3540	610	14.6
3	2012		3650	500	12.0
4	2013		3780	370	08.9
5	2014		3310	840	20.2
6	2015		3450	700	16.8
7	2016		3560	590	14.2
8	2017		3740	410	09.8
9	2018		3350	800	19.2
10	2019		3500	650	15.6
11	2020		3750	400	09.6
12	2021		3790	360	08.6
Average		4150	3600	550	13.2

Source: District Irrigation Department Kamber-Shahdadkot 2021

Rice Production (2010-11 to 2020-21)

District Kamber Shahdadkot is the 3rd largest district of Sindh province, Rice Crop is being cultivated. Rice is the main source of income of the Taluka Kamber, and more than 80% of people are engaged with rice cultivation, and used as staple food. Since last decade's growers faced difficulties to cultivate rice crops. The impact of water scarcity direct impacting on rice cultivation.

During the questionnaire survey, majority of the respondents were satisfied to cultivate the rice crop in cropping year 2010. They sell-out rice/paddy in markets, and remained grains stored for food in their homes in cropping year 2010. On the contrary, in year 2021, growers were not satisfied to cultivate rice crop, due to water scarcity.

Table 3
Area under Rice production (2010-11 to 2020-21)

Year	Area(Hector)	Production (Metric tons)	Production Per hector (Metric tons)	Drop in Production per hector
2010-11	74,554	290,212	3.8926	00000
2011-12	79,092	271,313	3.4303	-0.4623
2012-13	85,278	280,130	3.2849	-0.6077
2013-14	80,991	295,750	3.6516	-0.241
2014-15	80,565	281,280	3.4913	-0.4013
2015-16	86,432	270,110	3.1251	-0.7675
2016-17	88,188	323,530	3.6686	-0.224
2017-18	84,854	292,394	3.4458	-0.4468
2018-19	83,922	266,020	3.1698	-0.7228
2019-20	91,579	299,950	3.2753	-0.6173
2020-21	87,361	305,110	3.4925	-0.4001
Average	83,892	288,709	3.45	-0.44

Source: District Irrigation Department Kamber-Shahdadkot 2021

Water Scarcity and Socio-Economic deprivation

Water scarcity is a burning issue of the research area, and directly impacts the socio-economic standard of common people. During the field survey, more than 64% farmers said that our agriculture land has been converted to barren land due to inadequate availability of water. More than 18% were of the view that part of agricultural land has been converted to barren land owing to insufficient investment in crop cultivation. More than 16.7% of respondents highlighted that agriculture productivity has been severely affected by water scarcity.

Table 4
Impacts of water scarcity on agricultural land (Respondents view) (2010_2021)

Value	Respondent	Percent
Agricultural land converted to barren land due to water scarcity.	105	64.8
Agricultural land converted to barren land due to lack of resources	30	18.5
Water deficiency has put adverse impacts on agricultural productions	27	16.7
Total	162	100.0

Annual income of households from agriculture

As per record of the Pakistan Bureau of Statistics, the annual income of households from agriculture was estimated to be around Rs. 2,031 billion in 2019-20. However, it is important to note that this figure may vary depending on several factors such as geographical location, crop yields, and other economic and social factors (P.S.YB, 2017).

During a survey for prices identification, I asked about the common commodities prices for 2010 and 2021. The price of a basket containing items of 10 kg oil, 8 kg sugar, 1.5 kg tea, 90 kg floor, 25 kg rice, 3 kg detergent powder in 2010 was Rs 8920 PKR. However,

the price of the same basket containing the aforementioned commodities in 2021 was Rs. 17520 PKR.

Table 5
Prices of a household common commodities for a month

S.No	Basket containing common food items	Prices 2010	Prices 2021
1	10 kg oil	3200	5500
2	8 kg sugar	320	620
3	1.5 kg tea	800	1500
4	90 kg flour	2800	6500
5	25 kg rice	1200	2200
6	3 kg detergent powder	600	1200
7	Total commodities (Basket)	8920	17520

For finding inflation this study used Consumer Price Index (CPI) which is represented with the help of the following formula

$$\text{CPI} = \text{Ct} / \text{Co} \times 100$$

Where

CPI = consumer price index

Ct = cost of the basket in 2021

Co = cost of market basket in 2010

The price of a basket in 2010 was Rs. 8920 PKR and in 2021 it was Rs. 17520.

By putting the prices in formula, i.e. $\text{CPI} = 17520/8920 \times 100$, we get $\text{CPI} = 196\%$,

So, it indicates 196% inflation rate between 2010 and 2021 which can be interpreted as those household earning 100,000 PKR in 2010 should have to earn 196,000. However, if a person earn less than that it means he is in loss in comparison to 2010. Rest of the calculations is presented in Table 6, which shows the change in socio-economic conditions of the household during 2010 and 2021.

Table 6
Annual income of households from agriculture (2010 and 2021)

S.No	Amount	2010		2021	
		Respondent	Percent	Respondent	Percent
1	No data	21	12.9	08	4.9
2	100,000	30	18.5	01	0.6
3	200,000	30	18.5	06	3.7
4	300,000	21	12.9	05	3.0
5	400,000	16	09.8	37	22.8
6	500,000	21	12.9	55	33.9
7	600,000	23	14.1	23	14.9
8	700,000	0	0	09	5.5
9	800,000	0	0	09	5.5
10	900,000	0	0	05	3.0
11	1,000,000	0	0	04	2.4
	Total	162	100.0	162	100.0

Findings

An average 23.6%, water scarcity in Rice Canal was measured which is continually affecting the agricultural productivity of Rice crops. Similarly, the average water scarcity in Ghar-Wah Canal was measured as 13.2%, this is cause to produce low productivity /grains, which creates the issues of law and order. Landlords illegally divert the irrigation water into their agricultural lands, which creates tribal conflicts.

The research shows that farmers saved foodgrains (wheat and rice) in their houses for a year and remained grains sold in the market, at present they sold all grains in the market and not saved for their live hood due to poor economic conditions.

Conclusions

The impact of water scarcity on agriculture in research areas has wide-ranging economic and social consequences. This did to a decline in economic activity in rural areas and an increase in migration to cities in search of employment and better living conditions. Conflicts over water resources can also occur as different groups compete for access to limited water supplies, as also mentioned in the finding. No new irrigation techniques are still introduced in the region, likewise water-saving techniques such as *drip irrigation, using drought-tolerant crops*, and improving *water management practices*. The construction of dam (water reservoirs) are the source to increase water availability and helps ensure a stable water supply for agricultural production, and water reservoirs may help the water table. The construction of water reservoirs is also suggested in the recommendations section of this study. It is also observed that farmers are facing the issue of different plant diseases, the cause of this issue is water shortage and aridity in agricultural lands.

Finally, the issue of water scarcity and its impacts on agriculture in the research area is requiring careful management and planning to mitigate its impact. This may include implementing more efficient irrigation systems, promoting sustainable agricultural practices, and increasing investment in water infrastructure and management. Ultimately, tackling water scarcity is critical not only to ensure food security and sustainable agriculture but also to promote economic development and social stability. However, with effective management and conservation practices, it is possible to reduce the impact of water scarcity on crop and livestock production, as recommended in the suggestion section of this research.

Recommendations

- The study area is a marginalized and remote area of Sindh province; the traditional agricultural practices are still prominent. It is suggested that, this is need of time to change agriculture Pattern.
- It is suggested that, introduce Low Water Requirement Crops (L.W.R.C) instead of traditional Rice pattern or introduce System of Rice Intensification (S.R.I) in the region.
- From the Eastern slope of the Khirthar Mountain range, a few dozen rivulets are running from the upland of the mountain in the rainy season, especially in the Monsoon season, the rivulets are the main source of water for agriculture, therefore, it is suggested that water reservoir (Dams) may construct at the slope of Khirthar to store the rainwater. This will increase the water availability and helps ensure a stable water supply for agricultural production.
- This is also suggested that introduce new techniques of irrigations, like *Drip Irrigation System*, (DIS) *Drought-Tolerant Crops*, (DTC) and *Water Management Practices* (WMP) in the research area.

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