

Chapter-1 INTRODUCTION

1.1 Background

Arsenic testing of groundwater is considered an important activity due to its serious effects on human health. Two South Asian countries, India and Bangladesh, are facing arsenic contamination in drinking water in many places. Arsenic problem in Pakistan has recently been identified as a result of field testing, firstly in ground water of Attock and Rawalpindi districts (year 2000) by a joint study by Pakistan Council of Research in Water Resources (PCRWR) and United Nations Children Fund (UNICEF) and secondly from National Water Quality Monitoring Program (NWQMP) of PCRWR. The data collected from the Phase-I (2001-2002) of NWQMP program revealed the presence of arsenic above 50 ppb in some cities of Punjab particularly in Multan, Sheikhpura, Lahore, Kasur, Gujranwala and Bahawalpur.

The situation of presence of arsenic in ground water of Southern Punjab has become clearer as the result of detailed testing by UNICEF and PCRWR. According to field data, 22.63% samples had arsenic concentration above the WHO guidelines of 10 ppb (Kahlow et.al, 2003). It was reported that arsenic contamination exceeded 200 ppb in some districts of Sindh (Kahlow, et.al, 2002). The province of Sindh forms the Lower Indus basin with an area of 1,40,915 sq.km. The population of the province stands around the 40 million souls. In 2001, the Public Health Engineering Department (PHED), Government of Sindh in collaboration with the UNICEF, Sindh Karachi conducted drinking water quality survey in nine districts of Sindh in order to determine presence of Arsenic in drinking water. For this evaluation study five samples were taken from each Union Council of these districts. The survey found that out of nine (09) districts, five districts namely Khairpur, Dadu, Nawabshah, Nausheroferoz, and Thatta contained arsenic in drinking water.

UNICEF initiated a program of arsenic monitoring by using field testing kits with the help of Sindh Agricultural and Forestry Workers Coordinating Organization (SAFWCO) owing to reports regarding arsenic contamination in groundwater of Sindh especially in Districts of Dadu and Khairpur Mirs. The assignment was undertaken from September 2002 to February 2003. It was found that field testing kits can detect high levels of arsenic but are typically unreliable at lower concentrations of concern for human health. Reliability of field methods can be evaluated by external validation using sophisticated and state of the art equipment and trained staff. On these basis, it was decided that about 10% samples (approximately 2000) would be got analyzed by PCRWR with the help of Atomic Absorption Spectrometer to evaluate the results of field testing kits. Therefore,

PCRWR was made responsible for the analysis of about 2000 samples and writes a report based on the results of overall samples.

1.2 General Occurrence of Arsenic

Arsenic is the twentieth most common element in nature. It is widely distributed throughout the earth's crust and commonly found in the atmosphere, soils, rocks, organisms and in natural waters. It can combine with other elements to form inorganic and organic arsenic compounds. The inorganic arsenic appears in compounds with oxygen, sodium, potassium, copper, chlorine, iron and sulphur. Arsenic in plants and animals combines with carbon and hydrogen to form organic arsenic. Organic arsenic compounds that are found in foods are quite harmless and pass through the body quickly. Inorganic arsenic is more toxic. It is deposited in the body and gets concentrated overtime and cause long-term damage. Arsenic in general is said to be about four times as poisonous as Mercury (Aapo SaaK, 2001). It exists in oxidation states of -3, 0, 3 and 5. The trivalent arsenic (As III) is considered 60 times more toxic than the pentavalent (As V). Arsenic is considered to be the most toxic form, followed by the arsenites (Arsenic-III), the arsenate (Arsenic V) and organic arsenic compounds. Arsenic occurs as a major constituent in more than 200 minerals including arsenic, arsenide, sulfides, oxides, arsenates and arsenites usually. Arsenic is used in semi-conductor manufacturing, petroleum refining, wood preservatives, animal feed additives and herbicides (Hungerford and Terry, 2003). It is mobilized in the environment through a combination of natural processes such as weathering reaction, biological activities and volcanic emissions as well as through a range of anthropogenic activities.

1.3 Study Objectives

- i) To evaluate arsenic contamination in Khairpur and Dadu Districts (Central Sindh).
- ii) To extend the area of research to localize arsenic contamination.
- iii) To validate arsenic analysis results with the help of Atomic Absorption Spectrometer.

1.4 Project Area Description:

1.4.1 Khairpur Mirs:

Former princely state of Khairpur Mirs is located in Sindh. It was founded in 1783, recognized by the British in 1832 and acceded to Pakistan in 1955. It is located about 20 km in South West of Sukkur on the bank of river Indus. It is bounded on the north by Larkana and Shikarpur districts and on the South by Sanghar district. Eastern boundary links with Rajasthan (India). It is about 60 meters above the sea level with an area of 15,736 sq. k.m. District lies between Latitude 26-0' 27'-45' and

Longitude 68°-0'-70-15'. Khairpur Mirs is an important trading centre by having four sugar Mills, Six Cotton Factories and three leather industries. It comprises of eight Tehsils namely Khaipur, Gambat, Kotdiji, Kingri, Sobhodero, Thair Mirwal, Faiz Gang and Nara. Out of eight, only three Tehsils i.e. Khairpur, Gambat and Kotdiji were selected for arsenic monitoring. According to 1981 census, population of district is 7,86,433. Temperature ranges from about 25°C to 41°C during summer and 16°C to 27°C in winter. The sand dunes starts from Tharparkar District which passes through some talukas of Khairpur Furthermore, Khairpur Mirs Considered a traditional centre by holding different Jashans/Melas like Mela of Sachal Sar Mast held at Gambat. Shah Abdul Latif University is also situated in this district.

1.4.2 Dadu:

The District derives its name from its headquarters town Dadu. It covers 19069 sq. km. area with population of 1,688,811 (censuses 1998). It is about 39 meters above the sea level. The Dadu District may be divided into three parts on the basis of difference in character namely the Kohistan or hilly area, the barrage zone and the low lands riverian area. It comprises of seven Tehsils namely Mehar, Khairpur Nathan Shah, Kotri, Thano Bula Khan, Dadu, Johi and Sehwan. Out of these, three Tehsils i.e., Dadu, Johi and Sehwan have been selected for monitoring. A major portion of Sehwan is hilly whereas Johi is considered the least productive part of the district due to diminishing supply of water. The river Indus, flows along the eastern boundary of the district. The Manchar lake (the biggest natural lake in Asia) and Ganero lake are present in Dadu District. Climate is intensively hot in summer and cold enough in winter. Major part of Sehwan have moderate climate while Dadu and Johi have extreme weather conditions. The district is irrigated by Sukkur Barrage System except for small portion, which is irrigated by Kotri Barrage. There are two main canals in the district, Rice canal and Dadu canal. All crops of kharif and Rabi are grown in the district. The growing of flowers, fruits and vegetables is not practiced on large and commercial scale but ample horticulture is carried out to fulfill the local needs. There are two industrial units, one at Kotri and other at Nuriabad, which have heavy and light industries like textile, tobacco, detergent and cement etc. The Dadu Sugar Mill at Piaro Goth is providing employment opportunities to locals to some extent. Apart from that, reservoirs of gas and petroleum have been explored in Sehwan, Johi and Thanno Bula Khan Tehsils. Gorak hills, a health resort and Rani Kot an archieve are located in Kirthar range in this district.