

Measuring physical access obscures the hidden out-of-pocket crisis.



Highly Measured (SDG 6 Goals)

- Physical accessibility
- Infrastructure presence
- Universal coverage targets

The Hidden Burden

- Recurring out-of-pocket costs
- Caste-based spatial exclusion
- Quality of housing stock

Rapid urbanization in South Asia has created a **crucible where physical access is improving, but complex socio-economic hierarchies dictate true affordability.**

Objectives

1. To construct and analyse the Composite Household WASH Expenditure (CHWE) by aggregating its three measurable monthly components, namely, Drinking Water Payment, Non-Drinking Water Payment, and Toilet Maintenance Cost.
2. To examine the distribution and composition of CHWE across districts, caste groups, religious community groups, house types, and other key demographic and socioeconomic groupings.
3. To assess the influence of economic determinants, including household income, type and ownership of houses, and financial asset possession, on WASH expenditure incidence and intensity.
4. To evaluate the role of sociocultural determinants such as caste groups, religious community groups, and family structure on household WASH expenditures.
5. To determine the relative significance of economic versus sociocultural determinants using standardised regression analysis to generate policy-relevant evidence for targeted WASH interventions.

Data Source

- ❖ Study conducted using primary data collected through the Baseline Survey on WASH in Tamil Nadu, as part of the Rashtriya Uchchatar Shiksha Abhiyan (RUSA) 2.0 Thematic Research Project – Social Sciences, titled “Access to Water, Sanitation and Hygiene (WASH) in Urban and Peri-urban Areas in Tamil Nadu: Challenges and Concerns of Gender, Environment, and Marginalized Communities.”
- ❖ The data were gathered from seven districts selected based on the Human Development Index and Agro-Climatic Zone divisions. Six districts- namely Nagapatinam (Cavery Delta), Perambalur (North Eastern), Theni (Western), Karur (North Western), Nilgiris (Hilly Area), and Kanyakumari (High Rainfall Area)- were chosen as representative samples across various Agro-Climatic Zones. Additionally, Ariyallur, identified as the lowest-performing district in Tamil Nadu in terms of HDI according to the State Human Development Report, was included.
- ❖ Households in each district, constituting 2–6 percent, were selected through **proportionate random sampling**, culminating in a total of **19300 households across seven districts**, encompassing urban and peri-urban areas. The data underpinning this study were obtained from a baseline survey of the specified sample.

Composite Household WASH Expenditure (CHWE)

The Composite Household WASH Expenditure (CHWE) is defined as the monthly aggregate of three recurrent out-of-pocket cost components:

- (a) **Drinking Water Payment (DWP):** The monthly amount paid for the household's primary source of drinking water (conditional on the household paying for it).
- (b) **Non-Drinking Water Payment (NDWP):** The monthly payment for non-drinking water used for domestic purposes, such as cooking, bathing, and cleaning (conditional on payment).
- (c) **Toilet Maintenance Cost (TMC):** The monthly cost of maintaining the household toilet, including materials such as cleaning agents and minor repair materials, and any labour costs incurred.

Thus, the CHWE is computed as

$$\text{CHWE} = \text{DWP} + \text{NDWP} + \text{TMC}.$$

Economic Determinants

- Household Income
- Type of House
- Ownership of House
- Financial Assets

Socio-cultural Determinants

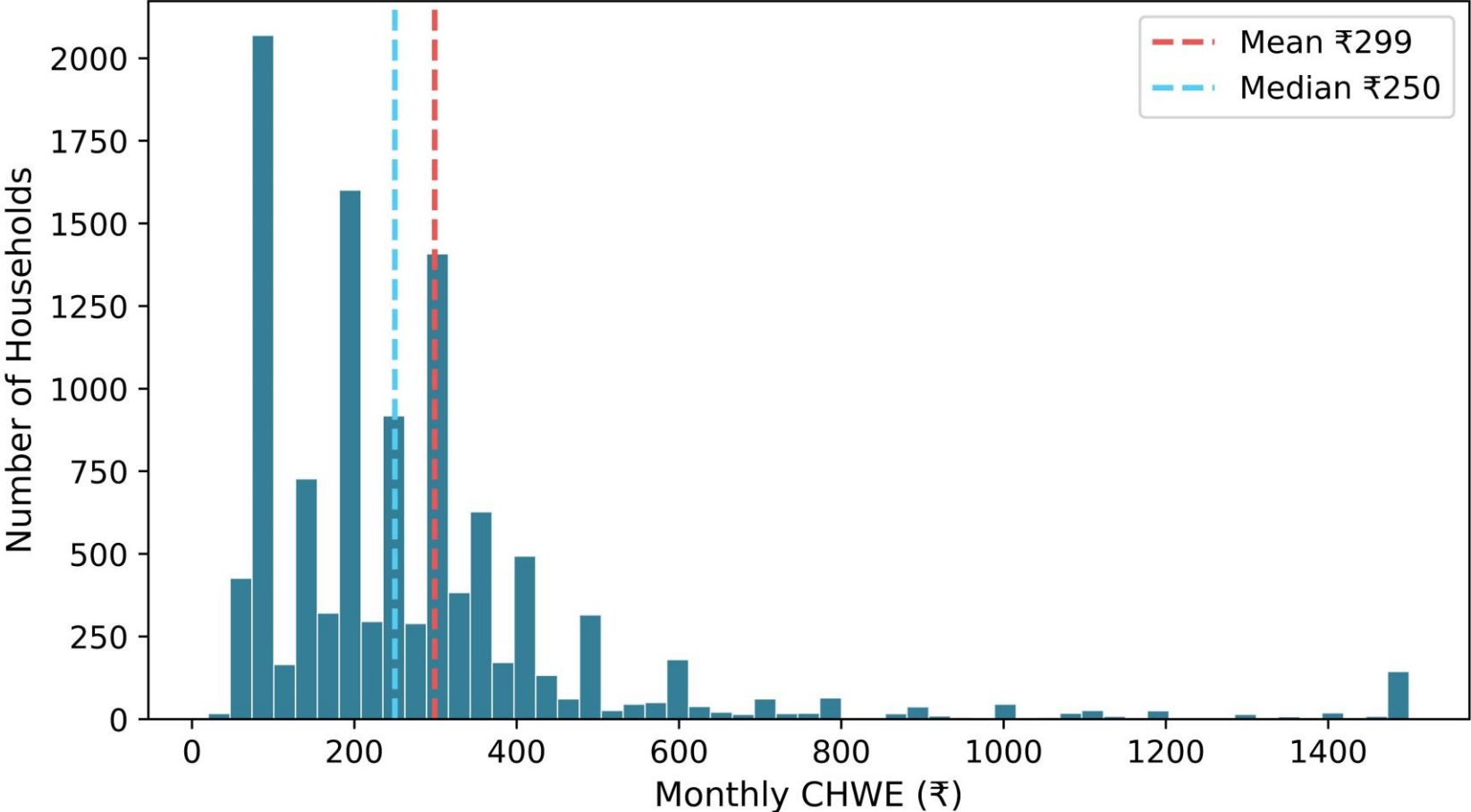
- Caste/Community
- Nature of Family
- Person Collecting Drinking Water
- Gender of Toilet Cleaner
(Family Member)

Composite Household WASH Expenditure (CHWE) and its components

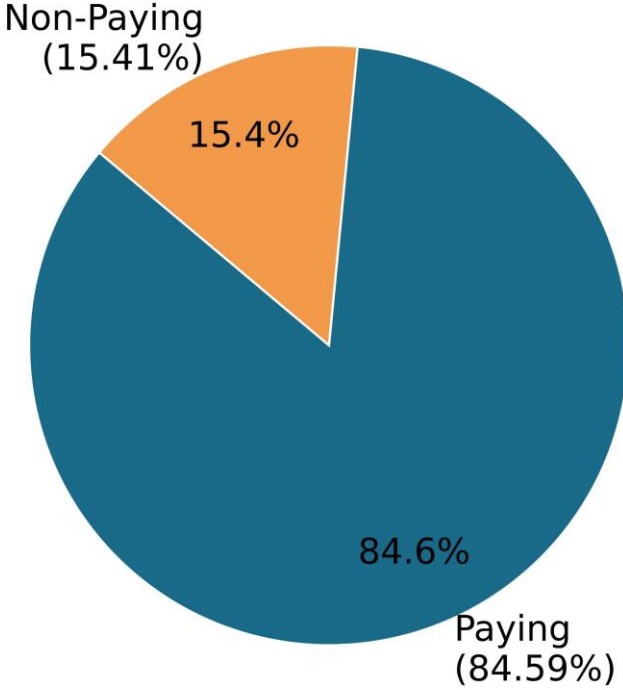
Statistic	All Households (n=13,427)	Paying Households Only	Drinking Water Payment	Non-Drinking Water Payment	Toilet Maintenance
Count (n)	13,427	11,358	7,130	1,075	9,608
Mean (₹)	252.90	299.00	₹77.84	₹10.52	₹164.55
Median (₹)	200.00	250.00	₹100.00	₹60.00	₹200.00
Std. Dev. (₹)	347.64	355.26	₹211.12	₹89.64	₹233.40
Min / Max (₹)	₹0 / ₹8,000	₹0.07 / ₹8,000	₹0 / ₹4,000	₹0 / ₹3,000	₹0 / ₹8,000
25th / 75th Pctile	₹100 / ₹300	₹150 / ₹400	—	—	—
Skewness / Kurtosis	7.57 / 91.78	7.21 / 83.42	8.66 / 119.89	10.44 / 175.08	5.21 / 39.71
Incidence Rate	84.59%	100%	53.10%	8.01%	71.55%
Share of Mean CHWE	100%	—	30.8%	4.2%	65.1%

Composite Household WASH Expenditure (CHWE) and its components

Distribution of Composite WASH Expenditure (Paying Households, n=11,358; clipped at ₹1,500)

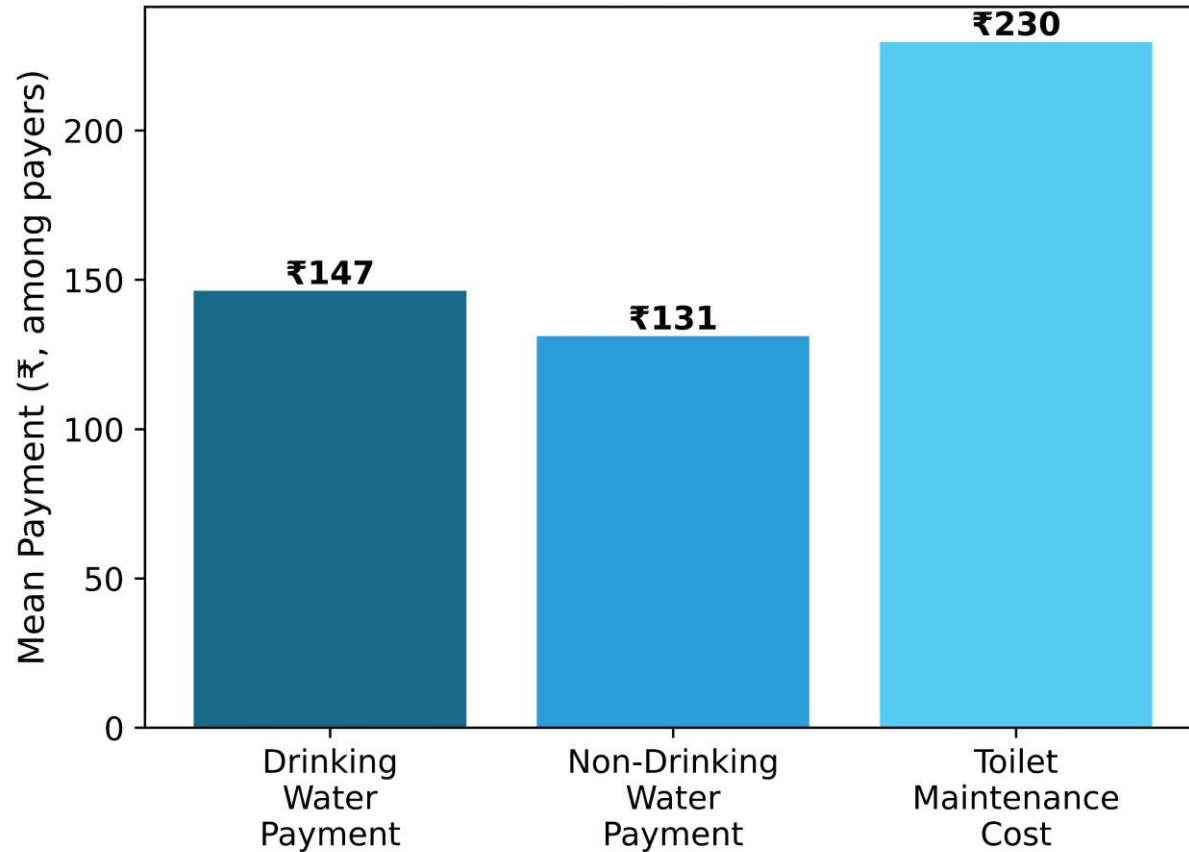


CHWE Incidence (n=13,427)

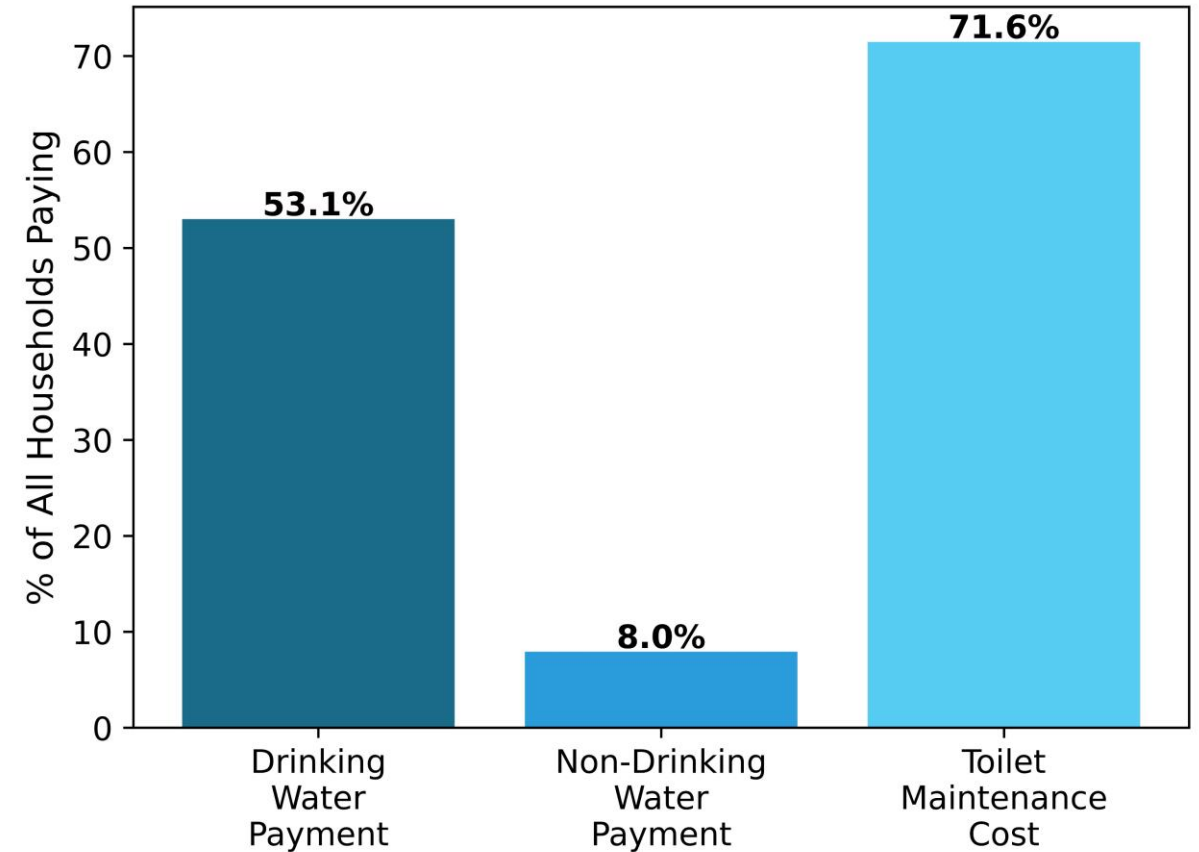


Mean Payment by WASH Component (Among Payers) and Component Incidence Rates

Mean Payment by WASH Component
(Among Paying Households)

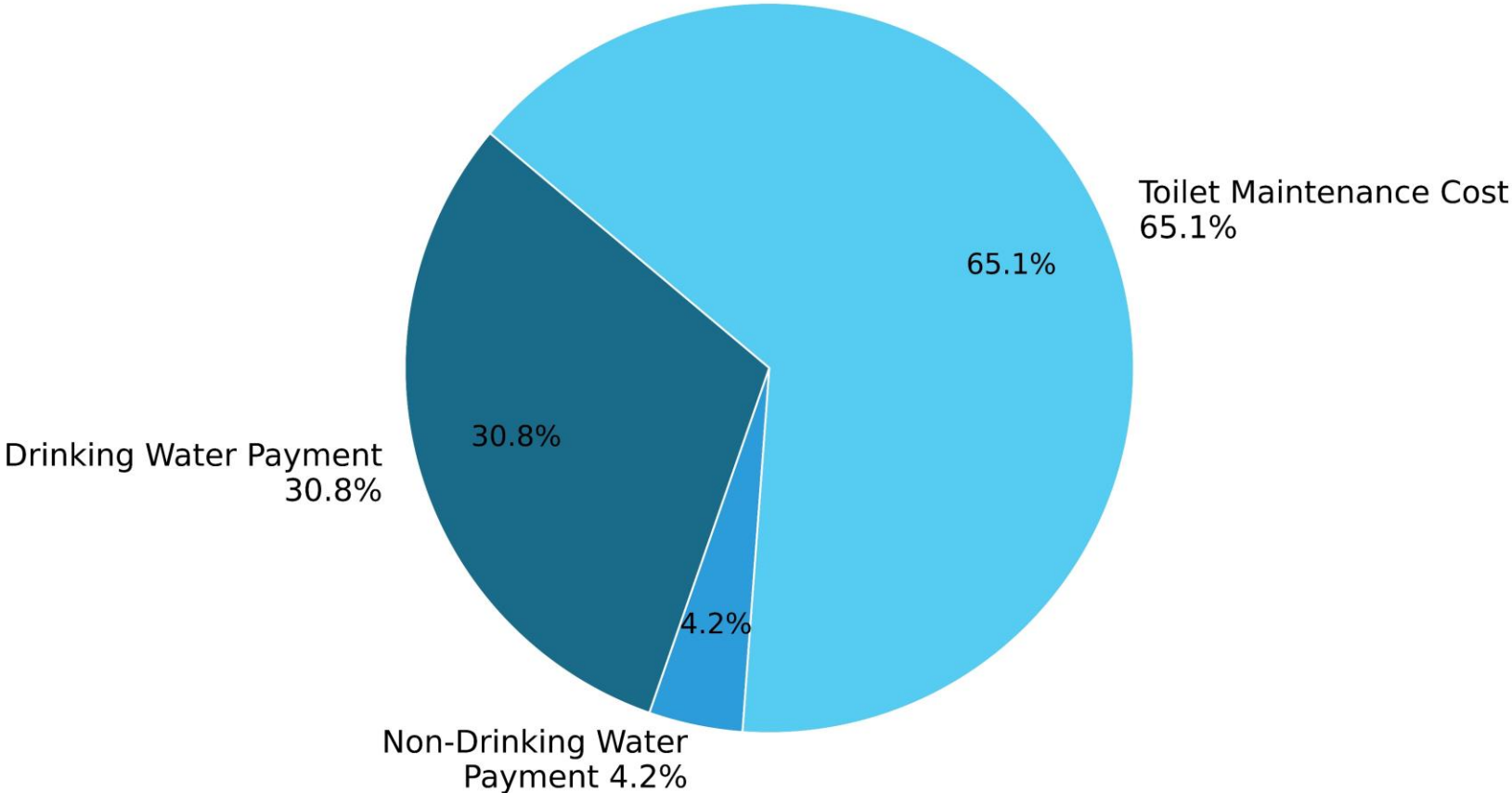


CHWE Component Incidence Rates
(% of All Households)



Component Share of Composite WASH Expenditure

Component Share of Composite WASH Expenditure
(CHWE = DWP + NDWP + TMC)

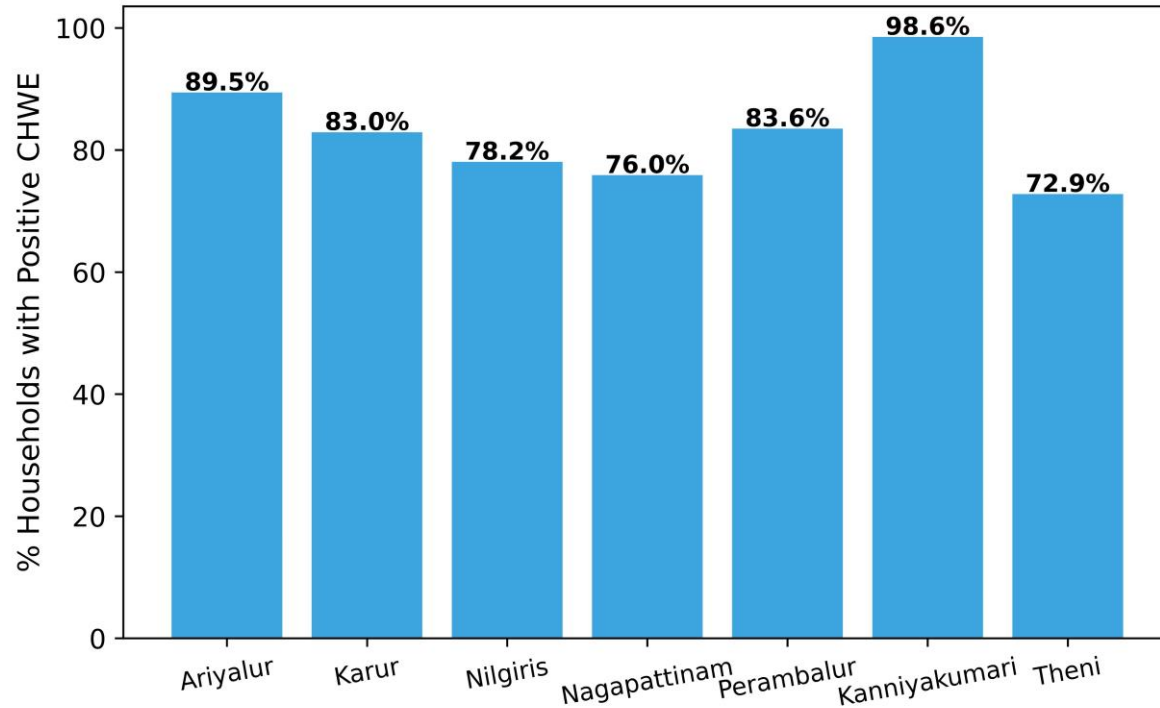


Composite Household WASH Expenditure (CHWE): District-wise Analysis

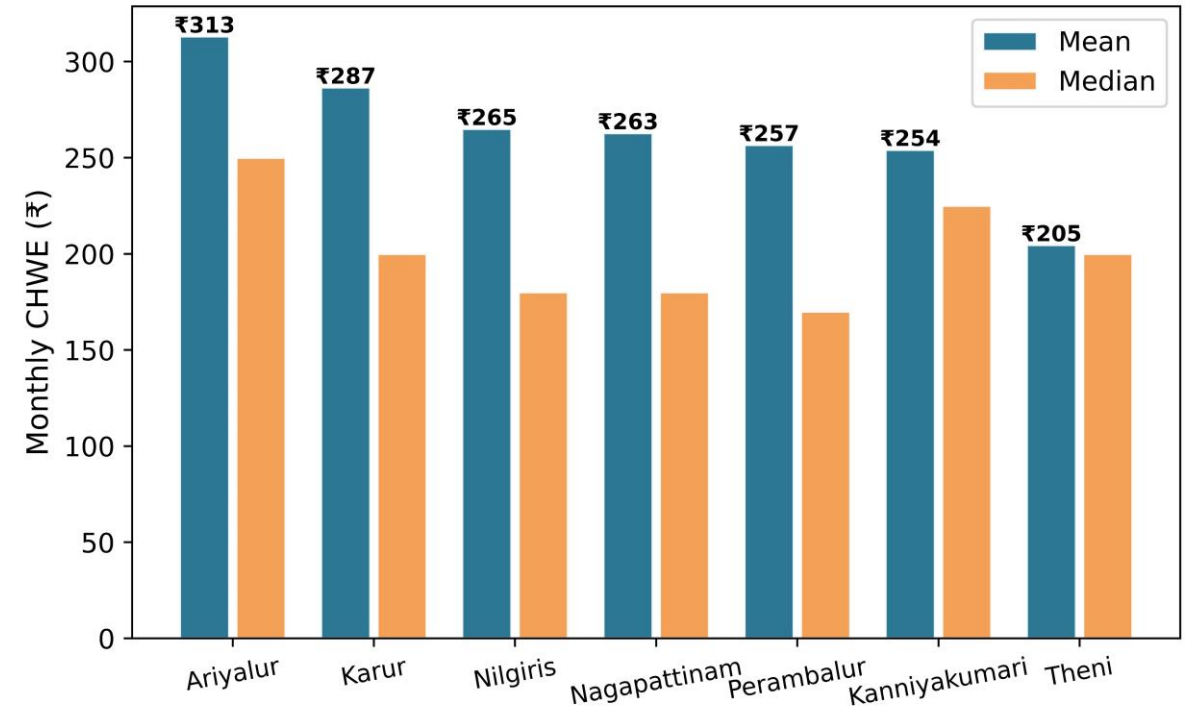
District	n	Mean CHWE (₹)	Median (₹)	Std Dev	Incidence (%)
Nilgiris	1,218	290.14	250.00	351.29	88.02%
Karur	1,054	238.57	200.00	299.44	83.30%
Perambalur	1,233	244.18	200.00	318.47	83.05%
Ariyalur	1,097	231.82	175.00	302.66	82.86%
Nagapattinam	1,849	263.21	200.00	338.70	84.75%
Kanniyakumari	3,995	258.22	200.00	352.48	84.73%
Theni	2,981	249.68	200.00	356.15	84.97%

Composite Household WASH Expenditure (CHWE): District-wise Analysis

CHWE Incidence Rate by District

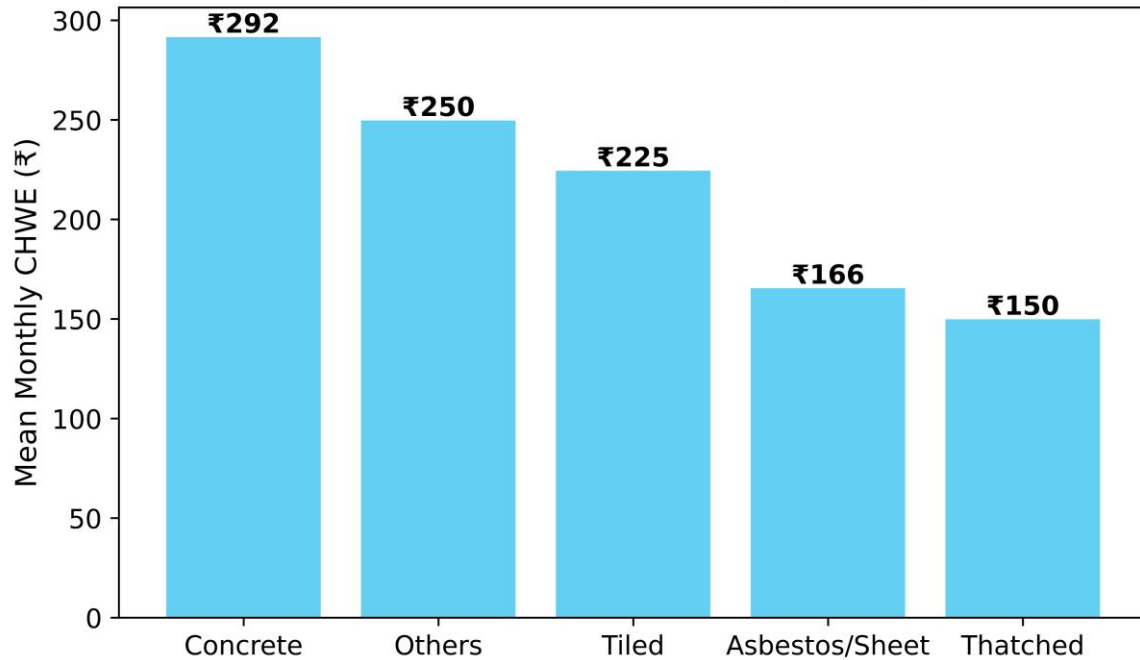


Mean & Median CHWE by District
(Kruskal-Wallis H=435.70, p<0.001)

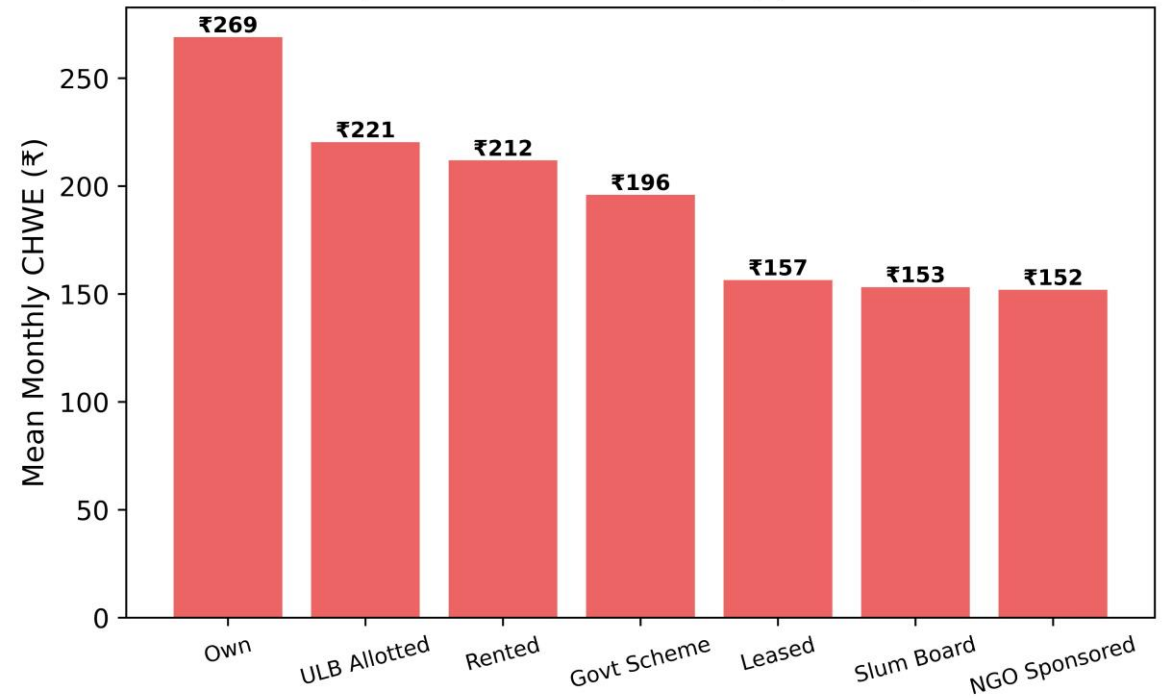


Economic Determinants

Mean CHWE by Type of House
(Kruskal-Wallis H=1,179.48, p<0.001)

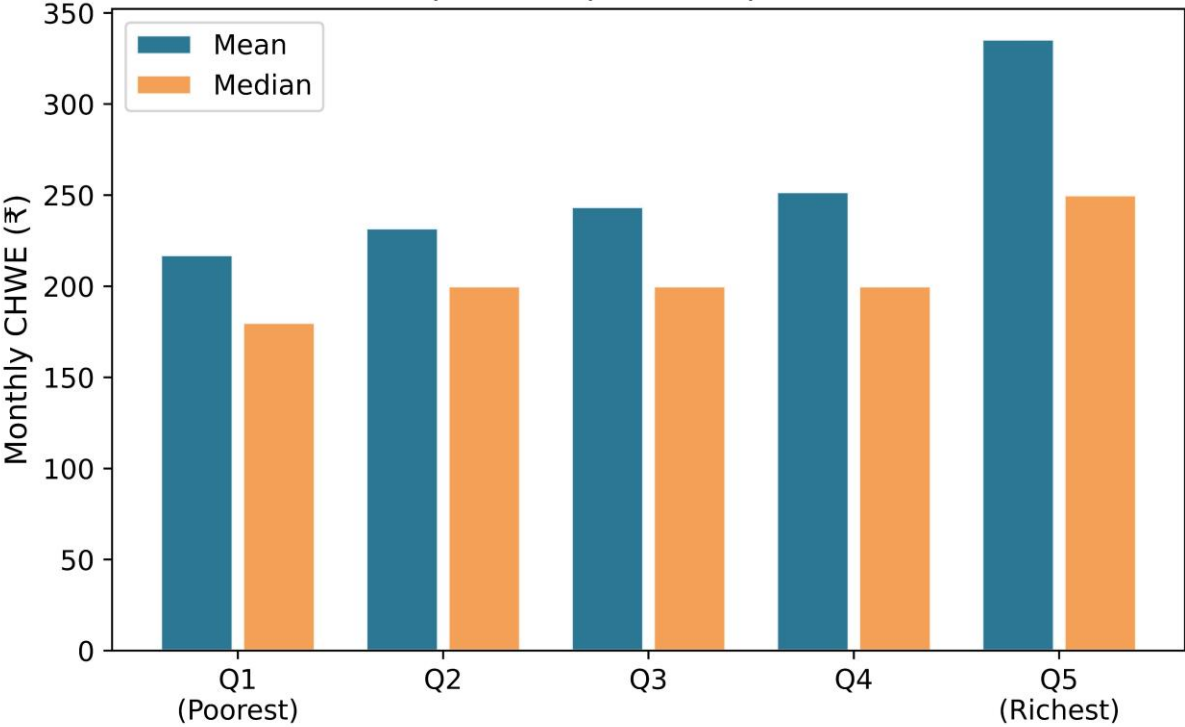


Mean CHWE by House Ownership
(Kruskal-Wallis H=168.41, p<0.001)

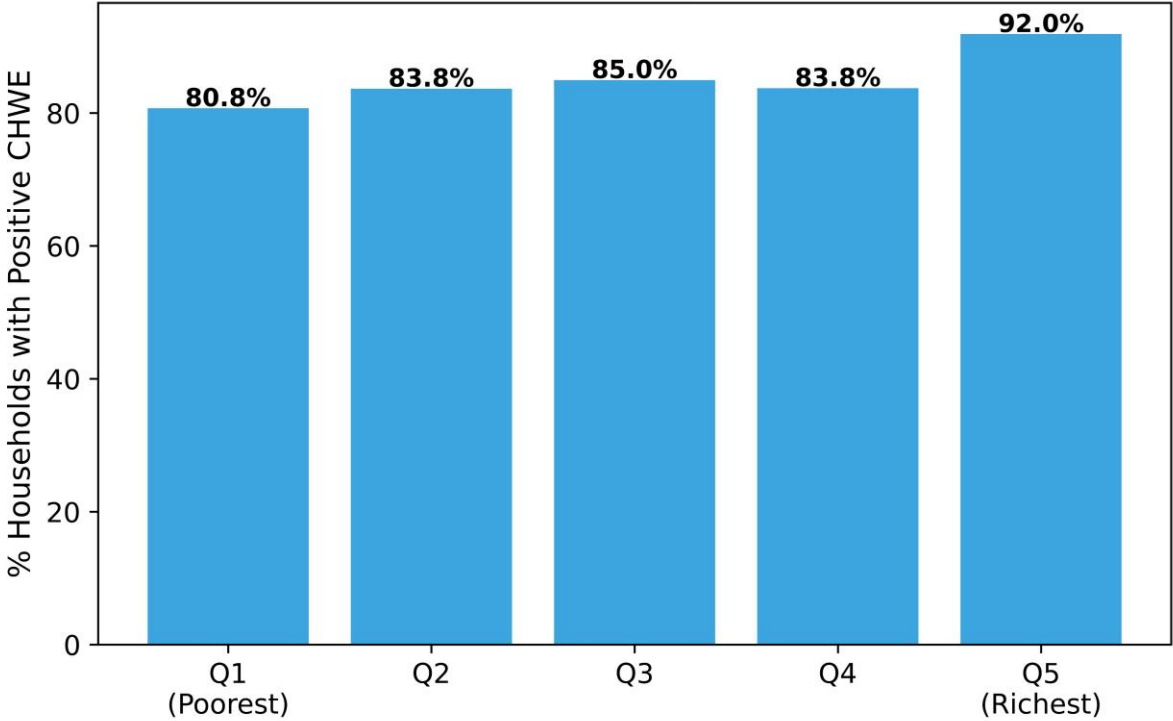


Household Income and Quintile Analysis

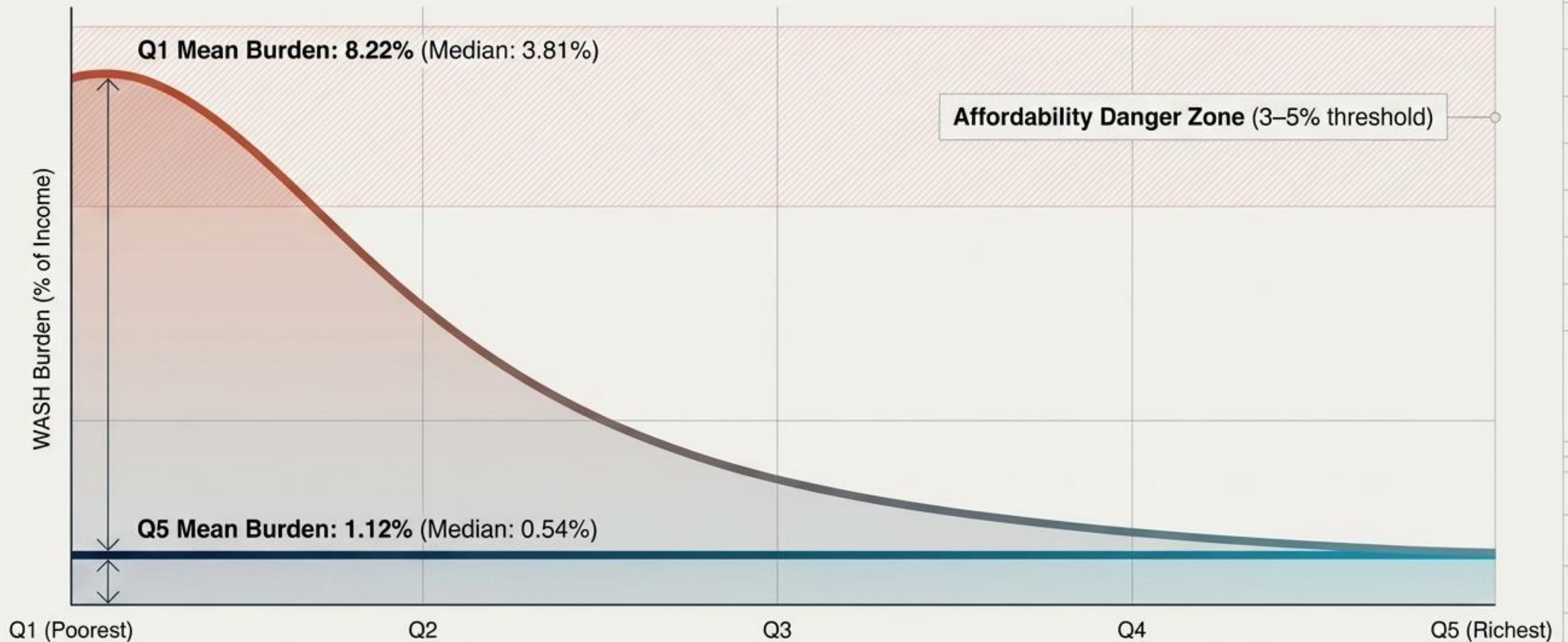
CHWE across Household Income Quintiles
(Spearman $\rho=0.159$, $p<0.001$)



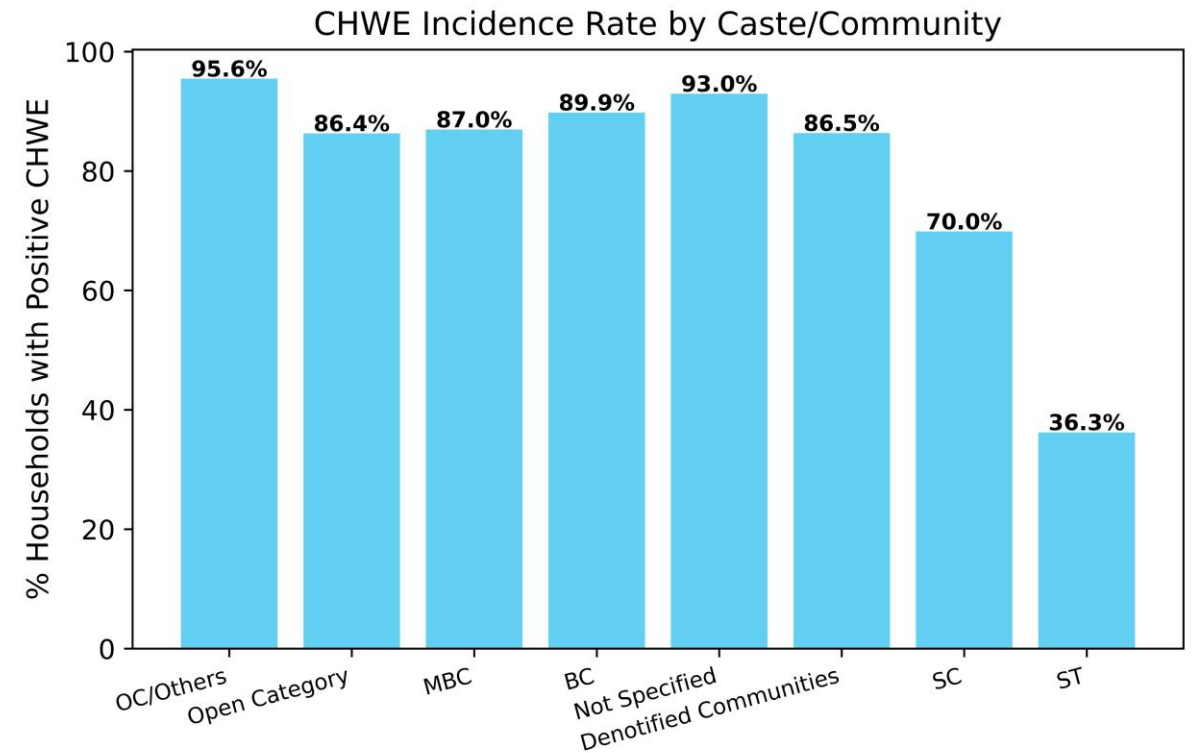
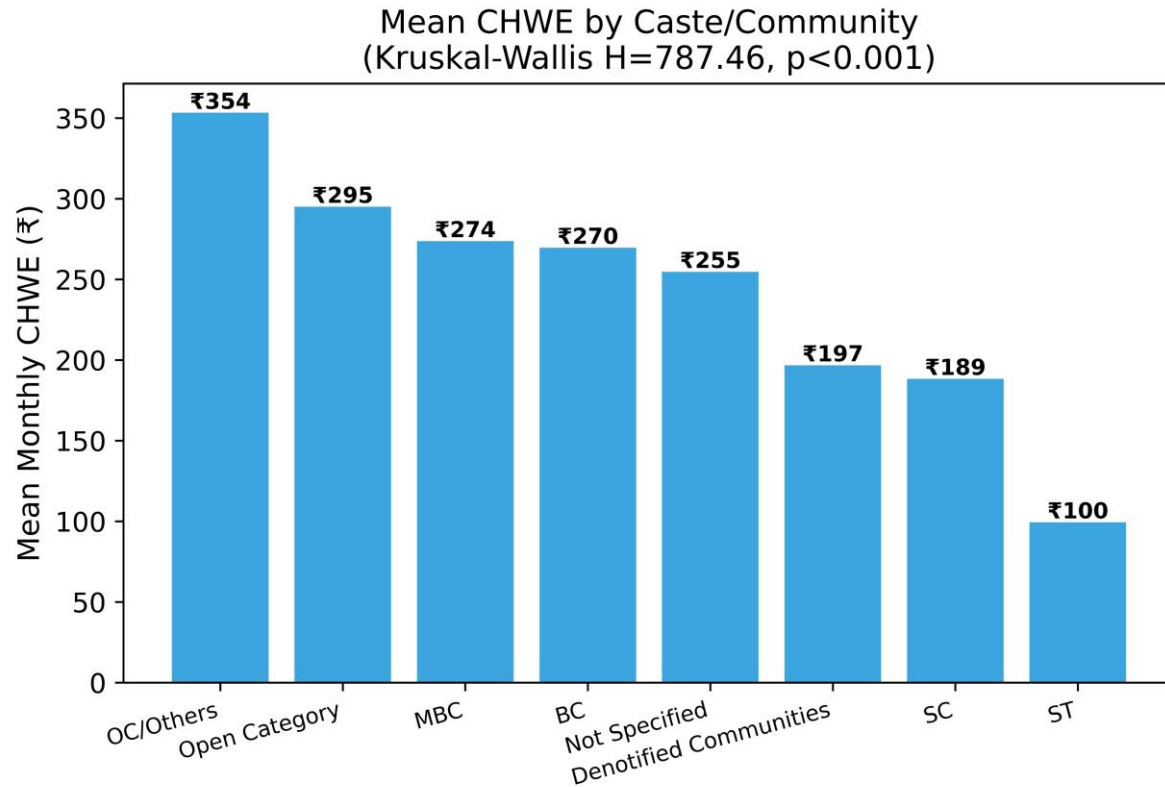
CHWE Incidence Rate by Income Quintile



The poorest households bear a disproportionate and dangerous financial burden.

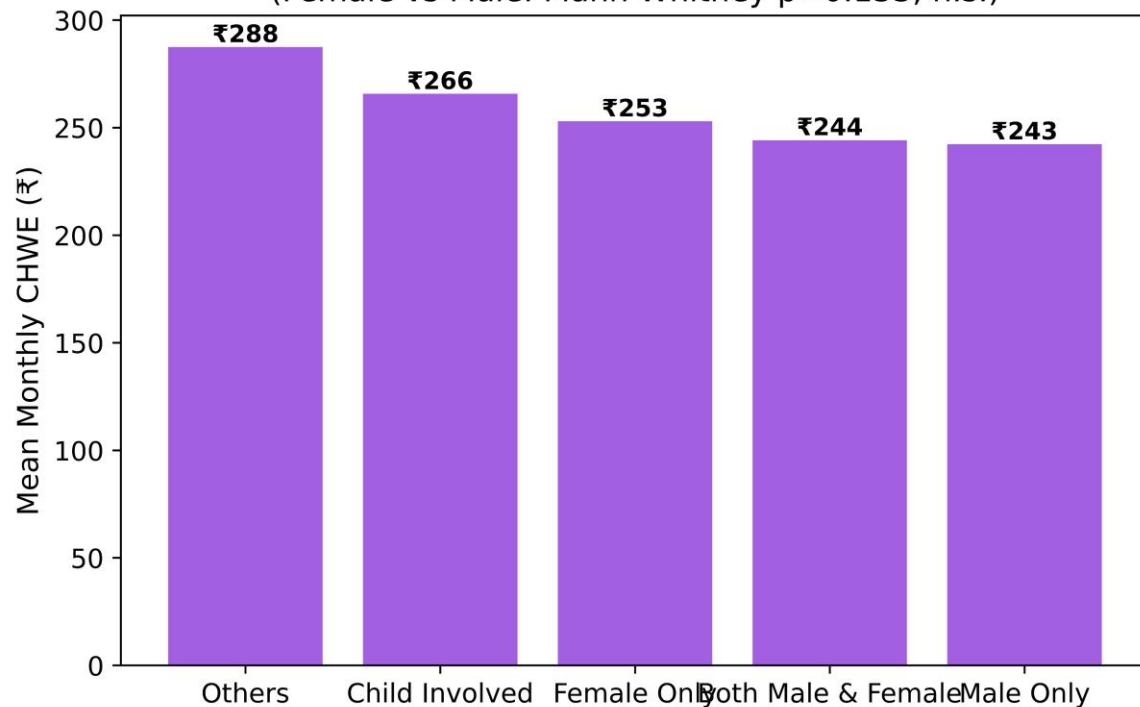


Mean CHWE and Incidence Rate by Caste/Community

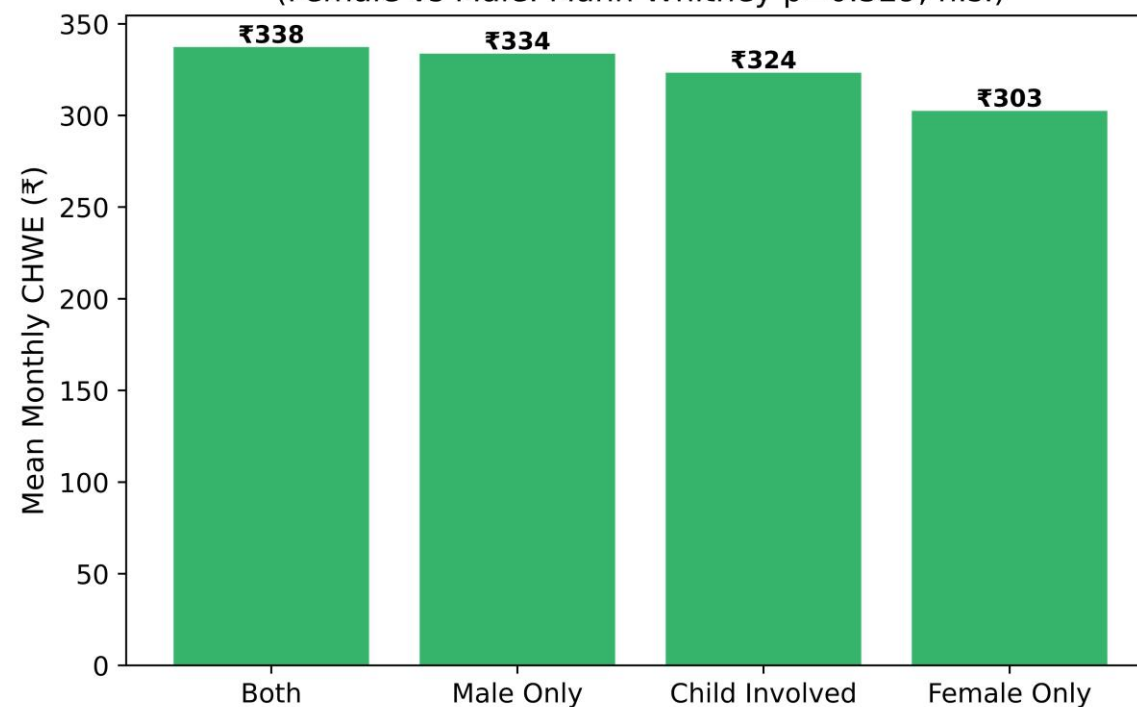


Gender Roles in WASH

CHWE by Person Collecting Drinking Water
(Female vs Male: Mann-Whitney $p=0.133$, n.s.)



CHWE by Gender of Toilet Cleaner (Family Member)
(Female vs Male: Mann-Whitney $p=0.329$, n.s.)



Gender dictates time poverty and dignity, but does not alter monetary expenditure.



The Gender Impact Scale

Time & Labor Poverty

Women bear the overwhelming physical burden of water collection (60% Female-Only) and toilet cleaning.

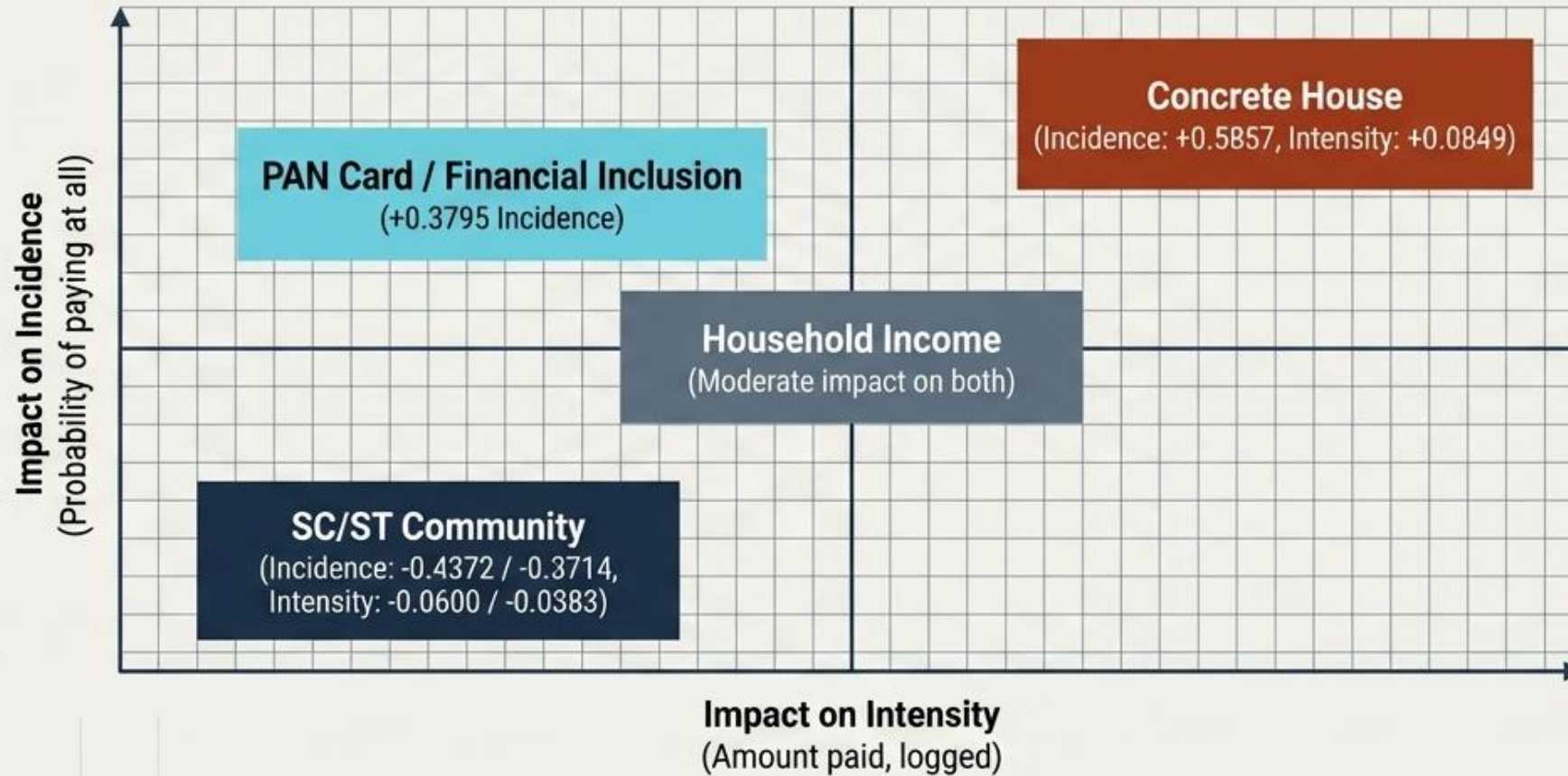


Monetary Budget Impact

No statistically significant difference in financial CHWE between female-only and male-only collector households ($p=0.133$, n.s.).

Gender-responsive programming must focus on infrastructure that buys back women's time, not interventions expecting to alter monetary household budgets.

The forces that trigger a payment versus the forces that inflate its magnitude.

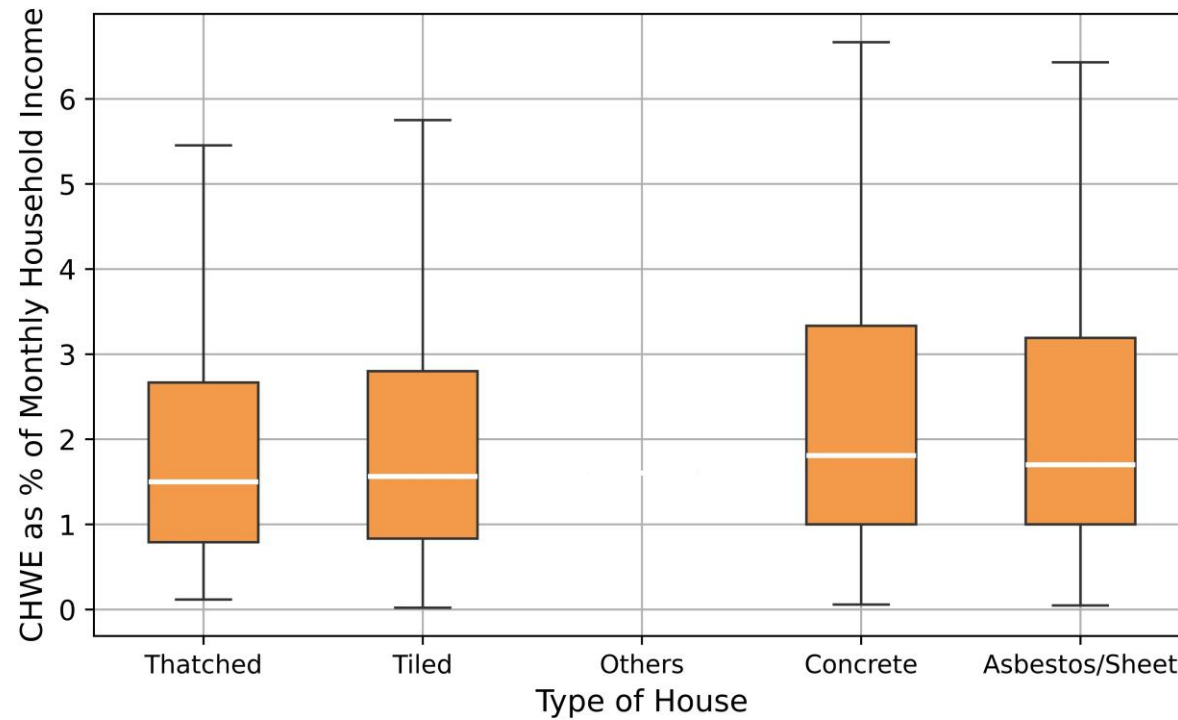
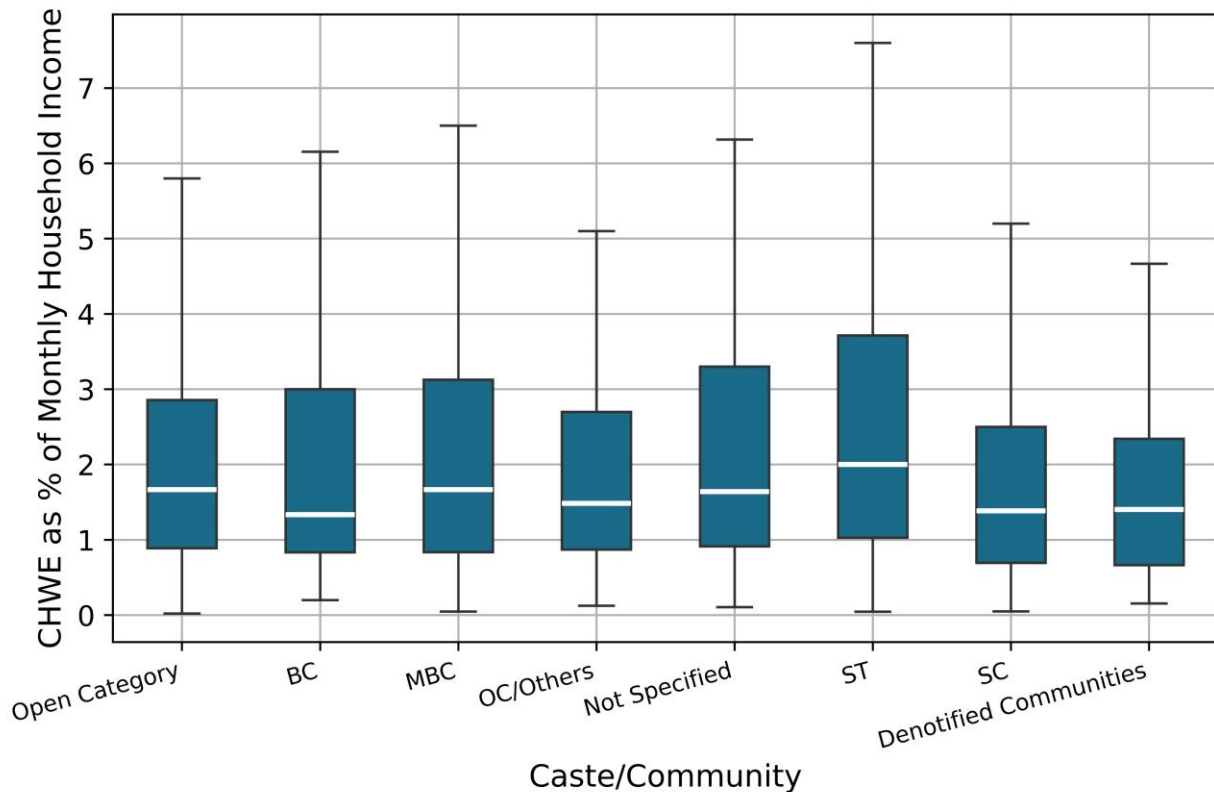


Decomposing the drivers reveals that infrastructure quality dictates spending magnitude, while social and financial inclusion dictates market entry.

WASH Financial Burden

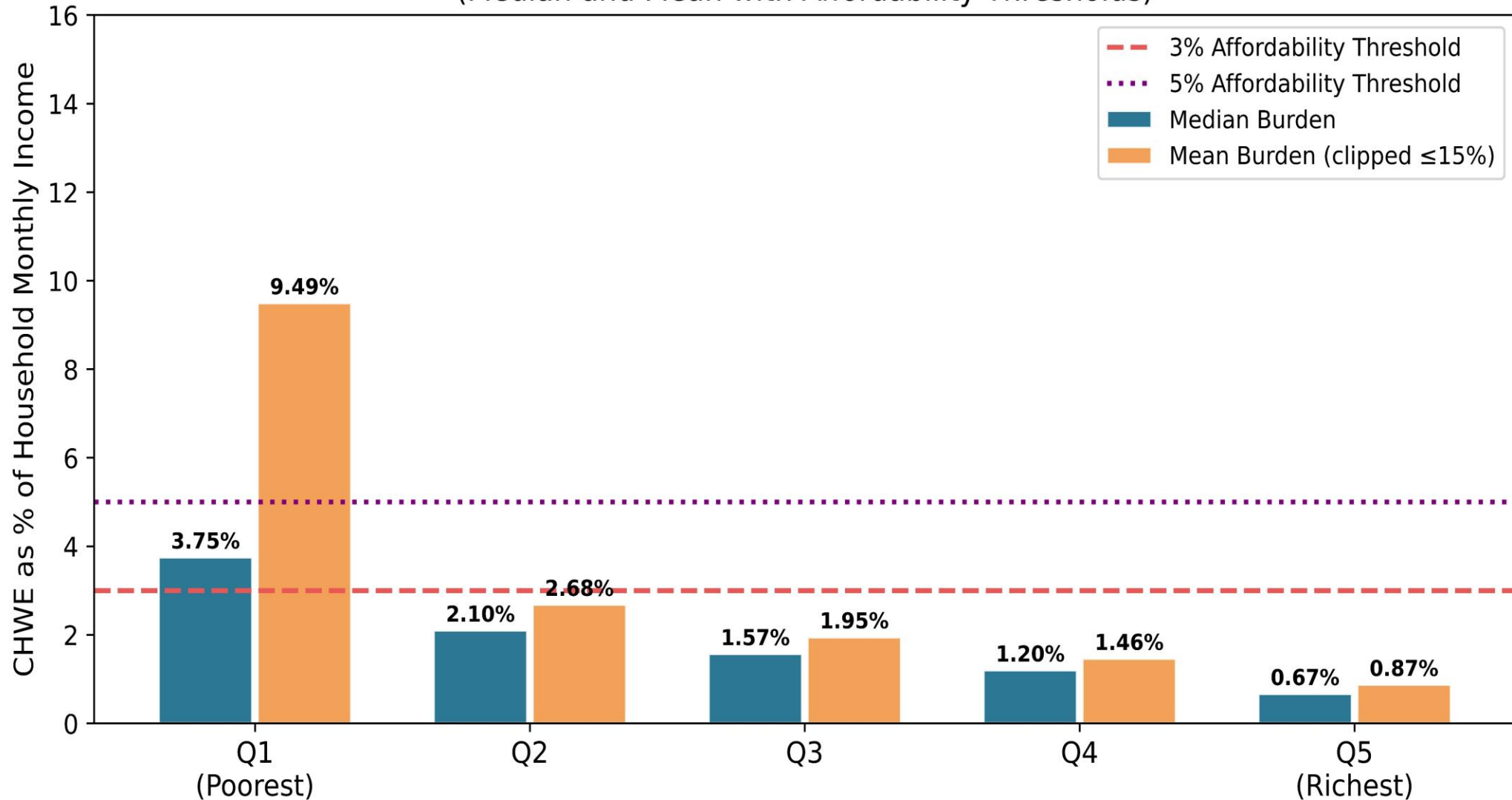
Statistic	All HH (Payers)	Q1 (Poorest)	Q2	Q3	Q4	Q5 (Richest)
Median Burden (%)	1.60%	3.81%	2.34%	1.67%	1.17%	0.54%
Mean Burden (%)	3.55%	8.22%	4.11%	2.88%	2.03%	1.12%
75th Pctile (%)	2.94%	7.14%	4.29%	2.86%	1.98%	0.88%

WASH Financial Burden

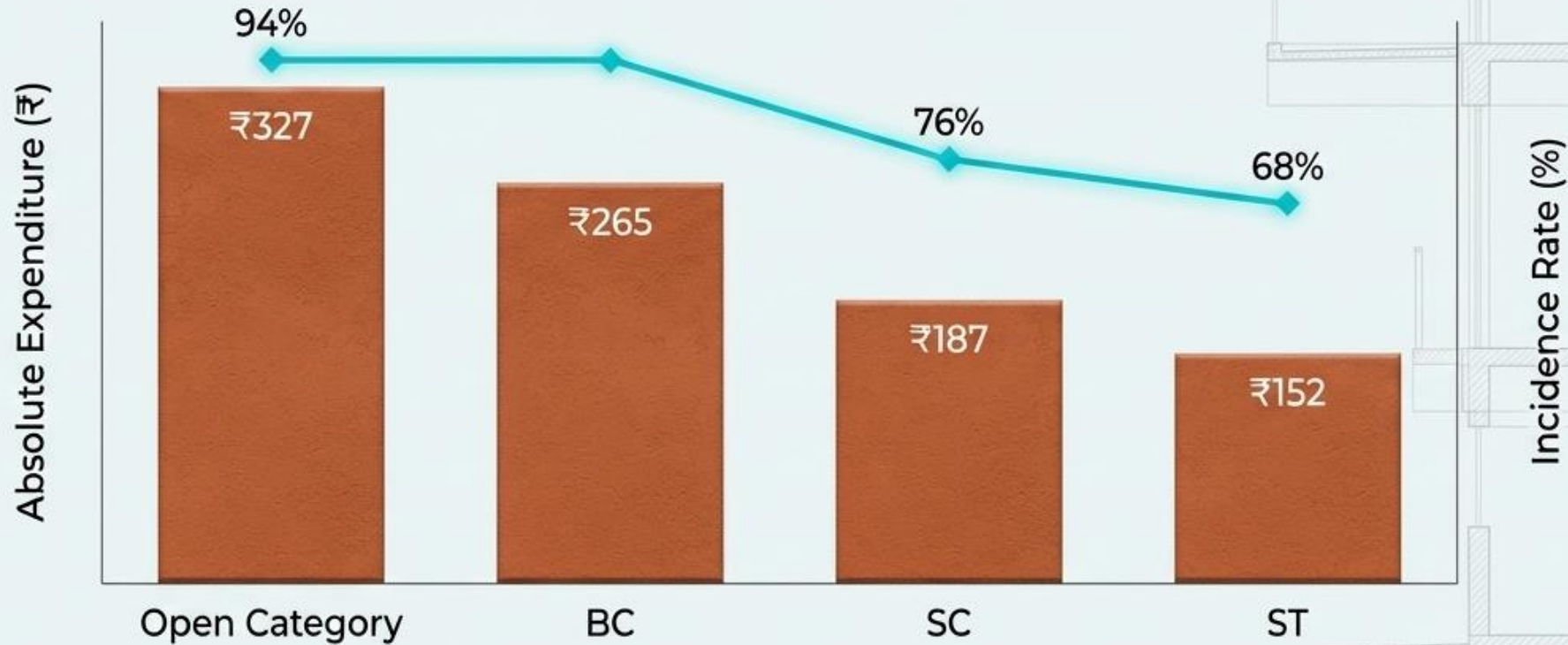


WASH Financial Burden

WASH Financial Burden by Income Quintile
(Median and Mean with Affordability Thresholds)



Systemic exclusion artificially depresses absolute WASH spending for marginalized groups.



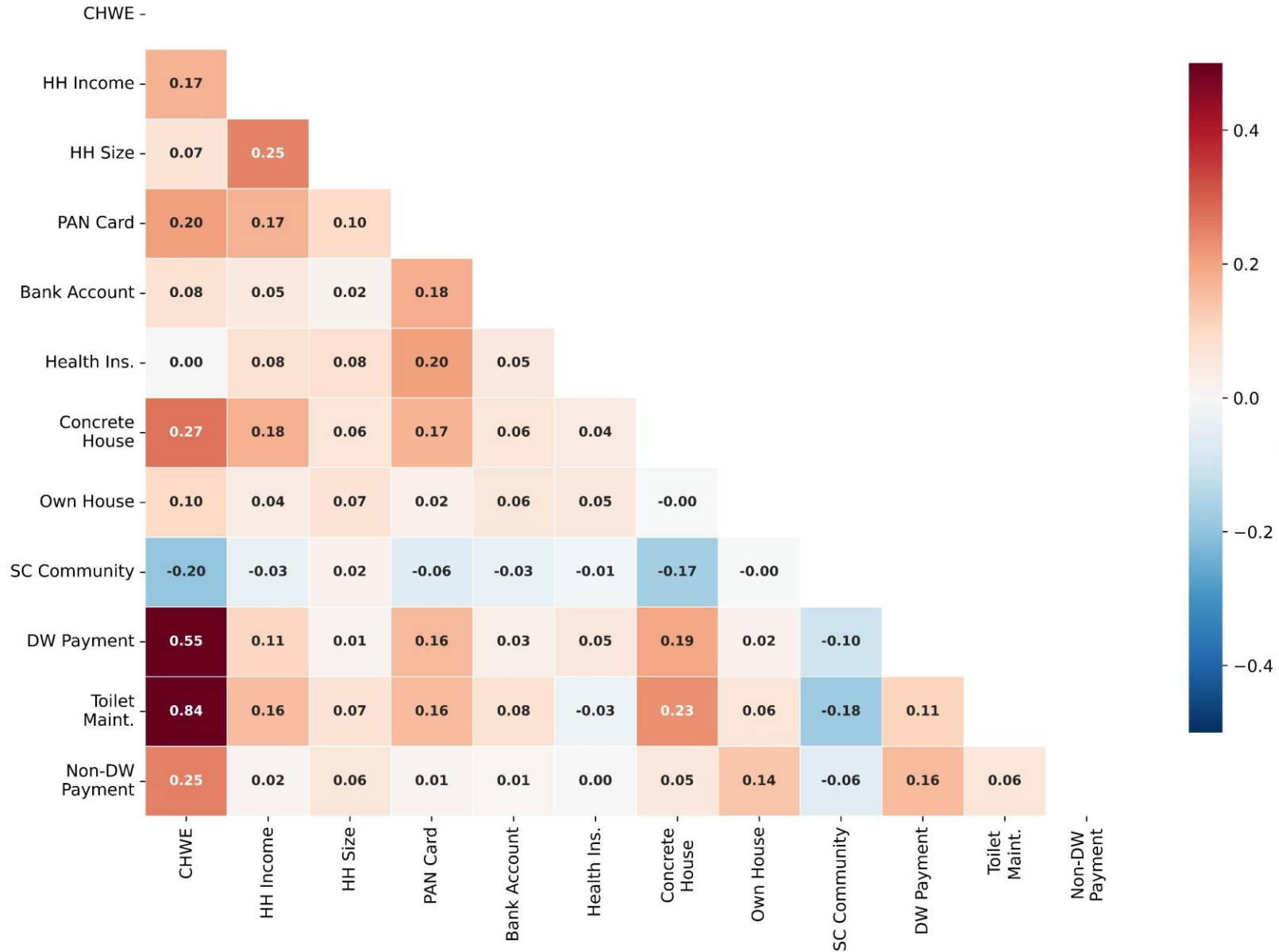
Marginalized groups face historical spatial segregation, keeping their habitations at the periphery of urban service networks.

Marginalized groups share the exact same proportional burden despite lower absolute spending.

The Caste-Expenditure Diagnostic Matrix			
	Advantaged (Open Category)	Marginalized (SC/ST)	
Absolute Mean Expenditure	₹327	₹152–₹187	← Massive Gap
Incidence Rate	94%	68–76%	← Massive Gap
Relative WASH Burden (% of Income)	1.55%	1.55%	← Identical

Expenditure gaps reflect structural exclusion from formal infrastructure, not a lower valuation of WASH or differing spending priorities.

Spearman Correlation Matrix
CHWE, Components, and Key Determinants



Correlation Analysis

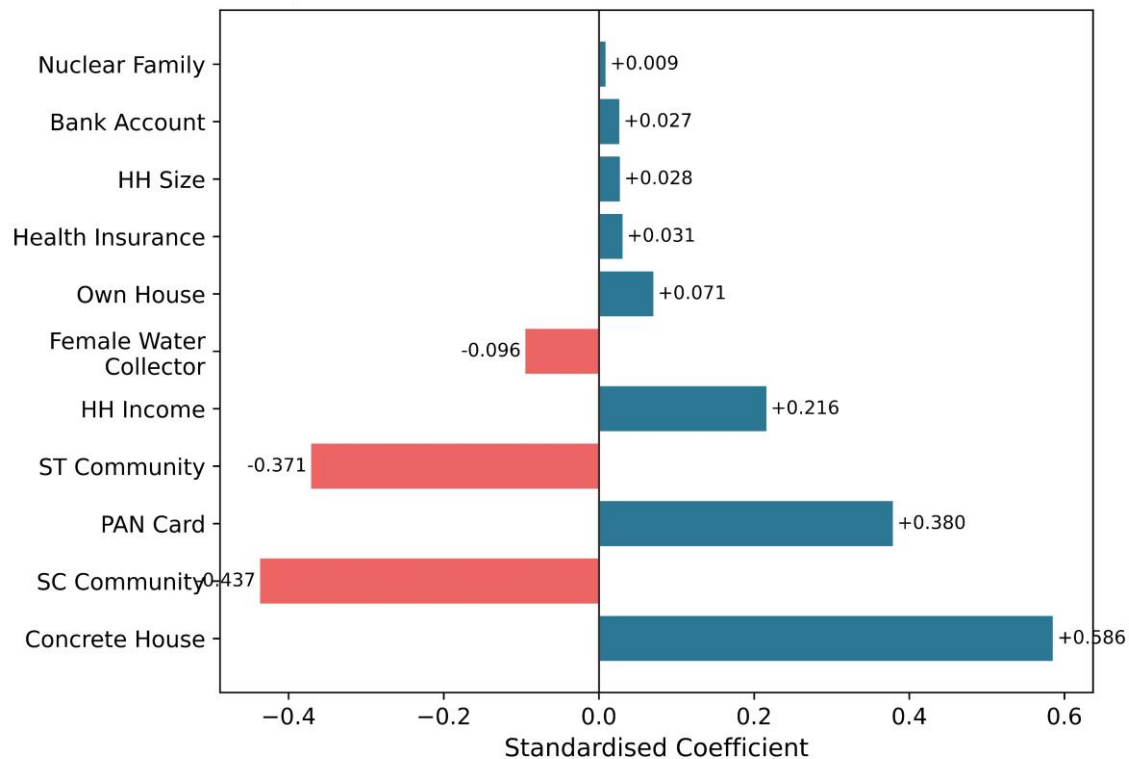


Regression Analysis: Decomposing Incidence and Intensity

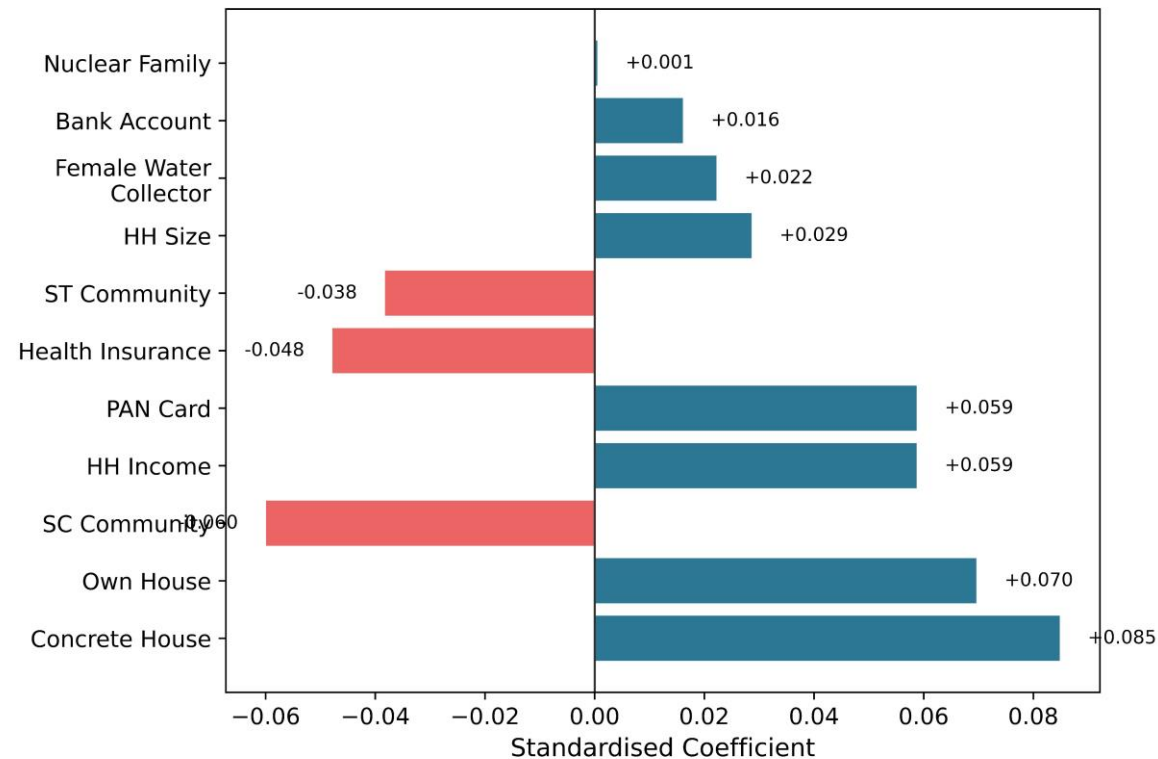
Variable	Incidence Coeff.	Direction	Intensity Coeff.	Direction
Concrete House	0.5857	Positive***	0.0849	Positive***
SC Community	-0.4372	Negative***	-0.0600	Negative***
PAN Card	0.3795	Positive***	0.0588	Positive***
ST Community	-0.3714	Negative***	-0.0383	Negative***
Household Income	0.2165	Positive***	0.0588	Positive***
Female Water Collector	-0.0955	Negative***	0.0223	Positive
Own House	0.0708	Positive***	0.0697	Positive***
Health Insurance	0.0311	Positive	-0.0479	Negative**
HH Size	0.0277	Positive***	0.0287	Positive***
Bank Account	0.0269	Positive	0.0162	Positive
Nuclear Family	0.0092	n.s.	0.0006	n.s.

Regression Analysis: Decomposing Incidence and Intensity

Logistic Regression
WASH Incidence (Any Payment vs None)



OLS Regression
Log-CHWE Intensity (Payers Only, R²=0.066)



Income is a weak lever; economic growth alone will not solve WASH affordability

Rank 1: Concrete Housing (+0.585)

Rank 2: SC Community (-0.437)

Rank 3: Financial Inclusion/PAN (+0.379)

Rank 4: ST Community (-0.371)

Rank 5: Household Income (+0.216)

The income elasticity of CHWE is remarkably weak (Spearman $\rho = 0.159$).

Social factors vastly out-predict pure economic capacity.

Key Findings

- 84.59% of households incur positive CHWE, with toilet maintenance accounting for 65.1% of mean expenditure.
- The construction of concrete houses constitutes the primary predictor of both the incidence and severity of CHWE.
- Households belonging to SC and ST communities experience markedly lower CHWE and incidence rates attributable to structural exclusion.
- Household income exhibits a statistically significant yet weak positive correlation with CHWE.
- Gender roles in water collection and toilet cleaning do not significantly predict monetary CHWE.
- WASH financial burdens are notably regressive, with first-quartile households experiencing a median burden of 3.81% compared to 0.54% for fifth-quartile households.

Policy recommendations

- ❑ **Caste-Sensitive WASH Infrastructure Planning**
- ❑ **Housing Quality as a WASH Lever:**
- ❑ **Mitigation of Regressive Burden**
- ❑ **Gender-Responsive Infrastructure Investment**
- ❑ **Integrated WASH Expenditure Monitoring**

Acknowledgements

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Thank You

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