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Management of Waste Derived Due To Conflicts in the Context of Post Conflict Reconstruction

G. Karnasena¹, R.M.N.U Rathnayake^{1*} and K.M.M.C. Karunarathna¹

¹University of Moratuwa, Moratuwa, Sri Lanka *E-Mail: uthpalarathnayake@ymail.com, TP: +94779861365

Abstract: Increase of man-made conflicts around worldwide has created conflict waste as a major challenge. Improper management of conflict waste creates issues in public health and safety, environment, economic cost on already strained communities and post conflict reconstruction. End of three decade lasted civil war in the country has created significant amount of conflict waste affecting post conflict reconstructions. Hence, this research was mainly focused on identifying the impact of conflict waste on post conflict reconstruction with special emphasize for Construction and Demolition (C&D) waste. Five organizations involved in post conflict reconstruction in conflict areas were selected as the cases and semi structured interviews were conducted to gather data. The collected data was analyzed using content analysis. It was revealed that, lack of capacity to handle an enormous quantity, difficulty in estimating the quantity and composition, identifying dumping sites, coordination among different parties' involved, financial incapability, and lack of technical peoples as major challenges related with management of conflict C&D waste during post conflict reconstructions.

Keywords: Conflict waste, C&D Waste, Post Conflict, Reconstruction

1. Introduction

The world is confronting a growing frequency and intensity of man-made conflicts that has destructive influences to the society. Man-made conflict situations mainly rise due to political motivations or lack of foods. International humanitarian law distinguishes two types of armed conflicts, namely international, opposing two or more States, and noninternational, between governmental forces and nongovernmental armed groups, or between such groups only [1].

Both International and non-international (Civil war) creates direct and indirect deaths, direct injuries (both physical and psycho logical, permanent and temporary) and indirect injuries, population dislocations and environmental problems. These include direct and indirect damages and destruction to environment due to use or release of explosive, corrosive, and chemical combinations and toxic materials. Also it reduced quality of life, fulfilling basic needs, future visions of affected societies, lack of investment and exchange [2].

Among these consequences infrastructure and building damage has a huge impact on the country's

economy and post conflict permanent building reconstructions. Generally, it is generated by the demolition and site clearing of the large numbers of buildings and structures which were damaged fully or partially due to conflict [3]. Many conflict and post-conflict settings, infrastructure has been destroyed and roads, power stations, water pipelines, hospitals, schools, and sewerage facilities must be completely rebuilt [4].

In this context, C&D waste management represents one of the main challenge due to lack of political interest, less awareness of respective urban managers and limited resources [5]. Specifically, the waste generated by conflict such as concrete, brick, bridges, roadways, railway structures requires heavy machinery such as excavators and bulldozers which creates a high cost [6]. Equally, in Sri Lankan due to last three decades of civil war, it has been identified that lack of awareness of the mechanisms and systems for post conflict C&D waste management is а critical challenge during post conflict reconstruction works. The common practice is managing waste by open dumping. However, lack of sites to use for waste disposal has been major impediment. Within this context, this research was focused on investigating the impacts of conflict waste on post conflict reconstruction with special emphasize for C&D waste for future resilience. Accordingly, the paper presents conflict waste and it's impacts on post conflict reconstructions with special emphasis to C&D

waste in Sri Lanka. The aim was achieved through three objectives; identification of composition of conflict waste, investigation on the impact of construction and demolition waste for post conflict reconstruction, and by proposing remedies to overcome the above mentioned impacts. The scope of this study is limited to construction companies carrying out permanent construction buildings extensively in highly war affected areas. The paper presents brief introduction to post conflicts and impacts on C&D waste in post conflict reconstruction, methodology adopted and research findings.

2.0. Literature review

2.1 Conflict and post conflict

A conflict is an external clash with adjoining countries or internal clash with in a country together with disputes disturbing only to specific parts of a country [7]. Moreover, the conflicts are commenced in a country due to the greed and grievances against its government due to the dominant behaviour or due to the injustice against the citizens and in some cases due to discrimination of a certain part of the population [8].

A country which is having a recent end to violence can be described as a 'post-conflict' country [9]. In order to achieve a long-lasting recovery over a conflict, countries have to perform a number of improvements and changes including building lifelong peace by ensuring political stability, reconstructing or strengthening the basic functions of the country's administration, resettling migrants and internally displaced citizens, disbanding combatants, and rebuilding basic economic and social infrastructure, reorganizing public expenses by shifting public money allocated for military expenditure into national development, reforming revenue by changing the source and method for collecting taxes and other revenues, restructuring trade and exchange by changing the method of collecting import duty and quotas as well as implementing new policies to the foreign exchange markets, restructuring financial sector by modifying the methods of managing lending and borrowing by

the financial system, and reforming sector by varying policies for agriculture, industry, energy, and utilities [10].

The era of post conflict reconstruction was one of the most crucial and controversial periods which the societies that were affected by the war. Post conflict reconstruction works can be categorized into some particular key areas. Most of the time government and other donors has largely been directed into four areas as follows [11]; political reconstruction such as moving to elections, support for security such as retraining the police force humanitarian relief Reconstruction of physical infrastructure Countries making the shift from war to peace face a multi-pronged transition in the economic, legal, political, social, and security sectors. This multifaceted transition, economic reconstruction is fundamentally different from the 'development as approach taken by the international usual' community to address typical socio-economic challenges faced by peaceful developing countries [12]. It means that the economic reconstruction is not an easy task to accomplish. Economic reconstruction involves basically transforming a society's economic institutions in order to short-term growth and development as well as to resolve supposed economic and social problems. The economic reconstruction process as a whole therefore involves rebuilding infrastructure, restoring physical, social, and human capital, and restructuring fiscal, monetary, and trade policies in order to allow for a strong private sector to emerge.

2.2. Waste management in post conflict reconstruction

Post-conflict societies are burdened by various problems where the generation of waste either from demolished structures, trash from remaining weapons and other hazardous war material are most critical [13]. In general, waste streams generated by conflict situation can be categorized

- as,
- Construction and demolition debris
- Industrial and toxic chemicals
- Human and animal corpses
- Landmines

During a conflict, highly considerable amount of buildings and infrastructures are damage resulting

more C&D debris. In 1999, in Kosovo's more than 120,000 housing units were damaged and it was roughly estimated that the waste from damaged buildings and structures reached to a magnitude of 10 million tons. In Gaza, it was estimated as 6,300 homes were destroyed or heavily damaged [14]. Table 1 summarizes impact on building and infrastructure facilities by conflicts in different parts of the world.

Table 1: S	Summary of impact on buildings and	d
	infrastructure facilities	

	minustracture racinties					
Type of Damage	Gaza North	Gaza	Middle Area	Khan Yunis	Rafha	Total
Building destroyed/	585	1000	95	241	739	2660
severely Damaged						
Greenhouse	58	74	9	25	20	186
severely damage / destroyed						
Impact	66	82	13	16	43	220
road						
Impact craters in	256	172	59	83	141	711
field						
Total	965	1328	176	365	949	3777

Sources- United Nations Environment Programme, 2009[15]

As tabulated in table 1, major percentage of the damages due to the conflict was building related damages. Therefore it is certain that the impact of C&D waste to the reconstruction works were very high. Specifically, conflict waste management become critical due to mix up materials causing various kinds of debris – hazardous to nonhazardous, biodegradable and recyclable to nonrecyclable waste. This can cause entire mounds of debris to deteriorate rapidly, making recovery and recycling more difficult [16]. This is further aggravated increasing use of land for new construction, renovation,

demolition of old structures and the reconstruction or expansion of the road transportation network [17]. The collection of conflict waste happens in two stages: (1) to clear debris those obstructs emergency areas and eliminate or mitigate the exposure to hazardous waste, (2) to clear the debris to facilitate reconstruction [18].

In the current state it was identified that even though waste management strategies addressed the disaster waste there are no mush attention for the conflict waste management. It is much cleared that during the site clearing and reconstruction works, there are several opportunities for the reuse and recycling of the demolition debris, with subsequent providence of building materials to the ensuing reconstruction works and thereby reducing the quantities of waste going to the often-limited disposal sites. It should be noted that the construction and demolition waste stream does not solely include the demolition rubble. but also the construction waste generated during the ensuing rehabilitation and reconstruction works. The composition of construction and demolition waste is consisting largely of concrete, masonry, metals, plastics, glass and wood. Demolition waste may also contain hazardous materials [3].

2.3. Waste management in post conflict reconstruction in Sri Lanka

Sri Lankan Civil War was a conflict fought between the Sri Lankan government and the Liberation Tigers of Tamil Eelam (LTTE). Nearly, 30 years of civil war in Sri Lanka, was come to an end with the military defeat of the separatist LTTE in May 2009 [19]. The conflict gained greater momentum since the 1983, has killed around 70 000 of people and displaced around two million people [20]. The end of the war left past conflict zones of 2,061 Sq.km heavily contaminated with approximately 1.6 million land mines. By January 2012, demines employed had cleared 1,934 Sq.km leaving about 127 Sq.km yet to be cleared. Three years after the conflict, the requirements are evolving from relief to early recovery humanitarian and development. By the end of September 2012, 468,000 people had returned to their places of origin, while an undetermined number remain displaced in various parts of the country. In this context, preserving place of safety and ensuring protection for refugees remain as a priority [21]. The destruction of property during the war is a huge problem when reconstructing the economy of the particular society. This was further aggravated due to the deaths of young men and over hundred thousand people were injured in battle leaving them out of the labour force. Further, the loss of wealth within the country caused major problem in rebuilding the economy. The lack of industry and railroads and other facilities is decrease the manufacturing capability of the country. These are some of the common major issues in rebuilding the economy of war affected countries [22].

In respect of conflict waste management, nonavailability of disposal lands, treatment mechanism. recycling and reuse options, transportation of waste materials, accessibility to waste management facilities, environmental hazards, financial implications, labour availability, and legal and ethical responsibilities are the critical challenges [23].

As a result, there is a huge impact on reconstruction by the waste generated by the war.

Major impacts of waste on reconstructions are;

• Health and environmental issues

The impact of debris disposed in an uncontrolled way can have a negative impact in the quality of the surface and groundwater due to contamination with a trace of hazardous chemicals.

Institutional issues

The municipalities have the responsibility for solid waste management and often do not have the expertise in the topic.

Legal issues

Lack of legal provisions and guidelines for management of conflict waste.

Financial issues

The uncontrolled disposal of waste can lead to huge economic losses due to loss of aesthetics especially in tourist areas and lack of possibilities for recycling or reusing of the useful materials, recuperating part of the financial losses due to the conflict.

Socio-cultural issues

Debris management is an essential part of reconstruction. There have been several programmes that have used the cash for work approach in clearing debris. Clearance of debris may have a positive social impact, though there is scant evidence from these projects [24].

For an example, Iraq had to deal with more than 0.9 million metric tons of conflict waste incurring a total cost of approximately US\$30 billion. In Sri Lanka, approximately produced 0.6 million metric tons of waste. The disposals begun with open burning which was eventually stopped due to air pollution. Then, burying of waste in existing dump-sites, coral mining areas and even playgrounds were practised to manage conflict waste [23].

Most extraordinary investments by aid agencies in waste disposal and management during post conflict activities are usually not accompanied by awarenessraising campaigns on civic responsibility, hygiene and the benefits of waste recycling thereby leading to failure of the intention.

3. Methodology

The aim of this research is to identify the impact of construction and demolition waste for post conflict reconstruction. Case study approach was used as it provide in depth investigation to collect new information that holds across many cases which can stimulate new theoretical thinking and less restrictive than other methods. Accordingly, five construction companies involved in post conflict reconstruction were selected as the cases The profile of the cases are illustrated at table 2.

Table 2: Profile of cases

Case	Type Grade		No.of		
			Participants		
А	Contractor	C1	1		
В	Contractor	C1	1		
С	Contractor	C1	2		
D	Contractor	C1	1		
Е	Contractor	C1	1		

Six semi structured interviews were conducted covering five case studies comprising with project managers, civil engineers and site engineers. The profile of interviewees is indicated in Table 3.

Interviewee	Designation		Experience
I 1	Project manag	ger	8 Years
I 2	Civil Enginee	er (6 Years
I 3	Civil Enginee	er	10 Years
I 4	Project Mana	ger	6 Years
I 5	Project manag	ger	9 Years
I 6	Site E	ngineer '	7 Years

Table 3: Interviewee profile

An appropriate interview guideline was prepared by focusing the three objectives; C&D waste composition, impact of C&D waste for post conflict reconstruction and the remedies. The interviews were tape recorded with the permission of the interviewee and thereafter transcripts were developed.

For the data analysis, code-base content analysis was used, since the interviews were semistructured, which consist with open ended questions. It breaks down data into segments with the purpose of organizing data to make them easier to interpret [25].

4. Research Findings

This section presents the findings of the analysed case studies on impact of construction and demolition waste for post conflict reconstruction and the probable recommendation to overcome the identified.

4.1 Composition of conflict waste in Sri Lanka

In Sri Lanka debris from damaged buildings and infrastructure, industrial and toxic chemicals, human and animal corpses, landmines, vehicles and heavy weapons identified as the major types of conflict waste. Among them damaged buildings and partially damaged buildings, houses were the biggest issue on post conflict reconstruction. According to the respondents, waste generated by the damage buildings vary district to district. For an example in Kilinochchi District there are less permanent houses and have used clay and timber to build houses. There are only few buildings with cement and bricks in town centre. Majority of the residential buildings were done with clay bricks and mud bricks and timber frames and the kadjhan roof. However in the Mulativ District, for a long time people were establish under the LTTE control. In Pudukuduirruppu still there large houses and buildings and they are abandon and damaged. In pre tsunami period the coastal areas were fishing hunts, after the tsunami NGO's funded and people

build permanent houses and those were damaged during the war period. Therefore in these areas there are a lots of construction waste mainly damaged roof tiles, damaged bricks, foundation works. Thus district wise construction waste differ and similarly it effect to the constructions in those areas.

Findings revealed the similar impacts identified through the literature and summarised as follows with probable remedies.

4.2 Impact of construction and demolition waste for post conflict reconstruction and proposed remedies

□ Poor waste management practices

Damaged buildings and infrastructure are often burned out, which results in the majority of the waste no longer exist. This also cause to reduced quantities of debris need to be managed. However, in managing those wastes, it is very difficult to find a properly established response plan. In general, none of the authorities promoting waste management, because it's very difficult to apportioning. In this context, responding for conflict waste should start from the community itself. Simple mechanism to separate, treat and dispose their waste need to introduce and response plans for each local authority need to be developed.

Waste response plan includes identification, and disposal of waste. In the current state without a proper plan the waste disposal is a very difficult task at the time of a disaster and people dump waste everywhere. Therefore, this issue should be addressed in the early stage of prior to the reconstructions. Due to that reason maintaining a conflict waste handling plan in municipalities in those areas is very essential. Though the plan is needed, it is very difficult and high costly to assess the waste (damage buildings) and implement properly established response plan. If construction companies can identify and separate the waste materials that they can destroy themselves and separate the materials that they can reuse, then the considerable amount of waste can be reduced. When demolishing debris, its needed heavy equipment such as excavators and bulldozers. Local authorities not having aforementioned heavy equipment. Hence the better option is that debris management left with the contractor's responsibilities and provide necessary supportive things to do that work properly. Because most of the times the contractors have such kind of a machineries. The Table 2 provides an example for a waste response plan.

Table 2: Waste response plan

mines always create a high risk for the construction works. Due to that workers have to be so much careful and so much thorough.

Apart from that, logistical problems are the major problems in waste demolition and clearing phase. Hence defining a proper logistical plan is very essential taking into account not only the means of transport but also the actual possibilities of getting one place to the other, alternatives for the prompt safe delivery and relief assistance.

Financial impact

Misuse of funds and unethical behaviours from most of the government authorities and irresponsible people result in incomplete projects which are abandoned in long run. Mainly, due to unavailability of regulations or mechanisms to regulate the funds donated for NGOs and other organizations by the donors. Simply, there is no responsible body to govern these funds and the projects. In this context, it is needed to have a properly

Waste stream	Transportation option	Disposal options	Recycle	Reuse
Concrete/bricks	Wheel barrow o excavator/bulldozer offload into truck for haulage	r Disposal at temporary site for future recycling if uncontaminated debris Otherwise disposal at dumpsite/landfill to be used a cover material	Attempt to store for future recycling. If not possible, then limited options for recycling in emergency phase. s	Can extract bricks, Steel for reuse
Timber	Wheel barrow or excavator/bulldozer offload into truck for haulage	If separated, reuse Otherwise dispose at dumpsite/landfill	Possible to separate timber for heating, cooking, shelter	Can use for roof structures or any other wood requirement of house construction
Unexploded objectives	Under controlled measures by specialists	Not applicable	Not applicable	Not applicable

Environmental, risk involves with workers, and logistical consideration

Dealing with conflict waste is a high risk activity due to risks of potential building downfall, hazardous materials such as chemicals and even unexploded objectives, decomposed organic waste and sharp items such as reinforcement bars and concrete. Further, the established management to allocate funds, and monitor the projects in long run. Specifically, government should take the responsibility and prepare effective communication chain and inspect it in a regular time intervals and see the cash inflow, allocation of funds, and progress of the projects and finally analyze the effectiveness of the usage of funds.

Lack of dump sites

Suitable approach need to be proposed to manage dump sites adhering regulations and recommendations of responsible authorities for safeguarding the public health and other issues. Identification of dump sites further aggravated due to banning of paddy field for usage as dump sites by the government. Also objections by the people of use of lands come as a greater issue hence they are not aware of works going to proceed and what are the benefits that they could acquire. Making people aware by conducting awareness programs lead to mitigate this problem.

• Lack of awareness on waste management and less expertise

There are some expertise within the country who aware of these aspects. However it does not mean that it was enough to work with the arisen problems. Therefore, getting the international support to fill the missing areas is the best option in this regards. Specifically, by getting aware of the plans and procedures which have been used with necessary changes for the benefit of our country will be useful.

Lack of trainee people familiar with reconstructions

Experienced and educated professionals' contributions for reconstruction are less in conflict areas. Due to that they have only a minimal experience with regard to the constructions. As a result, vocational training centres with the help of government and local authorities were established to enhance the technical knowledge. However, progress of training programs is very poor and participation of people related with reconstruction has to be promoted.

• Government involvement and restrictions Government involvement is a huge problem in reconstruction works. Because it governs the quality of the work and control some of the basic material prices. According the opinions by various interviewees by allocating enough funds, allocating committees to investigate problems occur, government can govern the qualities and control the matters against the reconstructions in a better way.

5. Conclusion

Generally civil wars disrupt economic, political and social system in Sri Lanka as well as worldwide. War is a man-made conflict between two political parties. Conflicts generate the significant quantities of solid wastes, which are unavoidable, and it causes major impacts on built environment. Most of the common wastes from the conflicts are building related waste and chemical hazardous waste. Management of these wastes is considerable challenges for national and local capacities during the rehabilitation, and prior reconstruction works.

This study focused on the identification of impacts of construction and demolition waste for post conflict reconstruction. Lack of capacity to handle an enormous quantity of waste, difficulty in estimating the quantity and composition of waste, identifying dumping sites and coordination among different parties involved, financial incapability, and lack of technical people were identified as the main impacts. Preparation of simple waste management plan at community level, waste handling plan at municipal level, waste demolishing plan at construction site level, establish transport facilities, better access routes, and enough dump sites associate with local authorities, implement safety procedures, provide adequate funds for both community and local authorities, make people awareness importance of conflict waste management, preparation of a proper mechanism for governing funds for reconstruction works and establish proper management with welldefined goals under single authority were proposed as suggestions to mitigate the impacts identified.

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