CHAPTER-1
INTRODUCTION

Clean water is an essential ingredient to life and development and investing in water and sanitation is imperative for community health and maintaining related human development index parameters. Water quality influences every one of us, and our lifestyles affect the quality of our water. United Nations (UN) General Assembly declared in 2010 that safe and clean drinking water and sanitation is a human right, essential to the full enjoyment of life and all other human rights. These commitments were built on a long history of support including the UN General Assembly adopting the Millennium Development Goals in 2000 and declaring the period 2005–2015 as the International Decade for Action, “Water for Life” (WHO, 2017).

In world over 884 million people still use an unimproved drinking water source (UNICEF and WHO, 2008). According to World Health Organization fact sheet on Drinking water updated in 2017 contaminated water can transmit diseases such diarrhea, cholera, dysentery, typhoid and polio and that is estimated to cause 502,000 diarrheal deaths each year. As per an earlier report, 801,000 children younger than 5 years of age perish from diarrhea each year, mostly in developing countries. This amounts to 11% of the 7.6 million deaths of children under the age of five and means that about 2,200 children are dying every day as a result of diarrheal diseases (Liu et al., 2012). Unsafe drinking water, inadequate availability of water for hygiene, and lack of access to sanitation together contribute to about 88% of deaths from diarrheal diseases (Pruss-Ustun et al., 2008). It was estimated that 220 million people in India do not have the access of safe drinking water and 86 percent of total diseases in the country is directly or indirectly related to poor quality of drinking water (Bansil, 2004).

Waterborne illness results when pathogens enter the water supply without detection and are then consumed, either directly through drinking water or indirectly from contaminated food and unsuspecting sources. Another problem related to the issue of safe drinking water is the unwanted burden of physicochemical attributes. The level of parameters like fluoride, nitrate, TDS, hardness etc. is also cardinal for the community health. Water quality problems are related to pollution and.
unwarranted contamination of drinking water resources. Water borne diseases like cholera, gastroenteritis, diarrhea erupts every year during summer and rainy seasons in India due to poor quality of available drinking water and sanitation problems. Even municipal water supplies are not strictly monitored for bacteriological and chemical contamination. Microbial contamination is one of the major issues of water pollution apart from the industrial effluents and heavy metals in water sources. This problem usually occurs due to inadequate and incompetent management of resources as well as inflow of sewage into the source. Studies and reports of numerous authors and agencies like WHO, FAO, and Central water board, Central Ground water board, Pollution control boards of India and states has emphasized this problem times and again.

Microbial contamination leads to gastrointestinal illness (GII) which comprises a constellation of symptoms that may include diarrhea, nausea, vomiting, abdominal pain and cramps, fever etc. One of the major symptoms of these GII diseases is diarrhea, which causes about 2.2 million deaths throughout the world, mainly in India, Africa, and South America (WHO, 2000). It is more prevalent among children and elderly in the population of lower economic strata not practicing proper hygiene. A number of different pathogenic agents, including bacteria, viruses, protozoans and helminthes are the causative factors of water-borne diseases. In developing countries, gastroenteritis is a common cause of death in children below 5 years. According to the World Health Organization, diarrheal disease accounts for an estimated 4.1% of the total daily global burden of disease and is responsible for the deaths of 1.8 million people every year (Bansi, 2004).

Fecal matter of human or animal origin can contaminate all kind of water sources like rivers, streams, lakes, ponds, streams, wells, reservoirs and rainwater runoff into tanks and cisterns. Apart from direct consumption of contaminated water, the water borne illness can also spread through means such as via clothes, hands, foods, materials used for cooking, eating and drinking. Frequently observe on salads served in parties. Salad washed in unclean water can be the source of such infection. Pathological microorganisms can enter the body through an open wound, eyes and nose as well. Public drinking water may represent only one source of waterborne contaminant exposure, as others are contaminated recreational waters, swimming pools and water parks, medical or dental devices, and commercial bottled water.
Infections owing to such exposure lower the body’s resistance and rob the intake of nourishment resulting in further infections and disease complications.

Personal and domestic hygiene practices indirectly depend on the socio-economic condition and education level of the concerned community. The people with formal education are more conscious about their health and always try to maintain proper hygienic condition in their houses (Nayyar, 2014). Therefore, the access to sanitation is not an infrastructure problem; there is a deeper behavioral and socio-cultural context at play. Open defecation dates back to the beginning of human civilization. It has been a way of life for millions of people in India for centuries. Successive governments have been running national sanitation programmes since the 1980s, but until 2014, only 39% of Indians had access to safe sanitation facilities (Jaitly, 2017). Influencing a change in behavior for 60 crore people is a challenge that has probably never been undertaken by anyone in the world. This could only be achieved through an intensive, time-bounded intervention, spearheaded from the highest level, and involving all sections of society and government alike.

The study may reveal that there are numerous barriers in detecting circuit of waterborne infections and the source of contamination. Understanding this subject area will provide the key elements necessary for healthcare providers to improve their clinical expertise on water-related disease and to enhance their awareness of water quality issues in their community.

The World Health Organization (WHO) has issued revised drinking water guidelines, urging governments to strengthen water quality management and asking water-supplying agencies to improve their provision quality in order to prevent episodes of water borne disease. Many of the signs and symptoms of waterborne disease and the health effects of water contamination are non-specific and often mimic other common diseases. So, well established disease surveillance systems can be very effective in monitoring, detection and control of such epidemic problems. Studies in this area may result in an improved understanding of the protection of water sources from contamination, up-gradation of water treatment technologies and development of strategies to prevent further outbreaks of related illness. Lack of awareness and poverty are considered to be the element for poor understanding of sanitation and personal hygiene. Awareness programs for the local communities are
warranted for alleviation of this problem. A Study by World Bank estimates that nearly 40% of India’s children are physically and cognitively stunted, primarily because of the lack of sanitation. Such a large proportion of our future workforce not being able to reach their full productive capacity poses a serious threat to our biggest strength and demographic dividend. The World Bank also estimated that the lack of sanitation costs India over 6% of our Gross Domestic Product (Jaitley, 2017).

Surface water bodies are presumed to be more susceptible to fecal contamination than groundwater reservoirs due to the absence of natural soil protection, filtration and possibly short distances between the point of contamination and water procurement. It is opined that during the heavy rainfall the microbial loads of running water may suddenly and substantially increase and reach reservoir bodies (Kistemann et al., 2001).

However, such studies were not carried out earlier for Dungarpur apart from Rathor et al., (2016). The selected water resources for present study are Gap sagar Lake, Dimiya Dam, Margiya Dam, Patri Dam (Dungarpur reservoir) and Sabela pond. In the study of Rathor et al., (2016) water quality of only one of these water bodies and only for physico-chemical characteristics was investigated. In view of this, an attempt has been made to assess the impact of drinking water on human health in prevailing conditions of its availability and contamination in this district. This is also a case study of water-borne illness in the context of socio-economic and educational background of residing community. The present investigation will embody the “Water borne gastrointestinal illness and impact of socio-economic status in Dungarpur district of southern Rajasthan: A case study”.

1.1 Scenario of Dungarpur

Dungarpur district is located in southern Rajasthan state of India at latitude 23°21′:24°01′ and longitude 73°21′:74°23′. This is one the district in Rajasthan where the average rate of depletion in ground water has been rated to be critical. Dungarpur is predominantly a scheduled tribe (ST) inhabited area; ST population constitutes about 65 percent of the total as per the census of India 2001. Typical of a (central Indian) Bhil tribal way of life, the rural populations have traditionally depended on at least three sources of subsistence: forest produce (flora and fauna), animal husbandry and seasonal agriculture. According to 2011 census, total population of Dungarpur
district was 1388552 with the composition of 1299809 rural and 88743 urban population. The sex ratio was 1,019 women for every 1,000 men; the only district in the state where this ratio exceeds 1,000. Almost twenty-one per cent of the total population falls in the age group of 0-6 years. The district located at end of the Aravali mountain range, receives rainfall not too low compared to the rest of the state. However, in the last decade there has been a perpetual shortfall in precipitation. Dungarpur district has four tehsils. The literacy rate in Dungarpur district is 59.5 percent which is lower than the State Average (66.1 percent). The economy of Dungarpur district is mainly dependent on agriculture, 64.2 percent workers in the district are either cultivators or agricultural or urban laborers. In 2006, the Ministry of Panchayati Raj (Govt. of India) named Dungarpur one of the country’s 250 most backward districts in country.

Illiteracy, unemployment, poverty and poor governance entwined with social beliefs, ignorance, superstition and perceptions of this area lead to many health related problems and untimely death of patients suffering from preventable diseases (like: diarrhea). Some of the rural areas of Dungarpur are located far away from the city and thus population residing these areas are far from the basic facilities including hospitals or health posts (Primary or Community Health Centers (PHC and CHC)). The PHC and CHC are usually away from the community settlement and hospitals are at the district or tehsil headquarters, and all these health centers are also understaffed.

Poverty in this tribal dominated area is major cause of unaffordability of health services. Financial crunch is so acute that residents cannot afford travelling expenses, food and lodging expenses and medical bills away in hospitals. So instead of going to the city hospitals they rely on Jhola Chhap Doctors (Unqualified personnel who are practicing medicine in these remote areas) and traditional options like going to Bhopas (local exorcist) without thinking of the consequences. In rural India, lack of safe water and sanitation facilities results in worsening public health conditions, deteriorating quality of life and increased economic costs to society (Pokhrel and Viraraghavan 2004).

1.2 Drinking water and sanitation facility in Dungarpur

The average annual rainfall at Dungarpur is approximately 750mm, but because of the highly undulating terrain, the retention capacity is low; hence, there is
perpetual shortage. Next, the water reservoirs cannot effectively cater to the population as the settlements are scattered. An added factor: the reservoirs are also not properly managed and maintained. Hand-pumps provide most of the water for human consumption, and almost 55 per cent wells/hand-pumps are dry for at least some part of the year. Locals are therefore, forced to depend on waters accumulated in the small patches and ponds near their habitats for their daily needs (incl. human consumption). Since these waters are subject to multiple human usages, hence in addition to being contaminated- they are mosquito-infested as well and water borne diseases are widely prevalent.

Water-borne diseases like acute diarrhea are responsible for higher morbidity and mortality among all age groups in the population, especially during rainy season. Eating and food storage habits also matter: many households eat leftover (unpreserved) food in their next meal. So, unprotected food, left for long periods, is susceptible to bacterial and fly-borne infections. Poor sanitation (e.g. improper disposal of human and animal excreta, or living in the same shelter along with cattle) contributes to unhygienic environmental conditions and hence, water-borne illness, skin problems and malaria is prevalent. The problem is perpetuated by low literacy coupled with unscientific cultural beliefs. Lack of access to medical facilities further aggravates health problems.

People are more likely to drink untreated water as water supply system in the rural area does not have provision of water treatment facilities. During the dry seasons (March/April to May/June) there is huge scarcity of water in Dungarpur, while in rainy season (June/July to September/October) the availability of water increases as the quantity but is severely contaminated with excreted organisms due to surface water runoff. Many areas of groundwater and surface water are laden with high fluoride and now said to be contaminated with heavy metals, POPs (persistent organic pollutants), and nutrients also causing adverse effect on health.

According to various earlier surveys and human development indices Dungarpur is among of the most backward district of India. As mentioned earlier, more than 60% of population is tribal and general economic profile of the people residing in the district falls in poor category. Resources of drinking water are also scarce in some of its pockets. Hence, during the months of summer people living in
small / isolated dwelling and on hillocks have to depend on the open water bodies for drinking purpose as hand-pumps and other sources dries up. Lack of toilet facilities compels the village populace to defecate in field and unknowingly near a water source. Flooding during the rainy season leads to major coliform contamination of drinking water sources. In such a scenario occurrence of GI problem is very common all through the year and in rainy season, all the hospitals and health center register a major surge in the number of such patients. Hence, in this district general problem of water borne GI illness somehow augments the other problems of the people. This problem of microbial contamination of drinking water and consequential symptoms of GI epidemic gets more compounded when the sanitary condition are poor due to economic backwardness and unawareness towards observing proper hygiene in daily life, and Dungarpur district falls in such a category. Hence, studying the problem of water born GI illness in this district is very relevant particularly in socio-economic prospective.

1.3 Objectives

The goals of this study were to investigate the incidence of waterborne illness in Dungarpur, describe the complex systemic inter-relationships between disease incidence, water quality (Physico-chemical and microbiological), and to project the potential impact of socio-economic status on those relationships.

The objectives of this study are:

1. To determine if the quality of the surface water investigated may pose any significant health threats to the people of the communities that utilize the water.

2. To investigate the issue of the community health related to the use of drinking water and hygiene practices in the background of economic and social profile of the surveyed groups.

The research addresses the possible consequences of the incidence of (waterborne) infectious diseases on vulnerable populations that are important for public health policy and identifies where and how the expected environmental changes resulting from climate change will affect population health in terms of waterborne disease incidence, outbreaks, and hospitalizations.
1.4 Hypothesis

The domestic waste and sewer is being directed to the main water reservoirs of the area. Besides, lack of toilet facilities in rural areas compels the people to defecate in open. During monsoon and other season the fecal matter or sewer line joins water body. This is bound to cause microbial load in the sources of drinking water and it is imperative that microbial load or contamination manifest itself into the elevated score of water borne disease among general population.

The group of bacteria that can be found in intestinal tract of humans and other mammals mainly belongs to *Enterobacteriaceae*. These short, gram-negative non-spore forming bacilli can be grouped into Pathogens (*Salmonella* and *Shigella*), occasional pathogens (*Proteus* and *Klebsiella*) and normal flora (*Escherichia coli*: though some *E.coli* strains are pathogenic; and *Enterobactor*). There are many other microbial pathogens like *Campylobacter jejuni*, *Vibrio cholerae* etc. Many Protists are also causative factors of waterborne ailments like diarrhea and gastroenteritis. Their transmission occurs through zoonotic/environmental route and reservoir hosts. Detection of enteric microbes particularly the *E. coli* and other coliforms in water indicates its fecal contamination and health hazard potential.

The lack of awareness towards the proper hygienic practices in daily life that is some how related to the economic and educational strata of the concerned community, and sanitation problem simply aggravates the general health issues related to drinking water.

1.5 Data Sources and Collection Procedures

The samples for analysis of water were collected from the said water bodies, which are the sources of drinking water. To ascertain the seasonal fluctuations sampling was conducted thrice in different seasons of the year.

To procure the data of the socio-economic and educational background of the people along with their water-borne sickness general survey was conducted using a carefully prepared standard questionnaire.

1.6 Scope of Work

The importance of the availability of safe drinking water cannot be over emphasized. It has been stated earlier that 220 million Indians do not even have
access to safe drinking water. And, as such study in this area has not been conducted earlier, so in view of the gravity of this problem, generation of this data was imperative. The outcome of this study will identify the issues related to the problem in the integrated context.

An improved drinking water source is one that by the nature of its construction adequately protects the source from outside contamination, in particular from fecal matter. An improved sanitation facility is one that hygienically separates human excreta from human contact. In addition, water should be provided in sufficient quantities to enable proper hygiene. If, no action is taken to address unmet basic human needs for water, as many as 135 million people will die from these diseases by 2020. This problem is one of the most serious public health crisis facing us, and deserves far more attention and resources than it has received so far (Peter H. Gleick, 2002). Therefore, safe drinking water is the major problem of the economically poor countries in tropical region of the world and India is none of exceptions. Water borne disease constitutes a major public health hazards in India also and 70% of epidemic emergencies are either water born or water related (Khera et al., 1996).

Although it is impossible to eliminate the risk of waterborne disease, still adopting a multi-barrier, source-to-tap approach to safe drinking water will reduce the numbers of microorganisms in drinking water. This approach includes the protection of source water (where possible), the use of appropriate and effective treatment methods, well-maintained distribution systems, and routine verification of drinking water safety (Health Canada, 2003). Besides, water analysis and survey data also warrants community awareness campaign related to this problem and sanitation issues. The study would signify the ways to mitigate the aforesaid hazard through all the approaches with its data and conclusions.