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Hill Torrents' Management and Social Relations of Farmers: A Study of Arid Land in Tehsil D.G. Khan

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Abstract

The present study explored the use of hill torrents' water among farmers and its effects on their social relations in catchment areas of hill torrents from Koh-e-Suleman in Tehsil Dera Ghazi Khan. The study found that hill torrents' water is the only source in often areas and it is stored by different methods to use for agriculture and livestock round the year. The water distribution mechanism promotes cooperation among farmers and helps them to form new relations with co-farmers at their neighboring land. It could also lead to competition and conflict among famers sometimes as water remains scarce. Further, government and non-government organization should cooperate local people through timely weather forecasts, building concrete diversions, bundhs, ponds and small dams to manage water of hill torrents.

Keywords: *Hill torrents management, catchment area, water distribution mechanism, social relations*

Introduction

The region's rugged terrain promotes rapid water runoff from hills and deep soil storage that provides ample moisture for crops during dry seasons (Mehrai et al., 2005a). A technology known as Rod Kohi irrigation (Hill Torrent-Spate) diverts run-off water from mountain springs and flash floods by building small dams (bunds), embankments and channels. It's employed to irrigate farmland in the valley. It offers water directly or indirectly through recharge of shallow aquifers for the local farming system, forestry, and rangelands as well as drinking water sources. Rods are the natural water channels that carry water down from hills (FAO, 2010). In the Punjab and Khyber Pakhtunkhwa regions, sprinkle irrigation is referred to as Rod Kohi, in Balochistan as Sailaba, and in Sindh and Punjab as "Nai" (Ahmed, 2001). It is a distinctive strategy of water management, especially in regions where flooding is caused by significant rainfall on mountains (Mehrai et al., 2005b).

A water distribution system (warabandi) that was institutionalised by the British administration prior to Pakistan's independence is implemented by Rod Kohi irrigation. Since that time, the Pakistani government has adhered to the same regulations governing shareholders' rights to hill torrent water. Farmers' irrigation rights are entered into a register designed for each rod kohi to maintain the warabandi system. These handwritten registers continue to be used as official records. However, the warabandi system has not been put into practise on the ground. There has been no government interference in the system the farmers have created for allocating water. The farmer who is upstream irrigates his land first and reserves as much water in his bund as he can, according to the current warabandi system. Farmers frequently overirrigate and waste water as a result of this practise. After the upstream farmer has met his water needs, he diverts water to the land of the following farmer. According to Ahmad and Choudhry (2005), the next farmers' rights determine how much water would be diverted to them.

The issue at the head is an excess of water, whereas the tail reaches only get water if the amount is more than the higher reaches. According to Ahmad (2001), some of the tail reaches get water just once every three years. Additionally, the farms upstream frequently violate the regulations while diverting water to the right. Instead, they divert water to their friends and family members, even though they do not have the legal authority to irrigate on that waterway. Powerful landowners typically carry out this activity (Ahmad and Choudhry, 2005).

The centuries-old system functions according to some shared rules. Upland and lowland systems are used to categorise geographical regions and resource locations. The upland system refers to the methods used to distribute torrential downpours of water on mountains, whilst the lowland system refers to the processes used in the valleys beneath the mountains. The operational rules of these two systems diverge somewhat from one another.

- The irrigation rights for lowland and upland are distinct for people. Further land is divided in “Haqooq lands” (land with an irrigation right) and “non-haqooq” lands (land without the right of irrigation).
- In lowland, transfer rights for water were related to land which were transferred with sale/purchase of land while in upland, transfer rights for water and land were different.
- Distribution of work assessed based on the number of oxen required for cultivating haqooq land or labour and financial contributions proportional to water haqooq in both lowland and upland.
- In both systems, the rule of head to tail is commonly employed with irrigation prioritizing head end. The irrigation turn in upland is selected by "lottery". Non-perennial systems often irrigate as much as they require, whereas perennial systems have defined time intervals.
- In lowland, each share holder is only allowed to irrigate a specific amount of haqooq lands. The land cannot be replaced with other land without irrigation rights and without the group's approval. While in upland, the land and water have separate transfer rights in revenue records. If the land starts to erode, one member may sell their water share so that other members who have recovered land or non-haqooq land in the system might buy this right.
- In upland, irrigation sequence is known to all community members and maimar while in lowland, where the tail end farmer can break the diversion structure at main water course if the head end farmer's water is travelling to non-haqooq lands or is being wasted.
- In lowland, if farmers and maimar are incapable of resolving an issue, Rod-kohi (spate) department assists to enforce the rules. For upland, the tribal elders who make up the Jirga mediate to resolve water distributions issues (Kamran and Shivakoti, 2013).

Research Objectives

This study focused on following objectives

1. To observe the methods used to store hill torrents' water by local farmers.
2. To explore the use and importance of hill torrents' water among farmers.
3. To examine how hill torrents' water management affects social relations of farmers.

Review of Literature

Bakhash (2004) conducted the first survey study at the Mithawan Hill Torrent area in D.G Khan. The findings demonstrated that farmers living in commanded areas of Rod Kohi are poor because of having lower crop yields compared with other areas mainly due to scarcity of water for drinking as well as for agriculture purposes. Despite its enormous potential, the system has been the most neglected and under developed irrigation system because of low investment, poor farmers, lack of improved water management practices, unpredictable, short duration high intensity rainfall and runoff, non existence of control structure, lack of integrated scientific study to improve the system.

Nawaz and Han (2008) described that Rod Kohi system of irrigation is the least known and the most unattended among the irrigation systems in Pakistan, and therefore, remains undeveloped. The major reasons include poor resources of Rod Kohi farmers, ignorance of farmers to advanced irrigation practices, and excessively high flows. Agriculture in these areas totally depends on hill torrent flows that are un-predictable in terms of timing and magnitude making scheduled irrigations impossible. Although, the production level of these areas cannot be brought at par with those in irrigated areas, however, it can certainly be increased if suitable cultivars, appropriate technologies of soil and water conservation, best suited to the agro-climatic conditions, are evolved and developed for adoption by the farmers.

Ahmad and Steenbergen (2010) concluded that developing spate irrigation will both considerably improve national food security and improve livelihoods in some of the poorest and unsettled areas in the country. Pakistan has the largest area of any country globally under this resource management system. Spate irrigation in Pakistan has a large potential but is also largely unknown and not well understood. In the system, water from short duration flash floods is diverted to irrigate land and fill drinking water ponds, water rangelands and forest ranges.

FAO (2010) reported that Spate irrigation is an ancient practice by which floodwater is diverted from its river bed and channelled to basins where it is used to irrigate crops and feed drinking-water ponds, serve forest and grazing land and recharge local aquifers. It has evolved over the centuries and provided rural populations in arid and semi-arid regions with an ingenious way to cope with the aridity of their climate. It is thought that spate irrigation started in present day Yemen, where it has been practised for around five thousand years. Today, spate irrigation covers more than 3 million hectares across the world. Although its extent is relatively minor compared to other types of irrigation, it represents a unique option for the management of scarce water resources in support of agricultural production and rural livelihoods in many arid regions.

UNDP (2010) reported that Rod Kohi is a system of irrigation in which run-off water from flash floods and mountain springs is diverted by constructing small dams (bunds), embankments, and channels and is used for irrigating fields located in the foot hill plains. It provides water for local farming system, forestry, and rangelands, as well as drinking water supplies—either directly or through re-charge of shallow aquifers. Currently, the major part of hill-torrent water (about 50 %) goes wasted because of insufficient hill torrent management facilities. Proper management of hill torrents can significantly enhance agricultural production and ensure food security in Pakistan.

Research Methodology

The study was done in Tehsil Dera Ghazi Khan's dry regions, which periodically see hill floods from the Koh-e-Suleman range. Tehsil Dera Ghazi Khan has four significant hill torrents, which are as follows:

1. Suri Lund 2. Vidore 3. Sakhi Sarwar 4. Mithawan

The study's population included all farmers who were impacted by these hill torrents and who depended on hill torrents' water for domestic and agricultural purposes. The researchers employed quota sampling. According to the catchment area of hill torrents, the population was divided into four categories, and sixty five respondents were chosen from each category. Thus present study's sample size was (65x4=260). The importance of hill torrents' water, its storage methods and consequences of hill torrents on the respondents' social relationships were explored during interviews with the respondents using structured and semi-structured questions. Through pre-testing with forty respondents, the research tool's validity and reliability were examined.

Two questions were added, two questions were rephrased, and one question's response category was altered after the pre-testing. Chi-square and percentage analyses of the data were performed.

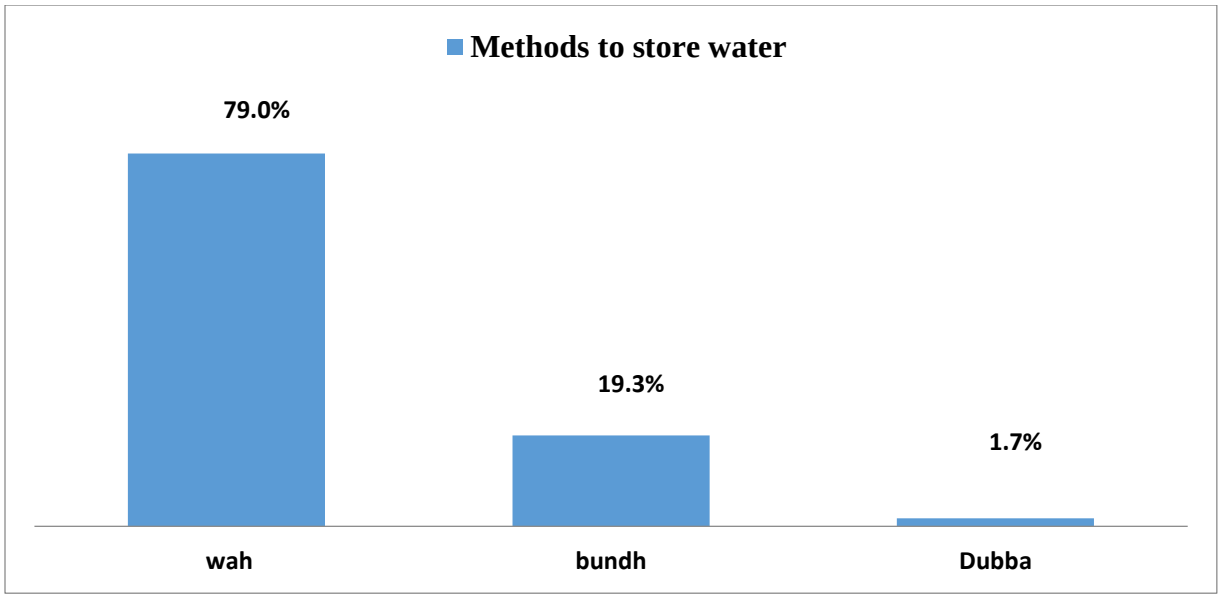
Results and Discussion

The majority of respondents were over forty years old, and their annual income was less than ten thousand rupees, the statistics showed. Due to the erratic supply of water in these places, agriculture was not a consistent source of revenue for the younger generations. This stopped individuals from investing in agriculture and growing cash crops. Additionally, the majority of respondents had only received an elementary level of education or were illiterate. The most common type of family unit was the joint or extended family, which included the couple's children as well as some of the spouses' close relatives, such as parents and siblings. Most people did not own huge amounts of property because water was not always available and the water table was very low.

Because of this, the majority of the land in this region remained uncultivated. Millet (Bajra), pakmillet (Jawar), chickpeas, and barley were the most widely grown crops in the region because they needed the least amount of water. The livestock of farmers had a significant impact on their socioeconomic status. Livestock was frequently employed as a source of income in rural areas, particularly in arid regions where crop water availability was frequently unpredictable. As a result, the population of arid regions depends mostly on livestock. The hill torrents used to occur more frequently than twice each year. In other words, if there is a big downpour on the mountains, water gushes down and moves towards the valley. By constructing buildings called Gandh, this water is turned into water channels known as Wah.

The water route is then redirected to Bundh, an area with elevated borders where additional water can be stored. In Bundh, water is kept in storage for a longer period of time in order to preserve moisture for succeeding harvests. The place where the water joins the Bundh is referred to as Moonh. It is made to be easily filled with water by gravity and is typically on the side that is higher up. Water is naturally stored in the downlands of Dubba, creating a water pond. These traditional techniques were used by the native population to store the water from highland torrents, as shown in figure 1.

Figure 1



The results show that majority of respondents i.e. 79.0 percent used the method of Wah to store water, and 19.3 percent of respondents used the method called Bundh while only 1.7 percent of respondents stated that water is stored in ponds called Dubba. Wah and Bundh are actually the different names of the same mechanism used in this area. The variation in names is because of different areas.

As already discussed the hill torrent water is stored through different methods for future use. This stored water is then used for agriculture, livestock and domestic use. The major usage of this water is agriculture and livestock because in most of the areas, this is the only source of water. The results in figure 2 shows that majority of the respondents i.e. 68.0 percent said that the water is used for agriculture and livestock, 17.0 percent of respondents said that the water is used for domestic and agricultural purposes, and 10.0 percent of respondents said that the water is used for all purposes including agriculture, livestock and domestic while only 5.0 percent of respondents said that water is used for livestock and domestic purposes.

In the study area, the hill torrents are the only source of water because the water table is very low and there are no streams or lakes. So the people of the area are fully dependent on hill torrent water agriculture, domestic and livestock use. Most of the water is used for agricultural purposes because it requires much amount of water while some amount of water is also used for domestic and livestock purposes.

Figure 2

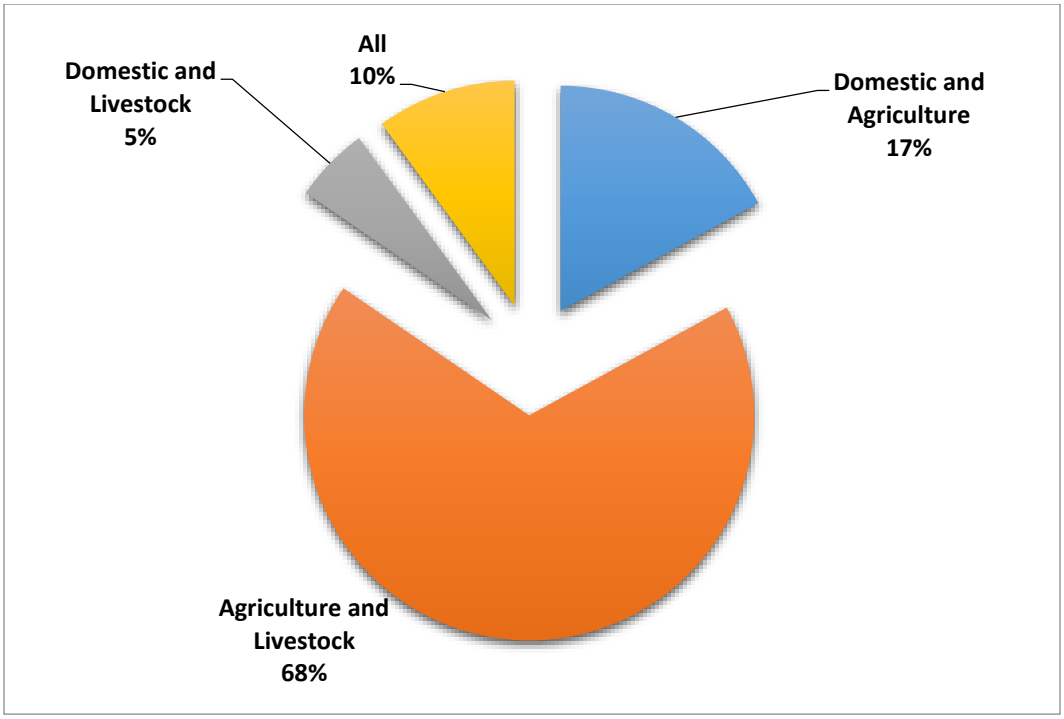
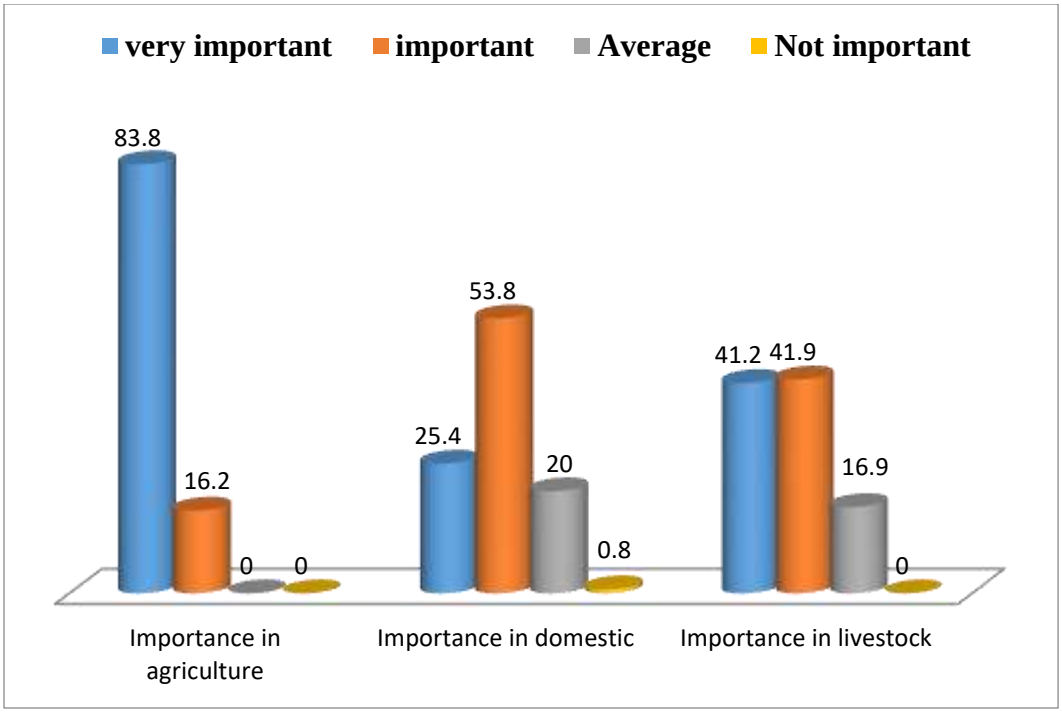


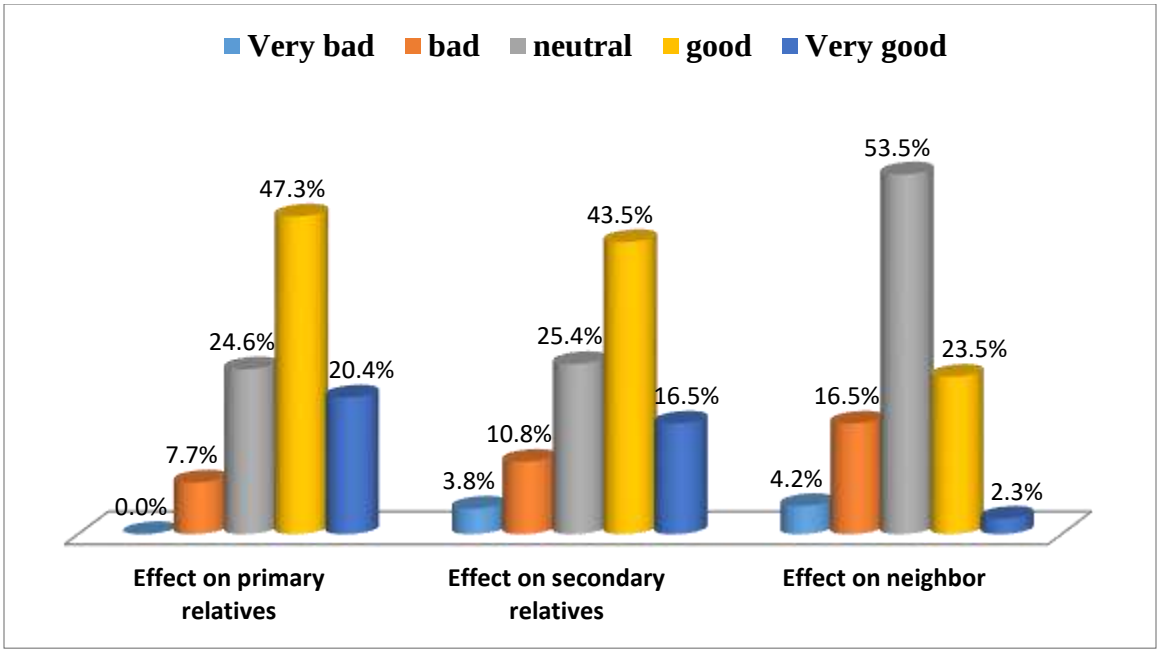
Figure 3



The results in figure 3 presents that majority of the respondents i.e. 83.8 percent said that hill torrent water was very important for their agriculture, and 16.2 percent of respondents said that hill torrent water was important while none of the respondents selected the options of average or not important. For domestic use, 53.8 percent of respondents said that hill torrent water was important, 25.4 percent of respondents stated that it was very important, and 20.0 percent of respondents reported the importance to average level while only 0.8 percent of respondents that hill torrent water were not an important source for domestic use. For livestock use, 41.9 percent of respondents said that hill torrent water was important, 41.2 percent of respondents said that it was very important, and 16.9 percent of respondents reported the importance to average level, while none of the respondents said that the water was not important for their livestock use. All the respondents said that for agriculture use hill torrent water was either important or very important, for domestic use 79.2 percent of respondents said that hill torrent water was either important or very important while for livestock use 83.1 percent of respondents accepted the importance of hill torrent water. So hill torrents are an important source of water in these areas for different purposes.

The effects of water distribution mechanism in hill torrent irrigation on social relations of farmers may take many forms such as relations with primary relatives (blood relatives such as parents, siblings and children), secondary relatives (primary relatives of primary relatives such as grandparents, in-laws, aunts, uncles, cousins, nephew and nieces) and relations with neighbors (banna Sharik). The effects on these relations may be good and positive or bad and negative. The results showed that majority of the respondents accepted that the water distribution mechanism in hill torrent irrigation affects the social relations of farmers. The social relations are divided in primary relatives, secondary relatives and the neighbors. To measure and estimate these effects a scale was designed having five categories of very bad, bad, neutral, good and very good. The categories of very bad and bad measure the negative effects while the categories of very good and good measure the positive effects. The negative effects means that hill torrent irrigation causes competition and conflict between the farmers while positive effects means that due to hill torrent irrigation, the cooperation and coordination among farmers has been increased.

Figure 4



The figure 4.16 is about the distribution of 254 respondents who said that water distribution mechanism in hill torrent irrigation affects their social relations among various categories such as effects on primary relatives, secondary relatives and neighbors. In order to discuss the effects on primary relatives, the results show that 47.3 percent of respondents said that hill torrent irrigation had good effects, 24.6 percent of respondents said that effects were neither good nor bad instead they were neutral, 20.4 percent of respondents said that effects were very good, and 7.7 percent of respondents stated that effects were bad while none of the respondents said that the effects were very bad. These results depict that 67.7 percent of respondents said that the effects of hill torrent irrigation on primary relations of farmers were positive either good or very good while only 7.7 percent of respondents said that they were negative or bad.

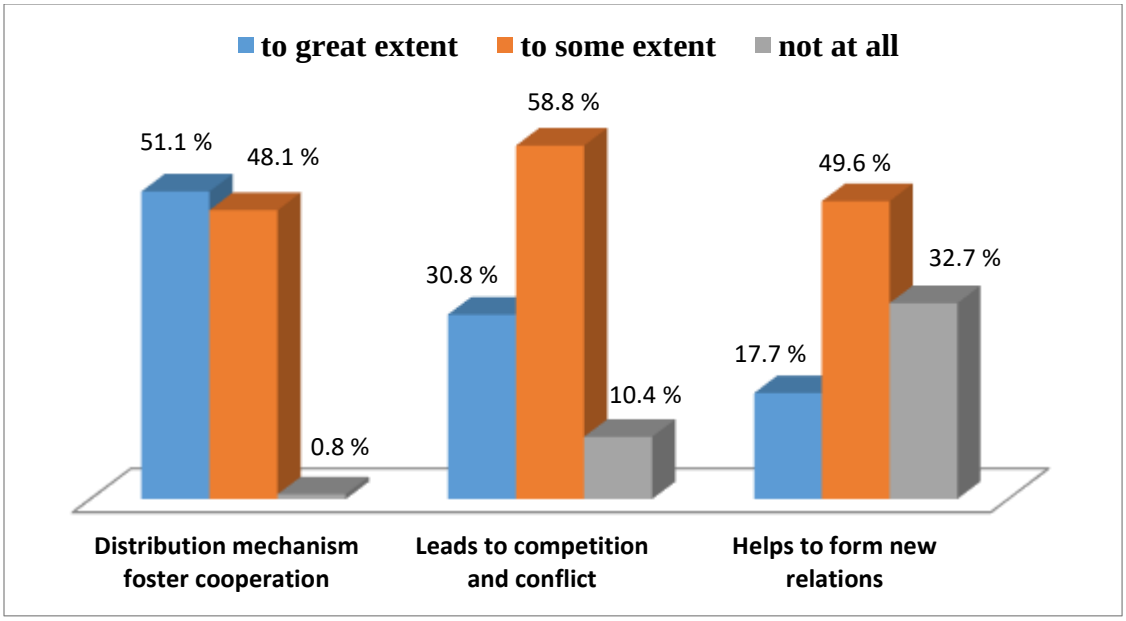
The second indicator to measure the effects of hill torrent irrigation on social relations was to measure the effects on secondary relatives. The figure shows that 43.5 percent of respondents said that the effects were good, 25.4 percent of respondents said that the effects were neutral, 16.5 percent of respondents stated that the effects on secondary relatives were very good, and 10.8 percent of respondents said that effects were bad while only 3.8 percent of respondents said that the effects were very bad. This shows that 60.0 percent of respondents said that the effects

were positive either good or very good while only 14.6 percent of respondents said the effects of hill torrent irrigation on secondary relatives were negative either bad or very bad.

The third criterion was to measure the effects of hill torrent irrigation on neighbors (banna sharik). The results show that majority of the respondents i.e. 53.5 percent said that the effects on neighbors were neither good nor bad instead they were neutral, 23.5 percent of respondents said that the effects were good, 16.5 percent of respondents said that the effects were bad, and 4.2 percent of respondents stated that effects were very bad while only 2.3 percent of respondents said that the effects were very good. This shows that 25.8 percent of respondents said that the effects of hill torrent irrigation on their relations with neighbors were positive either good or very good and 20.7 percent said that the effects were negative either bad or very bad while majority of the respondents said that there were no effects. This could help to assume that the implementation of rules is very good that is why the farmer's relations with their neighbors (banna sharik) are not affected.

Once determined that water distribution mechanism in hill torrent irrigation affects the social relations of farmers, the next important factor is to measure the extent of these effects. In this context, three indicators were devised including the cooperation that represents the positive effects, conflict the represents the negative effects and forming new social relations. The neighbors (banna sharik) on fields are mostly the primary or secondary relatives of the farmers so the effects could be to great extent either positive or negative.

Figure 5



The results in figure 5 is regarding the extent to which the water distribution mechanism in hill torrent irrigation affects the social relations of farmers. The first indicator in this context was to measure the extent to which water distribution mechanism helps to foster cooperation among farmers. The results show that majority of the respondents i.e. 51.1 percent said that water distribution mechanism fosters cooperation among farmers to great extent, and 48.1 percent of respondents said that cooperation is fostered to some extent while only 0.8 percent of respondents said that it did not fosters cooperation at all. This shows that 99.2 percent of respondents said that the water distribution mechanism in hill torrent irrigation fosters cooperation among farmers either to great extent or to some extent because this is the collective operation and the farmers require the cooperation and help of each other in this operation.

The second criterion was to measure the extent to which the water distribution mechanism leads towards competition and conflict among farmers. The results depict that majority of the respondents i.e. 58.8 percent stated that this mechanism causes conflict to some extent, and 30.8 percent of respondents claimed that conflict is caused to great extent, while only 10.4 percent of respondents said that the water distribution mechanism in hill torrent irrigation did not lead toward conflict at all. It could be concluded from these results that 89.6 percent of respondents accepted that water distribution mechanism leads towards conflict among farmers either to great extent or to some extent.

The third and last indictor in this regard was to measure the extent to which water distribution mechanism helps to form the new relations with co-farmers. The results describe that 49.6 percent of respondents said that new relations were formed to some extent, and the 32.7 percent of respondents stated that water distribution mechanism did not help to form new relations at all, while only 17.7 percent of respondents claimed that new relations were formed to great extent. This shows that 67.3 percent of respondents accepted that the water distribution mechanism in hill torrent irrigation helps to form new relations with co-farmers either to great extent or to some extent.

To see the association between hill torrent management social relations of farmers, the researcher applied chi-square test.

Table 1
Association between hill torrent management and cooperation among farmers

Methods to store water	distribution mechanism foster cooperation			Total
	to great extent	to some extent	not at all	
Wah	101	88	2	191
Bundh	14	33	0	47
Dubba	5	0	0	5
Don't Store	13	4	0	17
Total	133	125	2	260

Chi-Square Value = 18.975 Degree of freedom = 6

Level of significance = 0.05 Significant

Gamma Value = 0.03

Table 2
Association between hill torrent management and social relations

Store water	Helps to form new relations			Total
	to great extent	to some extent	not at all	
Yes	46	116	81	243
No	0	13	4	17
Total	46	129	85	260

Chi-Square Value = 6.32 Degree of freedom = 2

Level of significance = 0.05 Significant

Gamma Value = 0.08

Table 1 describes the association between hill torrent management and its effects on cooperation among farmers. The independent variable was hill torrent management and dependent variable was cooperation among farmers. The chi-square value shows that relationship is significant. The gamma value is positive which depicts that relationship is direct. This means greater the hill torrent management, greater will be the cooperation among farmers. So the alternate hypothesis is accepted and null hypothesis is rejected.

Table 2 describes the association between hill torrent management and its effects on forming new social relations with farmers. The independent variable was hill torrent management and dependent variable was forming new social relations with farmers. The chi-square value shows

that relationship is significant. The gamma value is positive which depicts that relationship is direct. This means greater the hill torrent management, greater will be the number of new social relations with farmers. So the alternate hypothesis is accepted and null hypothesis is rejected.

Conclusion

Mostly people did not have large landholdings because the water was not available round the year and water table was also very low. Most commonly used methods to store hill torrents' water were Wah (water channels) and Bandh (field with raised borders), which are actually the different names of the same mechanism used in study area. The variation in names is because of different areas. The major usage of this stored water is in agriculture and livestock because in most of the areas, this is the only source of water. So hill torrents are an important source of water in these areas. Majority of the respondents accepted that the water distribution mechanism in hill torrent irrigation affects the social relations of farmers. The social relations are divided in primary relatives, secondary relatives and the neighbors. Majority of respondents reported positive relations with primary relatives and secondary relatives. Further, neighbors (banna sharik) on fields were mostly the primary or secondary relatives of the farmers so the effects could be to great extent either positive or negative. The water distribution mechanism in hill torrent irrigation fosters cooperation among farmers because this is the collective operation and the farmers require the cooperation and help of each other in this operation. But sometimes it also leads towards conflict among farmers. Majority of respondents also accepted that the water storage of hill torrents also helps to form new relations with co-farmers.

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