

Assessment of the Water Quality of the Swan River Watershed

Venu and Madhuri Rishi

Department of Environment and Vocational Studies, Panjab University

Email - venus.jun25@gmail.com

Abstract: The water, one of the essentials for life and nothing is more fundamental to it on earth. Rivers being one of the major source of water, are the circulatory system of the nations. They are helping in meeting the demands of rapid industrialization. India ranks 5th in world in potential waterpower resource. But mere possession is no reason for celebrations. In developing countries like India poor designed or ill managed irrigation is the main source of non point pollution of river bodies. Negative effects of rapid industrialization, expanding urbanization and advanced agricultural activities have kept the rivers under high levels of pollution. In the present study Swan River watershed, Una district, Himachal Pradesh has been taken, which is receiving effluents discharges and wastewater. The economic growth of the district has accelerated the pace of industrialization and urbanization. Increase in number of residents, industries and agriculture activities are imposing environmental stress on the watershed. The main pollutional sources to Swan River watershed are domestic and municipal waste, agro-chemicals. Industrial wastewater, solid waste disposal. Domestic and municipal wastewater is also discharged through various nallas and choes. The catchment area of Swan River is also used for agricultural activities accompanied by over doses of fertilizers and pesticides. All these activities are adding toxic substances, oxidized organics, inorganics, suspended solids, sewage, pathogens to river water disturbing the river ecosystem and its morphology. The present study is aimed at studying the nature and impact of various effluents discharge in river swan.

Key words: Industrialization, Urbanization, Pollution, solid waste disposal, Fertilizers, agriculture.

INTRODUCTION

One of the most basic and important element for our existence on this blue planet is water. In 1978, the UN reported consumable water levels at 2.7% of earth's water. Although river water makes up only about 0.2 percent of all the fresh water on Earth, it plays a very important role. Rivers have been the initiative point for civilizations throughout the history of human beings. But, only, the supply of water is not enough, the adequate and hygienic water is the need of any nation's prosperity and health. Ever growing Industrialization and increasing population further deteriorates the water quality of the rivers. The deteriorating environmental

status of rivers is subject of great ecological interest.

STUDY AREA

The present study examines the environmental status of the Swan River watershed, Una district, Himachal Pradesh. District Una is situated on the bank of Swan River and spans between 75°58'2" - 76°28'25" East Longitude and 31°17'52" - 31°52'0" North Latitude.

River flows from North to West direction. This river, Once, was known as river of sorrow as during monsoon period the flood creates havoc in District Una. But it was taken under the reclamation process by Swan River Flood

Management and Integrated development Project and turned to the gift for district. This would revolutionize the economy of the farmers of Una district as it would result in raising of 1,500 metric tonnes of fish, 14,450 metric tonnes of food-grains, pulses, vegetables and 7,700 metric tonnes of fruits every year besides mitigating miseries caused due to floods to life and property both.

River's length is 85Kms ,out of which 65 Kms is in Una ,Himachal Pradesh and 20 Kms in Punjab after crossing Mehatpur ,River enters Punjab and at Anandpur Sahib it confluences with river Satluj in Punjab.

The river also serves as a source of water for bathing, irrigation, washing and recreation for the community people. The catchment area is used for cultivation, pulses & cereals and also for forestry .It also helps in recharging the groundwater in nearby areas. In conditions of scarcity of water (in summer season), help in meeting basic needs of the local people. With an area of 1549 Km², Una is serving a population of 5 lakhs approx. both Rural and Urban. Being a town and industrial area people are migrating to

Una for better facilities and employment. Una is lacking in planned sewerage system. So all the municipality waste is also discharged to River Swan through various Nallas and choes adding human excreta and pathogens to river water

The response of a fluvial ecosystem of river is maximal during warm, dry and drought conditions, when the river flow is low and nutrient concentrations are highest, resulting in degradation of water quality. At few points color transition is observable and water foul smells.

METHODS

The information for this paper was gathered from both primary and secondary sources. Water samples were collected randomly from October .2007 to April, 2009. The sampling sites were located on along the length of the river, down stream Santokhgarh (**D.D.S**), upstream Landfill (**U.S.L**) and downstream Landfill site (**D.L.S**).

The physicochemical and microbiological parameters were studied. Water samples were collected in acid-cleaned and rinsed 15-mL

Table 1 : General Description of Swan River

S.No.	Parameters	Values
1	Length	85 Kms (65 Kms in UNA),20 Kms in Punjab
2	Catchment Area	1400 Kms(1200 Kms in UNA)
3	Tributaries	80
4	Soil of catchment area	Alluvium, Sand and Gravel
5	Quality of soil	Fertile
6	Vegetation	Northern dry mixed deciduous type & Lower Shivalik chil pine type.
7	Major Trees	Sal, Pine, Khair, Poplars, Eucalyptus, Shisham, Bamboo clumps
8	Population in catchment	-Urban-21179 :: Rural -22900

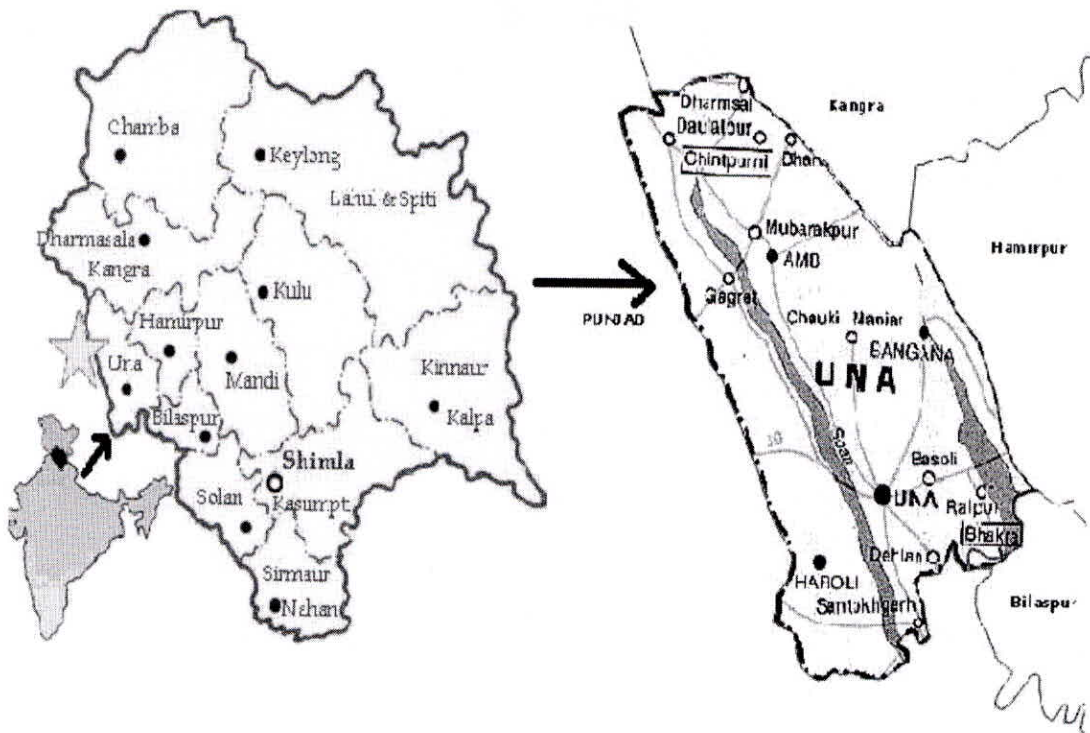


Fig. 1 : Map showing District Una and Swan River Watershed.

drinking water bottles sealed with water. The bottles were rinsed three times with river water before filling with the sample. After collection, the water samples were stoppered and taken for laboratory analysis. The testing of samples was done according to the procedure prescribed by APHA (1995). The water samples were put in to ice box during transport and kept at 4°C in the laboratory. The following parameters were analyzed; pH, temperature, conductivity (is/cm), dissolved oxygen (DO) (mg/L), biochemical oxygen demand (BOD) (mg/L), total dissolved solids (TDS) (mg/L), phosphate (PO_4^{3-}) (mg/L) and Sulphate (SO_4^{2-}) (mg/L). Few parameters CO_3 , HCO_3 , Cl, COD, T.H, T.D.S, Ca^+ , Mg^+ , K, SO_4 , PO_4 , NH_3) were analyzed for the month of October, 2008 and April 2009.

RESULTS AND DISCUSSION

Results of physico chemical and biological analysis are given in Table.3.and 4.

A total number of 27 samples were analyzed from October, 2007 to April, 2009. Results show significant variations in the values. The increase in the industrialization, urbanization, irrigation activities and increased discharge volume of domestic garbage are the major sources of the pollution to the river.

Temperature

Seasonal data of temperature are visible in Table .3 .Increase in temperature was recorded in D/S landfill where the pollution is maximum.

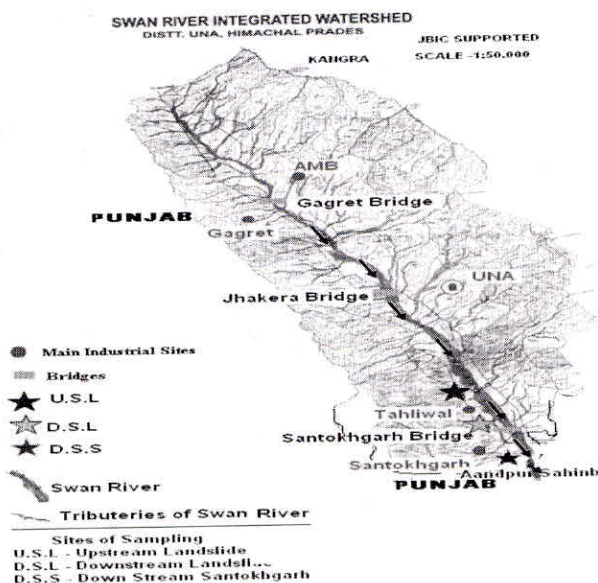


Fig. 2 : Map showing Sample sites and swan river watershed

Table 2 : Main Industrial areas in the catchment area of Swan River in Una

AREA	UNITS (approx.)	MAJOR CATEGORIES OF INDUSTRIES
MEHATPUR	169	Pharmaceutical Formulation, IMFI Bottling, Soaps & Detergents, Calcium Carbide, Chemicals, Metal finishing, Zinc Sulphate, Distilleries, Hotels etc.
Tahliwal & Bathua	138	Bakery, Fruit Processing, Oil & Oil cake, Printings, Pharmaceutical Formulations, Weaving, Paint & Varnish, Soaps, Small dye House, Induction Furnaces, Metal Finishing, Paper Board etc.
AMB	133	Bandage, Concrete Blocks, Charcoal Batteries, Food processing, Hotel and Restaurants, laboratories, Forest and Agriculture products, Printings, Pharmaceutical Formulations, Rosin & Turpentine, Soap, Calcium Carbide Induction Furnaces etc.
GAGRET	40	Cold Store, Hotels, Printing, Activated Carbon Powder, Pharmaceutical Formulations, Induction Furnaces, Metal Finishing, Lead acid Batteries, Lead smelters, Pulp industries, Automobile servicing & Repair station etc
UNA (excluding other industrial areas)	149	Food processing, Hotel and Restaurants, laboratories, Ice cream, Poultry farm, Sawmill, Ayurvedic Medicines, Induction Furnaces, Pharmaceutical Formulation, Tyres Reseeding, Fragrances & Flavours, Automobile servicing & Repair station, Mineral Water, Lime Kiln, Zinc Oxide, Stone Crushers etc

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Table 3: Values of Physico-Chemical and Biological parameters of Swan River watershed at Una District, Himachal Pradesh.

S.NO	Site	Temp.	pH	EC ($\mu\text{mho/cm}$)	D.O (mg/L)	B.O.D (mg/L)	NO ₃ -N (mg/L)
OCT.2007							
1	D/S Santokhgarh	26.5	8.83	608	2.4	1.6	0.4
2	U/S Landfil site	26	8.93	565	5.2	1.2	0.9
3	D/S Landfil site	27	8.88	395	7.5	1.6	0.5
Jan.2008							
1	D/S Santokhgarh	10	8.01	449	7.1	2.2	0.5
2	U/S Landfil site	11	7	575	7.8	1.4	0.7
3	D/S Landfil site	16	7.6	526	6.9	1.8	0.2
July,2008							
1	D/S Santokhgarh	22	8.01	498	6.9	2	0.4
2	U/S Landfil site	26	8.88	508	6.2	0.3	0.4
3	D/S Landfil site	25	8.87	537	5.7	2.6	0.5
OCT.2008							
1	D/S Santokhgarh	24	8.85	421	6.2	2	0.6
2	U/S Landfil site	26	8.71	374	6.1	1	0.5
3	D/S Landfil site	28	8.84	423	6.2	1.2	0.3
Jan.2009							
1	D/S Santokhgarh	20	7.6	426	3.6	0.2	0.4
2	U/S Landfil site	20.5	8.1	429	5.9	1.9	0.1
3	D/S Landfil site	21	8.25	570	7.1	2	0.3
July,2009							
1	D/S Santokhgarh	17	8.84	368	6	24	0.1
2	U/S Landfil site	17.6	8.01	484	5.5	0.3	0.2
3	D/S Landfil site	17.5	8.81	335	5.1	0.6	0.3
APRIL,2009							
1	D/S Santokhgarh	23	8.87	509	7.8	0.5	0.21
2	U/S Landfil site	23.5	8.89	553	6.6	0.8	0.191
3	D/S Landfil site	23.5	8.90	692	6.1	1.2	0.119

Higher temperature was recorded in summer season.

pH

The pH ranges from 7 to 8.88. Values varies randomly .Higher values of pH were recorded in summers season as compared to winters. Longitudinal variation can be due to the exposure of river water to biological activities and chemicals. Higher values were seen D/S Santokhgarh and D/S landfill.

Electrical Conductivity

Electrical conductivity (EC) varies from 335 to 608 $\mu\text{mho/cm}$.These values indicate relatively organic pollution.

Dissolved Oxygen

The value of D.O reflects the physical and biological processes prevailing in the water. Air from the atmosphere or produced by photosynthetic organisms are the reasons for the

Table 4: Values of Physico-Chemical and Biological parameters of Swan River watershed at Una.for the months of October 2008 and April, 2009.

Site	CO ₃	HCO ₃	Cl	C.O.D	T.H	T.D.S	Ca ⁺	Mg ⁺	K	Na	F	SO ₄	PO ₄	NH ₃
OCT.2008(mg/l)														
D S.S	60	164	30	19	364	332	113.7	12.6	b d	85.9	0.279	3.3	0.27	0.08
U.S. L	40	201	21	12	381	184	142.5	19.4	b d	280.5	0.284	1.8	0.31	0.15
D.S. L	55	199	17	16	393	393	108	20.2	b d	55.9	0.281	1.1	0.38	0.21
APRIL.2009														
D.S. S	32	140	32	18	334	239	113.7	14.6	b d	85.9	0.279	3.3	0.36	0.09
U.S. L	bdl	196	30	12	382	184	142.5	21.4	b d	280.5	0.284	1.8	0.37	0.12
D.S. L	bdl	184	19	15	391	393	108	28.2	b d	55.9	0.281	1.1	0.41	0.11

(bd –Below detection limit)

present dissolved oxygen. The D.O. varies from 2.4 to 7.8 mg/l. These values indicate relatively varying organic pollution. The value is relatively lower in D/S Santokhgarh in January means in winter seasons.

Biochemical Oxygen Demand

B.O.D determines the amount of bio-chemically oxidisable carbonaceous matter B.O.D recorded was low, indicating low organic pollution.

Chemical Oxygen Demand

C.O.D is the amount of oxygen consumed during the chemical oxidation of organic matter using a strong oxidizing agents like acidified potassium dichromate. In present study, the C.O.D vary from 12to 19 mg/l. Highest values were observed in D/S Santokhgarh where industrial effluents from Mehatpur naming Holi khad discharged by industrial units.

Total Hardness

Observed values of Total Hardness range from 334 to 393 mg/L. Values also vary according to seasonal variations .Higher values were

observed at D/S landfill sites. Hard water has no known effect on health but not suitable for domestic use like bathing and washing purposes. The river water is used in the times of scarcity of water in summers.

Other parameters

Parameters like Nitrates, Sulfates, Phosphate, alkalinity chlorides, calcium .magnesium, and potassium; Fluoride, Ammonical nitrogen etc were also determined. Values of the various parameters indicate the effect of industrial pollution.

In winters water quality comes out to be better than in summer seasons. In January 2008 and January 2009, in both the periods values of pH and Electrical conductivity is lower than in other periods. Highest values for EC were recorded in the October 2007 at down stream Santokhgarh. At average, values of most of the parameters were in higher side at downstream landfill site, possibly because of the domestic and sewerage waste.

Total Dissolve solids

Total solids analysis has great implications

in the control of biological and physical waste water treatment processes.

Alkalinity

It is the quantitative capacity of water sample to neutralize a strong acid to a designated pH [5.8]. In the present study, in post monsoon period, observed values range from 164 to 201 mg/ at three stations and in premonsoon period values range to 40 mg/l to 196 mg/l. Higher values in post monsoon period can be attributed to the industrial effluents discharged upstream. Increase dilution in premonsoon may be because of one of the distilleries shifting to grains than molasses lowering its effluent discharge.

Chloride

This is the most common inorganic anion present in water. Chloride values range from 17 to 30 mg/L in post monsoon period and in April 2009 value ranges to 19 to 32 mg/L.

Chemical analysis (Table .4) revealed that concentration values were higher at down stream Santokhgarh site possibly because of the industrial effluent discharge.

Effects of chemicals in River water system:-

- Excess nutrients from all the fertilizer and industrial discharges, runoff leads to algae blooms sometimes big enough to make waterways impassable.
- When the algae die, they sink to the bottom and decompose in a process that removes oxygen from the water.
- Fish and other aquatic species can't survive in these so-called "dead zones," and so they die.
- Chemical ingestion by fish makes them diseased. Humans who eat diseased fish can themselves become ill, completing the circle wrought by pollution.

- Oxidized sulfur (as sulfate, SO_4^{2-}) is reduced to sulfide (as in hydrogen sulfide, H_2S) under reducing conditions near the lake sediments. The resulting hydrogen sulfide gas, when released from the water, is characterized by the familiar "rotten egg" smell.
- Many aquatic organisms have fairly strict pH requirements, so the amount and stability of pH is very important
- The most common ions present in many lakes and rivers include: calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), bicarbonate (HCO_3^-), sulfate (SO_4^{2-}) and chloride as they determine the total salinity of water.
- Algae, in aquatic ecosystems, require the major nutrients—carbon, nitrogen, and phosphorus. If one of these nutrients is present in a higher proportion, it will boost the algae growth.

Significance of Swan river :-Why its important to protect the water quality of Swan river watershed ??

For the betterment of Swan, Swan River Flood Management and Integrated Development Project was framed by IPH Department in 1984. Total cost of the treatment of the catchment works out to about Rs.259 crore for first phase.

- For providing embankments on both banks of Swan River NABARD has approved project in two phases. In 1st phase, approval was received for Rs. 26.99 crore. In second phase, approval was received for Rs. 20.93 crore. For remaining portion project for Rs. 310.34 crore has been sent to G.O.I. for JBIC (Japan Bank for International Cooperation) funding.
- On the completion of the Swan River Integrated Watershed Management Project,

1,000 hectares of land would be reclaimed and 1,260 hectares saved from flood inundation. This would revolutionize the economy of the farmers of Una district as it would result in raising of 1,500 metric tonnes of fish, 14,450 metric tonnes of food-grains, pulses, vegetables and 7,700 metric tonnes of fruits every year besides mitigating miseries caused due to floods to life and property both.

CONCLUSION

Lenihan and Fletcher (1976) noted that man is more the product of his environment than of his genetic make-up. In other words, the health of human beings is determined not by heredity but also by his environment. Collected data from field work survey and analysis concerning industrial and agricultural practices mainly using types of fertilizers and pesticides were analyzed and results are as presented in Table .3 and Table.4. The river water is used for irrigation and domestic uses. The presence of varying values of nutrients indicates contamination of water. Efficient usage of limited water resources in order to increase agricultural production is an issue in India because rainfall differs from region to region and from season to season. It can, therefore be concluded from observations in the study area made so far that river Swan has good water quality in its upper reaches but its quality and ecosystem is degrading in its lower reaches. The factors attributing to this deterioration are various anthropogenic activities such as sewage from residential areas, chemicals from industrial wastes and urban waste water, unfair agricultural operations along with surface run-off. The need of the hour is proper planning and management of this natural resource.

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