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Impacts of Drain Water on Soils and Crops and it Causes: A Case Study of Kamber Taluka, Pakistan

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Abstract: Taluka Kamber has been facing natural calamities-turned disasters due to its geographical location. The area is under constant threat of the surface drainage effluent coming from Balochistan Plateaus and local drains. The highly soil contaminated water from different drains has devastating impacts on the natural lakes and agricultural lands of the region. The natural flow routes of the flood water have been interrupted at many places which have increased the impact and frequency of the floods in the area. The investigated area is very famous for the paddy and wheat production in the country, but average production of both crops in the area is reducing. Growers dependent on the cultivation of wheat crop on the land degraded by the Hairdrin Drain as well as on rain fed agriculture on the uplands of Kachho also have been facing difficult situation. Interestingly, since 1998-1999 not only the Rabi Minor command lands were submerged in Hairdrin Drain but there has been drastic reduction in the rainfall in Kachho resulting in the failure of crops in the area. The salinity is affecting the area of Kachho. The situation has become dismal to the extent that last year, the wheat crop yield was not even 200 kgs per acre (494 kgs per hectare). As a result, the growers were not even able to recover the expenditure incurred on the inputs. The study shows that a solution of the problem is possible for the development of the agriculture in the study area.

Keywords: Drain Water, Soils, Crops, District Kamber, Shahdad kot, Pakistan

1. INTRODUCTION

Like other areas of Sindh, there are two cropping seasons i.e Rabi and Kharif. Wheat is the principal crop of Rabi season; local communities' wheat in the command area of Rabi Minor. If grew water resources are in abundance, the local communities grew wheat. At the western area of the region, where canal water is not available, local peasants are the using water of Right Bank Out Drain Canal for the wheat crops, as groundwater of the focus area is not useful for cultivation. Paddy is a key crop of Kharif season, which local communities cultivated in the Eastern side of the region. The area considered being irregular topography, 15% area is under western mountains 75% area is considered as an agricultural and other remaining 10% area is considered as foothills of mountain (Katchoo) (Chandio 2009). All crops of the region are under crises due to these natural calamities.

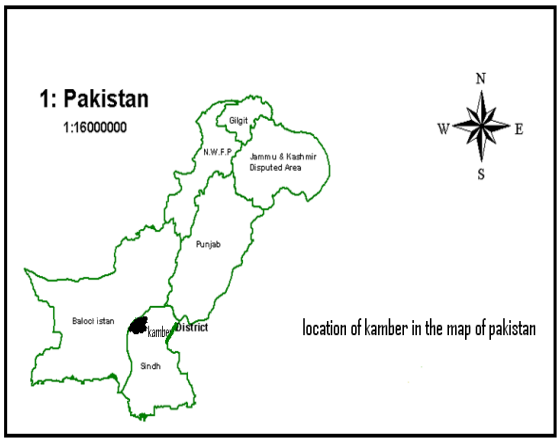


Fig. 1: Pakistan: Location of Kamber

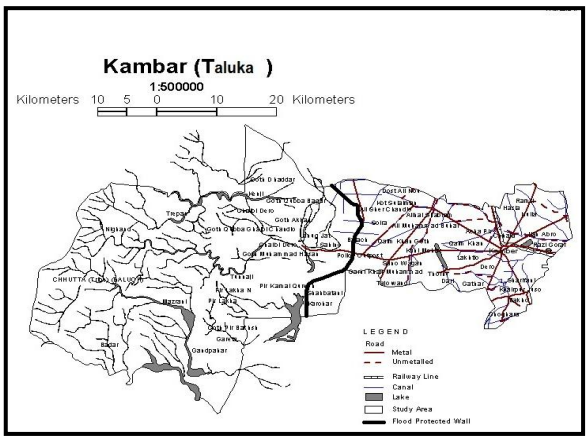


Fig. 2:Taluka Kamber: Physiography

The other minor crops *i.e.* sesame, maize and sorghum are cultivated here. Bumper agriculture crops were cultivated by the local communities in the past. The production from both key crops i.e wheat and rice was high to the extent that the Government and private sector trader used to open markets to purchase the grains during wheat and paddy crop harvesting season. The area was famous for providing a livelihood to not

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only the local communities but also to the people migrating from other remote areas of Sindh and Baluchistan. In year 1997 – 98, it was the first time they saw the drainage effluent Hairdin Drain of Baluchistan flowing on their fertile lands. (Pirbhat 2010)

The degradation of their lands continued as with each passing year the quantum of drainage effluent increased and degraded more lands. It clearly means that about 15,000 acres (6070 hectares) of land on which mainly wheat crop was cultivated has become degraded since 1998 and nothing is being cultivated on this land. Thousands of local families (80% to 100%) depending upon the agriculture on those lands have been deprived of agriculture since the last nine years or more. Unfortunately, the local communities have been facing double-edged sword of disasters during the last two years. On other hand their land, the western side of Flood Protective Bund (FPB) was completely *submerged in the Hairdin Drain* effluent. Now result is that yield per acre of wheat crop was recorded as 600 – 800 kgs per acre (1483-1977 kgs per hectare) before *Hairdin drain* disaster which has now reduced to the level of 300 kgs per acre (741 kgs per hectare). This reduction has occurred despite the fact that the proportion of seed and fertilizer inputs per acre has been increased with the passage of time. Similarly, the yield per acre of another main crop of the area *i.e.* paddy was 1200 kg per acre (2965 kgs per hectares) which has now reduced to only 800 kg per acre (1977 kgs per hectare) (NDS 2010).

Deprived of the land which the grower of the area used for wheat cultivation, some of the growers adopted a unique method of livelihood survival. They started to fetch drainage effluent of Hairdin Drain to the uplands of Kachho through the tube wells. It was unique experience as those lands were previously cultivated through rains and floods of Khirthar Mountain range. During the initial sessions the experience seemed good as the growers found some alternative livelihoods. However, the experienced started taking its toll as due to the use of saline water. The uplands of Kachho started being affected by salinity. The situation has become dismal to the extent that last year, where wheat crop was not even able to produce even 200 kg per acre (494 kgs per hectare). As a result the growers were not even able to recover the expenditure incurred on the inputs. Therefore, from this year many growers stopped growing crops on the uplands by using saline irrigation water. This practice has also largely degraded the upland Kachho lands and salinity levels have alarmingly increased in those lands. The flush floods from *MULA* and *BOLAN* rivers completely devastated the existing flood protection network on the right side of River Indus. Right Bank Outfall Drain (R.B.O.D) breached at several Points and added in the misery of communities. The floods also exposed the susceptibility of existing flood protection and drainage network apart from many precious lives. The devastation spread over 382.09 acres (i.e 154.62 hectares) of land resulted in 1,226 affected villages, 48,308 acres (i.e 19550 hectares) damaged crops. (Pibhat, 2010)

Main causes of salts accumulation in the soil:

Geographical location of Pakistan is arid and semi-Arid climatic belts. At these belts high evapo-transpiration of water is chief cause of salt accumulation. An average temperature of Pakistan in summer season is about 40^0C but maximum temperature is more than 50^0C on Indus plain in May and June. On the contrary, an average temperature in winter season is 5^0C, but -10^0C temperatures recorded at Northern Mountains in December. Weather map of Pakistan, showing the isohyets, reveals rain between the 100 mm to 700 mm. The deficient rainfall favoring high rate of evaporation and groundwater may reduce and shallow groundwater depth, enhances the movement of salts towards soil surface. (Alam *et al.,* 2000). Salinity is the cancer for the fertile soil, about a lakh acres area affecting by this disease in a year in Pakistan (Chandio 2009). But in some areas, inappropriate irrigation system and use of drain water is also main cause of salt accumulation, which is very harmful for crops. Growers are not awarded to change the commodity at the level of salinity present in their agricultural lands. According to a survey, about 120 million tons of salts are added to the land in canal water and brackish underground water (Munns 2002). This is an interesting that only 1/5 of these salts are able to reach in Arabian Sea.

Principal Crops

Kharif Crops:

Rice is the staple crop of the district. It is cultivated on extensive plain area of the Kamber Taluka. Irri 6, Irri 8 and Sugdasi varieties of rice are cultivated in the taluka. On the contrary, in western side of the Taluka, *Juwar* is one of the main crops. White and red verities of *Juwa*r are cultivated here. *Bajra* and sesame are also cultivated on rare patches near foot hills of Khirthar Mountain.

Rabi Crops

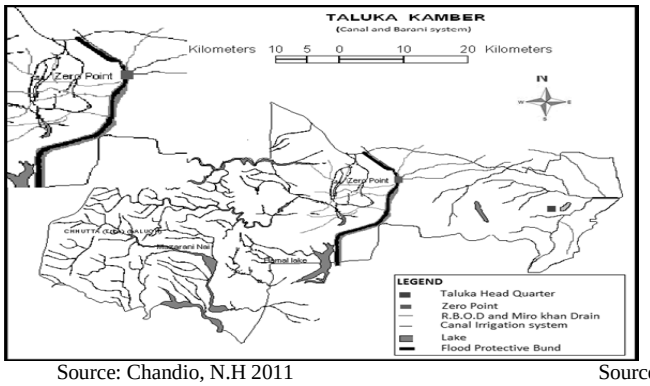
Wheat, Grams and local peas are cultivated here, but wheat is grown in every part of the Taluka, which have been submerged by the spill of all canal (Sailabi) or on lands which have been given a flooding towards the end of the stream. The chief varieties of wheat like, TD1, Saher, Inqlab and Bosi are cultivated at the study area.

Vegetables: The indigenous vegetables are also cultivated in the Taluka; commonly local farmers are using tube wells and wells for the cultivation of vegetables. Potatoes, ladyfingers, and water millions are famous crops of this season. (Gazetteer of Larkana 2003)

Irrigation System of the region

Canal Irrigation System

For the development of agriculture, an extensive network of the canals irrigation since the Kalhora period is still active. All small canals originated from the Ghar Wah, Noor Wah, Noorag Wah, Hasula branch, Koor branch, Khan Wah, and Sheikh Wah are main canals. But unfortunately, all canals end near the Flood Protective Bund (FPB). A part from the seasonal canals, other three drain canals are also flowing; all these are drain canals, i,e Right Bank Outfall Drain[111] (R.B.O.D[111]), Miro Khan drain and Shahdadkot drain. All these drain canals meet at Zero Point. At the Zero point, Shahdadkot drain merges in the Miro Khan drain. Remaining two braches R.B.O.D[111] and Miro Khan drain move along with the FPB.



Source: Chandio, N.H 2011

Fig. 3 Irrigation system of Taluka Kamber



Source: Chandio, N.H 2011

Fig. 4 Laboratory process of Soils filtration

Drain irrigation system

Farmers are using water of drains by small water courses dinged from the Miro khan drain and R.B.O.D[111] towards Kachho. This is a main cause of salinity in the region. The original sources of these salts are the exposed rocks and minerals of the earth curst. Irrigation water is also an important source of salts. The concentration of salts in river waters in Pakistan is generally low.

2. MATERIALS AND METHODS

For the laboratory analysis purpose Soils and Water samples were collected from the 40 different locations of the Taluka, (34 samples of soils and 6 samples of water). Soils samples were collected from 34 different locations of the study area (soils samples were ranged from 0-15, cm depth and packed in plastic bags, then those samples were air dried. Thirty grams of filtered soil mixed in150 ml of distaked water in conical flasks. All samples were kept on the Mechanical Shaker in Conical Flasks for 30 minutes only. After the shaking process, (**Table 1)** all the elements dissolved in water. We used filter paper for pure filtration of soil analysis, and then we checked the pH, E.C and TDS of the soil. pH was measured by pH meter (Hanna instruments HI 8014), Electrical Conductivity (E.C) calculated by E.C tester (Hanna instruments HI 98304) and Total Dissolved Salts (TDS) were calculated by the TDS tester (Hanna instruments HI 98301) at Soil and Water testing laboratories department of Botany, Shah Abdul Latif University (SALU) Khairpur, Sindh.

Similarly, the water samples were collected from the 06 different sites of the region in purified plastic bottles. (Chandio 2010). All water samples were analysis at District Soil and Water Testing Laboratory, Sukkur at Rohri under the supervision of Assistant Agriculture Chemist.

Table 1: Showing the water analyzed data of R.B.O.D111 and Miro khan Drain

S. No	Date of collection	Time	pH	E. C (ds/m)	TDS (PPM)
1	24.12.2009	13.40	8.00	.1	291
2	24.12.2009	14.45	7.9	.6	381
3	24.12.2009	15.20	7.9	.1	170
4	24.12.2009	15.40	7.9	.6	486
5	25:122009	09:00	8.00	.3	266
6	25:12:2009	10:30	7.7	.2	372

*T.S.S = Total Soluble Salts. 700 PMM = 1st Class. 700 to 1000 = 2nd Class 1000 to 1200 = 3rd class. 1200 PMM unfit

Table No. 2: Showing the Soil analyzed data of Taluka Kamber

S. No.	latitudes	Longitudes	Ele.Ft)	pH	E.C	TDS
1	27º 35' 19.58 "	67º 57' 33.58 "	164	7.8	1.00	180
2	27º 35' 22.65"	67º 53' 32.65"	154	7.9	90	230
3	27º 34' 56.24"	67º 53' 07.79"	152	8.1	1.90	280
4	27º 35' 19.19"	67º 52' 34.64"	148	7.9	2.10	320
5	27º 34' 52.81"	67º 50' 43.65"	151	7.6	1.80	290
6	27º 35' 07.61"	67º 50' 30.21"	152	7.9	1.60	270
7	27º 37' 54.37"	67º 49' 59.95"	156	8.2	2.5	430
8	27º 34' 48.17"	67º 45' 65.32"	145	7.5	2.30	340
9	27º 35' 28.69"	67º 38' 14.36"	153	7.2	3.32	577

10	27º 35' 56.87"	67º 38' 32.15"	152	7.1	2.84	550
11	27º 35' 13.02"	67º 38' 10.69"	154	7.0	4.9	650
12	27º 33' 17.18"	67º 37' 0.56"	153	7.2	3.91	780
13	27º 37' 36.55"	67º 38' 7.32"	152	7.7	3.62	612
14	27º 38' 32.43"	67º 38' 2.24"	150	7.9	3.42	567
24	27º 39' 26.47"	67º 37' 2.28"	158	7.8	2.71	713
15	27º 29' 51.76"	67º 36' 5.01"	170	7.5	3.43	445
16	27º 38' 49.04"	67º 33' 9.66"	190	7.9	2.84	627
17	27º 37' 56.86"	67º 36' 2.44"	163	7.8	3.72	540
18	27º 37' 25.91"	67º 35' 5.64"	164	7.6	4.08	546
19	27º 35' 11.85"	67º 36' 9.68"	158	8.0	3.1	627
20	27º 36' 11.17"	67º 36' 5.47"	161	7.9	2.8	543

3. RESULTS AND DISCUSSION

The objectives of this research were to investigate the long-term positive effects of irrigation by leaching process from Warah canal, on pH, E.C and TDS of the soil. The investigation was carried out by comparison of pH, EC, and TDS of leached soil and drain water of the study area. Soil samples were taken from selected plot. It is observed from the data presented in the table No.1, 2 and 3 that soils of the surveyed area are high concentrated.

Result of sample 1 (0- 15 cm depth)

Sample 1	pH	EC **(ds/m)**	TDS (PPM)
Before leaching	8.2	2.5	430
Applied Canal water	7.3	0.6	180
After leaching Result	7.6	1.7	310

Result of sample 2 (15-30 cm depth)

Sample 2	pH	EC **(ds/m)**	TDS (PPM)
Before leaching	8.0	2.3	390
Applied Canal water	7.3	0.6	180
After leaching (Result)	7.5	1.3	310

Result of sample 3 (30-45 cm depth)

Sample 3	pH	EC **(ds/m)**	TDS (PPM)
Before leaching	7.8	2.0	240
Applied Canal water	7.3	0.6	180
After leaching (Result)	7.6	1.2	210

4. CONCLUSION/SUGGESTIONS

According to research point of views, the farmer should implement the given suggestions for the betterment and treatment of given saline land.

1: leaching process by Warah Canal:

Soil can be improved by the leaching process by FAO standard water quality. For this purpose; water of the Warah canal is one of the easiest methods for leaching in the region. In this process, extra water added in soil affected area for removal of the salts. When water is leached through soil, a surface depth of 6 inches of water for every foot of plant root will leach out 50 percent of the salt. One foot of water for every foot of root zone leaches out 80 percent of the salt. Two feet of water per foot root zone leaches out 90 per cent of the salt. But on the contrary, in the research area, the canal irrigation water is not present for leaching process. But an easy solution is that an irrigation canal (Warah Canal) is just 10km away from Flood Protective Bund (FPB). If, local and provincial government take a series step for the development of the region, that they can extend the Warah Canal up to FPB for leaching process and irrigation development in the region.

2: Water Reserves Dam: (Mazarani Dam)

Geographically, an area of region is uneven topography, western side is covered by Khirthar Mountain range and its sub hill ranges. Area support the Dam and Dam will save the rainwater coming from the uplands of mountains. Irrigation system of Kamber can be divided into two parts, Canal irrigation and another is Barani Irrigation system. Canal irrigation supports the irrigation at the Eastern side of FPB and Barani covers the area between the foothills of Khirthar Mountain and FPB. Therefore, suitable location of the Dam is an upper side of Mazarani Nai. This is the Largest Nai in the region, Mazarani Nai fills the Hamal Lake, (in Kamber and Warah Taluka) then Manchher Lake in Dadu district. Apart from the Mazarani Nai, about ten other Nais are available. Their water is mostly wasted in Arabian Sea through the Hamal Lake, Manchher Lake and Indus River. By the construction of Mazarani Dam, the water table will rise and quality of groundwater will change also. Economically, region will be developed.

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