Economic Burden Of Waterborne Diseases And Unsafe Drinking Water In Thoothukudi District

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Abstract:
In India after independence, the government of India took a great initiative in providing clean drinking water by introducing various methods, but the progress achieved is not significantly. By investing more money on merits goods like educations and health government was able to establish more infrastructure development covering both rural and urban areas. Clean water is a key factor for economic growth worsening health condition, reducing food production and magnifies poverty in many countries. This study aims to assess the socioeconomic effects of drinking-water quality on selected households. Specifically, it examines the prevalence and impact of water-related diseases, estimates the economic costs incurred through medical expenses and loss of income, and evaluates households' willingness to pay for safe, high-quality drinking water. The study also analyses how socioeconomic factors influence drinking-water quality, disease exposure, and household preferences for improved water services.

Key words: Economic Burden, Waterborne Diseases, Drinking Water

Introduction

Ensuring the supply of safe drinking water is a constitutional provision under Article 47 of the Constitutions. Although water is a state subject, the union government is responsible for setting drinking water quality standards. Water quality issues have emerged as a major concern over the last four decades, starting with the enactment of water (prevention and control of pollution) Act, 1974. In the national development plans, water quality was not emphasized upon till the end of the Sixth Five-year Plan. The first national initiative for providing safe drinking water was taken up in the Seventh Plan period and National Drinking Water mission (NDWM) was launched in 1986. The main aim of NDWM was to improve the performance and cost effectiveness of the ongoing drinking water supply programmes and policies, and to make sure that an adequate quantity of drinking water of an acceptable standard quality is made available to the people at large.

The national water policies (NWPs) of 1987, 2002, 2012 in India emphasised that both surface-water and groundwater should be monitored for quality, and a phased programme should be undertaken for improvements in water quality (GoI 1987, 2002, 2012). While access to drinking water in India has increased over the past decade, the adverse impact of unsafe water on health continues (WHO/UNICEF 2004).

There is a dire need to solve the twin problem of sustainability of water resources and water quality. Water quality problems are caused by the pollution of surface water and/or groundwater. Water quality is affected by both point and non-point sources of pollution. These include sewage discharge, discharge from industries, run-offs, and percolation of the chemical substances into the groundwater. Water quality is also affected by floods, droughts, and lack of awareness among users. This study reviews the water quality problems, and incidence of various water-related diseases and their economic impact on households in Thoothukudi District.

1.2 Review of Literature

Samra et al. (2011) examined access to safe drinking water in rural Punjab and found disparities between urban and rural areas. Although the rural water supply project improved water quality, affordability and socioeconomic conditions continued to restrict access to safe water. Philippe Cullet (2011) examined the fundamental right to water in rural India and observed that, despite recognition of this right, the absence of a comprehensive legal framework remained a major concern.

Singh and Turkiya (2013) studied household water consumption, sources, quality, supply frequency and awareness of rainwater harvesting. The study found considerable dependence on government water supply, dissatisfaction with the duration of supply and low awareness of rainwater harvesting. Onjala et al. (2013), using household data from Kenya, found that perceived water-related risks influenced households' decisions to treat drinking water, while high connection fees discouraged access to piped water.

Satapathy (2014) analysed water, sanitation and hygiene conditions among slum and non-slum households. The study emphasised that water availability alone was insufficient and that water quality, sanitation, hygiene and service delivery were equally important for reducing health risks. Pooja Prasad et al. (2014) examined rural drinking-water programmes in Maharashtra and reported that actual ground-level coverage was poorer than official records suggested. Poor institutional capacity and inadequate expertise were identified as important causes of scheme failure.

Satyajit Singh (2014) examined decentralisation in the rural water sector and highlighted the importance of institutional design, local power structures and political factors in determining the outcomes of decentralised water reforms. Bedi et al. (2015) studied contaminated water supply in Ludhiana and found that poor water quality, leaking pipelines, storage problems and slow water transmission contributed to water-related diseases and imposed economic costs on households. Junaid Zahid (2018) investigated childhood diarrhoea and its relationship with household sanitation facilities. The study found higher incidence of diarrhoea among children living in households with inadequate toilet facilities and highlighted the importance of maternal education in reducing childhood morbidity. Aneesh (2021) examined socioeconomic disparities in access to water and sanitation and found that economically weaker households had poorer access to water and sanitation facilities. The study also identified differences across social groups and demonstrated the importance of household income in improving sanitation access.

1.3 Research Gap

The reviewed studies demonstrate that water-related problems are influenced by accessibility, affordability, quality, sanitation, socioeconomic conditions, institutional capacity and public awareness. However, there remains a need for location-specific studies that jointly examine household access to water, sanitation conditions and the occurrence of water-related diseases. The present study attempts to contribute to this area by examining these dimensions at the local level.

1.4 Objectives of the Proposed study

The following are the objectives formed to achieve them:

To find the impact of people affected by water-related diseases in the selected households.

2. To find out economic cost of water related diseases in the selected households.

3. To examine the willingness to buy quality of water in selected households.

4. To analyses the socio economic study of quality of drinking water in selected households.

1.5 Limitation of the study

Data on water quality, health outcomes, and economic impacts may be incomplete or unreliable, especially in regions where monitoring and reporting systems are weak. This can lead to underestimations or misinterpretations of the true extent of the issue.

The long-term health and economic impacts of unsafe drinking water may not be fully captured, as many studies focus on short-term data or overlook chronic illnesses and delayed effects.

Establishing a direct cause-and-effect relationship between unsafe drinking water and specific health outcomes can be challenging. Many factors contribute to health problems, and isolating the impact of contaminated water from other environmental, lifestyle, and socio-ecoonomic factors is difficult.

Estimating the economic costs of health impacts can be difficult. Assigning a monetary value to the loss of life, disability, or reduced quality of life caused by waterborne diseases is inherently subjective and can vary based on the methodology used.

If the study sample is not representative of the larger population, the findings may not be applicable to all affected population.

3.1 METHODOLOGY

Designing a suitable methodology and selection of analytical tools are essential for a meaningful analysis of any research problem. In this segment, an effort is complete to prepare a methodology of the present study. It includes sample design, collection of data and tools of analysis.

3.2 Type of Data

This research is descriptive and analytical in nature this study is entirely based on primary and secondary data. A primary data is a data, which is collected for gathering information first time and to analyses the problem. In this study the primary data was collected among the selected respondents. The secondary data are used for gathering theoretical, conceptual, and technical and information. Data were collected from the Journals, Books, News Paper, E-Books, Conference proceedings and websites

3.3 Sampling Design

The study is based upon both primary and secondary data. Data regarding the water quality and incidence of diseases was taken from secondary sources. To work out the economic cost of coping mechanisms and disease, cross-sectional data from 180 households was collected. The different localities of Thoothukudi were categorized into six income clusters as follows:

Very high income group (VHIG) areas with well-planned localities and buildings, and plot sizes more than 150 square yards.

High income group (HIG) areas with well-planned localities and buildings, and plot sizes varying between 100 and 150 square yards.

Middle income group (MIG) areas with well-planned localities and buildings, and plot sizes varying between 75 and 100 square yards.

Low income group (LIG) areas with well-planned localities and buildings, and plot sizes less than 75 square yards.
Mixed areas.

Slum areas.

The number of clusters falling under each income group was identified from six clusters namely Thattaparai, Puthukottai, Puthiyamputhur, Thoothukudi, Udangudi, Tharuvaikulamand from each localities 30 households were surveyed. Hence, the total sample included 180 households from six income categories in simple random method.

4.1 ANALYSIS OF DATA

The analysis is based on field-survey information collected from 180 respondents. The results describe the socioeconomic and housing characteristics of the households and examine the incidence and economic consequences of water-related diseases. The analysis also considers household coping mechanisms used to obtain safer drinking water.

4.1.1 Gender of Respondents

Gender	Respondents	Percentage
Male	131	72.8
Female	49	27.2
Total	180	100

Source: Field Survey.

The gender distribution shows a male majority: 72.8 per cent of respondents were male and 27.2 per cent were female. Thus, the field survey contains substantially more male respondents.

4.1.2 Religion

Religion	Respondents	Percentage
Hindu	152	84.4
Christian	28	15.6
Muslim	0	0
Total	180	100

Source: Field Survey.

Hindus constituted 84.4 per cent of respondents and Christians 15.6 per cent, while no Muslim respondent was included. The sample is therefore predominantly Hindu.

4.1.3 Community

Community	Respondents	Percentage
SC/ST	43	23.9
MBC	16	8.9
BC	57	31.7
Others	64	36.6
Total	180	100

Source: Field Survey.

The Others category represented the largest share at 36.6 per cent, followed by BC at 31.7 per cent, SC/ST at 23.9 per cent and MBC at 8.9 per cent.

4.1.4 Marital Status and Family Type

Indicator	Category	Respondents	Percentage
Marital	Married	145	80.6
	Unmarried	35	19.4
Family	Nuclear	109	60.6
	Joint	71	39.4

Source: Field Survey.

A large majority (80.6 per cent) were married. Nuclear families accounted for 60.6 per cent and joint families 39.4 per cent. These characteristics are relevant because household structure can influence water use, sanitation practices and illness-related costs.

4.1.5 Education and Family Size

Indicator	Category	Respondents	Percentage
Education	Primary	48	26.7
	Secondary	69	38.3
	Higher Secondary	19	10.6
	Degree	44	24.4
Family size	1–5	154	85.6
	6–10	26	14.4

Source: Field Survey.

Secondary education was the largest category at 38.3 per cent, followed by primary education at 26.7 per cent and degree education at 24.4 per cent. Most households (85.6 per cent) had one to five members.

4.1.6 Housing Characteristics

Residence	Respondents	Percentage
Owned	136	75.6
Rented	44	24.4
Total	180	100

Source: Field Survey.

Three-fourths of respondents (75.6 per cent) lived in their own houses, while 24.4 per cent lived in rented houses, indicating a relatively stable residential base for most surveyed households.

House type	Respondents	Percentage
Concrete	116	64.4
Tiled	41	22.8
Thatched	23	12.8
Total	180	100

Source: Field Survey.

Concrete houses were predominant at 64.4 per cent, followed by tiled houses at 22.8 per cent and thatched houses at 12.8 per cent.

House size	Respondents	Percentage
Below 75 sq. yard	65	36.1
Above 75 sq. yard	41	22.8
Above 100 sq. yard	34	18.9
Above 150 sq. yard	40	22.2
Total	180	100

Source: Field Survey.

The largest group (36.1 per cent) lived in houses below 75 square yards. The remaining households were distributed across larger housing categories, showing variation in housing space.

4.1.7 Duration of Residence

Years	Respondents	Percentage
10–20	49	27.2
20–30	47	26.1
30–40	35	19.4
40–50	12	6.7
50–60	19	10.6
>60	18	10.0
Total	180	100

Source: Field Survey.

The largest shares had lived in the present location for 10–20 years (27.2 per cent) and 20–30 years (26.1 per cent). Nearly one-fifth had lived there for 30–40 years, providing a useful context for examining local water and health experiences.

4.1.8 Incidence of Water-Related Diseases

Disease status	Respondents	Percentage
Diarrhoea	8	4.4
Malaria	10	5.6
Cholera	5	2.7
Not affected	157	87.2
Total	180	100

Source: Field Survey.

Most respondents (87.2 per cent) reported no listed water-related disease. Among reported cases, malaria accounted for 5.6 per cent, diarrhoea 4.4 per cent and cholera 2.7 per cent. Although the affected proportion is smaller, the reported cases demonstrate the presence of health risks within the surveyed population.

4.1.9 Analytical Interpretation

The socioeconomic and housing profile shows variation in social background, education and living conditions. Such differences are important for understanding disease exposure and the ability of households to absorb treatment costs and income losses. The next stage therefore examines disease incidence and economic costs across income and area-based groups.

4.2 Incidence of Water-Related Diseases and Treatment Cost

Group	Total	Affected	Days ill	Treatment cost (Rs.)	Per-capita treatment (Rs.)
Very High Income	30	0	0	0	0
High Income	30	2	12	12000	6000
Middle Income	30	3	18	15000	5000
Low Income	30	4	17	19000	4750
Mixed	30	6	16	24000	4000
Slum	30	8	17	23000	2875

Source: Field Survey.

Each group contains 30 respondents. No affected respondents were recorded in the very high-income group, whereas eight cases were recorded among slum households. Low-income households recorded four cases and the mixed group six cases. The distribution therefore indicates greater reported incidence among more vulnerable groups.

Total treatment expenditure was highest in the mixed group at Rs.24,000, followed by the slum group at Rs.23,000 and the low-income group at Rs.19,000. High-income and middle-income groups recorded Rs.12,000 and Rs.15,000 respectively. Per-capita treatment expenditure among affected respondents was highest in the high-income group (Rs.6,000) and lowest in the slum group (Rs.2,875). The lower expenditure in poorer groups should not be interpreted as a lower burden; it may reflect differences in treatment intensity and available resources.

The total number of illness days was 12 in the high-income group, 18 in the middle-income group, 17 in the low-income group, 16 in the mixed group and 17 in the slum group. The middle-income group recorded the highest total illness duration among groups with reported cases. This demonstrates that medical expenditure alone does not capture the full economic effect of illness.

The concentration of reported cases in lower socioeconomic groups is notable. The slum group had the highest number of affected respondents, while the very high-income group had none. This pattern suggests that socioeconomic vulnerability is associated with differences in exposure or ability to protect households from water-related health risks.

Illness creates both direct and indirect costs. Direct costs include treatment expenditure, while indirect costs arise from lost working time and income. The combined economic-cost measure is therefore used to compare the burden across groups.

4.3 Per-Capita Economic Cost of Water-Related Diseases

Group	Treatment (Rs.)	Income loss (Rs.)	Economic cost (Rs.)
VHG	0	0	0
HIG	6000	8000	14000
MIG	5000	7667	12667
LIG	4750	7000	11750
Mixed	4000	5500	9500
Slum	2875	4000	6875

Source: Field Survey.

The combined economic cost comprises treatment expenditure and income loss. High-income households record the highest per-capita economic cost among groups with illness (Rs.14,000), followed by middle-income households at Rs.12,667 and low-income households at Rs.11,750. Mixed and slum groups record Rs.9,500 and Rs.6,875 respectively.

Absolute cost, however, does not show how large the burden is relative to household resources. A smaller expenditure can represent a much greater sacrifice for a low-income household. The proportional measure in Table 4.15 is therefore particularly important for assessing inequality.

4.3.1 Economic Cost as a Proportion of Per-Capita Income

Category	Annual per-capita income (Rs.)	Annual economic cost (Rs.)	Cost as % of income
VHIG	256667	0	0
HIG	156667	14000	5.45
MIG	95333	12667	13.29
LIG	73333	11750	16.03
Mixed	47300	9500	20.08
Slums	22500	6875	30.55

Source: Field Survey.

The proportional burden rises sharply as income falls. It is 5.45 per cent for high-income households, 13.29 per cent for middle-income households and 16.03 per cent for low-income households. It increases to 20.08 per cent in mixed areas and reaches 30.55 per cent among slum households.

This is a central finding of the study. Although the poorest households do not record the highest absolute per-capita cost, the cost represents the largest share of their annual per-capita income. Thus, the relative economic burden of water-related disease is substantially greater for economically disadvantaged households.

4.3.2 Implications

The results indicate that reducing disease incidence can generate both health and economic benefits by preventing treatment expenditure and preserving working days. Policy evaluation should therefore consider distributional effects rather than only average expenditure.

4.4 Household Coping Mechanisms for Safe Drinking Water

4.4.1 Reverse Osmosis (RO)

Group	Users	%	Investment/HH (Rs.)	Repair/HH (Rs.)
VHIG	3	10	24500	4667
HIG	3	10	24333	4667
MIG	2	6.6	23000	3000
LIG	1	3.3	22000	2000
Mixed	2	6.6	20000	2000
Slum	0	0	0	0

Source: Field Survey.

RO adoption is highest in very high- and high-income groups and absent among slum households. The investment and repair costs indicate that such technologies may be difficult for economically weaker households to adopt.

4.4.2 Aqua Guard

Group	Users	%	Investment/HH (Rs.)	Repair/HH (Rs.)
VHIG	3	10	19167	4667
HIG	3	10	18000	4000
MIG	2	6.6	18000	4000
LIG	1	3.3	18000	4000
Mixed	1	3.3	17500	3000
Slum	0	0	0	0

Source: Field Survey.

Aqua Guard usage follows a similar pattern, with adoption concentrated in higher-income groups and no reported users in slum households. This suggests that purchasing capacity influences access to household water-treatment technologies.

4.4.3 Boiling and Filtering

Group	Boiling %	Boiling investment (Rs.)	Filter %	Filter investment (Rs.)
VHIG	33.3	980	6.6	1000
HIG	33.3	930	6.6	1000
MIG	16.6	900	16.6	980
LIG	16.6	860	10	900
Mixed	33.3	815	16.6	900
Slum	66.6	800	6.6	900

Source: Field Survey.

Boiling is the most widely reported coping method among slum households, at 66.6 per cent. Its relatively low investment requirement makes it more accessible than RO or Aqua Guard. Filter use ranges from 6.6 to 16.6 per cent.

4.5 Conclusion & Overall Analytical Discussion

The analysis reveals three connected dimensions of the water problem. First, households differ in socioeconomic and housing circumstances. Second, reported disease incidence is more concentrated among vulnerable groups, with the slum group recording the highest number of affected respondents. Third, the economic burden becomes much larger relative to income as socioeconomic status declines: the proportional burden rises from 0 per cent in the very high-income group to 30.55 per cent among slum households.

The coping-mechanism findings reinforce this pattern. Higher-income households can adopt relatively expensive technologies such as RO and Aqua Guard, whereas poorer households rely more on low-cost methods such as boiling. Improving water safety therefore requires not only infrastructure and public-health measures but also attention to affordability and the capacity of poorer households to adopt protective technologies.

Overall, the field evidence indicates that unsafe drinking water can impose both health and economic costs. The relative burden is particularly serious for economically disadvantaged households. Improving access to safe water, strengthening sanitation and hygiene awareness, and promoting affordable household water-treatment options can reduce disease risk and financial pressure associated with illness.

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