

Sanitation Coverage and Open Defecation Rate in Indian States: A Pooled Data Analysis

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Abstract

To fulfil the sanitation needs of the people, Government of India has implemented the several sanitation programmes during its planning period. Still there is a nearly 30 percent household having no sanitation /latrine facilities (National Family Health Survey-5, 2019-21). The enormous negative externalities of lack of sanitation facilities motivate us to measure sanitation situation across states in India and identify the factors that affect the sanitation coverage. Sanitation status across states has been measured in terms of changing sanitation coverage during the period 1998-99 to 2019-2020 and Open Defecation Rate (OD) during the period 1998-99 to 2015-16. To measure the influences of various social-economic and demographic conditions on the state level sanitation coverage; we applied the multi-variable regression framework. Our overall conclusion is that the sanitation coverage in a state is appeared to be high where the literacy rate, per capita net state domestic product (PCNSDP), concentration of SC/ST population is high whereas the state having a higher percentage of poor population, higher proportion Hindu population, higher share of rural population adversely affects the sanitation coverage in a state.

Keywords: Sanitation, Open Defecation, Multi-regression Model, NFHS

Introduction

In India, sanitation needs are enormous as it has only 69.3 Percent households having an improved toilet facility (NFHS 5). The situation is worse according to the usage of latrine by the people. According to the report of WHO, India has Open Defecation (OD) rate of 40 percent in 2015, whereas in rural areas this figure is subsequently as high as nearly 56 percent (WHO & UNICEF, 2017, p 82). During 2019, it has declined to nearly 19 percent (data.worldbank.org). Various studies have documented the health and thereby economic consequences of lack of sanitation or OD. High Infant Mortality Rate (IMR) in India, one of the most important determinants of Human Development Index (HDI), is argued to be the outcome of poor sanitation (Ministry of Drinking Water and Sanitation, GOI, 2007). Various studies in the context of India, Bangladesh and Indonesia pointed out that OD plays a vital role in the physical growth of the children (Spears 2013; Spears and Hammer 2012; Cameron *et al*, 2013; Lin *et al*, 2013;). People living in poor environment and hygiene are very prone to suffer from environmental enteropathy which is argued to be caused by ingestion of large quantities of fecal pathogens (Kosek *et al*, 2013). This parasite infection is argued to mainly the outcome of OD. OD is found to contribute to a disease environment which causes haemoglobin deficiency (Coffey, 2013). This haemoglobin deficiency is argued to have enormous human and economic consequences like enhancement of maternal mortality and reduction of adult productivity etc. (Basta *et al*, 1979; Rush, 2000; Thomas *et al*, 2004;). Some other children's problems like impair cognitive ability and physical development are argued to be the outcome

of haemoglobin deficiency. (Grantham-Mc Gregor & Ani, 2001; Walter et al., 1989; Scrimshaw, 2000). Therefore, there is a direct relationship between lack of sanitation and health outcome. To overcome the severe adverse consequences of OD and to fulfil the target of MDG, Government of India has introduced several initiatives during its planning period to address the problem.

The first of these programmes was launched in 1986 under the banner of Central Rural Sanitation Programme (CRSP) with the objective of improving the standard of living and dignity of the rural people, especially the women population. The goal was to provide latrine facilities to at least 25 percent of the rural population by the end of that decade. The programme primarily focused on construction of latrines, and the efforts were mostly supply-driven. The success of this programme in terms of access to this facility was found to be very unsatisfactory as most of them were found to be unused. The slow progress of rural sanitation under CRSP resulted in formation of a well-crafted sanitation programme under the banner of 'Total Sanitation Campaign (TSC)' in 1999. TSC was designed to make it be a community-led, people-centred, demand-driven and incentive-based programme (Peal *et al.*, 2010). For these purposes, greater investment was made on behavioural change of the people through imparting Education and providing information about the negative externalities of OD. Besides, various incentives like offering subsidies for construction of latrine to the people living below poverty line, Nirmal Gram Puraskar (NGP) to the OD free communities etc. were also a part of this programme (Annual report, Ministry of drinking water, sanitation, Govt of India, 2012). Despite these efforts, TSC failed to achieve even one-third of its target in construction of toilets (Census 2011), the latrine usage was far behind the stipulated target. To achieve OD free status for all villages and to provide improved sanitation facilities to all the rural households by 2022, Nirmal Bharat Abhiyan (NBA) was launched in 2012. Under this programme, Drinking and Sanitation Committee³⁹ have been formed at the village level to ensure Information, Education and Communication (IEC) campaign, capacity building for effective behaviour change to achieve a saturated outcome (GOI, MoDWS, 2012). Enhancement of subsidy for construction of toilet and allocation of subsidies for the APL families are the two additional features of this programme. To cover all households with latrine, cluster toilets and community toilets in both rural and urban areas, NBA has been restructured and renamed as Swachh Bharat Abhiyan (SBA) or Clean India Mission in 2014. This mission aims to make OD free India by 2019. To fulfil the target, the emphasis has been given to engage various actors like social health workers, anganwadi workers, self-help groups, civil society organization to carry out the sanitation activities. As on march, 2018, nearly 316 districts have been declared as OD free districts (GOI, MoDWS, 2018).

Various studies have documented the performance of the sanitation coverage by comparing the performance of different countries (UNICEF & WHO, 2017). However, most of the studies deal with the negative externalities of lack of sanitation or open defecation. The challenges related to factors affecting access to sanitation facilities remain largely unaddressed. In this context, this paper aims: (I) to assess the performance of India in terms of coverage of sanitation for the period 1998-99 to 2019-20; to measure the state-wise variation in sanitation coverage; (II) to determine the inter-state OD rate; (III) to identify the factors affecting the access to sanitation of the people.

³⁹The Village Health and Sanitation Committee (VHSC) is one of the nine institutional mechanisms under NRHM initiated by Government of India in the year 2005. The District Health Mission would guide the activities of sanitation at district level and promote joint IEC activities for sanitation and hygiene through VHSC.

Data and Methodology

In this study, we have used data from secondary sources. State-level data has been collected from the National Family Health Survey (NFHS) for the year 1998-99, 2004-05, 2015-16 and 2019-20, Census data for the year 1991, 2001 and 2011, RBI report 2015-16. The NFHS state-level data provides information on sanitation coverage (percentage of households having latrine/toilet facilities), religious and caste status of the population. Various other demographic information, namely, state-wise total population; total households, total rural and urban population etc. have been collected from various census reports. Information on some other variables like state-wise percentage of BPL population, per capita net state domestic products has been collected from RBI report 2015-16. The author has also calculated the state-wise open defecation rate on the basis of total sanitation coverage.

The details of variables, which are considered for this analysis is given below:

- (I) Sanitation coverage (State-wise percentage of households having latrine/toilet facilities)
- (II) Religious status (State-wise percentage of Hindu population)
- (III) Caste (State-wise percentage of ST/SC population in India)
- (IV) Economic Status (Percentage of BPL population in a state)
- (V) Per capita net state domestic product at factor cost.
- (VI) Rural urban population ratio

Sanitation Coverage in India

Physical progress of the sanitation coverage is measured in terms of households having sanitation facilities. The performance of the states are classified into five categories; a) states having below 20 percent of sanitation coverage is identified as very poor performing states; b) states having sanitation coverage of greater than 20 percent to 40 are earmarked as poor-performing states; c) States having greater than 40 percent to 60 percent sanitation coverage are identified as medium performing states; d) For good performer states, sanitation coverage varies from greater than 60 percent to 80 percent; e) excellent performing states are those who achieve the target of more than 80 percent of sanitation coverage.

Table 1 presents the relative position of the states in terms of their performance in sanitation coverage over the year 1998-99 to 2019-20. Table 1 shows that in 1998-99, total of 12 states was identified as deficient in terms percentage of households having sanitation coverage. In 2015-16, only three states, namely, Jharkhand, Bihar, Orissa were experiencing this status. In 1998-99, only three states have been recognized as very good performing states, whereas in 2015-16, the performance of total 15 states are found to be very satisfied with more than 80 percent of sanitation coverage. This success might be due the implementation of different sanitation programmers specially the Total Sanitation Campaign (TSC) in 1999 and the Swachh Bharat Abhijan in 2014 (Mission clean India). The position of each state in terms of sanitation coverage is presented in Figure 1. The sanitation coverage data of Bihar, Madhya Pradesh and Himachal Pradesh in 1998-99 have been used for Jharkhand, Chhattisgarh and Uttarakhand respectively⁴⁰.

Table 1: Performance of the States Measured in Terms of Sanitation Coverage

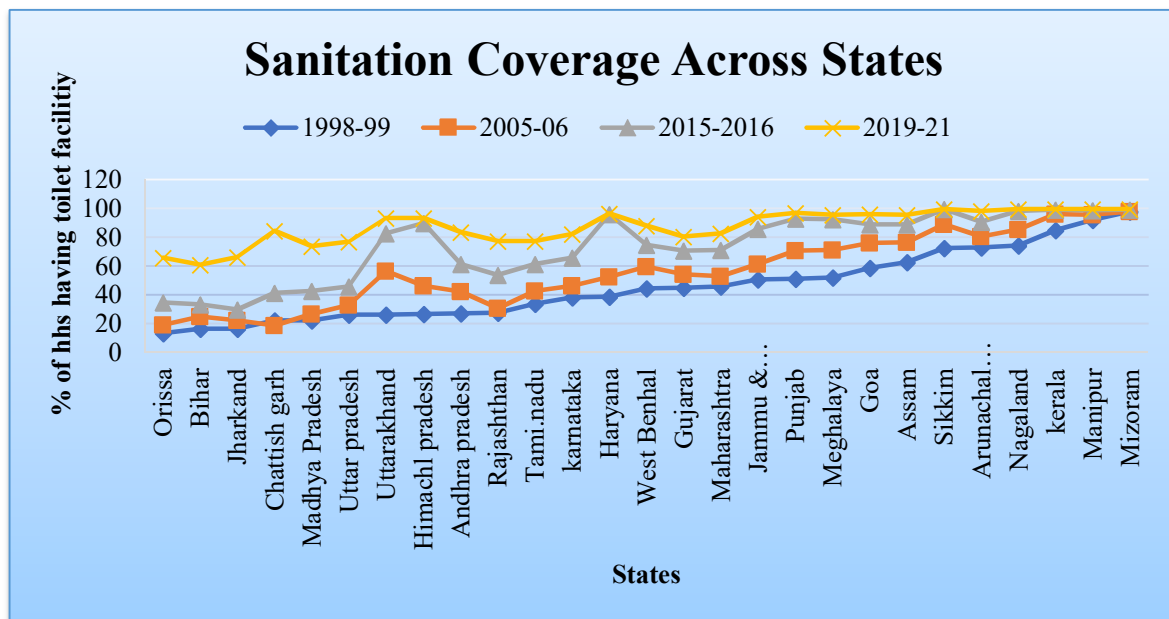
⁴⁰During 1998-99, Jharkhand, Chhattisgarh and Uttarakhand were the part of Bihar, Madhya Pradesh and Himachal Pradesh Respectively. Jharkhand was created from Bihar on 15th November, 2000. Initially, Uttarakhand was bifurcated from Uttar Pradesh on 9th November, 2000 whereas Chhattisgarh was created on

NFHS rounds & Year	Percentage of households having sanitation facilities				
	Very Poor (0 -20 %)	Poor (> 20 % to 40 %)	Medium (< 40 % to 60 %)	Good (> 60 % to 80 %)	Very Good (80 % and above)
NFHS-2 (1998-99)	Orissa, Bihar, Jharkhand	Chhattisgarh, Madhya Pradesh, Uttar Pradesh, Himachal Pradesh, Andhra Pradesh, Rajasthan, Tamil Nadu, Karnataka, Haryana.	West Bengal, Gujarat, Maharashtra, J & K, Punjab, Meghalaya, Goa.	Assam, Sikkim, Arunachal Pradesh, Nagaland,	Kerala, Manipur, Mizoram
NFHS-3 (2005-06)	Chhattisgarh, Orissa	Jharkhand, Bihar, Madhya Pradesh, Uttar Pradesh, Rajasthan	Andhra Pradesh, Tamil Nadu, Himachal Pradesh, Karnataka, Haryana, Maharashtra, Gujarat, Uttarakhand, West Bengal	J & K, Punjab, Meghalaya, Goa, Assam	Arunachal Pradesh, Nagaland, Sikkim, Manipur, Kerala, Tripura, Mizoram
NFHS-4 (2015-16)	NIL	Jharkhand, Bihar, Orissa	Chhattisgarh, Madhya Pradesh, Uttar Pradesh, Rajasthan	Andhra Pradesh, Tamil Nadu, Karnataka, Telangana, Gujarat, Maharashtra, West Bengal	Uttarakhand, J & K, Assam, Goa, Himachal Pradesh, Arunachal Pradesh, Meghalaya, Punjab, Haryana, Tripura, Nagaland, Manipur, Mizoram, Kerala, Sikkim.
NFHS-5 (2019-21)	NIL	NIL	NIL	Jharkhand, Bihar, Orissa, Madhya Pradesh, Uttar Pradesh, Rajasthan., Tamil Nadu.	Chhattisgarh, Uttarakhand, J & K, Assam, Goa, Himachal Pradesh, Arunachal Pradesh, Meghalaya, Punjab, Haryana, Tripura, Nagaland, Manipur, Mizoram, Kerala, Sikkim, Andhra Pradesh, Karnataka, Telangana, Gujarat, Maharashtra, West Bengal.

Source: NFHS 2, NFHS 3, NFHS 4, NFHS 5

Figure 1 highlights that there is wide variation among states in the availability of the sanitation facilities in the entire four specific time period though this variation is found to be reduced over time. During 1998-99 to 2015-16, some states, namely, Himachal Pradesh, Haryana was found to enhance their sanitation coverage by more than 50 percent. The other better performing states in this regard are Punjab, Meghalaya where sanitation coverage increases more than 40 percent. In West Bengal, sanitation coverage has increased by more than 30 percent by this time. In 2019-20, almost all the states have more than 60 percent households having basic sanitation facilities. During the period 2015-16 to 2019-20, the better performing states are Bihar, Orissa, Jharkhand and Chhattisgarh in this regard. The performance of these states might be due to the capability of the respective state authority to implement the existing sanitation activities properly.

Figure 1: Sanitation Coverage across States



Source: NFHS 2, NFHS 3, NFHS 4, NFHS 5

Open defecation rate is argued to be another important instrument to assess the sanitation status of a state. In this section, we also attempt to measure the OD rate⁴¹ across states in 1998-99, 2005-06 and 2015-16. The OD rate is argued to be the most appropriate technique to assess the sanitation status as it controls the total area of a state while measuring it. To measure OD rate in 1998-99, the information on population and households has been collected from census 2001; for 2005-06, we calculated the projected population for 2005-06. To estimate the OD rate in 2015-16, we have taken the information on population from census 2011. To estimate OD rate, all members of households having sanitation facilities are assumed to use it (though the actual situation is different, many cases use of latrine/ toilet is found to be the part of behavioural factor). Table 2 presents the OD rate across states and their progress in reducing OD in the last two decades.

⁴¹In this study, variable for open defecation is constructed at the state level. Here open defecation is reported on the basis of households without latrine or toilet. It is the numbers of persons defecate in the open per square kilometre. For this purpose, we first divided the total population of a state by the number of its households to get the average family size. Then we multiplied this average family size with the number of households without latrine or any type of sanitation facilities to get the number of persons involved in open defecation. OD rate in a state is calculated by dividing the population without any latrine / toilet facilities by the area of the state. (In this analysis it is assumed that the people of the households having sanitation facilities do not defecate in open in a place. In many cases OD is appeared to be a behavioural issue. Many studies argue that the members of the households involve in open defecation is much higher than the members of the households who don't have latrine /toilet.

Table 2: Open Defecation Rate across States

Name of states	OD rate in 1998-99	OD rate in 2005-06	OD rate in 2015-16	% change in decline of OD rate during 1998-99 to 2015-16
Mizoram	1	1	0	100.00
Sikkim	21	9	0	100.00
Arunachal Pradesh	4	3	2	50.00
Manipur	8	5	2	75.00
Nagaland	31	17	2	93.55
Kerala	121	33	7	94.21
Tripura*		11	7	36.36
Jammu & Kashmir	22	20	8	63.64
Meghalaya	50	34	10	80.00
Himachal Pradesh	80	62	13	83.75
Haryana	292	250	23	92.12
Uttarakhand*	-	75	32	57.33
Punjab	235	151	39	83.40
Goa	150	91	43	71.33
Assam	126	87	44	65.08
Gujarat	142	129	89	37.32
Rajasthan	119	126	92	22.69
Maharashtra	170	160	105	38.24
Karnataka	169	159	109	35.50
Chhattisgarh *	-	139	111	20.14
Andhra Pradesh	201	168	119	40.80
Madhya Pradesh	152	157	135	11.18
Orissa	204	204	175	14.22
Tamil Nadu	317	295	212	33.12
West Bengal	499	390	258	48.30
Jharkhand*		291	290	0.34
Uttar Pradesh	507	508	450	11.24
Bihar	733	743	735	-0.27

Note: for Tripura, Urrarakhand, Chhattisgarh, Jharkhand, percentage change in OD rate is measured for the period 2005-06 to 2015-16.

Source: NFHS 2, NFHS 3, NFHS 4, Census 2001, Census 2011.

A comparison of the state-wise OD rates shows that all the north-eastern states have achieved tremendous success in this regard. The OD rate in Mizoram and Sikkim have been found to be zero, followed by Arunachal Pradesh, Manipur and Nagaland with OD rate of 2 per sq. Km. The highest OD rate is recorded in Bihar, where 735 people per sq km. use open places for sanitation activities. Even no improvement in this regard has been observed in Bihar during the last 15 years even though the availability of latrine and toilet facilities have increased from 16.8 percent households in 1998-99 to 33.5 percent in 2015-16. High population density and high population growth might be contributing to the stagnant OD rate over the last two decades (as per census 2011, Bihar is identified as most densely populated state and having highest population growth rate). There are four more states, Uttar Pradesh, Jharkhand, West Bengal and Tamil Nadu, where OD rate is more than 200 per sq. km.

This wide variation either in sanitation coverage or in OD rate across states have raised many questions regarding it: Does lack of access to sanitation or OD isa manifestation of the people's

poverty? Which section of the society is not accessing sanitation? Does people's lack of awareness regarding negative externalities of OD or lack of sanitation hinder the progress in this regard? Do rural people are more reluctant to access sanitation facilities? In the next section, we attempt to answer these questions.

Determinants of Access to Sanitation Facilities by the people

In a state, people's access to sanitation facilities depends on various social, economic, demographic and cultural status of the people. In this study, this status is captured in terms of social backwardness, religion, the concentration of poor people, economic condition of a state, literacy rate and urbanization of the state. Backwardness status of a state is measured in terms of percentage of schedule caste and scheduled tribe population in a state. Religious status is captured in terms of percentage of Hindu population in a state. Percentage of population living below the poverty line determines the poverty status of a state. The economic status of a state is captured in terms of PCNSDP at factor cost. Literacy rate of a state is captured by the percentage of population literate in a state. In this study, rural-urban population ratio is used as a proxy indicator of urbanization. The association of these factors with access to sanitation is presented in Table 3. It is observed from Table 3 that all the factors described here are highly correlated with the sanitation coverage. The sanitation coverage is appeared to be positively correlated with higher concentration of SC/ST population, high literacy rate in a state. Moreover, states having higher economic status exhibits higher sanitation coverage. All three relationships are appeared to be statistically significant. However, sanitation coverage in a state is found to be negatively and significantly associated with the concentration of Hindu population, BPL population and concentration of rural population.

Table 3: Correlation Matrix Showing Association Between Access to Sanitation and Other Factors

Variables	Access to Sanitation (% of Households access sanitation facilities)	
	Correlation Coefficient (r^2)	Probability
Percentage of SC and ST Population in a state	0.308	0.005**
Percentage of Hindu Population in a state	-0.59	0.000***
Percentage of population living below the poverty line in a state	-0.444	0.000***
Percentage of Literate population	0.665	0.000***
Per Capita State Domestic Product at Factor Cost	0.486	0.000***
Rural-Urban Population Ratio	-0.264	0.017**

Notes: *** & ** imply 1 percent and 5 percent level of significance respectively

Source: NFHS 2, NFHS 3, NFHS 4, Census 2001, Census 2011.

The above Table 3 suggests that there is some association between socio-economic, demographic characteristics in a state and its sanitation coverage. Nevertheless, the above analysis failed to measure the actual magnitudes of the influences of these characteristics (factors) on the access to sanitation coverage. To measure the actual magnitude of all the inputs, we have estimated the multi-variables regression model by using the pooled data for 1998-99, 2005-06 and 2015-16. In such regression, we have attempted to measure the influences of various socio-economic and demographic indicators on access to sanitation facilities. The multi-variables regression model expresses a quantitative variable (dependent variable) as a function of several explanatory variables. To avoid the multicollinearity problem, we have used two regression models.

In model-I, we have considered three explanatory variables, namely Percentage of Hindu population (HINDU), Literacy rate (Literacy) and the concentration of BPL population (BPL_P). In Model-II, effects of three other explanatory variables, namely, percentage of SC/ST population in a state (SC/ST_P), per capita net state domestic product (PCNSDP) and state-level rural-urban population ratio (R/U_P on sanitation coverage have been assessed. All the six variables have been selected as possible factors that are likely to determine the sanitation coverage in a state. Let us mention the hypotheses relating to the relationships between the explanatory variables considered by us and the dependent variable.

Explanatory Variables and Hypotheses

In this analysis, six state-level characteristics have been selected as possible factors that are likely to determine the sanitation coverage in a state. Let us mention the hypotheses relating to the relationships between the explanatory variables considered by us and the dependent variable.

1. The concentration of Hindu population (HINDU): There exists some relation between the religious status and the sanitation behaviour of the people. The religious belief of the Hindus might de-motivate the Hindu population to avail sanitation facilities within the household premises. So they might pay little importance to avail sanitation facilities either investing their own fund or to access the government fund to construct the same. The concentration of Hindu population in a state is measured by the percentage of Hindu population in a state. We hypothesise a negative relationship between the concentration of Hindu population in a state and the sanitation coverage.
2. Literacy Rate (Lit_Rate): The factor literacy rate is used here as a proxy variable of people's awareness about access to sanitation facilities. People's awareness about the negative externalities of open defecation might be expected to enhance the demand for sanitation facilities. A positive relationship between the literacy rate in a state and the sanitation coverage is hypothesised in this study.
3. Domination of the BPL population (BPL_P): Insufficient financial resource is assumed to have a negative effect on the people's choices towards sanitation facilities. Therefore, a negative relationship is hypothesized between the domination of BPL population of a state and its sanitation coverage. In this study, the percentage of BPL population in a state is considered to assess the domination of BPL population in a state.
4. Social backwardness (SC/ST_P): In this study, the percentage of schedule caste and schedule tribe population is used to assess the backwardness of a state. The poor socio-economic status among the people belonging to these social groups might insufficiently contribute to their capability to access sanitation facilities. Therefore, we hypothesise a negative relationship between the backward status of a state and the coverage of sanitation facilities.
5. Per capita net state domestic product (PCNSDP): Higher PCNSDP is expected to the outcome of good economic performance of the economic agents of the state and it contributes sufficiently to access basic needs by the people. Therefore, in this study, a positive relationship between the PCNSDP and the sanitation coverage is hypothesised.
6. Rural urban population ratio (R_U_P_ratio): The process of urbanisation may lead to more access to sanitation facilities. Here the degree of urbanisation is captured by the rural urban population ratio. It is expected that the rural urban population ratio is negatively associated with the access to sanitation facilities.

3. Result of the Multiple Regression Models

The multiple regression model involving the depending variables Y_i and explanatory variables X_{j_i} is specified as

$$Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \epsilon_i$$

Where i denote the i th observation, β_j s denotes the vector of unknown coefficients and X_{j_i} is a vector of covariates that affect the access to sanitation facilities.

The dependent variable in our model is the access to sanitation facilities. To avoid the multicollinearity problem, we have fitted two regression models. Table 4 presents the results of regression models of access to sanitation facilities.

Model-I

Table 4: Results of Regression of Access to Sanitation Facilities on Various Socio-Economic and Demographic Factors

Variables	coefficient	Std Error	t' Value	P-value	Tolerance	VIF
Hindu	-0.459	0.0267	-7.33	0.000	0.939	1.06
Literacy	1.479	0.196	7.56	0.000	0.758	1.32
BPL	-0.108	0.150	-0.72	0.475	0.734	1.36
Constant	-10.39	16.697	-0.62	0.535	-	-
Number of observations				81		
F-Statistics (3, 77)				55.15 (0.000)		
R-square				0.682		
Adj R-square				0.670		

Source: NFHS 4, NFHS 3, NFHS 2, Census 2001 & 2011, Handbook of Statistics of Indian States, RBI, 2015-16

Model-I shows that the concentration of the Hindu population and the literacy rate significantly affect the sanitation coverage across states. It appears that the sanitation coverage is appeared to be less in the Hindu dominated areas and high where the level of education among people is found to be relatively high. States having a higher concentration of BPL population exhibits the lower sanitation coverage, though it is found to be statistically insignificant. It needs mention that the model has overall statistical significance as revealed by statistical significance of the F statistics.

Model-II

Table 5: Results of Regression of Access to Sanitation Facilities on Various Socio-Economic and demographic Factors

Variables	coefficient	Std Error	't' Value	P-value	Tolerance	VIF
SC/ST	0.403	0.102	3.94	0.000	0.939	1.01
PCNSDP	0.0006	0.0001	5.5	0.000	0.758	1.14
R_U_P_ratio	-1.243	1.188	-1.05	0.299	0.734	1.13
Constant	34.84	7.425	4.69	0.000	-	-
Number of observations				81		
F-Statistics (3, 77)				15.29 (0.000)		
R-square				0.373		
Adj R-square				0.349		

Source: NFHS 4, NFHS 3, NFHS 2, Census 2001 & 2011, Handbook of Statistics of Indian States, RBI, 2015-16

The estimation results in Model II exhibits that the access to sanitation coverage is higher where the concentration of SC/ST population is higher which is contrary to our hypothesis. Moreover,

this relationship is appeared to be statistically significant. This might be due to the excellent performance of the north-eastern states in this regard. The results also further highlight that the sanitation coverage is higher in the states having larger PCNSDP and lower where the Rural-Urban Population ratio is high. The positive relationship between the access to sanitation facilities and the PCNSDP is expected as our hypothesis. The magnitude of F- statistics also highlights the overall statistical significance of the model.

Summary and Conclusion

To make India as OD free country, several programmes, namely, Central Rural Sanitation Programme (CRSP, 1986), Total Sanitation Campaign (TCS, 1999), Nirmal Bharat Abhiyan (NBA, 2012) and Swachh Bharat Abhiyan (SBA, 2014) have been implemented since eighties of the nineteenth centuries. Despite the implementation of these programmes, in India there is 55 percent households have sanitation/ latrine facilities (NFHS 4) and OD rate is 40 percent (WHO& UNICEF, 2017) in 2015. While comparing the states in terms of households having sanitation coverage during the period 1998-99 to 2019-20, it appears that some states, particularly the north-eastern states in India, have achieved tremendous success in this regard, but many states namely Jharkhand, Bihar, Orissa, Chhattisgarh, Madhya Pradesh, Uttar Pradesh and Rajasthan have to go a long way in this regard. As regards OD rate across states, it varies from 1 in Sikkim and Mizoram to 735 in Bihar in 2015-2016. Some states, namely Haryana, West Bengal, Punjab have achieved remarkable success in reducing OD rate during the period 1998-99 to 2015-16.

To identify the factors affecting the sanitation coverage in a state, the required state-level information has been collected from NFHS 2, NHFS 3, NFHS 4, census of India 2001,2011, Report of RBI (2015-16). Two multiple regression models are used to identify the factors affecting the sanitation coverage in a state. The regression results show that the sanitation coverage in a state is appeared to be high where the literacy rate, PCNSDP, concentration of SC/ST population is high whereas the state having a higher percentage of poor population, higher proportion Hindu population, higher share of rural population adversely affect the sanitation coverage in a state. All the variables, except the concentration of BPL population and share of rural population, turned to be statistically significant. The overall significance of the two models has also been reflected by the F- statistics.

The ongoing sanitation programs, despite being designed to address social and economic issues, have not achieved satisfactory success. Sanitation is closely tied to public health and well-being. Poor sanitation affects communities, leading to diseases, discomfort, and social stigma. Inadequate sanitation can lead to economic losses due to health-related issues, reduced productivity, and increased healthcare costs. By improving sanitation coverage, economies can benefit from healthier populations, reduced medical expenses, and increased workforce productivity. Behavioural change is crucial for promoting better sanitation practices. Raising awareness about latrine usage and the negative impact of open defecation can positively influence social norms. Changing people's behaviour regarding sanitation practices requires targeted efforts. Provision of related facilities, such as water supply, sufficient land for constructing toilets, and proper waste disposal is essential. Lack of these facilities can hinder sanitation program effectiveness. All these efforts can translate the sanitation efforts into tangible outcomes.

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