Horizontal and Vertical Inequalities Explaining Disparities in Access to Urban Sanitation:

Evidence from the National Sample Survey of India

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ABSTRACT

Burgeoning urbanisation coupled with policy implementation gaps have resulted in growing disparities in the provision of public infrastructure services in urban areas of India. Apart from the impact of this, a household's ability to procure basic amenities is also subject to its economic and social condition and the prevalence of social or spatial inequalities. This paper considers a basic household amenity – toilets – and using survey data gauges a household's likelihood of owning one based on economic and social conditions and infrastructural parameters such as water supply and drainage using a binary multivariate logistic regression model. Horizontal or social group-based inequalities, which are often neglected in the sanitation discourse in India, are found to have a significant impact on access to toilets along with the existence of disparities based on consumption expenditure and drainage. The findings ascertain the existence of multidimensional disparities at the state level, refuting centralised programmes adopted to meet Sustainable Development Goals.

AUTHOR'S PROFILE

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INTRODUCTION

Of the 1.7 billion people globally who do not have access to toilets (exclusive or shared), nearly 640 million live in India. Again, of the 657 million people who have unimproved drinking water sources,[i] approximately 77 million are from India (JMP Estimates, 2015). The progress made in delivering improved water supply from 1990 to 2015 has been significant with a jump from 71 per cent in 1990 to 94 per cent in 2015. However, while improved sanitation[ii] (including shared facilities) in India has risen by 27 per cent from 22 per cent in 1990, the coverage of 50 per cent in 2015 (as predicted by JMP) is poor. Currently, with approximately 564 million people practising open defecation, India contributes to almost 60 per cent of global open defecation.

Water and sanitation services generate positive externalities in terms of improved public health and better infrastructure (Esrey *et al.*, 1991; Prüss-üstün *et al.*, 2004; Fewtrell *et al.*, 2005; Bartram *et al.*, 2005; Montgomery and Elimelech, 2007; Agoramoorthy and Hsu, 2015; Spears, 2012). Improved water and sanitation services manifest in an overall improvement in quality of life and the indivisible nature of demand for these services necessitate them to be provisioned equally and non-discriminately. Plausibly, there has been a recognition of water and sanitation as basic human rights by the United Nations[iii] (Gonzalez *et al.*, 2014) in order to mitigate the exclusion of people from these services. Developing countries like Brazil and South Africa have decreed sanitation services as a basic human right (Tissington, 2011; Barcellos, 2014). In India there is an acknowledgement of these rights under the right to life although the inclusion is not categorical (Muralidhar, 2006; Cullet *et al.*, 2009; Pandey, 2014).

Despite the comprehension of the merits of and indivisible demand for sanitation services in India, there has been a continued inadequacy in their provision. The deliberations on the sector often attribute the impediments to behavioural and pecuniary issues. The inequities in access to basic services in India are, in fact, sustained by a complex mix of institutional, financial, technological and socio-economic factors. Studies, mostly on the rural areas of India, have established the linkages between sanitation and socio-economic indicators like religion, education, access to water, access to electricity (Geruso and Spears, 2014; Pillai and Parekh, 2015). Disparate provisioning of water and sanitation services based on vertical and horizontal inequalities[iv] have rendered these services toll/club/quasi-public goods[v] which are non-rivalrous but excludable, rather than public goods which are non-rivalrous and non-excludable[vi] (Isham and Kahkonen, 1998; Stewart 2002; Bhattacharya et al., 2016). Another interesting study asserts that the states in India with multiple political parties use club rather than public goods to mobilise certain communities to win elections compared to those with two parties (Chhibber and Nooruddin, 2004).[vii] Studies also assert discrimination in the provision of sanitation services in India based on gender, religion and other forms of social stratification (Geruso and Spears, 2014; Lande, 2015).

India has been urbanising at a rapid pace, with urbanisation climbing from from 28.53 per cent in 2001 to 31.6 per cent in 2011 (Census). Approximately 22–25 per cent of urban growth can be attributed to rural to urban migration (Bhagat, 2011; Pradhan, 2013). Health hazards are potentially worse in dense urban settlements with poor sanitation

even though in percentage terms urban areas have better sanitation infrastructure. The situation is dire in urban areas given the predominance of on-site sanitation systems such as septic tanks and pit latrines (46 per cent) and inadequate facilities for waste water treatment and discharge.[viii] Another issue is the insufficient treatment capacities of existing sewerage treatment plants (STPs) in the urban areas[ix] (CPCB, 2013) to cater to the 33 per cent urban households which have toilets connected to the piped sewer network (Census 2011).

Disparities in access to basic services in urban areas have been a much debated issue in recent times as urban infrastructure programmes are being formulated to keep up with growing urbanisation. The risk of exclusion from these services remains high in urban areas despite the all-inclusive and wide-ranging goals of the ongoing policies and programmes. Caste[x] continues to shape the organisation of residential space in urban areas of India and there is a high correlation of SCs/STs with slum populations (Vithayathil and Singh, 2012). A study on big cities of India, which has corroborated a higher incidence of residential segregation based on caste than gender or socio-economic status (male literacy), also finds a high segregation in terms of access to a basic public good – in-house drinking water – and a basic private good – an in-house latrine (Sidhwani, 2015).

While studies on inequalities in access to basic services in contemporary urban India are sparse, the little literature available on this topic does suggest the existence of disparities based on socio-economic characterisitics, gender and space (Vakulabharnam *et al.*, 2012; Vithayathil and Singh, 2012; Sidhwani, 2015). This paper investigates the likelihood of a household owning a basic private good, an in-house toilet, given its socio-economic status and access to public goods, drainage and in-house drinking water. The analysis undertaken has attempted to gauge the disparities in access to in-house toilets with a primary focus on the impact of vertical inequalities (monthly per capita expenditure); horizontal inequalities based on differential access to drainage infrastructure; and social stratification based on the caste system in urban India. The paper concludes with a brief discussion of the policy implications of the findings.

INSIGHTS FROM CENSUS DATA

In India, 47 per cent of households have toilets within premises (Census 2011). 31 per cent of rural households have access to toilets and 81 per cent of urban households have toilets within premises. 71 per cent of urban households have tap water provision for drinking water, 62 per cent treated and 9 per cent untreated. Only 54 per cent of urban households have tap water in the premises and 17 per cent have tap water sources near the premises or away. The Census also reveals access to waste water drainage. Around 18 per cent of Indian households have access to closed drains, 33 per cent have access to open drains and a staggering 49 per cent of households do not have access to drains. In urban areas 45 per cent of the households have access to closed drains, 37 per cent to open drains and 18 per cent lack access to drains.

DATA AND METHODOLOGY

The National Sample Survey Organisation of India published the 69th round on 'Water, Sanitation, Hygiene and Housing Condition' in 2012. The 69th round survey was based on a questionnaire with questions on socio-economic indicators, household conditions, the dwelling unit, drinking water and sanitation services. For rural India, the number of Census villages surveyed in the Central sample was 4,475 and the number of urban blocks surveyed was 3,522.[xi] The total number of households surveyed was 53,393 in rural India and 42,155 in urban India.

The analysis is confined to the urban areas of 15 states selected on the basis of population. The states thus chosen are Punjab, Rajasthan, Uttar Pradesh, Bihar, Assam, West Bengal, Jharkhand, Odisha, Madhya Pradesh, Gujarat, Maharashtra, Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. Collectively these states consist of 60 NSS regions.[xii] The selected states comprise 42,648 sampled households from rural areas and 32,321 sampled households from urban areas. This study focuses on urban areas; hence the analysis is confined to 32,321 surveyed samples.

The analysis confines itself to state level data aggregates instead of delving deeper and looking at district or city level data primarily because of the inclusion of public health and sanitation, water supply and drainage as state subjects in the Constitution of India. The nature of the Indian federal system is such that most of the powers are vested in the state governments with very little administrative and financial autonomy to local governments (rural and urban local bodies), thus making state governments the ideal level of analysis. This argument is further substantiated by the fact that the share of state expenditure in the water and sanitation sector has increased since the 11th plan,[xiii] and the current programmes and schemes also advocate a bigger share of investment in infrastructure by the state governments.

The data provided on types of toilets in surveyed households – toilet/s for exclusive use of a household, toilets for common use of households in a building, public/community toilets, others and no latrine – has been used to create a new categorical variable with two categories: households with toilets and households practising open defecation.[xiv]

The households accessing public and community toilets and reported to use other facilities have not been considered in the study. Presented in Table A1 (see Appendix) are the figures on access to toilets for different drainage systems. It is interesting that most of the states under study have over 90 per cent of households with toilets when they have access to closed drains. Gujarat, with 79 per cent, has the highest percentage of households with access to closed drains. Kerala, Odisha and West Bengal, with 30 percentage, have the highest percentages of households with no access to drains. Jharkhand, Kerala, Odisha and West Bengal have high percentages of households with access to open drains at 61, 48, 45 and 57 per cent respectively.

The NSSO 69th round also provides information on the consumption expenditure of every household with a 30-day recall period. In the absence of income data, consumption data has been used as a proxy for income with the assumption that higher monthly per capita expenditure (MPCE[xv]) reflects higher well-being. Using the MPCE figures for every household, the urban households from the 15 selected states have been divided into five equal quintiles –

first, second, middle, fourth and fifth – in increasing order of MPCE. The ranges of each of these quintiles vary for different states, implying different consumption patterns in different quintiles for all states. There are noticeable variations in the distribution of people with and without toilets in these quintiles. Table A2 (see Appendix) gives the distribution of households with and without toilets in different states across their respective consumption quintiles. It is seen that even though the majority of households without toilets are from the poorest (first) quintile of all states, the richer quintiles also have households without toilets. This indicates that consumption and income are not the only factors that affect access to toilets.

Some methodological issues were faced due to the complexity of the data. The urban survey blocks covers all of the 7,933 cities/towns including both Statutory Towns and Census Towns.[xvi] However, while it is possible to segregate Statutory Towns and Census Towns in the Census data, they are difficult to segregate in the NSSO data. Consequently, the urban areas considered in the NSSO 69th round, and hence this analysis, include Census Towns, which have rural administration. There are also some ambiguities in the data presented by the NSSO 69th round so far as types of toilets present in households are concerned – whether they are pour-flush toilets to piped sewer system or pour-flush toilets to septic tanks, and so forth – as also the discharge of waste water to open land, rivers, drainage systems and so on. Table A3 (see Appendix) shows that 71 and 41 per cent of households with toilets connected to septic tanks or pits (which are on-site treatment systems) discharge waste water into the drainage system (open drains). This could mean some error in data arising out of incorrect reporting of information by enumerators since such on-site systems have a different waste disposal mechanism. However, such a high percentage of on-site systems reporting the discharge of their waste water into drains could also mean they are actually connected to drains. This has been recognised as an environmentally hazardous activity but is often prevalent because of the dearth of on-site waste treatment systems (CPCB, 2013).

ANALYSIS

Sanitation, in the broader sense, includes toilets and an array of services which cover collection, transportation and treatment of solid and liquid wastes, as has been mentioned in the National Urban Sanitation Policy (NUSP), 2008.[xvii] However, the analysis in this paper would be confined only to measuring access to toilets and how such access is affected by consumption patterns of households and access to drainage. Nevertheless, the association of other parameters to access to toilets has not been overlooked. Variables which are presumed to have an impact on the likelihood of a household owning a toilet have been included in the regression equation.

The total sample size of the urban areas of the 15 selected states is 32,321. With the intention of exploring the degrees of association between access to toilets and household socio-economic characteristics, separate analyses at the state level have been undertaken. There is a conscious attempt to understand the associations between the dependent and the independent variables for different states separately following the presumptions that different states will have different degrees of association and that in some states some parameters will be more crucial than the rest.

Theoretically, the access to toilets in different states could be different because of varying demographics, infrastructure endowments, policies or institutional structures. This presumption has been validated by the calculation of the percentages of households of different caste groups with toilets for different levels of drainage infrastructure access for all five consumption quintile groups (see Figure 1).

Figure 1: Region-wise[xviii] percentages of different social groups and drainage access for all consumption quintiles

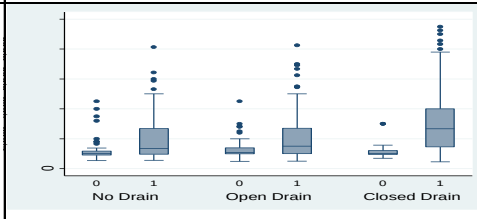
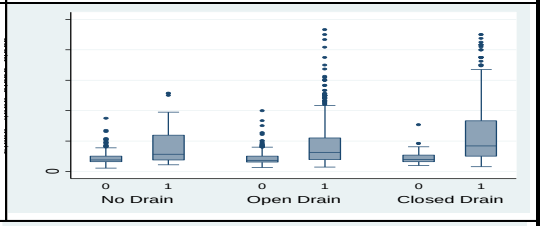
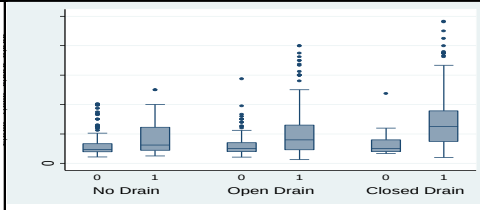
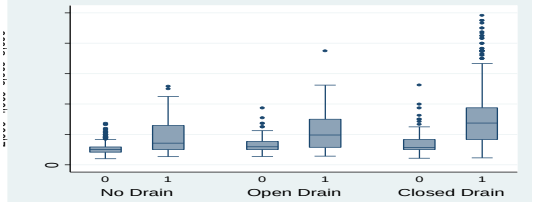
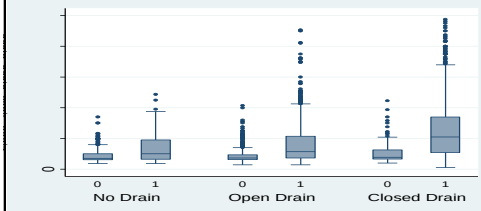
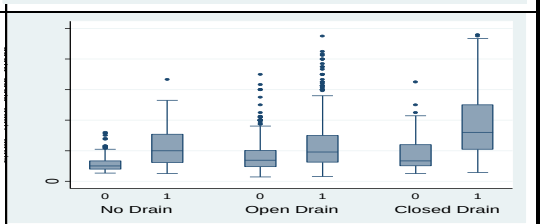
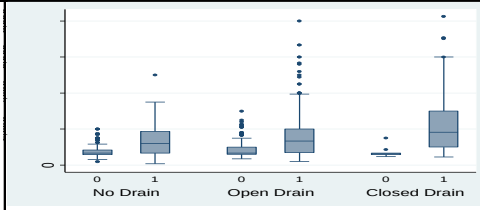
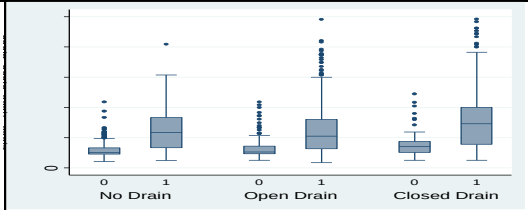
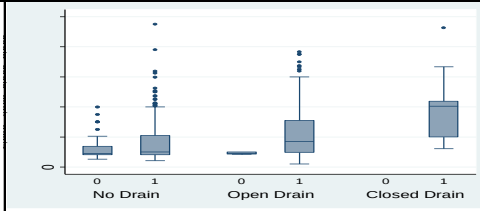
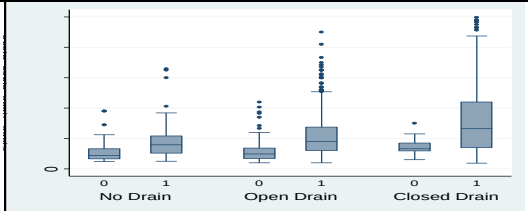
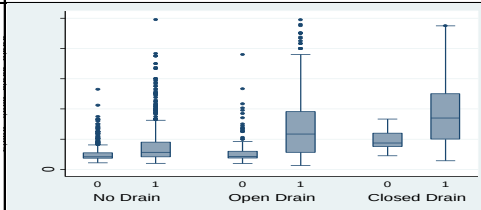
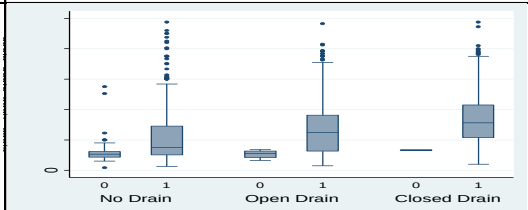
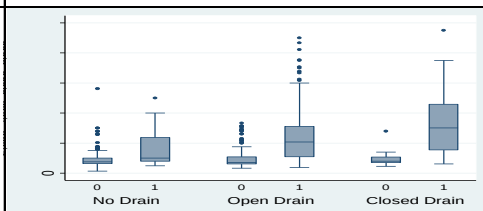
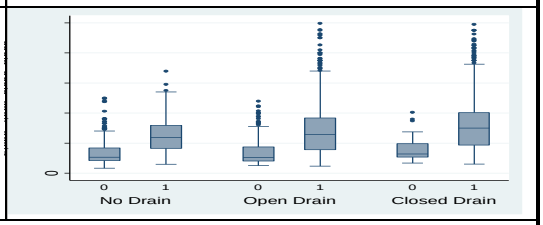
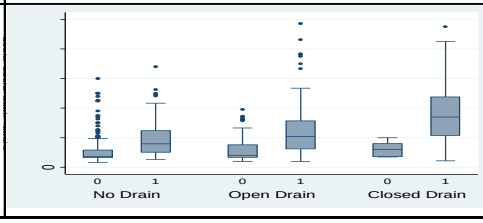
Source: National Sample Survey Data, 2012

Figure 1 has been obtained by dividing the estimated population of the four regions into five quintiles and segregating them based on caste and access to drainage infrastructure. The percentages indicate the percentage of households of the selected caste category with toilets and drainage status from the selected quintile. It is noticed that in all of the regions the percentages of households owning an in-house toilet improve not only along the quintile groups but also along caste groups and drainage infrastructure. This plot validates the different levels of association between access to in-house toilets and the indicators of consumption expenditure, infrastructure and social group. It provides ample motivation to explore the nature of these associations through econometric analysis.

Table 1:1: State-wise mean and median MPCE differences for toilet and drainage status

Drainage Status	State	Mean MPCE		Mean Difference	State	Mean MPCE		Mean Difference
		No IHL	IHL			No IHL	IHL	
No Drains	Punjab	1281	2049	768	Madhya Pradesh	873	1616	743
		(46)	(74)			(273)	(105)	
Open Drains		1274	1996	723		866	1661	795
		(90)	(238)			(280)	(815)	
Closed Drains		1325	2929	1604		894	2181	1286
		(20)	(569)			(60)	(856)	
No Drains	Rajasthan	1223	1638	415	Gujarat	1059	1809	750
		(174)	(105)			(233)	(150)	
Open Drains		1204	1947	743		1378	2153	775
		(184)	(691)			(64)	(246)	
Closed Drains		1334	2677	1343		1440	2846	1406
		(26)	(506)			(83)	(1214)	
No Drains	Uttar Pradesh	890	1486	596	Maharastra	1140	2264	1124
		(204)	61			(225)	(116)	
Open Drains		891	1614	723		1652	2212	561
		(516)	(1582)			(716)	(898)	
Closed Drains		1062	2391	1329		1750	3462	1713
		(127)	(1639)			(214)	(1627)	
No Drains	Bihar	759	1386	627	Andhra Pradesh	1189	2384	1195
		(175)	(115)			(265)	(133)	
Open Drains		875	1521	646		1306	2410	1103
		(182)	(628)			(171)	(1135)	
Closed Drains		713	2074	1361		1681	2915	1234
		(10)	(133)			(42)	(1116)	
No Drains	Assam	1301	1706	405	Karnataka	1050	1822	772
		(46)	(226)			(152)	(110)	
Open Drains		925	2206	2192		1137	2150	1014
		(5)	(452)			(227)	(744)	
Closed Drains		.	3891	.		1452	2982	1530
		(0)	(22)			(21)	(761)	
No Drains	West Bengal	1054	1601	547	Kerala	1295	2064	769
		(415)	(690)			(41)	(573)	
Open Drains		1185	2618	1433		1056	2703	1647
		(171)	(1762)			(4)	(799)	
Closed Drains		1904	3477	1573		1331	3357	2026
		(17)	(276)			(2)	(466)	
No Drains	Jharkhand	908	1601	693	Tamil Nadu	1396	2513	1117
		(198)	(82)			(332)	(185)	
Open Drains		1048	2310	1262		1385	2744	1359
		(124)	(370)			(407)	1066	
Closed Drains		1079	3141	2062		1551	3068	1517
		(9)	(47)			(80)	(730)	
No Drains	Odisha	1060	1898	837	**Note:** Figure within () represent number of samples for the corresponding category. Mean differences column shows the difference between mean MPCE for houses with and without toilets for corresponding drainage status. **Source:** National Sample Survey Data, 2012			
		(307)	(149)					
Open Drains		1312	2285	973				
		(60)	(333)					
Closed Drains		1222	3473	2251				
		(7)	(194)					

Table 2:1: State-wise box plot

State	Box Plots (Median MPCE for IHL/No IHL & No/Open/Closed Drains	State	Box Plots (Median MPCE for IHL/No IHL & No/Open/Closed Drains
Punjab		Madhya Pradesh	
Rajasthan		Gujarat	
Uttar Pradesh		Maharastra	
Bihar		Andhra Pradesh	
Assam*		Karnataka	
West Bengal		Kerala**	
Jharkhand		Tamil Nadu	
Odisha			

Note:
The codes of "0" and "1" on x-axis represent No IHL and IHL respectively.
*For Assam the mean differences are not significant according to two-way t-test. Pr(|T|>|t|))=0.0504 for no drains, Pr(|T|>|t|))=0.0582 for open drains and no result for closed drains due to inadequacy of data.
**For Kerala the mean differences are not significant for open and closed drainage.
Source: National Sample Survey Data, 2012.

The effect of MPCE on access to toilets given differential drainage infrastructure was also checked by generating box-plots as shown in Table 1.1 and Table 1.2. The significant results of two-sample student's t-test run for all states separately for different drainage services[xix] substantiate the presumptions on the association between MPCE, access to drainage and access to toilets. Further, it is interesting that the differences in mean MPCE for households with IHL and no IHL increase with improvement from no drain status to open drain and closed drain statuses. For some states the differences are steeper than others, signifying more pronounced disparities based on MPCE and access to drainage in different states. Similar results were seen for two-sample t-tests for different social groups.

A logistic model has been developed with a binary categorical variable, named IHL,[xx] for households with access to toilets within premises (exclusive use) or within a building for common use of residents. This is the dependent variable for the logistic equation. The logistic model yields results in the form of an odds ratio which is the odds of a household owning a toilet (IHL=1) against the odds of a household not owning a toilet (IHL=0). This model is a variant of the logit model in which coefficients are the log of the odds ratios for a unit change in the independent variable if they are continuous or for an alternative category of categorical independent variables.

The independent variables considered for the model are:

Monthly Per Capita Consumption Expenditure (MPCE) transformed to MPCE divided by 100 for every household to show changes in the odds ratio of a household for every Rs 100 increment in the MPCE of the household. This is the only continuous variable in the model.

Drainage Status which shows the access of the household to drainage that is pure public service provisioned by the government (central, state or local). NSSO 69th round questions the access of the surveyed household to closed drains, open drains or no drains. It is to be noted that this question assesses the availability of drainage infrastructure for the surveyed household in the locality and does not mean that the household is necessarily connected to that facility.

Caste Status which shows the social group of the surveyed household. Of the original four caste groups, SC and ST castes are combined under one head for this study, effectively reducing the categories to three – SC/ST, OBC and General.

Drinking Water Source which divides the drinking water supply into two broad categories – improved and unimproved water supply. The WHO-UNICEF JMP definitions of improved and unimproved drinking water have been used to make this segregation.

Drinking Water Access denotes the kind of access households have to drinking water, that is, whether households have exclusive access or community or common building use and so on.

Drinking Water Sufficiency gives an insight into the sufficiency of drinking water for households.

Area of Dwelling provides the slum status of the surveyed household. Households which are in notified or non-notified slums or squatter settlements are categorised under slums.

Dwelling Unit indicates what kind of dwelling unit the surveyed household is – whether an independent house or a flat or other.

House Condition captures the condition of the structure of the house. Households have reported their houses as good, satisfactory and bad. Houses which did not require any major or minor repairs were coded as good.[xxi]

NSS Region takes into account the regions comprising different districts of a state, as devised by the NSSO in its 66th round. Every state has been divided into different NSS regions, each of which is a cluster of some neighbouring districts. 60 NSS regions which constitute the 15 selected states have been considered in the analysis.

Binary Multivariate Logit Model

$$P = \frac{1}{1+e^{-z}}$$

Alternatively, $P = \frac{e^z}{1+e^z}$

Where, $z = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k$, e represents the base of natural logarithm, which has the value of 2.718 approximately, and P represents estimated probability of a household owning a toilet given the X_i's. X_i's represent the independent variables – *MPCE/100*, *drainage status*, *caste status*, *drinking water source*, *drinking water access*, *slum status*, *dwelling unit*, *NSS region and house condition*. It is to be noted that z here is not the response variable but represents a linear function of the set of predictor variables.

$$Odds = \frac{P}{1-P} = e^z$$

$$logit\ P = \log\left(\frac{P}{1-P}\right) = log\ (Odds) = z$$

In the binary multivariate logit model the coefficient is β_i. This is relative to the reference category of every parameter which is 1 for the coefficient of different categorical variables in the model (all variables except MPCE/100). It should be noted that the coefficients of different parameters are also relative to the alternative situation, that is, when a household doesn't have a toilet. Thus, the odds for every parameter which is given by e^{β_i} also gives the odds ratio[xxii] for that parameter. Simply put, the odds ratio gives the odds of a household owning a toilet with every change in the category of parameters when a household has a toilet, against the odds of a household not owning a toilet for the same changes in the category of parameters.[xxiii] For example, considering *MPCE/100* variable the odds ratio is as follows:

$$Odds\ Ratio\ for\ MPCE/100$$
$$= \frac{Odds\ for\ a\ household\ with\ toilet\ for\ every\ Rs\ 100\ increase\ in\ MPCE}{Odds\ for\ a\ household\ without\ toilet\ for\ every\ Rs\ 100\ increase\ in\ MPCE}$$
$$= \frac{P(IHL=1|MPCE=M+100)/P(IHL=1|MPCE=M)}{P(IHL=0|MPCE=M+100)/P(IHL=0|MPCE=M)} = exp^{\beta_{MPCE}}$$

The logit regressions were run separately for the 15 states since it can be intuitively presumed that there will be varying degrees of association of different parameters with access to toilets in various states. Given the intent of this research to understand state-wise disparities in access to sanitation, the analysis has not been made at any sub-state level apart from the inclusion of NSS regions in the state regression equations to understand region-wise disparities within states.

Table 2 gives the table of odds ratios for different parameters for all the 15 considered states. The first column gives the household characteristics which form the right hand side of the logit regression equation, the independent variables/parameters based on which access to toilets is analysed for different states (given in the subsequent columns). The table gives the odds ratios and robust standard errors for every category of parameters for all the states. In addition, it also gives the number of samples and the pseudo-R^2 results for every state's logistic regression.

Table 2: Odds ratios for logistic regression model for all independent variables and all states

Household Characteristics (Independent Variables)	Odds Ratio/[Standard Error] for different household characteristic for every state														
	Punjab	Rajasthan	Uttar Pradesh	Bihar	Assam	West Bengal	Jharkhand	Odisha	Madhya Pradesh	Gujarat	Maharashtra	Andhra Pradesh	Karnataka	Kerala	Tamil Nadu
MPCE/100	1.059***	1.034***	1.079***	1.107***	1.073	1.05***	1.075***	1.037**	1.12***	1.067***	1.03***	1.069***	1.069***	1.046	1.078***
	[0.018]	[0.01]	[0.01]	[0.018]	[0.043]	[0.009]	[0.016]	[0.012]	[0.016]	[0.015]	[0.007]	[0.012]	[0.016]	[0.031]	[0.009]
Drainage Status (Ref: No Drains)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Open Drains	1.872	3.142***	3.693***	3.094***	28.235***	2.805***	2.874***	4.049***	4.924***	3.977***	1.621**	6.61***	3.529***	6.149**	2.994***
	[0.61]	[0.619]	[0.79]	[0.594]	[25.483]	[0.346]	[0.706]	[0.932]	[0.876]	[1.073]	[0.262]	[1.26]	[0.777]	[3.623]	[0.471]
Closed Drains	12.567***	7.933***	10.767***	4.481***	..	1.158	1.851	6.223***	11.278***	5.783***	4.238***	23.643***	22.053***	4.967	5.549***
	[5.113]	[2.323]	[2.5]	[1.93]	[.]	[0.349]	[1.092]	[2.631]	[2.435]	[1.231]	[0.766]	[6.871]	[7.636]	[4.341]	[1.14]
Caste Status (Ref: SC/ST)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
OBC	1.841	1.677**	2.213***	2.351***	0.271	2.338***	2.999***	1.122	1.577**	1.649*	1.47**	1.417	3.562***	4.702***	4.185***
	[0.698]	[0.308]	[0.281]	[0.511]	[0.305]	[0.478]	[0.744]	[0.296]	[0.234]	[0.368]	[0.208]	[0.272]	[0.781]	[1.92]	[0.65]
General	1.993*	7.242***	4.162***	5.495***	0.096**	1.674***	5.956***	2.872***	2.293***	2.9***	2.057***	4.026***	8.264***	1.598	22.374***
	[0.595]	[1.872]	[0.663]	[1.779]	[0.084]	[0.209]	[2.319]	[0.819]	[0.51]	[0.796]	[0.295]	[1.097]	[2.205]	[0.765]	[15.168]
Drinking Water Source (Ref: Improved Source)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Unimproved Source	0.098*	1.56	1.701	0.332	0.447	1.696	0.496*	2.925*	0.445*	0.902	2.934*	0.298**	0.338*	2.846*	2.429*
	[0.102]	[0.699]	[0.843]	[0.243]	[0.476]	[0.574]	[0.176]	[1.25]	[0.147]	[0.441]	[1.343]	[0.127]	[0.171]	[1.384]	[1.076]
Water Access (Ref: Household Exclusive Access)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Common Building Access	0.482	1.05	0.953	1.411	5.214	1.233	1.402	1.066	0.662	0.598	0.708*	0.608	1.133	..	1.165
	[0.192]	[0.285]	[0.186]	[0.34]	[6.746]	[0.391]	[0.631]	[0.42]	[0.183]	[0.206]	[0.109]	[0.16]	[0.393]	[.]	[0.299]
Neighbour's Source	0.018***	0.257***	0.439**	0.296***	0.075*	0.172***	0.227*	0.191**	0.227***	0.146***	0.246***	0.158***	0.132***	0.166***	0.243**
	[0.009]	[0.103]	[0.113]	[0.092]	[0.078]	[0.065]	[0.159]	[0.113]	[0.083]	[0.062]	[0.062]	[0.059]	[0.056]	[0.079]	[0.109]

Community Access	0.156***	0.177***	0.266***	0.198***	0.022***	0.366***	0.227***	0.143***	0.335***	0.245***	0.261***	0.159***	0.192***	0.552	0.199***
	[0.059]	[0.043]	[0.036]	[0.058]	[0.017]	[0.073]	[0.063]	[0.046]	[0.062]	[0.065]	[0.04]	[0.033]	[0.039]	[0.287]	[0.03]
Private Source	0.079***	0.266**	0.16***	..	0.106*	0.279	1.435	..	0.327*	0.052***	0.721	0.535	0.399	..	0.188*
	[0.05]	[0.127]	[0.077]	[.]	[0.117]	[0.318]	[0.801]	[.]	[0.143]	[0.044]	[0.4]	[0.37]	[0.268]	[.]	[0.133]
Others	..	0.296*	0.299*	..	0.001***	0.104***	..	0.194	0.601	0.481	0.143***	4.21*	1.372	..	0.204***
	[.]	[0.141]	[0.144]	[.]	[0.001]	[0.035]	[.]	[0.218]	[0.328]	[0.26]	[0.078]	[2.404]	[0.816]	[.]	[0.093]
Water Sufficiency (Ref: Yes)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
No	1.594	0.629*	1.161	0.863	0.353	0.421***	0.551*	0.595	1.055	1.606	0.526***	1.027	0.655*	0.531	2.606***
	[0.888]	[0.127]	[0.273]	[0.322]	[0.447]	[0.083]	[0.16]	[0.207]	[0.166]	[0.455]	[0.075]	[0.237]	[0.125]	[0.232]	[0.683]
Slum Status (Ref: Slum Household)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Non-Slum Household	1.359	1.514	2.237***	1.382	2.035	3.304***	4.576**	3.197**	1.749**	8.134***	4.03***	1.497*	1.594*	0.397	1.716**
	[0.398]	[0.333]	[0.475]	[0.485]	[1.624]	[0.493]	[2.134]	[1.137]	[0.308]	[1.947]	[0.468]	[0.241]	[0.293]	[0.447]	[0.351]
Dwelling Type (Ref: Independent House)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flat	2.093*	3.89***	4.365***	8.531**	0.336	3.554***	9.449***	4.306***	5.9***	4.061***	4.183***	4.123***	3.042***	..	3.579***
	[0.71]	[1.124]	[0.93]	[6.459]	[0.349]	[0.678]	[5.137]	[1.56]	[1.525]	[1.523]	[0.698]	[0.915]	[0.975]	[.]	[0.622]
Others	1.298	0.39***	0.712	1.564	0.077**	0.658**	0.899	0.665	0.851	0.539*	0.433***	0.646	1.177	0.877	0.243***
	[0.514]	[0.096]	[0.124]	[0.373]	[0.067]	[0.1]	[0.37]	[0.188]	[0.148]	[0.163]	[0.073]	[0.159]	[0.449]	[0.729]	[0.056]
House Condition (Ref: Good)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Satisfactory	0.316*	0.445***	0.402***	0.346***	0.975	0.515***	0.524*	0.406***	0.487***	0.344***	0.302***	0.517***	0.407***	0.604	0.496***
	[0.165]	[0.088]	[0.054]	[0.074]	[1.413]	[0.085]	[0.15]	[0.1]	[0.077]	[0.076]	[0.036]	[0.091]	[0.079]	[0.334]	[0.069]
Bad	0.146***	0.211***	0.212***	0.202***	0.138	0.271***	0.105***	0.126***	0.215***	0.099***	0.14***	0.186***	0.107***	0.181**	0.33***
	[0.079]	[0.061]	[0.036]	[0.055]	[0.201]	[0.051]	[0.042]	[0.046]	[0.05]	[0.029]	[0.029]	[0.045]	[0.036]	[0.104]	[0.084]
N	1056	1701	4160	1242	618	3411	834	1045	2420	2012	3894	2902	2064	1609	2856
pseudo R-squared	0.497	0.455	0.432	0.402	0.709	0.368	0.517	0.556	0.461	0.550	0.502	0.550	0.543	0.339	0.505

Note: Robust Standard Error in square bracket[]; Reference group in parantheses (); * p<0.05, ** p<0.01, *** p<0.001

Source: National Sample Survey Data, 2012. Author's Analysis.

The logit regression analyses yield some interesting findings. All of the states have significant[xxiv] logistic regressions with pseudo-R^2 ranging from 0.339 to 0.709.[xxv] On checking for specification bias of the models it was found that it existed for only one state – Odisha.[xxvi] However, the use of an alternative model, dropping house condition, dwelling unit type and slum status of household variables, resulted in specification bias of four states – Uttar Pradesh, Maharashtra, Andhra Pradesh and Tamil Nadu. The impact of every variable for all the states has been explained in detail in an attempt to highlight the relative importance of different variables in explaining access to toilets.

The logistic regressions were run for the 15 states separately, all of which were significant with varying pseudo-R^2s. The predictors included one continuous variable (*MPCE/100*) and several categorical variables. The results are as expected. Some predictors yielded significant results for access to toilets for some states while the coefficients/odds ratios were not significant for some states.

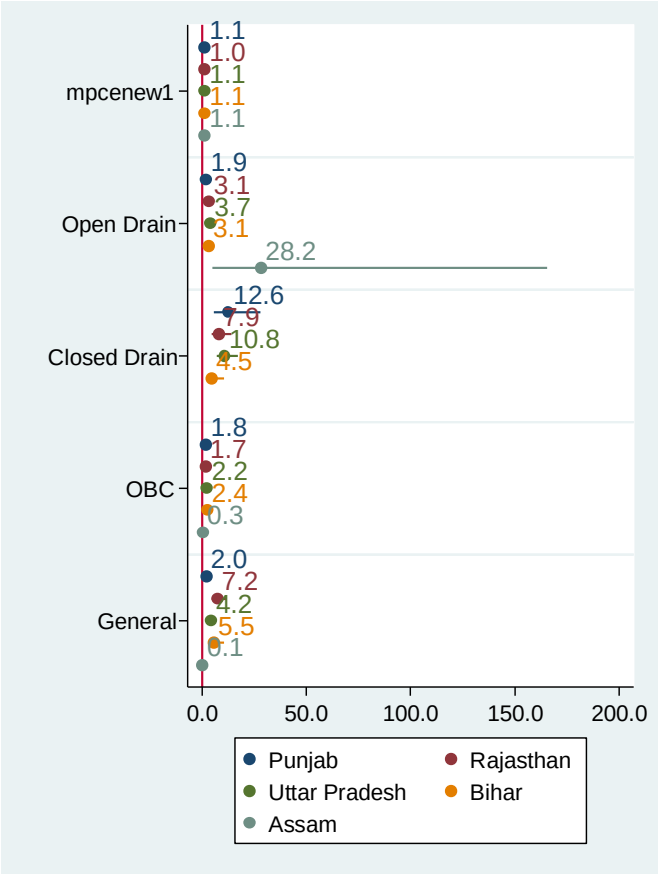
MPCE/100 as a predictor which represents the consumption behaviour of a given household is a significant predictor for almost all of the 15 states at 99.9% confidence interval ($p<0.001$) except Assam and Kerala. It was found that for an increment of Rs 100 in the consumption expenditure of a given household in the 15 states the odds ratio ranges between 1.03 to 1.12 against 1 (odds ratio for reference condition of no increment in MPCE). The highest odds ratio is for Madhya Pradesh and the lowest is for Maharashtra. Alternatively interpreted, it means that the odds of a household owning a toilet increase by a minimum of 3 per cent and a maximum of 12 per cent for Rs 100 increase in its MPCE of the odds of households without toilets.

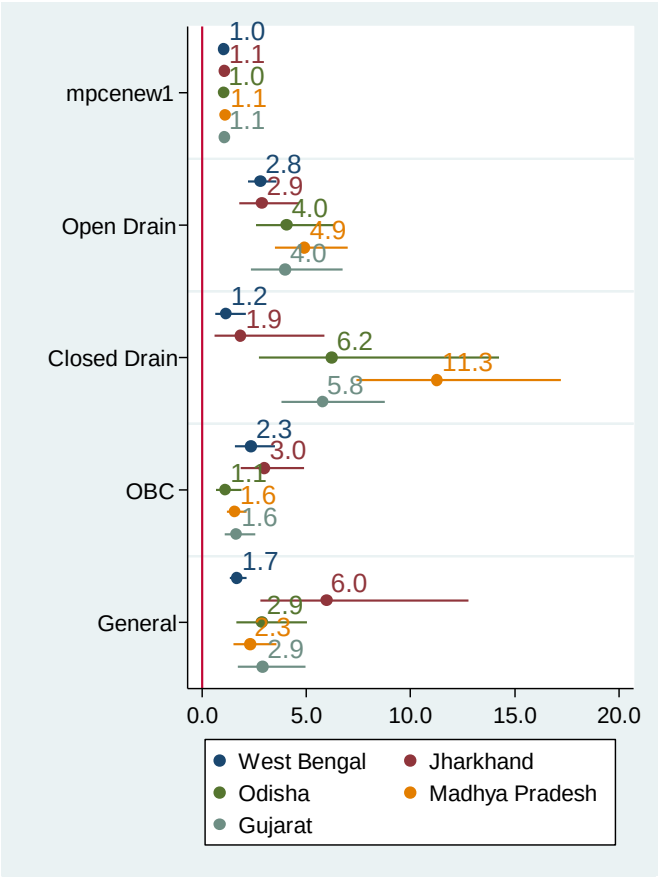
For drainage, with three categories of no drains, open drains and closed drains, the odds ratios are significant for most of the states. The 'no drains' condition has been taken as the reference category (OR base 1) and the odds ratios for the states have been assessed for households with access to open drains and closed drains. It was found that for households connected to open drains, the odds ratios for all the states were significant except those for Punjab. For households with access to open drains, the odds of a household with toilets are 62 per cent (minimum given by Maharashtra) and 2723 per cent (maximum given by Assam[xxvii]) more than the odds of households without toilets. While the odds ratio for a household with open drains is greater than 2 for most of the states, for states which are largely water scarce, such as Rajasthan and Gujarat, the odds ratios for open drains are 3.14 and 3.98 times the odds of no drains. For closed drains the odds ratios for households are even more than those for open drains and the results are significant at 99.9% confidence interval for 11 out of 15 states. The odds ratios for households with access to closed drains range from 4.238 (Maharashtra) to 12.567 (Punjab) times the households with no access to drainage. This corroborates the presumption that the availability of public infrastructure of drains would incentivise households to have toilets.

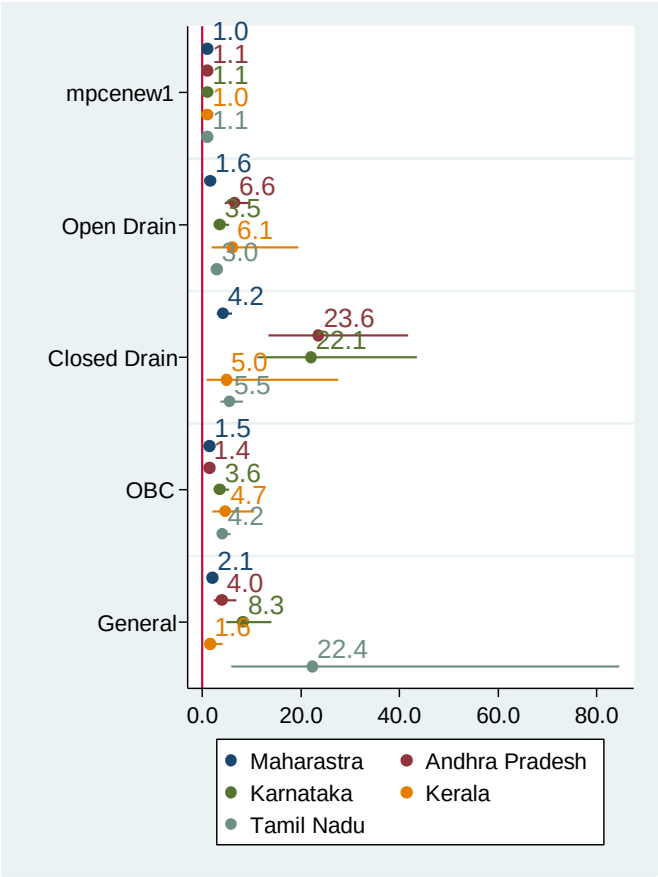
Similarly, the odds ratios for households with different caste statuses has also been computed. It is seen that the odds ratio for households belonging to OBC are 1.47 (minimum for Maharashtra) to 4.702 (maximum for Kerala) times the odds ratio of SC/ST households taken as the reference. For the General category, the odds are fairly high. With 14 out

of 15 states having significant odds ratios it is seen that the odds ratio for General caste households vary from 1.993 times (Punjab) to 22.373 times (Tamil Nadu) of the SC/ST households. This shows varying levels of caste-based disparities in different states. In states like Rajasthan and Karnataka the caste-based discrepancies relating to access to toilets are very high, which is evident from the high odds ratios of 7.242 and 8.264 against SC/ST households. In most of the states the odds ratios are high for General caste households compared to SC/ST or OBC households.

Figure 2: State-wise odds ratios for MPCE/100, drainage and caste status




mpcenew1
Open Drain
Closed Drain
OBC
General
1.0
1.1
1.0
1.1
1.1
2.8
2.9
4.0
4.9
4.0
1.2
1.9
6.2
11.3
5.8
2.3
3.0
1.1
1.6
1.6
1.7
6.0
2.9
2.3
2.9
0.0
5.0
10.0
15.0
20.0
West Bengal
Jharkhand
Odisha
Madhya Pradesh
Gujarat


mpcenew1
Open Drain
Closed Drain
OBC
General
1.0
1.1
1.1
1.0
1.1
1.6
6.6
3.5
6.1
3.0
4.2
23.6
22.1
5.0
5.5
1.5
1.4
3.6
4.7
4.2
2.1
4.0
8.3
1.6
22.4
0.0
20.0
40.0
60.0
80.0
Maharastra
Andhra Pradesh
Karnataka
Kerala
Tamil Nadu

Note: "mpcenew1" represents the variable MPCE/100. "Open Drain" and "Closed Drain" represent the Drainage Status Variable for which the reference category is No Drain. "OBC" (Other Backward Classes) and "General" represent the Caste Status variable and the reference category for them is SC/ST (Scheduled Caste/Scheduled Tribe).
Source: National Sample Survey Data. Author's Analysis.

Figure 2 depicts the different odds ratios for the 15 states considered for the study. It is evident that in all the states the independent variables as shown here – MPCE/100 (mpcenew1), drainage status (with no drains taken as reference) and caste status (with SC/ST taken as reference) – affect the access to toilets to varying degrees. The odds ratio for MPCE/100 varies marginally since an increment of Rs 100 is considered. However, for drainage and caste status the odds ratios vary quite considerably. For example, the odds ratios for households with access to open drains and closed drains in Bihar relative to no drains are 3.1 and 4.5 respectively, compared to Maharashtra where the concurrent figures are 1.6 and 4.3. Similarly, for caste the odds ratios vary for OBC and General households relative to SC/ST households to different degrees for the considered states.

For drinking water supply the odds ratios for households with improved supply are compared to households with unimproved water supply. The results are fascinating. For eight states – Punjab, Bihar, Assam, Jharkhand, Madhya Pradesh, Gujarat, Andhra Pradesh and Karnataka – the odds ratios are less than 1 for households with unimproved water source (relative to the reference, which is household with improved drinking water). This means for these states the likelihood of households owning toilets is more when they have an improved water source. However, for the other states like Maharashtra, Uttar Pradesh, Kerala, Odisha and so on, the odds ratio is greater than 1 for households with unimproved drinking water sources. It is to be noted that a very low percentage of households have access to unimproved drinking water in urban areas. Similarly, for the water sufficiency variable (whether households have sufficient water for basic needs) which gives categorical information of yes or no, the odds ratios which were significant for a few states were mostly high for households with sufficient water. However, in Tamil Nadu and a few other states the odds ratios were high for households with insufficient water which can probably be explained by the general water scarcity in the region.

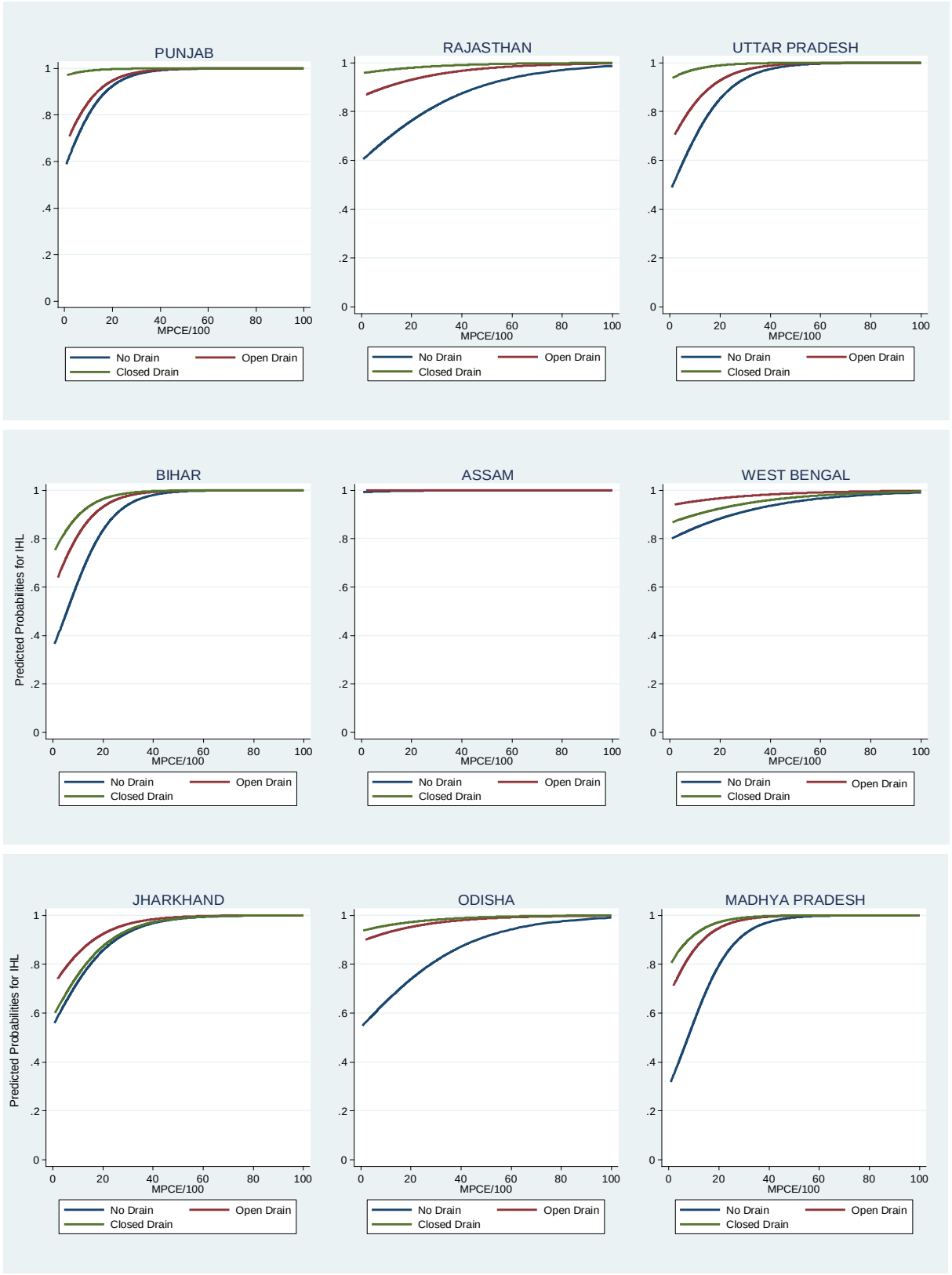
We are familiar with disproportionate provision of services in cities for slums and non-slum households. When the slum status of a household is taken into the equation 10 out of the 15 results are significant. For the non-slum households the odds ratios are quite high, ranging from 1.497 (in Andhra Pradesh) to 8.134 (in Gujarat) times households in slums. Bihar, Jharkhand, Odisha, Madhya Pradesh and Maharashtra have among the highest odds ratios for non-slum households against slum households, displaying greater disparities in allocation of resources and accordingly likelihood of households owning toilets. Gujarat and Maharashtra, which are amongst the most urbanised states in India, register 5 and 3 per cent jumps in pseudo-R^2 after the inclusion of slums in the logistic equation and exhibit the most disparities in access to toilets between slum and non-slum households.

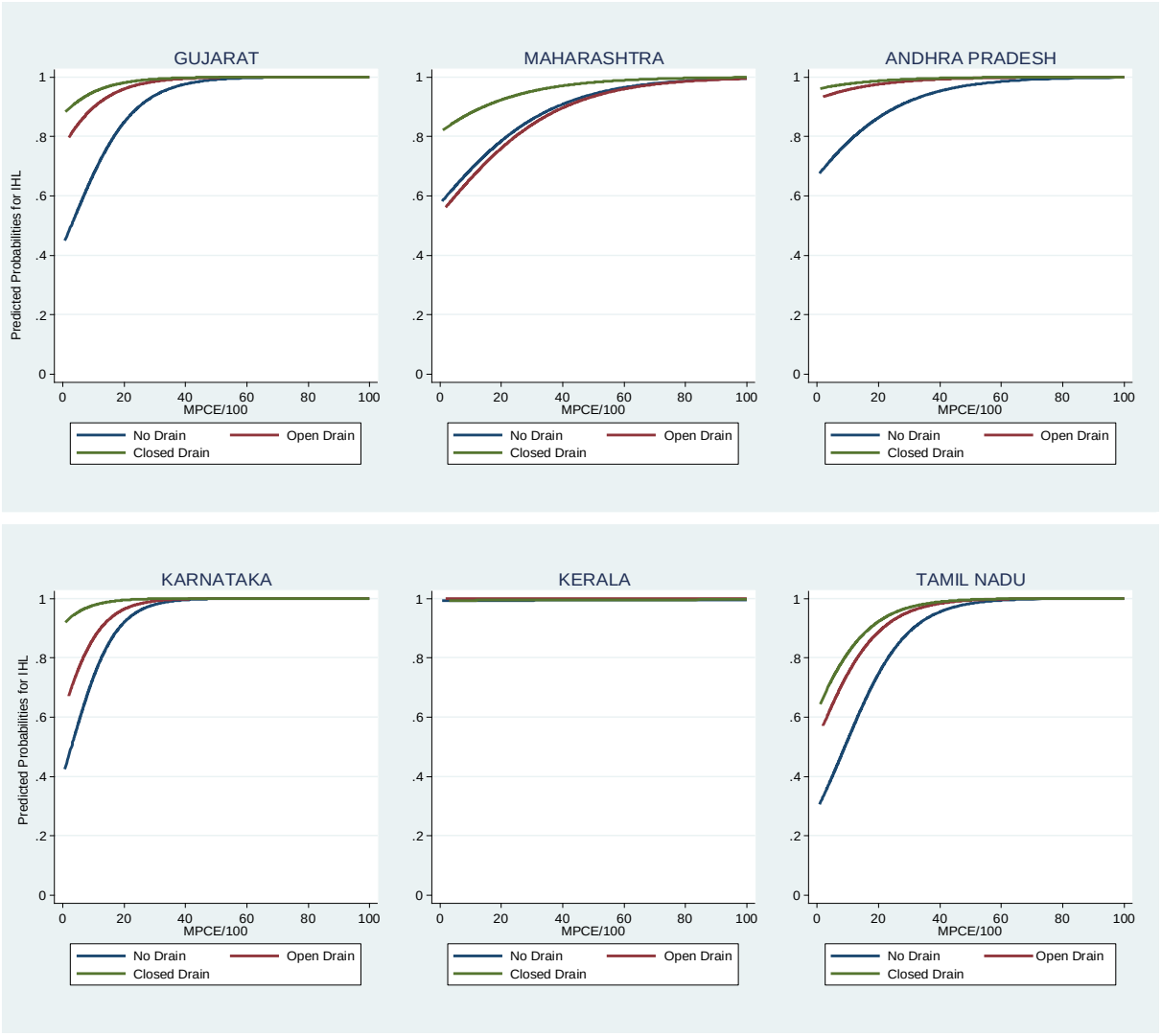
The dwelling type and housing conditions of individual houses have also been included in the model and they yield significant results for most of the states. As it turns out, these two variables explain much of the variance for Maharashtra, Rajasthan and Tamil Nadu (8, 7 and 6 per cent of the R^2 respectively). The households with independent houses have been taken as the reference for the dwelling type variable and the odds ratios for the states are greater for flats and lower for others. For the housing condition variable where 'good' households have been taken as the reference, satisfactory and poor households have lower odds ratios.[xxviii]

In the analysis of predictive variables and their respective impacts on access to toilets in different states the key finding has been that they have varying effects in the states. This is evident from the varying odds ratios for different categories of the predictor variables for different states. For example, slum-related disparities in access to toilets are more acute in Maharashtra and Gujarat. Caste-related disparities in access to toilets are more pronounced in Tamil Nadu and Bihar. Punjab, Madhya Pradesh, Andhra Pradesh and Karnataka show the highest increase in pseudo-R^2 by the inclusion of MPCE in the logistic regression equation. Water sufficiency is an important predictor of Rajasthan. While the disparities in access to toilets are clear from simple tables in different states, it is only by the inclusion of relevant predictors in the logistic model that the degrees of disparities for different parameters become clear.

In an alternative portrayal of the results to show the variation in predicted probabilities for IHL=1 for different categories in the drainage status and caste status a list of graphs have been generated, as shown in Figure 3 and Figure 4 respectively. Figure 3 gives the predicted probability for IHL=1 on the Y-axis and MPCE/100 (MPCE in hundreds) on the X-axis to show the interaction between drainage and consumption expenditure. The findings are quite interesting. It can be observed that the predicted probabilities for IHL=1 for every drainage condition converge at a higher MPCE, the levels of convergence (where P(IHL=1|Drainage=No Drain), P(IHL=1|Drainage=Open Drain) and P(IHL=1|Drainage=Closed Drain) are equal to 1) and the levels of predicted probability for different drainage status are different for different states. Consider Madhya Pradesh: at zero MPCE the predicted probabilities for IHL=1 for no drains, open drains and closed drains are 0.3, 0.7 and 0.8 approximately. The probabilities converge to 1 for all drainage cases at MPCE=7000 (or mpcenew1 which is the variable representing MPCE/100=70). Similar trends are seen in most of the states chosen for the study where different drainage statuses have different predicted probabilities for a household with a toilet and the predicted probabilities converge at a certain MPCE. Evidently, some states do not exhibit much difference in their predicted probabilities for different drainage conditions which reflects a lesser degree of disparities in access to toilets for different levels of services and consumption expenditure. Assam and Kerala show the least disparities in predicted probabilities in access to toilets for different drainage conditions.

Figure 3: State-wise predicted probabilities for different drainage conditions



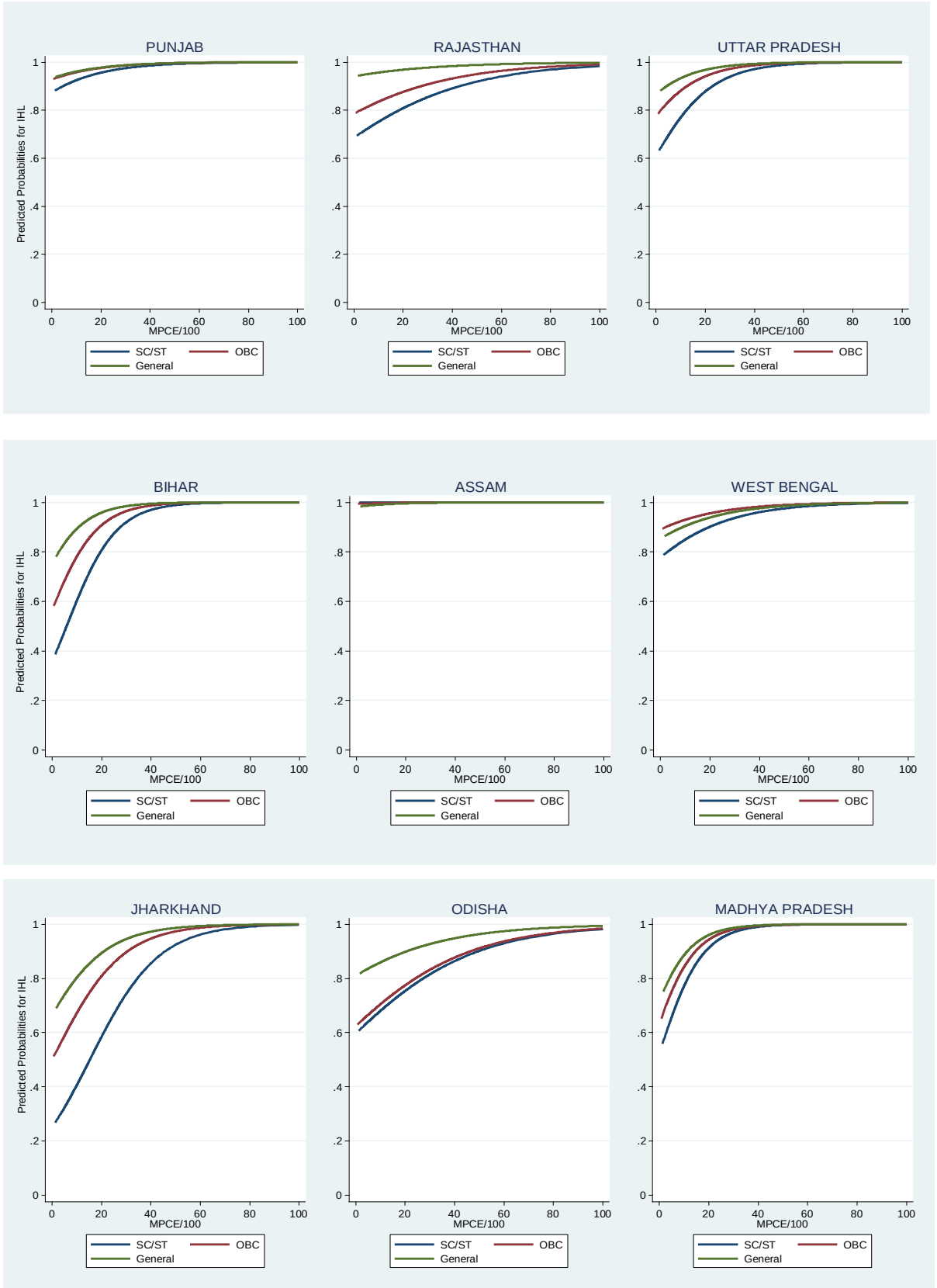


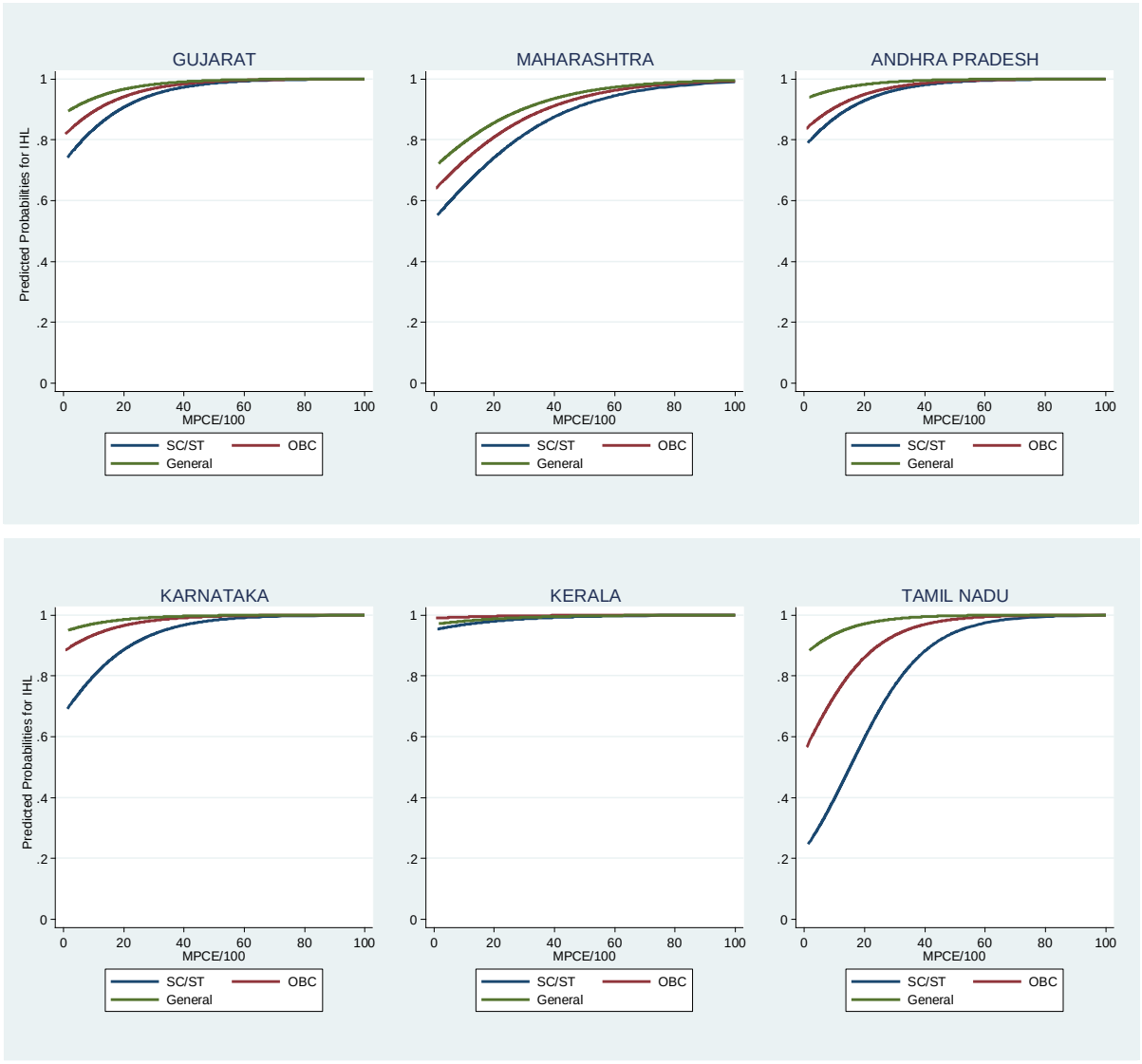
Note: The x-axis represents the predicted probabilities of households owning in-house latrines (IHL) The y-axis represents the Monthly per Capita Income of households in hundreds (MPCE/100)
Source: National Sample Survey Data, 2012. Author's Analysis.

Graphs of predicted probabilities similar to the previous table have been generated to check the levels of caste-based discriminations in different states. From the graphs of predicted probabilities for different castes in the 15 states presented in Figure 4 it is evident that probabilities differ the most in Tamil Nadu followed by Jharkhand and Bihar. In Tamil Nadu access to toilets exhibits a lot of variation across caste groups. It is seen that for SC/ST the predicted probability to own a toilet when MPCE=0 is a meagre 0.3 compared to 0.6 for an OBC household and 0.9 predicted probability of a General household. With increase in MPCE the predicted probabilities of all caste groups increase differentially and converge when MPCE is around Rs 8000. In Rajasthan, Odisha and Maharashtra the average predicted probabilities for SC/ST, OBC and General households do not differ as significantly as in Tamil Nadu or Bihar at a lower consumption level; however, the predicted probabilities converge at a higher consumption level around Rs 10000 MPCE. Caste-based deprivation of toilets is the least in Kerala, Assam, Punjab and West Bengal. These

findings corroborate the exclusionary nature of the hierarchical caste system in India which causes deprivation of resources and services.

Figure 4: State-wise predicted probabilities for caste status

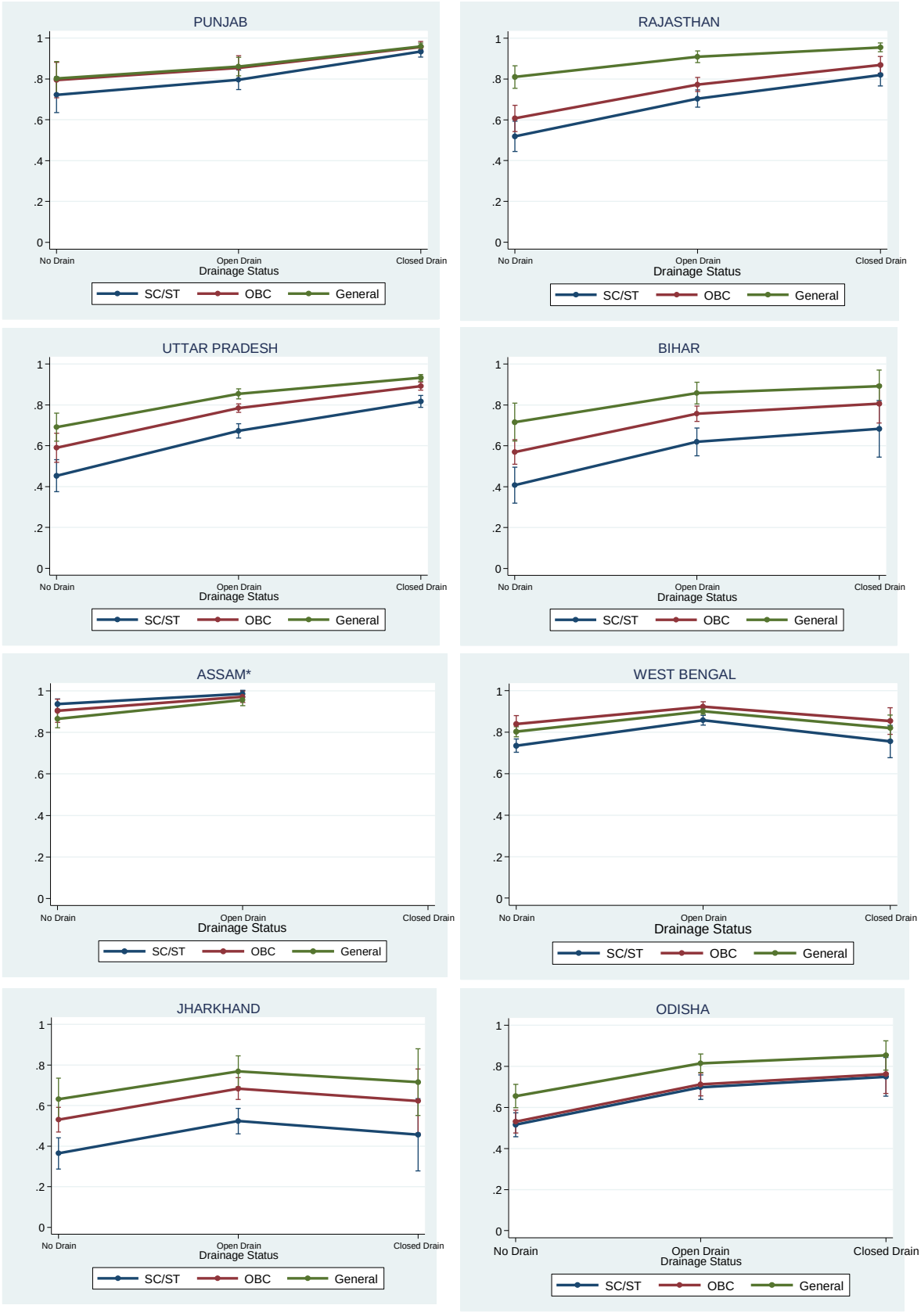


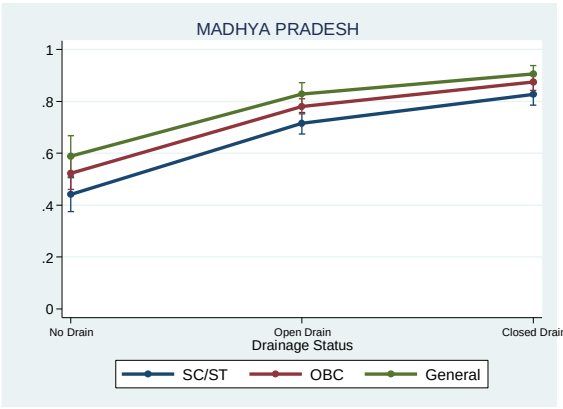


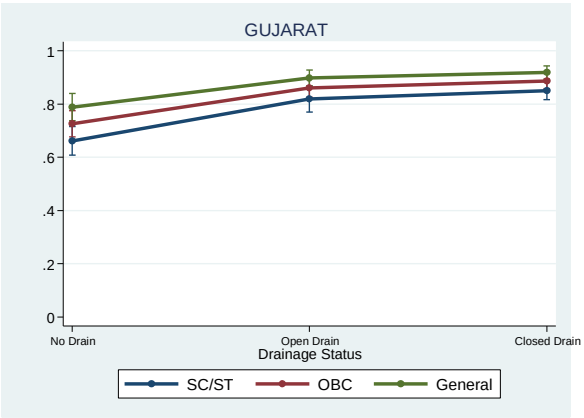
Note: The x-axis represents the predicted probabilities of households owning in-house latrines (IHL) The y-axis represents the Monthly per Capita Income of households in hundreds (MPCE/100)
Source: National Sample Survey Data. Author's Analysis.

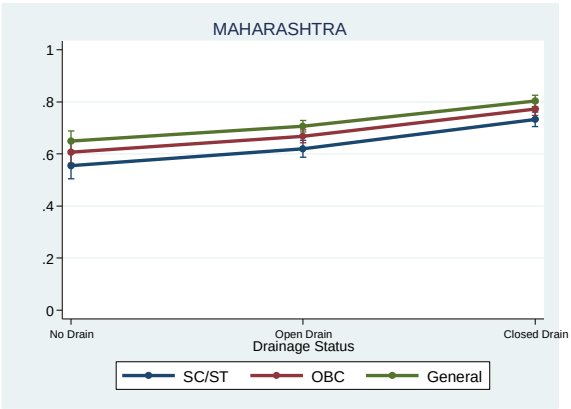
The predicted probabilities graphs for different drainage statuses and caste groups validate the premise of layered disparities in access to toilets in India. These graphs help gauge the degrees of disparities in access to toilets that can be associated with different parameters. The predicted probabilities for different service levels (drainage infrastructure) or caste groups, in fact, substantiate the impact of consumption behaviour (taken as proxy for income) on access to toilets. They also reveal how the disparities are eventually mitigated with increase in consumption expenditure, manifested in the convergence of the predicted probability curves for different categories with increase in consumption. Suffice it to say that both vertical and horizontal inequalities significantly affect the access to toilets. Hence, the presumptions of deprivation in toilets and sanitation being caused primarily by financial and technical constraints are unfounded in the light of the gamut of horizontal inequalities that too offer considerable impediment.

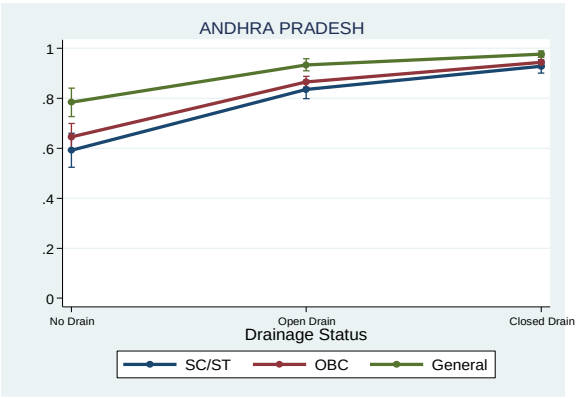
Figure 5: State-wise predicted margins for drainage and caste interactions at state median MPCE

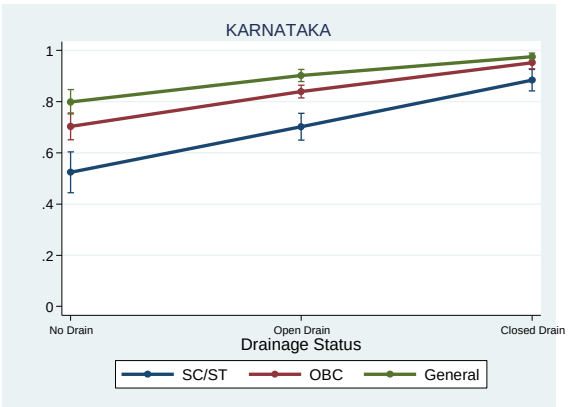


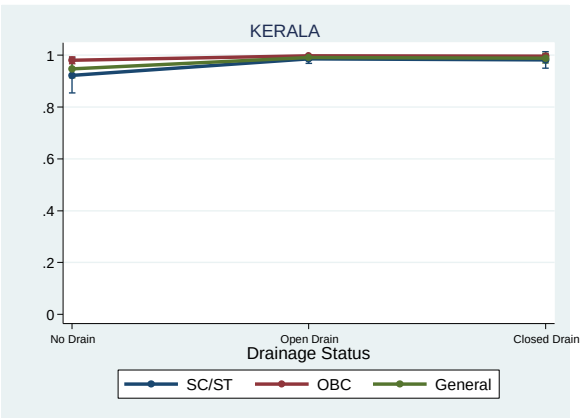


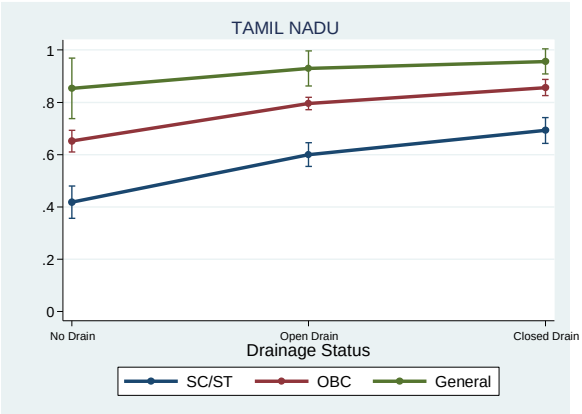












Note: Pr(ihl) on X-axis denotes predicted probability of the households owning an in-house latrine (IHL) *Assam has no predicted probability for IHL due to inadequacy of data

Source: National Sample Survey Data, 2012. Author's Analysis.

The fact that drainage and social stratification parameters in the state regressions yield significant results and are not dropped means that they are uncorrelated. This facilitates the exploration of the interactive effect of drainage infrastructure and social group on access to toilets. For this purpose predictive margins[xxix] for different combinations of drainage and caste categories have been generated for the considered states at their respective median MPCE. Figure 5 gives the predictive margins for interactive combinations of drainage and caste for the considered states. Different states exhibit different combined effects of drainage and caste on access to toilets. Rajasthan, Uttar Pradesh, Bihar, Odisha, Madhya Pradesh, Andhra Pradesh and Tamil Nadu show high drainage-based disparities in the likelihood of access to toilets at their median MPCEs.[xxx] Rajasthan, Uttar Pradesh, Bihar, Jharkhand, Odisha, Karnataka and Tamil Nadu have high caste-based disparities in access to toilets. The interactive effect of drainage and caste is noticed in the converging lines for different caste groups with improvement from no drainage to closed drainage. In other words, the SC/ST and OBC lines are more slanted than the General caste group lines for some states, showing an improvement in the likelihood of access to toilets for the lower caste groups with improvement from no drainage to closed drainage. This means that at a fixed median MPCE level an improvement in drainage infrastructure not only increases the access to toilets but also reduces caste-based disparities in states like Rajasthan, Andhra Pradesh, Karnataka and Tamil Nadu.

POLICY IMPLICATIONS AND CONCLUSION

The findings of this analysis validate the association of disparities in access to toilets with economic, behavioural and social factors. They buttress anthropological and anecdotal evidence on gaps in opportunities to own toilets induced by social fragmentation and infrastructure gaps along with the economic condition of households. The capability of a household to own a basic private good, a toilet, is defined not only by pecuniary factors but also by several other factors effected by social conditions, household behaviour, residential parameters and, most importantly, access to certain incentivising public services. There is an indispensable need to address these parameters in the policies and development programmes designed for sanitation development.

The inadequacy of sanitation services in India has been a much debated issue, domestically and internationally. Goal 6 of the Sustainable Development Goals[xxxi] prescribed by the United Nations and the current initiatives of the Government of India resonate the efforts to improve sanitation services. While the ongoing Swachh Bharat Mission (SBM) – Gramin (Rural) and Urban – has been focusing on providing subsidies to households to build in-house toilets, it does not target building public infrastructure which would certainly yield benefits in the form of externalities, and hence larger benefits in the long run (Lama-Rewal *et al*., 2011). Other centralised programmes – Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Smart City Programme and Clean Ganga – and state government initiatives that target urban infrastructure development have a small share of expenditure allocated for capital intensive sewerage and drainage infrastructure. The overall improvement of the water and sanitation sector in India would necessitate innovation in low-cost technologies for sanitation to cater to the predominant on-site systems like

septic tanks and improved pit latrines[xxxii] and the increasing reliance on them in constrained urban spaces because of rural–urban migration (Mara and Alabaster, 2008; Larsen *et al.*, 2009; Satterthwaite *et al.*, 2015).

Further, studies have emphasised the need for a paradigm shift from centralised policies to decentralised policies, giving due consideration to different political, economic and social conditions in the states (Kundu *et al.*, 1999; Bagchi and Chattopadhyay, 2004). Decentralisation in the delivery of primary basic services, and especially water and sanitation services, to locally elected governments or community-based organisations can potentially augment the provision of these services (Keefer and Khemani, 2004). The policy lessons for the water and sanitation sector are in terms of promulgating the tenets of decentralisation by devolving more responsibilities to local elected representatives and by providing autonomy to state institutions to execute directives given through centralised advisories and policies.

Urban inequities have been rising sharply with changing urban dynamics due to rapid urbanisation and have impacted the availability of infrastructure and basic civic amenities in regions with different levels of development and in different size categories of urban agglomerations (Kundu *et al.*, 1999; Kundu, 2003; Khan, 2014). Continued exclusion of sections of society because of caste, class or political motive is detrimental to the overall infrastructure development of urban areas and exacerbates the problems of unequal economic and social opportunities (Dreze and Sen, 1995). Dreze, Sen and other sector proponents have emphasised the use of cash subsidies as an effective policy instrument, as a complement to and not substitute for large public infrastructure investments (Dreze and Sen, 2011). The sanitation sector in particular has ranked low on the priority order of public infrastructure investment to boost development and though there is an implicit acknowledgement of the right to sanitation under the right to life there has been a failure in attaining adequacy. There is an over-reaching merit in recognition of economic, social and spatial inequalities and patterns of marginalisation and subsume them into policy efforts to universalise sanitation services (Winkler *et al.*, 2014). The enthusiasm engendered by the national and state efforts will translate into an improvement in sanitation indicators, and concurrently living standard indicators, by ushering a reform agenda to address any form of discrimination as well as dovetailing of efforts undertaken in different programmes.

NOTES

[i] The WHO-UNICEF Joint Monitoring Programme (JMP) has defined improved water sources to include piped water into dwelling, piped water to yar/plot, public tap or standpipe, tubewell or borehole, protected dug well, protected spring and rainwater.

[ii] Improved sanitation as defined by JMP: flush toilet to piped sewer system or septic tank, flush/pour flush to pit latrine, ventilated improved pit latrine (VIP), pit latrine with slab, composting toilet.

[iii] The first UN Human Rights Council resolution to affirm the right to water and sanitation as legally binding was passed in September 2010.

[iv] Vertical inequalities mean inequalities pertaining to income, consumption and wealth. Horizontal inequalities refer to group inequalities based on socio-economic parameters such as caste, religion, access to infrastructure, spatial/regional differences and so forth.

[v] Glenn Loury contended that differential access to quasi-public resources to affiliational groups exacerbates inequalities in society (1987). His research was on differential access of education among whites and blacks in USA. This resonates the concept given by Joseph Stiglitz which associates a certain "privateness" to a local public good; when within a community that collectively demands it the good is public, and between communities it is a private good (1977, 1980).

[vi] Public goods are both non-rivalrous and non-excludable, while club/quasi-public goods are non-rivalrous but excludable, that is, group-wise discrimination exists in the provision of these services

[vii] Chhibber and Nooruddin (2004) argue that the states with a multi-party system in India uses the plurarity of the voting system to mobilise smaller segments by providing club goods instead of public goods. Their research is on the investment of different state governments in development expenditure (public goods) and salaries (club goods). They found states with multiple parties spent more on club goods and those with two parties spent more on public goods.

[viii] Only 45 per cent of urban households discharge waste water into closed drains (no distinction has been provided between underground sewer lines and closed storm water drains). 37 per cent discharge waste water into open drains and 18 per cent of urban households do not have access to drainage for waste water disposal (Census 2011).

[ix] The treatment capacity of STPs is 32 per cent in Class I towns (including metropolitan cities) and 8 per cent in Class II towns. These STPs are meant only for toilets connected to piped sewers which account for 33 per cent of urban households.

[x] Caste refers to a hereditary or ascriptive form of stratification that forms a hierarchical order in any society; membership in a caste is by birth and does not change by change in income, occupation or employment status (Beteille, 2007; Vaid, 2012). The Constitution of India recognises the Scheduled Castes (SCs), Scheduled Tribes (STs), Other Backward Classes (OBCs) as 'backward' communities; others fall into the General category.

[xi] The rural survey blocks designed are called First Stage Units (FSUs) while the urban survey blocks are called Urban Frame Survey (UFS) units.

[xii] Each state/union territory is divided into several NSS regions and these regions comprise different districts of the respective states.

[xiii] A position paper by the Department of Economic Affairs, Ministry of Finance, on the water and sanitation sector highlights that the state share of investment in this sector increased from 33 per cent in the 10th plan to 67 per cent in the 11th plan.

[xiv] Although the response code for this category is 'no latrine' it is inferred that these households practise open defecation.

[xv] Since the reference period for the consumption expenditure of every household is 30 days the monthly per capita expenditure of every surveyed household has been computed by the following formula:

$$MPCE = \frac{Total\ Expenditure\ of\ Household}{Household\ Size}$$

[xvi] Statutory Towns are administratively declared urban areas by the state laws and include municipal corporations, municipalities, notified area councils and so on. Census Towns are settlement units classified as urban areas by the Registrar General of India (RGI), as part of the Census process, if they fulfil three urban characteristics, viz. population (population is at least 5,000), density (at least 400 persons per square kilometre) and occupation (at least 75 per cent of the male population is in the non-farm sector). The CTs are thus categorised as urban areas despite rural governance.

[xvii] *Environmental sanitation* is the broader definition enshrined in the NUSP and it includes safe management of human excreta, including its safe confinement treatment, disposal and associated hygiene-related practices; solid waste management; generation of industrial and other specialized/hazardous wastes; drainage; and also the management of drinking water supply.

[xviii] Northern and Central States – Punjab, Uttar Pradesh and Madhya Pradesh; Eastern States – Bihar, Assam, West Bengal, Jharkhand and Odisha; Western States – Rajasthan, Gujarat and Maharashtra; Southern States – Andhra Pradesh, Karnataka, Kerala and Tamil Nadu

[xix] Several two-sample student's t-test were run as a hypothesis testing to validate the significance of differences of MPCE of households with and without IHL for different drainage conditions. Results were not significant for Assam for all three drainage statuses and for Kerala for open and closed drains.

[xx] Households with toilets in premises or a building for shared use (excluding public toilets and other facilities) are coded 1 and households without them are coded 0.

[xxi] Housing condition is preferred over the structure since it represents the perceived behaviour of the household with regard to the structure.

[xxii] Logistic regression (alternatively logit equation with an option for odds ratio) generates odds ratios instead of coefficients.

[xxiii] The logic is similar for continuous variable – MPCE/100.

[xxiv] $p<0.001$ for all the individual state regressions.

[xxv] The logistic regression in Stata yields McFadden's pseudo-R^2. This essentially means that all of the regression equations have taken into account an adequate number of predictive covariates, thereby preventing any loss in power of the model.

[xxvi] It was noted that dropping the variables house condition, dwell type and slum status from the regression model for Odisha resulted in a significant model with a pseudo-R^2 of 0.5005 and no specification bias. This suggests that in Odisha the individual house condition doesn't influence access to toilets as much as public infrastructure as drainage or drinking water supply or consumption expenditure of the household.

[xxvii] For Assam, even though the odds ratio of 28.63 is significant, it is primarily because almost 99 per cent of the households with access to open drains have toilets.

[xxviii] Where the good category means that the houses are not in immediate need of any repair and poor category houses require urgent repair.

[xxix] The predictive margins generate probabilities of households owning a toilet and in this particular case probabilities for different combinations of drainage infrastructure and social groups.

[xxx] West Bengal and Jharkhand don't have strictly upward sloping lines for different castes with improvement in drainage infrastructure because of a very high percentage of households with open drainage access and a very low percentage of households with closed drainage. In the plot for Assam, closed drainage is dropped because of multicollinearity.

[xxxi] Goal 6 of the Sustainable Development Goals by the UN encompass several targets pertaining to achieving univerals and equitable safe drinking water and sanitation for all by 2030.

[xxxii] 38 per cent and 6 per cent respectively in urban areas (Census 2011).

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APPENDIX

Table A1: State-wise access to drains and toilets

State	No Drains			Open Drains			Closed Drains			Total
	No Toilets	In-House Toilets	Total	No Toilets	In-House Toilets	Total	No Toilets	In-House Toilets	Total	
Punjab	35492 (20%)	142101 (80%)	177593 [8%]	105289 (15%)	582122 (85%)	687411 [30%]	14241 (1%)	1404213 (99%)	1418454 [62%]	2283458 [100%]
	{46}	{78}	{124}	{90}	{239}	{329}	{20}	{583}	{603}	{1509}
Rajasthan	238521 (50%)	241677 (50%)	480198 [14%]	293211 (17%)	1382761 (83%)	1675972 [49%]	45057 (4%)	1215161 (96%)	1260218 [37%]	3416388 [100%]
	{174}	{105}	{279}	{184}	{695}	{879}	{26}	{517}	{543}	{2859}
Uttar Pradesh	238936 (65%)	131203 (35%)	370139 [5%]	656318 (19%)	2783388 (81%)	3439706 [42%]	140062 (3%)	4263109 (97%)	4403171 [54%]	8213016 [100%]
	{204}	{61}	{265}	{516}	{1587}	{2103}	{127}	{1673}	{1800}	{6536}
Bihar	161490 (56%)	125654 (44%)	287144 [15%]	229223 (19%)	949047 (81%)	1178270 [63%]	12401 (3%)	405291 (97%)	417692 [22%]	1883106 [100%]
	{175}	{115}	{290}	{182}	{630}	{812}	{10}	{136}	{146}	{2350}
Assam	16315 (8%)	180285 (92%)	196600 [28%]	333 (0%)	456708 (100%)	457041 [65%]	0 (0%)	45905 (100%)	45905 [7%]	699546 [100%]
	{46}	{230}	{276}	{5}	{453}	{458}	{0}	{22}	{22}	{1490}
West Bengal	558281 (29%)	1366184 (71%)	1924465 [30%]	182996 (5%)	3510977 (95%)	3693973 [57%]	30044 (4%)	797850 (96%)	827894 [13%]	6446332 [100%]
	{415}	{693}	{1108}	{171}	{1812}	{1983}	{17}	{318}	{335}	{6517}
Jharkhand	128508 (38%)	212734 (62%)	341242 [26%]	101297 (13%)	696845 (87%)	798142 [61%]	10572 (6%)	166827 (94%)	177399 [13%]	1316783 [100%]
	{198}	{82}	{280}	{124}	{375}	{499}	{9}	{50}	{59}	{1617}
Odisha	228946 (55%)	190282 (45%)	419228 [30%]	37341 (6%)	599487 (94%)	636828 [45%]	4043 (1%)	359162 (99%)	363205 [26%]	1419261 [100%]
	{307}	{149}	{456}	{60}	{335}	{395}	{7}	{198}	{205}	{1907}
Madhya Pradesh	216850 (62%)	134514 (38%)	351364 [8%]	345125 (19%)	1449998 (81%)	1795123 [43%]	91673 (4%)	1959288 (96%)	2050961 [49%]	4197448 [100%]
	{273}	{105}	{378}	{280}	{823}	{1103}	{60}	{879}	{939}	{3901}
Gujarat	297517 (53%)	266755 (47%)	564272 [10%]	169292 (25%)	519851 (75%)	689143 [12%]	128523 (3%)	4455635 (97%)	4584158 [79%]	5837573 [100%]
	{233}	{150}	{383}	{64}	{247}	{311}	{83}	{1235}	{1318}	{2706}
Maharashtra	393023 (53%)	349175 (47%)	742198 [7%]	1918468 (51%)	1865788 (49%)	3784256 [36%]	602733 (10%)	5400015 (90%)	6002748 [57%]	10529202 [100%]
	{225}	{116}	{341}	{716}	{905}	{1621}	{220}	{1712}	{1932}	{5856}
Andhra Pradesh	354747 (58%)	251972 (42%)	606719 [8%]	221289 (7%)	2841510 (93%)	3062799 [38%]	109085 (3%)	4204530 (97%)	4313615 [54%]	7983133 [100%]

	{265}	{137}	{402}	{171}	{1146}	{1317}	{42}	{1141}	{1183}	{4621}
Karnataka	243400 (46%)	284720 (54%)	528120 [9%]	405052 (16%)	2202630 (84%)	2607682 [43%]	36438 (1%)	2938892 (99%)	2975330 [49%]	6111132 [100%]
	{152}	{110}	{262}	{227}	{748}	{975}	{21}	{806}	{827}	{3301}
Kerala	33067 (5%)	694406 (95%)	727473 [30%]	3097 (0%)	1156073 (100%)	1159170 [48%]	5047 (1%)	548456 (99%)	553503 [23%]	2440146 [100%]
	{41}	{586}	{627}	{4}	{807}	{811}	{2}	{477}	{479}	{3355}
Tamil Nadu	743530 (49%)	789032 (51%)	1532562 [17%]	809207 (19%)	3477629 (81%)	4286836 [48%]	356218 (11%)	2777661 (89%)	3133879 [35%]	8953277 [100%]
	{332}	{185}	{517}	{408}	{1087}	{1495}	{80}	{764}	{844}	{4868}

Source: National Sample Survey Data, 2012

Note: Estimated number of households for every category. () gives percentage of households with or without toilets in every drainage category, respective drainage category for every state being 100%. [ ] gives percentage of drainage category for every state, state estimated number of households being 100%. {} gives number of samples for every category.

Table A2: State-wise access to toilets across consumption

States	Households without toilets										Households with toilets within premise or within building for shared use									
	Poorest Quintile		Second Quintile		Middle Quintile		Fourth Quintile		Richest Quintile		Poorest Quintile		Second Quintile		Middle Quintile		Fourth Quintile		Richest Quintile	
Punjab	98442 (122)		47216 (21)		287 (2)		5637 (7)		3440 (4)		360453 (290)		503118 (133)		370542 (84)		441138 (107)		428101 (275)	
	[64%]	{21%}	[30%]	{9%}	[0%]	{0%}	[4%]	{1%}	[2%]	{1%}	[17%]	{79%}	[24%]	{91%}	[18%]	{100%}	[21%]	{99%}	[20%]	{99%}
Rajasthan	202727 (1)		229489 (79)		94030 (31)		20989 (22)		29646 (20)		496773 (359)		537295 (174)		625959 (185)		521545 (229)		645890 (362)	
	[35%]	{29%}	[40%]	{30%}	[16%]	{13%}	[4%]	{4%}	[5%]	{4%}	[18%]	{71%}	[19%]	{70%}	[22%]	{87%}	[18%]	{96%}	[23%]	{96%}
Uttar Pradesh	524906 (612)		274249 (112)		175107 (64)		57803 (52)		3397 (8)		1115771 (1027)		1363718 (418)		1486356 (446)		1554720 (723)		1628207 (698)	
	[51%]	{32%}	[26%]	{17%}	[17%]	{11%}	[6%]	{4%}	[0%]	{0%}	[16%]	{68%}	[19%]	{83%}	[21%]	{89%}	[22%]	{96%}	[23%]	{100%}
Bihar	184431 (247)		123605 (67)		76763 (29)		12217 (17)		6098 (7)		192064 (247)		249943 (120)		325620 (128)		342817 (178)		358093 (205)	
	[46%]	{49%}	[31%]	{33%}	[19%]	{19%}	[3%]	{3%}	[2%]	{2%}	[13%]	{51%}	[17%]	{67%}	[22%]	{81%}	[23%]	{97%}	[24%]	{98%}
Assam	6628 (36)		6547 (6)		1810 (3)		898 (5)		765 (1)		132737 (290)		134903 (107)		135559 (68)		142636 (112)		133298 (124)	
	[40%]	{5%}	[39%]	{5%}	[11%]	{1%}	[5%]	{1%}	[5%]	{1%}	[20%]	{95%}	[20%]	{95%}	[20%]	{99%}	[21%]	{99%}	[20%]	{99%}
West Bengal	405344 (459)		176990 (69)		89885 (31)		90791 (34)		8311 (10)		888235 (895)		1129448 (329)		1132035 (318)		1206143 (460)		1239453 (761)	
	[53%]	{31%}	[23%]	{14%}	[12%]	{7%}	[12%]	{7%}	[1%]	{1%}	[16%]	{69%}	[20%]	{86%}	[20%]	{93%}	[22%]	{93%}	[22%]	{99%}
Jharkhand	133705 (237)		71505 (55)		2890 (11)		29985 (23)		2292 (5)		126188 (119)		190162 (72)		293359 (65)		214957 (106)		233359 (141)	
	[56%]	{51%}	[30%]	{27%}	[1%]	{1%}	[12%]	{12%}	[1%]	{1%}	[12%]	{49%}	[18%]	{73%}	[28%]	{99%}	[20%]	{88%}	[22%]	{99%}
Orissa	159251 (264)		73144 (58)		24454 (24)		10156 (18)		3325 (10)		125297 (130)		218145 (98)		254118 (135)		272828 (157)		277724 (161)	
	[59%]	{56%}	[27%]	{25%}	[9%]	{9%}	[4%]	{4%}	[1%]	{1%}	[11%]	{44%}	[19%]	{75%}	[22%]	{91%}	[24%]	{96%}	[24%]	{99%}
Madhya Pradesh	306986 (408)		214271 (138)		96759 (45)		35552 (18)		80 (4)		533810 (507)		612001 (319)		737378 (258)		831138 (362)		793040 (344)	
	[47%]	{37%}	[33%]	{26%}	[15%]	{12%}	[5%]	{4%}	[0%]	{0%}	[15%]	{63%}	[17%]	{74%}	[21%]	{88%}	[24%]	{96%}	[23%]	{100%}
Gujarat	404928 (319)		145064 (34)		36740 (16)		3329 (10)		5401 (2)		900897 (459)		1133825 (196)		923323 (225)		1190147 (424)		1055462 (320)	
	[68%]	{31%}	[24%]	{11%}	[6%]	{4%}	[1%]	{0%}	[1%]	{1%}	[17%]	{69%}	[22%]	{89%}	[18%]	{96%}	[23%]	{100%}	[20%]	{99%}
Maharashtra	1045415 (679)		839845 (221)		523185 (129)		469372 (108)		32801 (18)		1040288 (582)		1434415 (382)		1363803 (441)		1918956 (621)		1723914 (658)	
	[36%]	{50%}	[29%]	{37%}	[18%]	{28%}	[16%]	{20%}	[1%]	{2%}	[14%]	{50%}	[19%]	{63%}	[18%]	{72%}	[26%]	{80%}	[23%]	{98%}
Andhra Pradesh	345964 (347)		169871 (78)		87482 (31)		71640 (16)		10298 (7)		1199349 (626)		1409526 (318)		1454302 (335)		1440127 (567)		1533957 (554)	
	[50%]	{22%}	[25%]	{11%}	[13%]	{6%}	[10%]	{5%}	[2%]	{1%}	[17%]	{78%}	[20%]	{89%}	[21%]	{94%}	[20%]	{95%}	[22%]	{99%}
Karnataka	463337 (286)		178040 (77)		35280 (29)		8233 (8)		0 ()		748411 (435)		1025213 (347)		1175051 (315)		1179845 (301)		1187297 (245)	
	[68%]	{38%}	[26%]	{15%}	[5%]	{3%}	[1%]	{1%}	[0%]	{0%}	[14%]	{62%}	[19%]	{85%}	[22%]	{97%}	[22%]	{99%}	[22%]	{100%}
Kerala	24192 (41)		8233 (3)		3625 (1)		0 ()		5161 (2)		467162 (612)		474774 (207)		475115 (250)		484410 (361)		477690 (424)	
	[59%]	{5%}	[20%]	{2%}	[9%]	{1%}	[0%]	{0%}	[13%]	{1%}	[20%]	{95%}	[20%]	{98%}	[20%]	{99%}	[20%]	{100%}	[20%]	{99%}
Tamil Nadu	927233 (522)		545653 (126)		269775 (98)		151698 (60)		14482 (13)		877289 (375)		1234314 (243)		1501317 (368)		1593243 (528)		1758024 (498)	
	[49%]	{51%}	[29%]	{31%}	[14%]	{15%}	[8%]	{9%}	[1%]	{1%}	[13%]	{49%}	[18%]	{69%}	[22%]	{85%}	[23%]	{91%}	[25%]	{99%}
Total	5405847		3074888		1632694		6,77,011		1,62,360		9615352		11362101		12570316		13748558		13491947	
	[48%]	{36%}	[28%]	{21%}	[14%]	{11%}	[9%]	{7%}	[1%]	{1%}	[15%]	{64%}	[19%]	{79%}	[20%]	{89%}	[22%]	{93%}	[22%]	{99%}

Source: National Sample Survey Data, 2012

Note: The above table lists the estimated number of households from the selected states which either have toilets within premises or building for shared use or do not have toilets and practise open defecation. () gives the sample size for the corresponding cell. [] gives the percentage of households from each quintile for households which do not have toilets (100%) and which have toilets (100%). For example, for Punjab 64 per cent of the open defecation/households without toilets are from the poorest quintile, 30, 0, 4 and, 2 per cent from the second, middle, fourth and, richest quintiles respectively. {} gives the percentage of open defecation or households with in-house toilets from each quintile. For example, 21 per cent of households from the poorest quintile in Punjab do not have toilets, complementarily, 79 per cent of the poorest quintile have toilets.

Table A3: Cross-table for type of toilets in households against type of disposal of waste water in Urban India

Type of Toilets	Safe Reuse after Treatment	Untreated to Open Land	Untreated to Ponds	Untreated to River	Untreated to Drainage System	Untreated to Unknown	Untreated to Other Places	Missing	Total
Pour-Flush to Piped Sewer	6175 (0%)	618706 (2%)	29522 (0%)	26161 (0%)	23560335 (95%)	266654 (1%)	241093 (1%)	0 (0%)	24748646 (100%)
	(4)	(235)	(16)	(14)	(7075)	(67)	(110)	(0)	(7521)
Pour-Flush to Septic Tank	8241 (0%)	5498277 (16%)	715489 (2%)	448529 (1%)	23520231 (71%)	453028 (1%)	2670875 (8%)	12975 (0%)	33327645 (100%)
	(9)	(2693)	(405)	(254)	(10588)	(166)	(1231)	(5)	(15351)
Pour-Flush to Pit	882 (0%)	1389638 (31%)	130451 (3%)	31758 (1%)	1844188 (41%)	14944 (0%)	1090204 (24%)	3565 (0%)	4505630 (100%)
	(2)	(908)	(78)	(56)	(999)	(5)	(815)	(1)	(2864)
Pour-Flush to Others	0 (0%)	162418 (24%)	34270 (5%)	14938 (2%)	419822 (63%)	997 (0%)	37947 (6%)	0 (0%)	670392 (100%)
	(0)	(53)	(27)	(10)	(227)	(1)	(15)	(0)	(333)
Ventilated Improved Pit	0 (0%)	104936 (28%)	21958 (6%)	154 (0%)	242140 (65%)	0 (0%)	5099 (1%)	0 (0%)	374287 (100%)
	(0)	(37)	(5)	(1)	(117)	(0)	(8)	(0)	(168)
Pit with Slab	81 (0%)	348622 (39%)	70315 (8%)	23706 (3%)	351108 (39%)	0 (0%)	107197 (12%)	0 (0%)	901029 (100%)
	(1)	(233)	(41)	(24)	(178)	(0)	(82)	(0)	(559)
Pit without Slab	0 (0%)	32995 (51%)	2371 (4%)	980 (2%)	9201 (14%)	0 (0%)	18741 (29%)	0 (0%)	64288 (100%)
	(0)	(35)	(1)	(2)	(10)	(0)	(12)	(0)	(60)
Composting Toilet	0 (0%)	306 (2%)	4614 (29%)	0 (0%)	10908 (69%)	0 (0%)	0 (0%)	0 (0%)	15828 (100%)
	(0)	(1)	(1)	(0)	(8)	(0)	(0)	(0)	(10)
Other	0 (0%)	10531 (5%)	15251 (8%)	7483 (4%)	140574 (70%)	2847 (1%)	22854 (11%)	0 (0%)	199540 (100%)
	(0)	(8)	(12)	(3)	(38)	(6)	(20)	(0)	(87)
Toilet Not Used	0 (0%)	54117 (35%)	1920 (1%)	0 (0%)	65842 (42%)	7673 (5%)	26414 (17%)	0 (0%)	155966 (100%)
	(0)	(30)	(2)	(0)	(51)	(3)	(8)	(0)	(94)
Open Defecation	6647 (0%)	3310313 (49%)	291744 (4%)	87522 (1%)	2051523 (30%)	47537 (1%)	981692 (14%)	845 (0%)	6777823 (100%)
	(4)	(2533)	(241)	(122)	(1556)	(32)	(781)	(5)	(5274)
Total	22026 (0%)	11530859 (16%)	1317905 (2%)	641231 (1%)	52215872 (73%)	793680 (1%)	5202116 (7%)	17385 (0%)	71741074 (100%)
	(20)	(6766)	(829)	(486)	(20847)	(280)	(3082)	(11)	(32321)

Source: *National Sample Survey Data, 2012*

Note: (%) gives the percentage of kind of disposal for the corresponding type of toilet facility, adjacent to the estimated population for the respective categories.
() gives the number for samples from the NSS data for the correspondiong category of type of toilet and type of disposal.