To assess the quality of Drinking water of Dhar city and their adjacent villages. Water samples were collected during 2010-2011 analysed for various Physico-chemical analysis and microbiological parameter.

Protozoa such as *Entamoeba histolytica*, *Entamoeba coli* and *Giardia intestinalis* and Helminths such as *Ascaris lumbricoides*, *Ancylostoma duodanale*, *Taenia species*, *Trichuris trichiuria* and *Enterobius vermicularis* are some of the common intestinal parasites responsible for considerable morbidity in young and adult population.

Interesting examining of survey data for a study area was questionnaire carried out to describe the water supply and sewage distribution systems in relation to human dwellings, their wastes, Locality of water source in wards and villages, condition of water source, drinking water quality and sanitary practices in the study area Dhar city and adjacent village of Dhar city.

**Objectives**-

1-Physico-chemical analysis of drinking water samples.

2-Microbiological study of drinking water samples.

3-To assessment of faecal samples.

4-Study of water borne diseases in the study areas.

5-Socio- Ecological and health survey of study areas.

6-Statistical study of correlation and compare their results.

**Material and methods**-

Water samples were analyzed physically, chemically and bacteriological by Standard method of water and waste water (APHA, 1989).

Following parameters with their methods were analyzed.

1. pH  
   pH meter
2. Conductivity  
   Conductivity meter
3. Total dissolved solids TDS meter
4. Total alkalinity Phenolphthalein and methyl Orange indicator method
5. Carbonate Phenolphthalein indicator method.
7. Calcium hardness EDTA Trimetric method
8. Magnesium hardness EDTA Trimetric method
9. Total hardness EDTA Trimetric method
10. Chlorides Argentometric method
11. Sulphate Turbidimetric method
12. Silicates Molybdosilicates method
13. Phosphates Stannous chlorides method
14. Nitrates Brucin method
15. Fluoride Spands method (spectrophotometric)
16. Sodium Flame photometric method
17. Potassium Flame photometric method
18. Iron Phenonthroline method (spectrophotometric)
19. Copper Bathocoprione method
20. Microbial study of water WHO water testing kit (cholera, typhoid).
Conclusions-

Physico-chemical analysis-

In the present study the values of pH of drinking water of Dhar city varied from 7.1 to 8.7, 7.2 to 8.9 and 7.7 to 8.8 during rainy winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of pH of drinking water varied from 7.3 to 8, 7.6 to 8.8, and 7.9 to 8.7 during rainy winter and summer seasons respectively.

The value of TDS of drinking water of Dhar city varied between 530 mg/l to 2045 mg/l, 447 mg/l to 2340 mg/l and 421 mg/l to 2610 mg/l during rainy winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of TDS of drinking water varied between 364 mg/l to 796 mg/l, 408 mg/l to 926 mg/l, and 523 mg/l to 1032 mg/l during rainy, winter and summer seasons respectively.

The value of electric conductivity of drinking water of Dhar city ranged from 915 µmhos/cm to 3480 µmhos/cm, 764 µmhos/cm to 3938 µmhos/cm and 721 µmhos/cm to 4437 µmhos/cm during rainy winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of Electric Conductivity of drinking water range from 621 µmhos/cm to 1342 µmhos/cm, 412 µmhos/cm to 1561 µmhos/cm, and 523 µmhos/cm to 1805 µmhos/cm during rainy, winter and summer seasons respectively.

The value of total hardness of drinking water of Dhar city varied from 180 mg/l to 1260 mg/l, 209 mg/l to 1405 mg/l and 184 mg/l to 1490 mg/l during rainy winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of total hardness of drinking water varied from 120 mg/l to 530 mg/l, 146 mg/l to 584 mg/l, and 197 mg/l to 496 mg/l during rainy, winter and summer seasons respectively.

The value of calcium hardness of drinking water of Dhar city was noted to vary from 40 mg/l to 320 mg/l, 56 mg/l to 417 mg/l and 86 mg/l to 497 mg/l during rainy winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of calcium hardness of drinking water was noted to vary from 26 mg/l to 124 mg/l, 34 mg/l to 183 mg/l and 56 mg/l to 186 mg/l during rainy, winter and summer seasons respectively.

The value of magnesium hardness of drinking water of Dhar city was ranged from 15.79 mg/l to 111.78 mg/l, 34.02 mg/l to 235.46 mg/l and 41.31 mg/l to 241.29 mg/l during
rainy winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of magnesium hardness of drinking water was ranged from 13.36 mg/l to 53.46 mg/l, 26.01mg/l to 97.2mg/l and 33.29 mg/l to 75.33 mg/l during rainy, winter and summer seasons respectively.

In the present study the values of carbonate of drinking water in Dhar city were absent in Rainy season and it has observed in only 5 samples varying from Nil to 10 mg/l during winter season and it’s also present in 3 samples varying from Nil to 8 mg/l during summer season. Whereas, in the adjacent village of Dhar city the values of carbonate of drinking water were absent in all samples during rainy, winter and summer season respectively.

The value of bicarbonate of drinking water of Dhar city varied from 120 mg/l to 530 mg/l, 117 mg/l to 538 mg/l and 185 mg/l to 552 mg/l during rainy winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of bicarbonate of drinking water varied from 110mg/l to 300 mg/l, 132 mg/l to 316 mg/l and 156mg/l to 426 mg/l during rainy, winter and summer seasons respectively.

The value of total alkalinity of drinking water of Dhar city ranged from 120mg/l to 530 mg/l, 117mg/l to 538mg/l, and 185 mg/l to 552 mg/l during rainy winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of total alkalinity of drinking water ranged from 110 mg/l to 300 mg/l, 132 mg/l to 316 mg/l and 156 mg/l to 426 mg/l during rainy, winter and summer seasons respectively.

The value of chloride of drinking water of Dhar city varied from 102.8 mg/l to 847.25 mg/l, 115 mg/l to 920 mg/l and 131.14mg/l to 981mg/l during rainy winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of chloride of drinking water varied from 113.44 mg/l to 336.77 mg/l, 115 mg/l to 384 mg/l and 126 mg/l to 417 mg/l during rainy, winter and summer seasons respectively.

The value of fluoride of drinking water of Dhar city was noted to vary from 0.002 mg/l to 0.09 mg/l, BDL to 0.9 mg/l and 0.008 mg/l to 0.96 mg/l during rainy winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of fluoride of drinking water was noted to vary from 0.004mg/l to 0.06 mg/l, 0.006 mg/l to 0.11mg/l and 0.046mg/l to 0.17 mg/l during rainy, winter and summer seasons respectively.
The value of nitrate of drinking water of Dhar city ranged from 0.065 mg/l to 1.99 mg/l, 0.071 mg/l to 3.41 mg/l and 0.036 mg/l to 4.65 mg/l during rainy, winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of nitrate of drinking water ranged from 0.028 mg/l to 1.98 mg/l, 0.013 mg/l to 2.03 mg/l and 0.12 mg/l to 2.13 mg/l during rainy, winter and summer seasons respectively.

The value of sulphate of drinking water of Dhar city varied from 10.92 mg/l to 51.22 mg/l, 14.11 mg/l to 72.53 mg/l and 21.02 mg/l to 101.24 mg/l during rainy, winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of sulphate of drinking water varied from 11.62 mg/l to 39.82 mg/l, 14.05 mg/l to 38.39 mg/l and 29.16 mg/l to 48.45 mg/l during rainy, winter and summer seasons respectively.

The value of phosphate of drinking water of Dhar city varied from 0.022 mg/l to 1.65 mg/l, BDL to 3.89 mg/l and BDL mg/l to 4.2 mg/l during rainy, winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of phosphate of drinking water varied from 0.003 mg/l to 1.46 mg/l, 0.004 mg/l to 1.72 mg/l and 0.008 mg/l to 2.13 mg/l during rainy, winter and summer seasons respectively.

The value of sodium of drinking water of Dhar city ranged from 4 mg/l to 200 mg/l, 12 mg/l to 200 mg/l and 27 mg/l to 200 mg/l during rainy, winter and summer seasons respectively. Whereas, in the adjacent villages the value of sodium of drinking water ranged from 18 mg/l to 60 mg/l, 18 mg/l to 91 mg/l and 29 mg/l to 109 mg/l during rainy, winter and summer seasons respectively.

The value of potassium of drinking water of Dhar city was noted to vary from 1 mg/l to 160 mg/l, 1 mg/l to 183 mg/l and 2 mg/l to 197 mg/l during rainy, winter and summer seasons respectively. Whereas, in the adjacent villages the value of potassium of drinking water was noted to vary from 1 mg/l to 20 mg/l, 1 mg/l to 23 mg/l and 1 mg/l to 29 mg/l during rainy, winter and summer seasons respectively.

The value of iron of drinking water of Dhar city varied from 0.0001 mg/l to 0.129 mg/l, 0.001 mg/l to 0.132 mg/l and 0.001 mg/l to 0.125 mg/l during rainy, winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of iron of drinking water varied from 0.0001 mg/l to 0.0004 mg/l, 0.001 mg/l to 0.009 mg/l and 0.001 mg/l to 0.008 mg/l during rainy, winter and summer seasons respectively.
The value of copper of drinking water of Dhar city ranged from 0.0001 mg/l to 0.027 mg/l, BDL to 0.012 mg/l and BDL to 0.019mg/l during rainy winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of copper of drinking water ranged from 0.0001mg/l to 0.0007 mg/l, 0.001mg/l to 0.006 mg/l and 0.001mg/l to 0.003 mg/l during rainy, winter and summer seasons respectively.

The value of silicates of drinking water of Dhar city varied from 0.04 mg/l to 2 mg/l, 0.02 mg/l to 2.5 mg/l and 0.01mg/l to 2.16 mg/l during rainy winter and summer seasons respectively. Whereas, in the adjacent villages of Dhar city the value of silicates of drinking water varied from 0.1 mg/l to 1.4 mg/l, 0.3mg/l to 1.6 mg/l and 0.3 mg/l to 2.1 mg/l during rainy, winter and summer seasons respectively.

**Bacteriological study**

In Dhar city we have found that 15%, 15% and 35% of drinking water samples unfit for drinking purpose during rainy winter and summer seasons respectively. However, in case of adjacent villages of Dhar city 10% and 30% drinking water samples unfit for drinking propose during rainy, winter and all samples were fit in summer season respectively.

**Faecal Examination**

We have found that Protozoan parasites of Dhar city shows 20.22% of *E. histolytica*, 22.67 % of E.coli and 29.11% of *Giardia intestinalis*. However, in adjacent villages of Dhar city 21.33% of *E. histolytica*, 24.67% of *E.coli* and 31.33% of *Giardia intestinalis* respectively. In case of Helminthic parasites of Dhar city shows 14.44% of *Ascaris lumbricoides*, 2.44% of *Ancylostoma duodanale*, 10.67% of *Taenia species*, 7.33% of *Trichuris trichiura* and 5.56% of *Enterobius vermicularis*. In the adjacent villages Dhar city 21.33% *Ascaris lumbricoides*, 4.67% *Ancylostoma duodanale*, 13.33% *Taenia species*, 9.33% *Trichuris trichiura* and 8.67% of *Enterobius vermicularis* were noted.

**Socio- Ecological and health survey**

In the presents study the sampling were randomly selected in Dhar city and adjacent villages of Dhar namely- Delmi, Badpipli, Sitapat, Padliya, Matalabpura, Gyanpura, Khilchipura, Tornod, Jetpura and Utawad.
In the Dhar city we have found that the locality of drinking water sources maximum in Plaines 50.33% and as followed by 14.44% near of sewer line, 14% in hilly areas, 13.67 % near of garbage and 7.55% near of refuge dumps. Whereas, in the adjacent villages of Dhar city in Plaines 44.5%, in hilly areas 17%, near of garbage 16%, near of refuge dumps 13.5% and near of sewer line 9%.

In the Dhar city maximum drinking water (51.11%) is supplied by municipal tap water followed by (30.55%) of tube well, (17%) of hand pump and (1.33%) of well water. Whereas, in the adjacent villages of Dhar city maximum sources of water noted hand pump (42.5%) followed by tube well (24.5%), tap water supply (15.5%) and well water (14.5%) of the study area.

Common and water born diseases in the study area of Dhar city- we have reported that the maximum incidence of cold cough (18.63%) followed by amoebiasis (15.63%), pain in joint (13.52%), typhoid (9.84%), diarrhoea (9.52%), jaundice (8.64%), indigestion (8.13%), skin disease (5.71%), malaria (4.98%), dysenteric (3.19%), T.B. (1.40%), cholera (0.23%) and fluorosis (0.41%). Whereas, in the adjacent villages of Dhar city maximum incidence of cold cough (20.40%) were noted followed by amoebiasis (18.46 %), indigestion (10.51%), diarrhoea (10.07%), and jaundice (9.54%), skin disease (9.27%), pain in joint (7.68 %), typhoid (5.65%), dysenteric (2.82%), malaria (2.56%), T.B. (2.20%), cholera (0.35%) and fluorosis (0.44%).

Maximum population of Dhar city used house toilet 87.78 % as defecation site followed by agriculture field (8.78 %) and community (3.44 %). Whereas, in the adjacent villages of Dhar city house toilet 51% as defecation site followed by community (13.5%) and (35.5%) of agriculture field in the study area.

Survey explained that in the Dhar city 49.22% of the population was business class followed by 29.78% of service, 13.44% of labour and 7.56% of agriculture farming. Whereas, in the adjacent villages of Dhar maximum engaged of farming 75.5% followed by 12.5% of labour, 7.5% of business and 4.5% of service class.

In the study area of Dhar city the level of literacy we have noted maximum level of middle 27.43% followed by intermediate 22.95 %, primary 21.40 %, higher educate 15.80 % and illiterate 12.39%. Whereas, in the adjacent villages of Dhar city maximum
level of illiterate 30.16%, primary 28.13%, middle 20.67, intermediate 15.59 % and higher educate 5.42%.

**Statistical study of correlation**

In Dhar city total dissolve solid showed highest positive correlation with electrical conductivity (0.99, 0.99 and 0.99), total hardness (0.91, 0.92 and 0.90), calcium hardness (0.87, 0.81, and 0.82), magnesium hardness (0.89, 0.93 and 0.94), total alkalinity (0.68, 0.76 and 0.72), chloride (0.79, 0.81 and 0.82) and sodium (0.67, 0.69 and 0.73) during rainy winter and summer season respectively. Whereas, in the adjacent villages of Dhar city highest positive correlation with electrical conductivity (0.99, 0.98 and 0.96), total hardness (0.89, 0.89 and 0.83), calcium hardness (0.92, 0.93 and 0.89), magnesium hardness (0.72, 0.86 and 0.74) total alkalinity (0.76, 0.77 and 0.83) and chloride (0.55, 0.74 and 0.78) during rainy winter and summer season respectively.

In Dhar city positive correlation obtained between electric conductivity and total hardness (0.91, 0.92, and 0.90), calcium hardness (0.87, 0.81, and 0.82), magnesium hardness (0.89, 0.93, and 0.93), total alkalinity (0.68, 0.76, and 0.72), total dissolve solids (0.99, 0.99, and 0.99), chloride (0.79, 0.81, and 0.82) and sodium (0.67, 0.69, and 0.73) during rainy winter and summer season respectively. Whereas, in the adjacent villages of Dhar city positive correlation obtained between electric conductivity and total hardness (0.89, 0.86 and 0.82), calcium hardness (0.92, 0.89 and 0.84), magnesium hardness (0.73, 0.84 and 0.77), total alkalinity (0.76, 0.76 and 0.82), total dissolve solids (0.99, 0.98 and 0.96) and chloride (0.54, 0.76 and 0.78) during rainy winter and summer season respectively.

In Dhar city total hardness showed highest positive correlation with calcium hardness (0.98, 0.91 and 0.92), magnesium hardness (0.94, 0.99 and 0.96), total alkalinity (0.60, 0.66 and 0.63), chloride (0.54, 0.63 and 0.61), total dissolve solids (0.91, 0.92 and 0.90), electrical conductivity (0.91, 0.92, 0.90) and sodium (0.62, 0.61 and 0.63) during rainy winter and summer season respectively. Whereas, in the adjacent villages of Dhar city total hardness showed highest correlation with calcium hardness (0.96, 0.98 and 0.94), magnesium hardness (0.92, 0.99 and 0.98), total alkalinity (0.88, 0.90 and 0.86), total dissolve solids (0.89, 0.89 and 0.83) and electrical conductivity (0.89, 0.86 and 0.82) during rainy winter and summer season respectively.
In Dhar city calcium hardness showed highest positive correlation with magnesium hardness (0.86, 0.87 and 0.87), total hardness (0.98, 0.91 and 0.92), total alkalinity (0.57, 0.58 and 0.60), total dissolve solids (0.87, 0.81 and 0.82), electrical conductivity (0.87, 0.81 and 0.82) and sodium (0.58, 0.55 and 0.54) during rainy winter and summer season respectively. Whereas, in the adjacent villages of Dhar city calcium hardness showed highest correlation with magnesium hardness (0.79, 0.95 and 0.85), total hardness (0.96, 0.98 and 0.94), total alkalinity (0.88, 0.84 and 0.74), total dissolve solids (0.92, 0.93 and 0.89) and electrical conductivity (0.92, 0.89 and 0.84) during rainy winter and summer season respectively.

In Dhar city magnesium hardness showed positive correlation with calcium hardness (0.86, 0.87 and 0.87), total hardness (0.94, 0.99 and 0.96), total alkalinity (0.60, 0.65 and 0.64), chloride (0.55, 0.65 and 0.65), total dissolve solids (0.89, 0.93 and 0.94), electrical conductivity (0.89, 0.93 and 0.93) and sodium (0.62, 0.61 and 0.65) during rainy winter and summer season respectively. Whereas, in the adjacent villages of Dhar city magnesium hardness showed highest correlation with calcium hardness (0.79, 0.95 and 0.85), total hardness (0.92, 0.99 and 0.98), total alkalinity (0.78, 0.91 and 0.89), total dissolve solids (0.72, 0.86 and 0.74) and electrical conductivity (0.73, 0.84 and 0.77) during rainy winter and summer season respectively.

In Dhar city total alkalinity showed positive correlation with calcium hardness (0.57, 0.58 and 0.60), magnesium hardness (0.60, 0.65 and 0.64), total hardness (0.60, 0.66 and 0.63), total dissolve solids (0.68, 0.76 and 0.72), electrical conductivity (0.68, 0.76 and 0.72), sodium (0.78, 0.77 and 0.77) and potassium (0.59, 0.62 and 0.61) during rainy winter and summer season respectively. Whereas, in the adjacent villages of Dhar city total alkalinity showed highest correlation with calcium hardness (0.88, 0.84 and 0.74), magnesium hardness (0.78, 0.91 and 0.89), total hardness (0.88, 0.90 and 0.86), total dissolve solids (0.76, 0.77 and 0.83), electrical conductivity (0.76, 0.76 and 0.82) during rainy winter and summer season respectively.

In Dhar city the chloride showed highly positive correlation with total dissolve solids (0.79, 0.81 and 0.82), electrical conductivity (0.79, 0.81 and 0.82), total hardness (0.54, 0.63 and 0.61), and magnesium hardness (0.55, 0.65 and 0.65) during rainy winter and summer season respectively. Whereas, in the adjacent villages of Dhar city chloride
showed positive correlations with total dissolve solids (0.55, 0.74 and 0.78), and electrical conductivity (0.54, 0.76 and 0.78) during rainy winter and summer season respectively.

In the adjacent villages of Dhar city phosphate showed positive correlation with potassium (0.95, 0.90 and 0.91) during rainy winter and summer season respectively.

In Dhar city the sodium showed positive correlation with total dissolve solids (0.67, 0.69 and 0.73), electrical conductivity (0.67, 0.69 and 0.73), total hardness (0.62, 0.61 and 0.63), calcium hardness (0.58, 0.55 and 0.54), magnesium hardness (0.62, 0.61 and 0.65), total alkalinity (0.78, 0.77 and 0.77) and potassium (0.62, 0.66 and 0.71) during rainy winter and summer season respectively. Whereas, in the adjacent villages of Dhar city sodium showed positive correlations with total dissolve solids (0.57 and 0.56) and chloride (0.59 and 0.67) during winter and summer season respectively.

In Dhar city the potassium showed positive correlation with total alkalinity (0.59, 0.62 and 0.61) and sodium (0.62, 0.66 and 0.71). Whereas in the adjacent villages of Dhar city potassium showed positive correlations with total phosphate (0.95, 0.90 and 0.91) and nitrate (0.51 and 0.79) during rainy winter and summer season respectively.

In this study, the Physico chemical parameter of drinking water samples of Dhar city including adjacent villages has been done. This study help to monitoring the ground water level safe for drinking purpose, since decreasing quality of drinking water due to pollution has hazardous effect on living organisms. Thus their importance with proper consultation and scientific way is important and necessary to make the water safe and to prevent the individual from water born disease.

Thus, it is suggested that user should take the drinking water, tested in laboratory, for drinking purpose and good health.