IMPACT OF URBANIZATION ON POTABLE WATER QUALITY: A BACTERIOLOGICAL CASE STUDY OF BANNU CITY.

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Abstract: *In this study ground and surface water samples were analyzed and are reported here for microbial contamination before and after the storage for the main urban center of district Bannu. Total 100 water samples were collected from drinking water cycle i.e. tube wells, water tanks and consumer ends and tested for faecal contamination by using membrane filtration technique. It was found that post storage ground water samples were contaminated and pre storage ground water samples were free from faecal contamination. Pre storage and post storage surface water samples were highly contaminated. Ground water quality is much better than surface water. Further turn down in microbial water quality from source to the consumer end shows hygienic conditions of the urban dwellers.*

Keywords: water quality, membrane filtration technique and faecal contamination.

1. Introduction:

Water quality can be deteriorated by pipe material, lack of back flow preventers and uninstalling of connection rings at the joint [1]. Warm blooded organism excreta contain faecal coliform and other bacteria. Each calender day per capita excreta of faecal coliform and other bacteria ranges from 100 to 400 billion [2]. Highly spreading water borne ailment specially diarrhea in summer season felt the need to check the physicochemical water quality parameters in the urban area of Peshawar. Analysis of the collected water samples suggested that tube well water of the study area was feasible for drinking and other domestic activities [3]. High incidence of diarrheal diseases in summer enforced to investigate the causes of potable water contamination in the rural areas of district Hangu. It was found that pH and turbidity gently follow WHO guideline values while water samples were faecally contaminated at the source or in between the source and consumer end. It was suggested that health safety can be ensured by protecting source and distribution network from faecal contamination [4]. Due to high dependency on surface water in the rural areas of Gilgit Baltistan, water samples were analyzed for microbial contamination. It was found that springs water is found safe for drinking at the source while streams water is faecally contaminated [5]. Water quality testing results of tube well water for district Mardan revealed that water was not feasible for human consumption due to physicochemical contamination [6]. The study was carried out to evaluate the water quality of various springs' water and found that it needs simple treatment such as filtration and disinfaction to improve microbial water quality [7]. In the vacinity of Australian Capital conventional centralized water distribution system exists. Different modelling tools were used to decline urban drinkng water demand which was best achieved by demand management tools [8]. The study was conducted to evaluate the potential benefits of modern technology in urban water cycle. Water saving schemes like rain water harvesting and grey water has decreased potable water demand by 27% [9]. The study conducted for Tel Aviv city has confirmed that rain water harvesting and waste water reuse has reduced potable water demand by 10% and 32% respectively. It has proved that water recycling can reduce water demand effectively [10]. Smart water metering system was introduced in Harvey Bay to record hourly water utilization which was further used for water management. One can effectively manage potable water by using modern technology [11]. Water demand is a big issue for any nation of the world due to increasing urban population. It can be decreased by water demand management statergy [12]. The research has confirmed that water quality was well enough at the source and deteriorated in water conveyance system which shows the hygiene of the inhabitants [13, 14].

It is obvious that bacteriological water quality is a big issue for any nation of the world. This problem is aggravated by poor water supply infrastructure, lack of management system and lavish use of water. The study aims to investigate the causes and extent of bacteriological water contamination in urban water supply schemes.

2. MATERIALS AND METHODS

A total of one hundred water samples were collected randomly from ground and surface water sources from the main urban center of district Bannu for bacteriological examination. Pre storage and post storage water samples were collected from both ground and surface water sources. Water samples were collected in 120ml pre sterilized plastic bags. Before sampling, tap was allowed to flow for 2 to 3 minutes to get rid of any contaminant present. The collected samples were brought to the laboratory in cold chain box and tested within 5 hours after the collection. pH and turbidity were tested in the field. Faecal coliform testing was carried out in Wagtech Potatest water testing kit which is based on membrane filtration method. A specific volume of 100ml water sample is allowed to pass through membrane filter whose pore size is less than the faecal coliform size. A food supplement of Lauryl Sulfate Broth was added to the retained faecal matter and incubated at specific temperature of 44^0C for a period of 18 to 24 hours. After the above mentioned time samples were checked for any presence of

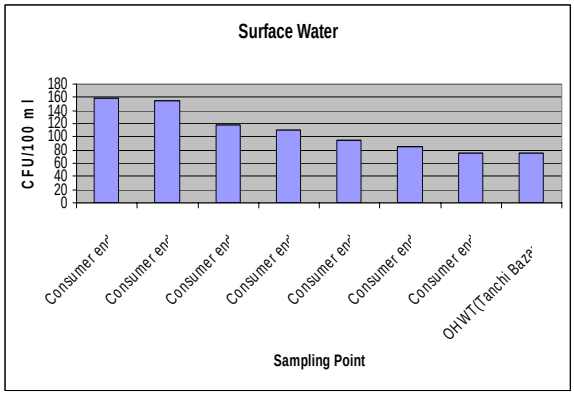

Fig. 1: CFU/100ml for surface water

yellowish faecal coliform colonies. The result was presented in coliform unit (CFU) per 100ml.

3. RESULTS AND DISCUSSION

It is evident from the faecal coliform water testing results that water quality is deteriorated by warm blooded organisms excreta and it has shown remarkable changes throughout the distribution network. Faecal contamination increases from source to the consumer end. Detail of water sampling is given in table 1.

Table 1. Summary of water samples(ml).

Type of Source	**Tube well**	**Water tank**	**Consumer end**	**Total**
Ground water	15	1	76	92
Surface water	-	1	7	8
Total	**15**	**2**	**83**	**100**

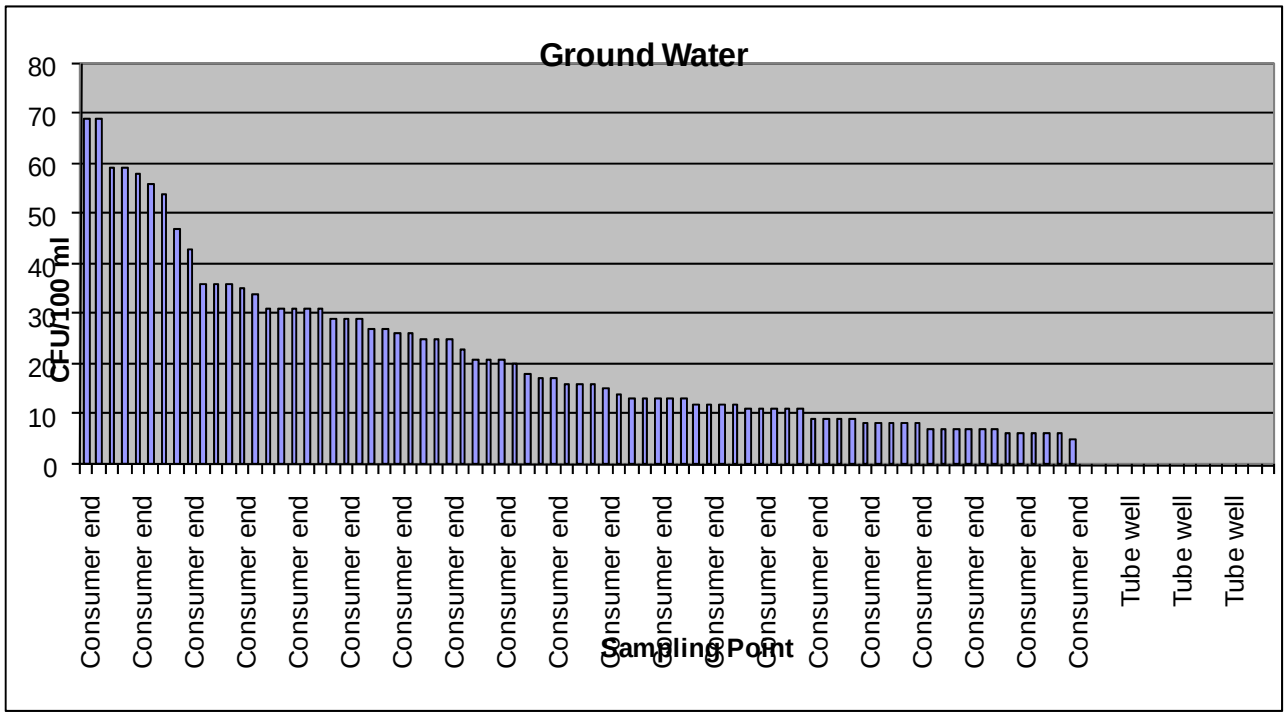

Fig. 2: CFU/100ml for ground water

It is obvious from fig.1 that faecal contamination increases from water tank to the consumer end. Fig.2 shows that tube well water is free from faecal contamination and is feasible for drinking and other household activities while consumer end is at high risk .It is obvious from fig.3 that only tube well water meets the WHO guideline values while water tank and consumer end is at high risk.

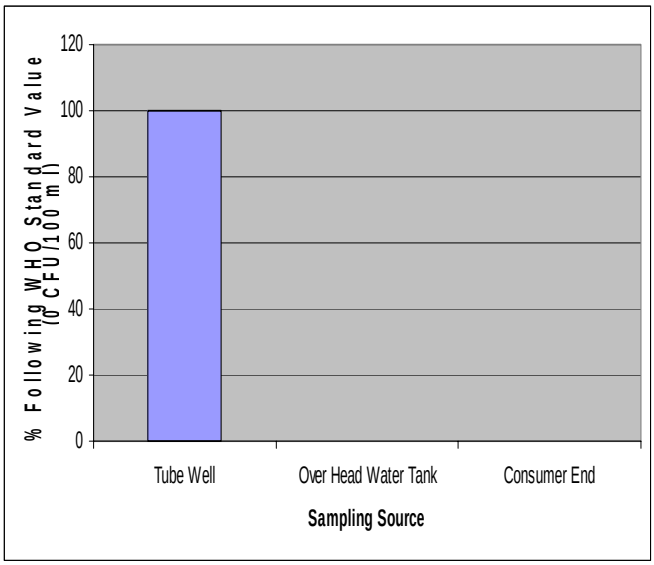

Fig.3: CFU/100ml for ground water.

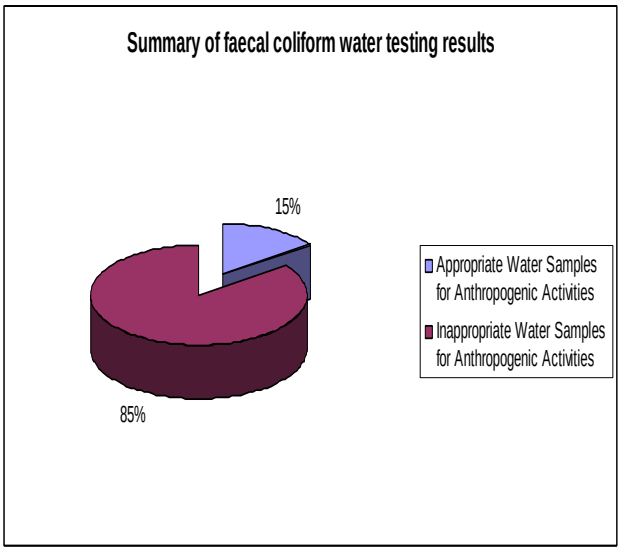

Fig.4: % of appropriate and inappropriate water samples for drinking

From fig.4 it is clear that urban community of the selected under study
area is at high risk because only 15% matches WHO standards.
Microbial analysis was carried out using Geographic Information System (GIS) and found that land use adversely effect water quality.

It is obvious from fig.5 that microbial ground water quality is highly deteriorated in the main urban center owing to high unhygienic anthropogenic activities. Peripheral animal market is at high risk due to animal faeces

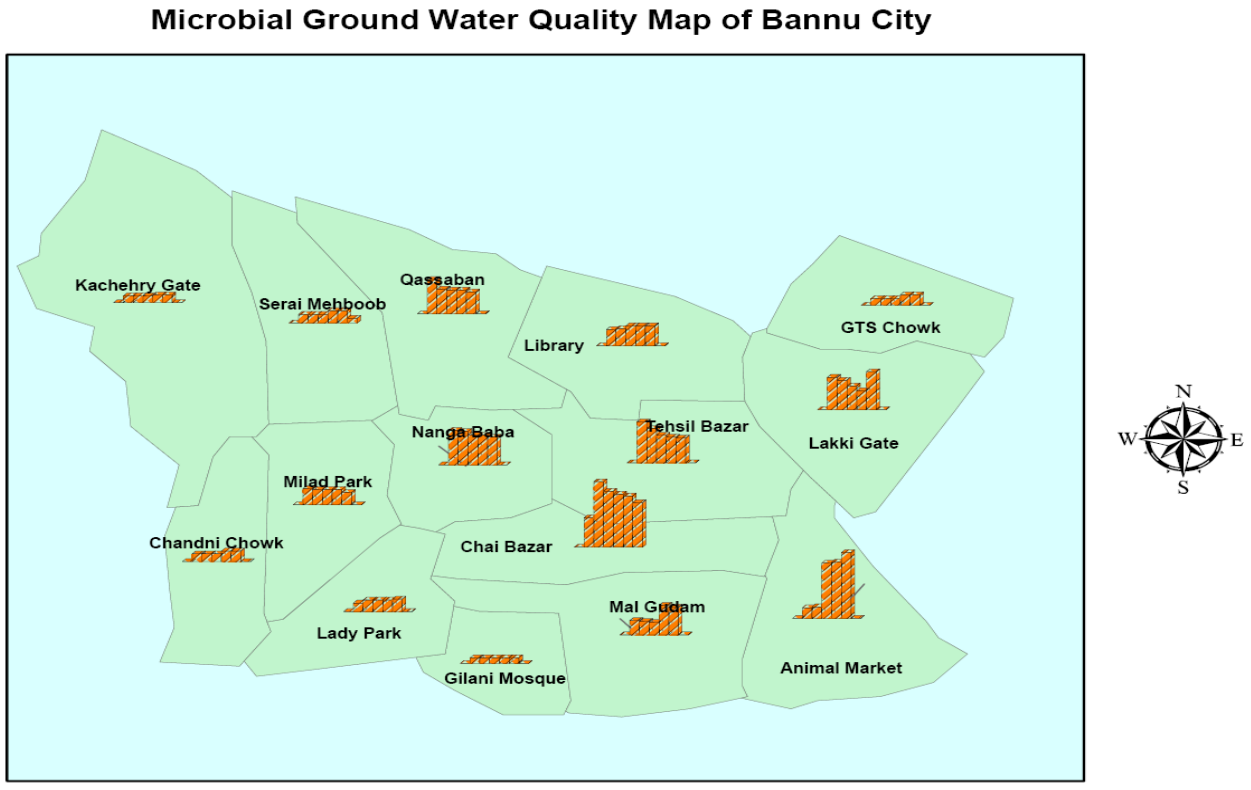

Fig.5: CFU/100ml for ground water.

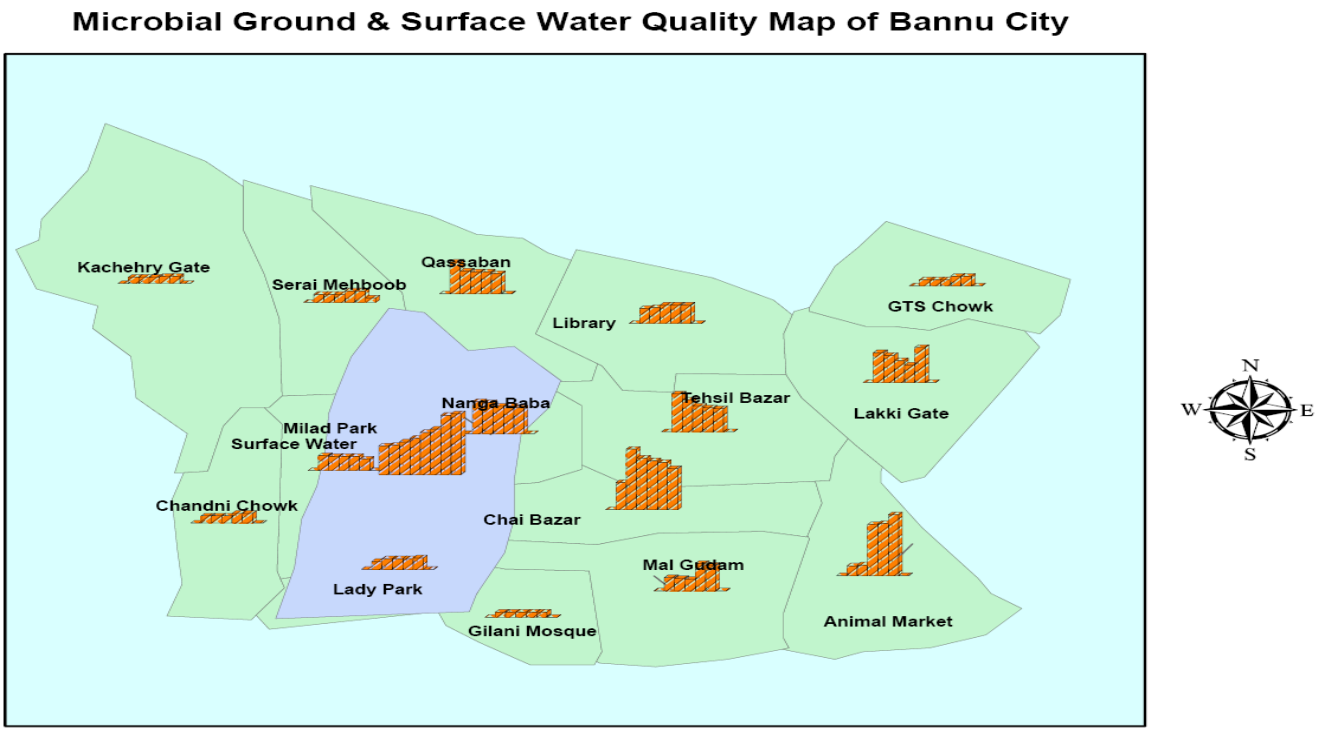

Fig.6: CFU/100ml for ground water and surface water

Fig. 6 shows that surface water is more contaminated than ground water.

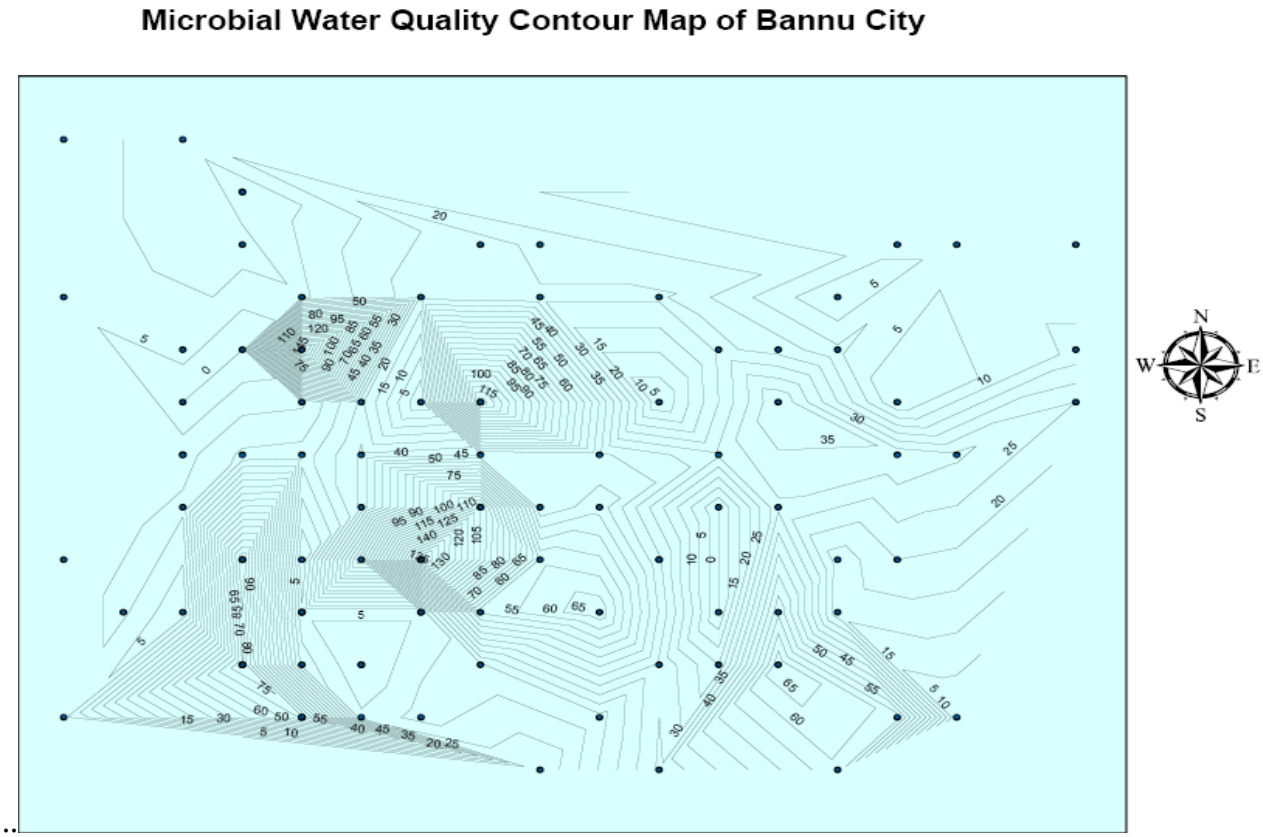

Fig.7: Faecal coliform ground and surface water contour map.

It is obvious from the research work that faecal contamination increases with the increasing distance from the source due to old rusted water mains, bare pipes on the road surface, lack of proper sanitary inspection, closeness of water mains to sewerage drains, offensive system for solid waste collection, inappropriate system for chlorination, improper periodic water testing, careless use of water and unavailability of proper storm water collection system.

4. CONCLUSIONS AND RECOMMENDATIONS:

1. It is concluded from the research work that tube well water in the under study area follows WHO guideline values. It suggests that ground water is found safe both, for drinking and domestic purposes.
2. Surface water is highly contaminated and it is not suitable for drinking and other family circle activities
3. Water stored in tanks is found to be contaminated which is injurious to human health. It should be treated chemically and cleaned periodically.
4. Water is highly contaminated at the consumer end which is high threat to the residents of the selected under study area. Many factors are involved in water contamination, e.g. old rusted pipes, water supply pipes lying inside or at the banks of the sewers, unburied water supply pipes lying on road sides exposed to vehicles movement, improper solid waste disposal system which clogs the sewer and the water supply pipes submerge in the sewerage.
5. The concerned authority should focus on water chlorination. It will ultimately cut down the water borne diseases upward trend.
6. Old rusted pipes should be replaced by installing new one as these pipes have completed their design life. Adequate storm water collection system should be installed in order to discourage pounding of water on the streets and roads

Fig.8: Broken roof slab and polluted overhead water tank.

Fig.9: Storm water standing in the street.

Fig. 10: : Bare leaked water supply mains lying at the banks of the sewer

7. Fig.10: Bare leaked water supply mains lying at the banks of the Water supply mains should be properly concealed in closed conduits at proper safe distance from the sewers.
8. Water supply pipes should be properly buried in trenches owing to avoid its exposure to the traffic movement.
9. Slow sand filter should be cleaned periodically.
10. There should be proper solid waste collection and disposal system.
11. Sewers should be cleaned periodically and the removed debris/floating materials should be carried outside the city to its legal dumping sites.
12. Residents of the area should be educated to boil water especially for drinking.

13. House filters are recommended to be used if affordable sewer.

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