

A  
Report on  
**Detection and Management of Arsenicosis in the Selected Local  
Communities of Terai Regions of Nepal**



**With Support of:**  
**World Health Organization (WHO)**

**Submitted by:**  
**Dr. L. R. Pathak**



**Submitted to:**  
**Nepal Health Research Council (NHRC)**

**December 2005**

### **Study Team Members**

- Dr. L.R. Pathak (Principle Investigator)
- Dr. Manen P. Gorkhaly (Co- Principle Investigator)
- Ms. Pooja Pant (Co-Principle Investigator)
- Mr. Chandra Dev Sah (Research Assistant)
- Mr. Bhupendra Das (Data Analyst, Report Preparation)

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<b>CBS</b>	Central Bureau of Statistics
<b>Comm.</b>	Community
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<b>DWSS</b>	Department of water supply and sewerage
<b>ENPHO</b>	Environment and Public Health Organization
<b>FeAs<sub>2</sub></b>	Iollingite
<b>FeAsS</b>	Arsenopyrite
<b>HW</b>	Health workers
<b>IEC</b>	Information Education and Communication Program
<b>Mg/l</b>	Milligram per litre
<b>MoH</b>	Ministry of Health
<b>MoHP</b>	Ministry of Health and Population
<b>NASC</b>	National Arsenic Steering Committee
<b>NEWAH</b>	Nepal Water for Health
<b>NGOs</b>	Non Governmental Organizations
<b>NOO</b>	National Operation Officer
<b>NRCS</b>	Nepal Red Cross Society
<b>ppb</b>	Parts per billion
<b>RONAST</b>	Royal Nepal Academy of Science and Technology
<b>RWSSFDB</b>	Rural Water Supply and Sanitation Fund Development Board
<b>SQ</b>	Survey Question
<b>VDC</b>	Village Development Committee
<b>WHO</b>	World Health Organization

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**Dr. L. R. Pathak**

Principal Investigator

Nepal Health Research Council (NHRC).

## **Executive Summary**

Arsenic related problem has accelerated to such a extent that has become very much concerned to different authorities to extend various programs like awareness raising programs in the vulnerable areas along with the more depth study for detection and identification of Arsenic contamination cases and degree their health impacts for the better management. As identification and detection of the arsenic related problems are in nascent stage in Nepal, therefore “*Detection and Management of Arsenicosis in the selected local communities of Terai region of Nepal*” has been designed to detect and manage the cases of Arsenicosis.

The study focuses great attention towards: orientation to health workers of 5 selected communities of Terai region, Arsenicosis detection, conductance of disease surveillance of Arsenicosis, awareness raising and organization of national workshop. Inorder to detect the cases of Arsenicosis and hence initiate the management of these cases, the study was carried out in three distinct phases: Review phases, Field study phase and Data processing and Analysis phase. Field study phase comprised of Site selection, Field Reconnaissance, Orientation to Health Professionals, Awareness raising to the local communities and Detection and Surveillance of Arsenicosis.

The communities have been chosen on the basis of level of vulnerability to Arsenic contamination and very low uncertainty level designated by the study of NASC/ENPHO in 2003. Based on the study report, 3 Village Development Committees (VDCs) of Rautahat and 2 VDCs of Bara were selected as the target communities for the study. The field visit was conducted by four members and was carried out from March to August 2005.

The study and survey conducted reveals that in Rautahat, 93.33% of the health workers were not familiar with Arsenicosis cases and that of Bara 70%. The occurrence Arsenicosis among the exposed population in Rautahat and Bara reveals



the majority in Male and majority of population are being affected by Keratosis problem. Out of 250 household sampling done, 4.78% of population is affected from Arsenicosis problem. The survey reveals that maximum populations are being affected above 25 years of their age.

There is also a chance of prevalence rate to increase in future because of the cumulative nature of Arsenic toxicity. So if not checked in time, there will be huge loss in terms of money, time and labour investment. For this purpose National policy decision making would be the most appropriate.

Inorder to stop for health effects caused by the Arsenic contamination, Awareness raising, Orientation and Training programs for the both Health Workers and Communities are necessary. Further health survey should be conducted with the initiation from the Ministry of Health in all hotspot areas and a separate recording system should be developed in all health institution for identification, treatment and monitoring of Arsenic patients.

## ANNEX

### ANNEX 3

#### Participant List- Community Awareness Program

Field Site	Name
Samanpur VDC, Rautahat	Chandra Kala Devi
	Tirha Devi
	Champa Devi
	Malati Devi
	Sita Kumari Shah
	Kbiman Khatun
	Chandreshwor P. Shah
	Sangita Shah
	Chameli Devi
	Gayatri Devi
	Babu Lal Chaudhari
	Dipendra Das
	Santosh Kumar Chaudhari
	Khadga B. Shrestha
	Shankar B. Shrestha
	Santosh Kumar Tiwari
	Ranjan B. Shah
	Hemant K. Pant
	Bhagya N. Tiwari
	Ram Gopal Sah

	Rudhra Raj
	Hari Sanker Sah
	Habiban Khatun
	Pramila Devi
	Sagarbati Devi
Sangrampur VDC, Rautahat	Anandi Devi
	Mahabati Devi Sah
	Kaliya Devi
	Nagiya Devi
	Rakhika Devi
	Fuljhariya Devi
	Basundhara Devi
	Ramadulari Devi
	Pufiyama Devi
	Mira Devi
	Rambalak Prasad
	Bijundar Ray Yadav
	Sambhu Prasad Patel
	Hari Kishor Sah
	Shyam Sundar Mishra
	Bir Bahadur Sah
	Nanda Kishor Yadav
	Rajendra Ray
	Bindeshwor Sah
	Ram Pukar sah
	Sakindra Prasad Patel
	Prem Narayan Ray
	Tekesh Chaudhari
	Mohan Chaudhari
	Narahari Chaudhari
Raghunathpur VDC, Rautahat	Shek Majahar Alam
	Deep Lal Sah Teli
	Dhar Narayan Sahani
	Shek Amarullaha
	Jokh Prasad Sah
	Upendra Sah Teli
	Panilal Das
	Sarf Lal Paswan
	Sudish Lal Srivastab
	Ramdayal Mahato
	Jagar Nath Sah
	Rabindra Kumar Das
	Chandrashwor Sah
	Shek Yarmahagad
	Paramanda Das

	Mohammad Abdul Kalam
	Baiju Lal Sah
	Pramod Kumar Mishra
	Mamar Lal Gulal
	Jasodha Devi
	Bajariya Devi
	Paniya Devi
	Koseli Devi
	Saradhe Devi
	Sunaina Devi
	Souman Khatun
	Sagar Batiya Devi
	Sadhe Deri Devi
	Kabila Khatun
Purainiya VDC, Bara	Kalabati Devi
	Sunita Devi
	Jay Kali Devi
	Uma Devi
	Dhanwar Khatun
	Husan Khatun
	Symulne Sah
	Rameshwor Dubedi
	Bachha Singh
	Shiv Shankar Baitha
	Abdul Haqim
	Aftab Allam
	Parikchyan Ray
	Dularchan Ray
	Rajip Patel
	Dhirendra Jha
	Ramchandra Thakur
	Panilal Ray
	Chabilal chaudhari
	Prasant Narayan Sah
	Arjun Ram
	Dwarika Jha
	Ram Bilas Chaudhari
	Binaki Jha
	Ram Kalewar
Batara VDC, Bara	Poonam Devi
	Mahjari Devi
	Jasoda Devi
	Thetal Devi
	Gandhari Devi
	Kalawati Devi

	Meena Devi
	Daulati Devi
	Devkali Devi
	Ram Chetri Prasad Sah
	Achela Sah
	Dasai Paswan
	Ganesh Prasad Sah
	Ram Lochan Prasad Yadav
	Shambu Prasad Sah
	Maya Devi
	Masika Devi
	Uma Devi
	Gayatri Devi
	Ramadulari Devi
	Hari Lochan Yadav
	Devan Prasad Chaudhari
	Mohan Krishna Yadav
	Sohan Kanta Raya

## ANNEX 5

### List of Participants of “Dissemination Workshop On Detection and Management of Arsenicosis in the selected local Communities of Terai Regions of Nepal”

S.N	Name	Designation	Institution	Address
1	Dr.S.K Pahari	Chairman	NHRC	Ramshapath
2	Dr. S.P Singh	Member Secretary	NHRC	Ramshapath
3	Dr. M.B Bista	Director	EDCD	Teku
4	Mr. A.K. Mishara		DWSS	Panipokhari
5	Prof.Dr. Umakant Ray Yadav	Department Chief	TU,CDDES	Kirtipur
6	Dr. Madan Koirala	Scientific Advisor	Ministry of Environment, Science and Technology	Singhdurbar
7	Dr. Dirga Singh Bam	Chief	Focal Point, MOHP	Ramshapath
8	Dr. Krishna R. Amatya	Environmental Chemist	Soil Test	Baneshwor
9	Dr. L.R Pathak	Consultant	NHRC	Ramshapath
10	Dr. Manen Prasad Gorkhaly	Consultant	NHRC	Ramshapath
11	Dr. Rajendra K.BC	Research Officer	NHRC	Ramshapath
12	Dr. Saroj Prasad Rajendra	Focal Point	Environmental	Ramshapath

			Health, MOHP	
13	Dr. Sudhamshu KC		Bir Hospital (NAMS)	Mahaboudh
14	Mr. Bhupendra Das	Consultant	NHRC	Ramshapath
15	Mr. Bipin Dangol		ENPHO	Baneshwor
16	Mr. Mohan Singh Khadka	Deputy General Manager	NBSM	Balaju
17	Mr. Meghanath Dhimal	Research Officer (Environmental Health)	NHRC	Ramshapath
18	Mr. Nirbhay K. Sharma	Administrative Officer	NHRC	Ramshapath
19	Mrs. Pearl Banmali	Research Officer	NHRC	Ramshapath
20	Mr. Subodh K. Karn	Account Officer	NHRC	Ramshapath
21	Mr. Sharad Prasad Adikari	NOO	WHO	Pulchowk
22	Mr. Shyam Prasad Adhikari	Thesis Year Student	CDES, TU	Kirtipur
23	Mr. Sunil Babu Khattry		NESS	Thapathali
24	Mrs. Shailee Singh Rathor	Program Assistant	NHRC	Ramshapath
25	Mr. Bijay Jha	Program Assistant	NHRC	Ramshapath
26	Mr. Ajay Karn	Program Assistant	NHRC	Ramshapath
27	Mr. Gopal K. Prajapati	Program Assistant	NHRC	Ramshapath
28	Mr. Pursotam Dhakal	Program Assistant	NHRC	Ramshapath
29	Dev Bahadur Kunwar	Reporter	Gorkhapatra Daily	New road
30	Rekha Kusum	Reporter	Rastriya Samachar Sammittee	Kathmandu
31	Dr. Ram Bahadur Sha	Associate Professor, Central Department of Geology	TU	Kirtipur
32	Jagannath Aryal	CDES	TU	Kirtipur
33	Pravin Aryal	SDE	MOWR	

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## Chapter 1

### 1.0 Introduction

#### 1.1 Background

Arsenic is one of the most dangerous and predominantly found elements, a shiny metal that is found in rocks, soil, natural water and organisms. The simplest and most immediately achievable option of water in the rural sector of Nepal is digging out tube-wells. The Arsenic problem is complex, while the solution elusive. The underground distribution of Arsenic highly variable within small areas. Generally Arsenic is mostly found in shallow aquifers, those at depth less than 150m. Nonetheless deep aquifers are also occasionally found to be as invisible and do not affect the taste and odor of the water. Even the symptoms/signs of at as skin discoloration and order recognizable symptoms are visible only after several years of water consumption. Arsenic poisoning is manifested primarily in skin lesions on the palms of the hand and soles of the feet. Chronic exposure can cause adverse health effects including skin and lung cancer (*Hopenhayn-Rich et al,1998*). The process may take between 5 and 15 years to reveal clinical manifestations of Arsenicosis (British Geological Survey 1998; *Mazumder et al, 1998*). Studies conducted elsewhere report that Arsenic affects many organs and system in the body such as skin (*Tondel et al, 1999*), heart vessels (*Abernathy et al, 1999*), respiratory organs (*Mazumder et al, 2000*) and kidneys (*Kurttio et al,1999*), and may lead to the development of lung, kidney and bladder cancer (*Hopenhayn-Rich et al,1998; Hindmarsh, 2000*).

In Nepal especially of Terai region, identification and detection of Arsenic related problem are in nascent stage. Therefore, there is dire need for the extensive study on this matter for benefit of affected local communities and Health Workers for betterment skill. It is right time for the concerned authorities to extend various programs like awareness raising programs in the vulnerable areas along with the more in depth study for detection and identification of Arsenic contaminated cases and degree their health impact for the better management. Hence, on this regard *Detection and Management of Arsenicosis in the Selected Local Communities of Terai Region of Nepal* has been designed and activities has been carried out in the southern section of the country with the aim to detect and manage the cases Arsenicosis in-situ ambience.

Several studies have been carried out in Nepal since late 1990s in order to assess the risk of Arsenic contamination. The evidences from the studies and health surveys indicated that a

significant number of populations in the southern Terai are posed to the threat of Arsenic, the carcinogenic heavy metal, contamination. Initial health survey in 2001-2002, conducted by Nepal Red Cross Society, Department of Water Supply and Sewerage, Rural Water Supply and Sanitation Fund Development Board in technical assistance of Environment and Public Health Organization, found evidence of Arsenic related dermatosis and elevated amounts of Arsenic in human hair and nail samples in four districts (Nawalparasi, Bara, Parsa and Rautahat) Where the average prevalence rate of Arsenicosis related dermatosis was found to be 2.6% (*Shrestha et al*, 2004). Ground water Arsenic contamination and its associated skin lesions have also been reported in Nepal . This implies high vulnerability and uncertainty of Arsenicosis issues.

Inorder to detect the cases of Arsenicosis and hence initiate the management of these cases, the study was carried out in three distinct phases: Review phases, Field study phase and Data processing and Analysis phase. Field study phase comprised of Site selection, Field Reconnaissance, Orientation to Health Workers, Awareness raising to the local communities and Detection and Surveillance of Arsenicosis.

## **1.2 Objective**

1. Orientation to Health Workers of 5 selected communities of Terai region on WHO publication, namely “A field guide for detection, management and Surveillance of Arsenicosis” updated in December 2004.
2. Detection of Arsenicosis in five selected communities of Terai Districts.
3. Conducting a diseases surveillance of Arsenicosis in those selected communities based on case detection and secondary information.
4. Awareness raising about Arsenicosis in those selected communities.
5. Organization of a national workshop to disseminate findings and share experiences.

## **1.3 Justification of the Study**

Drinking arsenic-rich water over a long period is unsafe, and in some countries around the world the health effects are well known. Reports from epidemiological studies indicate that 0.3-ppm arsenic in drinking water results in increased of hyperkeratosis (rough nodules on palms and sole)

and skin cancer with increased consumption of water. There are no available medical options that can either block or cure Arsenicosis. Medical interventions are limited to alleviating the effects of symptoms and treating diseases, such as cancer, that can ultimately result from arsenic exposure. The Health workers' knowledge on Arsenic and Arsenicosis was almost negligible. They did not even know proper definition of Arsenic, its sources, its occurrence and its implication. However, only some were familiar with Arsenic but regarding Arsenicosis, it was negligible. They were not able to know its health impact, detect sign and symptoms of Arsenicosis. This implies their knowledge towards Arsenic was almost negligible and therefore they were not able to detect the cases of Arsenicosis, how to treat and where to refer. In spite of their limited knowledge, it had become a problem for health workers for their duty and responsibility. Therefore Orientation to Health Workers of 5 selected communities of Terai Region had become important for Detection, Management and Surveillance of Arsenicosis.

In order to find out the Degree of vulnerability of Arsenic impact on human health, there was dire need for detection of Arsenicosis in selected region. Conductance of diseases surveillance was also focused for finding actual cases on Arsenicosis.

Awareness raising was aimed with the vision that community itself would help to disseminate the information regarding Arsenic and its health impacts in various communities in their approach. It is believed that this would be a stride to create awareness in the vulnerable communities in the region. Inorder to clear up their doubts and confusions on Arsenic and its implications, Awareness was selected to be the best medium.

#### **1.4 Limitation of study**

The time factor has been the major limitation for the study. Detail study could not be done within the limited time frame. The prevailing political condition of the country coupled with the limited time frame for the study constrained the study team to function profusely. The situation of national conflict, and financial and technical resource were also the limiting factors for the study.



## **Chapter 2**

### **2.0 Methodology**

With the prime objective to detect the cases of Arsenicosis and hence initiate the management of these cases, the study was carried out in 5 communities in Rautahat and Bara districts in Central Terai region of Nepal where the Arsenic contamination has been reported to be relatively higher by various other studies. The study was carried out in three distinct phases namely, Review phase, Field study phase and Data Processing and Analysis Phase.

#### **2.1 Review Phase**

The study started with the review of past and ongoing works, primarily using research reports, other published documents and secondary data relevant to Arsenic contamination in water and Arsenic related health impacts. The review was more focused on Arsenic related health impacts in Nepal including the experiences of SAARC countries in context of international area.

#### **2.2 Field Study Phase**

On the basis of literature review and experience of the study team, 5 communities in Rautahat and Bara Districts, namely, Samanpur VDC, Sangrampur VDC, Raghunathpur VDC, Batara VDC and Purainiya VDC were selected for the study. The study team comprises of four members and study was carried out from March to August 2005. The data were collected in the field using various tools such as secondary data, primary data, General Observation, general discussion/consultation, orientation to health workers, general awareness campaign, case detection and surveillance.

##### **2.2.1 Site Selection**

On the basis of the literature review, the high Arsenic prevalence areas and communities for the detection and management of the Arsenicosis were selected. The communities have been chosen on the basis of the vulnerability to the Arsenic contamination and very low uncertainty level designated by the study of NASC/ENPHO in 2003. Based on the study report, 3 Village Development Committees (VDCs) of Rautahat and 2 VDCs of Bara were selected as the target communities for the study. Thus the selected five communities and the selection criteria were shared with the NASC. Nevertheless, during the fieldwork, it was observed that the extent of

effect of Arsenic was relatively higher in Sangrampur than in Hardia Patuwa VDC in Rautahat. Therefore, perceiving that communities in Sangrampur VDC are more vulnerable, previously selected Hardia Patuwa VDC was replaced by community of Sangrampur VDC. The vulnerability level for Sangrampur has also been quoted high status in the NASC/ENPHO report.

Table No 1

<b>Districts by vulnerability and uncertainty levels</b>				
<b>District</b>	<b>Vulnerability</b>		<b>Uncertainty</b>	
	<b>Level</b>	<b>% Of As tested TW above WHO guideline</b>	<b>Level</b>	<b>Proportion of HH using As tested TW to total HH (%)</b>
Rautahat	High	57	Low	27
Nawalparasi	Mod. High	47	Medium	17
Kailali	Mod. High	33	High	1
Kapilbastu	Moderate	12	Low	27
Bara	Moderate	12	Low	28
Parsa	Moderate	11	Low	34
Bardia	Moderate	22	Medium	11
Saptari	Moderate	14	Medium	7
Rupandehi	Moderate	13	Medium	15
Banke	Moderate	11	Medium	7
Sarlahi	Moderate	25	High	3
Dhanusha	Moderate	16	High	2
Kanchanpur	Moderate	15	High	1
Siraha	Moderate	21	High	3
Jhapa	Moderate	13	High	1
Sunsari	Moderate	8	High	1

Morang	Moderate	8	High	1
Dang	Moderate	5	High	1
Mahottari	Moderate	5	High	5
Chitwan		0	High	1

Source: The State of Arsenic in Nepal, 2003

Figure No 1

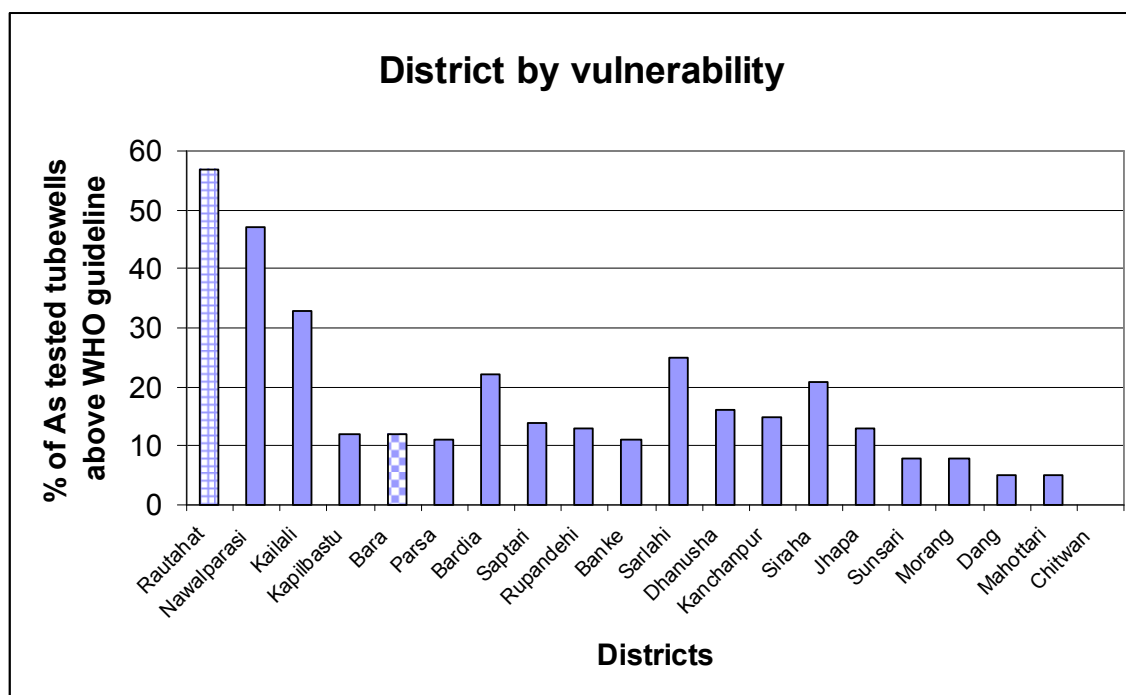


Table No 2

Selected Sites and their Relevance for the study

Districts	Vulnerability Level	Uncertainty Level	Proportion of HH using As tested tube-wells to total HH (%)	Selected VDCs	Vulnerability Level	Uncertainty Level	Proportion of HH using As tested Tube-wells to the total HH (%)
Rautahat	High	Low	27	Sangrampur	High	Low	49
				Raghunathpur	High	Very Low	51
				Samanpur	High	Low	51

Bara	Moderate	Low	28	Batara	High	Very Low	12.3
				Purainiya	Moderately High	Low	40

Source: NASC/ENPHO, 2004, The State of Arsenic in Nepal-2003

### 2.2.2 Field Reconnaissance

A weeklong field reconnaissance was done in the selected communities before the actual fieldwork. A local Research Assistant took a brief survey in Rautahat and Bara districts and also to the selected communities. In consultation with the local authorities like Red Cross Society and communities, the relevant health workers and the active community representatives were identified prior to the fieldwork. Letters were issued to the target participants to invite for the discussion and the orientation program. Hence, a detail schedule for the field visit was framed.

### 2.2.3 Orientation of Health workers

Altogether 25 health workers were selected in 5 different respective communities representing 5 health workers from each community. During the field visit, orientation on the Arsenic and its health impact was provided to the health workers and staff in each of the selected VDCs. The orientation to the health workers were conducted based on “A Field Guide for Detection, Management and Surveillance of Arsenicosis”, a WHO technical publication. In each site, a pretest was done to assess the level of knowledge of the health workers on the effect of Arsenic. The health workers were made to fill up a pretest questionnaire, which contained a set of questions, related to the Arsenic, its sources and health impacts. The health workers have oriented and trained to detect and record further cases of Arsenicosis in their respective areas, which would be later, reexamined and verified by the team. A set of survey questionnaire has been provided to each of the participant health workers. Hence, the cases of Arsenicosis would be recoded with reference to the questionnaire. About 10 copies of such questionnaires have been provided to each participant. The list of health workers participated in the orientation is provided in Annex.

### 2.2.4 Awareness Raising to the Local Communities

General awareness was created on the Arsenic and its health impacts in all the selected VDCs. The programs was particularly focused to the community workers and elites such as Female Community Health Workers, members of mother group, representatives from Community Based

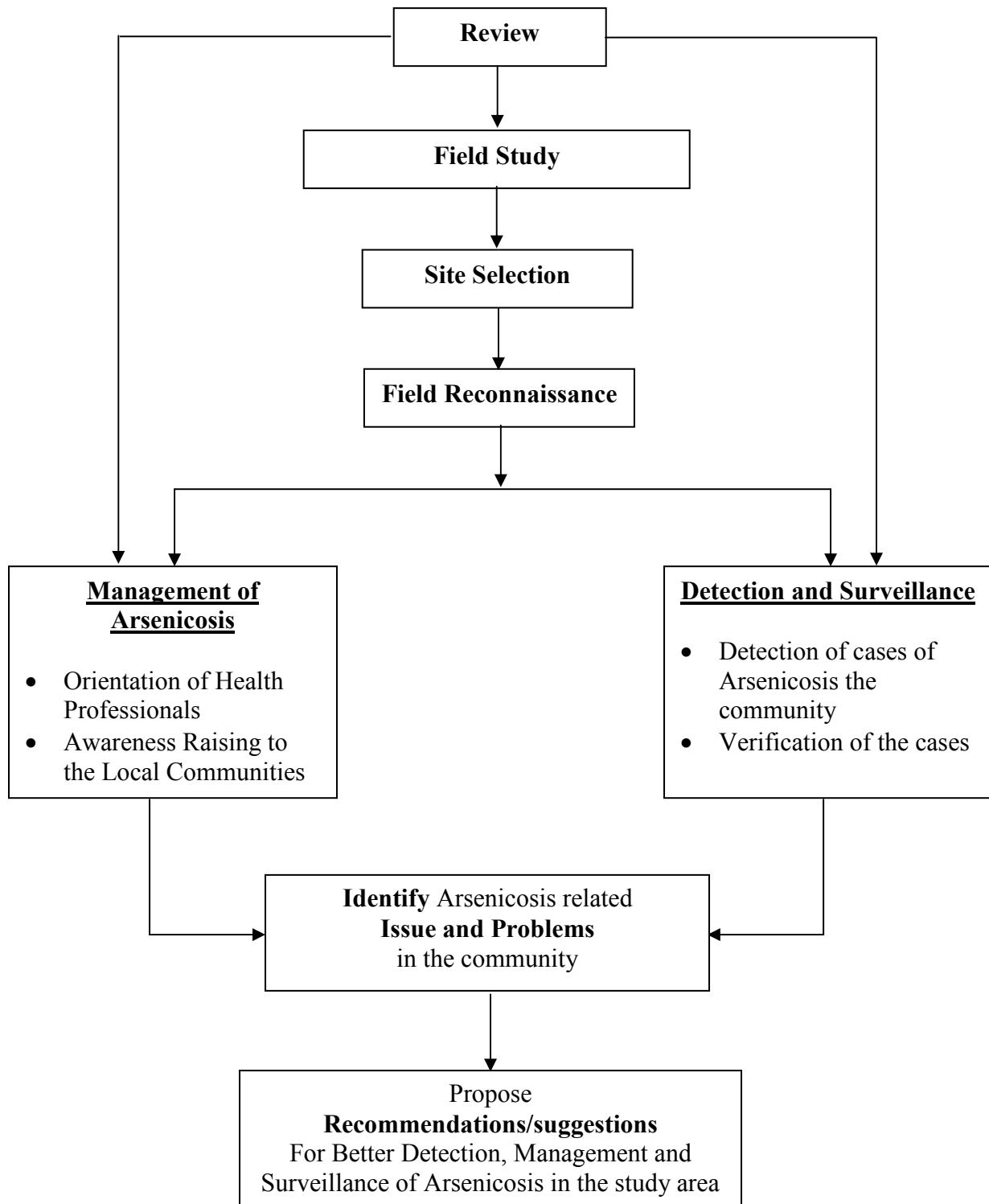
Organizations, social worker, teachers and local leaders. The participants were invited with the vision that these people would help to disseminate the information regarding Arsenic and its health impacts in various communities in their approach. In each VDC at least 25 representatives from the community were invited for the program. It is believed that this would be a stride to create awareness in the vulnerable communities in the region. The participants were encouraged to show their active participation in the discussion and to clear up their doubts on Arsenic and its implications. Apart from discussion, relevant pictures, pamphlets and brochures were also distributed among the participants.

### **2.2.5 Detection and Surveillance of Arsenicosis**

In 5 communities, 250 sampling were done (5 Comm. x 5 HW x 10 SQ). The main objective of the first field visit was to perceive the level of understanding of the health workers and the community of the region regarding Arsenicosis; to detect the cases of Arsenicosis in the region; and to train the local health workers in order to manage the cases of the disease. The trained health workers were then expected to record the probable cases of Arsenicosis on the basis of their experience and symptoms, which they detect and examine. While the second visit was conducted by the study team to detect the cases of Arsenicosis further and verify the cases recorded by the trained health workers. This would provide a picture of the extent of Arsenicosis and its health impact on the local community could be projected. Hence, could propose relevant recommendations pertaining to minimizing the health implication of Arsenicosis in the communities.

### **2.3 Data Analysis and Processing Phase**

The data gathered from the field study were processed. The information and data were then analyzed. The cases of Arsenicosis were recorded and hence the extent of the disease was accredited. On the basis of review and field experiences important issues and problems were identified and the necessary recommendations and suggestions were incorporated for the better management and surveillance of Arsenicosis.



**Methodology of the Study**

## Chapter 3

### 3.0 Literature Review

Arsenic is an element, a shiny metal that is found in rocks, soil, natural waters & organisms. It is ubiquitous in the environment with its concentration ranging from 0.1 to 40 mg/kg in uncontaminated soils (*Kabata-Pendias and Pendias, 1992*). Arsenic came from the Greek word Arsenicon that meant poison content in any substances. Arsenic is a transitional reactive element that forms chemical & organic complexes together with other metals (most commonly with Iron), carbon, sulfur & oxygen. Dominant natural Arsenic bearing rocks include realgar (AsS), Orpiment (As<sub>2</sub>S<sub>3</sub>), iollinginte (FeAs<sub>2</sub>) & Arsenopyrite (FeAsS), which is the most common Arsenic ore mineral. Pelitic (slates & phyllites) & argillaceous (black shales coals) have among the highest average values of Arsenic & are the common rocks in the himalayan mountains.

The geological formation determines largely the level of Arsenic in water & soil, which occurs as a result of leaching from rock into groundwater & possible geothermal activity. Additionally, non ferrous mining & smelting operations, refining operations, wood preservative use, pesticides manufacturing sites & past use of pesticides on crops may add to the elevated concentration of Arsenic in water & soil.

It is presumed that Terai is underlain by thick clastic deposits of alluvium that was deposited by streams from the Himalayan Mountains & upland areas thousands of years ago through soil erosion & flood. Along with sand, gravels, silts & clay Arsenic was deposited in low-lying active flood plain areas which now make up most parts of Terai of Nepal, west Bengal of India & Bangladesh. These Arsenic bearing sediments were buried over thousands of years forming parts of the aquifers that are at present being tapped for water resources.

### 3.1 Arsenic in ground water of Terai

Arsenic is transitional reactive element that forms chemical and organic complexes together with other metals. The Arsenic has probably been present in the ground water for thousand of years. It is widely believed that the contamination of people occurred only recently

because of the extensive use of ground water for drinking and irrigation purposes in the rural areas since 1960s (British Geological Survey, 1998). In recent years, Arsenic contamination of ground water has become a major concern in various parts of the world, more specifically, in South East Asia region. A natural Arsenic belt formed Arsenic laden alluvium or sediments deposited in the Brahmaputra - Gangetic river basins millions of years ago coupled with the many activities in one province of Thailand are the main source of Arsenic in this belt. Hence, about 30 millions people residing in countries in South East Asia including countries like Bangladesh, parts of India, Myanmar and Nepal may be at risk for Arsenic related diseases by virtue of consuming Arsenic contaminated water (WHO, 2004).

Normal value of Arsenic in soil ranges from 5-40 ppm. Its main natural source is known to be metamorphic and sedimentary rock rather than igneous rocks. Other sources are volcanic eruption, burning of forests, dung cakes & vegetation.

One of the sources of Arsenic in Nepal is coal combustion since Arsenic & its compounds are volatile & are released in low temperature, burning of low graded coal for brick making forest fuels, fuel woods & dung cakes could possibly emit Arsenic into the atmosphere & deposit to the ground by the rain. These could be the main sources of Arsenic in Nepal.

An estimate of number of people in the Terai who may be using groundwater containing high Arsenic concentration is about 3.2 million (29% of Terai population).

Arsenic contaminated in ground water has been reported in more than 20 countries of the world. Bangladesh, West-Bengal, India, China and Taiwan are the most affected country in Environmental health point of view. However it has also been reported in Laos, Vietnam, Cambodia, Myanmar, Pakistan and Nepal. Arsenic contaminated of ground water in Taiwan was first identified in the year 1960, Thailand 1987, India 1976 (Punjab), Bangladesh after 1993.

The first study on arsenic was carried out in Nepal by the DWSS and the WHO in late 1999. The initial 268 analyzed samples revealed the potential presence of Arsenic in ground water in Jhapa, Morang and Sunsari districts (*Sharma, 1999*). Early in 2000 the NASC was created as a first step taken by the government to address the Arsenic issue in the country.



Investigation about Arsenic in Nepal had found to be started from 2057 B.S while the strategy & test about Arsenic had started from 2001. After the establishment of National Directive Committee for Arsenic in government level, the test of Arsenic in effected districts had started seriously. At present, Nepali government, foreign water related organization with Nepali NGOs like ENPHO, NRCS, DWSS, NEWAH, RWSSFDB had already tested the Arsenic in 18,635 tubewell. The test showed district like Nawalparasi, Kapilbastu, Rupandehi, Bara, Parsa, Rautahat, Banke, Kanchanpur and Kailali have Arsenic level high than Nepali standard 50ppb. Amongst KapilVastu had 589 ppb & Rupandehi had 2620 ppb while west Nawalparasi have 571 ppb. Alarmed by the results of neighbouring India & Bangladesh, preliminary studies in investigating Arsenic in ground water was started in Nepal in 1999. Results showed that shallow tube wells in the Terai region of Eastern Nepal contained elevated level of Arsenic in the drinking water & some symptoms of Arsenic related diseases in the Terai plains of Nepal.

### **3.2 WHO Guidelines**

The WHO guideline value of Arsenic in Water is 0.01mg/liter. Thus, any samples containing arsenic concentration of greater than 0.01mg/lit. is considered to be positive. However some countries like India, Bangladesh and Nepal have set up national standards of Arsenic that are 0.05mg/lit and are considered to be positive. It is assumed that Arsenic concentration of greater than 0.08mg/kg of body weight in hair and Arsenic concentration of more than 1.28mg/kg body weight in nail may be considered as indicative of exposure to unsafe dose of arsenic within the preceding 11 months

## Chapter 4

### 4.1 Description of the Study Area

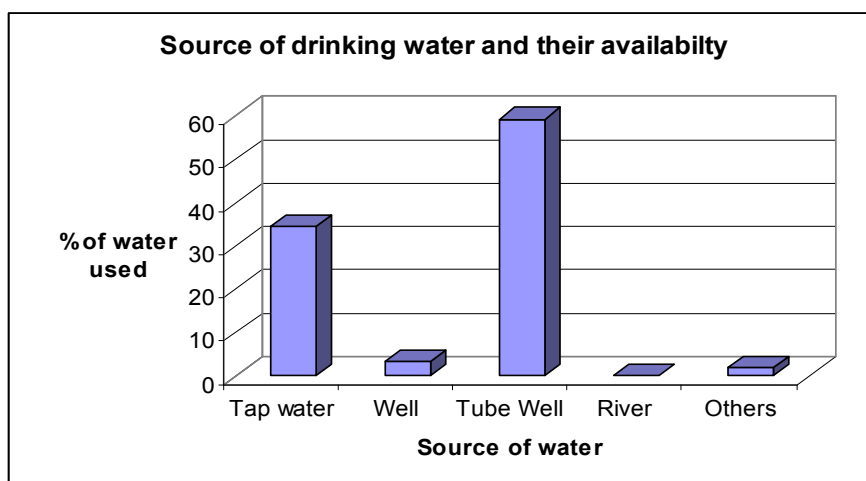
Rautahat lies at the south of Terai district a flood plain area of Nepal. The district has 1 Municipality (Gaur) & 96 VDCs. Its border districts are Sarlahi in the east. Bara in the west, Makwanpur in the north & Bihar state of India lies in the south. Gaur municipality is the headquarter of Rautahat district. The area of districts extends over 1126 square kilometer. According to the 2001 Census (CBS), the population of the districts was 545,132.

The males (282,246) outnumbering females (262,886). The density of population for the district as a whole was 484 person per square kilometer, which is one of the thickly populated districts of Nepal With a total of 88,162 households.

As other Terai districts of Nepal, Rautahat is topographically made up of alluvial soil deposited by the Bagmati river & its tributaries. Being a flood plain, the depth of groundwater is relatively low. The climate prevailing over the districts is characterized by hot & humid summers & cool winters. There are 1 district level hospital, 3 primary health centers, 9 health posts & 85 sub-health posts. One Ayurvedic health centers & 2 Ayurvedic Ausadhalayas. The districts are connected with other Terai districts by the East-West highway. About 2144 tubewells have been installed under NRCS, of which 1765 tube wells were tested for Arsenic contamination. According to CBS (2001), proportions of the households of Rautahat districts accessed to different sources for drinking water are as follows:

- Tap water 34.68%
- Well 3.42%
- Tube well 59.38%
- River 0.04%
- Others 1.77%

Figure No 2



The tube well & tap water (which is also provided through deep boring ground water) putting together represent 94.06% of the total households among all sources.

Bara lies at the south of Terai district a flood plain area of Nepal. The district has 1 Municipality (Kalaiya) & 98 VDCs. Kalaiya Municipality is the headquarter of Bara district. The area of districts extends over 1,190 square kilometer. According to the 2001 Census (CBS), the population of the districts was 559,135.

The males (289,397) outnumbering females (269,738). The density of population for the district as a whole is 470 person per square kilometer which is also one of the thickly populated districts of Nepal With a total of 87,706 households.

In Bara, there were 40 tubewells having Arsenic above 50ppb however the number increased to 45 tube wells after reconfirmation test. The beneficiaries of contaminated tubewells were provided with various alternative options by the program. Among them it includes, Identification of 3 units of Arsenic safe tubewells, installation of 18 new arsenic safe tubewells, rehabilitation of 10 dugwells, 3 two gagri filters and 36 biosand filters.

With aim to detect the cases and conduct surveillance of Arsenicosis, orientation to health workers and creating awareness on Arsenicosis the study was focused in Samanpur, Raghunathpur and Sangrampur VDCs in Rautahat and Batara and Purainiya VDC in Bara district.

#### **4.2 Samanpur VDC**

Samanpur VDC lies the eastern flank of Rautahat district. The village is about 27.2 km from Gaur Municipality. According to the 2005 projection made in District Profile 2004, there are about 1233 households with the average household size 6. 7399 people inhabit the VDC. From the study carried out by NRCS/ENPHO 2003, of the total 30 tube wells tested, 17 percent of the tube wells had Arsenic level above 50ppb; 50 percent above 11-50ppb; and 33 percent below 11. The highest Arsenic level recorded in Samanpur VDC is 85ppb. The Arsenic testing facility for the people of the region is provided in Nepal Red Cross Society, Branch Office Gaur.

#### **4.3 Raghunathpur VDC**

Ragunathpur VDC is located about 25.6 km from Gaur Municipality at the eastern region of Rautahat district. The population projection 2005 in District Profile 2004 shows that the total population of 5426 resides in the VDC with the average household size of 6.09. There are about 892 households in the village. As in other Terai communities, the maximum percentage of the people is dependent on ground water for their subsistence. However, of the total 33 tube wells tested during study by NRCS/ENPHO, it was revealed that 30 percent tested tube wells have Arsenic level above 50ppb, 70 percent in between 11 – 50ppb, and none below 11ppb. The highest recorded Arsenic level in the VDC is 113ppb.

#### **4.4 Sangrampur VDC**

Sangrampur VDC lies in the eastern section of Rautahat district, where a portion of VDC falls between Raghunathpur VDC and Samanpur VDC. It is about 25.6 km away from Gaur Municipality. The total population of the VDC according to District Profile 2004 projection 2005 is about 5459 residing in 891 households. The average household size of people of the VDC is 6.13. During the study by NRCS/ENPHO Arsenic level upto 146ppb was also been

recorded. Nonetheless, of the total 34 tube tested, 76 percent tube wells exhibited Arsenic level above 50ppb, 21 percent between 11 – 50ppb while only one below 11 ppb. This depicts severity of potential threat to the human health and the horrific condition of the village.

#### 4.5 Batara VDC

Batara VDC is situated in the southwest corner of Bara district. It is about 30.72 km from the nearest city center, Kalaiya Municipality. The total population of the VDC is 3433 residing in 508 household (District Profile 2004). The average household size of the VDC has been estimated as 6.76. On the other hand, of the total 34 tube wells tested, 21 percent contained Arsenic above 50ppb, 32 percent between 11 – 50 ppb and 47 percent below 11 ppb. The highest level of Arsenic recorded in the VDC is of 88ppb (NRCS/ENPHO 2003).

#### 4.6 Purainiya VDC

Purainiya VDC also lies in the southwest section of Bara district and northeast from Batara VDC. It is around 24.0 km from Kalaiya Municipality. There are about 825 households in the region with 6293 population size. The average household size of the VDC is about 7.63 (District Profile 2004). Of the total 25 test tube tested by NRCS/ENPHO in 2003, 20 percent of the test tube wells were declared to contain Arsenic above 50ppb, 8 percent contained 11 – 50ppb and 254 contained below 11 ppb. The highest level of Arsenic recorded in the VDC is 254ppb. The nearest tube well water sample-testing center for Arsenic in both Batara VDC and Purainiya VDC is in Kalaiya Branch Nepal Red Cross Society.

Table No 3

SN	Community	Household	Pop <sup>n</sup>	As Level (%)		
				> 50 ppb	11 - 50 ppb	< 11 ppb
1	Samanpur VDC	1233	7399	17	50	33
2	Raghunathpur VDC	892	5426	30	70	-
3	Sangrampur VDC	891	5459	76	21	3
4	Batara VDC	508	3433	21	32	47
5	Purainiya VDC	825	6293	20	8	72

Source: District profile,2004 and NRCS/ENPHO,2003

## **Chapter 5**

### **5.0 Orientation of Health Workers**

Altogether 25 health workers were selected in 5 different respective communities representing 5 health workers from each community. During the field visit, orientation on the Arsenic and its health impact was provided to the health workers and staff in each of the selected VDCs. The orientation to the health workers were conducted based on “A Field Guide for Detection, Management and Surveillance of Arsenicosis”, a WHO technical publication.

In each site, a pretest was done to assess the level of knowledge of the health workers on the effect of As. The health workers were made to fill up a pretest questionnaire, which contained a set of questions, related to the Arsenic, its sources and health impacts. The health workers have oriented and trained to detect and record further cases of Arsenicosis in their respective areas, which would be later, reexamined and verified by the team. A set of survey questionnaire has been provided to each of the participant health workers. Hence, the cases of Arsenicosis would be recorded with reference to the questionnaire. About 10 copies of such questionnaires have been provided to each participant.

### **5.1 Effectiveness of the Program**

#### **5.1.1 Before orientation**

In Rautahat, 53.33% of the health workers knew about Arsenic while remaining 46.66% of the health workers were not familiar. Whereas 6.66% of them were aware of Arsenicosis while 93.33% were not aware.

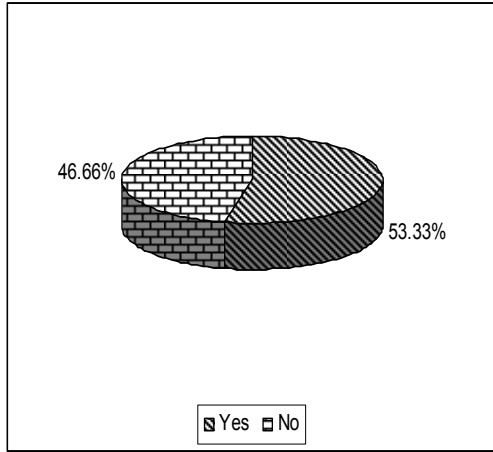


Fig. 3` Response in Rauatahat about Arsenic

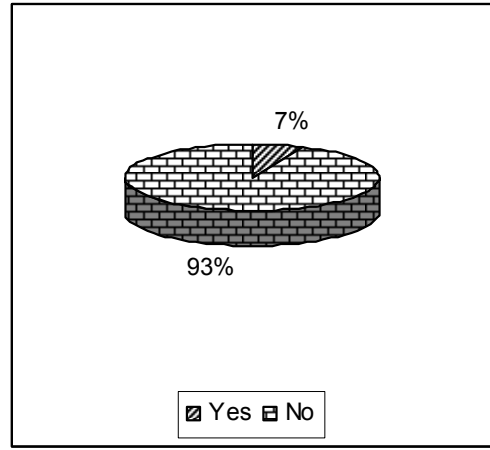


Fig. 3 Response in Rautahat about Arsenicosis

In Bara, 90% of the health workers knew about Arsenic while remaining 10% didn't know. But about Arsenicosis, only 30% were familiar and remaining 70% were unfamiliar.

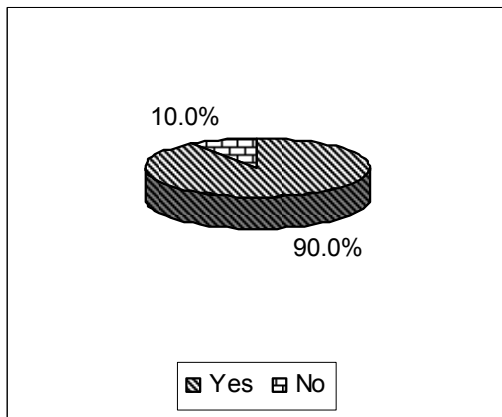


Fig. 4 Response in Bara about Arsenic

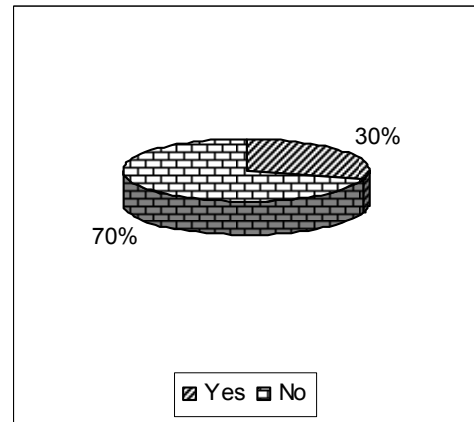


Fig. 4 Response in Bara about Arsenicosis

### 5.1.2 After orientation

The percentage of health workers awareness and Knowledge about Arsenic and Arsenicosis increased to 90%, which reflects a great change in their knowledge and skills. After completion of the orientation, the health workers in each selected VDC became more familiar to detection, management and surveillance of Arsenicosis.

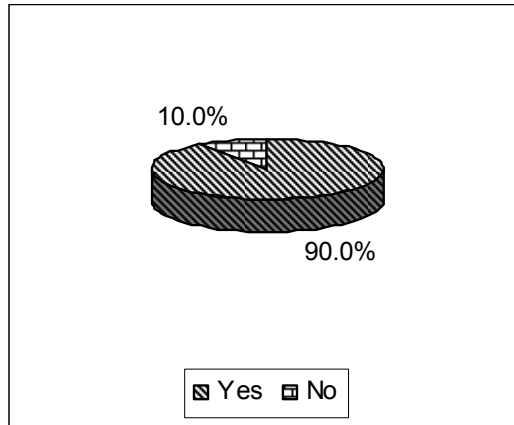


Fig. 5 Response in Bara and Rautahat about Arsenic and Arsenicosis

### **5.2 Awareness raising to community**

General awareness was created on the Arsenic and its health impacts in all the selected VDCs. The programs was particularly focused to the community with the vision that these people would help to disseminate the information regarding Arsenic and its health impacts in various communities in their approach. It is believed that this would be a stride to create awareness in the vulnerable communities in the region.

After the Awareness program, community were known about Arsenic, Arsenicosis, its cause and effects, health impact, mitigation measures, preventive and curative measures. Their feedback was very positive. They also claimed that this sort of program would be more effective if conducted on regular basis. Besides this, brochure and pamphlets were also distributed to different communities.



## Chapter 6

### 6.1 Case Detection, Surveillance and Prevalence of Arsenicosis in the Study Area

Of the total population of 250 sampling, 4.78% were found to be suffering from Arsenicosis cases. Of the total observed cases, 1.10% was confirmed to suffer from Melanosis and 3.68% from Keratosis. The prevalence rate of Arsenicosis in Rautahat is 5.3% and that of Bara is 3.61%. The highest prevalence rate is found in the age group of 15 - 49 years in Rautahat and that of Bara 65+ years. Whereas the lowest value/negligible in the age group of 5 - 14 years in Rautahat and Bara. The health survey of Arsenicosis symptomatic people of Rautahat and Bara confirmed of clear higher prevalence of Arsenicosis cases in male (53.54%) than in female (46.16%).

Of Arsenicosis symptoms identified, skin manifestations such as pigmentation changes (Melanosis) and Keratosis were common. Melanosis case of Rautahat is 1.06% and that of Bara is negligible and Keratosis case of Rautahat is 3.71% and that of Bara is 3.61%. Melanosis was commonly present on the Palm and Chest or trunk while keratosis on the Palms and Soles. Most of the patients was found to be suffered at the old stage and only a few were in the moderate stage. The questionnaire filled by different health workers confirms that 20% of them were aware of detecting Arsenicosis cases. This implies that limited health worker can not overcome the Arsenic related issues. Therefore, health workers' capability or skills needs to be accelerated and for that conductance of more Training and Workshops would be more appropriate.

Table No 4

Description	Study District		Total
	Rautahat	Bara	
Total VDCs	96	98	194
Sample VDC	3	2	5
Arsenicosis Prevalence rate (%)	5.3	3.6	4.45

Survey of 250 households shows that in Sangrampur 2.65% are affected by Black/White Spot on skin and 0.26% from thick and rough skin, in Raghunathpur 1.32% are affected by Black/White spot and in Samanpur 0.26% is affected by Black/White Spot. Besides, Melanosis and Keratosis has also been the major problem. In contest to Melanosis, 1.06% are affected in Palm, 0.79% in Sole and 1.06% in Trunk and in contest to Keratosis, 3.44% are affected in Palm and 0.26% in Sole.

In Purainiya 0.60% is affected by Black/White spot on skin and 0.60% from Thick and Rough skin, in Batara 1.20% are affected by Black/White spot and 0.60% from Thick and Rough skin. In contest to Melanosis, no any patients have been identified but in contest to Keratosis 3.61% are affected only in Palm.

Only 0.60% has claimed about skin itching but others have regarded painless in the skin.

Table No 5

Community	Rautahat		Community	Bara	
	Black/White Spot	Thick and Rough skin		Black/White Spot	Thick and Rough skin
Sangrampur	2.65%	0.26%	Purainiya	0.60%	0.60%
Raghunathpur	1.32%	-	Batara	1.20%	0.60%
Samanpur	0.26%	-			

## 6.2 Causes of Arsenicosis in the Study Area

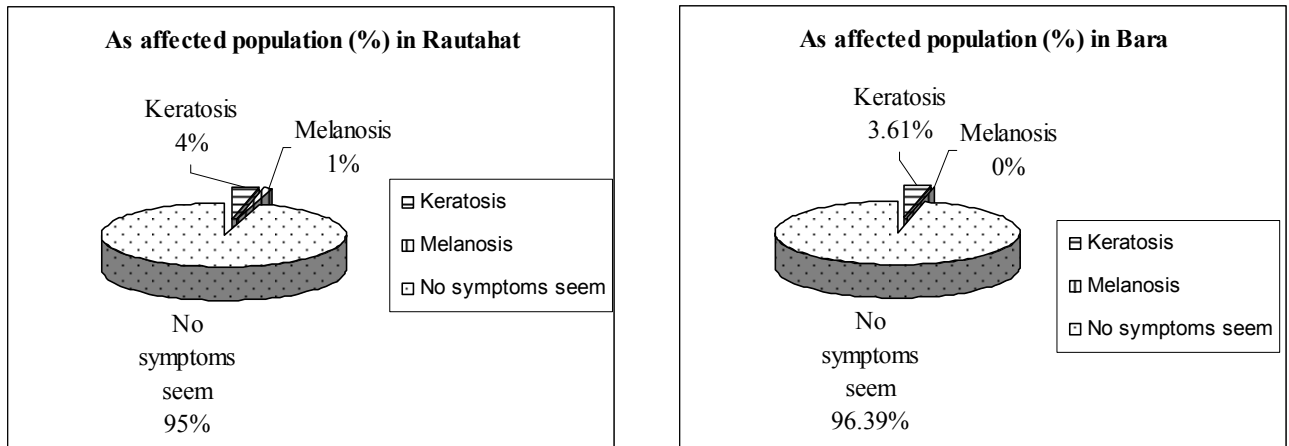
Water enriched Arsenic above 50ppb is one of the important cause of Arsenicosis.

Symotoms can be identified by Black/White spot and Thick & Rough skin. Melanosis and Keratosis are its result caused due to cumulative nature of Arsenic toxicity. Skin itching has also become an issue.

Table No 6

Rautahat		Bara	
Melanosis	Keratosis	Melanosis	Keratosis
1.06%	3.71%	-	3.61%

Figure No 6



## 6.3 Issues and Problems related to Arsenicosis

Health workers' knowledge and Skills towards Arsenic and Arsenicosis is very less. Most of them do not know the exact about Arsenicosis and its health impact. They could not recognize its signs and symptoms. It is not possible for them to detect, manage and surveillance of Arsenicosis cases in their community. It is seen that they are not familiar with preventive measures, primary treatment and referral mechanism.

There is lack of **Co-ordination** between Health Workers and community and other organizations like NRCS, DWSS, ENPHO, DOH and MOH.

Health Workers are not involved in any activities carried out by different organizations regarding Arsenic. They are not aware of any **mitigation programs** like local filter systems (Biosand filter, 2 gagri filter, Kanchan filter). Communities are also not involved and encouraged in knowledge dissemination, preparation, supervision and monitoring of local filter activities, reporting or referral of suspected cases to Health institution.

Arsenic problem is identified but no National mitigation program is seen. In spite of its higher occurrence too, Ministry of Health has not yet included Arsenic issue in five year and Annual plan. Arsenic issue is not included in National Health Training and Information Education

Communication Program. Operational research regarding Arsenic, its source, occurrence, Health impact and mitigation is not seen being done in Co-ordinated approach. Social mobilization is a key factor for the success of any Programs, however it is not seen in the program till date. Besides this, no linkage is to be seen with other Community based social sector program like **Poverty reduction activities**.

## Chaper 8

### 8.1 Conclusion

The study focuses great attention towards: orientation to Health Workers of 5 selected communities of Terai region, Arsenicosis detection, conductance of disease surveillance of Arsenicosis, awareness raising and organization of national workshop. In order to detect the cases of Arsenicosis and hence initiate the management of these cases, the study was carried out in three distinct phases: Review phases, Field study phase and Data processing and Analysis phase. Field study phase comprised of Site selection, Field Reconnaissance, Orientation to Health Workers, Awareness raising to the local communities and Detection and Surveillance of Arsenicosis.

The communities have been chosen on the basis of level of vulnerability to Arsenic contamination and very low uncertainty level designated by the study of NASC/ENPHO in 2003. Based on the study report, 3 Village Development Committees (VDCs) of Rautahat and 2VDCs of Bara were selected as the target communities for the study.

The study concludes that most of the health workers from Rautahat and Bara knew about Arsenic but only few knew about Arsenicosis. In Rautahat 53.33% of health workers knew about Arsenic while remaining (46.66%) were unfamiliar. Whereas 6.66% of them were aware of Arsenicosis and remaining (93.33%) were unfamiliar.

In Bara 90% of the health workers knew about Arsenic while remaining (10%) were unknown. But in context to Arsenicosis only 30% were familiar while remaining (70%) were unfamiliar.

The occurrence Arsenicosis among the exposed population in Rautahat and Bara according to survey of 250 households reveals the majority in Male than in female. Maximum populations are being affected above 25 years of their age. The majority of population is being affected by Keratosis problem rather than Melanosis. Out of total population, 4.78% are suffering from Arsenicosis problem. However this rate may be related to more recent

exposure of the population to Arsenic contamination or small sample. This prevalence will continue to increase in future because of the Cumulative nature of Arsenic toxicity. Policy decision is now the major parameter to find the alternative safer sources of drinking water or to run containment program with provision of decontaminating filters and processes. Preferably controlled cohort study is necessary for further understanding of the health effects of Arsenic contamination in drinking water

## 8.2 Recommendations

1. Conductance of **Orientation, Training and Awareness** programs for Health Workers seems to be very effective. So it should be carried out in other affected communities.
2. There should be Proper **Co-ordination** between Health Workers, Community and other organizations like NRCS, ENPHO, DWSS, DHO and Central Level Health Service.
3. Health Workers should be well facilitated for any activities carried out by different organizations regarding Arsenic. Besides they should be aware of **Mitigation Programs** like local filter systems (Biosand filter, 2 gagri filter, Kanchan filter) and reporting or **referral** of suspected cases to Health institution.
4. Community should be well **skilled** for proper water test activities and prepare water treatment facilities, repair and maintenance and monitoring so that it would be more sustainable.
5. Arsenic issue should be included in National Health Training and Information Education Communication Program
6. **Social mobilization** is a key factor for the success of any programs, therefore great attention should be taken towards it, for this integrated approach is essential
7. Since Poverty is also one of the main challenge, therefore linkage is to be developed with other Community based social sector program like **Poverty reduction** activities
8. District level offices of concerned Ministry should work together to overcome Arsenic Problem and DHO should be aware of any Arsenic programs carried out by different organizations.
9. One relevant Ministry should be identified as **Lead Ministry** under which National level functional Steering Committee should be established.
10. It is necessary to **screen** all the tube wells of the villages for Arsenic contamination to know the Arsenic safe or contaminated tube wells.
11. **Awareness** building and motivational programs regarding Arsenic contamination and its health need to be organized in the villages.
12. For Sustainability, there is a dire need to promote local communities to take **active part** in problem identification and management of the suspected cases.

13. All training manual whether technical or non technical should be developed involving all concerned.
14. **Policy decision** is the most effective tool or to initiate containment program with provision of decontaminating filters by Ministry of Health.
15. There is dire need to **Review** the existing Steering Committee Function.
16. The Arsenicosis cases should be supported with appropriate counseling and health education programs.
17. **Promotion of filter system** such as Two gagri filter, Bio-Sand filter, Kanchan Filter, etc should be initiated.
18. **Further health survey** should be conducted in **Cohort approach** with the initiation from the Ministry of Health in all hotspot areas and a separate recording system should be developed in all health institutions for identification, treatment and monitoring of Arsenicosis patients.
19. Inorder to justify prevalence of Arsenicosis related to drinking water contamination as compared to other affected areas, **more preferable research strategy** are to be needed.



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### ANNEX 3

#### Participant List- Community Awareness Program

Field Site	Name
Samanpur VDC, Rautahat	Chandra Kala Devi
	Tirha Devi
	Champa Devi
	Malati Devi
	Sita Kumari Shah
	Kbiman Khatun
	Chandreshwor P. Shah
	Sangita Shah
	Chameli Devi
	Gayatri Devi
	Babu Lal Chaudhari
	Dipendra Das
	Santosh Kumar Chaudhari
	Khadga B. Shrestha
	Shankar B. Shrestha
	Santosh Kumar Tiwari
	Ranjan B. Shah
	Hemant K. Pant
	Bhagya N. Tiwari
	Ram Gopal Sah
	Rudhra Raj
	Hari Sanker Sah
	Habiban Khatun
Pramila Devi	
Sagarbati Devi	
Sangrampur VDC, Rautahat	Anandi Devi
	Mahabati Devi Sah
	Kaliya Devi
	Nagiya Devi
	Rakhika Devi
	Fuljhariya Devi
	Basundhara Devi
	Ramadulari Devi
	Pufiyama Devi
	Mira Devi
	Rambalak Prasad
	Bijundar Ray Yadav
	Sambhu Prasad Patel
	Hari Kishor Sah
Shyam Sundar Mishra	
Bir Bahadur Sah	

	Nanda Kishor Yadav
	Rajendra Ray
	Bindeshwor Sah
	Ram Pukar sah
	Sakindra Prasad Patel
	Prem Narayan Ray
	Tekesh Chaudhari
	Mohan Chaudhari
	Narahari Chaudhari
Raghunathpur VDC, Rautahat	Shek Majahar Alam
	Deep Lal Sah Teli
	Dhar Narayan Sahani
	Shek Amarullaha
	Jokh Prasad Sah
	Upendra Sah Teli
	Panilal Das
	Sarf Lal Paswan
	Sudish Lal Srivastab
	Ramdayal Mahato
	Jagar Nath Sah
	Rabindra Kumar Das
	Chandrashwor Sah
	Shek Yarmahagad
	Paramanda Das
	Mohammad Abdul Kalam
	Baiju Lal Sah
	Pramod Kumar Mishra
	Mamar Lal Gulal
	Jasodha Devi
	Bajariya Devi
	Paniya Devi
	Koseli Devi
	Saradhe Devi
	Sunaina Devi
	Souman Khatun
	Sagar Batiya Devi
	Sadhe Deri Devi
	Kabila Khatun
Purainiya VDC, Bara	Kalabati Devi
	Sunita Devi
	Jay Kali Devi
	Uma Devi
	Dhanwar Khatun
	Husan Khatun
	Symulne Sah
	Rameshwor Dubedi

	Bachha Singh
	Shiv Shankar Baitha
	Abdul Haqim
	Aftab Allam
	Parikchyan Ray
	Dularchan Ray
	Rajip Patel
	Dhirendra Jha
	Ramchandra Thakur
	Panilal Ray
	Chabilal chaudhari
	Prasant Narayan Sah
	Arjun Ram
	Dwarika Jha
	Ram Bilas Chaudhari
	Binaki Jha
	Ram Kalewar
Batara VDC, Bara	Poonam Devi
	Mahjari Devi
	Jasoda Devi
	Thetal Devi
	Gandhari Devi
	Kalawati Devi
	Meena Devi
	Daulati Devi
	Devkali Devi
	Ram Chetri Prasad Sah
	Achela Sah
	Dasai Paswan
	Ganesh Prasad Sah
	Ram Lochan Prasad Yadav
	Shambu Prasad Sah
	Maya Devi
	Masika Devi
	Uma Devi
	Gayatri Devi
	Ramadulari Devi
	Hari Lochan Yadav
	Devan Prasad Chaudhari
	Mohan Krishna Yadav
	Sohan Kanta Raya

## ANNEX 5

List of Participants of “Dissemination Workshop On Detection and Management of Arsenicosis in the selected local Communities of Terai Regions of Nepal”

S.N	Name	Designation	Institution	Address
1	Dr.S.K Pahari	Chairman	NHRC	Ramshapath
2	Dr. S.P Singh	Member Secretary	NHRC	Ramshapath
3	Dr. M.B Bista	Director	EDCD	Teku
4	Mr. A.K. Mishara		DWSS	Panipokhari
5	Prof.Dr. Umakant Ray Yadav	Department Chief	TU,CDES	Kirtipur
6	Dr. Madan Koirala	Scientific Advisor	Ministry of Environment, Science and Technology	Singhdurbar
7	Dr. Dirga Singh Bam	Chief	Focal Point, MOHP	Ramshpath
8	Dr. Krishna R. Amatya	Environmental Chemist	Soil Test	Baneshwor
9	Dr. L.R Pathak	Consultant	NHRC	Ramshapath
10	Dr. Manen Prasad Gorkhaly	Consultant	NHRC	Ramshapath
11	Dr. Rajendra K.BC	Research Officer	NHRC	Ramshapath
12	Dr. Saroj Prasad Rajendra	Focal Point	Environmental Health, MOHP	Ramshapath
13	Dr. Sudhamshu KC		Bir Hospital (NAMS)	Mahaboudh
14	Mr. Bhupendra Das	Consultant	NHRC	Ramshapath
15	Mr. Bipin Dangol		ENPHO	Baneshwor
16	Mr. Mohan Singh Khadka	Deputy General Manager	NBSM	Balaju
17	Mr. Meghanath Dhimal	Research Officer (Environmental Health)	NHRC	Ramshapath
18	Mr. Nirbhay K. Sharma	Administrative Officer	NHRC	Ramshapath
19	Mrs. Pearl Banmali	Research Officer	NHRC	Ramshapath
20	Mr. Subodh K. Karn	Account Officer	NHRC	Ramshapath
21	Mr.Sharad Prasad Adikari	NOO	WHO	Pulchowk
22	Mr.Shyam Prasad Adhikari	Thesis Year Student	CDES,TU	Kirtipur
23	Mr. Sunil Babu Khatry		NESS	Thapathali
24	Mrs.Shailee Singh Rathor	Program Assistant	NHRC	Ramshapath
25	Mr. Bijay Jha	Proram Assistant	NHRC	Ramshapath
26	Mr. Ajay Karn	Program Assistant	NHRC	Ramshapath
27	Mr. Gopal K. Prajapati	Program Assistant	NHRC	Ramshapath
28	Mr. Pursotam Dhakal	Program Assistant	NHRC	Ramshapath
29	Dev Bahadur Kunwar	Reporter	Gorkhapatra	New road

			Daily	
30	Rekha Kusum	Reporter	Rastriya Samachar Sammittee	Kathmandu
31	Dr. Ram Bahadur Sha	Associate Professor, Central Department of Geology	TU	Kirtipur
32	Jagannath Aryal	CDES	TU	Kirtipur
33	Pravin Aryal	SDE	MOWR	