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Special Research Article on Health Policy

Access to Safe Drinking Water and Sanitation in Indonesia

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Abstract

In 1990, 30 per cent of Indonesian population had no access to improved drinking water source. Almost 65 per cent lacked access to improved sanitation—and almost 40 per cent defecate in the open. One of the Millennium Development Goals' objectives is to halve these numbers of disadvantaged by 2015. We explore the recent progress using World Health Organization/United Nations Children Fund report and the Indonesia's Socio-Economic Survey. We conclude that the country still face a great challenge to meet the targets, especially on sanitation. We next illustrate the importance of these facilities by estimating their impact on diarrhoea incidence. We find that the relative importance of sanitation is higher than that of water. A household with 'unimproved' drinking water source is about 12 per cent more likely to have diarrhoea than that otherwise. Lacking of improved sanitation, on the other hand, makes the household member about 23–27 per cent more likely to suffer from it.

Key words: MDG, Indonesia, water, sanitation, diarrhoea

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1. Background

Indonesia's recent economic development has been remarkable, with recent annual growth rates stable above 6 per cent, inflation rates under 5 per cent, fiscal deficit below 3 per cent of gross domestic product (GDP), debt-to-GDP ratio under 30 per cent and international reserves above US$ 100 billion. But challenges remain. While poverty and unemployment rates have gone down to 12 per cent and 7 per cent, respectively, income inequality has increased with a Gini ratio above 0.4. Furthermore, 'non-income' inequalities also worsen. These include access to basic health, safe drinking water and decent sanitation.

In its 2011 Millennium Development Goals (MDG) status report, Indonesia reported significant progress (Bappenas 2012). However, there are still many areas marked 'need special attention'. These include sustainable access to clean water and basic sanitation. This article has two objectives. First, it assesses Indonesia's MDG progress with regards to drinking water and sanitation facilities. That is, we intend to answer whether or not Indonesia is on the right track and if not, what are the challenges in achieving the targets. The second objective is to present an argument as to why improving access to safe drinking water and sanitation is warranted. We do this by exploring the relationship between water/sanitation facilities and diarrhoea. Some previous studies and reports have addressed these two objectives. For example, the Joint Monitoring Programme (JMP) of World Health Organization

Table 1 Indonesia's Progress on Water and Sanitation Provision in Two Decades

	1990			*2000*			*2010*		
	Urban	*Rural*	*National*	*Urban*	*Rural*	*National*	*Urban*	*Rural*	*National*
Population (million)	56	128	184	89	123	213	106	134	239
Population (%)	31	69	100	42	58	100	44	56	100
Water (per cent of population)									
Improved	90	61	70	91	68	78	92	74	82
Piped on premises	25	2	9	31	5	16	36	8	20
Other improved	65	59	61	60	63	62	56	66	62
Unimproved	10	39	30	9	32	22	8	26	18
Surface water	1	8	6	1	6	4	0	4	2
Other unimproved	9	30	24	8	26	18	8	22	16
Sanitation (per cent of population)									
Improved	61	24	35	64	30	44	73	39	54
Unimproved	40	76	65	36	70	56	27	61	46
Shared	8	6	7	9	9	9	10	12	11
Other unimproved	13	22	19	11	19	16	3	13	9
Open defecation	19	48	39	16	42	31	14	36	26

Source: WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation (accessed October 2013).

(WHO)/UNESCO (www.wssinfo.org) tracks and compiles the progress in water and sanitation development of more than 200 countries, based on the official report from each country. However, there are some issues with their used definitions, as we discuss below. As for diarrhoea in relation to water and sanitation, there are not many studies with Indonesian context. The recent one by Cameron and Olivia (2011) focuses on sanitation and gives less emphasis on water, while the present article covers them both. Therefore, this article aims to complement the previous works and provide new evidence as the basis for improved policy in water and sanitation in Indonesia. This is also timely, as Indonesia is still facing a big challenge in providing these two public goods.[1]

Table 1 summarizes Indonesia's progress on the provision of drinking water source and sanitation facility in 1990, 2000 and 2010. In 2010, 18 per cent of Indonesian population had access only to 'unimproved' drinking water sources, compared with 30 per cent in 1990 and 22 per cent in 2000. These include surface water (such as water from river or lake), unprotected dug well and unprotected spring. The figures for sanitation are worse: 46 per cent of the population in 2010 could only access 'unimproved' sanitation facility—shared or public toilet, pit latrine, open defecation (that is, to defecate in field, bush or yard), etc.—although this is a big drop compared with 65 per cent in 1990. For both categories, the condition is worse in rural than in urban areas. In 2010, for example, there was still 36 per cent of population in rural areas practicing open defecation, compared with 14 per cent in urban areas.

The urgency of access both to safe drinking water and to improved sanitation should not be underestimated. According to the WHO, such accesses are key to prevent the second leading cause of death in children under 5 years old: diarrhoeal disease. United Nations Children Fund (UNICEF 2012) mentions diarrhoea is responsible for 11 per cent deaths among children under age 5 worldwide, second only to pneumonia (18 per cent). A meta-study by Esrey et al. (1991) analyses 144 studies to examine the impact of improved water supply and sanitation on several diseases. It reports that the median reduction in morbidity for diarrhoea when the facilities are improved

1. A major newspaper in Indonesia reported that access to clean water remains low in Indonesia, with 44 per cent of households connected to the supply network (Satar & Wiryawan 2014). Another newspaper reported that 40 per cent of Indonesian population live with poor sanitation (Idrus 2014).

is 26 per cent. More recent study by Montgomery and Elimelech (2007) reports that global morbidity from diarrhoeal disease is estimated to be around 1 billion episodes per year, while mortality can reach 2.2 million deaths annually. Again, the study cites poor sanitation and unsafe drinking water as the main causes, along with poor hygiene. In the case of Indonesia, some reports and studies have documented how diarrhoea can lead to fatalities (for example, BPS and Macro International 2008; Napitupulu & Hutton 2008) and how diarrhoea prevalence is linked to bad facility such as poor sanitation (for example, Cameron & Olivia 2011).

2. Methods

Target 7C of the MDG aims 'to halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation' (Bappenas 2012). It does not explicitly state the benchmark year. Most reports and studies take 1990 as the starting year, to be consistent with the other targets. But this proves to be problematic in many (ironically) developing countries, for only few of them could provide reliable data sources as far back to 1990. Of more than 200 countries monitored by the WHO/UNICEF's JMP initiative, many did not report figures for the early years. As for Indonesia, its report in the recent years have been based on the National Socio-Economic Surveys (Susenas) conducted annually by Indonesia's Office of Statistics (BPS), comprising about 250–300 thousands sampled households, covering around 1 million individuals each year. In early 1990s, however, the report relied much on the Demographic and Health Survey series (also conducted by BPS) whose coverage is smaller than that of Susenas. This type of problem limits fair comparisons across countries and makes it rather hard to monitor progress of any given country.[2]

Bearing such caveat, in order to meet the first objective, we attempt to track Indonesia's progress by also assuming the year 1990 as the base. Using the data compiled by WHO and UNICEF, we estimate Indonesia's progress in 2015, based on the data for 1990 and 2012. Admittedly, we introduce another problem, namely linear growth assumption. Some studies have criticized such approach (for example, Osorio 2008; Hailu & Tsukada 2011). We proceed, nevertheless, as our objective here is merely to give indicative figures. We then compare the 2015 estimates with the implied MDG targets—the latter being simply the 1990 figures divided by two. Next, we assess the figures for rural and urban division. Finally, to provide a spatial picture of access to water and sanitation, we map the provincial averages of the unimproved water and sanitation in Indonesia.

To address the second objective, we run a series of logistic regressions where dependent variables are a binary that represents whether or not a member of the household has had diarrhoea (that is, 1 if the individual in the household experienced diarrhoea within 1 month prior to the survey and 0 otherwise) and independent variables include the use of unimproved drinking water supply and unimproved sanitation facilities.[3] In all regressions, we control for sex and age, the education of the household head[4], urban/rural location of the household, and whether or not the house floor is dominated by traditional earthen floor. In addition to these household characteristics, we also control for the number of health centres for every 1,000 population in the district, GDP per capita and the percentage of total household in the district with access to safe water and safe sanitation. It might be possible that a household's access to water supply or sanitation is good, but at the same time, the

2. Criticisms towards measuring the progress of MDG include Vandemoortele (2007), Tabatabai (2007) and Easterly (2008).

3. The regression model is inspired by Cameron and Olivia (2011). The problem with their study, however, is that they use linear regression, whereas the dependent variable is a binary dummy, so the predicted probability can go beyond zero and one (Hosmer & Lemeshow 2000). Second, they underexplore the role of drinking water. In this study, we use logistic model rather than linear regression, and we explore the role of access to drinking water in addition to sanitation.

4. Education of the household head is a categorical variable with 14 different values, from primary school (1) to post-graduate (14).

environment is not very hygienic as, for example, some neighbours might practice open defecation. To control for this, following Cameron and Olivia (2011), we also add a variable representing the percentage of population practicing open defecation in the village where the household is located. Also, we control for district-wide percentage of population with access to improved water and sanitation. Due to the multilevel nature of the data, where individuals/households living in the same area are not independent of each other, we employ a multilevel logistic regression (Rabe-Hesketh et al. 2005).

Another issue to note is about definitions. The WHO/UNICEF (2014, p. 40) report and its accompanying JMP website provide a guidance for definitions to be used in reporting country progress. They define 'unimproved drinking water' as consisting of 'surface water' (river, dam, lake, pond, stream, canal, irrigation channels) and 'unimproved sources' (unprotected dug well, unprotected spring, cart with small tank/drum, bottled water), whereas 'unimproved sanitation' consists of 'open defecation' (defecate in fields, forests, bushes, open bodies of water, beaches or other open spaces or disposed of with solid waste), 'unimproved facilities' (do not ensure hygienic separation of human excreta from human contact, including pit latrines without slab or platform, hanging latrines or bucket latrines) and 'shared facilities' (facilities of an otherwise acceptable type shared between two or more households). However, it is possible that one category (or subcategory) is defined differently in different countries. Also, a category as defined in JMP database as 'unimproved' might be considered 'improved' in different countries, vice versa. For example, 'bottled water' in general is considered unimproved by JMP's definition, but it is considered improved in Indonesia, as evident in its reports to JMP. This is another reason to look more closely into the components of water and sanitation facilities.

The use of different definitions is also evident across government offices in Indonesia. Indonesia's Office of Statistics (BPS) defines improved drinking water sources as 'retail piped water, meter piped water, rain water, and pump/protected dug well/protected spring located no less than 10 meters away from the septic tank or sewerage' (BPS website, <www.bps.go.id>, accessed May 2013). On the other hand, Indonesia's Ministry of Health (Kemenkes) defines it as 'protected sources of drinking water (including branded bottled water), located within 1 kilometer, with good quality (clear, odorless, no taste, colorless, foamless)' (Kementerian Kesehatan RI 2011). In what follows, therefore, we will explicitly state the used definition whenever necessary.

3. Results: Is Indonesia on Track?

Table 2 shows the provision of drinking water and sanitation in Indonesia as compared with its MDG targets. While the target to cut the number into half seems to be achievable for

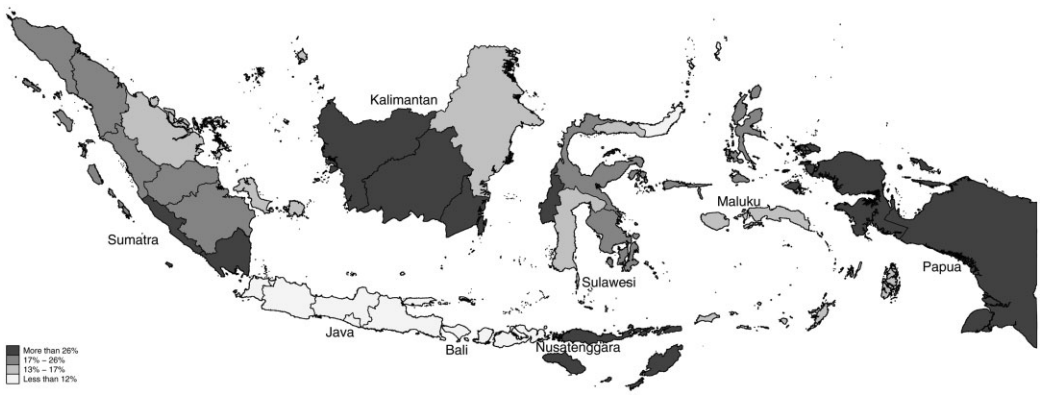
Table 2 Access to Unimproved Water and Sanitation

	Population (million, 2010)	*1990 (%)*	*2012 (%)*	*2015 (%)*[a]	*MDG Target (%)*[b]	*Difference (percentage points)*	*JMP Status*
Water: proportion of population with unimproved drinking water source							
Indonesia	240	30	15	14	15	1.0	Met target
Rural	121	39	24	23	20	–3.5	n/a
Urban	120	10	7	7	5	–2.0	n/a
Sanitation: proportion of population with unimproved sanitation							
Indonesia	240	65	41	39	33	–6.5	Not on track
Rural	121	76	54	52	38	–14.0	n/a
Urban	120	39	29	29	20	–9.5	n/a

Note: (a) Est. based on annual growth rate of 1990–2012; (b) Calculated as half of the 1990 figures.

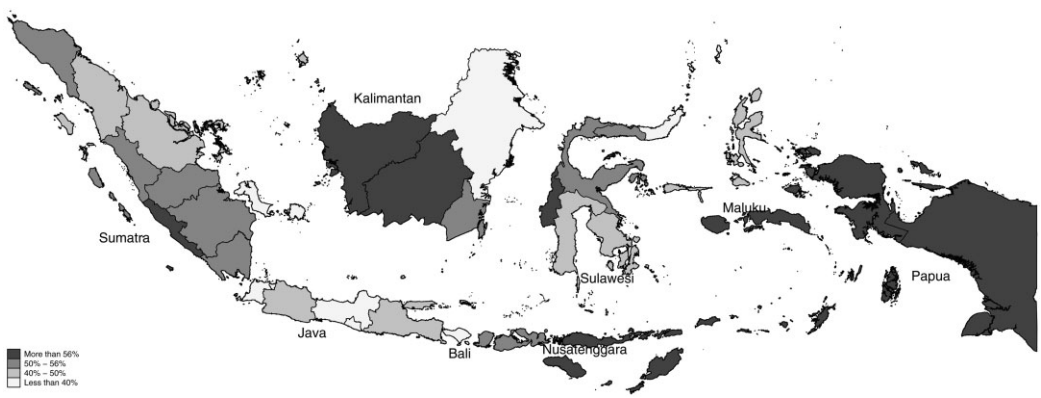
Source: WHO/UNICEF (2014), author's calculation.

Figure 1 Unimproved Water in Indonesia



Source: Susenas 2011.

Figure 2 Unimproved Sanitation in Indonesia



Source: Susenas 2011.

water, it is not the case for sanitation. This is confirmed when we compare the 2015 estimations and the MDG targets. Our results are also consistent with the status given by WHO/UNICEF (last column).[5] It is clear that Indonesia's main problem lies in the provision of improved sanitation. It is estimated that in 2015, there are still around 39 per cent of population with access only to unimproved sanitation, falling short of cutting it down to 33 per cent. The table also displays rural–urban differences in the case of Indonesia. Furthermore, it appears that the condition in rural areas is far worse than that in urban areas.

As Indonesia is a large and diverse country, it is interesting to see whether access to water and sanitation has a spatial pattern. The maps in Figures 1 and 2 show spatial distribution of lack of access to improved water and sanitation. These maps are drawn based on the 2011 Susenas data, since the WHO/UNICEF

5. The definitions used by WHO/UNICEF (2014, p. 44, footnote 21) are 'meet target' if the 2012 estimate of an *improved* facility is greater than or equal to the 2015 target, or if the 2012 coverage is greater or equal to 99.5 per cent; 'on track' if the 2012 estimate is within 3 per cent of the 2012 coverage-when-on-track; 'progress insufficient' if the 2012 estimate is within 3–7 per cent of the 2012 coverage-when-on-track; and 'not on track' if the 2012 estimate is greater than 7 per cent of the 2012 coverage-when-on-track.

database does not report subnational figures.[6] Definition used to construct 'unimproved water' from Susenas is 100 minus the percentage of population with access to 'branded bottled water, refill water, meter piped water, retail piped water, pump, protected dug well, protected spring, and rain water', and 'unimproved sanitation' is 100 minus the percentage of population with access to 'private or shared used of toilet facility with the type of water seal latrine and with final disposal to septic tank'.

The maps show that, while there are variations, the situations outside Java are in general worse than that in Java (main island that embeds the capital Jakarta). To a degree, this confirms the still uneven development in Indonesia, in favour of Java (for example, Miranti 2011). Looking more closely into individual provinces reveal that in both water and sanitation facilities, provinces in eastern Indonesia, especially Papua and West Papua, fare worse than the other provinces. Almost half of Papuans can access only unimproved drinking water source, and 77 per cent live with unimproved sanitation. Interestingly, two adjacent provinces can be very different, for example, West Nusatenggara and East Nusatenggara in the case of unimproved water (7 per cent and 26 per cent, respectively), and East Kalimantan and Central Kalimantan in the case of unimproved water (37 per cent and 65 per cent, respectively).

Susenas also reveals that the most-used types of drinking water source include protected well and pump (Table 3). However, about 25 per cent of those using these two sources actually have them located very close to the septic tank (less than 10 meters away). This is worrying especially in rural villages where the technology to isolate septic tank from drinking water sources is much less developed than that in big cities. Finally, more than 20 per cent of Indonesian population does not have access to toilet facility. Majority of them defecate in the open, especially in river/lake/sea and beach/field/yard. Again, this is a cause of concern, considering the risk of illness from human excreta to the affected communities. These situations have not improved much between 2007 and 2011, as Table 3 shows. The next section discusses the possible impact of *not* having access to improved water and sanitation to health.

Table 3 Water Sources and Sanitation (Per cent of Population)

Facilities	*2007*	*2011*
Drinking water sources		
Branded bottled water	5.3	4.9
Refill water	na	13.5
Meter piped water	14.2	10.2
Retail piped water	3.4	2.2
Pump	12.5	11.6
Protected well	28.3	24.3
Unprotected well	12.6	8.7
Protected spring	8.2	10.7
Unprotected spring	5.6	5.2
River	5.6	4.6
Rain water	3.8	4.0
Others	0.5	0.2
Drinking water sources located within 10 meters away from septic tank		
Pump	33.4	28.5
Protected well	28.0	24.5
Unprotected well	21.9	22.7
Protected spring	11.1	10.7
Unprotected spring	7.6	10.3
Disposal in the absence of toilet facility		
No access to toilet facility	25.8	20.9
Hence dispose to:		
Septic tank/sewerage	0.9	0.9
Pond/paddy field	4.7	5.0
River/lake/sea	51.3	50.6
Pit hole	6.3	4.9
Beach/open field/yard	31.2	33.8
Others	5.6	4.9

Source: Susenas, 2007, 2011.

4. Results: The Effects of Unimproved Water and Sanitation Facilities

We explore the effects of using only unimproved water and unimproved sanitation on health. We define 'unimproved water' as that coming from unprotected dug well,

6. There are other data sources from different agencies, for example from Ministry of Health and from the Office of Statistics (available upon request). Our calculations of national figures based on Susenas are closest to that reported by WHO/UNICEF's Joint Monitoring Programme.

unprotected spring, or river, and 'unimproved sanitation' as sanitation facility other than private or shared toilet facility with water-sealed latrine and final disposal to septic tank. However, to accommodate the different definitions discussed earlier, we also use an alternative, 'stricter' definition. Here, 'unimproved water' includes those under the aforementioned definition, but now we also add pump, protected dug well or protected spring *if* they are located within 10 meters away from the septic tank. On the other hand, the stricter definition of 'unimproved sanitation' now is facilities other than just private toilet with the same characteristics defined previously. We then look at the correlation between these figures and the selected health indicator, diarrhoea incidence, for the reasons discussed above. We are fortunate that the Susenas surveys ask the respondents if any of the family members has experienced diarrhoea within 1 month prior to the survey. This provides a good setting to try understanding the relationship between the likelihood of having diarrhoea with the characteristics of the environment where the family member lives, especially the source of drinking water and the sanitation facility. Table 4 summarises the variables we use in the regressions. The main data source is the 2011 Susenas, with around 300,000 households (more than 1 million individuals). We complement this with district level characteristics such as the number of health centres (Puskesmas) from the BPS' Village Potential dataset (Podes) and GDP per capita from the World Bank's Indonesia Database for Policy and Economic Research. We run multilevel logit regressions where the binary variable of diarrhoea is regressed on access to unimproved water and sanitation.[7] We do this for the two different definitions of unimproved water and sanitation.

Table 4 Descriptive Statistics of Variables Used

Variable	*Mean*	*Standard Deviation*
Response variable		
Diarrhoea (1 = yes, 0 = no)	0.02	0.12
Independent variables		
Unimproved water	0.19	0.39
Unimproved sanitation	0.51	0.50
Controls		
Male (1 = yes, 0 = no)	0.50	0.50
Urban (1 = yes, 0 = no)	0.41	0.49
Earthen floor (1 = yes, 0 = no)	0.08	0.27
Age	28.76	19.78
HH head education	4.13	3.79
Health centre for 1,000 pop	0.22	0.18
Log of GDP per cap	1.83	0.71
Pct open defecation	0.27	0.31
Pct improved water	56.45	21.31
Pct improved sanitation	62.24	17.08

Source: Susenas, Podes, Indonesia Database for Policy and Economic Research.

Table 5 summarizes the findings. Using the standard definition of unimproved water and sanitation, we find that only the latter significantly affect the odds of having diarrhoea. That is, an individual who lives in a house with unimproved sanitation has 1.23 times the risk of getting diarrhoea compared with those who live in a house with improved sanitation, holding all other variables constant. In other words, an individual in a household with unimproved sanitation is 23 per cent more likely to get diarrhoea than those with improved sanitation. When we use a stricter definition of unimproved water and sanitation, both estimates turn significant. Now the odds of getting diarrhoea are 12 per cent higher in a house with unimproved water, and 27 per cent higher in a house with unimproved sanitation.[8] It appears, therefore, that sanitation plays bigger role than water in the odds of getting diarrhoea.

5. Discussion

The fact that sanitation is more important than water source in regard to diarrhoea, incidence might raise a question. It is widely known that someone might suffer from diarrhoea through consumed food or water more than through how she or he excretes. However, the complete

7. We use the generalized linear latent and mixed model technique developed by Rabe-Hesketh et al. (2005). In this study, the first level is household and the second level is district.

8. We also run alternative regressions where we separate the unimproved water and unimproved sanitation variables. The results (available upon request) are similar to the cases where they are included in the same regressions.

Table 5 Summary: Determinants of Diarrhoea

	Coefficient	*Odds ratio*	*Confidence interval*
Model 1			
Unimproved water	–0.03 (0.023)	0.97 (0.022)	(0.93, 1.02)
Unimproved sanitation	0.20 (0.021)***	1.23 (0.025)	(1.17, 1.28)
Model 2			
Unimproved water	0.12 (0.026)***	1.12 (0.029)	(1.07, 1.18)
Unimproved sanitation	0.24 (0.008)***	1.27 (0.010)	(1.25, 1.29)

Notes: Control variables are sex, age, education of household head, urban/rural, percent of household in the village practicing open defecation, district GDP per capita, number of health centres per 1,000 population, percent of district population with access to improved water and sanitation; standard errors are in parentheses; *** is significant at $p < 0.001$.

Source: Author's calculation, see Appendix 1.

Table 6 Water, Sanitation and Hygiene (WASH) Survey in Indonesia

	West Nusatenggara	*East Nusatenggara*	*Papua*
Knowledge (per cent of respondents)			
Major causes of diarrhoea			
Eating contaminated food	37.5	36.0	34.5
Drinking contaminated water	30.5	35.5	44.5
Prevention of diarrhoea			
Avoid dirty food and drink	47.0	45.0	59.0
Attitude (per cent of respondents)			
OK to drink untreated water	63.0	23.5	23.0
Handwashing may prevent diarrhoea	85.5	92.0	81.5
Practices (per cent of respondents)			
Drink water directly from source	40.5	8.5	2.5
Use water and soap to clean cooking utensils	24.5	88.0	97.5
Always wash fruits and vegetables	82.5	83.0	94.0
Handwashing before eating	85.0	42.5	88.5
Use water and soap in handwashing	66.5	79.5	90.5
Handwashing after defecating	86.0	58.0	87.0
Use water and soap for cleaning after defecation	34.0	65.0	4.0
Diarrhoea prevalence (%) (SUSENAS)	1.9	2.8	2.1

Source: LPEM-FEUI (2009), Susenas (2011).

regression results in the Appendix 1 show that living in a community with higher proportion of population defecates in the open increases the odds of diarrhoea quite significantly. A 1 per cent increase in the proportion of population that defecate in the open might increase the odds of diarrhoea in the household nearby by around 11 per cent. Therefore, it is possible that bad sanitation factor channels to diarrhoea not just via the toilets in the house, but also from polluted environment caused by people in the surrounding. In addition, the lack of proper hand washing can strengthen the sanitation–diarrhoea channel. To get more insight into this particular issue, we explore previous studies. A series by LPEM-FEUI (2009) in collaboration with a UNICEF's water, sanitation and hygiene project reports their baseline surveys on environmental sanitation, hygiene and safe water in eastern Indonesia. They surveyed six provinces, focusing on knowledge, attitudes and practices among households with regards to water and sanitation. Table 6 gives a snapshot of the results in three least developed provinces, that is, West Nusatenggara, East Nusatenggara and Papua. The findings are rather mixed, but the results on handwashing practices seem to confirm the sanitation–diarrhoea channel. For example, in East Nusatenggara where respondents are rela-

tively less likely to practice handwashing before eating or after defecating, the prevalence of diarrhoea is higher than that in West Nusatenggara and Papua.

Finally, we look at the relevant policies. The 2009–2014 medium term development plan (RPJMN 2009–2014) states that the practice of open defecation should stop completely by 2014. This sounds very ambitious, as in 2012, there were still more than 50 million people defecate in the open (WHO/UNICEF 2014).[9] Initiatives such as community-led total sanitation that was adopted as a national program by the government in 2008 have helped freeing 2,000 villages (covering around 4 million people) from open defecation practice by 2010.[10] Clearly, this is not sufficient.

Moreover, there is a financing problem. The budget allocated for sanitation improvement in the 2015–2019 development plan only covers around 12 per cent of its actual need (Moersid 2015). Given the recent major change in the national budget structure (as the result of fuel subsidy removal), the government should have the opportunity to increase the allocation for sanitation improvement.

The recent regulation issued by Minister of Health (Regulation 3/2014) on community-led total sanitation is encouraging. It lays out important 'pillars' for sanitation improvement, including the calls to stop open defecation and to handwash with soap. The regulation is appended with detailed instructions on what constitutes sanitary toilets, hygienic handwashing etc. As in the case of many regulations, however, it is implementation that would matter.

6. Conclusions

We have highlighted the issues around Indonesia's progress in meeting the MDG's targets to cut the numbers of people with unimproved water source and unimproved sanitation. It is likely that Indonesia can meet the target for water, but not for sanitation. A deeper look into the current statistics reveals more complicated challenges.

Furthermore, our regression results show that providing access to decent water source and sanitation remains pivotal in reducing the prevalence of diarrhoea.[11] In this regard, the relative importance of improved sanitation is higher than that of improved water source. Policy-makers should therefore prioritize on improving sanitation facilities and on discouraging the practice of open defecation.

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9. The new, subsequent plan, 2015–2019 RPJM states no explicit target on this matter.
10. As reported in the March 2010 issue of *Percik*, a regular newsletter issued by the National Water and Sanitation Workforce (Pokja AMPL).
11. We acknowledge that there is also much interest in the impact of water and sanitation access on nutrition, especially in the case of stunting. However, the present study is limited into diarrhoea incidence as its health outcome proxy. We thank an anonymous referee for this point.

Appendix 1

Table A1 Model 1: Standard Definition of Unimproved Water and Sanitation

	Coefficient	*Odds ratio*	*Confidence interval*
Unimproved water	–0.03 (0.023)	0.97 (0.022)	(0.93, 1.02)
Unimproved sanitation	0.20 (0.021)***	1.23 (0.025)	(1.17, 1.28)
Earthen floor	0.09 (0.032)**	1.09 (0.035)	(1.03, 1.16)
Male (1 = yes, 0 = no)	0.06 (0.016)***	1.06 (0.017)	(1.03, 1.09)
Age	0.00 (0.000)***	1.00 (0.000)	(0.99, 1.00)
Education of HH head	–0.02 (0.003)***	0.98 (0.002)	(0.98, 0.99)
Urban (1 = yes, 0 = no)	–0.09 (0.022)***	0.91 (0.020)	(0.87, 0.95)
Pct. open defecation	0.10 (0.034)**	1.11 (0.037)	(1.04, 1.18)
Health centre for 1,000 pop	–0.09 (0.148)	0.91 (0.135)	(0.68, 1.22)
Log of GDP per cap	–0.03 (0.043)	0.97 (0.042)	(0.90, 1.06)
Pct. improved water	–0.00 (0.002)	1.00 (0.042)	(1.00, 1.00)
Pct. improved sanitation	–0.00 (0.002)	1.00 (0.002)	(0.99, 1.00)
Constant	–24.00 (2.049)		
Log likelihood	–78955.288		

Notes: Dependent variable is whether or not the individual experienced diarrhoea within 1 month prior to the survey (1 = yes, 0 = no), standard errors are in parentheses, ***p < 0.001; **p < 0.01

Source: Author's calculation.

Table A2 Model 2: Stricter Definition of Unimproved Water and Sanitation

	Coefficient	*Odds ratio*	*Conf. interval*
Unimproved water	0.12 (0.026)***	1.12 (0.029)	(1.07, 1.18)
Unimproved sanitation	0.24 (0.008)***	1.27 (0.010)	(1.25, 1.29)
Earthen floor	0.08 (0.031)*	1.08 (0.033)	(1.02, 1.15)
Male (1 = yes, 0 = no)	0.06 (0.016)**	1.06 (0.017)	(1.02, 1.09)
Age	0.00 (0.000)***	1.00 (0.000)	(0.99, 1.00)
Education of HH head	–0.01 (0.002)***	0.99 (0.002)	(0.98, 0.99)
Urban (1 = yes, 0 = no)	–0.10 (0.022)***	0.90 (0.020)	(0.86, 0.94)
Pct. open defecation	0.10 (0.032)**	1.11 (0.035)	(1.04, 1.18)
Health centre for 1,000 pop	–0.03 (0.095)	0.97 (0.092)	(0.80, 1.17)
Log of GDP per cap	0.04 (0.038)	1.04 (0.039)	(0.96, 1.12)
Pct. improved water	0.00 (0.001)**	1.00 (0.001)	(0.99, 1.00)
Pct. improved sanitation	–0.01 (0.001)***	0.99 (0.001)	(0.99, 1.00)
Constant	–27.72 (0.802)		
Log likelihood	–78938.522		

Notes: Dependent variable is whether or not the individual experienced diarrhoea within one month prior to the survey (1 = yes, 0 = no), standard errors are in parentheses, ***p < 0.001; **p < 0.01; *p < 0.05.

Source: Author's calculation.

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