CHAPTER 2

MATERIAL AND METHODS

The Semi urban and rural areas in Maharashtra, as part of urbanization process are exposed to rapid transformation, without necessarily having needed adequate resource backup such as potable water, which invariably poor in quality and quantityKolhapur is an ancient settlement also known as ' Karveer nagari' situated on the bank of River Panchaganga in Southern Maharashtra. The geographical area of the Kolhapur district is 7685 sq. Km. It is located at 15"45 and 17"11' N latitude and 73" 40' and 74"42' E longitude. The population according to census 2011 is 3,876,001. Out of the total population, 31.73% mass lives in urban area while remaining 68.23 % lives in rural area (Census, 2011). The district has four talukas, amongst which the study areas that is Karveer taluka has been selected for the study purpose. Karveer taluka has an area of about 61895.68 hectors. Karveer taluka includes the Kolhapur city and many other small settlements within it, Thus, it ranks first in population and in density as compared to other taluka.

Considering this scenario; the present research work was carefully designed after a pilot survey. This included identification of sites from study area with rural background around Kolhapur city, to represent similar areas in the state. Selected Physicochemical and microbiological parameters were studied from household drinking water samples from the randomly selected household sites. The field investigations were carried out during the pre and post monsoon season for year 2013 -2014.

Profile of study area

Location map of Maharashtra state and Kolhapur district is given in Figure No. 2.1. Kolhapur district is situated in the eco sensitive Western Ghats region in Maharashtra and over 2/3 part of the district is hilly, forming upper catchment of several tributaries of Krishna River in its upper basin. The district lies between 15°43' and 17°17' North latitude and 73°40' and 74°42' east longitude. The district is surrounded by Sangli district to the north, Belgaum district of Karnataka state to the East and South and Ratnagiri and Sindhudurga districts to the West.

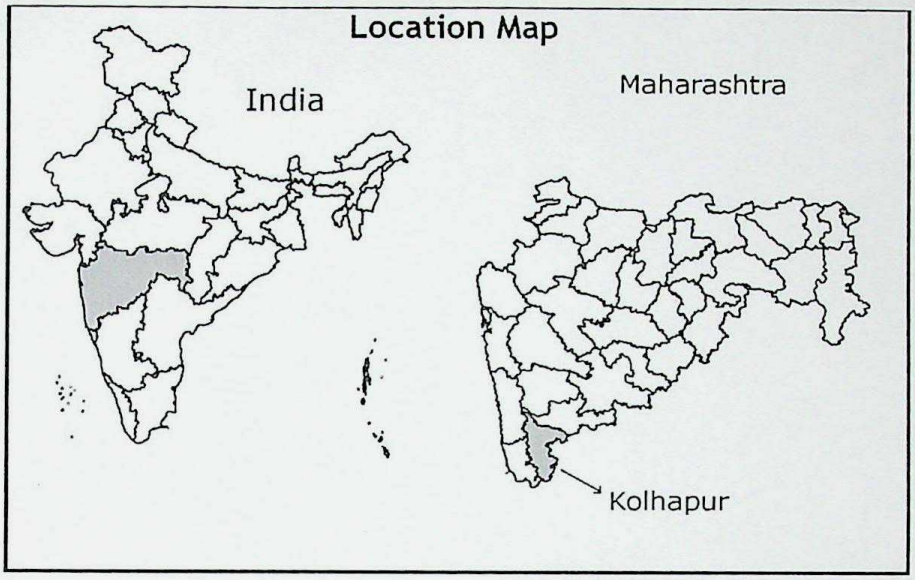


Figure No. 2.1. Location map of Maharashtra State and Kolhapur district

The Sahyadri mountain ranges, with high annual rainfall, form the west and Warna River to the north forms the natural boundary. The district has an area of 7685 sq. km, which is about 2.50% of the total area of Maharashtra state. Population of Kolhapur district, according to census 2011, was 3,876,001. Out of the total population of the district a majority (68.23%) lives in rural area. The district has 12 towns and 1203 villages spread over 12 Tahsils. A total of 128 villages are included in Karveer tahsil.

Climatic Conditions

The district experiences typical monsoon with three distinct seasons – summer, winter and rainy. The average elevation of Kolhapur city is 540 meters above mean sea level and leeward location with reference to the Western Ghats has made the climate moderate and healthy.

The minimum air temperature in winter season is about 15^0C and the maximum temperature in summer goes up to about 38^0C. However the average temperature remains around 27^0C. Three fourth of the annual rainfall of 1025 mm i.e. xx mm is during the months of June to September which is about 65 days in year. The wind

direction in the city is from western side and is about 5 Km.\hr. The average annual relative humidity is about 55% (ESR, 2012).

Sampling sites

Study sites selected from six villages in Karveer Taluka is given in Figure no. 2.2. During the study, selection of villages for drinking water sampling sites was done on the basis of overall objectives of the study. The sites were carefully selected during the pilot survey by visiting many potential villages with rural and semi-urban background in the study area. While selecting the field sampling sites, the entire village was covered in the initial rapid survey, interaction was made with the locals to understand their perception of local drinking water issues and only then the number, location and type of the sampling site was finalised.

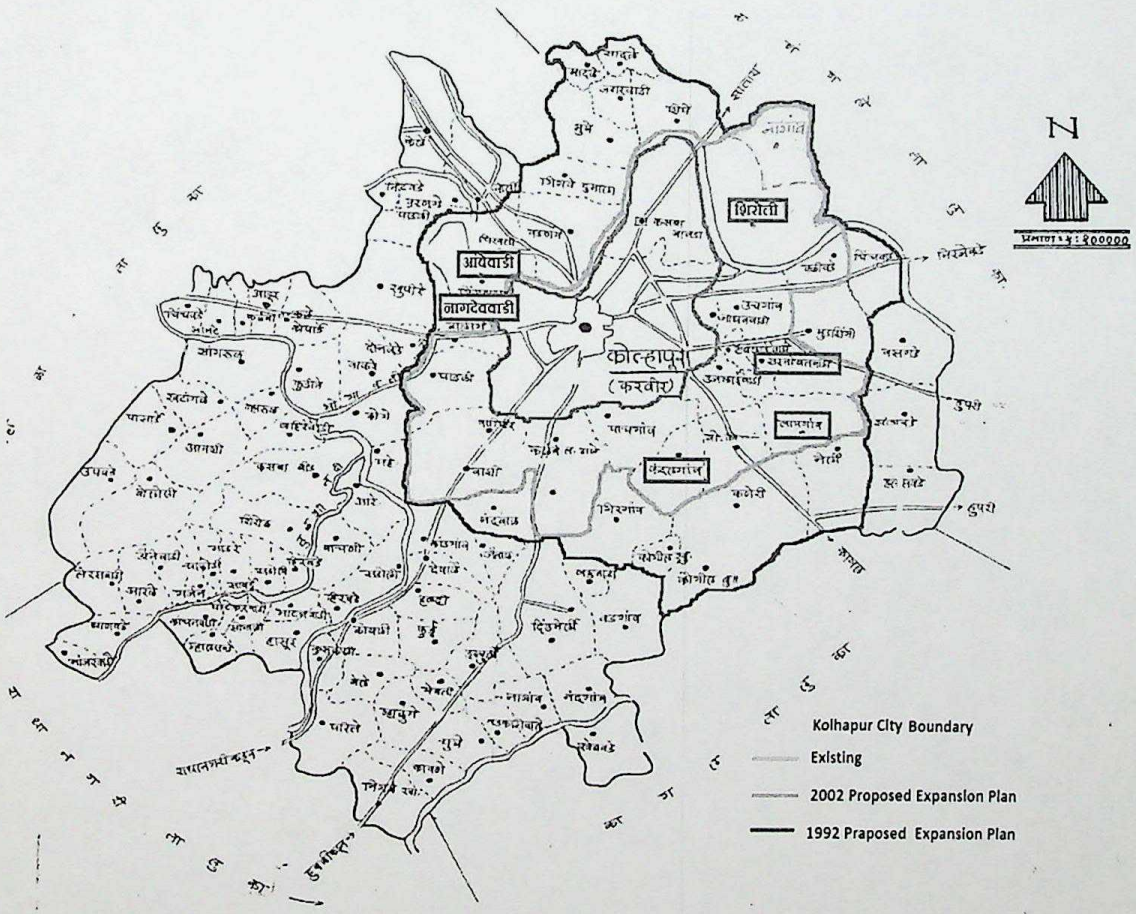


Figure.2.2 Map showing the six study villages in Kolhapur Municipal Corporation (KMC) existing Limit, proposed expansion of 1992 and proposed expansion of **2002**

The six villages thus short listed (Figure No. 2.2) are located on the boundary of Kolhapur city, and are included in the Kolhapur Municipal Corporation's city expansion plan which is under active consideration of Government of Maharashtra. Each study village since had different drinking water sources, were selected on the basis of their representativeness in addition to their specific locations and characteristics. Each village has different land use pattern and sources of drinking water supply.

A brief profile of the six villages selected for the study is given in Table 2.1

Table No. 2.1 Profile of the six study villages with the type of drinking water sources in study area (2011 census)

Name of village	MSL (Meter)	Distance from Kolhapur	Total Area (in ha)	Total Population	House holds	Water sources of village
Ambewadi *Latitude 16"71 Longitude 74"20*	570	5 Km	440.0	5,728	1,040	T W SS-T
Kandalgao *Latitude 16"38 Longitude 74"15*	630	8 Km	732.0	3,182	595	T HP W SST
Nagdevwadi *Latitude 16"41 Longitude 74"10*	548	15 Km	234.0	3,449	685	T W SS-T
Sarnobatwadi *Latitude 16"41 Longitude 74"16*	579	7 Km	43.0	2,586	565	T HP TW SS-T
Shiroli *Latitude 16"45 Longitude 74"16*	573	18 Km	828.0	5,926	940	T HP TW W R SS-T
Tamgao *Latitude 16"71 Longitude 74"20*	569	12 Km	804.0	4,189	978	T HP W SST

i) T: Tap water, ii) W: Well water, iii) TK: Tank Water, iv) TW: Tubewell Water v) HP: Handpump, vi) R: River water, vii) C: Canal water, viii) L: Lake water, ix) S: Spring, x) O: Others, and xi) SS: Summer source.

Ambewadi village s located on the bank of Panchaganga River, and at 570 m MSL along National Highway NH17. This is one of the low lying areas adjoining the river and always gets flooded during monsoon season. Most of the area in Ambewadi village is agriculture land with sugarcane (Figure No. 2.3). Kandalgao village is located on east? and 8 Km from Kolhapur city in the catchment of Kandalgao dam at 630 m MSL. This village is also surrounded by agricultural fields, sugarcane and horticulture (Figure No.2.4). From last few years residential area and educational institutions with hostel facilities are developing in this area.

Nagdevwadi village is located on the bank, and upstream of Panchaganga River at 548 m MSL. This village is also predominantly agriculture village (Figure No.2.5). Sarnobatwadi village is located on either sides of Pune- Benglore national Highway (NH4) and thus divided into two parts due to road. The surroundings of the village are grasslands or barren lands. This village is one of the nearest villages to Kolhapur city, and therefore under urban influence. The village has many old stone quarries (Figure No.2.6). The ribbon development, mainly small industries and commercial ventures are mushrooming along the road in the village boundary.

Shiroli village is located along the National Highway (NH4) at 573m MSL. Large part of the village is now in industrial area of Shiroli M.I.D.C., The village is now semi urban with heavily crowded residential area and small industrial units and number of warehouses. (Figure No. 2.7). Tamgao village is also located near industrial development area of Gokulshirgao MIDC and now has much less agricultural activities (Figure No.2.8). It is 12 Km away from Kolhapur city and at 569 m MSL. The water sampling sites from the six study villages and their codes are given in Table n. 2.2 along with the source of water at the site from where the households were collecting their drinking water supply.

Table No. 2.2 Water sampling sites with their codes and type of water source

Sr. No.	Sampling village Sites	Site Code	Household Source
1.	Ambewadi	S1	Tap
2.		S2	Well
3.	Nagdevwadi	S3	Tap
4.		S4	Tap
5.	Kandalgao	S5	Well
6.		S6	Well
7.	Sarnobatwadi	S7	well
8.		S8	bore
9.	Shiroli	S9	Tap
10.		S10	bore
11.	Tamgao	S11	bore
12		S12	bore

Two separate households in each study village were selected for collection of drinking water samples. The major type of water sources in the villages were taken into consideration. The sources selected and sampling site for each of the source were namely pipeline water supply (4), bore well (4) and open wells (4) i.e. a total of 12 samples from the six villages in study area.

Collection of Samples:

Water samples were collected in clean polythene cans of 2 litres capacity as per the standard sampling protocol provided by APHA. Physico-chemical analysis was carried out within 24 hrs after collection of samples. Due care was taken during sampling with reference to the container, gaseous exchange, sample analysis time, preservation required. The sample containers were properly washed in the laboratory prior to collection,. During collection in the field containers were rinsed 2 – 3 times with the sample to be analyzed before filling. The containers were directly filled with the sample on tap or with clean vessel and tightly capped. For transportation, sample

bottles were placed in sturdy, in the laboratory for further analysis. For field study of parameters glassware and reagents were taken to the field without contamination and tests were carried out.

Frequency of water samples:

The frequency and duration of water sampling is an important issue that should be considered while designing a sampling plan (Sunderam *et al.*, 2009).Since the sampling was done seasonally, the respective samples were collected in the Pre monsoon and Post monsoon season i.e. four times in a year. The basic aim of sampling was monitoring the variations in the quality of water of Karveer Taluka of Kolhapur district. The obtained results and their discussion have been further represented with average values. The average value was taken into consideration so as to avoid the ambiguity of the data.

Analysis of drinking water samples from study area

All the selected water parameters were analysed using methods described in the Hand Book of APHA, 20th edition, (2001). The water analysis was carried out into three separate parts such as: a) Physical parameters, b) Chemical parameters and c) Microbial analysis. The methods used in analyses of each of the fifteen parameter studied is given in the Table No 2.3

Table No. 2.3 Physicochemical and microbial parameters with their method

Sr. No.	Parameter	Method
1	Temperature °C	Thermometer
2	pH	Potentiometric (APHA part 4500)
3	EC (µS/cm at 20°C)	Conductivity meter (APHA part 2510)
4	Turbidity (NTU)	Nephelometer (APHA part 2130)
5	Hardness (mg/l)	EDTA Method (APHA part 2340)
6	Ca++ (Mg/l)	EDTA Method (APHA part 3500-Ca)
7	Mg++ (mg/l)	Calculation method (APHA part 3500-Mg)
8	Total Solids (mg/l)	Gravimetric (APHA part 2540)
9	TDS (mg/l)	Gravimetric (APHA part 2540)
10	TSS (mg/l)	Gravimetric (APHA part 2540)
11	Chlorides (mg/l)	Argentometric Titration (APHA part 3500-Cl)
12	Nitrates (mg/l)	UV spectrophotometer (APHA part 4500-NO_3)
13	SPC (CFU)	Nutrient agar
14	MPN/100ml	Mac Conkeys Broth
15	Fecal Coliforms per 100ml	Mac Conkeys Broth at 40° C