MATERIALS AND METHODS

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The present work encompasses a heavy metal load in the water, sediment and bivalve tissues from the Krishna river. The study extended over a period of twelve months from December, 1999 to November, 2000.

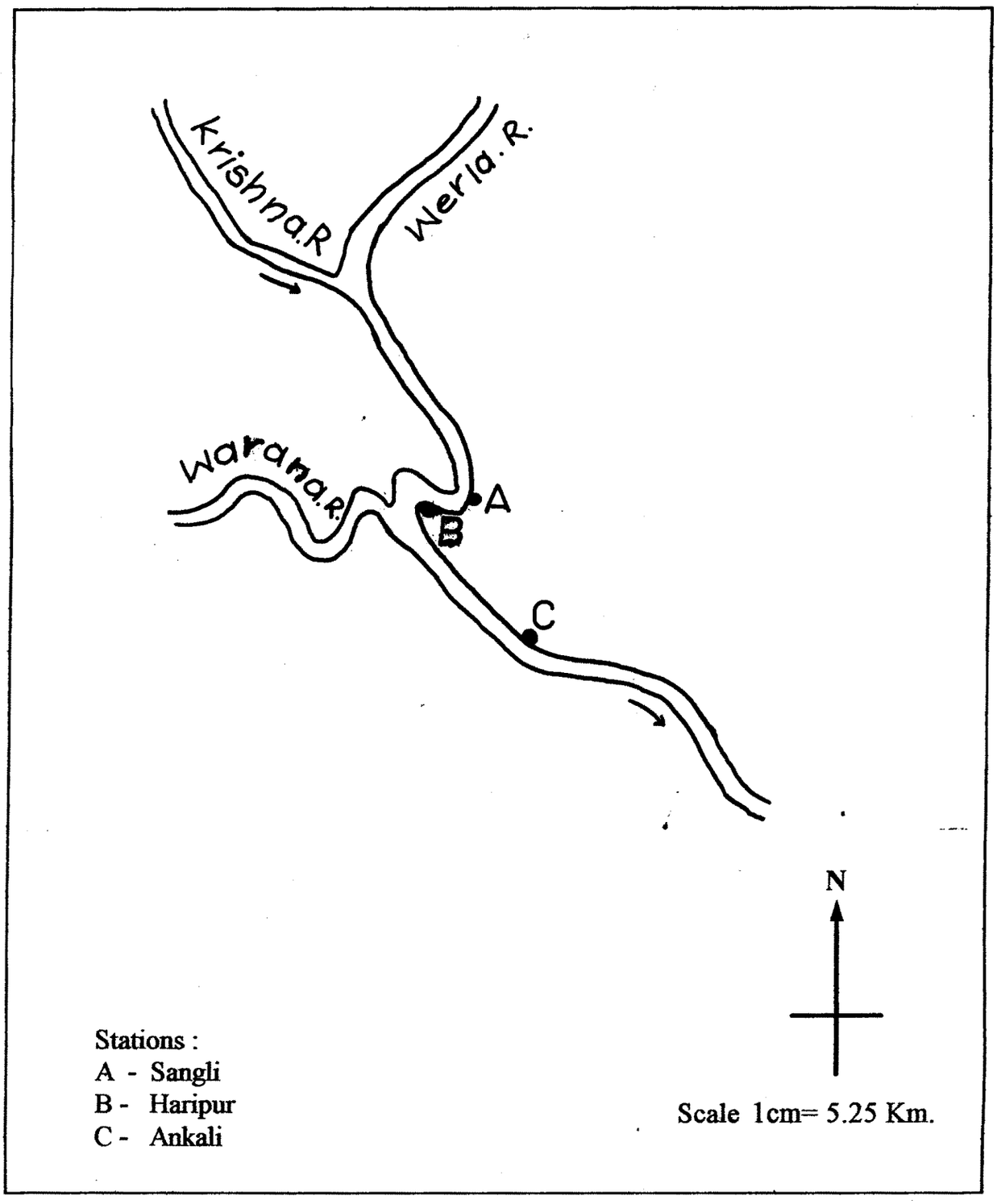
The investigation on physical, chemical and biological parameters were carried out during the above mentioned period. The experimental work was carried out partially in the field and partially in the laboratory. The different methods were selected considering the field conditions, requirements and availability of the material. Whenever necessary, the methods applied were modified to suit the field conditions and attempts were made to get the best results with the help of available instruments and chemicals.

Study Area

Krishna river is one of the major rivers in southern region of India. It flows through three states - Maharashtra, Karnataka and Andhra Pradesh. It originates at Mahabaleshwar in Satara district (Maharashtra). It's total stretch in Maharashtra is 270 Kms. Two major rivers viz. Warna and Koyana joins Krishna river. It has two large reservoirs such as Koyana and Dhom from which water releases monthly in the Krishna river during winter and summer.

Fig. 1

Map showing the flow of Krishna river with sampling stations A, B and C



The Krishna basin of Maharashtra measures 2657 Sq.Km. and spans 16 to 19 degree north latitude and 74 to 77 degree east longitude. The Sangli city which is close to river, a commercial place, District headquarter and growing town in Southern Maharashtra. According to 1991 census the population of Sangli city was 1,93,038. The topography of Sangli town is that the river flowing through the town, divides the town in two parts Fig. 1.

Pollution of Krishna River :

Around Sangli city, many small and big open drainages of domestic and industrial wastes enters into Krishna river, of which the following are important ones, Sherinalla locates on north side of main city and flows from north-east to west. Haripurnalla, it flows on southern side of city and flows from east to west. The major pollution point is Sherinalla, which joins the river at upstream of Kolhapur type weir. Sherinalla contributes flow from unsewered northern part of the town and pollutes river Krishna. Southern part of Sangli town has been sewered and sewage is taken into Haripurnalla. On the north side of the city, there are two major industries such as Vasantdada Sahakari Sakhar Karkhana, Sangli and Madhavnagar cotton mill and one industrial estate.

The upper basin of Krishna river from Karad to Sangli has been studied in the past, pertaining to aspects such as hydrobiology. The discharge of sewage and industrial effluent in the river has been

studied by Maharashtra Pollution Control Board (1981) and investigated the pollution of Krishna river due to fertilizers, pesticides, irrigation and industrial waste water. Besides bathing, the Krishna river water is widely used for domestic, industrial and land irrigation purpose. Along the stretch of Krishna river from Karad to Sangli there are eight sugar factories, three distilleries, one dairy and two MIDC areas (Subbarao, 1984). The stretch from Karad to Sangli is identified as the critical stretch with high recurrent pollution. The agricultural runoff, industrial wastewater, fertilizers, pesticides and heavy silt load brought by the runoff also affect water quality, causes many environmental problems in Krishna river basin. Similar observations were also documented in a project entitled "Discovering Krishna" published by River Valley Expedition (1976) and in a project entitled "Studies of the Krishna river ecosystem between Karad and Sangli" published by Science College, Karad (1980).

For Sangli city Krishna is the main water source. Due to rapid industrialization, there happened steady rise in population which ultimately result into increased demand of water for both industrial and human activities. There are 26 different industries present in Sangli which are water intensive requires treatment and disposal facility. Out of these 26 different industries, five are located near Krishna basin. Survey made by Science College, Karad (1980) reported that, the river water undergoes extreme fluctuations in the

concentration of elements during various seasons. Due to lack of information on heavy metal load in the water, sediment and bivalve species, prompted the present study to be undertaken. A variety of human activities have resulted into deterioration of ecological status of this river. The release of untreated sewage, organic load in the water and their effect on aquatic animals, attracted our attention and hence the present study was undertaken.

Sampling Stations :

Three sampling stations are selected for the collection and study of various parameters which are designed as follows :

Station A (Sangli) :

This station is selected due to various human activities and sewage flowing from Sangli city trough the Haripurnalla 500 m away from Sangli ghat towards the South point.

Station B (Haripur) :

This station is 1.5 Km away from Haripur village towards north side. It experiences comparatively less human activities but, here water flows from station 'A' with low water current as the river bed is deep at this point.

Station C (Ankali) :

This station is 500 m away from Ankali village. There is comparatively more human activities such as washing, bathing, swimming, digging of sand etc.

Plate I.A$_1$: Photograph showing sampling station 'A' of Krishna river with Weir (Sangli).

Plate I.A$_2$: Photograph showing discharge of sewage from Sangli city at station 'A'.

PLATE – I

A_1

A_2

Plate II.A_3 : Photograph showing sampling station 'A' with sand excavation.

Plate II.B_1 : Photograph showing sampling station 'B' of Krishna river (Haripur).

PLATE – II

A_3

B_1

Plate III.B_2 : Photograph showing locomotory activity of bivalves in sediment at station 'B'.

Plate III.C_1 : Photograph showing sampling station 'C' of Krishna river (Ankali).

PLATE – III

B_2

C_1

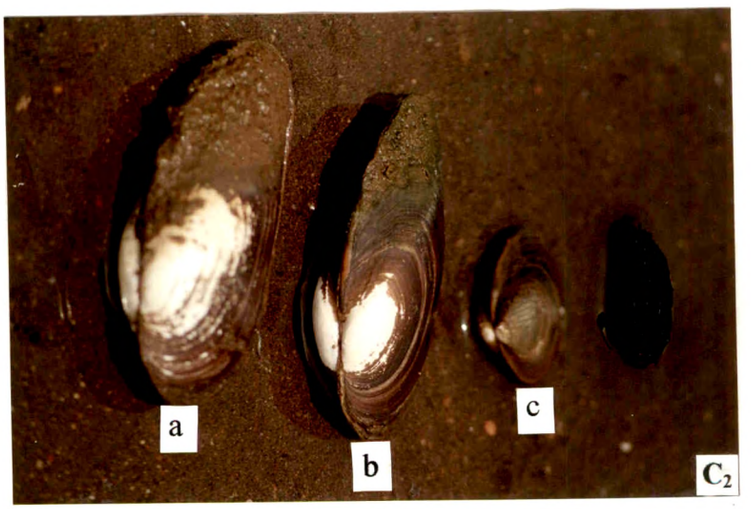
Plate IV.C_2 : Photograph showing three species of bivalves at station 'C'.

a) *L. corrianus* b) *L. marginalis*

c) *I. cearuleus*

Plate IV.C_3 : Photograph showing sampling station 'C' with washing of cattles and clothes by local people.

PLATE – IV



Field Studies

Collection of Water Samples :

Fortnightly water samples were collected in plastic PVC container from the selected sampling stations between 8.0 a.m. to 10.0 a.m. Then samples were brought into the laboratory for further analysis. Fortnightly readings were recorded for all experiments throughout the period of investigation (December, 1999 to November, 2000) and the data is statistically analysed for comparison of water quality parameters and seasonal changes by using graphics.

Laboratory Studies :

For the physical and chemical analysis of water following manuals were used :

1. Handbook of common methods in Limnology (Lind, 1974).
2. Standard methods for the examination of water and waste water (APHA, AWWA, WPCF 16th Ed. 1985).
3. Methods for physical and chemical analysis of freshwaters (Golterman, et.al; 1978).
4. Practical methods in ecology and environmental science by Trivedy and Goel (1987).

sampling stations were studied. The samples after collection were brought to the laboratory for analysis.

B. Chemical Parameters :

1. Hydrogen ion Concentration (pH) : The Hydrogen ion concentration (pH) was measured with pocket digital pH meter (Hanna instruments).

2. Dissolved Oxygen : The dissolved oxygen was measured by modified standard Winkler's method and results are expressed in mg/l.

3. Free Carbondioxide : The amount of free carbondioxide was estimated by titration method by using phenolphthalene as an indicator. The result are expressed in mg/l.

4. Hardness : Total hardness from water samples was estimated with standard EDTA method and expressed in mg $CaCO_3/l$

5. Chlorides : Chlorides was estimated with silver nitrate titrant. The results are expressed in mg/ l.

6. Alkalinity : Total alkalinity was determined by the titrimetric method, titrating against hydrochloric acid. The results are expressed in mg/l.

7. Alkalinity : Total alkalinity was determined by the titrimetric method, titrating against sodium hydroxide. The results are expressed in mg/ l.

8. Phosphate-Phosphorus : The amount of phosphate content in the water sample was determined by using stannous chloride reagent. The optical densities of the blue colour of ammonium molybdate developed in the samples are measured using spectronic-20 at a wavelength of 690 nm as given by Murphy, et.al; (1962). The results are expressed in µg/ l.

9. Nitrate-Nitrogen : The content of Nitrate-Nitrogen of water was determined by Brucine method, the resultant yellow colour by the reaction of nitrogen and brucine was measured using spectronic-20 at 410 nm and values are expressed as µg/ l referring to the standard graph (Charles, et.al; 1945).

Metal Detection - Water :

Water samples were collected fortnightly as described earlier. These samples from different sites were treated with 1:1 perchloric acid and nitric acid and were subjected for heavy metal detection by using A.A.S.

Metal Detection - Sediment :

Sediment samples were collected in polythene bags after fortnightly interval from the selected sampling stations. Then the samples were brought to the laboratory for further analysis.

In the laboratory, the sediment samples were air dried, pulverized in a mortar and sieved through a standard sieve of 0.5 to 0.6 m. The sieved samples were analyzed for detection of heavy metals. The required sediment samples were digested in 50 ml perchloric acid and 50 ml Nitric acid in 1:1 ratio for 48 hrs. The

digested samples were filtered and the filtrate were subjected for detection of heavy metals by using Atomic Absorption Spectrophotometer and values were expressed in ppm.

Metal Detection - Bivalve :

The bivalve species inhabiting along the bank of the Krishna river at Haripur and Ankali stations were selected for the present studies. The bivalve *Lamellidens corrianus* (9.5 cm to 10.5 cm), *L. marginalis* (5 to 8 cm) and *Indonaia caeruleus* (5 to 6 cm) in shell length from South bank of Haripur and North of Ankali, (500 m away from the railway bridge) were collected and brought to the laboratory. The shells of these bivalve molluscs were cleaned to removed the fauling algal mass and mud. The bivalves were then stocked in tap water for few hours. The shells were removed and the soft animals were taken in a tray. Various tissues of bivalve molluscs such as mantle, gill, siphon, foot, hepatopancreas and gonads were removed separately. These tissues were oven dried at 60^0C for 48 hours. Dried tissues were pulverized in mortar and kept in polythene bags and stored in the refrigerator. The powdered samples were analysed for detection of heavy metals.

The powered tissues were digested in 10 ml. Perchloric acid and Nitric acid in 1:1 ratio (Lithnor, 1975). The digested tissue solution was filtered and these samples were analyzed for detection of heavy metals by using Atomic Absorption/ Emission spectrophotometer (Chemito, 201) and the values were expressed in ppm.