

The Effects of Climate Change on Karez-Water and Agricultural Income: A Study of Small-Scale Farmer of Panjgur District, Balochistan

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Abstract

The study under hand analyzes the effects of climate change on Karez water, agricultural production and income. In this regard, the required information was collected from 100 farmers in Panjgur District of Balochistan in Pakistan and aimed at to acknowledge the small-scale farmers' production and income. However, the data was collected through household survey questionnaire, group discussions and key informant interviews. Through the Statistical Package for Social Sciences (SPSS), it analyzed the data by using the descriptive statistics such as frequency distributions and percentages. The findings of this study revealed that there were numerous climatic factors affecting farmers' productions. In addition, respondents informed that the major reason of less production in farm cultivation is rain scarcity caused (by irregular rain) that eventually the place has been turned into a barren patch of land with sands. Consequently, farmers switched to other sides for more income due to insufficient amount of Karez water to all farms in the vicinity. Indeed, in past, there were estimated more than 200 Karezes running in the district, nevertheless, recently few of them are running due to poor maintenance. The study found 90% farmers explained that lack of unsustainable dams and ponds reduced the underground water table. Besides, 99% farmers informed that dam is beneficial for maintaining ground water table which supports the farmers' livelihood. On the other hand, new technologies, inventions like allocated tube wells, electric motors, diesel engines and digging bores on individual grounds minimized Karez water level which is more expensive when compare to Karez water that need not fuel and other sources. As per farmers, they are unable to resolve their off-farm again and re-functionalize the traditional Karez water system for cultivation and

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change their socio-economic condition. It is, however, a priority for people to restore them as soon as possible.

Key Words: Panjgur, Karez water, Agriculture, Climate Change, Balochistan

Introduction

Climate change is one of the globally recognized challenges in the 21st century. It is briefly defined as increasing regular temperature, duration of the seasons, rainfall entailed with unanticipated floods and drought (Baig,2011). Climate change has intensively impacted agricultural productions beyond a certain high range of temperatures, warming tends to reduce yields and decreased grain in the process. And, higher temperatures also influenced natural water level, for example, green gas emissions (GHG) that highly impacted the earth's environment caused by continuous emissions of carbon mono oxide used in the factories and vehicles (Cline, 2008). However, these negative impacts changed the circumstances like sea level rise, irregular rain, droughts and floods (OPTA,2013). The current irrigation efficiency demonstrated low production of only 38% and was expected to increase gradually to 42% by 2030; that is lower than the projected developing world average of 50% in that year. Cultivated land under irrigation has projected to expand from the current 71 million ha (30 percent of the whole cultivated land) to 85 million ha (35 percent) in 2030. China only irrigated 51 million ha in 1995-1997 and was expected to bring another nine million ha under irrigation by 2030 (FAO,2000). The earth's temperature rose in the arid regions particularly in Northern Pakistan; in addition, many of farmers who struggled for rain-fed land and 47% farmers depended on agricultural farms for their living (Mohsin, 2011).

Similarly, extreme drought also influenced cultivated farms, number of trees, vegetables, reduced river flows and Kareze level (subterranean water channels) resulted highly impacted by climate change (US, 2016; Kiem,2014). Anciently, old traditional Karezes were found in 3000 years simultaneously in Afghanistan, Iran, Iraq, China and Arabic regions, in the north west of Balochistan, bordering with Afghanistan and Iran evident Qilla Abdullah, Pishin, Zhob, Chagi, Mustung, Kech and Panjgur districts (Nejad,2015). It was the most sustainable technology that operated very low cost for irrigation system as well as improved the socio-economic condition of small-scale farmers (Mafakheri,2015). Above all, the National Agriculture Research Council (NARC) focused on Balochistan to improve agricultural productivity on basis of sustainable knowledge, innovation, ideas and skills for farming community. In this program, 1000 farmers have been training from 23 districts of Balochistan working in many remote areas for providing solar systems to

farmers to increase production of vegetables on large scale in the country (PARC 2016). These efforts, nonetheless, increased the productions of small-scale farmers (Baloch 2016). The Karez system was usually a common property therefore, required social organizations, mechanism for effective management of the distribution of water, maintenance of the Karez; at times, the expansion of the Karez system, such social organizations required a common setup, norms and understanding. It also demanded an established public communication channel and required people to work together (Qazi, 2007).

Significantly, many government organizations, NGOs and researchers are supporting in the rehabilitation of abandoned karez system (Baloch,2017). According to Balochistan Conservation Strategy (BCS), Karez water channelization was usually constructed on a reciprocal basis. A Karez was owned by shares, each representing the amount of time on the availability of water for irrigation purposes. Characteristically, they provided 200 liters per second and served a maximum 200 shareholding families (Sheikh,2016). This was a reliable source of water supply given the climatic conditions of the province meanwhile, connected with economical method of tapping groundwater for irrigation, and above all, environmentally safe and powered by gravity (Ahemad, 2014). The principle keys for agricultural improvement were technologies and innovations to improve the agricultural production system (IFPRI,2014). Likely, (provide financial resources for climate plans that could implement solid actions in line) (AFD 2008). In the past 30 years, the Pakistani government and organizations had been installing electric motors, solar systems and diesel engines to modernize the agricultural sector to promote livelihood and poor farmers' incomes as modern means of irrigation. However, certain efforts continued at present time for the financial resources of farmers. Then again, it was the main cause of depletion of groundwater; indeed, Karez water levels were dropping down at alarming rates in Balochistan throughout its districts. A tube well is owned by an individual where two or three people are earning their bread from it. By contrast, Karez was communally owned and 500-1000 people were making their living means. With the dropping of the water table and with the introduction of every tube well, dozens of Karezes deprived of water as the water table shot highly down (Mustufa, 2014). Due to long droughts, some Karezes have ceased to flow in recent years. However, it is a priority for us to restore them as soon as possible (Baloch, 2017).

Selection of Study Area

There were estimated 3000 functional Karez channels once used in Balochistan (Shirazi,2007). Over a decade, extreme drought hit the agricultural production.

From 1990-2017, the climate change impacted irrigation system and reduced the most Karez channels. Only a few Karezes are functional with less water supply to the fields. Once there were some 200 Karezes functional and flowing with abundant water supply in the whole district of which only around 100 more or less are operational. Farmers had switched diesel engines on for watering their farms due to losses incurred by them in the past few years as rains were less frequent in the arid climate of the district. The subterranean water channels that provided water to farms, were a major source of subsistence pattern, nonetheless, this less water could never be ample to cultivate lands that reduced the source of income.

However, in Khudabadan - a union council in Panjgur - two Karezes were opted for a case study purpose, namely *Sufi Karez* & *Dal Abad Karez*. The prime rationale behind this selection was to know the climatic shift in the region. According to the local farmers, they face many challenges regarding their agricultural fields, such as dearth of rain, drilling wells, negligence of cleaning of Karezes, poor maintenance, lack and embezzlement of funds and lack of water reservoirs. Moreover, the farmers claimed that their incomes were insufficient to resolve and tackle these conundrums. The provincial government and other non-governmental organizations (NGOs) have been providing funds for the effects of climate change, water development, drought improvement, agricultural and livestock development in the region, nevertheless, these efforts were not utilized systematically for regaining the agricultural water of karezes despite the Karezes are the chief source of cultivation in this region (Baloch, 2017; Ahemad, 2007).

Research design and data analysis techniques

This researcher applied the descriptive research method aimed at to find climatic factors through SPSS. The researcher selected sample technique and sampling size at the case area. Here, I have randomly selected population, in addition, used as primary and secondary methods during the analysis period of the data. Thus, researcher collected 100 respondents from two Karezes, i.e. *Sufi Karez* & *Dal Abad Karez* based on Karez water, agricultural production and income of small-scale farmers. Furthermore, in this research, some related techniques were applied on agricultural departments, such as key informants' interviews, president district (*Zameendar*) action committee, focus group discussions and field observation, to name a few.

Results

Out of eight (8) factors included in the linear regression, the model depicted six (6) variables that influenced the agricultural income in the Panjgur district (Table 1).

- Results showed that where the “number of people working in farm” increased, the agricultural income significantly (54995.989) increased
- The findings showed that significant decrease in Karez volume of water due to climate change and poor maintenance has become a major cause for declining (-148.070) agricultural income and production.
- The results showed that both vegetable (1157.831) and date palm (1414.096) productions have increased in the study area. In this respect, the income of vegetable was better than Date palm. Similarly, number of rupees paid for the maintenance of Karez played an important role in improving the agricultural income. On the other hand, poor/insufficient income of farmers ‘significantly affected (-168412.115) the income.
- Farmers informed that 50% decreased in Karez water has been observed on decade consequently, 61% of land not cultivated in the study area so, the presence farmers cultivated production estimated 39% which may further reduce in low level. The results showed the engaged farmer’s annual income was estimated rupees 768,20/- with this less amount the farmer would not satisfy any more. The findings showed there was 62% poor maintenance in the study area such as practices, sustainable dams, rehabilitation of karez and allocation grants.

	Variables	Description	B	Std	Beta	T	Sig.
X1	Persons engaged on the farming	number	54995.989	15357.055	.282	3.581	.001
X2	Kariz water share	Hours	-176.162	705.456	-.026	-.250	.803
X3	Annual agricultural income	Scale	-148.070	53.115	-.401	-2.788	.006
X4	Income of vegetable	Scale	11570.831	2569.750	.405	4.503	.000
X5	Income of Palm trees	Scale	1414.096	618.521	.208	2.286	.025
X6	Affected Date trees percentage	Percentage	161.617	546.678	.026	.296	.768
X7	Community participation	Scale	105.916	52.242	.282	2.027	.046
X8	Water availability	1 if yes, 0 otherwise.	168412.115	41558.264	-.332	-4.052	.000

Table No. 1: Factors influenced the agricultural income (Courtesy: Field survey, 2016).

Discussion

Climate change is one of the globally recognized challenges in the 21st century. It has caused significant impacts on earth's temperature, sea level rise, irregular rain, droughts and floods water scarcity (OPTA, 2013).

Social factors influencing the agricultural production and income

The findings of this study showed that several factors influenced the agricultural production and income in the Panjgur District of Balochistan. For instance, as the number of people working at farm level increased, it has significantly helped in improving the agricultural income. Furthermore, an average two persons were engaged in agricultural activities from every household. The Findings reflected that yet most of the agriculture population adopted as their major source of the livelihood. Farmers informed that mostly Karez channels (wells) have been paved in the populated area. Where the people used water to irrigate their gardens to fulfill household necessities through dynamo illegally.

Community participation in terms of Karez cleaning, however, played a significant role for example farmers through their small groups planned and managed to clean Karez channels. Farmers could not clean the long Karez channels on their own. Furthermore, present study detected that 40% of famers participated in Karez cleaning. However, an over whelmingproportion (60%) of farmers had not participated in cleaning due to limited human resources. During the focused group discussion farmers informed that institutions have

not intervened the agriculture sector in general Karez. Despite, there was neither any government support nor any funds to rehabilitate the traditional Karez system. Farmers, nevertheless, claimed when Government paid for Karez cleaning, the less amount would not be enough cleaning for the long channels and land turned into off-farm. Farmers have turned their old traditional occupation when they could not see sustainable supports.

Community participation in terms of Karez maintenance by farmers or number of rupees paid for the akin purpose, played an important role. Nevertheless, tube wells, another extra pumping of ground water with no sustainable policy, rendered the subterranean water table highly below then expected ever.

Economic factors

The dependent farmers who had large scale of water shares for their vegetables and palm trees seemed better than those with less water shares. Water availability would increase the production. However, the local community collected an amount of PKRs 50,000 for the cleaning purpose of their water channels could not be sufficient in this regard. The community claimed that the local government allocated them a small amount for rehabilitation of Karez that could not clean the long-stretched subterranean water channel. Per farmer's annual agricultural income was estimated PKRs 20,000. This annually received insufficient income would not fulfill their daily necessities of life. However, the farmers are directly dependent upon karez water for their agricultural productivity; the farmers who receive 80% of the shared water could seem to be much better than others who receive merely 30% of the shared water. The respondents said that they would not purchase solar and dynamo on their farms due to the high cost. Consequently, the agricultural fields have dramatically been ignored; over 70% of farmers lost more than half of their expected income. Unfortunately, the reluctant sustainable policies drastically failed to stop farmers' diversification. In search of foods and shelters compelled farmers to go back to the town for other alternative jobs and subsistence patterns to meet their daily needs. Unfortunately, some of these have started illegal duties, such as oil and gas smuggling via Iran border to the district border of Panjgoor. It is, most of the times, risky and life losing as they are not professional at certain works. Furthermore, natural karez water was very popular for drinking and cultivation purposes, nonetheless, recent days, the flow of karez water would not be adequate to irrigate any field. In result, half of the cultivated lands turned into unfertile lands, and thus, farmers have sold more than 50% their productive lands in the very vicinity. This, of course, is a negative response on their sides.

Conclusion

The above findings showed that karez system of irrigation is quite imperative in these regions particularly in Balochistan where it is also a major source of drinking water. Over the past 10 years, the extreme drought affected the mother wells. Being based on the regular rains, Karezes need not any cleaning and rehabilitation every five years. Farmers informed that water volume has drastically undergone 50% below the actual water table in the district. Panjgur union council and agricultural director informed that water gravity force has reduced to dispatch water on the farms. Furthermore, they said sustainable dams and other water reservoirs are required to increase and maintain the ground water table. The present research manifested the discouragement of farmers and their shift towards other occupational activities. However, in Panjgur district a hundred thousand years old date palms cultivating seem to be perishing at a rapid pace. In most areas of the district like, Khudabadan town (SuppiAbdul Rehman and Dal AbadKarezes), were dried. It happened due to the extreme long-lasting drought since 2006. Eventually, many animals and houses are vanishing slowly and gradually with a major shift towards urban cities.

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