Persistent Open Defecation:

The Curious Case of North India

By

Harsh Vardhan Pachisia

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Professor Marti G. Subrahmanyam   Dean Geeta Menon

Faculty Adviser   Thesis Adviser

ABSTRACT

India accounts for over sixty percent of global open defecation resulting in a series of economic, health and social consequences. Efforts by the national government would be greatly supported by a better understanding of the unique drivers of open defecation in India. This paper contributes to existing literature by taking a holistic approach to analyze the drivers of persistent open defecation in India, examining how economic and cultural factors impact the habit. Through a quantitative analysis of a survey conducted in five North Indian states, it finds that changing social norms and attitudes are crucial in eradicating open defecation in India. Due to such conclusions, this paper recommends that the ongoing sanitation campaign (the Swachh Bharat mission) in India focus a lot more on Information, Education and Communication (IEC) efforts in order to generate sustainable demand for latrine adoption and eradicate the practice of open defecation around the country.

ACKNOWLEDGEMENTS

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INTRODUCTION

Sanitation is more important than independence." Mahatma Gandhi said that in 1925. Today, more than 90 years later, the statement still holds true. Globally, 2.4 billion people still lack access to proper sanitation facilities with over a billion people practicing open defecation (OD) worldwide. The practice of OD leads to a series of health, economic and environmental consequences. While approximately 15% of the global population practice open defecation, India has four times the global rate, with nearly 60% of its population practicing open defecation. Such high levels of OD have devastating effects such as leading to the death of 450,000 Indians annually from a variety of water-borne diseases in addition to dire long term consequences such as malnutrition and stunted growth of children. Furthermore, the lack of toilets & sanitary services in schools and workplaces decreased India's annual GDP by 6.4% or 53.8 billion dollars in 2011 (The Water & Sanitation Program, World Bank, 2011).

The Indian situation regarding open defecation is particularly remarkable given that it is wealthier by economic metrics than many countries that have reduced OD such as Bangladesh and other Sub-Saharan African countries. Culturally, however, India appears to really distinct from the other nations, which might explain its persistently high rates of OD. In particular, the problem of OD is most acute in the northern states of the country, where over 70% of the population practices OD.

This paper will take a holistic approach to analyze the drivers of persistent open defecation, examining how economic and cultural factors impact the habit in India. It begins by providing a background on the practice of open defecation and explores the adverse social and economic impacts OD has had on India and around the world. Following that, this paper examines the

various failed sanitation drives that have been undertaken by the Indian government over the years and provides lessons that the government could take from successful global campaigns.

Next, the paper conducts a literature review of the various economic and social indicators of open defecation and investigates how each of them applies to the Indian case. Following the inferences taken from the literature review, this paper runs logistic regression models on a survey conducted in five north Indian states to measure the impact that economic and social indicators have on the tendency to OD. To conclude, this paper discusses the implications of the results of the quantitative analysis on the latest sanitation initiative launched by the Indian government, the 2014 *Swachh Bharat* (Clean India) campaign. Ultimately, this paper's main objective is to showcase the unique case of North India where changing social norms and attitudes are extremely important to eradicate the problem of persistent open defecation.

1.   THE PROBLEM OF OPEN DEFECATION

1.1 Background on Sanitation & Open Defecation

Access to proper sanitation facilities is fundamental to human development and welfare. It is crucial not only for general health but also plays a massive role in an individual's social life. Furthermore, good sanitary practices help prevent contamination of water & soil, thereby preventing diseases. The term 'sanitation' includes open defecation, disposal of waste and hygiene. In particular, open defecation can be defined as the act of reliving oneself directly in fields, in local water sources such as ponds, or inappropriately disposing of excreta instead of using a toilet or latrine (Coffey, 2014).

The practice of OD is a major problem because if someone defecates in the open, pathogens (diseases causing agents) present in the feces can travel from hand to mouth through a two-step process. First, such pathogens latch onto agents such as flies, contaminated rainwater, wind, shoes, toys, etc. and bring human feces back to the household. Second, the human feces enter the mouth via dirty hands/fingernails, flies on food, fruits & utensils washed with contaminated water, etc. Furthermore, intestinal worms can be ingested if a person unknowingly swallows fecal matter or steps on it while barefoot (CLRA, 2013). Since each gram of human excreta contains ten million viruses coupled with the fact that the fecal-oral route is a frequent polio pathway, it can be seen why open defecation has become such a major problem (UNICEF, 2014).

1.2 The Adverse Impacts of Open Defecation

1.2.1 International Context

Poor sanitation and the practice of open defecation (OD) have a series of health, economic and environmental ramifications on every community. The lack of proper sanitation coupled with the practice of open defecation leads to about 700,000 premature deaths annually as well as the loss of approximately 443 million school days as a result of subsequent diseases (World Bank, 2014). Such diseases include cholera, typhoid, hepatitis, and polio in addition to dire long-term consequences such as malnutrition and stunted growth in infants (Monitoring Water & Sanitation, WHO, 2015). Furthermore, OD is regarded as the leading cause of diarrhoea, a disease that accounts for more deaths than HIV/AIDS, malaria and measles combined (UNICEF-WHO JMP, 2010).

The practice of OD coupled with poor sanitation also has negative consequences for the environment as it leads to contaminated sewage flowing directly into streams, rivers, lakes and wetlands. This ends up affecting coastal and marine ecosystems and leads to the loss of valuable biodiversity due to the spread of disease. Beyond being a health & environmental concern, the practice of open defecation is considered a major safety issue as around one in three women worldwide risk shame, disease, harassment and attacks such as rape since they do not have access to a safe, private toilet.

From an economic standpoint, poor sanitation leads to the crippling of national development. The workforce of a country with poor sanitation is less educated having missed school days, produces less due to higher rates of absenteeism at work and lives shorter lives due to the health consequences of OD. Hence, OD has long-term impacts on the future economic productivity of a country. The UN in 2013 estimated that poor sanitation costs countries between

0.5 to 7.2% of their GDP with global economic losses from lack of sanitation amounting to

US$260 billion annually. Ultimately, it can be seen that the practice of OD coupled with poor

sanitation has various economic and social consequences for communities around the world.

1.2.2 Indian Context

  While the economic, health and safety ramifications of global open defecation are

astounding, the practice of OD is regionally concentrated in South Asia and Sub-Saharan Africa,

which account for over 80% of OD in the world as shown in Figure 1.
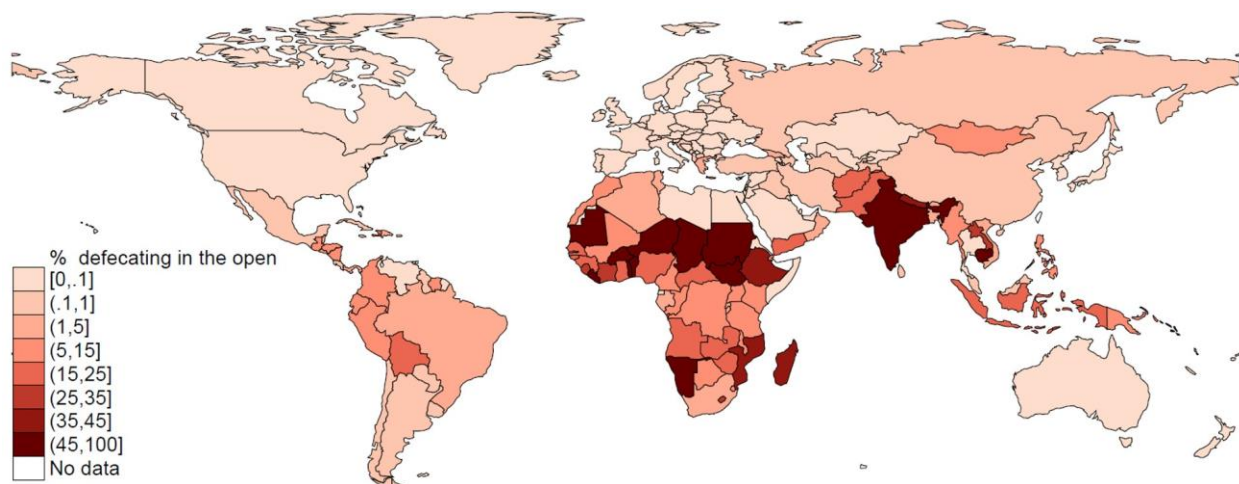
Figure 1: Global Rates of Open Defecation (RICE Institute, 2014)

  India itself has more than 564 million people defecating outside, a number that is almost

twice the entire population of the United States (Water Aid, 2017). Only one in two individuals

in India use a toilet with 65% of India's rural population practicing OD in addition to 12% of the

urban population. Moreover, 44% of Indian mothers dispose their children's feces in the open,

which leads to a high risk of microbial contamination of water leading to the spread of water-

borne diseases. Such practices affect children in particular with 188,000 kids under five dying

annually due to diarrhoea. Furthermore, frequent bouts of diarrhoea often lead children to

become more vulnerable to malnutrition, stunting and infections such as pneumonia. In rural

India, nearly 44 million children under five are stunted as a consequence. Overall, the practice of OD coupled with the lack of sanitation kills over 450,000 Indians every year. The lack of toilets in schools also forces 23% of Indian girls to drop out of school upon reaching puberty. Moreover, men in the rural villages spend up to an hour trying to find a private place to defecate. That delay alone causes India's annual productivity to decrease by ten billion dollars. As mentioned earlier, the practice of OD decreased India's annual GDP by over 6.4% in 2011. (The Water & Sanitation Program, World Bank, 2011). Hence, it can be seen that the issue of open defecation is critical in India from an economic, social and health standpoint.

1.3 Sanitation Campaigns to stop Open Defecation

1.3.1 Indian Sanitation Campaigns

Given scale of OD in India, it is not surprising to see that the Indian government has enacted a number of sanitation reforms over the years. The first major campaign was started in 1986, called the Central Rural Sanitation Program (CRSP), a program that aimed to increase sanitation coverage in all rural areas, with a special objective on providing privacy and improving the dignity of women. Furthermore, it aimed to provide 25% of India's rural population with access to improved sanitation facilities. The campaign also established the National Technology Mission, in order to provide states with technical and scientific guidance in building toilets. The CRSP was mainly supply-driven with the focus predominately being on incentivizing below-the-poverty line (BPL) households with an 80% government subsidy to build private toilets for themselves (Bhaumik & Kumar, 2014). Due to such a supply-heavy focus coupled with low demand, many surveys found that rural households used the constructed toilets as free storage spaces instead of using them for defecation.

Following the failure of the CRSP, the national government started a new drive, branded the Total Sanitation Campaign (TSC) in 1999. The main changes emphasized by the government were that the TSC would place a lot more focus on behavioral change and generating demand for toilets among Indian communities. In order to achieve the goal of becoming Open Defecation Free (ODF) by 2017, the TSC campaign started information, education and communication (IEC) drives around the country. Such an initiative consisted of providing literature to communities about the negative and adverse effects of practicing OD. In addition to the behavior change policies, efforts were made to increase latrine coverage. In particular, the monetary incentive to build toilets given to BPL households that had been started under the CRSP was continued. Furthermore, the Nirmal Gram Puraskar (NGP) plan was created in order to encourage competition amongst villages. Under the NGP, a monetary prize was given to communities that became ODF. However, despite a lot of promises, actual implementation of such programs was extremely limited with the major focus being on the construction and not the usage of toilets. This can be seen by the fact that while the TSC led to a 10% increase in latrine coverage; actual usage of toilets did not improve by 2011 (Heuso et.al, 2013). The failure of the TSC is even more striking when it is considered that that the national government was able to eradicate polio in India during the same time period.

The TSC was rebranded as the Nirmal Bharat Abhiyan (NBA) in 2012 with the "renewed focus on increasing the pace of sanitation coverage" and a new goal of providing access to sanitation to all Indians by 2022. The unique feature of the NBA was its emphasis on providing autonomy to local level officials through setting up "Village Water & Sanitation Committees" to manage the construction of new toilets at the ground level. Furthermore, for the first time, 'above

the poverty line (APL) households' were made eligible to receive government subsidies to build toilets.

The NBA campaign did not last for long. In 2014, newly elected Prime Minister Narendra Modi replaced the NBA with the Swachh Bharat Abhiyan (SBA) or "Clean India Initiative" with the goal of achieving 'sanitation for all.'[1] He set a deadline of October 2019 to make all of India ODF as a tribute to the 150th anniversary of Gandhi's birth. This deadline is three years lower than the deadline set up the NBA of 2022. However, the program is unique in a sense that for the first time in India's history, a government has staked a lot of its political capital on the success of a sanitation campaign. This can be seen in the fact that the SBA is India's largest sanitation drive with the government spending $22 billion dollars[2] (RGICS, 2016) in the initiative coupled with additional investments from international NGOs and a loan from the World Bank. In order to compare this level of expenditure, the government allocated only $8.3 billion for the entire elementary education program in FY 2014-15 (Alexander et.al, 2016).

Apart from heavy financial investment, the Swachh Bharat campaign also differs from past sanitation campaigns as it targets urban & rural, rich & poor Indian citizens rather than simply concentrating on rural BPL citizens. In order to achieve 'sanitation for all', the program has been divided into two to focus individually on the rural (i.e. SBA-Gramin) and urban (i.e SBA-Urban) parts of India. Furthermore, while the national government has provided a set of guidelines that each state should follow, it has recognized the heterogeneity of different states in India. Hence, a lot of autonomy has been given to individual states to add unique features in order to successfully achieve ODF status. In particular, every state has to outline a strategy that includes the specific annual activities it plans to undertake in addition to a comprehensive

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[1] Please see Appendix A for images of the SBA dashboard containing progress
[2] This is the total figure, which would be dispersed over a five-year period (2014-2019). RGICS is a research institute in New Delhi, India.

monitoring and evaluation strategy. Non-state actors such as social health activists, civil society organizations, *Anganwadi* workers and various self-help groups have also been hired by various state governments in order to help supplement government activity. Ultimately, the program is best understood "as a gradual aggregating of implementation plans from each unit of government in the Indian state, with national level plans meant to supplement state plans" (Alexander et. al, 2015 Page 5).

1.3.2 Lessons from International Sanitation Campaigns

The Bangladesh National Sanitation Campaign

In order to make sure that the Swachh Bharat campaign does not fail as previous sanitation initiatives, the government of India can learn lessons from many countries that have been able to mount successful ODF drives. A notable example is Bangladesh, a nation that has a shared history in addition to similar health and economic conditions as India. It was measured that the country had a 42% OD rate in 2003 (BRAC, 2012). In response to this, the government launched the 'Bangladesh National Sanitation Campaign' (BNSC) with the goal of ending open defecation by 2010. While it was a national sanitation campaign, the responsibility for implementing the policies outlined were given to the Union Chairmen, who are the lowest level of government in Bangladesh. Such officials were granted a lot of autonomy in the way they wanted to deliver interventions. In particular, they were allowed to fundraise from NGOs and international donors for their own villages. In order to coordinate with the central government, a 'Sanitation Secretariat' was appointed whose duties included allocating funds to each district and conducting progress checks (Hanchett et.al, 2011). By the end of 2010, the rates of OD in Bangladesh had fallen from 42% to just 3% (BRAC, 2012).

There are many reasons that have been pointed out for the BNSC's success. First, there was extremely strong political motivation seen to end open defecation at all levels of government. Second, there was clever coordination mechanisms put in place between central and local governments. Third, and perhaps most importantly, the BNSC implemented some of sanitation's best practices. In particular, they adopted the Community Led Total Sanitation (CLTS) method to enact behavioral change among Bangladeshi people who were practicing OD. The CLTS method is an integrated approach to achieve and sustain an open defecation free (ODF) status. In essence, it aims to generate demand for toilets among communities by showcasing the adverse effects of OD. The process entails that the members of local community come together to analyze their practices of OD. Facilitators of CLTS (usually from an NGO) lead these meetings with the aim of changing perceptions of OD. In order to achieve this goal, they showcase the process by which OD can actually lead to ingestion of human feces by members of the community. In such a way, facilitators intend to leave communities with the underlying shameful message that they might be ingesting their own feces by practicing OD (Kar et.al, 2008). In Bangladesh, such a method helped change social perception surrounding OD with a rapid increase in latrine demand experienced throughout the country.

Hence, through the BNSC, Bangladesh was able to increase access to latrines for over 52% of its citizens through strong government commitment coupled with a huge focus on behavior change methods. In this way, the campaign resulted in the toilet being seen as the only acceptable practice for defecation at all levels of society.

CLTS in Africa

There are various African countries that have also adopted the aforementioned CLTS method in order to help eradicate open defecation. For example, the government of Mali,

recognizing that it did not have enough funds to provide latrines to all citizens, used the CLTS method to instigate citizens to use locally available materials to build modest latrines for themselves. The program was incredibly successful with over 60,000 new latrines being constructed and over 1500 villages being declared open defecation-free in six years (Institute of Development, 2009). The unique takeaway for India from Mali's approach is that such change in OD practice was achieved without the use of government subsidies to build latrines. In fact, it relied solely on triggering messages about the adverse effects of OD in order to generate demand and led families to privately invest in toilets (Pickering et.al, 2015).

Kenya also implemented the CLTS method to good effect. The government joined forces with the WaterAid NGO (the creators of CLTS) in 2011 and sent thousands of facilitators across the country in order to lead CLTS interventions in communities. By 2014, 15% of villages in Kenya had received a CLTS intervention with over 40% of the triggered villages having achieved ODF status.

2. LITERATURE REVIEW OF THE DETERMINANTS OF OPEN DEFECATION

The case studies of Bangladesh and different African countries show that the problem of OD has been eradicated in various nations through successful ODF drives. However, the practice of OD still persists in India despite numerous sanitation campaigns. At the moment, the Indian government is making good headway in providing citizens access to toilets through the Swachh Bharat campaign. According to official government figures, the number of rural citizens with access to toilets has increased from 38.7% (in 2014) to 82.72% as of April 2018. Furthermore, the government states to have constructed over 70 million toilets since 2014[3]

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[3] Please refer to Figure A3 in Appendix A for the SBA-Gramin Dashboard

While providing access to toilets is extremely important, it is critical to see if there are any unique characteristics present in Indian society that have made it so difficult for the practice of open defecation to be eradicated. Hence, this section analyzes literature about the economic and social indicators of open defecation and examines if the case of India is unique to the rest of the world when tackling the practice of OD.

2.1 Economic Indicators

It is well established in sanitation literature that economic indicators such as income, years of education and water availability are strong predictors of better health outcomes and lead to the eradication of OD practices in a community. In fact, eradicating poverty and illiteracy in society are commonly referred to being the best ways to eliminate open defecation (Sara & Graham, 2014). Therefore, I first analyze the literature surrounding these determinants and apply them to the Indian context.

2.1.1 Wealth (Income)

It is very common to assume that people practice OD because they are too poor to own or attain access to latrines. The income of citizens has been seen to be a powerful predictor of latrine usage in various countries. First, in a study conducted in rural Tanzania, it was found that while over 67% of participants wanted to build a latrine, their "inability to pay for upgrading their sanitation infrastructure" was the main reason for them continuing to practice open defecation. Furthermore, the study concluded that the government needed to provide financing strategies in order to increase household ability to adopt sanitation facilities (Sara & Graham, 2014). Second, another study conducted in Kajiado District in Kenya found that higher income was the main determinant for owning a private toilet in the community. The study recommended that the government invest in the creation of jobs to increase family income. In this way, the

family would feel a sense of economic empowerment leading to private investment in household

sanitation (Augustine, 2016). Third, research conducted by Jenkins (2007) in Ghana found that

high rates of poverty was the main deterrent to household latrine installation throughout the

country. Fourth, in a randomized controlled trial (RCT) conducted by in Bangladesh, the

treatment group was provided financial subsidies such as vouchers in order to incentivize them to

build toilets. Relative to the control group, such an incentive led to a 40% increase in ownership

of toilets among the treatment group. Hence, it was concluded that financial constraints were the

most limiting factor in regards to ownership of toilets. Furthermore, the RCT found a spillover

effect as investment rates in toilets went up in the control group if the proportion of voucher

recipients (part of the treatment group) in the village increased (Guiteras et.al, 2014). Alexander

et.al (2016) showcase the importance of reducing poverty on a macroeconomic level. As seen in

Figure 2 (taken from Alexander et.al, 2016), toilet access and ownership becomes almost

universal in the 20th-40th percentiles of income in countries such as Bangladesh, Pakistan, Mali

and Kenya. Hence, from an international standpoint, it can be seen that improving income is

critical in regards to improving latrine adoption and ending OD.
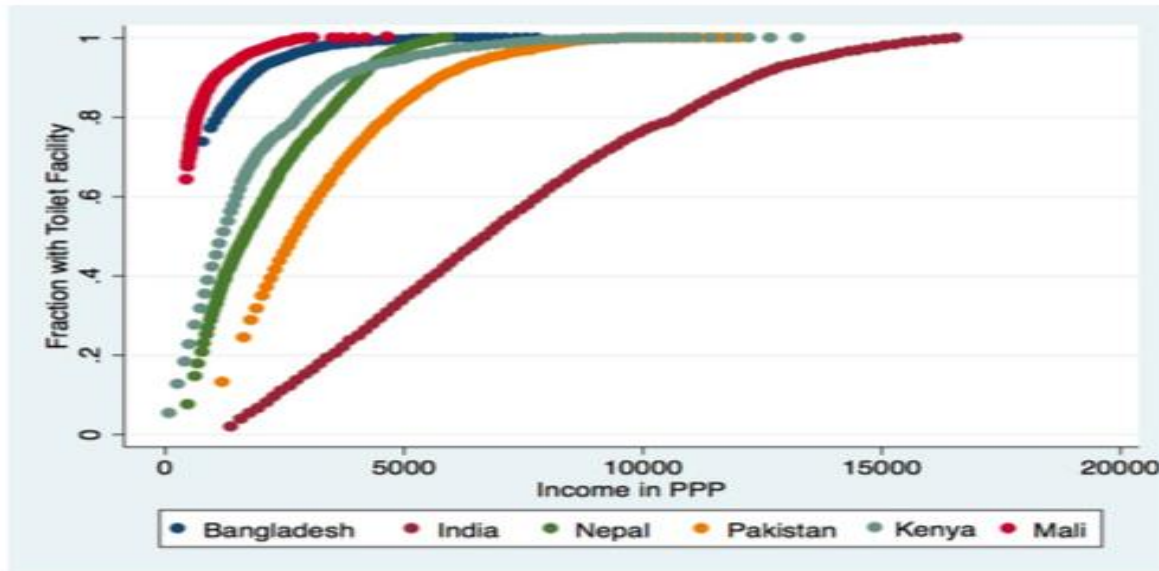
Figure 2: Percentage of individuals with access to toilets increases as income in PPP rises

However, as can be seen in the figure, India remains an outlier as the threshold for latrine

ownership occurs much higher in the income distribution for India. This finding is even more

surprising given the higher GDP per capita and median household income that India has over the

other countries. Moreover, the percentage of Indians with access to toilets is much lower at every

income level as compared to the other countries. Due to these findings, Alexander et al. (2016)

conclude that "rather than absolute wealth, individual preferences for OD is a more likely

constraint on latrine access in India". This conclusion is reinforced by research done by Coffey

et.al who label the role of wealth as the *Indian poverty fallacy* in their book *Where India goes.*[4]

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[4] I have shortened the title of the book for brevity. The full title is: '*Where India goes: Abandoned Toilets, Stunted Development and the Costs of Caste.*'

Figure 3: Indian OD does not occur because of poverty (Taken from Where India Goes by Dianne Coffey, et.al)

(Sources mentioned for figure- UNICEF-WHO JMP for OD, World Bank WDI for poverty)

In regards to poverty, the authors find that 21 countries have a higher fraction of the population that is poorer than Indians based on the World Bank's poverty line of $1.25 per day. However, in nineteen of these countries, a smaller fraction of the population defecates in the open as compared to Indians. Hence, it can be seen that India is an outlier and has more open defecation than 90% of the countries that have higher poverty rates (as showcased in Figure 3). Ultimately, such findings showcase that an increase in wealth may not be the most important indicator of Indian open defecation habits.

2.1.2 Years of Education

Investment in education and improving the literacy rates of a country (particularly female literacy) is often seen as one of the most important instruments for combating the problem of open defecation (FAO, 2015). Dollar et.al (1999) argue that for every 10% increase in female literacy in Africa, not only does the country's economy grow by 0.3% but also the practice of

open defecation is reduced by 8%. This finding is reinforced by Alemu (2017), who concludes

that a one unit increase in education expenditure leads to 0.30 unit decease in the practice of OD

across 33 African countries, statistically significant at the 1% level.

  While the role of education is seen as important in reducing OD rates in India, many

researchers have found that literacy rates are not the main determinant of latrine adoption in

India. For example, Coffey et.al (2014) examined the results of the 2012 Indian Human

Development Survey for rural Indian households. They found that 32% of the survey participants

holding a bachelor's degree or higher still practiced open defecation. Furthermore, 51% of rural

households that contained an adult who had completed high school still practiced OD regularly.

In order to make an international comparison, these findings can be contrasted with the results of

the Demographic and Health Survey (DHS) done on Bangladesh in 2011. In the DHS survey, it

was found that only 1% of participants who had attained secondary schooling defecated in the

open. Additionally, only 4% of households who have a member that had completed high school

still practiced OD.

  The aforementioned book, '*Where India Goes'* highlights this distinctiveness of India on

a macro level. The authors calculate that 28 countries have adult literacy rates that are lower than

India. However, 82% of these countries have better open defecation practices when compared to

India. These results can be seen in Figure 4 below. Hence, as was witnessed with income, it can

be observed that the lack of education may not be the main reason behind persistent OD practices
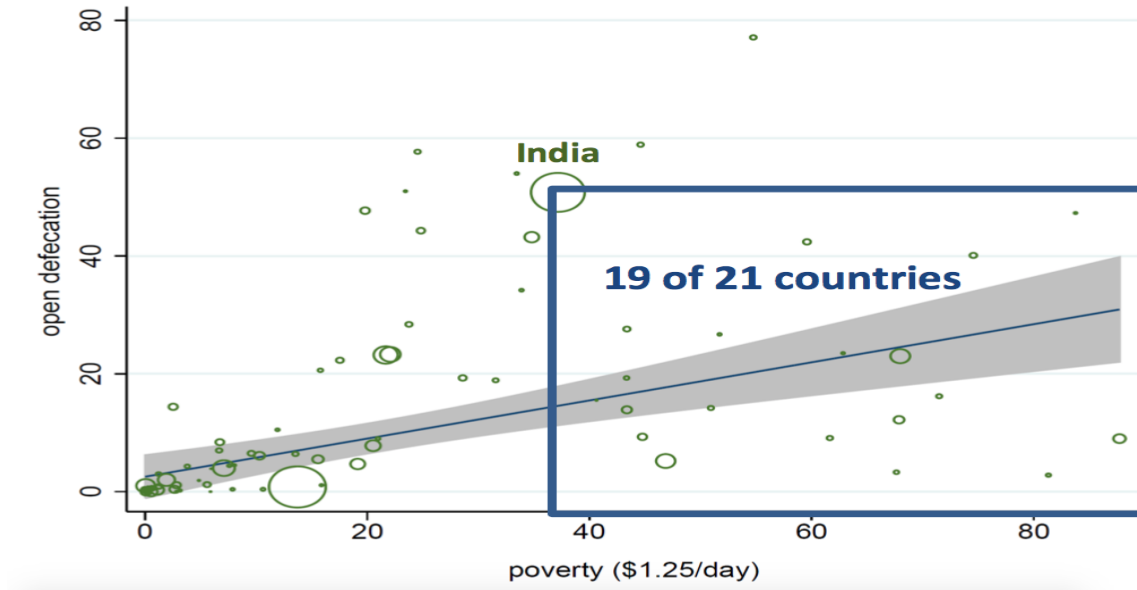
in India.

Figure 4: Indian OD does not occur because of illiteracy (Taken from Where India Goes by Dianne Coffey, et.al)

(Sources mentioned for figure- UNICEF-WHO JMP for OD, World Bank for literacy)

2.2.2 Water Availability

The importance of easy access to water as a significant determinant for latrine adoption

and eradication of OD practices has been a subject of much academic debate. On one side, there

has been a lot of research conducted that suggests that there is a significant correlation between

water and the ownership of a latrine. For example, Anderson et.al (2016), analyzing DHS survey

(2005-06) data undertaken on India, found that having access to water at home is associated with

a 4.23% increase in the probability of having access to a toilet, statistically significant at the 1%

level. Through this finding, they conclude, "having access to water is an important pre-requisite

for latrine construction". Additionally, Routray et.al (2015) concluded that a lack of running

water in latrines limited uptake across different social groups in Odisha, India. In particular, they

found that participants in their study required a lot of water for their post-defecation bathing

activity and would OD if they had less access to water. O'Reilly & Louis (2014) reinforced this

conclusion by finding that if villagers had access to water year-round; the practice of OD would reduce.

On the other side of the debate, many scholars state that water access does not play any significant role in the usage of toilets. For example, a study in rural Benin found that no statistical correlation between access to better water supply and the construction & subsequent use of toilets (Gross and Gunther, 2014). In regards to the Indian context, Kumar et.al (2015) upon analyzing data from the 2011 Indian census found that "almost half of rural households with piped water defecate in the open." Furthermore, Coffey et.al (2014) conducted qualitative research in rural North India and found that out of 99 interviews, water was never mentioned as being a significant factor to ending the practice of OD. Moreover, the aforementioned book, '*Where India Goes'* highlights this distinctiveness of India on a macro level. The authors find that despite the fact that 90% of people in rural India have access to an "improved water source", 48% of rural Indians practice OD. For comparison, while only 49% of people in rural sub-Saharan Africa have access to water, only 35% of them practice open defecation. These results can be seen in Figure 5 below.
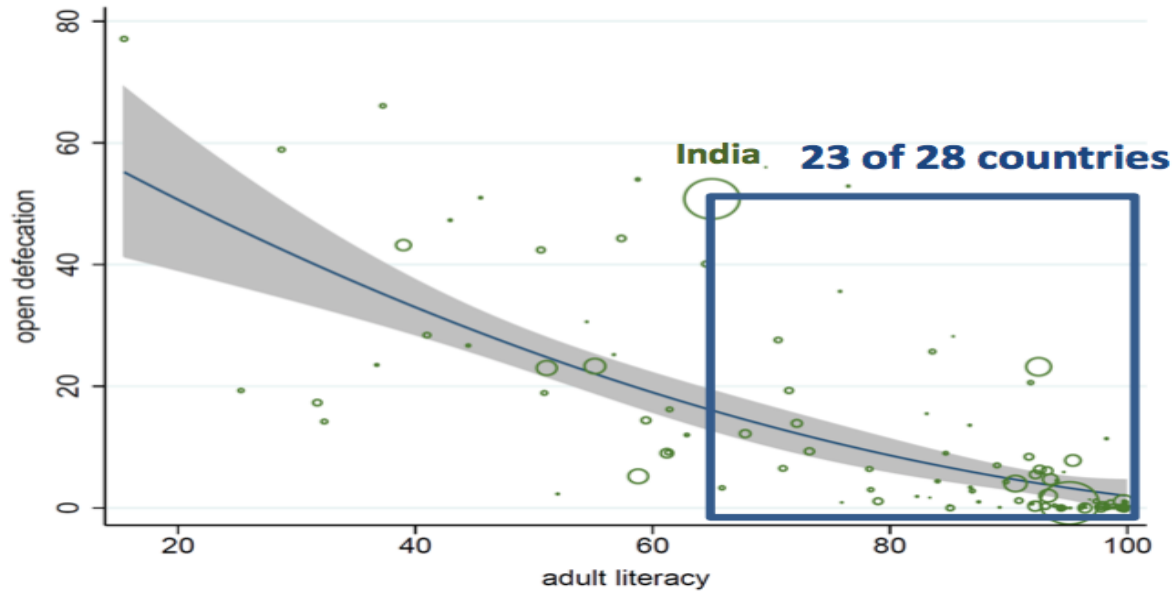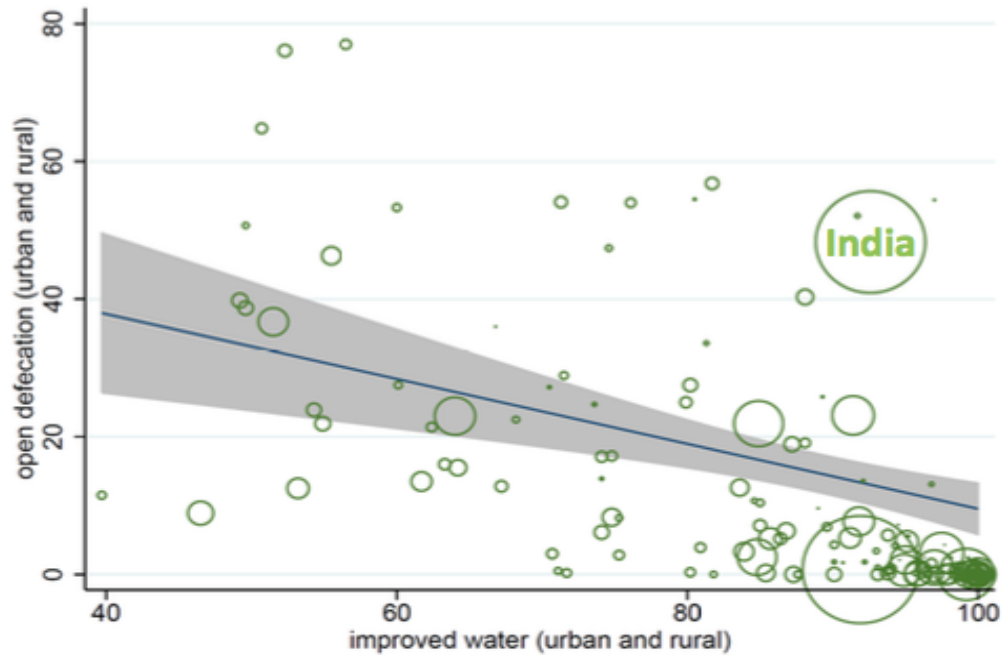
Figure 5: Indian OD does not occur because of lack of access to water (Taken from Where India Goes by Dianne Coffey, et.al) (Sources mentioned for figure- UNICEF-WHO JMP)

To test whether such conclusions held true in the northern states[5] of India, I found the percentage of households who received sufficient water throughout the year for all activities (including using a latrine). Next, I contrasted these figures with the percentage of households with a latrine in these states. The comparison can be observed in Table 1.

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[5] Bihar, Haryana, Uttar Pradesh, Rajasthan and Madhya Pradesh- Five states wherein 30% of the global population that practices OD is meant to reside (Coffey, 2014)

State Name	% Of Households who received sufficient water throughout the year for all household activities	% Of Households with a latrine
Bihar	93.4	18.1
Haryana	94.7	85.6
Uttar Pradesh	77.7	20.4
Rajasthan	96.5	41.4
Madhya Pradesh	78.7	24.4
All India Average (Rural)	86.0	37.7

Table 1: Source- NSS Survey done by Indian Ministry of Statistics and Program Implementation, 2012.

As can be noticed, almost all the states in Table 1 had more access to water for all household activities when compared to the national average. However, despite having greater access to water it is observable that the majority of the households do not yet own a latrine. Hence, this data reinforces the findings of Coffey (2014) and Kumar (2015) since the majority of rural households in these states do not own a latrine despite having access to water.

Such conclusions leads to the discussion of the *demand schedule*, an economic term that reflects a consumer's taste for a good at a range of levels. In general, taste depends on culture, income, prices of other goods, etc. If we apply such a theory to the demand for water, we find that our taste for water depends on how we use it. At first, a consumer has a very inelastic demand for the daily number of liters required to live. Hence, s/he will be willing to pay anything to get that amount of water. However, his/her taste for water will get weaker as s/he gets *additional* water that s/he would use for cooking food, washing utensils and yes, using a

toilet. Therefore, his/her demand for these items in the demand schedule is elastic (Zetland, *Living with Water Scarcity*, Page 9). This concept is visualized in Figure 7.
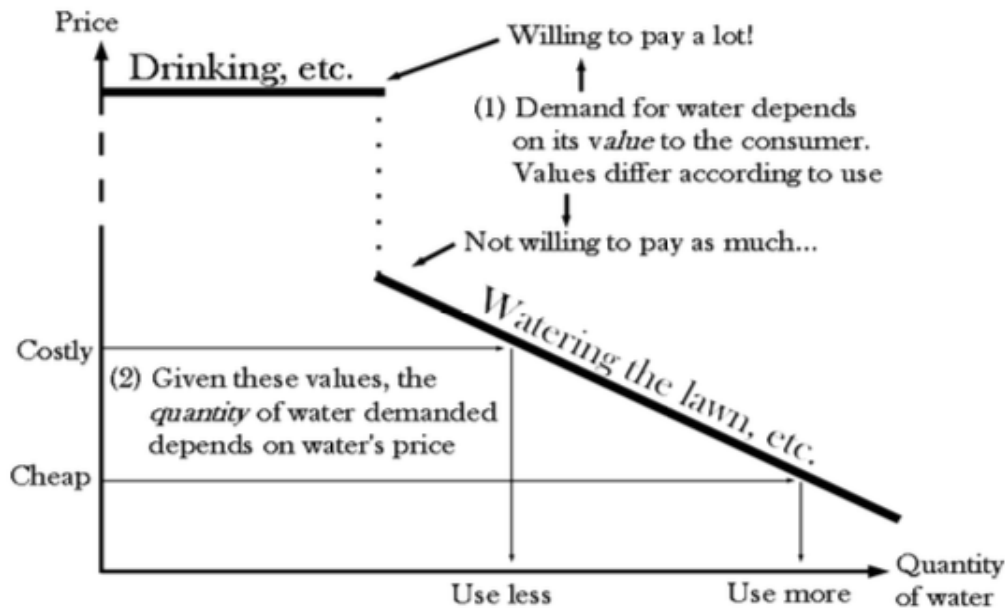
Figure 6: Taken from Zetland, *Living with Water Scarcity*, Page 10.

In simple terms, the demand schedule tells us that consumers have particular desired uses of water and prioritize the ones that they attribute more value to. Given these findings, it is fair to infer that the people in India might have an elastic demand in regards to using water for a latrine. Hence, while individuals in Indian rural areas have sufficient access to water, the rank of using this water for sanitation purposes on their demand schedule might be extremely low as stated by various studies.

2.2 Social Indicators

Upon conducting a review of the traditional/economic indicators for latrine adoption, it was seen that they might not be the main reasons behind persistent OD practices in India. Hence, I now review the social characteristics of Indian communities to see if they play a major role in explaining OD practices.

2.2.1 Religion

It is well known that the majority of Indians are followers of either Hinduism or Islam. According to the 2011 Census of India, the country was comprised of 79.8% Hindus and 14.2% Muslims. The remaining 6% is made up of Christians, Buddhists and Sikhs. From an economic standpoint, a 2011 survey conducted by the National Sample Survey Office (NSSO)[6] of India found that Muslims were the poorest amongst all religious groups in India. Their assessment used monthly per capita expenditure (MPCE) as a proxy for income and the standard of living of a family. It was found that an average Muslim living in rural areas had a MPCE of Rs. 833 as compared to an average Hindu who had an MPCE of around Rs. 900. Furthermore, the 2011 Indian Census also found that 43% of Muslims in India were illiterate as compared to 32% of Hindus.[7]

Despite the aforementioned facts that Hindus are richer and more educated than Muslims, research by different authors showcases that Hindus are far more likely to practice OD than Muslims. A study conducted by Geruso & Spears found that India's Hindu population is 19% more likely to practice OD than the minority Muslim population. In particular, they found that neighborhoods that were predominately inhabited by Muslim families were likely to have better health outcomes. For example, infant child mortality was 17% lower in Muslim neighborhoods as compared to Hindu communities. Furthermore, it was likely that child mortality would increase if a Hindu family started residing in a Muslim neighborhood. In essence, Geruso et.al found that externalities due to poor sanitation were a channel that linked the religious composition of communities to infant mortality. Rose George reinforces this finding in her book,

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[6] A department under the Indian Ministry of Statistics
[7] The survey defined illiteracy as having between 0 to 6 years of schooling.

The Big Necessity[8], where she states "it only takes one family without a latrine to pollute all common areas and drinking water. The irony of defecation is that it is a solitary business yet its repercussions are plural and public" (George, The Big Necessity, Page 186).

RS Khare (1962) found that there was a significant relationship between latrine adoption and Hindu views of ritual purity and pollution. He states that the words 'dirty' and 'clean' are ritual concepts as well as physical ones. In particular, a study he conduced in Uttar Pradesh showcases how Hindus find "some objects physically clean but ritually polluting". A latrine is seen as one such object. For Hindus in India, Coffey et.al (2014) finds that "distaste of latrines has to do with the importance of maintaining purity in the home." While many of such respondents can afford to build a simple pit latrine at home, they choose not to as they consider the smell of defecation to be ritually polluting to their house. Such beliefs have been passed down through a 2000-year-old Hindu religious text called the Laws of Manu. In particular, the book states the idea that one should defecate far from the home in order to preserve its purity. Hence, rural Hindus seem to stress that it is good to defecate in the open.

From a Muslim standpoint, Jeffery (2002) and Ali (2002) find that rural Indian Muslims do not follow the Hindu notions of ritual purity & pollution and are therefore, more likely to build simple pit latrines. Furthermore, on an international level, Hathi et.al (2014) conducted a counterfactual analysis to understand the level Indian sanitation coverage could reach if India had the same fraction of Muslims as Bangladesh.[9] They build several models using a progression of variables that captured the number of Muslims alongside multiple control variables. In their

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[8] I have shortened the title of the book for brevity. The full title is- *The Big Necessity: Adventures in the World of Human Waste.*

[9] India's population is currently 12.5% Muslim as compared to Bangladesh that has a Muslim population of 88.7% (Hathi, 2014)

final model, they concluded that sanitation coverage in India would improve from 45% to 81% if India had the same fraction of Muslims as Bangladesh.

The role that religion plays on sanitation has also led to major political ramifications in the past. For example, Bihar's government, in response to its extremely low ranking on the *Clean India Index*, stated on World Toilet Day 2013, that they planned to construct over 11 million bathrooms by the year 2017. However, interestingly enough, in 2016, the government dropped the clause that a mandatory toilet was required at the house of any candidate running for local panchayat elections (Indian Express, 2016). This move seems to be motivated by political considerations to appeal to the cultural beliefs of the majority Hindu rural voter base present in the state. Furthermore, future policy recommendations (such as conducting rural health education drives) to remove Hindu concepts of ritual purity could also lead to religious tensions between the Hindu and Muslim communities. Ultimately, the stark disparity between Hindu and Muslim OD and child mortality rates does showcase that religious beliefs might play an important role on sanitation practices in India.

2.2.2 The Caste System

No conversation about Hindu notions on ritual purity and pollution can be completed without analyzing the caste system that is present in Indian society. The religious book, Manusmriti (written around 3000 years ago) formed the basis of this system. This book divided Hindus into four main categories based on their karma (work) and dharma (duty). These categories from top to bottom were the Brahmins (priests & teachers), Kshatriyas (warriors & rulers), Vaishyas (farmers & merchants) and the Dalits (untouchable manual scavengers). The basis of the hierarchy in the caste system is rooted in the Hindu perceptions of purity and pollution. Due to the belief in karma, Hindus believe that people are reincarnated with their next life representing

either a reward or a retribution for their actions in their previous life. Hence, it was believed that being born in a lower caste was the punishment individuals had received as a result of their actions in past lives (Majid, 2012). Members of each category were not allowed to marry outside their caste. Furthermore, higher caste members refused to share anything with lower caste members, often making them live in segregated communities. Historically, the Dalits were the ones assigned to perform the most "menial of tasks" such as "manual scavenging, removing human waste & dead animals, leather workers and street sweepers" (Majid, 2012). Hence, they were assigned the tag *untouchable.* Anthropologist Sarah Pinto puts across this Hindu-held circular notion of caste and ritual cleanliness well, as Dalits were "considered dirty because they performed dirty jobs, and the jobs were dirty because Dalits performed them" (Coffey, Where India Goes, Chapter 3).

While this sort of rigid social stratification is not unique to India and has been legally banned since 1950, associations with caste are still extremely prevalent in rural Indian society. For example, a 2006 survey of 565 villages in 11 Indian states found that Dalit children in 37.8% of government schools were forced to sit apart from other children during meal-times (George, The Big Necessity, Page 89). Furthermore, it was found that people born into low-ranking castes in India continue to face economic, political, social, and health disadvantages coupled with daily discrimination (Despande, 2011). Hence, to showcase that the national government is trying to eliminate caste in Indian society, there are widespread political quotas that implement reservations on local political positions. In essence, there are various positions in the government that have to be held by members of lower classes.

To measure the effect of caste on sanitation, Lamba et.al (2013) combined such political reservations alongside a sanitation policy that promised to give village government leaders an ex

post cash incentive if they were able to eliminate open defecation in their community. Hence, this incentive was meant to be a prize for both toilet construction and use. They used data from Rajasthan for village chairmen (elected in 2005) to measure how likely they were to win the government's Clean Village Prize in 2012. The results of this study were that "villages reserved for low-caste chairmen were about two percentage points less likely to win the prize, a reduction of more than one-third" (Lamba, *Caste, 'Cleanliness' and Caste*, Page 3). Hence, they saw that villages with Dalit chairmen were less likely to win the prize due to the likelihood that higher-caste members in those communities refused to take orders from their Dalit leaders. In essence, this study showcases the interactions felt between caste and sanitation, suggesting that the caste system could be a barrier to improving sanitation.

Alexander et.al (2016) also wanted to measure if caste conflicts result in higher rates of OD. Hence, while analyzing Indian survey data, they created a binary variable serve as a proxy for the presence of *casteism*. This variable would be equal to 1 if the participant answered that the village sees caste-based conflicts or 0 if all castes live peacefully together. They found that for households with latrines, 18.3% of respondents reported conflicts between castes. Furthermore, "such individuals who report conflict between castes in their village have higher rates of OD on average, statistically significant at the 1% level" (Alexander et.al, Ending Open Defecation in India, Page 16). A qualitative explanation of this finding is that members of the Dalit caste that are traditionally considered responsible for performing manual scavenging (i.e. cleaning OD and latrines) do not want to perform such work in the 21st century. Hence, they have conflicts with members of higher castes since they do not want to clean their feces. As a result of this, higher-caste members who have toilets let them become unusable and then revert back to their practice of OD, leading to an overall surge in OD rates (Coffey et.al 2014). Professor Teltumbde of IIT

Kharagpur strengthens this explanation as he states "The Hindu notion of purity only exists

inside their homes. Once outside they can throw their trash and practice OD anywhere. It is not

merely out of laziness but also to assert their superiority on Dalits." (Coffey, Where India Goes,

Chapter 3). Ultimately, it can be seen that the perseverance of the Hindu caste system & the

notion of 'Untouchability' plays a major role in determining the OD rates of an Indian

community.

2.2.3 Gender

Given the inherent role that religion & the caste system play on the prevalence of OD, it

is important to analyze if the sex of an individual is a major factor in indicating OD practice. A

study conducted by Routray et.al (2015), found that there is a strong consensus among rural

Indians that the latrine is a commodity that is mostly been built for maintaining a woman's honor

in society. Due to this long-held belief that toilets are for women (the primary homemakers),

many national campaigns such as 'Poo2Loo' and the 'No Toilet, No Bride' aimed at building

toilets simply for the convenience of women.

Another important factor to consider regarding gender is the kind of role that rural Indian

women play in the households. Traditionally, it is the male heads of the households that make the

major economic decisions such as spending money to build a latrine. The aforementioned study

conducted by Routray et.al (2015), did find that male heads do show a particularly stronger

interest in constructing a bathroom when a newlywed daughter-in-law starts living in the

household. The authors ascertain that this occurs due to the traditional Indian values of *purdah*

and *ghuunghat*, cultural norms that state that the women of the household should cover

themselves and remain out of public view in their in-laws house. Hence, male heads of such

households are more likely to construct a toilet for their daughter-in-law in order to protect her

from being seen defecating outside by other men of the village. However, once the daughter-in-law has been married for a couple of years, she has to join the other women of the household in walking for miles during early morning hours or late at night to defecate in private. According to the BBC, more than 870 cases of rape were reported in Bihar in 2013. Police officials say over 400 of the women who had been raped could have "easily escaped" had they been given access to a proper bathroom at home.

However, despite such statistics, Coffey et.al (2014) find that only 4.3% of the women that they interviewed had been scared to OD due to security reasons. For them, practicing OD was seen more of a 'daily social occasion' where four to five women can band together and freely leave their household for sometime. Furthermore, the authors argue that sanitation campaigns aimed at women will not have a major effect. They state that even if women had the decision-making powers, they may not necessarily choose to build latrines. While they would benefit more than men with access to toilets, they could possibly reject simple toilets for the same reasons as men. These reasons include the joint belief that latrines and pit emptying are ritually polluting. Hence, it can be seen that while security may be a concern at a government level, the physical demand for toilets by women is low since they enjoy the freedom of movement and shared beliefs that practicing OD gives them. Ultimately, this results in women not demanding the male heads to construct toilets due to their underlying cultural low-status in the household, leading to further open defecation.

3. HYPOTHESIS

Analyzing the literature surrounding three important economic indicators (income, years of education and water availability) showcased that Indians are much better off than their

counterparts in other developing countries. Across the three indicators, it was observed that

Indians had higher income, literacy rates and better access to water. Due to these findings, I

analyzed the literature regarding social indictors such as the religion, caste and gender of the

individuals practicing open defecation.

The literature review of the social indicators showcased that each determinant plays a

major role in influencing the demand (or lack of) for sanitation in rural North India. The Hindu-

held notions of purity & pollution has led to a stark contrast in the rates of OD between Hindu

and Muslim households. Due to this culture of OD, rural Hindu households have higher rates of

child mortality than Muslim ones despite the fact that they are richer and more literate on

average. Furthermore, the perseverance of the caste system in India has added to persistent OD

practices. Lastly, the low-status of women has led to the lack of demand for toilets by them

despite OD endangering their safety and ultimately, their children's health & future.

As was mentioned earlier, the central government of India is making good headway in

providing citizens access to toilets through the ongoing Swachh Bharat campaign. [10] On the other

hand, it has only allocated 5% of total funds to Information, Education & Communication (IEC)

efforts (in FY2015-16) to tackle the social determinants of OD practice in India.

Due to the literature review of the indicators of OD that I have conducted in addition to the

review of successful international sanitation efforts, I believe that prioritizing toilet construction

will not fix the entire issue. Instead, I think a much larger proportion of Swachh Bharat funds

need to be allocated to IEC efforts to influence behavioral change. Hence, the hypothesis that I

want to prove through my thesis is: *'While building toilets does provide the means, the issue of*

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[10] According to official government figures, the number of rural citizens with access to toilets has increased from 38.7% (in 2014) to 82.72% as of April 2018. Furthermore, the government states to have constructed over 70 million toilets since 2014.

poor sanitation in Northern India will continue to be of concern unless the behavioral and

cultural factors are addressed.'

4. DESCRIPTION OF DATA AND METHODOLOGY

The northern states of India such as Bihar, Haryana, Madhya Pradesh, Rajasthan and Uttar

Pradesh are of particular interest to me since it is estimated that over 30% of the global

population that practices OD is living in one of these states as shown in Figure 7 (Coffey, 2014).
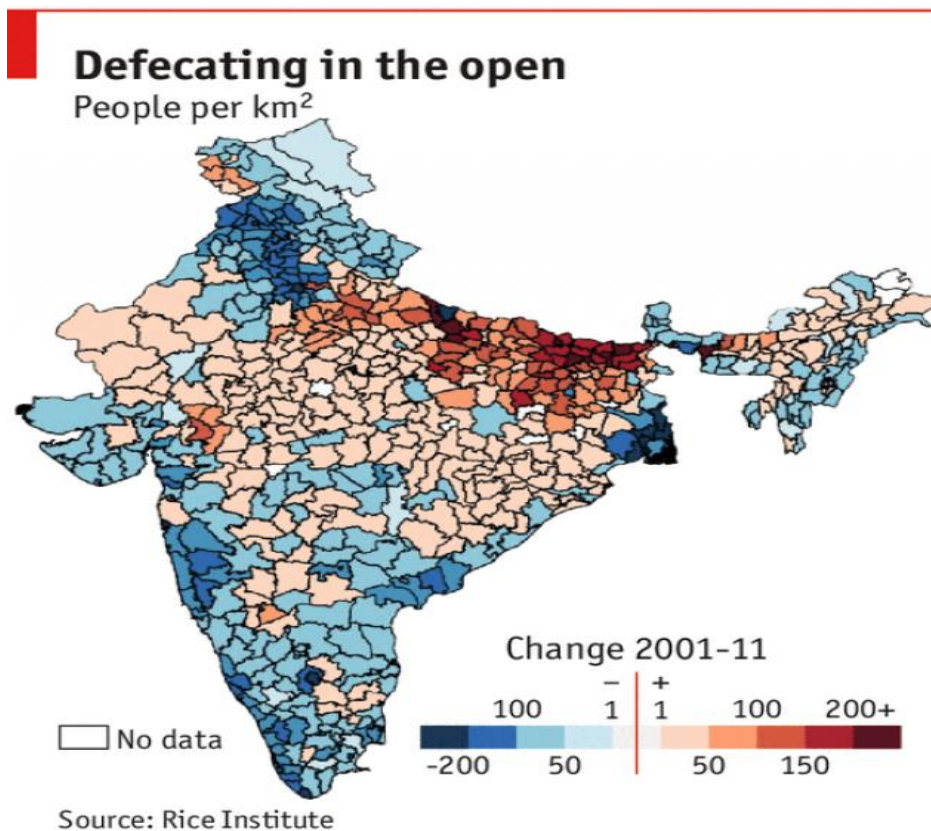

Figure 7: The northern states of India have much higher rates of Open defecation

In order to test my hypothesis, my main source of data is the 2014 Sanitation, Quality, Use,

Access, and Trends (SQUAT) survey conducted by the Research Institute for Compassionate

Economics (RICE).[11] This study was conducted in all five of the aforementioned northern states of India and contains 24,070 observations from 3,325 households. [12]

I will be examining this dataset to analyze my hypothesis. In particular, I have outlined two sets of variables through this dataset, namely economic and social indicators. The economic indicators include wealth (income), years of education and water availability. On the other hand, the social indicators include the role of religion, the caste system and the gender of the respondent. I first build logistic regression models that compare each indicator that I have outlined to an individual's tendency to practice OD.[13] Following such preliminary regression models, I create logistic regression models that include the interaction terms between different economic & social indicators. Through such regressions with interactions, I aim to showcase the importance of social indicators in North India when the economic indicators are held constant between two respondents. Lastly, I discuss the possible policy implications of such an analysis in regards to the aforementioned Swachh Bharat campaign in India and state the general steps that should be taken to eradicate the practice of OD.

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[11] A think-tank set up in India by two Princeton researchers namely Dianne Coffey and Dean Spears
[12] The raw data from the survey and the accompanying questionnaire can be obtained from the riceinstitute.org website
[13] It is the variable labeled 'g2_1' in dataset that is a binary variable.

4.1 Description of Variables Created & Used

VARIABLES	N	Mean	SD	Min	Max
Dependent Variable					
Tendency to OD	22,235	0.639	0.480	0	1
Predictor Variables					
Economic Indicators					
Number of Assets Owned	22,235	9.783	4.721	0	26
Years Educated	20,533	5.417	4.764	0	16
Access to Water	12,307	0.790	0.407	0	1
Social Indicators					
Religion	22,235	0.908	0.289	0	1
Caste	21,432	2.947	0.922	1	5
Gender	22,235	0.527	0.499	0	1

Figure 8: Summary Statistics of All Variables Used

The dependent variable used in my analysis is an individual's answer to where they would normally choose to defecate.[14] This is a binary variable with the usage of a latrine coded as '0' and choosing to OD coded as '1'.[15] I decided to code the practice of OD as '1' as my aim is to understand why a person would choose to OD and not whether or not they decide to use a latrine. Of the 24,070 observations in the dataset, there were 1,835 missing entries for this variable (7.62%), all of which I dropped in order to analyze an individual's tendency to OD with each of the predictor variables.

The first set of predictor variables, namely the economic indicators, begins with measuring the household wealth of the respondent. In section E of the SQUAT survey, respondents were asked to state whether or not they owned various assets such as a bed,

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[14] Answer to the question G.2.1 asked in the survey
[15] Please see graph on Tendency to OD in Figure B1

electricity, TVs, toilets, tables, mobile phones, etc. In order to measure wealth, I created a

variable 'asset_count' that summed the total number of assets that the household owned with all

assets being ascribed equal weightage for simplicity.[16] Furthermore, I performed a median split

and created a dummy variable ('isWealthy') to state whether a household could be stated as

being rich or poor. In this split, any household that owned higher than nine assets was considered

to be rich whereas any household with less than or nine assets exactly considered poor. The

second economic indicator was the years of education that each respondent had completed in

order to measure literacy rates.[17] In addition to removing the 1,398 missing values observed in

this variable, I removed 304 values wherein the respondent had completed non-traditional forms

of education such as 'Madrasa study', 'vocational education' and 'any other diploma' in order to

maintain simplicity.[18] Furthermore, I created a dummy variable to determine whether the

respondent should be considered literate based on the Indian census definition of illiteracy.[19] In

order to derive the last economic indicator (access to water), I performed a median split on the

second question[20] in the N section of the SQUAT survey. This binary variable was coded as '1'

if the water source was inside or attached to the respondent's home. On the other hand, if the

respondent had to walk outside their house in order to access water, the variable was coded as

'0'.[21] Since this question was only asked to female respondents of the survey, there are only

12,307 entries available for this indicator.

     The second set of predictor variables, namely the social indicators, begins with

determining the religion of the respondent. 90.77% of the respondents identified as followers of

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[16] Please see graph on asset_count in Figure B2
[17] This was variable B1.5 in the SQUAT survey
[18] Please see graph on years of education in Figure B3
[19] A person is considered illiterate if they have completed between 0-6 years of schooling
[20] The question asked the respondent how much time did it take for them to reach the water source
[21] Please see graph on access to water in Figure B4

Hinduism. The remaining 9.23% of respondents identified as followers of Islam, Christianity, Buddhism and Sikhism.[22] However, an overwhelming majority (82%) of the Non-Hindu respondents identified as Muslims. Such a sample is similar to the overall Indian population.[23] Due to theoretical expectations based on the literature review, I created a binary variable to determine if the respondent was Hindu or not. The next social indicator was the caste that each respondent was born into. As can be seen in Figure B6, respondents identified themselves as being part of a particular caste in society. In addition to removing missing entries, I deleted responses such as 'other caste' and 'don't know' (a combined 2.92% of all observations) to provide simplicity. Furthermore, I created a dummy variable called 'isHighCaste' which was coded as '1' if the respondent identified as a Brahmin or as part of an 'Other High Caste' (OHC). On the other hand, this binary variable was coded as '0' if the respondent was part of the Other Backward Caste (OBC), Scheduled Caste (SC) or Scheduled Tribes (ST). The last social indicator, gender, was ascertained using the answers of the respondents to question B1.2 of the SQUAT survey[24]. The gender variable was coded as '1' if the respondent was a man and '0' if the respondent was a woman.[25]

5. TESTS CONDUCTED & RESULTS

5.1 Preliminary Logistic Regression Models

The initial logistic regression models compared each economic and social indicator separately to measure their individual impact on the respondent's tendency to practice open

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[22] Please see graph on distribution of religions in Figure B5
[23] According to the 2011 Census of India, the country was comprised of 79.8% Hindus and 14.2% Muslims. The remaining 6% is made up of Christians, Buddhists and Sikhs.
[24] Question B1.2 asked the respondent to state their sex.
[25] Please see graph on gender in Figure B7

defecation.[26] Hence, the first regression model measured the effect of wealth on the individual's

tendency to OD (Table C1). As can be seen in the model, the odds of the respondent OD'ing

decreases by a factor of 0.767 or by 23.3% for every additional asset owned by the respondent,

statistically significant at α=1%.[27] This difference is also shown graphically in Figure C1.

Next, I measured the effect of education on the tendency to practice OD (Table C2). In

this model, I found that the odds of the respondent OD'ing decreases by 9.4% for every

additional year of education by the respondent, statistically significant at α=1%.[28] This difference

is also shown graphically in Figure C2. The effect of the last economic indicator, access to water

is measured in Table C3. As can be seen, the model states that the odds of the respondent OD'ing

decreases by a factor of 0.310 if the respondent has access to water, statistically significant at

α=1%.[29] Hence, each of the three economic indicators is proven to have an important effect on

an individual's tendency to practice OD. Of all three, water access can be seen as the most

powerful as it reduces the odds of OD by 69%.

Moving onto the social indicators, I first measured the role of religion on the

respondent's tendency to OD. As seen in Table C4, the odds of practicing OD increase by 67.1%

for Hindu respondents as compared to a non-Hindus, statistically significant at α=1%.[30] Next, I

measured the effect of the caste system on OD practices. Since there were five castes (i.e.

Brahmin, OHC, OBC, SC, ST), I used the Brahmin caste as a comparison variable to measure

the effects of being born in different castes in Indian society. This model can be seen in Table

C5. First, the odds of practicing OD decrease by 24.4% for 'Other High Caste' respondents

compared to the Brahmin Caste respondents. Second, the odds of practicing OD increase by

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[26] For all preliminary regression results, please refer to Appendix C
[27] LR χ^2 (1)= 60002.06, statistically significant at α□□□
[28] LR χ^2 (1)= 1024.57, statistically significant at α□□□
[29] LR χ^2 (1)= 546.98, statistically significant at α□□□
[30] LR χ^2 (1)= 119.63, statistically significant at α□□□

70.7% for 'Other Backward Caste' members as compared to the members of the Brahmin Caste members. Third, the odds of practicing OD increase by a factor of 3.71 or by 271% for 'Scheduled Caste' members as compared to members of the Brahmin Caste. Fourth, the odds of practicing OD increase by a factor of 10.71 or by 971% 'Scheduled Tribe' members as compared to members of the Brahmin Caste. All Odd Ratios' (OR) were statistically significant at α=1%. [31] Hence, it can inferred that the lower castes in Indian society, in particular, members of the SC and ST have a much higher likelihood of practicing OD as compared to higher castes such as Brahmins. Finally, I ran a regression to measure the effect of gender on an individual's tendency to practice OD. As can in Table C6, the odds of practicing OD increase by 10.4% for males as compared to females, statistically significant at α=1%.[32]

5.2 Logistic Regression Models using Interactions

While the initial regression models do show the importance of each predictor variable, it can be argued that the underlying correlations between the different economic & social variables might distort the results.[33] For example, as mentioned earlier, high caste Hindus have been consistently shown to be wealthier and more educated. Due to these facts, higher castes Hindus will always have lower odds of OD'ing as compared to members of lower castes when measured in isolation.[34] Hence, to showcase the individual importance of each social variable, I now build logistic regression models that include the interaction terms between different economic & social indicators. In this way, the odds of OD for literate lower caste respondents can be compared to the odds of OD for literate higher caste respondents. Since education is held constant for both, any difference in the odds for practicing OD can be attributed solely to the difference in castes.

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[31] LR χ^2 (4)= 1616.98, statistically significant at α□□□
[32] LR χ^2 (1)= 12.47, statistically significant at α□5□
[33] Please refer to Table B1 for correlation matrix
[34] As was done in the preliminary regression models

Ultimately, through such techniques, I am able to showcase the distinctive effect of each social variable.

5.2.1 The Role of Religion

The first social variable I examine is religion through interacting the 'isHindu' binary variable with the constructed dummy variables for wealth, literacy, water access[35] and gender in order to answer the series of research questions outlined below. I use the results of such research questions to display the underlying, individual importance of religion on OD practices in North India.[36]

i.   *Are Wealthier Hindus more likely to OD as compared to Wealthier non-Hindus?*

As can be seen in Table D1, the model states that the odds of practicing OD decrease by 75.5% for wealthy non-Hindus as compared to a decrease of only 62% for wealthy Hindus, both statistically significant at α=1%.[37] Hence, this showcases that while income plays an important role, a Non-Hindu is much more likely to stop OD'ing if they are wealthier as compared to a wealthier Hindu.

ii.   *Are Literate Hindus more likely to OD as compared to Literate non-Hindus?*

The results of this model (as seen in Table D2) show that the odds of the respondent OD'ing decrease by 5.7% if the respondent is a literate Hindu. However, the coefficient is observed to be statistically insignificant. On the other hand, the odds of the respondent OD'ing decrease by 39.5% if the respondent is a literate non-Hindu, statistically significant at α=1%.[38] Due to statistical insignificance, it is unclear whether a Non-Hindu is much more likely to stop OD'ing if they are literate as compared to a literate Hindu.

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[35] These dummy variables include: wealth- isWealthy, education- isLiterate and water access as described earlier.
[36] Please refer to Appendix D for all regression results for the role of religion
[37] LR χ^2 (3)= 4431.59, statistically significant at $\alpha\square\square\square$
[38] LR χ^2 (3)= 813.13, statistically significant at $\alpha\square\square\square$

iii.   Are Hindus with easy water access more likely to OD as compared to non-Hindus

with easy water access?

The results of this model (as seen in Table D3) show that the odds of practicing OD decrease by

53.3% for non-Hindus with access to water. In comparison, the odds of practicing OD decrease

by only 12.4% for Hindus with access to water. Both results were statistically significant at

α=1%.[39] Hence, this showcases that while water access plays an important role, a Non-Hindu

respondent is much more likely to stop OD'ing if they have access to water as compared to a

Hindu respondent.

iv.   Are Wealthy Hindus with water access more likely to OD as compared to Wealthy

non-Hindus with water access?

In this question, to see the individual effect of religion, I held both wealth and water access

constant. As shown in Table D4, the odds of practicing OD decrease by 85.4% for wealthy non-

Hindus with access to water. In comparison, the odds of practicing OD decrease by only 71.4%

for wealthy Hindus with access to water. Both results were statistically significant at α=1%.[40]

Hence, this showcases that with wealth and water access held constant, a wealthy Hindu with

water access is much more likely to OD as compared to a wealthy non-Hindu with water access.

v.   Are Hindu men and women more likely to OD as compared to non-Hindu men &

women?

Hindu men are also more likely to OD than non-Hindu men. This finding is shown in Table D5

which concludes that that the odds of practicing OD increase by 91.6% for Hindu males as

compared to a increase of only 20.4% for non-Hindu males, statistically significant at α=1% and

α=5% respectively. Hence, this showcases that Hindu men are more likely to openly defecate

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[39] LR χ^2 (3)= 701.30, statistically significant at α□□□

[40] LR χ^2 (7) = 2795.08, statistically significant at α□□□

than non-Hindu men. On the other hand, it is unclear if Hindu women are more likely to OD than non-Hindu women. While the model shown in Table D5 does show that the odds of the respondent OD'ing increase by 75.7% if the respondent is a Hindu female (statistically significant at α=1%), the increase in odds for non-Hindu females by 1.4% is statistically insignificant.[41] Hence, I cannot ascertain if Hindu women are more likely to OD than non-Hindu women.

    vi.   Are literate Hindu men & women more likely to OD as compared to literate non-Hindu men & women?

In this question, to see the individual effect of religion, I held both wealth and water access constant. However, as shown in Table D6, the model displays statistically insignificant results for both literate Hindu men & literate Hindu women.[42] Hence, the research question cannot be answered through this model.

5.2.2 The Role of the Caste System

The previous section showcased that religion has an important effect on the tendency of an individual to practice open defecation in North India. Given this finding, the underlying caste system might provide further disparities in OD practices between the lower and upper castes that are present in Hindu society. As mentioned earlier, I created a dummy variable called 'isHighCaste' which was coded as '1' if the respondent identified as a Brahmin or as part of an 'Other High Caste' (OHC). On the other hand, this binary variable was coded as '0' if the respondent was part of the Other Backward Caste (OBC), Scheduled Caste (SC) or Scheduled Tribes (ST). Hence, I now examine the role of the caste system through interacting the 'isHighCaste' binary variable with the constructed dummy variables for wealth, literacy, water

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[41] LR χ^2 (3) = 132.66, statistically significant at α□□□
[42] LR χ^2 (7) = 893.05, statistically significant at α□□□

access[43] and gender in order to answer the series of research questions outlined below. I use the results of such research questions to display the underlying, individual importance of the caste system on OD practices in North India. [44]

    i.   *Are Wealthy Lower Caste Hindus more likely to OD as compared to Wealthy Higher*

        Caste Hindus?

As can be seen in Table E1, that the odds of practicing OD decrease by 93.21% for wealthy high caste Hindus as compared to a decrease of only 84.3% for wealthy lower caste Hindus, both statistically significant at α=1%. [45]Hence, this showcases that while wealth plays an important role, a lower caste respondent is much more likely to OD as compared to a respondent who belongs to a higher caste.

    ii.   *Are Literate Lower Caste Hindus more likely to OD as compared to Literate Higher*

        Caste Hindus?

The results of this model (as seen in Table E2) show that the odds of practicing OD decrease by 81.7% for literate high caste Hindus as compared to a decrease of only 51.1% for educated lower caste Hindus, both statistically significant at α=1%.[46] Hence, this showcases that while education plays an important role, a lower caste respondent is much more likely to OD as compared to a respondent who belongs to a higher caste.

    iii.   *Are Lower Caste Hindus with access to water more likely to OD as compared to*

        Higher Caste Hindus with access to water?

As can be seen in Table E3, the model states that the odds of practicing OD decrease by 89.3% for higher caste Hindus with access to water as compared to a decrease of only 67.5% for lower

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[43] These dummy variables include: wealth- isWealthy, education- isLiterate and water access as described earlier.
[44] Please refer to Appendix E for all regression results for the role of religion
[45] LR χ^2 (3) = 4824.89, statistically significant at α□□□
[46] LR χ^2 (3) = 1781.40, statistically significant at α□□□

caste Hindus with access to water, both statistically significant at α=1%.[47] Hence, this showcases

that while access to water plays an important role, a lower caste respondent is much more likely

to OD as compared to a respondent who belongs to a higher caste.

  iv. *Are lower caste men & women more likely to OD as compared to higher caste men &*

     women?

Lower caste men are much more likely to practice OD than higher caste men. This finding is

shown in Table E4 which concludes that the odds of practicing OD decrease by 63.6% for higher

caste males as compared to an increase of 8.4% for lower caste males, both statistically

significant at α=1%. On the other hand, lower caste women are also much more likely to practice

OD than higher caste women. The odds of practicing OD are 69.1% lower for higher caste

females as compared as to the odds for a lower caste woman to practice OD, statistically

significant at α=1%.[48] Hence, such findings showcase that while gender plays an important role,

a lower caste respondent is much more likely to OD as compared to a respondent who belongs to

a higher caste.

  v. *Are lower caste literate men and women more likely to OD as compared to higher*

     caste literate men?

In this question, to see the individual effect of caste system, I held both education and gender

constant. As shown in Table E5, the odds of practicing OD decrease by 77.2% for literate higher

caste males as compared to a decrease of only 41.1% for literate lower caste males, both

statistically significant at α=1%. The same holds true for literate lower caste women in

comparison with literate higher caste women. The odds of practicing OD decrease by 82.7% for

literate higher caste females as compared to a decrease of only 51% for literate lower caste

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[47] LR χ^2 (3) = 1216.01, statistically significant at α□□□
[48] LR χ^2 (3) = 1276.18, statistically significant at α□□□

females, both statistically significant at α=1%.[49] Hence, this showcases that with education and

gender held constant, a lower caste literate men and woman are much more likely to OD as

compared to higher caste literate men & woman.

5.2.3 The Role of Gender

 I examine the role of gender through interacting the 'IsMale' binary variable with the

constructed dummy variable for literacy in order to attempt answering the research question

outlined below. The result of the research question does display the underlying importance of

religion on OD practices. The reason that I have not run regressions holding wealth & water

access constant (as I did in evaluating religion and caste) is because those variables have been

calculated at a household level as compared to gender which is calculated at the individual

level.[50]

 i. *Are literate men more likely to OD as compared to literate women?*

As shown in Table F1, the odds of practicing OD decrease by 51.8% for literate females as

compared to a decrease of only 40.3% for literate males, both statistically significant at α=1%.[51]

Hence, this showcases that literate women are less likely to OD as compared to literate men.

6. DISCUSSION, POLICY IMPLICATIONS AND FUTURE WORK

6.1 Discussion and Implications of Findings

 In the preliminary regression models that I ran, each of the economic and social variables

was shown to have a statistically significant effect on an individual's tendency to practice open

defecation. From the economic indicators, the availability of water seemed to most important

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[49] LR χ^2 (7) = 1849.23, statistically significant at α☐☐☐
[50] Please refer to Appendix F for regression results for the role of gender
[51] LR χ^2 (3)= 725.79, statistically significant at α☐☐☐

influencer given that the odds of OD went down by 69% if the respondent had easy access to water. On the other hand, the social indicators such as religion showed that Hindu's have 67.1% higher odds to practice OD as compared to non-Hindus. Furthermore, the practice of OD seems to really affect the lower castes of Hindu society. This was seen in the fact that the odds of practicing OD was 271% greater for members of SCs and 971% greater for members of STs than the odds of a Brahmin practicing OD. Lastly, it was expected that the odds for men practicing OD should be higher as compared to women given the livelihood & role of rural Indian men as opposed to Indian women. The regression confirmed this theory, as men were 10.4% more likely to practice OD than women.

Next, I showcased the distinctive effect of each social variable by building logistic regression models that included the interaction terms between different economic & social indicators. Through such an analysis, I obtained answers for various research questions that displayed the importance of each social variable. First, it was observed that Hindus who are wealthy, literate and have access to water still have higher odds to practice OD as compared to non-Hindus. Such findings displayed the importance of the underlying Hindu notions of ritual purity and pollution. Second, when analyzing the role of caste, it was found that lower caste members who are wealthy, literate and have access to water still have higher odds to practice OD as compared to higher caste Hindus. This finding implies that the job of disposal of human feces that have been traditionally assigned to members of lower caste might still be present. Furthermore, it shows that the Hindu notion of 'Untouchability' has led to the economic and geographic isolation of lower caste members causing them to practice OD. Third, the results from analyzing gender were similar to what has been seen in other studies. For example, it has often been stated that education of women should be targeted in order to reduce OD. This was

showcased in the regression ran which showed that literate females have a 10% larger decrease in tendency to practice OD as compared to their educated male counterparts. Ultimately, such an analysis did prove my initial hypothesis as it was found that social indicators such as religion, caste and gender have significant effects on an individual's tendency to practice OD independent of any economic indicators. Hence, they need to be addressed in order to sustainably eliminate the practice of OD in India.

Such a conclusion does provide a major policy implication to the aforementioned $22 billion Swachh Bharat (Clean India) campaign currently being undertaken in India. Upon examining the financials of the campaign, it can be seen that the SBA is making the age-old mistake of being another supply-focused latrine construction drive with 92% of the overall budget being allocated to building toilets in FY 2014. Only 5% of the remaining budget was allocated towards Information, Communication and Education (IEC) campaigns targeted for eradicating the social drivers of open defecation. In essence, such mistakes showcase the dichotomy of the Swachh Bharat campaign, as it is currently a supply-side infrastructure building policy working on solving a demand-driven social problem.[52]

Hence, I recommend that the Swachh Bharat campaign acknowledge that changing social norms and attitudes are crucial in eradicating open defecation and generating latrine adoption in India. Therefore, the government must allocate a large portion of the Swachh Bharat budget (i.e. much greater than 5%) towards IEC campaigns to overcome such behavioral barriers. Such IEC drives will comprise of health education forums and encouraging community discussions about culture, choices and caste as outlined by other successful international sanitation campaigns.

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[52] As found by this thesis

While allocating more funds towards IEC campaigns will render the mission to make India ODF by 2019 impossible, it is the only way to sustainably end the practice of OD. Ultimately, ending open defecation in India is critical due to its multiple positive externalities, as it would help improve the overall social & economic productivity of the country and accelerate its general national development.

6.2 Recommendations for Future Research

One of the main problems that I faced in my thesis is that it is the SQUAT dataset is the only survey that has been conducted in India that measures the behavioral issues involved in the usage of sanitation facilities in North India. All government surveys only account for the number of toilets that have been constructed and are not focusing on the usage levels of them. Hence, my analysis was limited as it relied only on the SQUAT survey dataset. Hence, one suggestion for future research would be that more third-party studies need to be conducted to measure such behavioral issues involved in the usage of sanitation facilities in India. Second, the heterogeneity of each Indian state should be recognized. In this regard, various randomized control trials (RCTs) should be run in each state that try to design and evaluate sanitation IEC initiatives personalized for the requirements of each state. Ultimately, such RCTs will provide policymakers with evidence on how to frame IEC initiatives to be most successful in their state in order to end the practice of persistent open defecation.

REFERENCES

Accountability Initiative, Center of Policy Research India, 2015
http://www.accountabilityindia.in/how-swachh-bharat-two-years

Alemu, A. M. (2017). To what extent does access to improved sanitation explain the observed differences in infant mortality in Africa? African Journal of Primary Health Care & Family Medicine, 9(1), 1370. http://doi.org/10.4102/phcfm.v9i1.1370

Alexander, Kathyrn, Cooper Allton, Colin Felsman, "Ending Open Defecation in India", Princeton University, January 2016.
https://wws.princeton.edu/sites/default/files/content/India%20Workshop%20Report_FINAL_2.2 5.2016.pdf

Ali, S. (2002, December). Collective and elective ethnicity: Caste among urban Muslims in India. In Sociological Forum(Vol. 17, No. 4, pp. 593-620). Kluwer Academic Publishers-Plenum Publishers.

Amy Pickering, Habiba Djebbari, Carolina Lopez, Massa Coulibaly, and Maria Laura Alzua. "Effect of a CommunitySLed Sanitation Intervention on Child Diarrhoea and Child Growth in Rural Mali: A ClusterSRandomised Controlled Trial." The Lancet Global Health 3, no. 11 (2015): e701–11. Accessed March 7, 2018 doi:10.1016/S2214S109X(15)00144S8.

Basu, Indrani. "Jharkhand Is Confiscating Lungis Of Men Caught Defecating In Open. "Huffington Post India, HuffPost, 26 Sept. 2017, www.huffingtonpost.in/2017/09/26/jharkhand-is-confiscating-lungis-of-men-caught-defecating-in-open_a_23222843/.

BRAC, "OD in Country Has Been Reduced from 42% in 2003 to 3% in 2012. Accessed April 10, 2018. http://www.brac.net/latestS news/item/688SopenSdefecationSinScountryShasSbeenSreducedSfromS42SinS2003StoS3SinS2 012.

Center for Legislative Research and Advocacy
(www.clraindia.org/admin/gallery/documents/03032016051112-0ODpolicybriefFinal.p
Clasen, Thomas, et al. "Effectiveness of a rural sanitation programme on diarrhoea, soil-transmitted helminth infection, and child malnutrition in Odisha, India: a cluster-randomised trial." The Lancet Global Health 2.11 (2014): e645-e653.

Coffey, Diane, Dean Spears, "Where India goes: Abandoned Toilets, Stunted Development and the Costs of Caste." HarperCollins Publishers, 2017.

Coffey, D., Gupta, A., Hathi, P., Spears, D., Srivastav, N., & Vyas, S. (2017). Understanding open defecation in rural India: Untouchability, pollution, and latrine pits. Economic & Political Weekly, 52(1), 59-66.

DHS Bangladesh Survey 2011, Accessed October 2017
https://www.dhsprogram.com/data/dataset/Bangladesh_Standard-DHS_2011.cfm?flag=0

Dollar, D., & Gatti, R. (1999). Gender inequality, income, and growth: are good times good for women? (Vol. 1). Washington, DC: Development Research Group, The World Bank.

George, Rose. The Big Necessity: The unmentionable world of human waste and why it matters. Macmillan, 2008.

Geruso, Michael, and Dean Spears. "Sanitation and health externalities: Resolving the Muslim mortality paradox." University of Texas at Austin Working Paper (2014).

Government of India, "Guidelines: Central Rural Sanitation Programme," Total Sanitation Campaign (2010): 1S37, Accessed October 20, 2015.

Gross, E., & Günther, I. (2014). Why do households invest in sanitation in rural Benin: Health, wealth, or prestige?. Water Resources Research, 50(10), 8314-8329.

Guiteras, R., Levinsohn, J., Mobarak, M., & WaterAid, B. (2011). Increasing Demand for Hygienic Latrines in Bangladesh. timeline, 2013.

Hathi, P., Gupta, A., Coffey, D.,Khurana, N., Spears, D., Srivastav, N., & Vyas, S. (2014). Revealed preference for open defecation. Economic & Political Weekly, 49(38), 43.

Hueso, Andrés, and Brian Bell. "An untold story of policy failure: the Total Sanitation Campaign in India." Water Policy15.6 (2013): 1001-1017.

"Inadequate Sanitation costs India 53.8 billion dollars". Water and Sanitation Program, World Bank, 2011. http://www.wsp.org/sites/wsp.org/files/publications/wsp-esi-india.pdf

Indian 2011 Population Census, http://censusindia.gov.in/

Jeffrey, C. (2002). Caste, class, and clientelism: A political economy of everyday corruption in rural North India. Economic Geography, 78(1), 21-41.

Jenkins, M. W., & Scott, B. (2007). Behavioral indicators of household decision-making and demand for sanitation and potential gains from social marketing in Ghana. Social science & medicine, 64(12), 2427-2442.

Kamal Kar and Robert Chambers, Handbook on Community Led Sanitation (UK, Plan UK, 2008)

Khare, R. S. "Ritual purity and pollution in relation to domestic sanitation." The Eastern Anthropologist 15.2 (1962): 125-139.

Kumar, Arjun. "Sanitation in Rural India: An Analysis of Households' Latrine Facility." Journal of Studies in Dynamics and Change (JSDC)-ISSN: 2348-7038 1, no. 6 (2014): 231-246.

Lamba, Sneha, and Dean Spears. "Caste, 'cleanliness' and cash: effects of caste-based political reservations in Rajasthan on a sanitation prize." Journal of Development Studies 49.11 (2013): 1592-1606.

"Mali | CommunitySLed Total Sanitation." Community Led Total Sanitation, Accessed December 8, 2015, http://www.communityledtotalsanitation.org/country/mali. http://rural.nic.in/sites/downloads/pura/Total%20Sanitation%20Campaign%20S%20DDWS.pdf.

Majid, Abdul. "Future of Untouchables in India: A Case Study of Dalit." South Asian Studies 27, no. 1 (2012): 263-285.

"Monitoring Water and Sanitation". World Health Organization, 2015. http://who.int/phe/events/wha_66/flyer_wsh_monitoring.pdf

Ministry of Drinking Water & Sanitation, Swachh Bharat Gramin, Web. Accessed 14th December 2017. http://swachhbharatmission.gov.in/sbmcms/index.htm

Ministry of Drinking Water & Sanitation NSS 69th Round (July 2012- December 2012), "Key Indicators of Drinking Water, Sanitation, Hygiene and Housing Condition in India", December 2013.

Nair, Rupam J. "Modi Aims to Shake up Sanitation with Clean India Drive." Reuters. Thomson Reuters, 02 Oct. 2014. Web. 22 March 2017. http://www.reuters.com/article/2014/10/02/us-india-modi-clean-idUSKCN0HR0PH20141002

O'Reilly, K., Dhanju, R., & Goel, A. (2017). Exploring "the remote" and "the rural": Open defecation and latrine use in Uttarakhand, India. World Development, 93, 193-205.

Pti. "Muslims Poorest among Religious Groups, Says NSSO Survey." The Hindu, The Hindu, 20 Aug. 2013, www.thehindu.com/news/national/muslims-poorest-among-religious-groups-says-nsso-survey/article5042032.ece.

RGICS PolicyWatch, "Swachh Bharat Mission- The Illusion of Success", September 2016, http://www.rgics.com/wp-content/uploads/policy-watch/PW-5.6%20(September%202016).pdf

RICE Institute, "Understanding Open Defecation in Rural India" RICE. 7 Jan. 2017. Web. 22 Mar. 2017. http://riceinstitute.org/data/squat/

Rina Chandran. "India Rejects U.N. Official's Criticism of Sanitation Drive. Reuters, Thomson Reuters, 12 Nov. 2017, www.reuters.com/article/us-india-rights-sanitation/india-rejects-u-n-officials-criticism-of-sanitation-drive-idUSKBN1DD063.

Suzanne Hanchett and Laurie Kieger, et al. "LongSTerm Sustainability of Improved Sanitation in Rural Bangladesh" WSP (2011): iii. Accessed December 4, 2017. https://www.wsp.org/sites/wsp.org/files/publications/WSPSSustainabilitySSanitationSBangladeshS Report.pdf.

Sara, S., & Graham, J. (2014). Ending Open Defecation in Rural Tanzania: Which Factors Facilitate Latrine Adoption? International Journal of Environmental Research and Public Health, 11(9), 9854–9870. http://doi.org/10.3390/ijerph110909854

Singh, Santosh. "Bihar Cabinet Withdraws Clause on Mandatory Toilet at Home." The Indian Express. The Indian Express, 03 Feb. 2016. Web. 22 Mar. 2017. http://indianexpress.com/article/india/india-news-india/nitish-kumar-bihar-government-bihar-local-body-poll/

Thitu, Anne & Kaseje, Margaret & Augustine, Afullo. (2016). Factors Influencing Latrine Coverage among the Maasai of Ildamat Location Kajiado District. Developing Country Studies www.iiste.org. 6. 22-27.

Tewary, Amarnath. "India Bihar Rapes 'caused by Lack of Toilets' - BBC News." BBC News. British Broadcasting Corporation, 9 May 2013. Web. 22 March 2017. http://www.bbc.com/news/world-asia-india-22460871

UNICEF-WHO Joint Monitoring Programme, 2010 Final Report

Water Aid, "Out of Order: The State of the World's Toilets 2017." Water Aid, 2017, https://washmatters.wateraid.org/publications/out-of-order-the-state-of-the-worlds-toilets-2017 Worldbank (www.worldbank.org/en/news/feature/2015/12/15/ending-open-defecation-achieving-clean-and-healthy-rural-india)

"World Bank Approves US$1.5 Billion to Support India's Universal Sanitation Initiatives." World Bank, World Bank, 15 Dec. 2015, www.worldbank.org/en/news/press-release/2015/12/15/world-bank-approves-usd-1point5-billion-support-india-universal-sanitation-initiatives.

"World Bank Yet to Release Fund for Swachh Bharat." The Economic Times, 9 Jan. 2017, economictimes.indiatimes.com/industry/banking/finance/world-bank-yet-to-release-fund-for-swachh-bharat/articleshow/56429289.cms.

Zetland, David. "Living with Water Scarcity". AguaEconomics Press, April 2014, http://livingwithwaterscarcity.com/

APPENDICES

Appendix A: The Swachh Bharat Campaign

Figure A1: The Swachh Bharat Logo
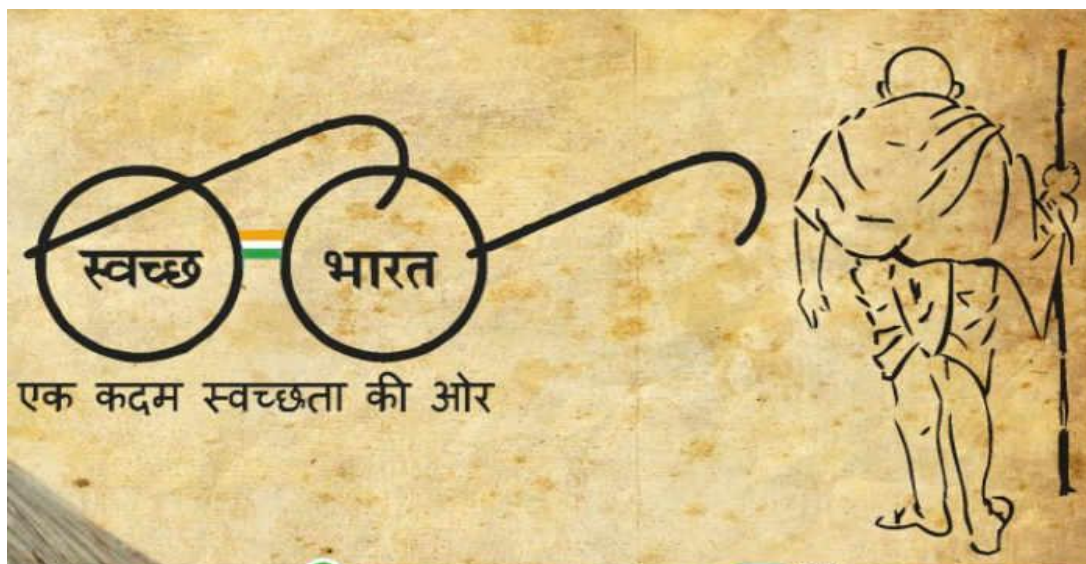
Figure A2: Prime Minister Modi kick starting the Swachh Bharat campaign

Figure A3: Swachh Bharat Dashboard (as of April 28, 2018)

Appendix B: Description of Variables

Table B1: Correlation matrix of variables used

	Tendency to OD	Wealth	Education	Water Access	IsHindu	Caste	Gender
Tendency to OD	1						
Wealth	0.495***	1					
Education	-0.227***	0.285***	1				
Water Access	-0.196***	0.253***	0.0787***	1			
IsHindu	0.0957***	0.0831***	0.0697***	0.0550***	1		
Caste	0.278***	-0.275***	-0.158***	-0.183***	-0.00585	1	
Gender	0.0189*	-0.00416	0.208***	0.000936	-0.000295	0.00478	1
* p< 0.05, ** p< 0.01, *** p<0.001							

Figure B1: Distribution of OD habits in the survey
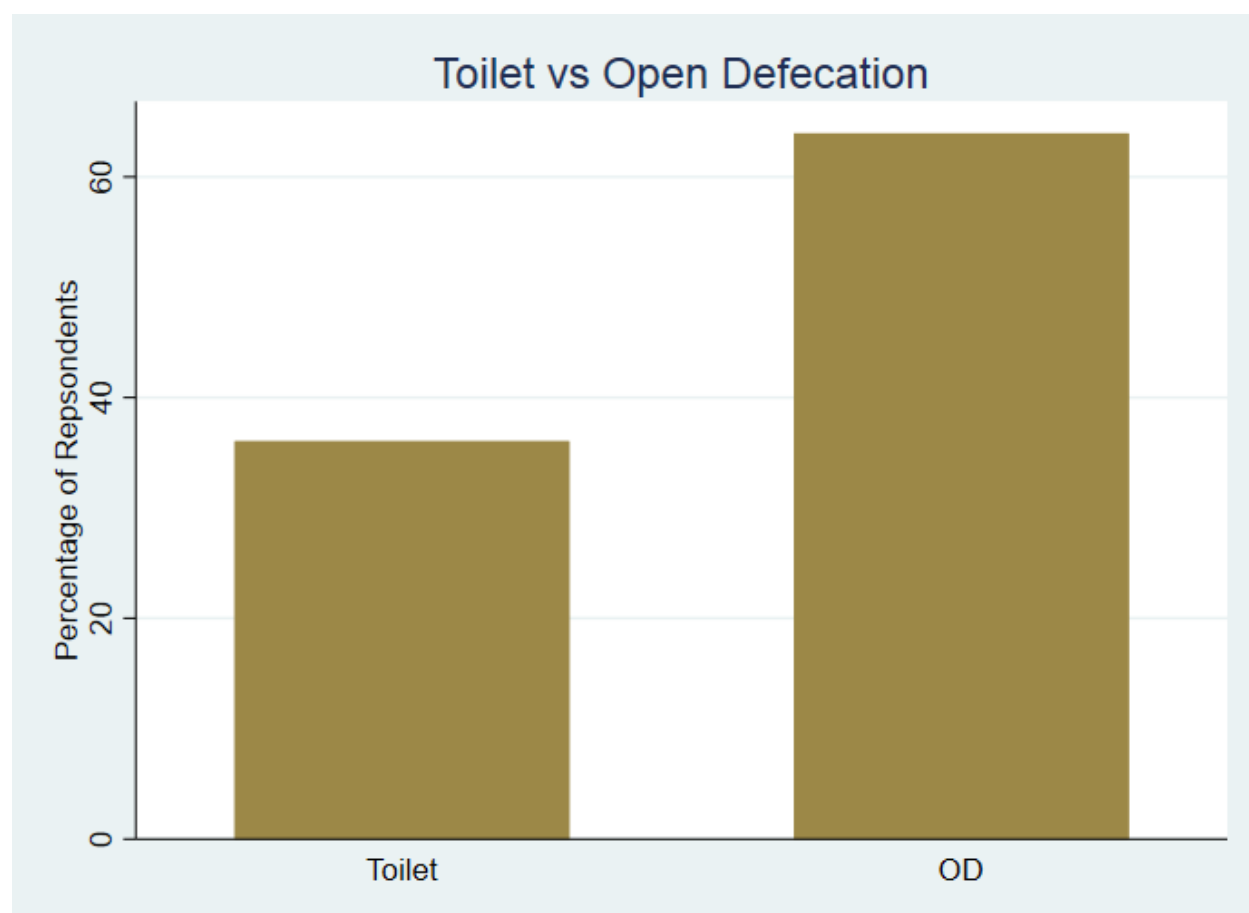
Figure B2: Distribution of 'asset count' in the survey

Number of Assets Owned
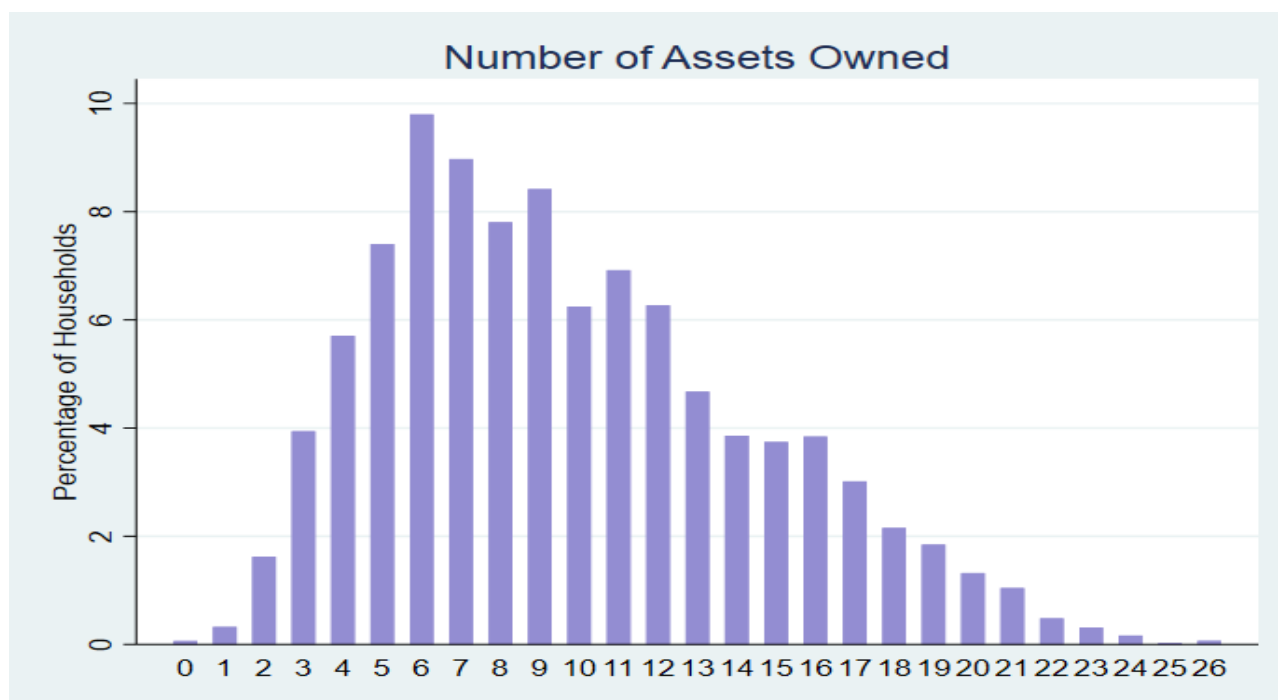
Figure B3: Distribution of years of education in the survey

Years of Education
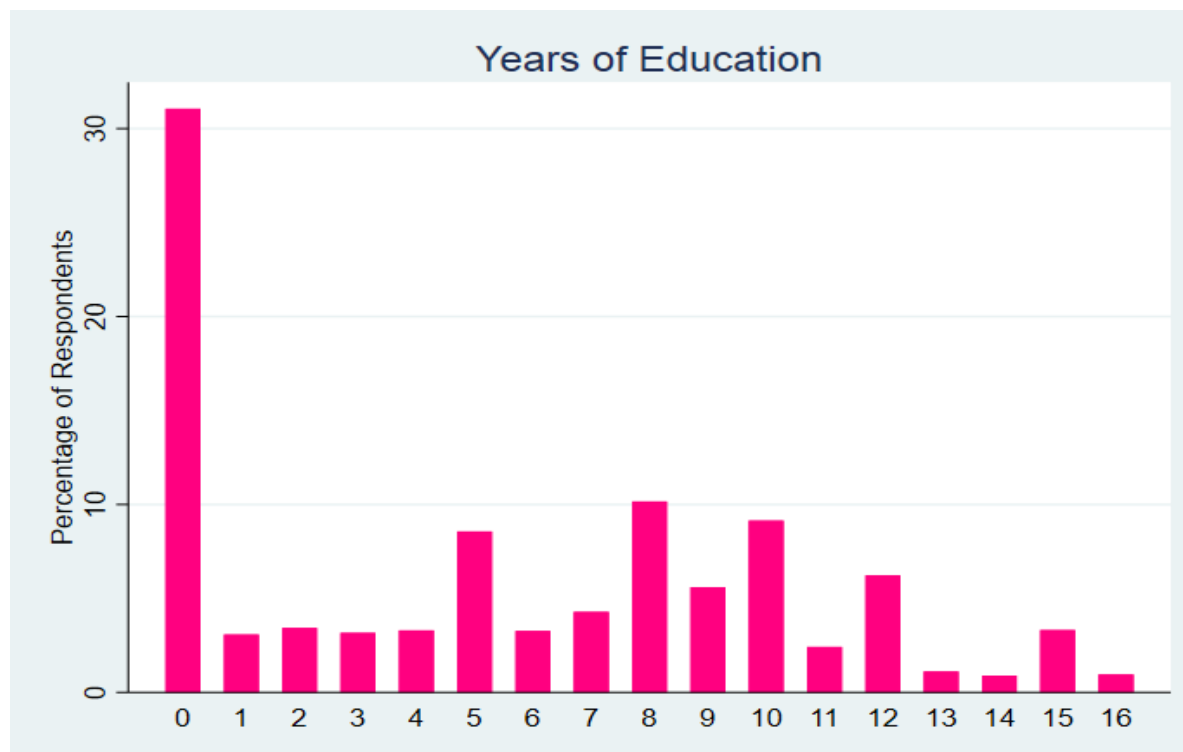
Figure B4: Distribution of access to water in the survey
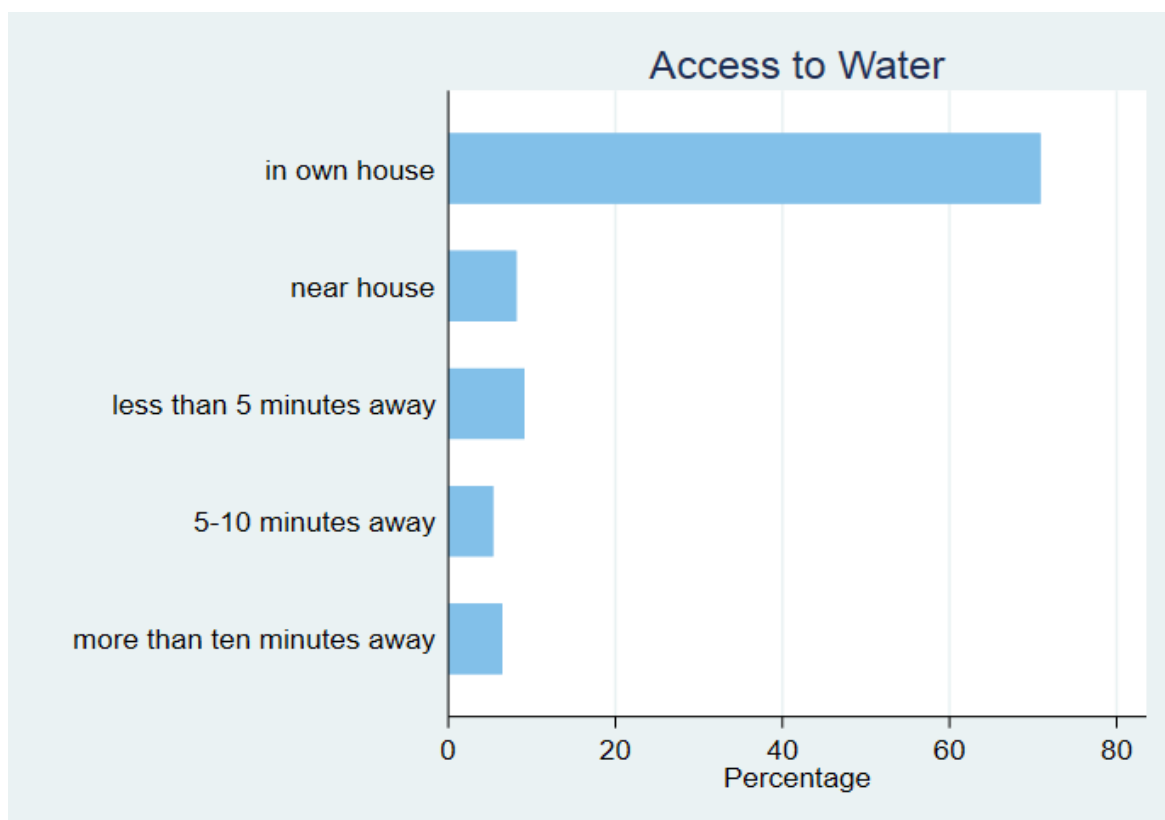
Figure B5: Distribution of religions in the survey
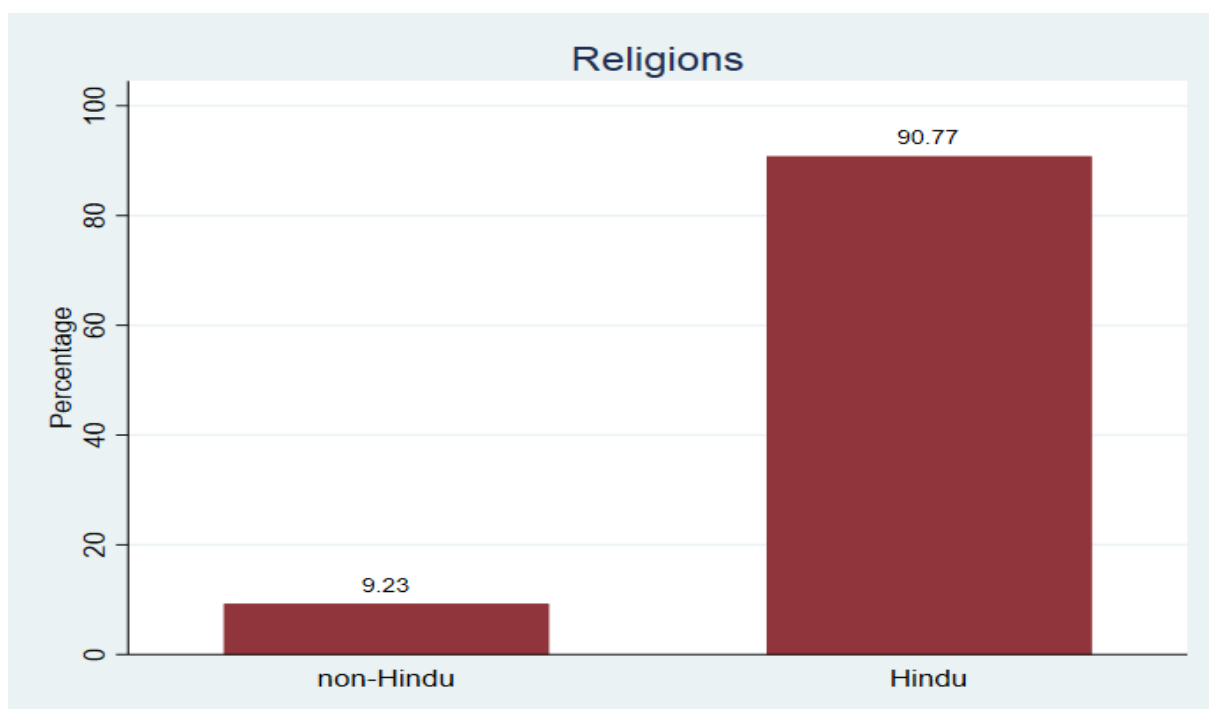
Figure B6: Distribution of castes in the survey
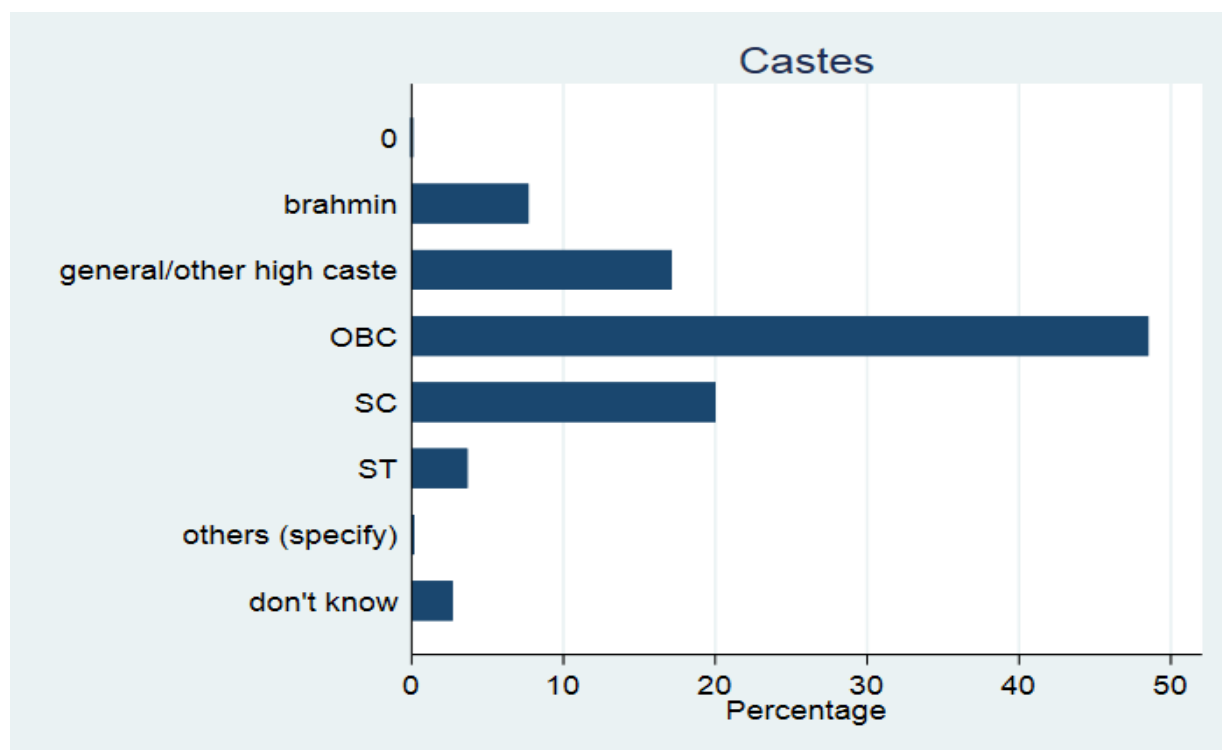
Figure B7: Distribution of gender in the survey

Appendix C: Preliminary Logistic Regression Results

<u>Economic Variables:</u>

Table C1: Effect of Wealth on Tendency to OD

VARIABLES	(1) Wealth Coeff	(2) Wealth Odds Ratio
Tendency to OD		
Number of Assets Owned	-0.266***	0.767***
	(0.00404)	(0.00310)
Constant	3.304***	27.22***
	(0.0455)	(1.238)
Observations	22,235	22,235

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (1) = 60002.06***

Figure C1: Effect of Wealth on Tendency to OD
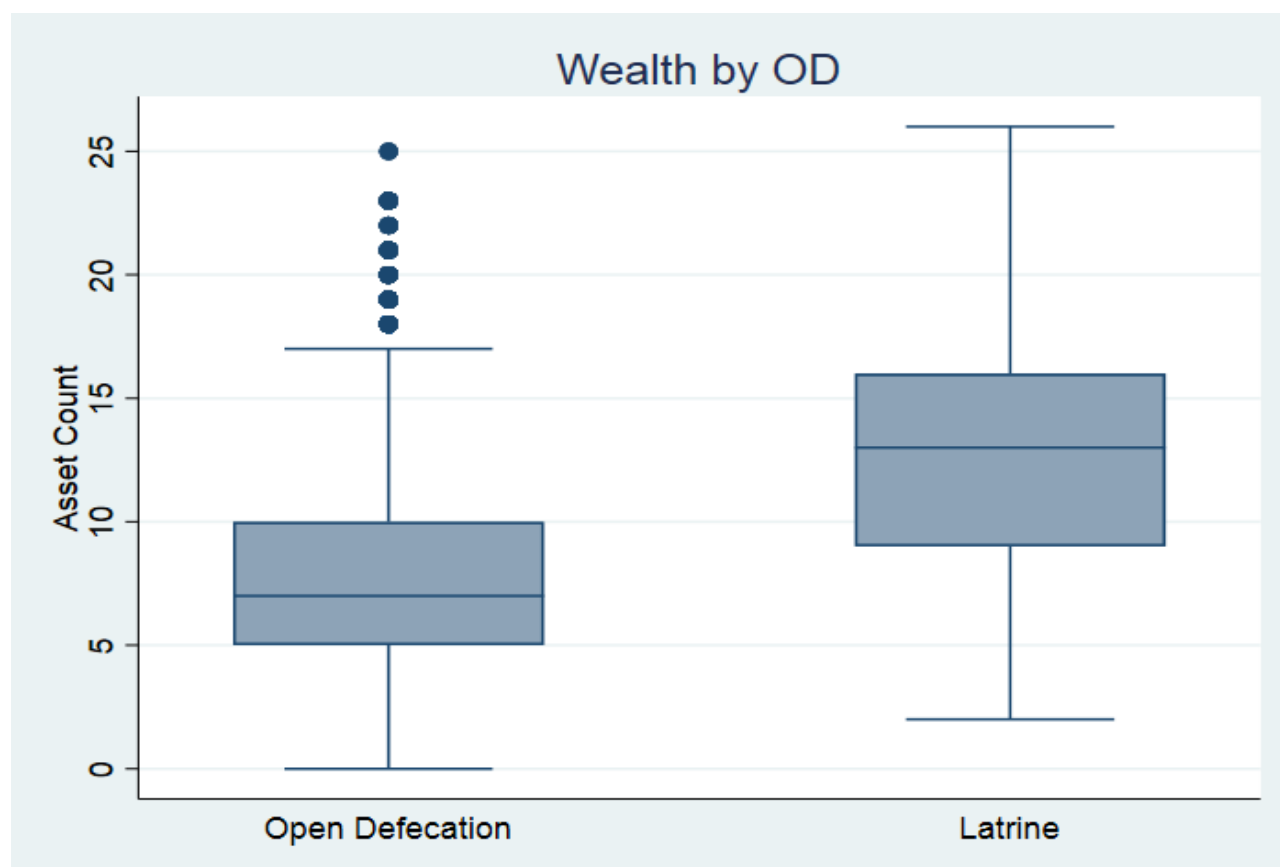
Table C2: Effect of Education on Tendency to OD

VARIABLES	(1) Education Coeff	(2) Education Odds Ratio
Tendency to OD		
Years Educated	-0.0990*** (0.00316)	0.906*** (0.00286)
Constant	1.135*** (0.0240)	3.112*** (0.0747)
Observations	20,533	20,533

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (1) = 1024.57***

Figure C2: Effect of Education on Tendency to OD
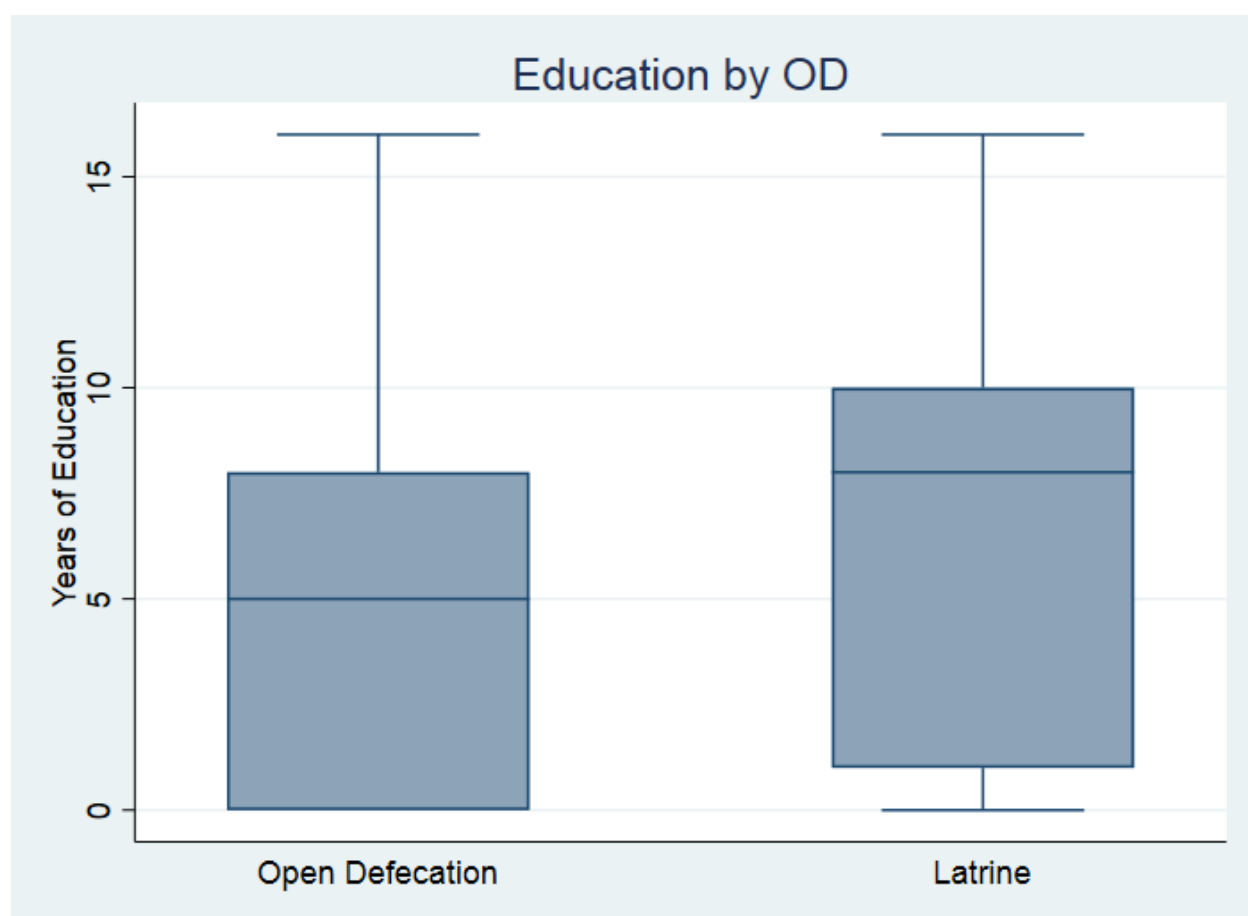
Table C3: Effect of Access to Water on Tendency to OD

VARIABLES	(1) Water Access Coeff	(2) Water Access Odds Ratio
Tendency to OD		
Access to Water	-1.171***	0.310***
	(0.0539)	(0.0167)
Constant	1.428***	4.170***
	(0.0498)	(0.208)
Observations	12,307	12,307

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (1) = 546.98***

Social Variables:

Table C4: Effect of Religion on Tendency to OD

VARIABLES	(1) Religion Coeff	(2) Religion Odds Ratio
Tendency to OD		
isHindu	0.514***	1.671***
	(0.0466)	(0.0779)
Constant	0.109**	1.115**
	(0.0442)	(0.0493)
Observations	22,235	22,235

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (1) = 119.63***

Table C5: Effect of Caste on Tendency to OD

VARIABLES	(1) Caste Coeff	(2) Caste Odds Ratio
Tendency to OD		
Other High Caste	-0.279***	0.756***
	(0.0517)	(0.0391)
Other Backward Caste	0.535***	1.707***
	(0.0448)	(0.0765)
Scheduled Caste	1.313***	3.717***
	(0.0549)	(0.204)
Scheduled Tribe	2.371***	10.71***
	(0.135)	(1.449)
Constant	0.0736*	1.076*
	(0.0400)	(0.0431)
Observations	22,235	22,235

Note: The Brahmin Caste is being used as the comparison variable
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (4) = 1616.98***

Table C6: Effect of Gender on Tendency to OD

VARIABLES	(1) Gender Coeff	(2) Gender Odds Ratio
Tendency to OD		
IsMale	0.0987***	1.104***
	(0.0280)	(0.0309)
Constant	0.521***	1.685***
	(0.0202)	(0.0340)
Observations	22,235	22,235

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (1) = 12.47**

Appendix D: Religion Regression Models

Table D1: Effect of Religion (based on Wealth) on Tendency to OD

VARIABLES	(1) Wealth & Religion Coeff	(2) Wealth & Religion Odds Ratio
Tendency to OD		
Poor non-Hindu	0	1
	(0)	(0)
Poor Hindu	1.050***	2.857***
	(0.0657)	(0.188)
Wealthy non-Hindu	-1.406***	0.245***
	(0.0961)	(0.0235)
Wealthy Hindu	-0.967***	0.380***
	(0.0635)	(0.0241)
Constant	0.667***	1.948***
	(0.0600)	(0.117)
Observations	22,235	22,235

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (3) = 4431.59***

Table D2: Effect of Religion (based on Education) on Tendency to OD

VARIABLES	(1) Education & Religion Coeff	(2) Education & Religion Odds Ratio
Tendency to OD		
Illiterate non-Hindu	0	1
	(0)	(0)
Illiterate Hindu	0.710***	2.034***
	(0.0621)	(0.126)
Literate non-Hindu	-0.502***	0.605***
	(0.0906)	(0.0549)
Literate Hindu	-0.0584	0.943
	(0.0613)	(0.0579)
Constant	0.314***	1.368***
	(0.0579)	(0.0792)
Observations	22,235	22,235

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

$$LR\ \chi^2\ (3) = 813.13^{***}$$

Table D3: Effect of Religion (based on Water Access) on Tendency to OD

VARIABLES	(1) Religion & Water Access Coeff	(2) Religion & Water Access Odds Ratio
Tendency to OD		
Non-Hindu without water access	0	1
	(0)	(0)
Non-Hindu with water access	-0.760***	0.467***
	(0.134)	(0.0624)
Hindu without water access	1.178***	3.247***
	(0.127)	(0.413)
Hindu with water access	-0.132	0.876
	(0.116)	(0.101)
Constant	0.444***	1.559***
	(0.114)	(0.177)
Observations	12,307	12,307

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
$LR\ \chi^2\ (3) = 701.30^{***}$

Table D4: Effect of Religion (based on Wealth & Water Access) on Tendency to OD

VARIABLES	(1) Wealth Religion & Water Access Coeff	(2) Wealth Religion & Water Access Odds Ratio
Tendency to OD		
Poor non-Hindu without water access	0	1
	(0)	(0)
Wealthy non-Hindu without water access	-1.006***	0.366***
	(0.258)	(0.0943)
Poor non-Hindu with water access	-0.424**	0.654**
	(0.167)	(0.109)
Wealthy non-Hindu with water access	-1.926***	0.146***
	(0.185)	(0.0269)
Poor Hindu without water access	1.410***	4.097***
	(0.159)	(0.652)
Wealthy Hindu without water access	-0.0419	0.959
	(0.164)	(0.157)
Poor Hindu with water access	0.723***	2.062***
	(0.143)	(0.296)
Wealthy Hindu with water access	-1.251***	0.286***
	(0.141)	(0.0404)
Constant	0.725***	2.064***
	(0.138)	(0.285)
Observations	12,307	12,307

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (7) = 2795.08***

Table D5: Effect of Religion (based on Gender) on Tendency to OD

VARIABLES	(1) Gender & Religion Coeff	(2) Gender & Religion Odds Ratio
Tendency to OD		
Non-Hindu Female	0	1
	(0)	(0)
Hindu Female	0.563***	1.757***
	(0.0668)	(0.117)
Non-Hindu Male	0.186**	1.204**
	(0.0886)	(0.107)
Hindu Male	0.650***	1.916***
	(0.0666)	(0.128)
Constant	0.0140	1.014
	(0.0633)	(0.0642)
Observations	22,235	22,235

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (3) = 132.66***

Table D6: Effect of Religion (based on Gender & Education) on Tendency to OD

VARIABLES	(1) Gender Education & Religion Coeff	(2) Gender Education & Religion Odds Ratio
Tendency to OD		
Illiterate non-Hindu Female	0	1
	(0)	(0)
Illiterate Hindu Female	0.677***	1.968***
	(0.0842)	(0.166)
Literate non-Hindu Female	-0.572***	0.564***
	(0.134)	(0.0758)
Literate Hindu Female	-0.0848	0.919
	(0.0857)	(0.0787)
Illiterate non-Hindu Male	0.213*	1.238*
	(0.116)	(0.144)
Illiterate Hindu Male	0.997***	2.710***
	(0.0868)	(0.235)
Literate non-Hindu Male	-0.281**	0.755**
	(0.121)	(0.0912)
Literate Hindu Male	0.117	1.124
	(0.0831)	(0.0934)
Constant	0.214***	1.239***
	(0.0791)	(0.0980)
Observations	22,235	22,235

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (7) = 893.05***

Appendix E: Caste Regression Models

Table E1: Effect of Caste (based on Wealth) on Tendency to OD

VARIABLES	(1) Caste & Wealth Coeff	(2) Caste & Wealth Odds Ratio
Tendency to OD		
Poor Low Caste	0	1
	(0)	(0)
Wealthy Low Caste	-1.854***	0.157***
	(0.0375)	(0.00587)
Poor High Caste	-0.991***	0.371***
	(0.0558)	(0.0207)
Wealthy High Caste	-2.690***	0.0679***
	(0.0472)	(0.00320)
Constant	1.788***	5.975***
	(0.0286)	(0.171)
Observations	22,235	22,235

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (3) = 4824.89***

Table E2: Effect of Caste (based on Education) on Tendency to OD

VARIABLES	(1) Caste & Education Coeff	(2) Caste & Education Odds Ratio
Tendency to OD		
Illiterate Low Caste	0	1
	(0)	(0)
Literate Low Caste	-0.715***	0.489***
	(0.0344)	(0.0168)
Illiterate High Caste	-1.200***	0.301***
	(0.0483)	(0.0145)
Literate High Caste	-1.698***	0.183***
	(0.0444)	(0.00813)
Constant	1.227***	3.411***
	(0.0250)	(0.0852)
Observations	22,235	22,235

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (3) = 1781.40***

Table E3: Effect of Caste (based on Water Access) on Tendency to OD

VARIABLES	(1) Caste & Water Access Coeff	(2) Caste & Water Access Odds Ratio
Tendency to OD		
Low Caste without water access	0	1
	(0)	(0)
Low Caste with water access	-1.125***	0.325***
	(0.0648)	(0.0210)
High Caste without water access	-1.139***	0.320***
	(0.114)	(0.0364)
High Caste with water access	-2.238***	0.107***
	(0.0723)	(0.00771)
Constant	1.690***	5.418***
	(0.0599)	(0.325)
Observations	12,307	12,307

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (3) = 1216.01***

Table E4: Effect of Caste (based on Gender) on Tendency to OD

VARIABLES	(1) Caste & Gender Coeff	(2) Caste & Gender Odds Ratio
Tendency to OD		
Low Caste Female	0	1
	(0)	(0)
Low Caste Male	0.0806**	1.084**
	(0.0339)	(0.0368)
High Caste Female	-1.174***	0.309***
	(0.0467)	(0.0144)
High Caste Male	-1.012***	0.364***
	(0.0447)	(0.0162)
Constant	0.833***	2.301***
	(0.0244)	(0.0563)
Observations	22,235	22,235

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (3) = 1275.18***

Table E5: Effect of Caste (based on Education & Gender) on Tendency to OD

VARIABLES	(1) Caste Education & Gender Coeff	(2) Caste Education & Gender Odds Ratio
Tendency to OD		
Low Caste Illiterate Female	0	1
	(0)	(0)
Low Caste Illiterate Male	0.274***	1.315***
	(0.0510)	(0.0671)
Low Caste Literate Female	-0.714***	0.490***
	(0.0502)	(0.0246)
Low Caste Literate Male	-0.530***	0.589***
	(0.0443)	(0.0261)
High Caste Illiterate Female	-1.199***	0.302***
	(0.0628)	(0.0189)
High Caste Illiterate Male	-0.918***	0.399***
	(0.0726)	(0.0290)
High Caste Literate Female	-1.753***	0.173***
	(0.0685)	(0.0119)
High Caste Literate Male	-1.476***	0.228***
	(0.0566)	(0.0129)
Constant	1.111***	3.036***
	(0.0325)	(0.0986)
Observations	22,235	22,235

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (7) = 1849.23***

Appendix F: Gender Regression Model

Table F1: Effect of Gender (based on Education) on Tendency to OD

VARIABLES	(1) Gender & Education Coeff	(2) Gender & Education Odds Ratio
Tendency to OD		
Illiterate Female	0	1
	(0)	(0)
Literate Female	-0.730***	0.482***
	(0.0414)	(0.0200)
Illiterate Male	0.290***	1.336***
	(0.0424)	(0.0567)
Literate Male	-0.515***	0.597***
	(0.0366)	(0.0218)
Constant	0.817***	2.264***
	(0.0270)	(0.0610)
Observations	22,235	22,235

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
LR χ^2 (3) = 725.79***