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Impact of water pollution on community and agricultural industry: A case study of River Krishna, Sangli District

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ABSTRACT

Environmental pollution is woven in the entire fabric of our modern style of living. Every few years the world is getting a severe shock of pollution disasters. Now a days water pollution is one of the serious problem in all over world. Life cannot exist without water. For day to days process water is essential. Water covers about 2/3 part of the surface (97.02%) most of it is salty for use, only 2.15% of the world's available water is not salty. Rain water is purposed by water. We are using water for domestic purpose industrial purpose and Agricultural production water is not only essential for survival of all living thing but also the source of economic wealth and creator of beautiful environment.
The major factors influencing water pollution are following.
1) Growing population 2) Inefficient irrigation system 3) Pollution
Study of the toxic element causing water pollution in River Krishna of Sangli District physico-chemical characteristics of River water were analyzed Water samples were collected from five different location's of River Krishna at Sangli District. Sample were analyzed by using various parameter such as Colour, Odor, T S, TDS, TSS, DO, COD, BOD, $_{P}H$, Total Hardness, Available Nitrate, Phosphate's, Chlorides, Turbidity, Ca, Mg with standard methods. Physico Chemical Analysis it has been observed that, values of TDS, COD, BOD, Turbidity, TS, Chlorides. Alkalinity are above the normal limit. A Few samples are hard and shows salinity such samples are not portable. While few samples are moderately hard, by giving proper treatment such hard water is converted to soft water and used for domestic and irrigation purposes.

INTRODUCATION

Water is the nature most precious and most wonderful gift to human kind. Indian Philosophy treats water as one of the five fundamental constituents of the universe The Panchmahabhutas – Air, Water, The Sun, The Sky and The Earth.

Water as we know is the most essential commodity for the existence of any life in any form. The use of water by plants, animals and man is universal. As a matter of fact, every living soul requires water for its survival. This is an essential requirement of life, health and sanitation. Man can live without food for about two months but he can hardly survive for three to four days without water. From the religious point of view, we Indians believe, that the God of Water called Varun who controls monsoon. The failure of monsoon causes many disasters such as an epidemic, a famine, etc.

Water is the most abundant and undoubtedly the most useful of all the hundreds of thousands of compounds known to man.

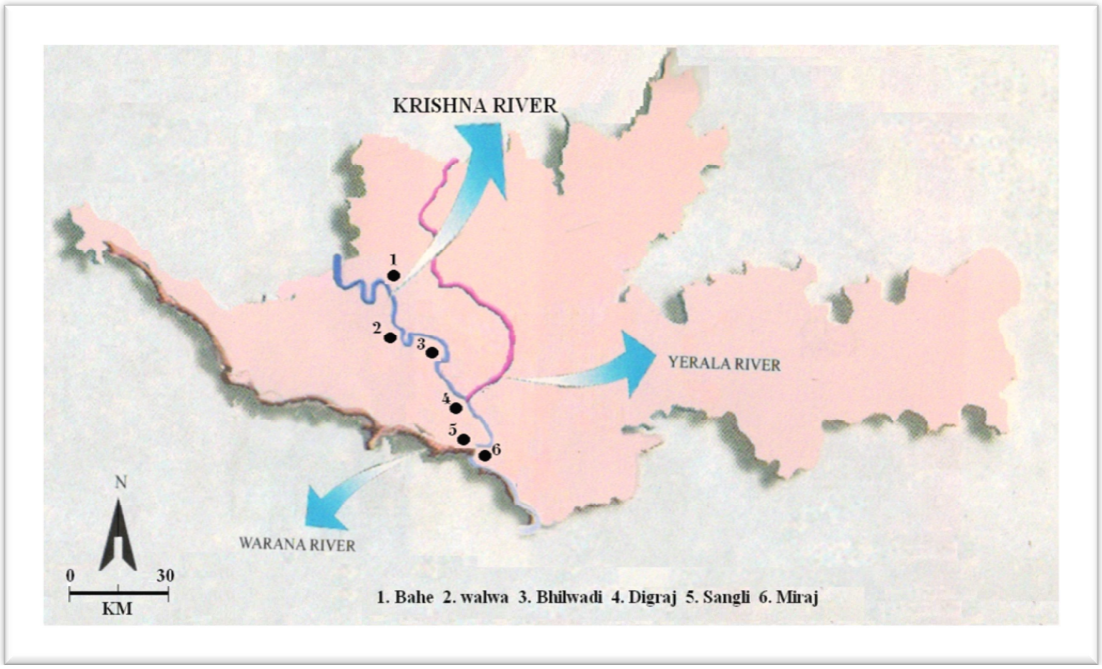
Water is very widely distributed compound in our environment. It covers about 75% of the earth's surface in the form of lakes, rivers oceans, etc. the human body contains about 70% of water by mass. All types of fruits and vegetables contain even higher percentage of water. Milk contains about 87% of water while tomatoes and cucumbers contain about 95% of water it is indeed, an essential ingredient of animal and plant life. No about, water is the most precious of all fluids, in many respects. Water is our principal cleansing agent. It is one of our most important aids in seeding up chemical action. It is a basic material needed by almost all industries. Water plays an important role in generation of hydro – electric power, system power, in recreation, in transportation, in agriculture, in engineering and industrial fields, in manufacture of essential commodities, viz. steels, rayon, paper, textiles, etc. as a coolant in power plants, as a solvent in chemical and pharmaceutical industries, for air conditioning, drinking, bathing, washing etc. Hence one may conclude that life on the earth would be totally impossible, if water is absent. The statement has been made very aptly indeed, that the chemistry of our world is the chemistry of water.

In the present research, we want to focus on water and water pollution of Krishna River in Sangli district and impact of water pollution on community and Agricultural industry.

We all are aware of the fact that the essential requirements of life are air, water and food.

Next to air, the most important requirements of life are organisms, plants and animals. Man needs water for drinking, cooking, washing, bathing and numerous other domestic, agricultural and industrial purposes. If total demand for water is calculated it comes to 1,000 to 5,000 cm^3 per day per capital.

As Man uses water he pollutes it inevitably and when the water returns to the open bodies, it contaminates natural water and causes water pollution. Every large river in the world is now no more than an open sewer. A very little attention was paid to this problem as water happens to be a renewable resource, globally most abundant, and is constantly recycled though natural distillation, via solar evaporation, cloud formation and raining.



MAP OF KRISHNA RIVER IN SANGLI DISTRICT

As long as the human population was small and communities were scattered over large area of land, the waste disposal created no problems. It was left to the nature dispose it by assimilation in the surrounding land and air but

with the increasing population especially on the banks of water bodies, the soiled water called sewage, was channelized to streams and river. At the beginning this mode of disposal was considered to be quite suitable. But with rapid urbanization and industrialization the natural water have been polluted to such as extent that they have become unsuitable as the sources of water supply. The common approach solution of pollution is dilution has turned to be a curse to human life. The times have approached and it has become obligatory to move away the waste water from streams and rivers and to divert them to land where these have to be tried as the valuable resources.

EXPERIMENTAL SECTION

Methodology

The primary objective of this study is to analyze the impact of ongoing global warming and effect of different factors on 'Water Pollution of River Krishna' of western Maharashtra.

The methodology used is experimental analysis. For the purpose, the water samples are collected from different area of River Krishna.

Collection of Water Samples

Collection of water samples from particular selected site, sample was placed in a sterile glass bottles with a rubber cork for microbiological examination and remaining in a polythene bottle for chemical examination. The samples thus collected were immediately transported to the laboratory and stored in a refrigerator at 5^{o} C for microbiological analysis and at room temperature for chemical analysis. The water samples collected were subjected to chemical and microbiological examination as detailed below

Physicochemical Analysis Of Water

Procedure For Water Analysis

Following parameters were used for physicochemical analysis of water

1.	Colour	9. Available Nitrogen
2.	Odor	10. Available Phosphors
3.	TS mg/lit	11. Available Potassium
4.	TDS mg/lit	12. Chlorides
5.	TSS	13. Total Hardness
6.	DO	14. COD
7.	pH	15. BOD
8.	Conductance	16. Turbidity

Colour

This test is applicable to drinking water and is carried out by comparison with known standards. The colour of water is due to the substance present present as a fine colloids, industrial effluents, soil particles etc.

Odor

Disagreeable odor in water are due to the presence microscopic organisms, decaying material, dissolved gases like NH4, Organic matter, different agents present in the water gives different odors and can be defected simply with nose with this we can have different types of odor like fishy, septic, earthy, grassy, milky etc.

Total Solids (Ts.)

Total Solids can be determined by the residu left after evaporation of unfiltered water sample.

1. Take an evaporatating dish of suitable size and weight
2. Put 50-100 ml unfiltered well shake sample in it and evaportate on a water bath or hot plate.
3. After evaporatating dry it in an oven at 1050c for some time
4. Cool in a desiccators and take the final weight.

Total Dissolved Solids (TDS)

Total dissolved solids denote mainly the various kinds of mineral present in water. These can be determine as the residue left after evaporation of the filtered sample.

Procedure
1. Take an evaporating dish of suitable size dry and weight it.
2. Filter the samples through what man filter paper so that the filtrate should not have any turbidity.
3. Evaporate the clear filtrate in the evaporating dish on hot plate or water bath.
4. After evaporating heat it at 1030c for 10 min. in an oven cool in desiccators and take the final weight.

Total Suspended Solids (TSS)
Determine the TSS the difference between total solids and Total Dissolved Solids

TSS mg/lit = TS – TDS

Dissolved oxygen (DO) : Wrinkle's Method
Requirements:-
Glassware's :- BOD Bottel, Pipette, Burette, Conical Flask

Chemicals :-
1. $Na_2S_2O_3$ (Sodium Thiosulphate 0.025 N)
2. Alkaline potassium iodine solution (KI)
3. $MnSO_4$ (Manganese Sulphate Solution)
4. Starch Solution
5. Suphuric Acid, Concentric H_2SO_4

Procedure
1. Fill the sample in BOD Bottle of 300 ml carefully avoiding bubbling and trapping of air bubbles in the bottle after placing the stopper.
2. Add 2 ml MnO_4 and Alkaline KI solution. Use Separate pipettes for these two reagents, a precipitate will appear.
3. Place a stopper and shake the contents well inverting the bottle for some time to settle down the precipitate.
4. Add 2 ml Conc. H_2SO_4 and shake well to dissolve the precipitate.
5. Take 100 ml from BOD bottle in conical flask for titration.
6. Titrate the contents, with sodium thisulphate solution using starch as an indicator.
7. At the end point initial dark blue colour change to colourless.

pH
Part I : standardization of pH meter
1. Keep the instrument switched on for a few minutes before starting experiment.
2. Take some 3 of standard buffer solution (pH = 4) in a 100 cm3 beaker.
3. dip the combined glass electrode in this solution and connect the cable end of the electrode to the pH meter.
4. Set 'pH – mV' knob on the pH position.
5. Set the temperature control knob at temperature of buffer solution.
6. Adjust the slope knob so that the display reads pH = 4.0

Part II : Determination of pH of Water
1. Take 25 cm3 of water sample.
2. Dip pH meter in the solution.
3. Measure the pH of solution.

Electrical Conductivity
The water sample was measured with conductivity meter.

Part A : standardization of Conductometer
1. Keep the instrument switched on for few minutes before starting experiment.
2. Keep the range switch 2mm position and keep the 'Standard conductance' switch at down position
3. Adjust the 'Standardize' Knob till the digital display reads 1.000

Part B : Determination of conductance of water sample.
1. Take 25 cm3 of given water sample.

2. Dipp conductivity cell in water sample.
3. Measure the conductance.
4. The display reads conductance in m. mhos convert it to mhos (s) and record in the observation table (as reading x103s)

Available Nitrogen [Kjeldahl's Method]
Nitrogen is estimated by Kjeldahl´s distillation assembly, in alkaline medium as detailed below.

50 ml of water sample was taken in a 500 ml capacity conical flask, to which 200 ml, 10% Sodium chloride was added and flask was kept for 30 min with intermittent stirring, diluted to 250 ml with 10% Sodium chloride solution. The total content was transferred to Kjeldahl's flask. Ten ml 1:1 HCl was added to acidify the medium and also five drops of phenolphthalein indicator was added. Then 50% NaOH was added till the solution became pink. The liquid was then distilled to collect ammonia in boric acid containing five drops of mixed indicator which resulted in development of blue colour. From this 150 ml distillate was collected and titrated with 0.02 N H_2SO_4 to pink end point.

Nitrogen was calculated in percentage and kg/ha as

Available Phosphorous - Olsen Blue Colour Method
5ml water sample was taken and was added in 50 ml bicarbonate extractant with 2g activated charcoal. It was shaken for 30 minutes on the mechanical shaker and 5ml of this colourless solution was filtered 5ml of this colourless solution was taken in the Nessler's tube. Two ml of ammonium molybdate and 5drops of stannous chloride were added to make the volume 50m1 with distilled water, blue colour was appear. Reading of blue colour was taken in spectrophotometer at 690 nm and absorbance reading was recorded for P in mg.

Phosphorus was calculated in percent and kg/ha as:

Percentage of phosphorus was calculated from graph reading

Available Potassium – Flamephotometric Method
2 ml water sample was taken and added it in 100 ml neutral ammonium acetate extractant and it was shaken for half an hour intermittently and was used for determination of K. Atomized the sample, reading was recorded and potash concentration was find out from the standard graph

Potassium was calculated in percentage and kg/ha as

Chlorides
50ml water sample was taken in conical flask and 2ml of K_2CrO_4 solution was added to it and content was titrated against 0.02 N $AgNO_3$ till the persistent reddish brown tinge appears.

Determination Of Total Hardness Of Water
Hardness of water is caused by calcium and magnesium ions present in water polyvalent ions of some other metals like strontium, iron, aluminium, zinc and magnesium can also precipitate soap thus contributing to hardness. However, the concentration of these ions is very low in natural waters. So hardness is generally measured as concentration of only calcium and magnesium as calcium carbonate, which are higher in quantities over other hardness producing ions. The hardness is determined by titrating the sample of hard water against standard EDTA solution by maintaining proper pH.

Preparation Of 0.01 M $CaCI_2$ Solution
Weigh accurately 0.250 g of pure $CaCO_3$ powder by using a chemical balance using a watch glass and transfer to a 250 cm^2 beaker. Wash the watch glass using small quantities of distilled water and transfer the washings to the same beaker. Add pure concentrated solution of $HC\ell$ drop by drop till all the $CaCO_3$ particles dissolve completely liberating small bubbles of CO_2 gas. When liberation of CO_2 is stopped transfer the solution to 250 cm^3 standard volumetric flask wash the beaker 2-3 times with 10 cm^3 distilled water and transfer all the washings to the same 250 cm^3 standard volumetric flask. Dilute the solution upto 250 cm^3 mark using distilled water shake well.

Standardization of EDTA Solution

Pipette out 25 cm^3 of the 0.01 M calcium ion ($CaC\ell_2$) solution into 250 cm^3 conical flask dilute it with about 25 cm^3 of distilled water, add 2 cm^3 buffer (P_H =10) and 4-6 drops of Eriochrome Black–T indicator. Titrate with the standard 0.01 M EDTA solution until the color changes from wine red to sky blue. No tinge of reddish blue should remain at the equivalence point. Titrate slowly near the end point. Take two more readings and find out constant burette reading as "X" cm^3.

Determination of hardness of water

1. Take 25 cm^3 sample of water in a 250 cm^3 conical flask.
2. Add 2 cm^3 of buffer solution to it.
3. Add 4-6 drops of Eriochrome Black – T indicator, the solution turns wine red.
4. Titrate the contents against standardized 0.01 M EDTA solution. At the end point color changes from wine red to sky blue.
5. Take two more readings and find out constant burette reading as "Y" cm^3.

Calcium

2 ml water sample, was added in 100 ml of ammonium acetate extract. It was kept for an hour with intermittent mixing, 100mg Murexide indicator and 5m1 1.0 N NaOH were titrated by 0.01M E. D. T. A. till the purple colour was appeared (end point-pink to violet). The volume of E.D.T A. required was noted.
Determination of Calcium was calculated in percentage as:

Magnesium

20m1 water sample was taken in a conical flask, 2ml ammonia buffer and 100mg erichrome black T indicator were added in conical flask and flask was shaken for two minutes to mix all the contents. It was titrated against 0.01M E.D.T.A. solution until the solution was changed from red to blue. The volume of E.D.T.A. required was noted.
Determination of Magnesium was calculated in percentage by

COD

The water sample is then subjected for Chemical Oxygen Demand (COD) the Procedure was proceeding by reflux method.

Aim : To determine chemical oxygen demand of given sewage by dichromate method.
Procedure :

1. Place the diluted 20 ml sample with D/W in flat bottom flask and add to it 10 ml of dichromate sol.
2. Then carefully add 30 ml H2So4
3. Mix after each addition thoroughly add about 10 mg each mg SO4 crystal.
4. Attach the flask to fridrich condenser and reflux excess of dichromate with std. ferrous ammonium sulphate using ferron indicator.
5.The color change is sharp changing from bluish green to wine red.

Calculations :
Burette reading of blank –Burette reading of Sample x

BOD

The water sample is then subjected for Biological Oxygen Demand (BOD) the Procedure was proceed by wrinkling method.

Aim : Determination of Biological Oxygen Demand of given water sample.

Procedure :
1. Collect the sample in 300 ml bottle taking care to avoid contact of sample with air.
2. Bottle should be filled completely
3. Add 2ml manganese sulphate sol^n following by 2 ml alkali iodine oxide reagent.

4. Dipping the end of pipette below the surface & stopper mix thoroughly by inverting bottle 4-5 times let the ppt settle down carefully remove the stopper of immediately add 2ml conc. H2SO4
5. Re stopper it deprecipitate by shaking
6. Amount needed for titration corresponds to 200 ml of original sample
7. Thus total of 4 ml reagent add in 300ml bottle for determination of BOD prepare dilution of water by aerating distilled water with supply of clean compressor for 10 –70 min.
8. Make several dilutions of water to obtain following dilution such as 1:10, 1:20, 1:30, 1:30 etc.
9. Prepare desired mixture by adding the sample in 2 sets.
10. Fill one bottle of 300 ml with aerated distilled water and other by diluted sample in 2 sets.
11. One set incubated for 3 days at 27^0 C another set is subjected to find out D.O of sample immediately.
12. After incubation of 1^{st} set find out D.O of that sets.
13. Record the result.

The Biological Oxygen Demand of Water sample is used for irrigation in agricultural Industry. If BOD is more than 100 this water sample is used for irrigation. So above result indicate this water sample is not used for irrigation, because it is highly polluted.

Turbidometry
Aim : To determination the turbidity of given water sample.
Chemicals :
1. Dissolve 1 g hydrazine sulphate in water and diluted to 100 ml with distilled water.
2. Dissolve 10 g hexamethylene telramine in distilled water and diluted to 100 ml.
3. Stock turbidity suspension :

Mix 5 ml solution (1) with 5 ml solution (2) in 1:1, allow to stand for 24 hours at 25 – 30^0c and diluted to 100 ml d.w. this solution (3) will have turbidity of 400 N.T.U

Procedure :
A. Preparation of Calibration Curve

The solution of 400 NTU of different concentration was prepared as given in th table. Zero turbidance is adjusted by taking distilled water as a blank solution and 100 was adjusted by higher concentration solution.

The turbidity was measured for each solution of different concentration

Graph of observed NTU vs ml of 400 NTU solution added is plotted and found the turbidity of unknown solution.

Observation Table

Obs. No.	Ml of 400 NTU Solution	Final Volume in ml	N.T.U Calculated	N.T.U observed
1.	25	100	180	180
2.	20	100	80	80
3.	15	100	60	56.7
4.	10	100	40	39.3
5.	5	100	20	19.2
6.	2.5	100	10	7.5

From the above experimental result it has been observed that the turbidity of given water sample is negligible.

The Experimental data is collected and compared with world global water pollution, therefore researcher is completely relies on this information on this research work. The data collected, complied, classified and compared according to required heads and presented in a systematic manner, with the available tools of presentation i.e. in the form of tables diagrams graphs and photos.

For this purpose of analysis and comparison, mere observation of data and Physico – Chemical analysis methods are used.

Comments are made on the basic of graphical trends of the data.

The Sangli District is one of the important southern district of Maharashtra. It has occupied an area of 8564.96 sq. kms, with seven urban centers and 539 villages, Geographically, the district is divided into four regions as southern lowlands, Yerala basin, the master valley of Krishna and Warna basin with adjoining hills. The location of Sangli district in Maharashtra is given in fig.1.

Out of 8.61 lakh hectares geographical area of the district, cultivated area occupies 6.42 lakh hectares. 3.82 lakh hectares of land is under main kharif crops and 2.6 lakh hectares of land remains under rabi crops.

It has been estimated that, about 2477 hectares area of Sangli district is saline (supanekar 1995). Large area of the land is about to become saline. Thus soils of Sangli district can be divided in three main categories.

1. **Normal soil (N.S.) :** In these soils there is no heavy irrigation in practice. It may be due to scarcity of water in some area specifically away from Krishna river. These are fertile soils.
2. **Partially saline soils (P.S.S) :** These soils are not completely saline but in these soils heavy irrigation is continued. These soil are on the way to became completely saline. At present these are partially saline and moderately fertile. These soil are mainly along the Krishna river.
3. **Deep saline soils (D.S.S.) :** These soils are barren and completely non fertile due to heavy accumulation of salt. These soils are mainly along the Krishna river.

Considering these aspects 36 soil samples were collected from Sangli district, 12 from each type of soils. 12 villages along the Krishna basins were selected. From each village three soil samples were collected, one belong to normal soil, second belong to partial saline soil and third belongs to deep saline soil.

RESULTS AND DISCUSSION

Water samples collected from different location of Krishna River		Sangli City	Miraj City	Bhilwadi	Walwa	Bahe
1) Physical Analysis i) Colour(units in ppm)		47	44	42	27	22
ii) Turbity(units in ppm)		27	25	22	20	18
iii) Test		Objectionable	Objectionable	Objectionable	Objectionable	Unobjectionable
2) pH Metry		7.2	7.6	6.9	6.7	7.4
3) Conductivity		125	99	80	110	45
4) COD		1200 Mg/ml	1150 Mg/ml	910 Mg/ml	1070 Mg/ml	890 Mg/ml
4) BOD		940 Mg/ml	830 Mg/ml	770 Mg/ml	950 Mg/ml	740 Mg/ml
6) Total Hardness		970 ppm	965 ppm	874 ppm	800 ppm	770 ppm
7) NPK Count Kjl. and Colourimetric Analysis	N P K	225 200 345	172 140 215	145 132 189	245 218 382	150 127 181
8) Total Dissolved Salts Solids		10.2 1400 mg/ml	10 1350 mg/ml	9.4 1270 mg/ml	09 1379 mg/ml	8.5 945mg/ml
9) Toxic Elements(in ppm) i) Ca ii) Mg iii) Nitrate iv) Fluorides v) Arsenic vi) Cyanide vii) Lend viii) Selenium		 310 180 66 202 0.06 0.014 0.132 0.017	 285 180 62 2.00 0.057 0.012 0.130 0.0164	 265 177 57 1.85 0.052 0.012 0.0124 0.0161	 260 164 52 1.67 0.047 0.01 0.122 0.0160	 255 160 47 1.65 0.37 0.01 0.120 0.0157
10) Chlorides by Colorimetric Analysis		435	410	230	225	210
11) Bacteriological Analysis (MPN)		525	327	125	87	Less then 2

By comparison of all these experimental results with standard values of Quality of Portable Water. It has been observed that water in River Krishna is highly polluted and it is unfit for drinking purposes.

CONCLUSION

Experimental results reveals that all values are exceeding over normal limit it is necessary to treat the water by Physical, Chemical and Biological treatments to set up all these values is normal range.

It is necessary to create awareness about water pollution of river Krishna among the society, farmers and students.

Every year due to such type of water pollution, disease like Cholera, Typhoid, Diarrhea, Jaundice, Malaria, Gastro etc. are spread in community. To avoid such type of water born disease it is necessary to create awareness and precautions should be taken to avoid such disease. It is necessary to give suggestions about polluted water and what type of precautions should be taken by society?

Under such precautions suggestions may be given about,

1. Water should be used by boiling 2. Water should be used by filtration 3.Water should be used by chlorination 4. Water should be used by ozonolysis 5. Water should be used by fluoridation
6. Water should be used by ferric alum 7. It is necessary to take medical treatment.

Importance / Significance of The Problem
By taken an account of above discussion the following message were incorporated (display) in community.
1. The polluted water is dangerous for the survivals of life of all living things.
2. It causes different types water born diseases like Typhoid, Paratyphoid, Dysentery, Gastro, Entreaties, Jaundice, Fever, Headache etc.
3. Hence, it is necessary to create awareness in community about irradiation of such water born diseases.
4. For healthy survival of life it should be free from color, odor and bad test.
5. It should be free from any pathogenic microorganisms for example. Pseudomonas such as E.coli salmonella, shegella, enterobacter etc.
6. It should be free from any toxic elements or carcinogenic chemicals.
7. It should be free from Organic, Inorganic and Biological pollutants
8. It is necessary to employ physical, biological and chemical treatment for the purification polluted water
9. Municipal water treatment process should be under proper condition for water treatment.
10. It is necessary to create awareness in society to avoid water pollution so that no serious problems were created
11. Use of water harvesting system to reuse it in community.

This message aims the community peoples and framers in agricultural industry also this research project is useful to those who are directly or indirectly associated with this subject in this part of research work there is sufficient uses of terms, tables, diagrams and observations with results.

This research work is also useful to farmers, urban and rural peoples, colleges students, science researchers. The message is in the form of written, oral and graphic communication.

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