Sindh Univ. Res. Jour. (Sci. Ser.) Vol. 41 (1) 47-54 (2009)

Sindh Univ. Res. Jour.

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FLUCTUATION OF GROUND WATER, ITS CAUSES AND IMPACTS ON SOIL AND AGRICULTURE IN KAMBER, SINDH, PAKISTAN

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(Received 08th February 2009 and Revised 12th May 2009)

Abstract

An area of the Kamber taluka is 2260sq. kilometers situated at the foothills of khirthar Mountain range, the highest peak of khirthar mountain is kuti ji kabar (dog's grave) situated in Kamber taluka. Total human population of the region is 268934 persons, in which 210565 persons inhabit in rural area and remaining 58369 persons are living in urban area. Kamber is located between latitudes 27.9^0 north and longitude 72.5^o. The region is distributed by uneven topography, like plain and mountainous. Water table of the region is not same everywhere in whole region. Administratively Kamber can be divided into four circles, twenty Tapas, sixty-nine Dehes. More than 78% area of the region is able for cultivation, in which only 48.5% area is under cultivation.

Keywords: *Fluctuation, Ground water, Causes, Impacts, Soils, Agriculture, Kamber.*

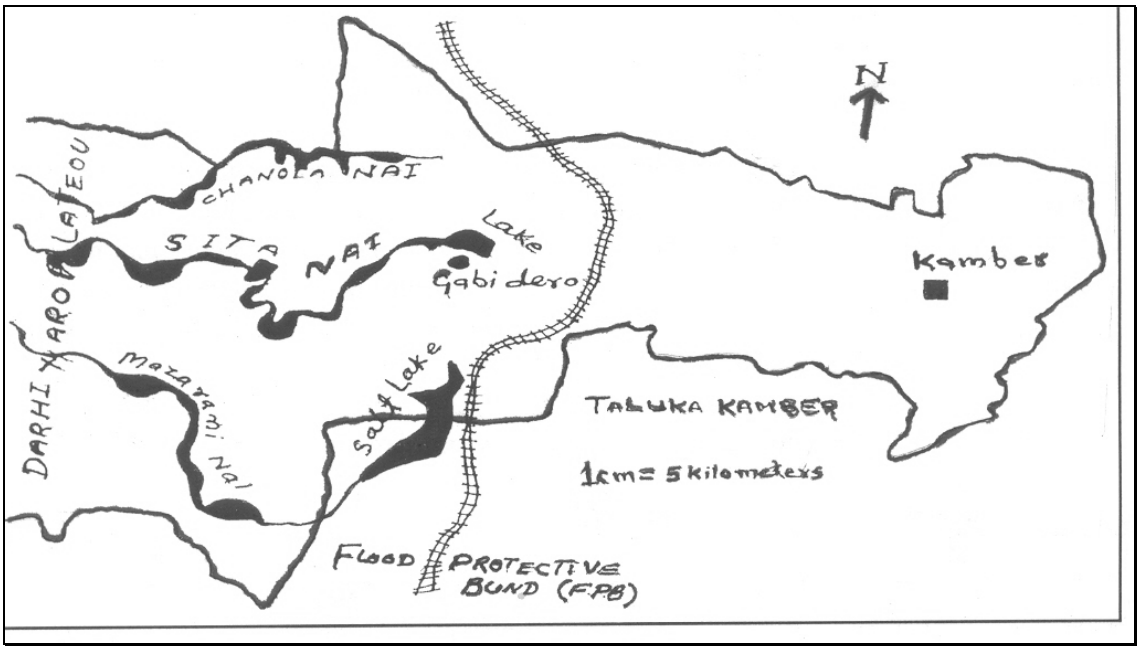
1. Introduction

Pakistan is quite outstanding country in the world with regard to its well-knit irrigation system, which covers from upper parts of the country, down to the mouth of Indus in the south. Irrigation areas (nearly 16.0 million hectares) are generally limited to the Indus plain and river Indus and its tributaries are the main sources of the irrigation water. Of this 12.09 million hectares are canal-irrigated 3.35 million hectares by tubewells and another 0.6 million hectares by other sources. Of the total area under irrigated agriculture about 9.6 million hectares is arid, 3.8 million hectares semi arid and the remaining area is characterized by sub-humid. No doubt irrigation system has increased agricultural production, but on the other hand has created the problems of salinity and waterlogging. Percolated irrigation water has raised the underground water level and subsequently has waterlogging. Excessive salinity of the underground water has also harmful effects on the soil body. Ascent of dissolved minerals of irrigation water through capillary action increases the soil at salinity and damages its fertility. It is rightly said that waterlogging is the ***cancer*** of the soil. Because of poor soil drainage and improper irrigation practices, the huge amount of arable land is waterlogged and has become saline now.

This problem has destroyed million of acres of farmland in the country. Waterlogging and deposition of whitish crust of salts are changing farmland into unproductive land and many areas, the crop fields are reduced considerably. Reports say that during every five minutes, one acres fertile farmland is taken out from agriculture, because of this problem.

The region facing lot of trouble due to drought since last six years, ground water is different, in different areas, after the drought, wells has be come saline, stored water (pond) has been finished and people are shifting from the western border towards the eastern border of the region.

Fig.1. Map of Kamber



Under-ground water is that part of subsurface waters which fully saturates the pores of the rocks or its overburden and which behaves in response to gravitational force. The ground water occupies the zone of saturation. Above it is the zone of saturation, in which does not fully saturate the pores. (the water below the earth surface). The level of the water in the tiny or large holes and surrounding ground is called water table. in a moist climate region the water table is close to the surface. In fact, it might even come right up to the surface and form a swamp, lake, or a spring.

The Khirthar mountain range cross from the western border of region (Kamber). At the foothills of Khirthar mountain range numerous thermal springs give rise to hidden oases and small settlements only on reset occasion does the region shares the monsoon rainfall, and runoff is trapped behind earthen embankments in wet years, is sufficient there moisture for cultivation at the foothills of this mountain complex. Some seasonal rills (nai) flow from the Bolouchistan plateau due to high rainfall in the months of June and July. Khirthar mountain range is 1500 meters above sea level and water (**Table-1)** of this area is very deep.

On the contrary, the plain considered as an agricultural area of the region, so underground water table is few feet below the surface. But due to shortage of rainfall and canal water system in Pakistan, there is also underground water table going down. There are two types of water table one is permanent and another is called seasonal water table. About five years ago the seasonal water table was not more than 09 meters (average) in depth and average depth of permanent water was 15 meters.

Table-1. Showing process of evaporation and fall of precipitation on land and oceans..

Evaporation		Precipitation	
From ocean	84%	On ocean	77%
From land	16%	On land	23%
Total	100%	Total	100%

From the 100%, 97.6% water is salt, remaining 2.4% is fresh water, in which 1.9% is under icecaps, 0.02% under different rivers, 0.0001% is hanging in atmosphere and another 0.05% is only underground water. Generally we are using water in different three ways, About 50% water used for industries. 40% for agriculture and other 10% for the domestic use.

But due to low industrial development in the region, industrial use of water is not possible, but agriculture and domestic use of ground water is found everywhere.

In many parts of the region where runoff is very slight, people depend upon ground water for their water supply. Ground water occurs in the pores of bedrock some distance below the surface. Ground water is obtained from springs and wells, but tubewells are also found in whole region more than springs and wells, but few natural springs are found at foot *Dharhario* (name of mountain) plateau, in the west of Kamber taluka. But supply of ground water in any one locality can be quickly reduced by excess use of pumping (tubewells) and wells, due to shortage of precipitation and canal water in any region may be reduced to the permanent water table, due to recharching process in the region.

Quality of water

The water of the region vary widely in a number of qualities are critical for purpose while other are of little consequences. The soluble mineral contents (hardness), the amount of suspended matter, and the organic content are likely to be the most significant qualities. Such qualities as the color (of clear water) and the temperature are not likely to be as critical.

Hardness may be defined as the proportion of dissolved mineral, usually expressed in parts per million (PPM). Soft water has up to 50 parts of dissolved minerals per million; medium hard water has 50 to 100 parts; hard water has more than 100. A rough indication of hardness is the amount of soap required to make a permanent lather; for example, 10 grains of soap to a gallon of water indicates a hardness of 171 ppm, an amount just tolerable for domestic uses. Hard water may leave a scale in pipes and cooking utensils, on the other hand, very soft water may be corrosive. Hard water can soften by precipitation of soluble minerals and by filtration. Associated with the hardness of water is its acidity or alkalinity, a quality measured by the pH factor. A pH value of 7 indicates neutral water; more than 7 indicate alkaline water; less than 7 indicate acid water.

A saline water pond near the foothill of Khithar Mountain in the region

Water usually contains minute's traces of many minerals, which are necessary to human health, in certain areas however minerals other than those found naturally in the local water supply must be added to human diet to avoid deficiency disease. Iodine, for example, is necessary for the proper of functioning of thyroid gland. The case of fluorine is a little more complicated. Small qualities of soluble fluoride are needed to minimize tooth decay in growing children. However too much fluoride produces spotted teeth (a highly undesirable condition from standpoint of beauty) and perhaps other undesirable effects. Individual dose of fluoride may be added to the milk or drinking water of children, but this individual application is considered a nuisance and many cities add small quantities of fluoride to the entire water supply.

Table -2. Showing composition of ground water, collected from different Areas of the region

1.	**Date of collection**	03.06.2000	20.07.2000	01.05.2006	03.05.2006
2.	**Parameters**	01*	02*	03**	04***
3.	**Time**	13.05	16.10	17.10	18.20
4.	**Temperature of water**	29.0	34	28.03	25.9
5.	**pH**	7.84	7.12	8.00	7.91
6.	**Conductivity**	4507	1480	4380	4112
7.	**TDS mg/L**	2885	947	2277	2693
8.	**M. Alkalinity as ca co3 mg/L**	216	112	211	219
9.	**Chlorine mg/L**	1151	415	995	1050
10.	**Hardness as Ca Co3 mg/L**	830	400	795	760
11.	**COD mg/L**	B.D	B.D	57	51
12.	**Sodium in mg/L**	550	227	555	475
13.	**Potassium**	56	22	59	51
14.	**Calcium in mg/L**	212	212	160	190
15.	**Magnesium in mg/L**	190	34	180	165

* taken from scientific sindh Vol: 11.2004
**Tube well (80ft deep) near village Juma khan Chandio, Kamber
*** Hand pump, old Bus stand Mahalla Kamber

Although minute's quantities of many trace elements are necessary for health of plants and animals, a little too much of them may be very harmful. For example, although the element boron is essential for the proper growth of plants, series damage to plants boron exceeds one part per million. Organic matter living and dead may affect the quality of the water to a

critical degree. Water derived from swamps, lakes or sluggish streams may be brown in color, have an unpleasant taste and odor, and be difficult to filter, but it is the living organism in water, which cause most concern. In populated area the surface waters and in some cases the ground water may carry organisms associated with typhoid, dysentery and other disease. Proper chlorinating kills most but not all of these organisms.

Quality of Soil:

Fertile soil is containing 19 chemical elements that are of particular importance in soil. In which 12 main chemical elements are given below with its symbols and ratio. All 19 elements are help plants, which have been in soil. Aluminum, silicon and sodium are not essential to the growth of plants when grow in culture solutions in the laboratory, but they undoubtedly contribute to plant growth in the fields. These elements are important if not essential. Silicon and aluminum as oxides constitutes the *skeleton* of the soil. The oxides of these two elements constitute 80–85 percent of most soils.

2. Materials and Methods

A hole drilled to find water table to get that water table is called a well. Near large body of water, water table is not deep and wells can be quite shallow. In other places you may observes big deeper perhaps hundreds of meters deeper to find the water table. As mentioned above that the topography of the region is not uniform.

About 80 kilometers away from Kamber city, near the foothill of the khirthar. Where surface consists of the pebbles and gravel's, water table is more than 100 meters, and canal water system is not found, rain water (Barani) disappear through out the year, but during the monsoon season (July and August) rain falls here in rare case.

Cause of fluctuation of ground water

Water resources are decreasing due to researching process by precipitation in the region. On the contrary use of ground water is abundant, there is no sources of canal water in winter season for the crops of wheat. millets, sugarcane, etc. therefore people are using ground water by tubewells and wells for agriculture purpose. When water reached at surface level may evaporate in atmosphere by heating process. This is fact that since last six years Sindh is facing to drought due to heavy temperature and low precipitation. Region is famous for its rice production in Pakistan, because of Kamber was a part of larkana. On contrary western border (Kachho) of Kamber is low productive area of the region due to lack of canal water system, but the soil of ***Kachho*** is very fertile.

According to a survey, in the season of Rabi more than five tubewells are drilling in the region by local formers in a day, so this is a main cause of fluctuation in the region. Geographical locations of Kamber favor to hot climate and belongs to BWh so temperature of the region crosses 50^0c in month of July. However due to drought and climatic change in the region ground water sources are going down and become saline. There are more than 15 wells drilled by local people for drinking on good expectation, but they are mostly saline.

3. Result and Discussion

An area of the region is bound with the boundary of khirthar mountain range at the western side of Kamber. About more than 20% area is under mountain or its foothills .The highest peak of khirthar mountain range is (Dog's Grave) kuti-ji-kabar, comes in the region. So, it is clear after the drilling that 20% area of Kamber has deep water table but on the contrary, plain area is not deeper than foothills due to excess of canal water system In some area, local people are using ground water for purpose of agriculture i.e. wheat, maize, barely, millet, pulse, peas, coriander and, mustard in Rabi season due to shortage of water. But due to salinity and water table, farmers are living always in trouble, but some farmers are continuously exploiting, due to compulsion. The salinity is not only harmful for agriculture fields, but also dangerous for the health. During the survey, some of wheat crops were found affected by the salinity.

Taluka Kamber is located at slope of khirthar mountain range, and this is a boundary

wall between Sindh and Balochistan, some rills (nai) flow from the Khirthar Mountain and Balochistan plateau. As we know, mountains are rich in several different types of minerals and salts, these minerals and salts eroded by rain and flow with rills and mix-up in agricultural fields hence is harmful. ***Nai Gaj***, *Nai Boolan* and *Nai Mazarani* are most famous *Nai* (rills) from uplands. Khirthar Mountain range belongs to sedimentary rocks, this type of the rock commonly contain, shells, limestone, sandstone, dolomite, potassium, calcium, magnesium, phosphorus, in excess amount. When rills come from Balochistan plateau the water is saturated with above minerals. So agriculture fields may become saline.

Impact on soil

Soil has been described as the uppermost, superficial layer of loose and unconsolidated material of the earth in which plants may grow. Soil contains the organic and inorganic material. Organic material derived from plants and animal's decomposition and inorganic material is a result of natural phenomenon. The chief elements required by plants are oxygen, nitrogen, carbon, potassium, phosphorous, and iron. These elements are mixed in soil by natural way.

The soil of Kamber taluka belongs to residual and transported soil, residual comes from uplands of mountains resulted by denudations process. (Weathering and Erosion) By the process of denudations, decomposed soil stored at the foothills of Khirthar Mountain. This type of the soil occurred on 35% area of the region. This area is known as Kachho. The transported soil is occupied on 65% area, sufficient for rice and other crops. This area is formed by the deposition of River Indus and its tributaries. The soil belongs to alluvial soil with mixture of silt and clay (loam) soil.

Table Showing the pH value of ground water from different union council and Tapas of Kamber Taluka.

Union council (1) Kamber		Union council. (2) Rawiti		Union council (3) Dost Ali		Union council (4) Gabi dero.	
Tapo Kamber	Tapo additiona l Kamber	Tapo Rawiti	Tapo Lakha	Tapo Dost Ali	Tapo koor suluiman	Tapo Gabi dero	Tapo Karohar
1 meter depth	1 meter depth	1 meter depth	1 meter depth	1 meter depth	1 meter depth	Ponds water	Ponds water
9.1 ph	7.95 ph	8.1 ph	7.8 ph	8.7 ph	8.9 pH	with less chlorine	with less chlorine

Source: Wapda scarp larkana

The chemical composition of soil, especially a young soil depends greatly upon the parent's materials. The soil becomes changed chemically as well as being altered physically by temperature and rainfall. One important aspect of the chemical character of the soil is the amount of lime found in it. Lime is a very soluble. In the region of plentiful and persistent rain it is generally leached from the surface layer of the soil; conversely, in region of light rainfall and light season, lime is apt to accumulate in the soil. So, soil of Kamber consists of lime material from surface erosion of Khirthar mountain, about 35% soil of this area belongs to this soil. There are two division of lime soil in the region one is Pedocals (from Ca, calcium) and (from Al, aluminum and Fe, iron) next is pedalfers, with deficient in lime and possess a high percentage of iron and aluminum.

Impacts on Agriculture

This is fact that Kamber Taluka is a famous for its rice production in Sindh as well as in Pakistan, but due to drought since last six years the region is mostly affected by climatic deterioration. No doubt agriculture of our country is depending on canal water but lack of canal water, farmers are using ground water. Groundwater of region is not pure but mixture of

different chemicals; according to a survey 05 tubewells are drilling in a day during the season of the Rabi crops by this way ground water kept our impacts. Land fields (soils) of Kachho are very much fertile but due to shortage of canal water this area may be neglected in different times by Government. Secondly, Kachho is located at the foothills of upland of Khirthar Mountain, therefore in the season of monsoon, a few rills flow from Balochistan plateau reach here. The first flow of rills is mostly saline, This water is not only harmful for crops but also dangerous for human and animal life. In April 2005, 25 people were died and more than 500 were affected by Gastro, due to drinking of stored water from lake Saroh and lake Hamal of Kamber and Warah talukas.

Rice is one of the leading cash and foreign exchange earning food crops of the world, including Pakistan. It requires a constant and plentiful supply of irrigation water. It needs 46 acre inches as soaking dose 4-6 days before transplanting, 1-2 acre inches at the time of transplanting and 3-4 acre inches 7-10 days after transplanting to maturity of the crop. The reproductive stages from penicle initiation to flowering and grain formation are the critical stages. Any stress at this stage will affect the yield and grain quality. However, rice requires over all 60-70 acre inches irrigation water on the basis of varieties. Current flow of water in the region is not sufficient for rice cultivation.

Millet (*Bajra*): The area under millet crop is highly variable, because it is dependent on the amount and time of the rainfall. It is mostly confined to the desert and mountain (*Thar, Cholistan* and *Kohistan*) area. 3-4 irrigations are sufficient for better yield, as recommended for sorghum. During the season of heavy rain Millet are found there in excess.

4. Conclusion

About more than 60% of ground water of Kamber taluka is saline, even to citizens of Kamber are also using the saline water, but some affordable citizens, using fresh water from Mastoi Mahla Kamber (1000 meter away from kamber city)`This water is only for sale purpose. Ground water of Kamber City can not be used for drinking purpose, but even also not for cocking purpose. Only we can use it for washing purpose. During the months of April, May June, July some inflectional diseases are found there like Gastro etc, due to saline water. The inhabitants of Kamber also in trouble due to ground water, in some area of Kamber people are using ground water for drinking and agriculture by wells and tubewells.

About 40% villages of western Kamber (west of flood protective bund) using ground water, like *Gabi Dero, Sono Chandio, Saboo Buriro, Khan jo Ghoth, Soomer Chandio, Shakal ji Wahi* and so many villages are using saline water, and 60% people depend on *Naies* (*Nai Gaj*) from khirthar,s uplands. This is fact that, this water is very harmful for human and animal life, as well as for agriculture fields.

This is a proposal, that a small Dam (*Gaj Dam*) may be constructed in the region, for facilities of local inhabitant on flow of the *Nai Gaj*. This *Nai* flows from Bolouchistan cross the khirthar mountain range during the monsoon season; this is the biggest Nai in Sindh, which is a main cause of damage in Kamber and Dadu district. The minimum flow of *Nai Gaj* is one feet and eight inches and maximum flow of the Nai Gaj is 18 feet. So *Gaj* flows at the rate of 03 lakes 25 thousand cusic, so this ratio may favor the Dam in the region After the flood by *Nai Gaj* in 1995 (more than 100 person died). By the construction of this dam the ground water table of fresh water may raise, fresh water for drinking may be provided, from *Gabi Dero* to *Goragh* to local inhabitant.

On the contrary, the condition of the eastern Kamber is varied to Western side this area is known as pacco (plain area) there is a good net work of canal water system. Rice crop of Kamber depending on *Gar Wah, Norang Wah* and *Hasula* branch some distributaries like *Khan Wah, Gari Wah* are also famous branches of Kamber. Due to sinking, water table is near the surface, during the drilling water is available at the depth of 12 to 20 meters, the upper layer of soil is transported by River Indus and its distributries, but some areas are quite different, they are un- fertile till, due to high salts in soils.

Condition of Kamber city is observing due to saline of ground water, local inhabitant drilling the Nalls (*Nalco*) not more than 25 meters because of beneath 25 meters hard rocks like granite can felt, so technician left their work due hardness. But this is possible that if the technician may success to break this hard rock, the ground water may appear for drinking. This experience is used in a Mahla of Kamber (Burira colony). Where technician drilled the Nalls at the depth of 40 meters, so the result is positive.

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