punjab geographer

A JOURNAL OF THE ASSOCIATION OF PUNJAB GEOGRAPHERS, INDIA

VOLUME 2

OCTOBER 2006

PUNJAB GEOGRAPHER Volume 1 Number 2 October 2006

HOUSEHOLD BURDEN OF WATER AND SANITATION ASSOCIATED DISEASES IN ALIGARH CITY

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Abstract

In this paper an attempt has been made to examine the household water supply and the occurrence of associated diseases. Aligarh city has been chosen as the study area. This is a medium sized city lying in the shadow of country's capital, New Delhi. Data has been collected mainly from household surveys with the help of questionnaire interviews. For in depth survey, ten wards have been selected on the basis of population density and location. From these ten wards, 1,794 households belonging to different income groups have been sampled. The differences in the occurrence of water associated diseases in the different income households suggest that most of differences are related to water supply conditions existing in their homes (such as, water supply inside/outside the premises, duration of water supply, state of supply and quality of water) open defecation, type of latrine facility, site of disposal of excreta, place of disposal of waste water, water logging and place of disposal of household waste.

Introduction

'The lack of water is the greatest obstacle to sustainable development and the most visible symbol of the growing gap between the rich and the poor' (United Nations, 2002). Water and sanitation are the basic necessities of a community and the most important precondition for development, as it plays an important role in improving health and quality of life. While provision of water to urban areas has improved over the years, the provision of sanitation has not received adequate attention (Ninth Five Year Plan, 1997-2002). About 60 to 80 per cent of illnesses in India are due to inadequate and poor quality of water and lack of basic sanitation. The diseases directly associated with water and sanitation and hygiene-include infectious diarrhoea (including cholera, amoebiasis and a number of other protozoanal and viral infections), enteric fever, hepatitis A, E and F, fluorosis, trachoma, intestinal helminth infections (including ascariasis, hookworm, tapeworm etc), scabies, dengue, filariasis, malaria, Japanese encephalitis (United Nations, 2002).

Keeping these aspects in mind, this research topic was chosen and Aligarh city was selected as the study area because too little attention is given to study the living conditions of medium/ small towns. In this paper an attempt has been made to examine the water supply and sanitation conditions and the occurrence of associated diseases in the sampled households of Aligarh city.

Data Base and Methodology

The study is based on primary sources of data which have been collected through questionnaire based interviews and field/ household surveys. The field-work has

Table 1

Aligarh City: Wards selected on the basis of location and population density

Location	Ward No.	Name of wards	Population Density	Number of Household Sampled
In the old part	2	Usmanpara	HD	109
of the city	12	Sarai lavaria	HD	123
(4 wards)	14	Jamerabad	LD	147
	50	Rasalganj	HD	126
In the new part	32	Ghanshyampuri	LD	220
of the city	40	Begpur	MD	292
(3 wards)	53	Bhamola	LD	288
In the fringe areas	23	Bhujpura	LD	119
(3 wards)	30	Jamalpur	MD	202
	48	Dorinagar	LD	168

HD – High Density >60,000 persons per km^2
MD – Medium Density 40,000 – 60,000 persons per km^2
LD – Low Density <40,000 persons per km^2

been done during the year 2004-05. For getting accurate information all the households have been visited frequently (Khan, 2005).

The following methods were used in the study:

(i) The selection of wards was purposeful one. Ten wards have been selected from the total 60 wards of the city (Table-1 and Fig.1) on the basis of their location (core area/civil lines area/fringe area) and on the basis of population density (high/ medium/low).

(ii) From each of the selected wards 10 per cent of the total households belonging to different income categories were selected using stratified random sampling procedure. The total sample size consisted of 1,794 households (Table 1A).

(iii) From each household a respondent has been selected. Usually the senior women of the household were chosen as the respondent because women remain more often at home and know more about their household conditions. They were personally interviewed.

Table 1A

Sampled Households

Income Category	Income per month (in Rs.)	No. of Sampled Household
Very high income	> 15,000	350
High	10,000 – 15,000	444
Medium	5,000 – 10,000	470
Low	< 5,000	530
Total		1,794

(iv) For testing the quality of water from the 10 selected wards, 10 samples from municipal tap water and 10 samples from hand pumps have been collected and put to physical, chemical and bacteriological tests. The tests have been conducted at Zonal Laboratory, Agra and at Jal Nigam, Aligarh.

(v) Ten water related risk factors are identified.

(vi) Correlation coefficient technique is applied to understand the relationship between income, water, sanitation and associated diseases.

Study Area

Aligarh is a medium sized city of North India. It is located (27°53' north latitude and 78°4' east longitude) in the western part of the state of Uttar Pradesh in the fertile Gangetic plain. From seventies to the present (2003-04), the city's area has doubled (from 33.45 to 68.97km^2) and its population has trebled (from 252,314 to 767,732). Because of this, the demand for basic facilities especially housing, water and sanitation has increased tremendously (Singh, A.L. 2003).

Aligarh city entirely depends upon the groundwater as its source of water supply. The city residents depend on municipal piped water connections, jet-pumps and handpumps for their water supply. The Aligarh Jal Nigam is the primary source for piped water supply. The water is usually pumped by tubewells and is first stored in the overhead/underground storage tanks to ensure regular supply. It is also supplied directly through pipe lines. At present the Jal Nigam has 54 tubewells, 18 overhead and 5 underground storage tanks and 500 kilometers of distribution pipe line (Aligarh Nagar Nigam, 2004). The municipal piped water supply is available only in the central part of the city. The residential colonies are expanding so rapidly that the local body is unable to keep up with the necessary infrastructural requirement. In rest of the area water is obtained through hand-pumps or private tubewells. The municipality is installing more tubewells/ hand pumps in its effort to meet the increasing demand. Residents have also installed tubewells and hand pumps in their own premises to meet their own demands. Many houses, flats, group housings, schools, hostels etc. have resorted to deep tubewells.

Much of the focus of the Jal Nigam was on the water distribution system and little attention has been paid to the demand which kept on rising. The city having about 0.7 million population require more than 120 million litre of water per day but the supply available is only 54 million litre per day. In such a scarce situation the Jal Nigam has planned to install many new tubewells and hand pumps.

An assessment of water quality showed a warning trend. All the samples were found to be polluted and contaminated by faecal, coliform and bacterial count. The quality of water from the municipal piped water connection was found to be poorer than that of the hand pump. This is due to the use of uncovered storage tanks and poor maintenance by the Jal Nigam of old, rusted, leaky distribution pipes submerged in sullage. The use of boosters by the consumers on the main municipal lines aggravates the problem of water pollution by sucking the waste product.

The city has very poor sanitation condition characterized by, open over flowing drains, non operative sewer lines, absence of water treatment plant, heaps of garbage and overflowing waste bins.

The topographical layout of the area is such that there is no natural drainage. In the sauce-pan shaped topography with two perennial rivers; the Ganga and Yamuna flowing on the highland peripheries, the city is located in the central low-lying tract. Not only does the dirty water from the city collect here but the water from the neighboring parts also flows in. As a result, the city suffers from water logging problem all the year round. There are 150 big and small open drains in which flow both the grey water (from kitchen, bathrooms, laundry etc) and the black water (from flush toilets). After leaving the home the water mixes up in the open drains and meets the bigger drain known as Jafari Cut which empties itself in the river Kali (16 km away). This river has metamorphosed itself from a serene body

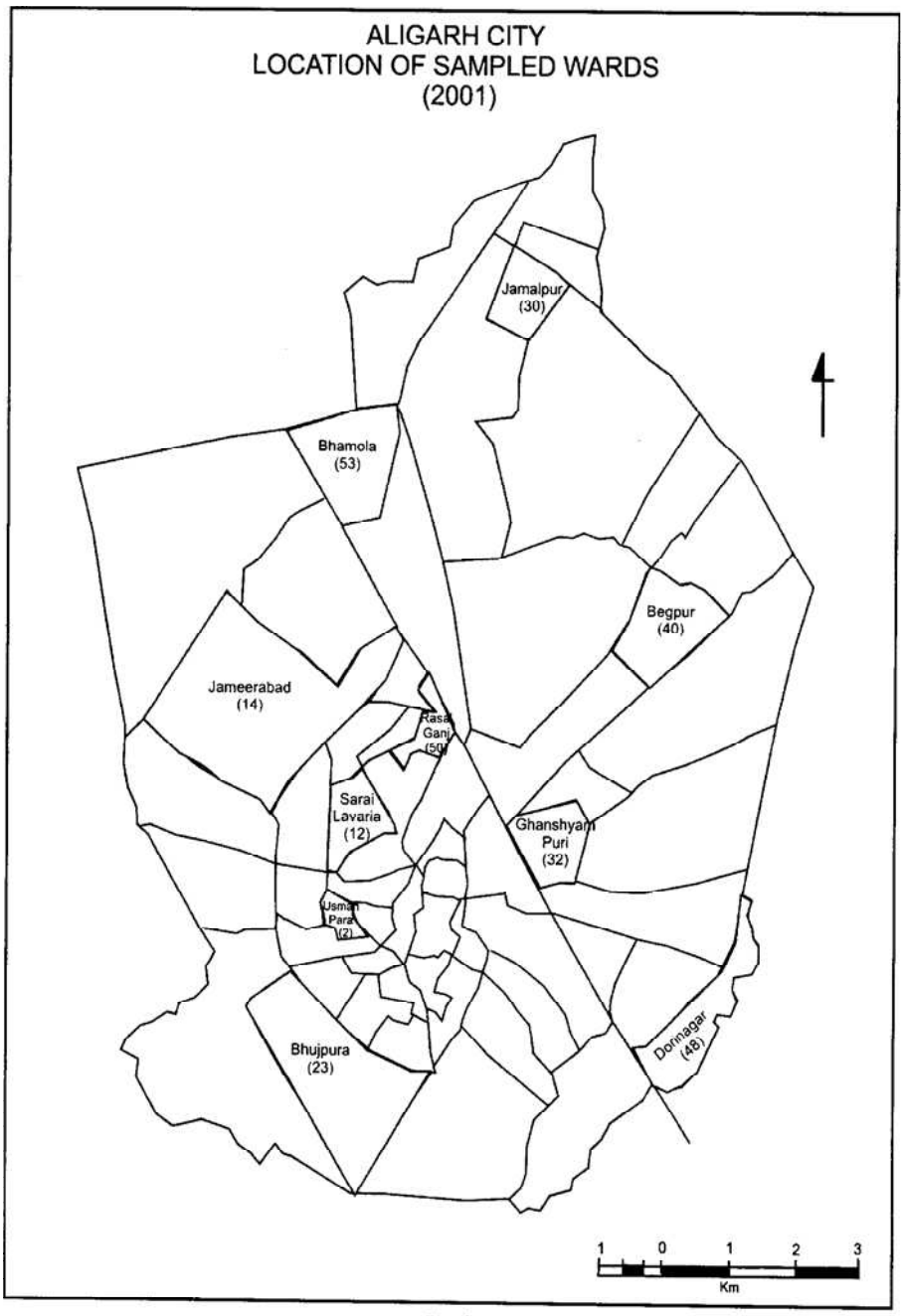
ALIGARH CITY
LOCATION OF SAMPLED WARDS
(2001)
Jamalpur
(30)
Bhamola
(53)
Begpur
(40)
Jameerabad
(14)
Sarai
Lavaria
(12)
Ghanshyam
Puri
(32)
Bhujpura
(23)
Dornagar
(48)
1 0 1 2 3
Km

Fig. 1

of pure water to a coliform carrying stinking black sewage. In about one-third of the city area the sewage system has been laid but it is mostly inoperative. There is one waste water treatment plant but it is not functioning. So large amount of untreated wastewater either finds its way in the fields or it re-enters the drains. The city has nearly 6,000 dry and 3,000 wet latrines (DUDA, 2005). The excreta from the dry latrines is disposed either in the open drains or along the roads or in the garbage bins. With non operative sewer lines the flush latrines are either connected to septic tanks or to the open drains. Heaps of garbage, overflowing municipal bins, littered roads, rag pickers and animals spreading out the waste near the bins and exhausted land fill sites can be seen. The city suffers from the problem of uncollected garbage.

Discussion

(i) Household water supply conditions

Field survey reveals that within the city the distribution of water supply is highly uneven. Income-wise household water supply conditions are presented in table 2.

All the very high income households have their source of water within the premises; nearly 57 per cent of sampled households depend on tube-well supply while rest depend either on hand-pumps or on municipal taps. Nearly 75 per cent households reported of having water in their taps for 24 hours, 80 per cent reported of regular supply and 52 per cent reported of its quality being average (Table 2, (1-2).

Nearly 50 per cent of the high income households reported of having water connections inside their premises (of which 45 per cent depend on hand pump, 31 per cent on municipal tap supply and only 24 per cent on tubewell supply), 30 per cent were depending on water sources both inside and outside the premises and 24 per cent were dependent on sources outside the premises. Only 33 per cent reported of having water in the taps for 24 hours while the rest reported of having 1-2 hours supply twice a day, 67 per cent reported irregular supply and 46 per cent reported that the quality of water was average (Table 2, (3-4).

Only 38 per cent of the medium income households reported of having the water source inside their premises (56 per cent depends on municipal taps, 28 per cent on hand pumps and 16 per cent on tube wells), and 53 per cent were fetching water from sources outside their premises. Nearly 83 per cent reported of irregular supply just ½ hour or less twice a day and the quality being average.

Nearly 80 per cent of the low income households were fetching water from outside their premises of which, nearly 67 per cent were fetching water from neighbors/roadside hand pumps and only 19.39 per cent were fetching from roadside municipal taps. Nearly 96 per cent reported of irregular supply, ½ an hour twice a day and poor quality of water.

(ii) Household sanitation conditions

Table 3 is showing the household sanitation conditions income-wise. All the very high income households have latrine facilities inside their houses. All have flush latrines of which, 76 per cent are connected to unsewered septic tanks, only 10 per cent to sewered septic tanks and 14 per cent to open drains. Nearly 91 per cent reported of waste water disposal in open drains. Most of the households reported of water logging problem. All households were storing waste in closed containers and 60 per cent were disposing off waste in municipal bins and the rest were disposing it on the road sides and in neighboring plot.

All the high income households have latrine facilities either inside their house or in the courtyard. They all have flush latrines of which 77 per cent were connected to unsewered septic tanks, 6

Table 2

Aligarh City: Income-wise distribution of the sampled households (in percentage) according to water supply conditions

(1) Source of water supply

Income categories	Within the premises				Away from the premises					Both
	Own hand pump	Municipal p.w.c.*	Own tube well	Total	Neighbor's hand pump	Roadside hand pump	Roadside municipal p.w.c.*	Any other connection	Total	
V. high	21.43	21.43	57.14	100.0	-	-	-	-	-	-
High	44.71	31.25	24.04	46.85	100.0	-	-	-	24.32	28.83
Medium	28.09	55.62	16.30	37.88	31.58	50.61	6.07	11.74	52.55	9.57
Low	64.52	35.48	-	5.85	42.79	24.11	19.39	13.71	79.81	14.34
Total sample	31.03	32.59	36.38	42.75	47.17	29.18	12.47	11.18	43.37	13.88

*p.w.c. – piped water connections

(2) State of water supply			**(3) Duration of water supply**			**(4) Quality of water**		
Income categories	Regular	Irregular	24 hours	1-2 hrs twice a day	½ hr twice a day	Good	Average	Poor
V. high	80	20.0	75.14	24.86	-	20.86	52.00	27.14
High	33.33	66.67	33.33	66.67	-	28.15	46.17	25.68
Medium	16.81	83.19	16.81	21.06	62.12	4.26	63.83	31.91
Low	3.77	96.23	3.77	26.42	69.81	-	24.34	75.66
Total	28.42	71.57	28.43	34.67	36.90	12.15	45.49	42.36

Source: Based on field work, 2003-04

per cent to sewered septic tanks and 17 per cent to open drains. Nearly 78 per cent households reported of waste water disposal in open drains while 22 per cent disposed inside/outside the houses. All of them reported having water logging problem and stored waste in closed containers. Nearly 45 per cent were disposing off waste in municipal bins while 55 per cent were disposing on road sides and in neighbouring plot.

Only three-fourth of the medium income households were having latrine facilities inside their houses whereas rest of them were either defecating in the open or using public latrines. Of the 76 per cent households who had latrine facility inside their house, 56 per cent had flush latrines of which 76 per cent were connected to open drains and the rest to septic tanks unsewered. Nearly 44 per cent households had manual latrines of which 60 per cent household were disposing excreta in open drains and rest were disposing on roads and in waste bins. Nearly 55 per cent reported of disposing waste water in and around the house. All of them reported of water logging problems. Only 60 per cent households were storing waste in closed containers and nearly 78 per cent of the households were disposing it on the road and in the neighbouring plot.

Nearly 84 per cent of the low income households were defecating outside either along the road or in fields or in public latrines or in latrines at their work place. The public latrines were manual latrines and mostly the excreta was either disposed in the open drains or along the roads. Nearly 83 per cent of the households reported of no drainage facility so the wastewater was disposed inside or outside the house. All of them reported of water logging problem. Nearly 82 per cent were storing waste in open containers and the waste was disposed along the roads or in the neighbouring plot.

(iii) The burden of water and sanitation associated diseases

Field and household surveys showed that poor people living in areas without access to safe and adequate water and basic sanitation and lack of hygiene education are found to be spending more money on health care than people who live in areas with access to these facilities and who have basic knowledge of hygiene. Water, sanitation and hygiene are three intertwined determinants of the water/ill health/poverty spectrum with hygiene to be considered in its broadest sense, including environmental as well as personal hygiene. The associated burden of diseases is not only felt in the world today but it also affects the potential of future generations.

In the present context ten water and sanitation related risk factors have been identified (Table 4, (1). These are water sources outside the premises, water duration, ½ hour or less twice a day, irregular water supply, poor quality of water, open defecation, manual latrines, excreta disposal in open drains/road, waste water disposal in/around homes, water logging, waste/garbage disposal on road/neighbouring plot.

The most frequently reported water and sanitation associated diseases of the sampled households were worms (68.19 per cent), malaria (50.76 per cent), enteric fever (48.37 per cent), cholera (48.03 per cent), diarrhoea (43.55 per cent) poliomyelitis (36.25 per cent), jaundice (35.42 per cent), eye infection (17.46 per cent), skin infection (6.91 per cent) and hepatitis A (4.95 per cent) (Table 4 (2). These diseases were not only reported by the respondents but these are by and large the most frequently reported health problems at the Out Patient Department of the Medical College Hospital, Government Civil Hospital and at various private hospitals and clinics in Aligarh city. Relationship between water and sanitation risk factors and the

Table 3

Aligarh city: Income-wise distribution of the sampled households (in percentage) according to its sanitation conditions

(1) Latrine facility

Income Categories	Within the premises				Away from the premises				
	Inside the house	In the Courtyard	Any other place	Total	Open Defecation: Near Railway Crossing	Open Defecation: Fields	Public Latrines Place*	Any other	Total
V. high	68.29	27.71	4.0	100.0	-	-	-	-	-
High	61.71	35.41	3.15	100.0	-	-	-	-	-
Medium	1.10	80.33	18.56	76.81	36.70	41.28	21.10	0.91	23.19
Low	-	36.14	63.86	15.67	21.92	36.69	22.82	18.57	84.33
Total sample	41.8	46.3	12.0	69.0	24.8	37.6	22.50	15.1	30.99

*work place, schools etc.

(2) Type of latrine and disposal of excreta

Income Categories	Flush	Excreta Disposal			Manual	Excreta Disposal		
		Open Drains	Septic Tank: Sewered	Septic Tank: Unsewered		Open Drains	Along the Roadside	In the Dustbin
V. high	100	14.29	10.0	75.71	-	-	-	-
High	100	16.89	5.86	77.25	-	-	-	-
Medium	55.96	75.74	10.89	13.37	44.04	59.75	30.19	10.06
Low	-	-	-	-	100.0	59.04	40.96	-
Total sample	80.5	27.91	8.33	63.76	19.5	59.50	33.9	6.7

(3) Drainage and disposal of household waste water

Income categories	Does exist	Does not exist	Disposal of household waste water		
			Into the *nali*	Around the house	In the house itself
V. high	90.57	9.43	90.57	9.43	-
High	77.70	22.30	77.70	20.05	2.13
Medium	44.89	55.11	44.89	49.15	5.96
Low	16.79	83.21	16.79	77.25	5.96
Total	53.62	46.38	53.62	38.01	8.36

(4) Water logging around the house

Income categories	Water logging	Type of water logging		
		Rain water	Waste water	Both
V. high	96.00	64.86	-	31.14
High	91.66	53.83	4.50	33.33
Medium	99.15	30.0	-	69.15
Low	99.24	25.09	-	74.15
Total	96.71	41.25	1.11	54.35

(5) Mode of storage of household waste and site of its disposal

Income categories	Open containers	Closed containers	Site of disposal of waste		
			On the road	Neighbouring plot	Municipal waste bin
V. high	-	100.0	18.29	21.43	60.29
High	-	100.0	27.48	27.70	44.82
Medium	39.79	60.21	38.72	38.94	22.34
Low	82.26	17.74	54.91	45.09	-
Total	69.20	30.80	36.70	34.60	28.71

Source: Based on field survey (2003-04)

occurrence of associated diseases in all the sampled households was examined by calculating correlation coefficient that found to be, r = +0.9. This shows that there is perfect positive correlation. Certainly water, sanitation and health are intricately linked.

Table 4, (2) is throwing light on the overall exposure of the income-wise households to the 10 identified water and sanitation risk factors and the occurrence of associated diseases

The most vulnerable group was predominated by the poors – the lower income households. The high incidence of water and sanitation associated diseases in the lower income households are mainly due to the exposure of these households to the water and sanitation risk factors. On an average, nearly 66 per cent of the low income households reported of being exposed (to all the 10 identified risk factors). This is because they are least able to afford homes that protect them against environmental hazards i.e. good quality housing with water connections either municipal piped water or deep hand pumps, adequate provision of sanitation, latrines, drains, proper collection and disposal of garbage etc. Lower income households are found to be living in unhealthy conditions where the basic necessary infrastructure is not developed. Environmental problems like polluted water, poor sanitation, inadequate housing, garbage dumps, poor diet, bad health and disease are immediate and visible in the poor households. Thus, they share the highest burden of associated diseases about 5 times more than the higher income households. On an average, nearly 56 per cent of the low income households reported of suffering from associated diseases like worms (93 per cent), malaria (86 per cent), enteric fever (81 per cent), cholera (80 per cent), diarrhoea (80 per cent), jaundice (73 per cent), eye infections (39 per cent), poliomyelitis (12 per cent), skin diseases (11 per cent) and hepatitis A (8 per cent). The correlation coefficient (r = +0.9) shows that there is nearly perfect positive strong correlation between risk factors and occurrence of diseases (Singh, A.L. and Rahman, A., 2001).

The conditions in the medium income households are almost the same and they can also be put in the vulnerable group. On an average, 54 per cent of the households reported of being exposed to the 10 risk factors. This was due to the fact that they were also living in unhealthy conditions. On an average, 37 per cent of the households reported of suffering from associated diseases like worms (85.10 per cent), malaria (57.87 per cent), cholera (55.31 per cent), enteric fever (50.64 per cent), diarrhoea (49.79 per cent), jaundice (33.40 per cent), eye-infection (20.21 per cent), poliomyelitis (10.64 per cent), skin infection (7.66 per cent) and hepatitis A (4.68 per cent). The correlation coefficient (r = +0.9) shows a strong positive correlation between risk factors and occurrences of diseases in the case of medium income households as well.

Conditions were reported to be better in the higher income households. On an average, nearly 38 per cent of the high income households reported of being exposed to only 6 water and sanitation risk factors including poor quality and irregular water supply, improper disposal of waste water, garbage and water logging. On an average, 27 per cent of the high income households reported of suffering from associated diseases including worms (66.44 per cent), enteric fever (45.05 per cent), malaria (43.02 per cent), cholera (37.84 per cent), diarrhoea (32.21 per cent), jaundice (26.58 per cent), eye infection (9.23 per cent), poliomyelitis (5.63 per cent), hepatitis A (3.38 per cent) and skin infection (2.93 per cent). The value of the correlation coefficient (r = +0.7) is less than that recorded in the case of medium and low income categories of households.

The results indicated that the resources were diverted towards the wealthier households. These enjoy good

Table 4

Aligarh City: Income-wise distribution of sampled Households (percentage) according to water and sanitation risk factors and occurrence of associated diseases

(1) Risk factors

Income Cagegories	Water Source Outside Permises	Duration ½ hr. or less	Irregular	Poor Quality	Open Defecation	Manual Latrine	Excreta Disposal Road/Fields/Open Drainage	Waste Water Disposal in and Around House	Water Logging	Disposal of Household Waste Road/Field	Number of Risk Factors	Average
V. high	-	-	20.00	27.14	-	-	-	9.43	96.00	39.72	5	19.22
High	24.32	-	66.67	25.68	-	-	-	22.30	91.67	55.18	6	37.68
Medium	52.55	62.12	83.19	37.91	18.09	33.83	30.42	55.11	99.15	76.66	10	53.46
Low	79.81	69.81	96.23	75.66	49.43	15.66	15.66	83.21	99.15	100.0	10	65.82
Total sample	39.17	32.98	66.52	40.09	16.88	12.37	11.52	42.51	90.49	68.13	7.75	44.04

(2) Associated diseases

Income Cagegories	Worms	Malaria	Entric Fever	Cholera	Diarrhea	Polio Myelitis	Jaundice	Eye Infections	Skin Infection	Hepatitis "A"	No. of Diseases	Average	r
V. high	28.00	15.71	16.86	19.14	12.0	2.86	8.86	1.14	6.29	3.43	10.0	11.43	+0.5
High	66.44	43.02	45.05	37.84	32.21	5.63	26.58	9.23	2.93	3.38	10.0	27.23	+0.7
Medium	85.10	57.87	50.64	55.31	49.79	10.64	33.40	20.21	7.66	4.68	3.10	37.53	+0.9
Low	93.21	86.42	80.94	79.81	80.19	12.45	72.83	39.25	10.75	8.3	10.0	56.42	+0.9
Total average	68.19	50.76	48.37	48.03	43.55	36.25	35.42	17.46	6.91	4.95	10.0	33.25	+0.9

Source: Based on field work (2003-04)

and regular water supplies and also have basic sanitation facilities. On an average, only 19 per cent of the very high income households reported of exposure to only 5 water and sanitation risk factors. Thus, the burden of diseases was the lowest. Only 11 per cent of the households reported of suffering from various diseases like, worms (28 per cent), cholera (19 per cent), enteric fever (17 per cent), malaria (16 per cent), diarrhoea (12 per cent), jaundice (9 per cent), skin infection (6 per cent), hepatitis A (3 per cent), poliomyelitis (3 per cent) and eye infection (1 per cent). The correlation coefficient between risk factors and diseases (r = +0.5) indicates that about 50 per cent of the very high income households were under the burden of water and sanitation associated diseases.

Conclusion

The household survey of water and sanitation conditions in Aligarh City evidently found the following striking facts:

- the water and sanitation condition of all the low and some of the medium income households are such that it carries the biggest risk to health.
- the overall exposure to the water and sanitation related risk factors is maximum in the low income followed by medium income households.
- diseases are largely influenced by the level of economic development.
- the lower income households share the highest burden of water and sanitation associated diseases.
- the correlation between income levels, water and sanitation risk factors and occurrence of associated diseases was found to be strongest in the case of low and medium income households.
- the lower income households are at greatest risk and they are the most vulnerable group.

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