

Social Effects of Disaster Waste Management: A Case Study of Brisbane Suburbs Post 2011 January Floods

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Abstract: In the aftermath of a disaster, large volumes of generated waste largely affect emergency response and post-disaster recovery efforts. Successful disaster waste removal process is almost always characterised by having an involved community who has a strong understanding of how this process is conducted. Nevertheless, the speed, nature and impact of disaster waste management process needs to be carefully examined as it may impose profound social impacts, which can adversely affect the recovery of the community.

This paper investigates how the speed and nature of disaster waste management impacts on residents belonging to different socio-economic backgrounds, with a particular focus on the 2011 January Floods in Brisbane, Australia. Using a survey-based research design, collection of data entailed asking residents from different socio-economic backgrounds about their perceptions, experiences and understanding on the speed and nature of the removal of flood waste and its influence on the disaster recovery of their neighbourhood.

The paper found that the management of disaster waste occurred rapidly which came at the expense of the residents' losing personal possessions as a result of not enough time to salvage. Furthermore, the paper highlights that residents from high and low socio-economic backgrounds had similar attitudes about the removal of flood waste in terms of limited time allocated to salvage for personal belongings and volunteers not being briefed appropriately.

Introduction: Disaster-affected communities have the overwhelming task of restoring some sense of normality to their lives. The removal of disaster waste after extreme events is one of the most important steps towards achieving normality and consequently contributing to recovery from a disaster. That is why it is essential to ensure the clean-up process is well planned to allow an efficient recovery.

Brisbane, the capital of Queensland, Australia, having a local government area population of 1,131,191 (BCC, 2013), has been known to experience floods on cyclic periods with major events occurring in 1841, 1893, 1974 and lastly 2011 (BCC, 2011a). While these major events produce adverse socio-economic and environmental impacts, the challenge of how to best manage disaster waste has become a persistent local community problem. The 2011 Brisbane floods generated approximately 402,000 tonnes of disaster waste (Lee, 2014). The estimated cost of the Council's disaster operations and clean-up was \$40 million (BCC, 2012), compared to an annual budget of \$2.9 billion (BCC, 2015). The clean-up was undertaken by residents, volunteers, the army, private waste industry companies and Brisbane City Council (Lee, 2014, Ralph, 2014). Flood waste was generally removed from the residential households to the local street where the private industry vehicle would then collect the waste; this strategy is called 'Kerbside Collection' (Ralph, 2014). The flood waste generally comprised of household items and mud. The waste was then transferred to landfill for final disposal (Lee, 2014, Ralph, 2014). The bulk of the flood waste took approximately 3 weeks to remove from the streets of Brisbane (Lee, 2014). However, six weeks after the floods, mounds of flood waste was still being found on the streets from residents disposing additional flood waste on the streets (Lee, 2014).

While it is clear that the removal of disaster waste needs to be undertaken swiftly; the approach on how this process is undertaken can have major implications on, not only infrastructure but also the recovering community. Brown et al. (2011) state that how the disaster waste management process is conducted, in terms of its speed and nature, determines how rapid a community recovers from the disaster, where a fast and efficient removal of disaster waste aids in the psychosocial recovery of a community (Brown, 2012). Brown (2012) further argues that engaging community members in the removal of disaster waste can empower communities and reduce their distress, depression and improve mental health after the traumatic event (Brown, 2012), consequently enhancing the social capital. Moreover, the extent to which the public understands and accepts the disaster waste management strategy employed guarantees that the community members and implementing authorities share a common goal (Petersen, 2004). While the call to examine the social dimension of disaster waste management is growing, there has been limited focus to date on how the constraints poses by socio-economic structures on communities affected the recovery of affected communities, this would require further scrutiny.

This study addresses this gap by investigating how disaster affected communities from different socio-economic backgrounds in Brisbane responded to the disaster waste management process employed, with a particular focus on their recovery, attitude and perception of the experience. This study also compares the perceptions and attitudes of residents from different socio-economic backgrounds to identify differences towards the removal of disaster waste. This information is applicable for policy makers within local governments to develop suitable disaster waste management plans which can be undertaken using the most appropriate strategies without adversely impacting on an already fragile community.

Literature Review: Disaster waste management is an important process following a major catastrophe as it determines how quickly a community recovers. However, when responding to disasters, waste management is often considered to be the weakest point (Karunasena et al., 2012, EPA, 2013). There is general consensus within the literature that an effective disaster waste management strategy should be implemented before the disaster strikes to ease impacts (FEMA, 2007, Rafee et al., 2008, Johnston et al., 2009, Brown et al., 2011, Brown, 2012, Petäjäväära, 2012, Fetter and Rakes, 2012, EPA, 2013) yet only a few governments have in place a plan on how to effectively manage disaster waste (EPA, 2013).

Managing disaster waste is often difficult to do due to the range of possible disasters which can strike, and their magnitude and impact (Brown et al. (2010a). The aftermath of a disaster adds further pressures in the management of disaster waste. These pressures are focused around urban planning context, waste composition, quantities and management phases, waste treatment (e.g. recycling, open burning) and the environmental, economic and social implications of waste management strategies (Brown et al., 2011). Within the literature, there is ample information on the technical aspects of disaster waste management (such as waste source, waste handling, waste treatment, final disposal and waste transportation). However there is little understanding on how a community's recovery is impacted by the disaster waste management process undertaken (Brown, 2011).

Brown et al. (2011) analysed the current literature on disaster waste management and found that there are a number of research gaps mainly on the different social aspects that need to be considered which are as follows:

- Public health and safety which encompasses;
 - Public health hazards such as vermin and vector breeding sites;
 - Health and safety risk from the waste management preferences, for example the health risks of using an incineration technique; and
 - Health and safety protection which may involve the use of safety equipment
- Community/psychosocial impact which encompasses how the disaster waste removal process speed affects the community recovery and rebuilding process; and
- Communication which considers the public perception, understanding and involvement of the community.

There are a small number of studies which explore the social effects of the disaster waste management process. For example, Denhart (2009) investigated the psychosocial impacts of deconstruction of building waste in New Orleans post Hurricane Katrina. The research conducted interviews based on a phenomenological approach, focusing on the experiences of persons affected by this hurricane. Through interviews, it was discovered that there were three core shared experiences amongst residents which included emotionally wrenching situation – residents having deconstruct their homes; empowerment, as residents had control over their recovery; and spread the word and keep going – telling other disaster affected residents about their experience. Denhart (2009) study is significant as it adds to the social components of this process as previously only the technical, mechanical, economic and environmental outcomes of disaster waste have been addressed.

Cook (2009) also commented on the importance of the disaster affected community returning after the event to participate in the clean-up. It is noted that post Hurricane Katrina, approximately two-thirds of the population did not return to assist in the removal of disaster waste, which made the recovery process slow and complicated.

It is significant that if the removal of disaster waste is managed appropriately it may have positive social effects on a community as it becomes a valuable resource in the recovery and rebuilding process (Brown et al., 2011). Conversely, if managed inappropriately, the removal of disaster waste may have undesirable impacts on the community. Allen (2007) noted that the selection of disposal sites near affected communities after Hurricane Katrina created adverse effects upon that community. Allen (2007) also noted that social factors such as race, class culture and education levels are important to consider when formulating plans for the removal of the

disaster waste. Segregation of New Orleans occurred where different demographic and ethnic neighbourhoods appeared to be prioritised in the rebuilding process.

Similarly, a fast and efficient removal process has been central to support the psychosocial recovery of a community (Brown, 2012). Physically participating in the removal of disaster waste can empower communities, reduce distress and depression plus improve mental health post disasters (Brown, 2012). Moreover, ensuring that the public understands and accepts the disaster waste management strategy guarantees that the community and authorities share a common goal. Boettke et al. (2007) also advocates that recovery efforts occurring on the ground produce faster, more robust and greater sustainable redevelopment outcomes than efforts that are directed from a political recovery plan. This is due to the government assistance provided and can inadvertently hinder long-term recovery of the social and economic systems that harmonise daily life.

In particular, the social aspects of the disaster waste management are neglected. Brown (2012) states that the majority of the disaster waste management plans are 'how to guides', are too prescriptive and do not appropriately address the impacts of different disaster types and scales. Brown (2012) acknowledges key future research needs to highlight the importance of further studying the benefits and limitation to public participation in the removal of disaster waste. This would be useful so that local governments can successfully prepare disaster waste management systems.

As this paper investigates the social aspect of disaster waste management it is important to understand the key components. A theoretical framework is developed to provide a visual tool of the literature that is present, the knowledge gaps and how this study will address the literature, as figure 1 shows. As mentioned earlier, the technical aspect of disaster waste management system is covered sufficiently within the literature. However the social effects of the disaster waste management are not appropriately identified within the literature, therefore it is classified as a knowledge gap. In particular, it is unknown how different socio-economic groups react to the process of disaster waste management. Several issues have been identified by the researcher which may hinder this study. Finally the research contribution is highlighted to show how this reduces the knowledge gap.

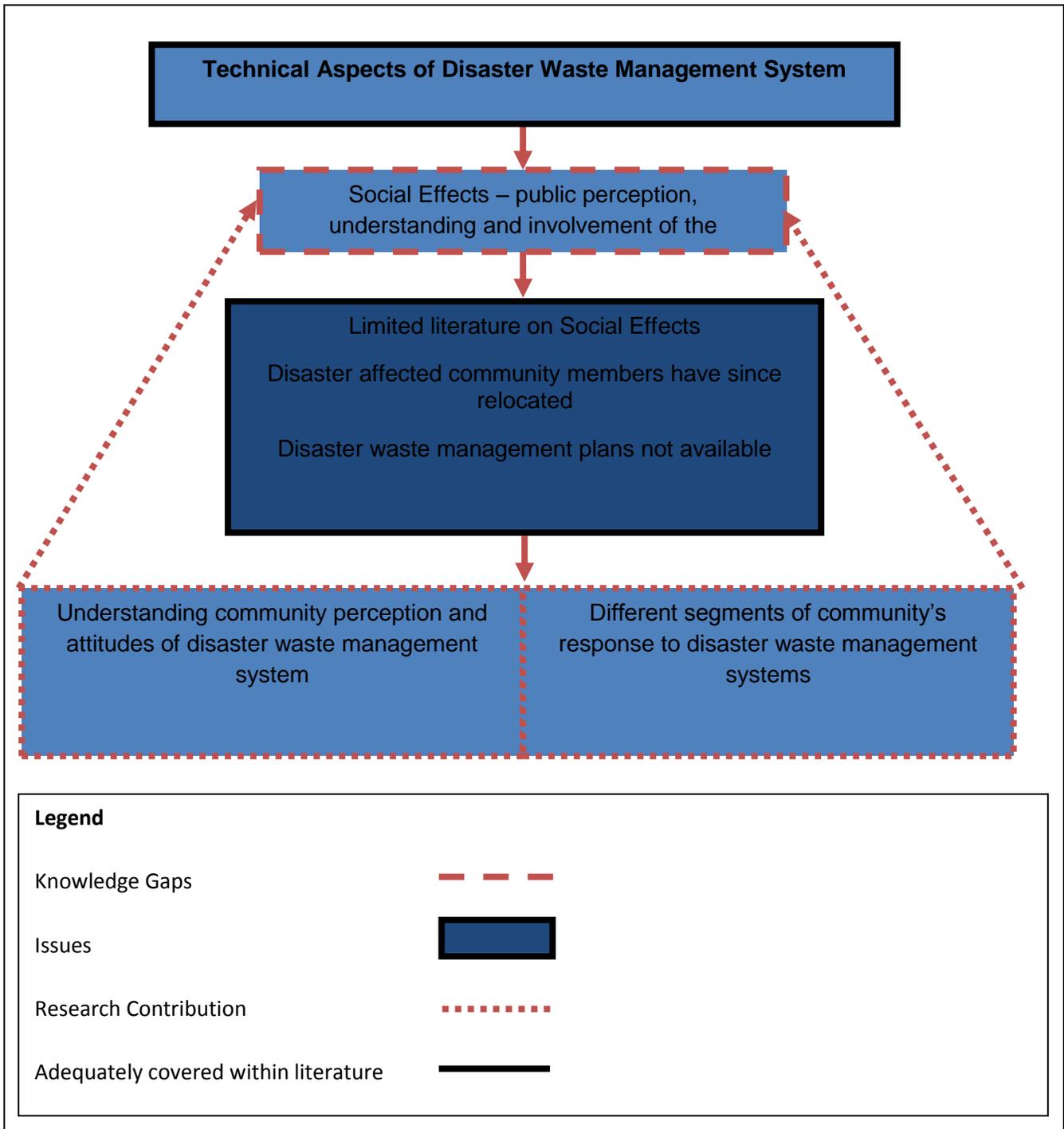


Figure 1. Theoretical framework of disaster waste management literature.

Methodology: The focus of this paper is to understand how a disaster-affected community's attitudes and perceptions of the waste management processes adopted during the flood. The paper also has a particular focus regarding how different socio-economic groups perceived this process. This study uses a case study of the 2011 January Floods in Brisbane and surveyed residents who participated in the clean-up process. The 2011 January Floods affected 94 suburbs in Brisbane which roughly equated to 22,000 homes being damaged (ABC, 2011, BCC, 2012).

Data was gathered using a survey based research design to target residents from the worst flood-affected suburbs of Brisbane, including advantaged and disadvantaged suburbs. Surveyed suburbs were selected using the Socio-Economic Index for Areas (SEIFA). This index rates areas based on how advantaged or disadvantaged the area is. The index rates the economic and social condition of households within an area (ABS, 2013). Residents from the worst flood affected suburbs were determined by the total hectares of residential land that was flood affected. Based on the criteria above the selected advantaged suburbs were Jindalee, Graceville and Chelmer. The disadvantaged suburbs were Rocklea, Archerfield and West End.

A qualitative and quantitative survey was distributed to residents via a letter box drop. Participants had the choice of completing the hard copy survey or undertake an online survey. A total of 645 surveys were distributed to the different households.

Within the discipline of disaster waste management the social effects of the removal of disaster waste is not well established. Therefore the survey questions were developed based on the literature available. Standardised qualitative and quantitative questions for the survey were created with a particular focus of the following themes:

- Demographics;
- Flood aspects: Property damage; participation in the clean-up; time taken to remove flood waste from the household and public areas; and time taken to fully recover.
- Community perception of disaster waste management: Information provided; time given to salvaging; safety; use of media; understanding of the disaster waste management process; usefulness of waste removal methods; recycling; and level of happiness of removal of flood waste.
- Community impact of disaster waste management: Time taken to remove flood waste; physically participating; volunteers; and level of coping before and after clean-up.

Data from the survey was analysed using a range of techniques. Bivariate analysis was conducted to show a statistical relationship between two variables (Neuman, 2006). Firstly, cross-tabulation was used to show where the residents from disadvantaged and advantaged suburbs agreed or disagreed on particular topics about the disaster waste management system. Cross-tabulations and independent t-test were also used to compare the means of residents from disadvantage and advantaged suburbs and to identify if there were any statistically significant difference between the perceptions and understanding between the groups.

The qualitative responses from the survey were analysed by using a 'pattern matching' technique. Yin (2003) suggests this technique is appropriate for studies that identify themes embedded in the qualitative responses. The qualitative data was used to identify if residents from disadvantaged and advantaged suburbs had similar or different attitude towards the removal of disaster waste.

Two interviews were undertaken with personnel from Brisbane City Council (BCC) and private waste industry representatives to understand how the clean-up process was implemented and managed.

Results of Survey: A total of 100 surveys were completed where 71 surveys were from residents from advantage suburbs and 29 responses were from residents from disadvantage suburbs. The median age of respondents ranged from the 33-39 years of age. The ethnicity of the respondents is predominately Australian (73%) with a small proportion of English respondents (7%). Other ethnicities included European (4%) and Asian (2%) persons. The sample population consists of persons who have generally a university or other tertiary education qualification (69%), secondary schooling qualification (14%) and vocational/technical or further institution qualification (14%). The weekly income of the respondents ranges from \$2,000 or more (33%), \$1,000-\$1,499 (11%) and \$1,500-\$1,999 (10%).

Perceptions & Attitudes of Disaster Waste Management System: Residents perceptions and attitudes from disadvantaged and advantaged suburbs are analysed to determine any differences. Overall, 84% of the respondents were either very happy (37%) or happy (47%) with how the removal of flood waste was

undertaken. However the independent t-test ($t(n) = 100, p = 0.05$) indicated that residents from advantaged suburbs were happier with the disaster waste management system implemented by BCC compared to residents from disadvantaged suburbs. This is supported by figure 2 illustrating residents from advantaged suburbs having a greater level of happiness than residents from disadvantage suburbs.

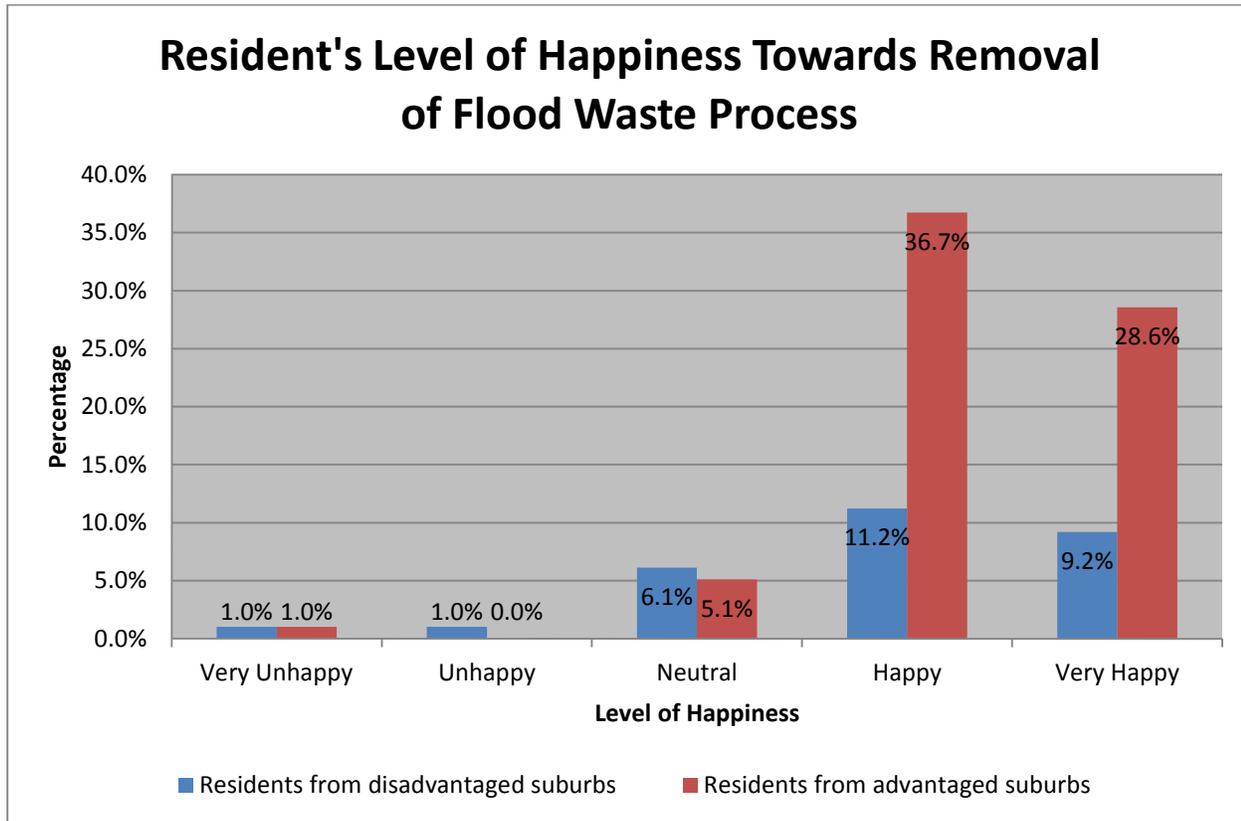


Figure 2. Resident’s level of happiness towards the removal of flood waste process

The strategies employed to dispose of flood waste were generally agreed more by residents from advantaged suburbs than residents from disadvantaged suburbs. Residents from advantage suburbs:

- Agreed that kerbside collection was a useful strategy to dispose of flood waste;
- Had a stronger understanding of the purpose temporary disposal sites;
- Reported being happier with the location of temporary disposal sites; and
- Had a stronger understanding of where the flood waste was being disposed.

The SEIFA index groups, which the survey respondents are separated into, contain a broad range of social and economic attributes. The SEIFA index is determined from characteristics that reflect disadvantage, for example income, low education, high unemployment and unskilled occupations (ABS, 2013). It is possible that these social and economic attributes contributed to how respondents of disadvantaged suburbs perceived and understood the disaster waste management system that was implemented. Still, the communication of the strategies and how it was presented to the flood affected residents may have also contributed to the residents understanding.

Johnston et al. (2009) emphasises the importance of a communication strategy to inform the community on how the removal of disaster waste may occur. Throughout the removal of disaster waste during the Brisbane floods, BCC engaged the community in different forms of media (BCC, 2011b). Nonetheless, the results from the survey shows those residents from disadvantaged suburbs did not agree as strongly as residents from advantaged suburbs on some of the strategies employed. This may be due to the communication strategy that was developed and inappropriately designed to communicate effectively to residents with different socio-economic backgrounds. Another possible factor is that flood affected households were not able to access

information from some of the sources of the media as most residential households did not have electricity or electronics (i.e. computers and televisions) may have been flood damaged.

An analysis of the qualitative questions on the survey showed residents from disadvantaged and advantaged suburbs having similar attitudes towards the removal of disaster waste. The main repetitive themes were in regards to the factors that hindered or assisted the clean-up. The most notable comment was the volunteers disposing of salvaged household items which was stated by nine respondents. Two examples of this are as follows:

"I was upset at people removing valued items from my property e.g. photos". Respondent 39 – resident from disadvantaged suburb.

"The only issue was volunteers putting out possessions as waste, which owners did not want discarded or needed more time to assess. Volunteers should have been briefed to consult owners, and not forced to make quick decisions or offer to take things home to clean if owners seemed overwhelmed."
Respondent 92 – resident from advantaged suburb.

Another theme which emerged was about the removal of flood waste where residents did not have enough time to salvage for belongings which was stated by six respondents. Two examples are as follows:

"The debris should have been left much longer in the street to allow residents to salvage belongings".
Respondent 89 – resident from disadvantaged suburb.

"The process was extraordinarily efficient. A major problem was that people rushed to throw everything rather than attempt to salvage." Respondent 9 – resident from advantaged suburb.

It is also noted that 53% of respondents agreed (33%) or strongly agreed (20%) that there was enough time to salvage. This resulted in 46% of respondents feeling neutral (19%), disagreed (12%) or strongly disagreed (15%). Disaster affected communities appreciate having the time to salvage for personal belongings and can be sensitive to others handling personal items (Brown, 2012). This was evident in the 2009 Victorian Bushfires, Australia where residents were given appropriate time to salvage personal belongings before they were disposed of. This ensured community satisfaction with the waste removal process (Brown et al., 2010a). In addition, allowing a community to salvage for longer periods of time can reduce the waste quantity.

Recovery of Flood Affected Residents: Community involvement was a major aspect of the disaster waste management system after the 2011 January floods. Volunteers, being both from affected and non-affected suburbs, assisted flood affected residents in disposing of flood waste from households. The survey suggested that 78% of respondents physically participated heavily in the removal of flood waste from their households and 11% of respondents physically participated frequently. Due to physically participating in the removal of flood waste, 74% of residents strongly agreed (37%) and agreed (37%) that the removal of flood waste assisted in their recovery from the floods. It is important to note, that some of the qualitative responses within the survey provide an insight into how flood affected residents were coping before and after the removal of flood waste, as table 1 shows. It can be seen that for some respondents, physically removing the waste is an important and positive step to recovery whereas others appeared to be daunted about the future.

Table 1. Responses from survey regarding how residents felt before and after the removal of flood waste.

Respondent #	Comments about how residents felt immediately before the removal of flood waste	Comments about how residents felt immediately after the removal of flood waste from house was completed.	SEIFA Index Status
14	<i>"Anxious to assess damage. Eager to start the clean-up. Grateful for offers of help"</i>	<i>"We were very lucky to have a resilient home and lots of friends who could help in a practical way"</i>	Advantaged
58	<i>"Relief that the damage was minimal"</i>	<i>"In a way, it was therapeutic, like having a purge of all your unnecessary stuff"</i>	Advantaged
62	<i>"Angry that it happened"</i>	<i>"Overwhelmed with the task facing us in re-building our home"</i>	Advantaged
85	<i>"Devastated and helpless"</i>	<i>"Removal of debris was an important symbol and beginning of rebuild"</i>	Advantaged
65	<i>"Exhausted mentally and physically. Devastated. Sometimes numb because no matter how bad you felt you just had to get up and keep going"</i>	<i>"You had to cope there was no choice there was so much to do"</i>	Advantaged
39	<i>"Disbelief"</i>	<i>"Relief"</i>	Disadvantaged
73	<i>"Panicked/under enforced, delighted with help"</i>	<i>"Daunted by the rebuilding ahead"</i>	Disadvantaged
82	<i>"Being in shock and homeless, all control is gone..."</i>	<i>"It was too quick, with no information given on health concerns, But food and physical help was effective just no one thought of the importance of salvage"</i>	Disadvantaged
26	<i>"...I was shredded by the mound of damage but happy that we could manage the recovery with the help of the government, volunteers, insurance, and builders. That proved to be true. I knew the following months would be difficult, but I expected a good result. Afterwards I was less worried about future flooding because the reality, though unpleasant, was not as bad as my worst fears beforehand"</i>	<i>"Exhausted, uplifted by the response from volunteers and the rapid effective government response..."</i>	Disadvantaged
70	<i>"We 'coped' because we had to but it was still very sad and overwhelming..."</i>	<i>"Financially stressed, tired, proud of Brisbane and how people pulled together to help strangers"</i>	Disadvantaged

There are no statistically significant results from the independent t-test to suggest that residents from disadvantaged and advantaged suburbs differ in how they were coping before and after the clean-up, and this is confirmed by figure 2. It shows a small proportion of residents coping levels increasing after the flood waste was removed. To further support this, figure 3 shows the majority of residents had the same coping level after the flood waters receded and the clean-up, with minimal differences between the residents from disadvantaged and advantaged suburbs.

The literature suggests that physically participating in the removing of disaster waste contributes positively in psychosocial terms (Brown, 2012). Respondents generally agreed (37%) or strongly agreed (37%) that

physically participating assisted in their recovery. Consequently, figure 4 shows that the majority of residents had the same coping rank before and after the removal of flood waste from their homes. Brown (2012) suggests that after disaster waste is removed, residents tend to recover faster, however in this case it appears to have stagnated. To note however, there were small improvements in how some residents coped immediately after the clean-up. This may suggest that the recovery process does not occur in the short term but in the long term once residents have come to terms with the disaster.

Nevertheless, Cook (2009) emphasises the importance of community involvement in the disaster waste management process. Cook (2009) noted after Hurricane Katrina, that the majority of New Orleans resident did not return for the clean-up process, resulting in an extremely slow and complication clean-up process. In contrast, with the 2011 January floods the disaster affected population returned to assist in the removal of flood waste. This is one of the main reasons why the disaster waste management system operated appropriately, as community members were able to be a part of the process which in turn allowed the process to be fast and efficient for BCC.

Residents coping before and after clean-up

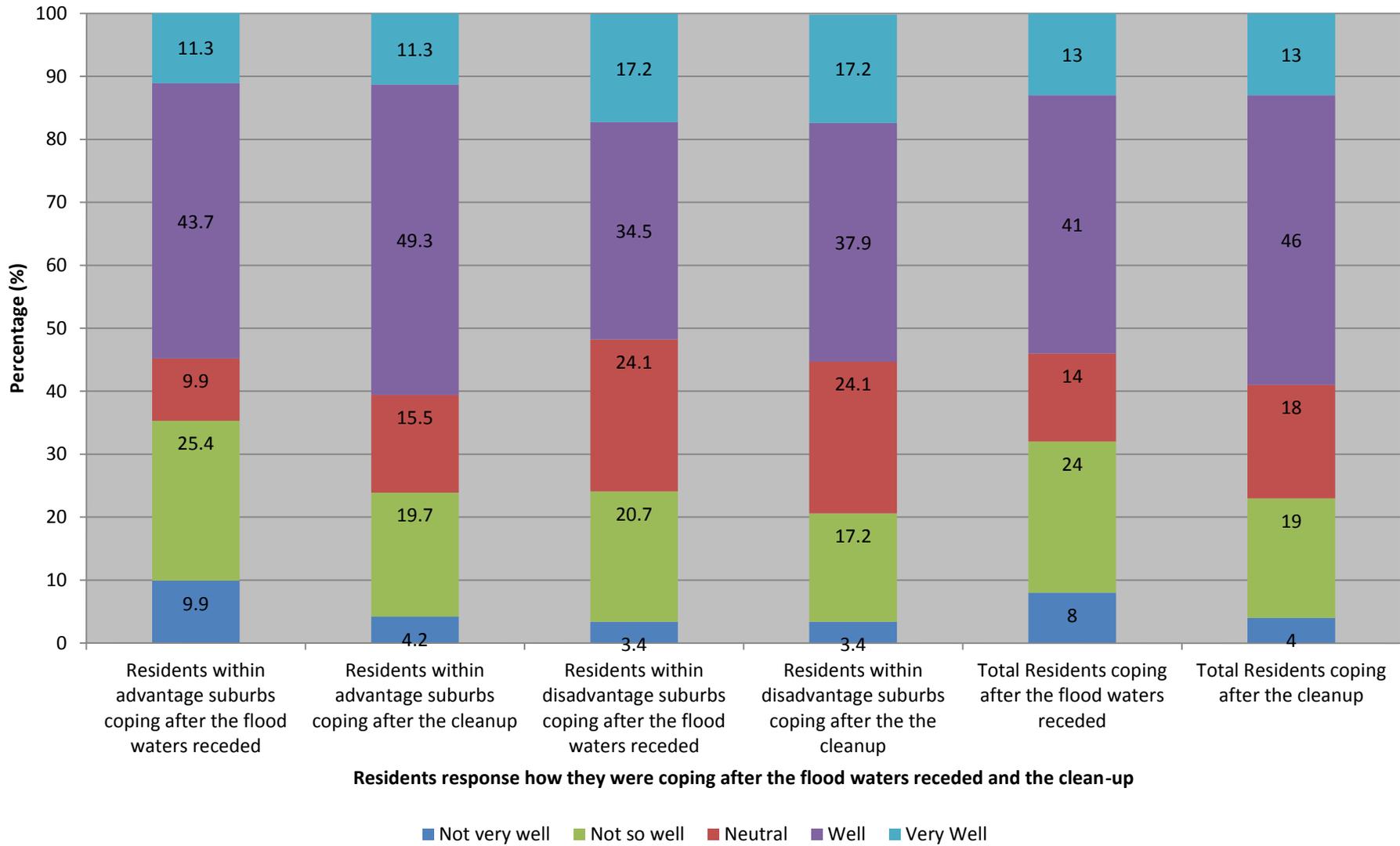


Figure 3. Residents coping level before and after the removal of flood waste.

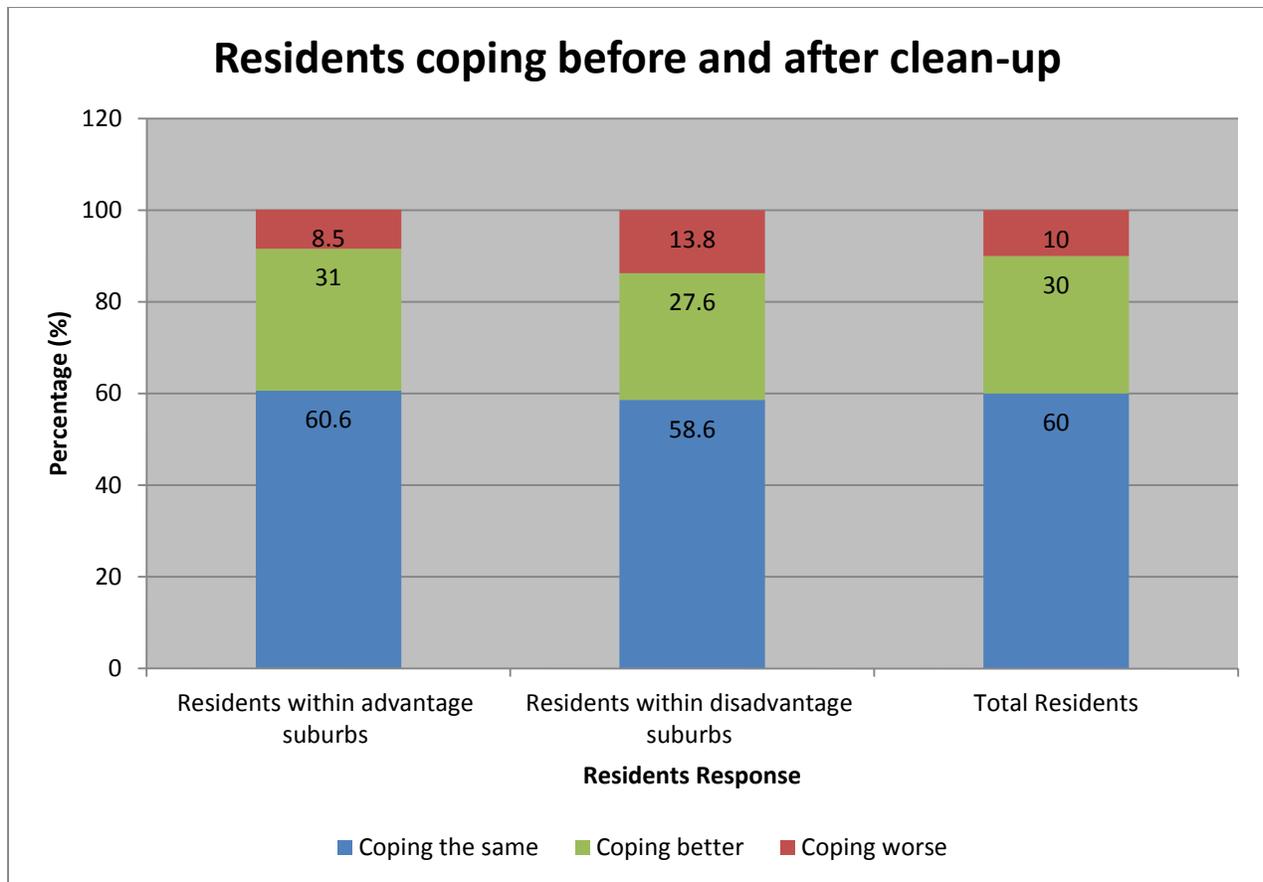


Figure 4. How residents were coping after flood waters receded and after clean-up.

These results highlight that there is minimal difference between residents from disadvantaged and advantaged suburbs in terms of their coping levels. A possible reason for this is that all residents had an equal opportunity to dispose of flood waste. BCC organised the overall systematic removal of flood waste from all disaster affected suburbs in Brisbane (Lee, 2014). Residents did not have to rely on their own financial resources or obtain appropriate vehicles and equipment to remove waste. It is noted within the literature that developing countries take longer to recover due to the lack of resources to remove flood waste (Baycan, 2004, Basnayake et al., 2005, Karunasena et al., 2009, Brown et al., 2010b, Brown et al., 2011, Brown, 2012, Karunasena et al., 2012). Although in this case Australia is a developed country and this may suggest that the coping level of different socio-economic groups may be determined by access to recourses to assist in the recovery process. Due to BCC organising the essential machinery to remove flood waste, residents were able to focus their financial resources on the rebuilding process rather than disposing of the flood waste. This appears to be an important factor which may influence recovery however more statistical analysis is require.

Conclusion: Disaster waste management is a complex process which needs to be well planned. A disaster affected community needs to have control on how their possessions are disposed of and in what timeframe. The floods which struck Brisbane in 2011 showed the complexities of removing disaster waste. By investigating how disaster affected communities from different socio-economic backgrounds in Brisbane responded to the disaster waste management process employed, this study was able to demonstrate that residents from both advantaged and disadvantaged suburbs had similar perceptions and attitudes regarding the process. Common themes of volunteers not having been briefed appropriately and inadequate time for salvaging personal belongings, may have resulted from the rapidness and efficiency of the removal of flood waste by BCC. Even though the waste was removed

quickly, this may have occurred at the expense of residents losing personal possessions. After disasters there is the urgency to return to normality, however, there needs to be a balance between removing disaster waste rapidly and ensuring disaster affected residents have time to assess their situation properly.

Residents from advantaged and disadvantaged suburbs also had similar coping levels before and after the removal of flood waste. Furthermore, their perceptions and attitudes were similar as well. This may have been due to BCC implementing a systematic strategy to remove flood waste. Additionally, providing the appropriate machinery and equipment to remove the flood waste allowed residents to focus their financial resources on rebuilding their homes or relocating. To gain a better and more comprehensive understanding of how different segments of communities respond to disaster waste management, future studies should examine the extent to which particular social factors (e.g. age, income, employment status, ethnic background) influence recovery and thereby contribute to an enhanced understanding of the social dimension of disaster waste management.

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