

Sanitation in an Emergency Situation: A Case Study of the Eruption Of Mt Merapi, Indonesia, 2010

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Abstract-Sanitation is a critical, though often forgotten or neglected determinant for survival in the initial stages of a disaster or an emergency situation. Global stakeholders have developed guidelines and created minimum standards required for a disaster relief situation but unfortunately, the lessons learned from previous experience indicates a persistent range of problems, such as damaged sanitation systems, inadequate assessment mechanisms, inappropriate technology choices and the lack of health promoting behaviours. This paper addresses sanitation issues in the context of the 2010 Mt Merapi eruption in Indonesia and describes the specific characteristics of this natural disaster and the affected population. It reviews how the relevant stakeholders addressed problems and issues affecting sanitation. It identifies opportunities and challenges relevant to sanitation in emergency situations and proposes recommendations for appropriate practices in the future.

Keywords-Sanitation; Disaster; Emergencies; Mt Merapi; Indonesia

I. INTRODUCTION

Despite the increase from 49% in 1990 to 59% in 2004, four out of ten people around the world still have no access to any type of improved sanitation facility [1]. It is essential, therefore, to recognise that greater efforts are required to achieve the Millennium Development Goal (MDG) target level of 75% sanitation coverage by 2015 [1, 2]. In Indonesia, a recent WHO-UNICEF [1] publication points out that while improved sanitation coverage increased from 46% to 55% during the 1990-2004 period; this figure is lower than the average level in both Southeast Asia (49% to 67%) and around the world (49% to 59%). 2004 data indicate that there is a huge gap between people in rural (40%) and urban (73%) areas in accessing improved sanitation facilities [1].

Sanitation coverage in Indonesia reflects disparities between the rural/urban population, between the rich and the poor and between those with more or less education [3-7]. 2010 national baseline health research [3] indicates that only 69.7% households had their own (family) latrine, 14.5% of households had shared facilities, while 15.8% of households had no latrine facilities. Furthermore, only 55.5% of households had adequate access to a latrine, relevant to meeting the MDG sanitation standard [1-3]. In terms of related behaviour, the previous national baseline health research in 2007 [4] indicated that about 71.1% of the population have appropriate behaviour relating to defecation, while 23.2% of people have appropriate behaviour relating to hand washing. It is noteworthy that around 16 out of the 33 provinces in Indonesia have a lower level of desired behaviour than the national average [4]. More specifically, low levels of desired behaviour have also been found amongst children (10-14 years old), the elderly (> 55), males, and those

who are less educated, have lower incomes and who live in rural areas [4].

Joint Monitoring Programme (JMP) 2010 data [8] indicate that only around 38% of the rural Indonesian population have access to improved sanitation services and that open defecation remains a widespread practice for over 60 million people. These figures are in line with the findings from the impact evaluation of the Global Scaling-Up Rural Sanitation Project in Indonesia [5]. This study estimated that in terms of open defecation practices, the proportion of the poorest households (55%) was higher than that of the richest (18%).

Although improved sanitation coverage has increased gradually as economic growth has spread to Asia's poorer countries, a recent World Bank study estimates improved sanitation coverage is only 57% in Indonesia, still far below the universal sanitation coverage achieved in other Southeast Asian countries such as Thailand and Singapore [9]. The same study estimated that, in economic terms, Indonesia loses an estimated US\$ 6.3 billion a year because of poor sanitation, which is approximately 2.3% of its gross domestic product (GDP), while the annual per capita loss is US\$28.60 [9]. A wide range of consequences in terms of health burden has been identified due to the failure to improve sanitation coverage [1, 2, 10-13]. The complexity of the situation is increased as sanitation not only reflects health problems, but also reflects complex social determinants, including poverty, behaviour and education [1, 2, 9-16].

When a disaster or an emergency situation occurs, sanitation plays a key role as one of the critical determinants for survival in the initial stages of such situations. The importance of this factor is, however, often forgotten or neglected [17, 18]. This study identifies issues related to sanitation, mainly focusing on the need for excreta disposal, during the disaster-relief situation of the Mt. Merapi eruption in 2010 and seeks to build a more general approach to sanitation issues highlighted by such emergency situations. Through a review of the literature, this case study may help to identify the gap between ideal strategies and current realities. These findings can be useful to related stakeholders who are responsible for dealing with the sanitation requirements of the affected population, both in emergencies and also in day to day life. These stakeholders include the national and local governments, the health sector, non-government organisations (NGOs) and civil society.

II. MANAGEMENT OF SANITATION ISSUES IN EMERGENCY SITUATIONS

A body of established literature both in the international and national context provides guidelines and minimum standards about sanitation. The World Health Organization

(WHO) [19, 20], for example, indicates five main stages for planning emergency excreta disposal: 1) Rapid assessment and priority setting; 2) Outline program design; 3) Immediate action; 4) Detailed program design; and 5) Implementation. Harvey [21] lists a number of criteria in selecting appropriate sanitation interventions, including socio-political factors, socio-cultural factors, user-friendliness, water availability and time constraints. The Sphere Project [17] states that there are at least two minimum standards that need to be addressed in relation to excreta disposal (sanitation) in emergency situations. First, the living environments should be free from human faecal contamination; second, the affected community should have appropriate, adequate and acceptable latrine facilities [17]. Each of these sets of standards is supported by a number of key indicators, such as coverage, location, privacy and security, hygiene and vulnerable groups [17].

Sanitation is a critical determinant for survival in the initial stages of a disaster or an emergency situation [17, 18]. Specifically, safe disposal of human excreta constructs the first barrier to excreta-related diseases and contributes to reduction of disease transmission through direct and indirect pathways [17]. Safe excreta disposal is, therefore, a major priority in most disaster situations and needs to be addressed with as much speed and effort as the provision of a safe water supply [17]. WHO recommends the provision of one pit latrine per family, while where that is not possible, both the UNHCR and UNICEF have set a maximum target of 20 people per latrine [22]. It is also essential that in emergency situations, efforts should be made to build separate latrines for men and women or separate latrines for children or to construct privacy screens [22]. Establishing one latrine per household, rather than sharing latrines, increases the likelihood that the facilities will be kept clean and healthy [22]. This is very important due the fact that mortality and morbidity rates among displaced populations are often higher in the first days and weeks following a disaster event [22].

In terms of human rights, the Global WASH Cluster [23] suggests that sanitation must be safe, physically accessible, affordable and culturally sensitive. 'Safe' refers to the indicator that sanitation should effectively prevent human, animal and insect contact with excreta. 'physically accessible' relates to the availability for use at all places and at all times. 'affordable' addresses the economic capacity of individuals or households, while 'culturally sensitive' means that the design and construction of latrines should be culturally appropriate, ensuring safety, privacy and dignity. Furthermore, there should be no discrimination towards the vulnerable and marginalized groups, with all affected people having access to information as well as the right to participate in any decision-making process [23].

Several policies in Indonesia relate to sanitation issues in emergency situations [24-26]. Law number 24/2007 on Disaster Management [24] states that during the initial phase of an emergency situation, basic services must be provided to the affected population, including the need for clean water and sanitation. This document also addresses the importance of a needs assessment to include vulnerable groups such as women and children. In the longer-term phase (rehabilitation and reconstruction), it is suggested that comprehensive improvements of public facilities as well as surrounding environments need to be conducted [24].

More technical details addressing sanitation issues in emergency situations can be seen in the establishment of the

Decision of the Head of National Agency for Disaster Management (BNPB) number 7/2008 about guidelines for the provision of basic needs in an emergency situation. This document [25] explicitly mentions the minimum standards of sanitation in terms of disposal of human excreta as following:

- One latrine to be used by a maximum of 20 people.
- Defecation areas must be at least 30 metres from water sources.
- The base of the pit latrine should be at least 1.5 metres above the ground water.
- Disposal of liquid waste from the toilet should not seep into any water source, either wells or other springs, rivers, and so forth.

Following the 2006 Mt Merapi eruption [27] a rapid assessment in 8 large temporary shelters in Magelang (about 8,994 displaced people) and Sleman (5,658 displaced people) districts conducted by USAID found a number of problems. These related to sanitation, including the limited number of toilets; displaced people bathing and defecating in nearby rivers; and some toilet facilities being either damaged or clogged. This led to the provision of additional toilets in temporary shelters and delivery of mobile latrines to cope with the fluctuating number of displaced people. In addition, health campaigns that included the regular cleaning of the toilets were required [27]. Despite the availability of established guidelines and minimum standards in providing sanitation in emergency situations, however, lessons learned from a number of case studies indicate major difficulties in addressing these issues [27-33]. Typical problems identified are those related to time constraints, coverage and disparity, security and privacy, community participation, knowledge and behaviour [17, 21, 27-33].

III. THE 2010 MT. MERAPI ERUPTION

Mt. Merapi has been widely recognised as the most active volcano in Indonesia as it has erupted regularly since 1548 [34-37]. Administratively, Mt Merapi is located in four districts: Magelang, Klaten and Boyolali Districts of Central Java Province and Sleman District of Yogyakarta Province. It is also very close to the city of Yogyakarta, one of the most densely populated parts of the world [35]. The estimated number of the potentially affected population in these four districts is around 400,000 people (see Table I), of whom 114,878 live in vulnerable communities located within the 10 km danger zone, while thousands of other people live in the villages surrounding the volcano [36, 38]. ECC-UGM for Merapi Relief [39] also indicates the large numbers of vulnerable groups, such as infants, pregnant women and the elderly.

TABLE I POPULATION POTENTIALITY AFFECTED BY THE ERUPTION OF MT. MERAPI

	Districts				Total
	Sleman	Mage- lang	Boyolali	Klaten	
Villages	32	33	30	7	102
Male	106,079	41,379	6,535	39,290	193,285
Female	110,762	42,133	6,872	40,971	200,738
Total	216,841	83,513	13,407	80,261	394,022

Source: Forum PRB DIY [38].

Compared to previous eruptions, the 2010 eruption of Mt. Merapi was the biggest recorded to date and the authorities were forced to expand the danger zone from 10-15 km to 20 km areas [35, 38]. This was also the deadliest of any volcanic eruption within the last decade, causing 379 casualties, 197 of which were due to burn injuries [40]. About 400,000 people were removed from their homes to around 114 refugee camp locations. Fig. 1 indicates the rapid increase in numbers of refugees, from October 26 to December 8, with the peak of the affected population reaching 399,408 on November 14 [40].

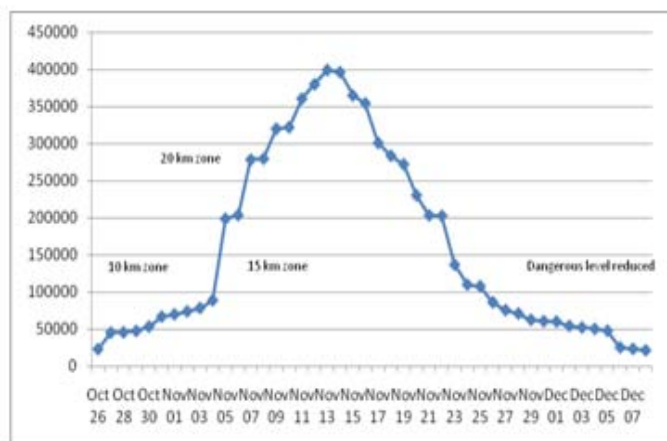


Fig. 1 Population evacuation trends during the eruption
(Source: National Disaster Management Agency (BNPB) [40])

The seismic and volcanic activities of Mt. Merapi increased rapidly from the middle of September 2010 [34, 35] and on October 25, the government raised the alert status to its highest level (Level 4) and urged people living within a 10 km danger zone to evacuate [35, 36]. The first major eruption occurred on October 26 which caused at least 28 deaths while another 91 people were admitted to Sardjito hospital due to respiratory problems and burn injuries [35, 36]. The second massive eruption occurred on November 1, and the government expanded the evacuation zone to a 15 km area two days later [35]. This eruption killed 31 people and destroyed 2 villages, a situation that made the authorities decide to conduct forced evacuation for people who refused to leave the danger zone [35]. On November 5, the biggest eruption of the 2010 Merapi disaster took place which caused the danger zone to be expanded to a 20 km area for the first time [35]. After this eruption, volcanic activities gradually subsided, however many people remained displaced for months due to the damage to houses and villages [35, 40]. Based on the joint assessment by Indonesia's National Disaster Management Agency (BNPB), the World Bank and UN Development Programme (UNDP), it was estimated that the total damage and losses from the Merapi volcanic disaster were equal to US\$ 450 million [40].

Difficulties in addressing sanitation issues arose particularly during the initial stage of the disaster [17, 18] with these difficulties mainly due to the unique characteristic of the 2010 disaster, which is the biggest eruption for a relatively long period [35, 41]. Furthermore, these difficulties became even more complex at the national level, as two other disasters took place in the same period, the floods in Wasior (Papua) and the earthquake and the tsunami in Mentawai Islands. National authorities for sanitation issues had to deal with all of these disasters [41-43].

In terms of established guidelines, most stakeholders used the Decision of the Head of BNPB number 7/2008 [25] as the foundation for program implementation. It was recognised, however, that even though this document had been adopted from international standards in emergency situations [17], several needs had not been fully addressed, including gender sensitivity [38]. One of the essential indicators for appropriate sanitation facilities, the extent to which the needs of vulnerable groups were considered [19, 23, 28, 44], was not adequately addressed in this situation. Women from villages surrounding Mt. Merapi, for example, felt uncomfortable using the facilities in their new temporary shelters, even though they were used to share facilities in their own villages [45]. Another difficulty identified was in the provision of facilities for women who were menstruating, an issue which is often neglected [45].

The action planning process in emergency situations involves a series of rapid assessments, priority setting and immediate action. In this context, data collection is an essential part of the rapid assessment and priority setting processes [19, 20]. However, there were difficulties in gaining accurate data during this emergency situation [38]. Information on the number of the refugees in temporary shelters, for example, was constantly changing and tended not to be verified. This required the use of data projections, or data from previously established sources [38]. In this context, BNPB estimated the maximum number of refugees to be 400,000 during the biggest eruption of Mt. Merapi [38]. This estimate was used for various purposes, including planning the budget for providing water supply and sanitation needs [38].

WHO has identified three different phases in an emergency situation: the immediate emergency, stabilization and recovery [19]. There was some confusion within related stakeholders in terms of identifying and working within each specific phase of the Mt. Merapi emergency situation [38]. Several weeks after the first major eruption on October 26, some stakeholders still considered that they were operating and developing their strategies within the initial stage (immediate emergency), while others had already moved on to a later stage (stabilization) [38]. These different approaches were mainly due to the continuous change in the status of the eruption, as well as the dimensions of the evacuation zone across the three month period (October-December 2010) [41, 42, 46]. The expansion of the danger zone from 15 km to 20 km on November 5, for example, resulted in the relocation of temporary shelters and sanitation facilities, particularly those which were located between 15-20 km areas [38, 42]. Several existing sanitation facilities which were built following the previous disasters within 5-15 km areas were also damaged due to the severity of the 2010 eruption [38, 42]. In Sleman and Klaten districts, for example, at least five villages reported a lack of access to water supply and sanitation, due to damage to existing facilities as well as contaminated rivers and ground water [42].

During the immediate emergency phase, Ditjen Cipta Karya (a leading organisation in the provision of sanitation needs in Indonesia) completed the establishment of 437 portable toilets as well as water supply facilities for 75,000 refugees in 27 temporary shelters in four affected districts – equal to 1 toilet per 170 people [42]. This figure was still very far from the ideal standard, with guidelines recommending a maximum of 20 people per latrine [17, 22]. The worst

situation occurred during the first three days of the immediate emergency phase as there were problems due to the lack of coordination and management [42]. Moreover, the BNPB report on December 8 [40] indicated that there was a substantial number of latrine facilities (403 toilets in 6 affected districts) where the provision/installation process was still under way. As a longer term plan, local government and related stakeholders planned to build 2,500 temporary shelters at a cost of AUD\$900 per unit [42]. Each shelter was to be supported by basic facilities, including electricity, water supply and toilet facilities [42].

Another sanitation problem occurred due to the settlement of a large number of refugees in one temporary shelter. The number of people in the Maguwoharjo football stadium (Sleman district), a shelter for around 26,000 affected people, for example, had toilet facilities that were not working properly and difficulties in the provision of water supply. This required a major effort to improve and maintain the existing sanitation system [42, 47].

An additional issue was related to the knowledge and behaviour of the affected population in relation to the use of modern sanitation facilities. Also, in the broader context, many people in the affected population were reluctant to be evacuated to a safer zone and could only be convinced to leave their houses, fields and livestock when eruptions were imminent or already underway. In an environment where they feared the loss of their property, possessions and livestock if they fled, some refugees who came from the villages surrounding Mt. Merapi to the temporary shelters in the city, were unfamiliar with the design and best use of facilities and faced difficulties in using and cleaning the built facilities, including water installation and toilets [32]. This lack of knowledge about the need for appropriate hygiene practices combined with limited toilet facilities resulted in on-going open defecation [39].

IV. OPPORTUNITIES AND CHALLENGES FOR THE FUTURE

This study has analysed issues related to sanitation in an emergency situation following the eruption of Mt. Merapi in Java, Indonesia, in 2010. Using a qualitative method through a review of the relevant literature, the study has revealed that one of the difficulties in dealing with sanitation issues was due to the unique characteristic of this disaster. It was the biggest eruption for many years and it took place over a period of time, during which the evacuation zone had to be expanded to a 20 km area for the first time. At the national level, two other disasters, the floods in Papua and the earthquake and the tsunami in Mentawai islands, which happened at the same time, added to the complexity of dealing with these difficulties. The 2010 Mt. Merapi disaster had a huge effect in terms of the number of the affected population. At least 379 deaths were recorded while the number of refugees peaked at about 400,000 on November 14. In terms of sanitation, this study found that the most difficult time was during the initial period of the emergency phase.

There were also problems related to information and data collection, an essential part of the rapid assessment and priority setting processes, which was not adequate. This resulted in the use of data projections, instead of real data from the refugee camps, for various purposes, including in planning the budget for providing sanitation needs.

V. CONCLUSIONS

Sanitation, even in emergency conditions, is not an issue of technology alone. In terms of knowledge and education, some refugees faced difficulties in using the water supply and cleaning toilet facilities and the expected related behaviour. The provision of facilities for specific vulnerable groups, such as women during menstruation, was linked with the privacy and security issues that emerged during the disaster, and which were often neglected. The sanitation needs of the affected population must address such problems as well as those of privacy and the security of vulnerable groups, and must allow the community to participate in the decision making processes.

Guidelines have been developed and minimum standards required for a disaster relief situation have been identified and these clearly recognise that sanitation is a critical, if sometimes neglected requirement after emergencies or disasters strike. The Mt Merapi eruption in Indonesia highlighted the significant role played by damaged sanitation systems, inadequate assessment mechanisms, inappropriate technology choices and the lack of health promoting behaviours amongst the displaced population. Many of these issues can be addressed at relatively low cost with locally developed initiatives, such as locally constructed latrines and promoting acceptable standards of hygiene. Such locally developed initiatives for example latrines constructed with cheap, readily available materials at very low cost, do not require expensive and time consuming interventions from international partners and are easily transferrable across emergency situations. At a broader level, they are also required in villages where improved sanitation is a vital requirement for improving the health of the rural poor.

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