

**COMPREHENSIVE GUIDELINE FOR SUSTAINABLE
INVOLUNTARY RESETTLEMENT**

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Degree of Master of Science in Environmental Management



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Declaration

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CERTIFICATION

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ABSTRACT

Resettlement has a long history in the world. According to the way of resettling, it can be categorized in to two. Depending on the method of resettlement it can be categorize in to voluntary and involuntary resettlement.

Several Law enacted by parliament, guidelines and policies at the different occasions of resettlement history. In fact, there was large scale resettlement program in Srilanka after the Tsunami devastation in December 2004.

For the post Tsunami recovery program, the National Housing Development Authority (NHDA), under the Ministry of Housing & Construction, formulated a detail guideline to be used by the prospective house builders in the disaster prone coastal belt in Sri Lanka.

Apart from this, Nongovernmental organizations and international organizations prepared guidelines and policies regarding the resettlement program.

However, there are several policies and guidelines available for resettlement, it was not happening in effectively. As a result involuntary resettlement sites have become partially and completely abandoned. This may attributed to the prevailing social, environmental, socio economic problems. The main issue is whether in voluntary resettlement has been correctly address by the resettlement project plan.

Most resettlement projects not correctly follow the available guidelines correctly. Beside some guidelines developed by the government bodies do not to address the real ground level situation.


In this research, the prevailing environmental, social, socio economic and physical problems of in involuntary resettlement have been identified and suggestions have been made to enhance NHDA guideline in to a comprehensive and more practical guideline for sustainable resettlement by considering the ten years experience of Tsunami resettlement in Galle district.

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ABBREVIATIONS

NHDA	-National Housing Development Authority
NEA	-National Environmental Act
NGO	-Non Governmental Organization
INGO	- International Non Governmental Organization
CEA	- Central Environmental Authority
H.S	- Housing Scheme
NWS&DB	-National Water Supply and Drainage Board
L.P.G	- Liquid Petroleum Gas
L.A	- Local Authority
AGA	- Assistant Government Agent
DS	- Divisional Secretary



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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The term resettlement means where an individual, particular family or community move from the currently residing location to an entirely new location due to a specific reason. Depending on the method of resettlement, it can be categorized in to voluntary resettlement and involuntary resettlement. Voluntary resettlement occurs according to the self interest of particular community. But involuntary resettlement can occur due to the following reasons like,

1. Loss of residence due to natural disasters like Tsunami, Flood, Land slides, Earthquakes
2. Create unsuitable conditions like Wars, Nuclear Power Plants
3. Mega development projects such as Dams construction, Reservoir construction, establishment of Power Plants, High way constructions, and Mining work leads to the evacuation of human settlements living in the project locations.



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Laws have been enacted and several policies and guidelines have been formulated from time to time to govern the voluntary and involuntary resettlement.

At present there are two government bodies which are responsible for resettlement are the resettlement authority established incorporated with the Resettlement Authority Act No 9 of 2007 and the Ministry of Resettlement. According to the Resettlement Authority Act No 9 of 2007, the ministry of resettlement introduced resettlement policy framework for internally dispersed persons at 2013.

Another national resettlement policy adopted by the government as national involuntary resettlement policy in may 2001 to ensure equity, fair of affected people by the development projects.

In 2005, National Housing Development Authority (NHDA), under the guidance of the Ministry of Housing & Construction, formulated a detail guideline to be used for the prospective house builders in the disaster prone coastal belt of Sri Lanka for post Tsunami recovery programs.

Although there are several local and international guide lines, policies and resettlement principles prepared by different government and nongovernmental organizations the problem of involuntary resettlement has not been solved effectively . As a result of that the involuntary resettlement sites become partially or completely abandoned by resettles. This may be attributed to the prevailing social, environmental, socio economic problems faced by the resettlers. The main issues are whether involuntary resettlement has been correctly addressed by the resettlement project plan. Most resettlement projects do not correctly follow the available guidelines or sometimes the available guideline failed to address the real ground level situation.

From Tsunami in 2004 created the largest involuntary resettlement in the Srilanka. Thirteen out of twenty five districts affected by Tsunami devastation.

About 65% of the total coastal belt residencies were affected. Nearly 38 000 people were died. 21500 people were injured and 5000 people were missing. Further about 60 000 houses were completely destroyed and 40000 houses were partially destroyed in the affected coastal area.

With the intervention of Government, NGOs, INGOs and also private donor's recovery programs were started. It was an emergency situation because thousands of people had lost their inhabitants and they had to reside in the temporary built refugee camps.

Because of that emergency requirement, at the several selected locations, by following or not laws, rules and regulations and guidelines constructed housing units for resettlement.

At present there are several social, socio economic, environmental problems arise at the resettlement such as Problems in accessing basic facilities, solid waste disposal problems, waste water disposal problems, drainage problems, not have proper surface drainage plan, low line areas had not been elevated and frequently flooding, slopes not leveled, and land not compacted before construction, conflicts between communities, low privacy, difficult to access to the livelihood, income generating problems ,Electricity and water supply provided but conditions and quality varied are the some of the prevailing issues. Very little and general guidelines were applied in the site planning process. Because some sites totally abandoned and some are partially abandoned. Some site constructions are not completed and abandoned also.

1.2 Research Question

As a result of Tsunami devastation in December 2004, there was a huge loss of residencies in the coastal belt of Srilanka. Several resettlement programs were initiated to recover the situation. As a result of this, number of Tsunami villages with cluster homes emerges at the inland area.

With the time, Social, Economic and Environmental problems affected to the Tsunami village and shades of these problems created unfavorable living condition to the original inhabitants of the village. When this critical living environment arise within the resettlement site, some resettles sold their houses, while others are shifted to earlier residencies by renting houses to the other party. Problem is even the second party also not stay at these houses long time comparing with the first occupant living time.

Because this problematic situation research has been done to have a better understand on matters. A site survey of fifteen sites with 885 numbers of housing units was done initially. Initial site survey form used for the survey as follows,

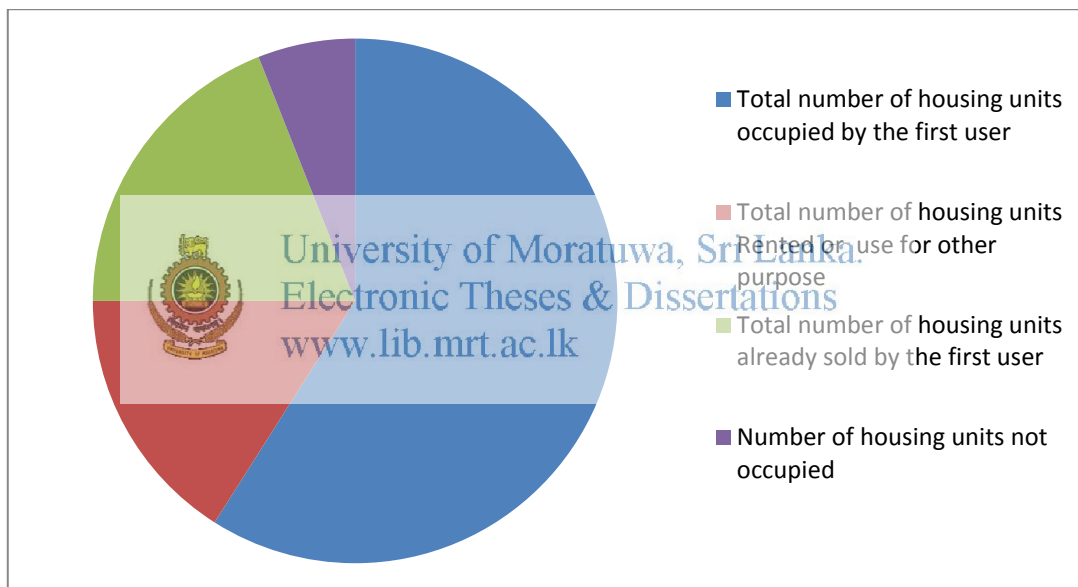
IDENTIFICATION OF THE SITE		DATE:	FORM NO:
(i)	Name of the Site		
(ii)	Address		
(iii)	District		
(iv)	Divisional Secretary Division		
(v)	Local Authority		
(vi)	Grama Niladari Division		
SITE DETAILS			
(vii)	Total number of housing units in the settlement?		
(viii)	Number of housing units not occupied?		
(ix)	Total number of housing units occupied by the first user?		
(x)	Total number of housing units already sold by the first user?		
(xi)	Number of housing units willing to sell by the first user?		
(xii)	Total number of housing units Rented or use for other purpose		
(xiii)	Number of housing units willing to sell by the next user?		

(Table 1.2.1- Initial Research Questionnaire)

Results of the initial survey as follows,

No	Matter	Amount
i	Total number of housing units in the settlement?	885
ii	Total number of housing units occupied by the first user?	59%
iii	Total number of housing units already sold by the first user?	19%
iv	Number of housing units willing to sell by the first user?	17%
v	Total number of housing units Rented or use for other purpose	16%
vi	Number of housing units willing to sell by the next user?	6%
vi	Number of housing units not occupied?	6%

(Table 1.2.2- Shifting behavior of residents in all fifteen numbers of housing schemes)



(Table 1.2.3- Shifting behavior of residents in fifteen numbers of housing schemes)

According to the Table 1.2.3 - 41% of first users left their homes. Although 17% of first users hope to leave from the housing near future.

When focus on this matter, it is understood, there are severe draw backs happened at the resettlement process. Therefore in-depth research study on this Tsunami Resettlement process is needed.

1.3 Research Objective

Nearly ten years have passed since the tsunami devastation. However problem of involuntary resettlement still exists. This research is conducted with the objective to identify the prevailing environmental, socio-economic and physical issues that have been experienced in involuntary resettlement sites. A representative sample of all resettlement sites that have been implemented up to now all over the Galle District will be selected based on a predetermined criteria with the aim to develop a comprehensive guideline for implementing resettlement sites which are more acceptable to beneficiaries. The study focuses on nearly ten years of experience of resettlers in selected sites in Galle District.



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CHAPTER TWO

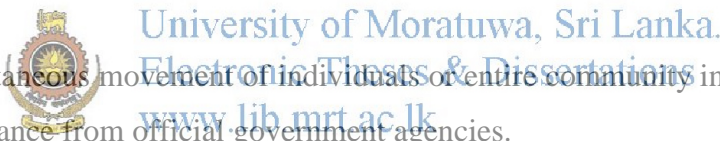
LITERATURE REVIEW

This chapter is essentially focuses on presenting and review literature which are available for resettlement. In this chapter national and international guidelines for the resettlement have been considered. This section has been use for questionnaire preparation. In this chapter key points to using in resettlement process have been extracted they will be upgraded in to detail questionnaire. The NHDA guideline developed in 2005 has been used as key document for this research. Other national and international guidelines have also been used for this review.

2.1 Definition for Resettlement

Burbrige, Nograd and Harston (1988) Suggested that the “Relocation of individuals family groups or entire villages”.

According to the Burbrige et al (1988) there are two main forms of resettlement. They are,

- 
1. Spontaneous movement of individuals or entire community in large scale without assistance from official government agencies.
 2. Officially funded, planned and managed or projects

As mentioned earlier several resettlement sites came up in the coastal belt of Srilanka. After the Tsunami devastation in 2005, now after a period of ten years several problems have arisen in the sites. To study these problems and issues it is needed to study the major stages of resettlement.

Burbrige et al (1988) outlined the stages in resettlement projects.

1. Startup of operation
2. Specification of reason for relocating people
3. Identification of people to be relocated
4. Identification of potential resettlement locations
5. Site selection
6. Plan preparation
7. Site preparation
8. Monitoring

2.2 stages in resettlement projects

1) Specification of reason for relocating people

At this stage main task is to identify the factor reasons to resettle people and their activities also. Then it is necessary to check the alternative if available without relocation, if it is not possible resettlement proceeds and the scope of resettlement should be identified.

2) Identification of people to be relocated.

Identification of social, economic background and special factors comes under this section. Further resources requirements of people and their basic economic activities also should be identified.

3) Identification of potential resettlement locations

At this stage, an assessment of resources, environmental functions and ecological systems must be considered in order to determine whether they are capable of sustaining resettlement. Further existing uses, land ownership and right to access to resources, assessment of alternative locations will be carefully studied.



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4) Site selection

At this stage, a survey of soil, water and vegetation should be done in order to determine appropriate locations for main activities.

According to the Burbrige et al (1988) this is the most critical step in resettlement planning. At the site selection following information should be collected regarding the site.

1. Geology and Geomorphology
2. Topography
3. Soil
4. Ground water resource
5. Vegetation including grass land and forest inventory
6. Wild life including critical habitat or ecological functions required to maintain the area set for nature conservation.

7. Natural hazards and other physical phenomena which influence the capabilities of land support resettles
8. Biophysical factors like land use and its status

According to the NHDA guideline it is mainly focused on construction in coastal zone. Coast conservation department (CCD) is the responsible institution governing this area.

The Coast Conservation Act No 57 of 1981 Srilanka, defines “coastal zone” as the “Area lying within a limit of three hundred meters landward of the mean high water line and a limit of two kilometers seaward of the mean low water line, and in the case of rivers, streams, lagoons or any other body of water connected to the sea either permanently or periodically, the landward boundary shall extend to a limit of two kilometers measured perpendicular to the mean low water line.”

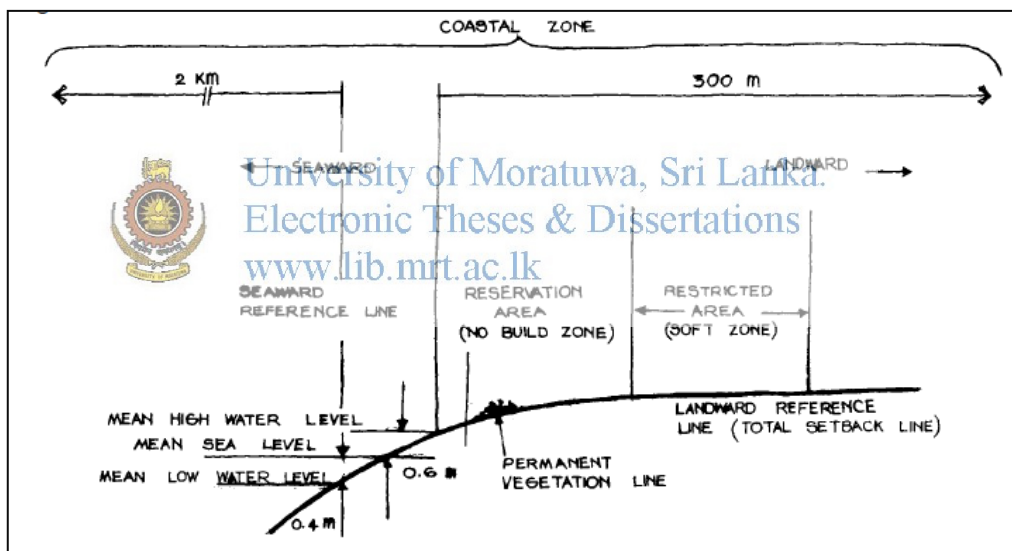


Figure 2.1 -Coastal Zone

According to the Coast Conservation Act No 57 of 1981 Srilanka, this coastal area is divided into two. First one is the “reservation area” it is the no build zone. Second one is the “restricted area”. Some development activity is allowed within this area .The seaward reference line of this sensitive area is fixed (i.e. 0.6meter above the mean sea level). The landward reference line varies, according to the sensitivity of a given coastal area to sea erosion and other natural hazards.

The landward reference line has been determined as follows:

- i. 100 m landwards from the mean high water line in the following districts – Killinochchi, Puttlam, Gampaha, Colombo, Kalutara, Galle, Matara, Hambantota.
- ii. 200 m landwards from the mean high water line in the coastal belt within the Jaffna, Mullaitivu, Trincomalee, Batticaloa and Ampara Districts.

5) Plan preparation

Design of settlement, allocation of land for main activities, comes under this stage. According to Burbrige et al (1988) key points has to be considered in assessing plans are,

1. Space Allocation

Number activities can be accommodated (including extra space for natural growth of population overtime), Laying out different land use areas and reservations of lands needed to conserve resource of the site, Provision of buffer zones to maintain adequate wild life habitat to prevent encroachment in to the adjacent forest reserves or other protected area.

2. Site management

Management plan contained guideline for development of the site maintain ace of service and facilities training resettles necessary for sustained site.

3. Provision of public health programs to control endemic vector bone disease and deal with other disease associate with the resettlement.

4. Identified unavoidable environmental impacts and does it contains measure to reduce or compensate for their adverse influence.

According to the NHDA guideline in planning settlement, the primary requirement is to ensure the proposed housing development in an area which is demarcated for residential land use.

For tsunami housing, minimum floor area of each dwelling unit is at least 46.5 m² – 500 ft². Preliminary planning clearance from the relevant local authority and/or the UDA should be taken before proceeding activities.

Settlement planning requirement by the UDA

Utilization	Coverage of settlement land
Housing neighborhood facilities	$\leq 65\%$
Common area	$\geq 10\%$
Road street, Foot paths and drainage	$\geq 10\%$
Social infrastructure	$\geq 5\%$

(Table 2.2.1- Site Land Space Utilization)

The following table shows the plot size and general requirements for individual houses in areas where pipe-borne water supply and sewage disposal are not available.

Plot size (individual dwellings) ^b	10 – 20 perch (253 – 506 m ²)
Plot size for town housed	6 – 12 perch (152 – 303 m ²)
Building line	Depends on the road size and the category of the road. If not available, assumed to be 12.5 m (40'-0" ft) from the center of the road
Street Line	Refer Figure 2
Rear Space	Refer Figure 2
Front Space	Refer Figure 2
Floor Area Ratio (FAR) ^e	1.5 (Max.)

(Table 2.2.2- Land Plot Size and Lines)

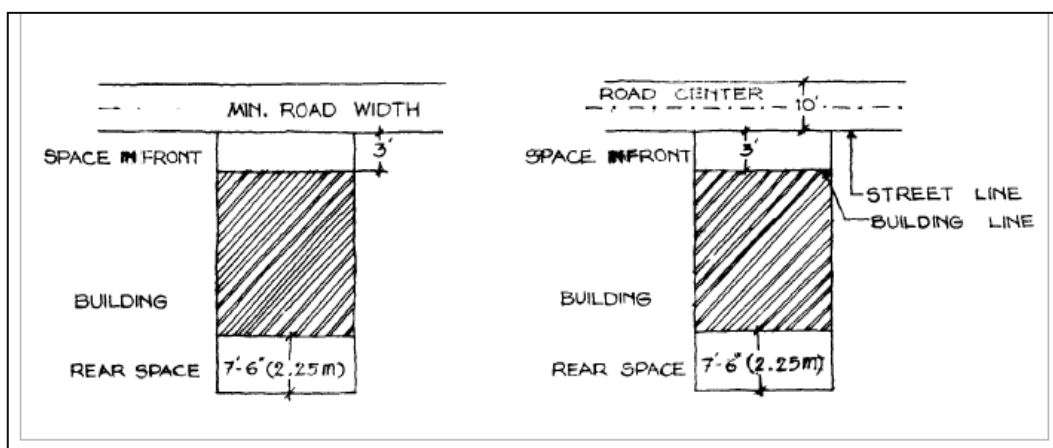


Figure 2.2 -Building lines & street Lines

6) Site preparation

Land clearance and construction of infrastructure (road, irrigation and water supply, drainage and sanitation) will come under site preparation. Further it is important to introduce control measures for soil erosion.

In addition, the construction of road within the resettlement site and provision of access between sites and service centers are important. Poorly constructed roads can lead to soil erosion, impeded drainage and even lead to land slips. Care also must be taken in the location of construction of irrigation channel and drainage facilities to avoid erosion.

According to the NHDA guideline provision of access roads is governed by the number of housing plots in land sub-division. The chart below shows the relevant road sizes. The building line should be kept according to the number of land lots.

Max. No of Lots	Max. Length of Road	Min width of road including drain	Building line
4	50 m	3 m (one side drain)	Min 1 m
8	100 m	4 m (one side drain)	Min 1 m
20	-	6 m (one side drain with pavement)	Min 1 m
>20	-	9 m (drain and pavement both side)	Min 1 m

(Table 2.2.3- Road Facilities according to the number of plots)

The parking space provision is governed by the floor area of the housing units or flats. Each parking bay should be of 2.4 m x 4.8 m which is the minimum size. The chart given below shows the parking requirement according to the different housing category.

Housing Category	Parking Requirement
Flats, dwelling units (excluding individual housing units) and terraced houses having a floor area up to 50 m ² (538 ft ²)	1 for every 3 housing units
Flats with gross floor area between 50-75 m ² (538-807 ft ²)	1 for every 2 housing units

Flats with gross floor area less than 100 m ² (1,076ft ²)	1 for each housing unit
Flats exceeding a gross floor area of 200 m ² (2,152 ft ²)	2 for every 3 housing units
Dwelling units exceeding floor area of 200 m ² (2,152 ft ²)	1 for each housing unit

Table 2.2.4- Parking Facilities according to the different type of housing units

7) Establishment of settlement and services

Construction of settlement facilities and services like housing community facilities, Electricity, water supply and drainage network come under this stage.

(i) Drainage network-

According to the NHDA guideline, there are two type of Storm water drains,

- i. Site drains (primary drains);
- ii. Off-site drains (secondary drains)

Site drains are constructed on the sides of internal roads, foot paths, streets, backyards. Main tasks of this to convey the accumulated water into the secondary drains, which sometimes disposes the water into a near-by stream or canal. Most of the secondary drains are off-site drains; the respective Local Authorities responsible for maintaining these drains.

8) Startup of operation

Provision must be made to allow people to establish support facilities like waste water disposal and solid waste management for their homes

(i) Waste water disposal systems

According to the NHDA guideline wastewater can be treated in three different ways:

- i. On-plot waste water disposal;
- ii. On-site waste water treatment and disposal;
- iii. Off-site waste water treatment and disposal.

i. On-plot waste water disposal

The primary mechanism of on-plot waste water disposal system is a septic tank followed by a soakage pit. Commonly available sizes of the tanks for a single family unit consisting 5 members are:

- i. 0.6 m (2'-0") Diameter and 2.4 m (8'-0") length;
- ii. 1.0 m (3'-3") Diameter and 2.4 m (8'-0") length.

High absorption capacity in the soil and low water table are the major requirements to establish soakage pits. Other methods which can be applied are, double pit compost toilets and a pour flush pit latrine.

ii. On-site waste water disposal

The primary components of an on-site system are, a Septic tank followed by an anaerobic biological filter and soakage pit, soakage drain field, evaporation mounds or discharge into an open water body after purification. Compacted water treatment plants such as oxidation ponds, package treatment plants, and aerated lagoons, also can be selected to suit the site conditions.

If the compacted water treatment plants are planned to be used at site, it should be introduced buffer zone from the housing units. Considering the respective plant specifications a approximately distance should 30 m away from the nearest housing unit.

Selection criteria of the above systems are governed by the following factors,

- i. Population density;
 - ii. Volume of waste water produced;
 - iii. Presence of shallow wells susceptible to waste water pollution;
 - iv. Soil permeability;
 - v. Unit cost of waste water collection;
 - vi. Socio economic and cultural considerations.
- iii. Off-site waste water treatment systems

Off-site treatment systems are considered when on-site treatment could create risks to public health or ground water. If central waste water treatment facilities available, discharging into a city sewerage system is the best option to overcome all the issues pertaining to disposal of all waste accumulation. Before planning a housing project, it is important to improvement of existing sewerage treatment facility if available. Otherwise it should be introduced to a proper off-site sewerage treatment system.

Site central septic tank should be located in area with proper access to a gully sucker. Soakage Pits should be located in an open area at least 18m away from the nearest well or other drinking water sources and at least 5m away from the nearest building.

(ii) Solid waste disposal -

According to the NHDA guideline all households should be provided a proper garbage disposal system. Further it is suggested domestic level composting program to be functioned within the site or individual basis. The Proponents of large housing schemes strongly encouraged to introduce and establish a commercial level waste recycling center to reduction of the accumulation of garbage at site. In order to facilitate the timely removal of garbage, adequate access must be arranged at the site design stage for Local Authorities.

9) Monitoring

Periodic or continuous assessment of key variables to determine whether resettlement activities are sustainable and what modifications are required to protect design and management polices and techniques.

Burbrige et al (1988) mentioned that scale of development is an important factor in resettlement. Scale of resettlement is a function of the people to be relocated and area of land required for housing and economic activities of people.

Management plans, policies and techniques for resettlement projects must be capable of being adopted to deal with unforeseen adverse impact. Monitoring can provided timely cost effective means of gaining information which help to reduce potential adverse impacts and improve the performance of project.

2.3 Adverse environmental impacts from resettlement

Burbrige et al (1988) suggested that several adverse environmental conditions can arise in resettlement. They are varied according to the different location of resettlement and different stages of resettlement process.

1. Site preparation

i. Coastal Lands

Fresh water Swamp forest- Lost of forest production, alteration of surface and ground water hydrology, erosion of organic matter and loss of soil nutrients, change in soil structures, loss of wild habitats.

Mangroves – Loss of sustainable forest production, loss of fishery habitat, increase salinity in soils and ground water, loss of nutrients flows in to estuaries, costal water, and loss of natural buffers to storms, loss of coastal erosion control, increase soil acidity.

ii. Low line lands

Increase the vulnerability of resettles to natural hazards and incidence of water borne disease vectors, conflicts over land tenure, important to migration of wild life and seasonal movement of live stock and people.

Further loss of economically valuable forest, loss of flood plain ecosystem and their ability to absorb.

iii. Upland Areas

Forest- loss of timber production, loss of wild life habitat, destruction of endangered species of plants and animals, reduction of gene pool, compaction of soil, loss of soil organic matters and fertility, loss of access to resources and economic hardship for indigenous population, displacement of existing forest use in to remaining forest areas and increased compaction for resources.

Water Shed- Increase surface water runoff, accelerated soil erosion, increase seasonality of water flows, increased incident and severity of downstream flooding, increased siltation of water storage facilities, irrigation and navigation cannels.

2. Construction of Infrastructure

i. Coastal areas

Construction of roads, channels and other facilities can lead to subsidence and interference with surface drainage can disrupt the exchange of fresh and salt water and nutrients among lagoons, mangroves and marshes. This can increase soil salinity, create species shift and reduce plant growth.

ii. Uplands

Poor road alignment can accelerate soil erosion, mass wastage and land slips and can interfere with surface drainage construction of dams for water impoundments can block the migration of fish, reduce seasonal fresh water flows and increase salt water intrusion in lower reaches of watershed in dry seasons.

3. Operations

i. Low line and Coastal Lands

Due to the high water tables and poor flushing rates in drainage canals, sewage and domestic waste can be pollute ground water and surface water used for irrigation. This can lead to increase the diseases and threat to public health.



3.4 Project Killers

Burbrige et al (1988) has suggested several reasons which can causes for the frailer of the resettlement projects. That matters are called as “Project Killers”. These matters have been developed for several type of economic base resettlement like agriculture base resettlement, inland fisheries base resettlement, forest base resettlement. Our topic is based on Costal fisheries base resettlement. So all that project killers not relevant with our topic. The selected killers relevant to the topics are as follows,

1. Selections of sites which are not capable of sustain planned economic activities and number of settlers.
2. Disregarded of the level of technology, capital investment and skilled manpower required to mange marginal land.
3. Failure to take in to the account the needs of indigenous people and to reduce conflicts between settlers and local groups.
4. Lack of sufficient onsite management which will safeguard and promote sustained development activities.
5. Failures to evaluate projects hydrographic positions with a broad understanding of natural systems (Ex – Watershed, Estuaries) and man induced changes.
6. Location of the projects in an area prone to natural disasters.
7. Lack of regional planning and watershed management controls to protect resettlement locations from bad land and upstream water management which increase the vulnerability of resettlement scheme to natural and manmade hazards.
8. Project located in closer proximity to critical habitat or ecosystem can cause disturbances and this will lead to conflicts with the use of land.
9. Failures to make provision for expansion of the resettlement area cause by the natural increase of the resident population and spontaneous migration will occur.
10. Failures to take human health hazards which can be occur by following changes in the ecology of the resettlement locations.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter elaborates the methodology designed to collect and analyze data for the research. It consists of the methodology of selecting appropriate secondary database, selecting sample site, preparing questionnaire.

The research objective has been perfectly identified in order to capture the research problem. The purpose of the literature review is to gain more information and knowledge on concepts, theories and guidelines pertaining to the resettlement.

At the end of this chapter it is developed the research instrument and the questionnaire further. Questions have been formulated to draw the attention of the people on available problems and issues in the site.

3.2 Sites Selection



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Several researches, surveys and studies had been done by Universities, Research institutes, NGO s, and Government Organizations on different aspects after the Tsunami disaster in December 2004 of Tsunami affected Coastal Zone in Sri Lanka. However the main objective of this research focused on Environmental, Physical, Social aspects of the problems of resettlement. Of the available data bases, the survey conducted by the University of Moratuwa called “Environmental Checklist for Assessing Suitability of Sites for Post Tsunami Housing Construction” seems the compatible database for this study.

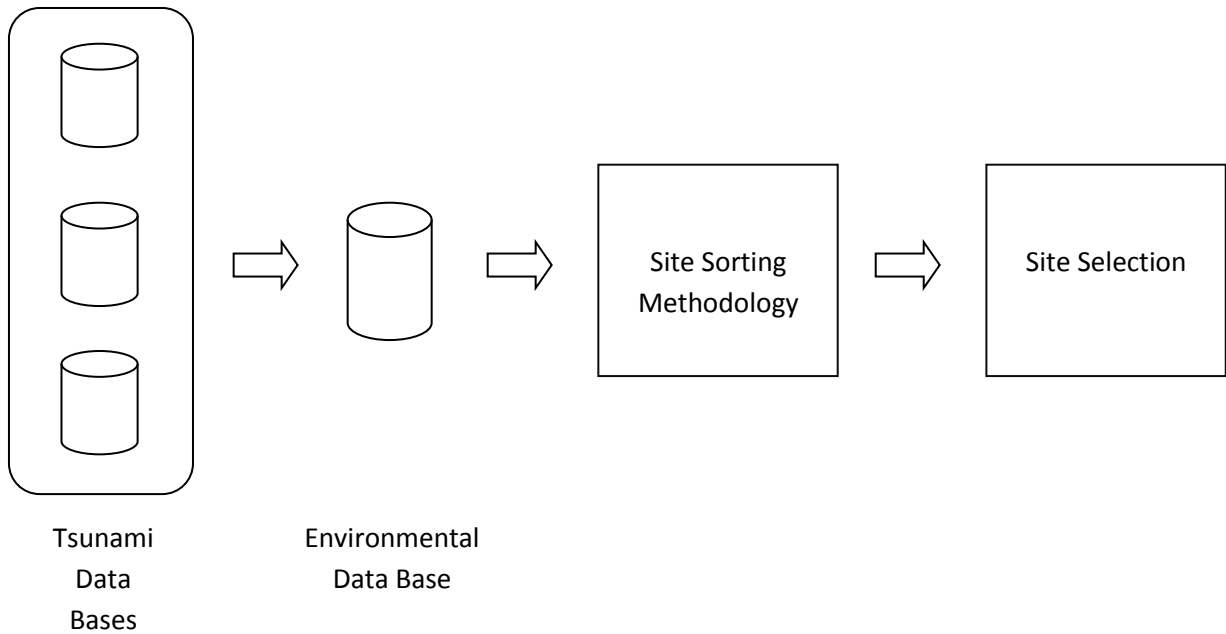


Figure 3.20 – Site Selection Methodology

3.21 Site Sorting Methodology

The above study was done by the University of Moratuwa Sri Lanka in the Tsunami affected District in Sri Lanka in the year of 2008. The chart given below shows the number of housing schemes at each site which were included in the survey.



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District	No of Tsunami Housing Scheme at the District
Galle	93
Matara	45
Hambantoata	67

Table 3.2.1.1- Number of Tsunami Resettlement sites in Southern Province

Galle, Matara, Hambantota districts severely damage from the Tsunami disaster. Of these three districts, our study focus on Galle District because of easily accessible for the field visits. According to the Environmental Checklist database, two hundred five Tsunami Resettlement Sites were located in the three Districts. Of these total ninety three sites in Galle District.

One of the main tasks of this section is selection of housing site which were badly affected by the environmental conditions, Poor physical feature, lower quality of construction, unfavorable social conditions.

3.22 First Site Sorting

Using the information given in 93 filled questionnaires of the database, the first step at this stage is extract sites which are affected by Environmental, Physical and Social issues and prepares a list which will includes the location, address and the description of issue in the site. (Refer Annexure 1 for the detail document.)

No	Document No at Database	Location of the site	Site address	Description Regarding the Issue
1	85	Godadeni Kanda Walahanduwa watta	Meegoda, Akmeemana ,Galle	This site is located adjacent to a tank. Construction of gabion wall is recommended. Proper landscaping and erosion prevention system should be implemented.



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Table 3.2.2.1 - First Site Sorting Methodology

3.23 Second Site Sorting

Using the information extracted at the first stage which evaluate significant problems in each site in terms of Biological/ Ecological and Physical characteristics and prepare list which mentioned the level of significant as “Acceptable”, “Minor impacts”, “Major impacts” under above main two terms.

Example as follows,

No	Doc No	Impact to Biological/ Ecological System				Condition of Physical Features			
		Acceptable	Minor Impact	Major Impact	Unacceptable	Acceptable	Minor Impact	Major Impact	Unacceptable
1	85								
2	86								

Table 3.2.3.1.1- Second Site Sorting Methodology

From the second sorting, except the acceptable level, all other levels (Minor Impact, Major Impact, and Unacceptable) will be considered as “Unsuitable Problematic Sites”.

Second site sorting complete table as follows,

Annexure 1

operational phase - status status Region - ②

No	Doc no	Biological/Ecological				Physical			
		Acceptable	Minor impacts	Major impacts	Unacceptable	Acceptable	Minor impacts	Major impacts	Unacceptable
1	85	✓					✓		
2	86		✓				✓		
3	87		✓						
4	88	✓				✓			
5	89	✓					✓		
6	90	✓							
7	91	✓					✓		
8	92	✓					✓		
9	93	✓					✓		
10		✓					✓		
11		✓					✓		
12		✓					✓		
13	97	✓							
14	98	✓					✓		
15	99						✓		
16	100	✓							
17	101	✓							
18	102	✓							
19	103	✓					✓		
20	104	✓					✓		
21	105	✓					✓		
22	106		✓				✓		
23	107	-				-			
24	108		✓				✓		
25	109		✓				✓		
26	110	✓					✓		
27	111	✓					✓		
28	112	✓					✓		
29	113		✓				✓		
30	114	✓					✓		

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86, 87, 93, 94, 95, 106, 108, 109

No	Doc no	Biological/Ecological				Physical			
		Acceptable	Minor impacts	Major impacts	Unacceptable	Acceptable	Minor impacts	Major impacts	Unacceptable
1	115		✓			—			
2	116		✓			—			
3	117	✓					✓		
4	118	✓					✓		
5	119		✓				✓		
6	120		✓				✓		
7	121		✓				✓		
8	122		✓				✓		
9	123	✓					✓		
10	124 124		✓				✓		
11	125 125			✓					
12	126 126	✓							
13	127 127	✓							
14	128 128								
15	129 129								
16	130 130								
17	131 131								
18	132 132	✓					✓		
19	133 133		✓				✓		
20	134 134		✓				✓		
21	135 135		✓				✓		
22	136 136		✓				✓		
23	137 137		✓				✓		
24	138 138		✓				✓		
25	139 139		✓				✓		
26	140 140		✓				✓		
27	141 141		✓				✓		
28	142 142		✓				✓		
29	143 143		✓				✓		
30	144 144		✓				✓		
	145		✓				✓		

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115, 116, 119, 120, 121, 122, 124, 125, 128, 129, 130, 131
 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144
 145.

No	Doc no	Biological/Ecological				Physical			
		Acceptable	Minor impacts	Major impacts	Unacceptable	Acceptable	Minor impacts	Major impacts	Unacceptable
1	146	✓	✓			✓			
2	147	—				—			
3	148		✓				✓		
4	149		✓	✓			✓		
5	150		✓				✓		
6	151		✓				✓		
7	152		✓				✓		
8	153		✓				✓		
9	154		✓				✓		
10	155		—				—		
11	156	✓					✓		
12	157	—					—		
13									
14									
15									
16									
17	162	✓					✓		
18	163	✓					✓		
19	164	✓					✓		
20	165	✓					✓		
21	166	✓					✓		
22	167	✓					✓		
23	168		✓				✓		
24	169		✓				✓		
25	170	✓					✓		
26	171	✓					✓		
27	172	✓					✓		
28	173	✓					✓		
29	174	✓					✓		
30	175	✓							



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148, 149, 150, 151, 152, 153, 154, 158
 168, 169

Table 3.2.3.1.2- Second Site Sorting Methodology

3.24 Third Site Sorting

The sorted sites as “Unsuitable Problematic Sites” at this second sorting will be sort again using set of criteria which is developed using Literature Review.

3.3 Problem Based Criterion

1. Site locate adjacent to a high environmental sensitive area
2. No proper water supply system available
3. Problem of handling solid waste
4. Problem of handling waste water
5. Need mitigatory measures for controlling soil erosion
6. No proper greenery at the site. So need to improve the greenery at the site.
7. Road condition is not in acceptable level in the site

According to the develop criterion in the literature review, the sites will be sorted again. At this sorting stage weighting system is introduced. This system includes the level of severity of each problem base criterion in each site. Then the site can categorize as high severity, Medium severity and Lower severity site under each criterion.



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3.4 Weighting values for severity

Level of Severity	Weighting Value
High Severity	III
Medium Severity	II
Low Severity	I
No Severe problem	0

Table 3.4.1- Weighting values

Except the values given above, a higher value will be given according to the specialty of the site or problem.

Special Case = Severity Value + II

Non Special Case = Severity Value + 0

Example -

No	Do c	Site locate adjacent to a high ESA	No proper water supply system	Problem of handling solid waste	Problem of handling waste water	Need Mitigation measures for controlling soil erosion	need to improve the greenery at the site	Road condition is not in acceptable level	Total Value
1	86	I	I	I		I			4
2	87			I		III			4
3	93		I	I		I			3
4	94		I	I		I			3

Table 3.4.2.1- Third Site Sorting Methodology

Considering the total value of weighted values, sites which are scored “4” or more than 4 will be considered as the selected site for the field survey. Field survey and data collection are done by filling questionnaire. Questionnaire is filled by the subject expert.

Third site sorting complete table as follows,

Region - 2 - Selected Site Problem Evaluation

No	Doc No	Site locating adjacent to High ESA	No proper water supply	Problem of handling solid waste	Problem of handling waste water	Need improvements to control soil erosion	Need to establish Greenery at the site	Road condition is not in accepted level	
1	86	①							✓ ⑦
2	87					②			✓ ④
3	93								3
4	94								3
5	95								3
6	106								3
7	108	①							✓ ⑦
8	109								⑤ ✓
9	115								3
10	116								3
11	119								3
12	120								④
13	121								③ 3
14	122							Ventilation	④ ✓
15	124								2
16	125								
17	128								③
18	133								⑤ ✓
19	135								⑥ ✓
20	136								④
21	137					✓			④
22	134								✓
23	135								⑤ ✓
24	136								② 2
25	137								④ ✓
26	138					✓			④ ✓
27	139								⑤ ✓
28	140	②							③ ✓
29	141								③
30	142		✓						③
31	143								④
32	144								④
33	145								3
34	148		 	 			 		
35	149		✓						④
36	150								3
37	151								④
38	152								3
39	153								④ ✓
40	154								3
41	158	①							✓

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86, 87, 108, 109, 124, 129, 130, 134, 137, 139, 140, 153, 158
133, 138, 142, 149, 176, 179, 140

42	168			1		1	1	2
43	169	1		1			2	2
44	176		1	1			1	④
45	177	1	✓				1	2
46	178	1		1			1	3
47	179			1	✓	1	1	④
		ESA	water	solid w	w.w	Soil E	Greenery	

Table 3.4.2.2- Third Site Sorting Methodology

3.5 Questionnaire Preparation

Questionnaire for data collection prepared base on mainly two documents. First one is the “Guidelines for Housing Development in Coastal Sri Lanka”. That document is published by the National Housing Development Authority (NHDA) Sri Lanka after the Tsunami Disaster in December 2004. This NHDA guideline specially refers in this research as construction and site planning standard guideline.

Through this questionnaire, it is going to check the

1. Level of satisfaction of resettlers regarding the provided infrastructure facilities, environmental condition and social condition at the site.
2. Conditions of the infrastructure facilities and environmental hygiene in the site and compare with the standards.

This questionnaire examines at the construction and operational periods, project implementers and users followed the guideline in optimum level or not. Standard values and measures included in the questionnaire by referring NHDA guideline.

Second document is the “Environmental Checklist for Assessing Suitability of the Site Post Tsunami Housing Construction”. This data set mainly used in this study to check consideration of Environmental Legislations in Srilanka by the project implementers at the implementing stage of Housing Project.

3.6 Data Analysis Methodology

Main objective of this research is to find the main reasons for the failure of most Tsunami housing schemes in the coastal zone Sri Lanka. This study especially focuses on Environmental, Infrastructure and Social condition which leads to fail the sites.

NHDA guideline gives guidance for planning and construction for housing schemes. This study will look for the problematic sites which had failed to follow the guideline prepared by the NHDA. This study will also examine whether sites had failed in spite of following the guideline or following guideline and got failed. The study will also look for the fault of the guidelines. If they not properly followed the guideline what are the reasons for not following the guideline will be further checked.

In other words this is kind of Evaluation of NHDA guideline. From this study it can be identified whether NHDA guideline meet the real ground situation in practical manner and provide proper guidance to fulfill the people real requirements.

This success or failure of housing scheme is going to measure in terms of people satisfaction and comments given by expert when do field visits.

As mentioned earlier this study is based on three “Major Factors” namely Environmental factor, Physical features and Social factor. Under main above factors there are six “Sub Main” factors derived and it is as follows

Compliance with legislation, Services, Physical features, Land use, Infrastructure and Social factor. Under these “Sub Mains” number of “Factors” is derived. These Sub Main factors and Factors are derived from the literature review.

Compliance with legislation (Main Sub 1)

- (i) Followed Environmental Legislations at the site selection(Factor1.1)
- (ii) Followed Planning Regulations at the site planning(Factor1.2)

1. Service(Main Sub)

- (i) Water Supply according to the standard(Factor 2.1)
- (ii) Solid Waste Management according to the standard(Factor 2.2)
- (iii) Waste Water Treatment according to the standard(Factor 2.3)

2. Physical Features (Main Sub)

- (i) Thermal comfort and greenery maintenance in the site(Factor 3.1)
- (ii) Low energy embodied material usage house construction(Factor 3.2)
- (iii) Water Table Level concerned at site selecting(Factor 3.3)
- (iv) Concerned on Slope Stability at site selection (Factor 3.4)

3. Infrastructure (Main Sub)

- (i) Distance to the public institutions at tolerable distance(Factor 4.1)
- (ii) Road condition and capacity (Factor 4.2)
- (iii) Distance to the public transport mode from the site at tolerable distance(Factor 4.3)
- (iv) Access to the earlier lively hood pattern at tolerable distance(Factor4.4)
- (v) Energy efficient transport mode usage(Factor 4.5)

4. Land Use (Main Sub)

- (i) Concern on earlier land use pattern at the selection of site(Factor 5.1)
- (ii) Natural Resource Consumption in sustainable manner (Factor 5.2)
- (iii) Energy usage(Factor 5.3)
- (iv) Pesticide Usage(Factor 5.4)

5. Social Factors (Main Sub)

- (i) Ethnic/ Religious Composition concerned when residing at the site at beginning(Factor 6.1)
- (ii) Concerned on social status of people when residing at the site at beginning(Factor 6.2)
- (iii) Measures for mitigate conflicts(Factor 6.3)

These are the factors on which the questionnaire has been developed. Please refer annexure 1 for the questionnaire.

3.61 Quantification

In this section, the factors developed above are correlated with the answers given to the questions in the questionnaire. For an example if take factor 1.1, there are several questions in the questionnaire which represent factor 1.1. For that each question if the answer is positive, weight that question as 1. If negative answer value gives as 0.

Example –


Factor 1.1

(i)	Question	→	Answerer from site 1(If positive)	→	1 (Give value)
(ii)	Question	→	Answerer from site 2 (If negative)	→	0 (Give value)
(iii)	Question	→	Answerer from site 3(If positive)	→	1 (Give value)
	Total Value				<u>2</u>

Percentage from total 2/15*100
13.33%

If this value mentioned as x1 (deviation) = 100 – 13.33%
x1 = 86.37%

All these values under each factor of all surveyed sites will be filled in the following chart,



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Main sub Factor	Factor 1	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Deviation %
	Question 1	1	1	0					X1
	Question 2								

Table 3.6.1- Data Analyzing Methodology

Refer Annexure 3 for complete data analyses table.

The above Chart elaborates how much each and every factor deviates from the Standard. These Positive Percentage Values, Percentage of deviation and Number of Positive Sites, Number of Negative sites will be together used for result and discussion.

In this factor development except guidelines in NHDA manual, it is used the other literature also. In this analysis stage it has to be clearly separate which are taken from NHDA guideline from the other literature.

Factor	NHDA Guide Lines	Suggestions From the Data Analysis
Main Sub Factor		
Factor 1		
Factor 2		

Table 3.6.1- Guideline Generating Methodology

Refer chapter 5- Summary table for complete details.

The peoples' satisfaction with NHDA guideline has been discussed in the results and discussion stage. Through the above comparison it can be identified the situation whether guideline instructions are properly followed and people are unsatisfied.

Further People are satisfied with the present available condition but real guideline requirement mentioned in the NHDA manual has not been complied also can be identified.



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No any satisfaction and not achieved guideline requirement mentioned in the NHDA guideline also there. In this type of situation it should be identified what is the reason for not achieving the guideline requirement.

According to the response of people in the field survey, using the ten years experience of Tsunami housing schemes several modifications can be suppose to the NHDA manual to make it more practical. .

CHAPTER FOUR

RESULTS AND DISCUSSION

Chapter three of this research report deals with the methodology designed to collect and analyses data for research. In this chapter collected data has been analyzed. At the first sorting stage, from the total ninety three Tsunami housing scheme in the Galle District forty five sites were selected as selected as problematic sites. The selected sites are given below,

Site ID Numbers

86,87,93,94,95,106,108,109,115,116,119,120,121,122,124,125,128,129,130,131,133,134,135,
136,137,138,139,140,141,142,143,149,148,150,151,152,153,154,158,168,169,176,177,178,179

(Please refer annexure II for more details about the sites)

At the third sorting stage of the forty five sites (according to the develop criteria in chapter three) fifteen sites were selected for the questionnaire survey. (Please refer annexure IV). This selection was done on “criteria” base discussed in chapter three.

Basing on the data collected from the questionnaire survey this chapter has identified the faults, errors, problem prevailing in the sites. The analysis based on three major elements. They are “People satisfaction”, “NHDA guideline”, and “Present situation at the site”. During the Tsunami housing scheme construction the main user manual or guideline was NHDA guideline. This manual directed and provided guidance for the project implementers for site planning, house designing, construction, Site selection. In 2015 some problems and issues have come up in these sites. People were not satisfied with prevailing conditions in the site. The Present site condition and people satisfaction have been greatly influenced by the NHDA guideline. If the NHDA guideline was properly followed, but they failed to satisfy the people, the direct responsibility focuses on the guideline. If the guideline was not properly followed and then got failed, reason for the failure focuses on undisciplined behavior of project implementing team.

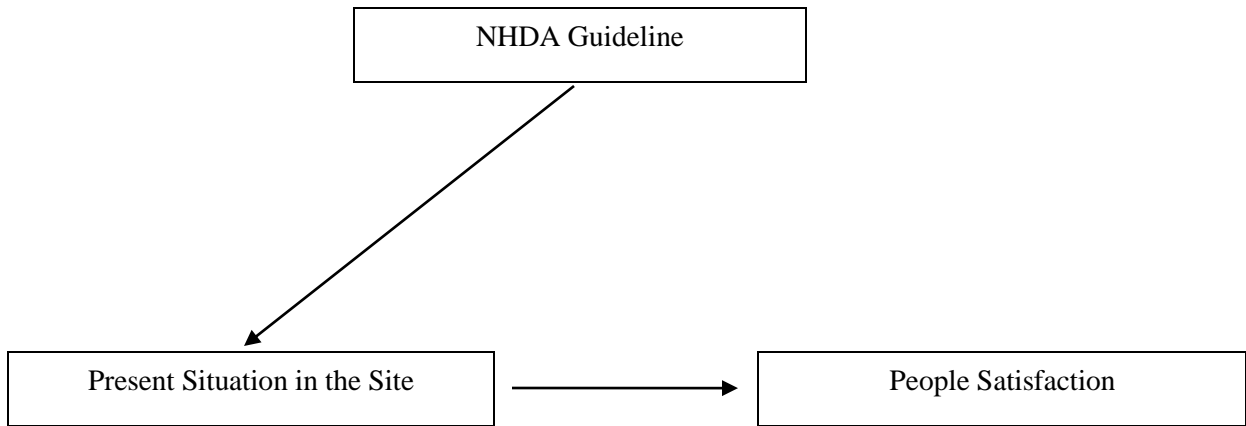


Figure 4.01

Collected data in the questionnaire survey going to be analyzed based on above three elements. It is as follows,

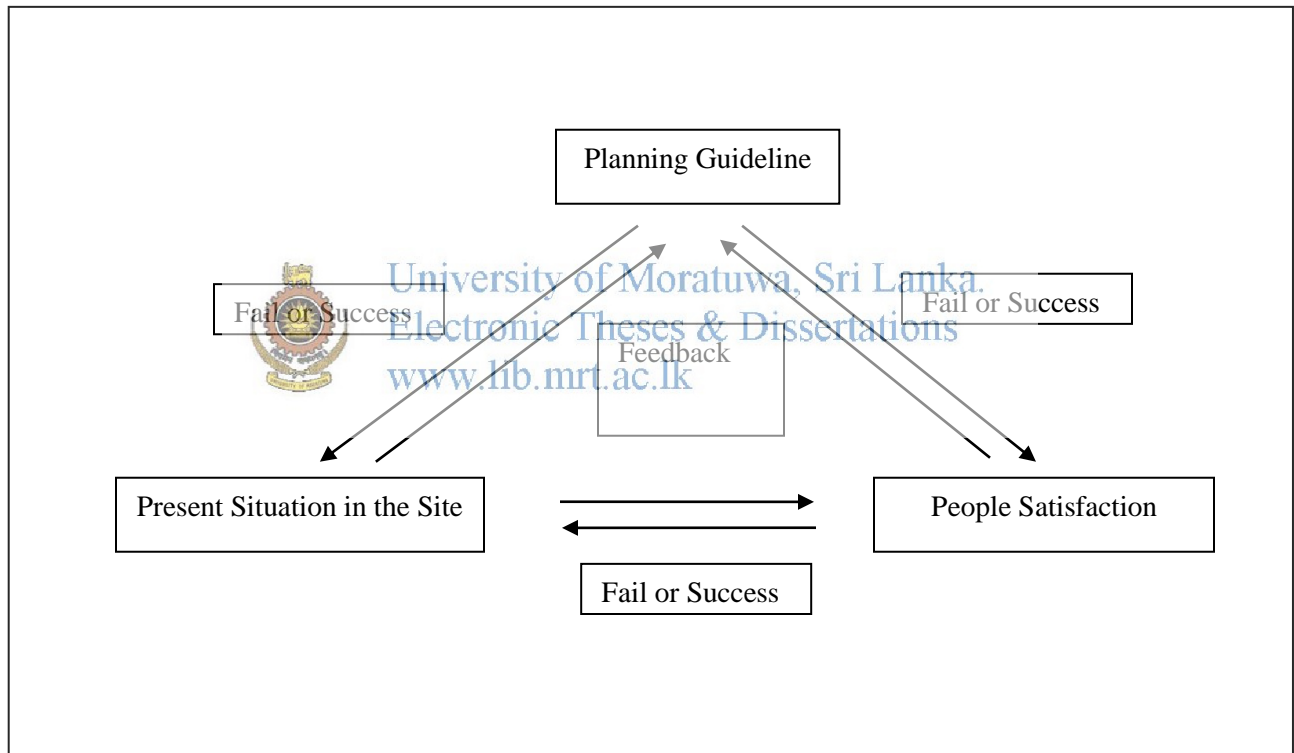


Figure 4.02

4.1 Planning rules and Regulations

4.1.1 Followed Environmental Legislations at the site selection

Under this section, the question whether environmental legislation was properly followed during the site selection stage has been discussed. According to the environmental legislation of Srilanka housing site should not be located in the following areas.

- 1.(i) 100m from the boundaries of or within any area declared under the National Heritage Wilderness Act No 4 of 1988.
- 1.(ii) Within the distance of easily accessible from the site above mentioned (i) Forest.
- 1.(iii) Any area declared under the Botanic Gardens Ordinance (Chapter 446)
- 1.(iv) Within 100 meters from the boundaries of, or within, any area declared as a Sanctuary under the Fauna and Flora Protection Ordinance (Chapter 469)
- 1.(v) Within a distance of one mile of the boundary of a National Reserve declared under the Fauna and Flora Protection Ordinance.
- 1.(vi) This site is located within the 60 meters from the bank of a public stream as defined in the Crown Lands Ordinance (Chapter 454) and having width of more than 25 meters at any point of its course
- 1.(vii) Any reservations beyond the full supply level of a reservoir
- 1.(viii) Natural wetland/ Marshy land / Lagoon availability
- 1.(ix) Any erodible area declared under the Soil Conservation Act (Chapter 450)
- 1.(x) Any Flood Area declared under the Flood Protection Ordinance (Chapter 449)
- 1.(xi) Any flood protection area declared under the Sri Lanka Land Reclamation and Development Corporation Act 15 of 1968 as amended by Act No 52 of 1982
- 1.(xii) Any archaeological reserve, ancient or protected monument as defined or declared under the Antiquities Ordinance (Chapter 188).
- 1.(xiii) 100 meters from the high flood level contour of or within, a public lake as defined in the Crown Lands Ordinance (Chapter 454) including those declared under section 71 of the said Ordinance

According to the National environmental Act (NEA), housing development site should not be within the prescribed areas mentioned above. In this research level of accessibility to the above mentioned (prescribed areas) from the already located housing site and bad impact on the above

mentioned areas have been examined. Besides the distance between already located housing site and ESA like forest, Botanic Gardens, Sanctuaries, and National Reserves also examined. ESA can be affected by the human activities when establishing high population density housing schemes much closer to that.

Under different ordinance and acts, further it is examined, is there any endemic, endangered, threatened species, availability in lagoon, Marshy lands, and Natural Wetlands.

The Data collected on the above mentioned facts under “Environmental Legislations at the site selection” section 1 and tabulate for overlook the situation in all sites.

Data enter in to the table based on three criteria. Following table is part of the main table which is extracted for results discussion. Three criteria as follows,

- 0 - Regarding this Matter no positive respond
- 1 - Regarding this matter positive respond available
- 1 - Regarding this matter according to the legislation respond is positive but legislation matters associates problems there.

(Highlighted Respond)
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Factors	Question number	Site Number															
		86	87	108	109	122	129	130	133	134	137	138	T.V	176	177	179	
Compliance with legislation																	
1.1 Followed Environmental Legislations at the site selection	1.(ii)	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
	1.(iv)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	1.(v)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	1.(viii)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	1.(x)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	1.(xi - i)	0	1	0	1	1	0	0	1	1	0	0	1	0	1	0	0
	1.(xi - ii)	0	1	0	1	1	0	0	1	1	0	0	1	0	1	0	0
	1.(xii)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 4.1.1.1- Questionnaire Survey Results

In the table given above, rows represent legislations and column represent housing sites. Each cell of the table represent that each legislation. If the cell value shows 0 value, it in indicate that

particular site violate that legislation. Cells which indicate the value 1 show that particular site do not violate the legislation or make no any influence to the matter discuss in the legislation.

Following legislations and environmental matters have not been violated by 15 number of sites. So it is not included in the above table. Full content of the above table attached back of this document as Annexure V.

Positive responded Legislations & Matters		
Number	Legislations	Number of Sites
1.(i)	100m from the boundaries of or within any area declared under the National Heritage Wilderness Act No 4 of 1988.	15
1.(iii)	Any area declared under the Botanic Gardens Ordinance (Chapter 446)	15
1.(vi)	Within a distance of one mile of the boundary of a National Reserve declared under the Fauna and Flora Protection Ordinance.	15
1.(xiii)	Any Flood Area Declared under the Flood Protection Ordinance (Chapter 449)	15
1.(xiv)	Any flood protection area declared under the Sri Lanka Land Reclamation and Development Corporation Act 15 of 1968 as amended by Act No 52 of 1982	15
1.(xv)	Any archaeological reserve, ancient or protected monument as defined or declared under the Antiquities Ordinance (Chapter 188).	15
1.(xvi)	100 meters from the high flood level contour of or within, a public lake as defined in the Crown Lands Ordinance (Chapter 454) including those declared under section 71 of the said Ordinance	15
1.(xvii)	Does the site fall within a prescribed project area based on National Environment Act?	15

	Matters	
1.(vii)	Within the distance of easily accessible from the site to above mentioned (vi) National Reserve.	15
1.(ix)	Is there any endemic, endangered, threatened species available in that stream as endangered species listed in the red data book	15

Table 4.1.1.2

According to the table 4.1.1.1, first zero answer can be found under section 1.1 -1(II) at site number 133. It is kesbepana Tsunami village which is located adjacent to the Rumaswala Cultural and Heritage site in Aunawatuna. It is declared as “Culturally and Historically Important site” and as specially protected area. Under project 3320 this site is identified as medicinal plant rich natural state. This project reveals 75 number of medical species are extensively spread in this area. Further this site is identified as one of the nine sites by the forest department



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Kesbepana Tsunami village is located adjacent to the “Rumaswala” Cultural and heritage site. According to the Regulations and Legislations, whether it is ok, people who are living in the resettlement site can easily access to that area. If it is like so, it is caused to happen bad impact on medicinal plants and species. At present people are using this area to for find some medicinal plants. When people frequently visit this area it will be reason to occur unfavorable conditions to this ESA.



(Satellite image: 4.1.1.1 Kesbepana Tsunami Resettlement Site)

This type of environment should not exist to the adjoining lands which have been declared as important sites by the government. There should be a legal provision for control the land uses of adjoins lands which are environmental sensitive areas.

The first highlighted respond appears under table 4.1.1.1 section 1.1 – 1(iv). Even the responding value is 1 some characteristics associate with this section seems to be problematic in Site no 129. Site name is Paragon Estate, Eluwila, Habaraduwa. This site is filled coconut land which is adjacent to marshy land. Which is environmentally important for mangroves and different species of birds. Because of the easy accessibility to marshy area people tend to extract resources like mangroves wood, kirala from the wetland vegetation. This is done intensive manner therefore nesting birds and their bleedings are affected. Further this area is popular for the seasonal birds also.



Image: 4.1.1.1 Paragon Estate Adjoin Marshy land 4.1.1.2 Paragon Estate Adjoin Marshy land

Earlier this land was part of the marshy land. During the very early period the land owner of this land began to cultivate coconut by erecting plots on marshy and they excavated canals beside the plots.

A high population density area is located adjacent to a marshy area which has some ecological value, with time, this area is highly threatened by the activities of the people. This situation becomes worse when human population increased with the time.

Another important issue is the area adjoining to the marshy land gets gradually filled by the non biodegradable waste and domestic waste. Another important issue is people live in these sites to earn additional income from coconut fiber production. For that industry so many “Husk pits” have been built in the marshy area. As a result bad odor, unpleasant, unfavorable hydrogen sulfide gas is generated from this industry.

The above bad consequences occur when housing sites are located closer to ESA which is not prohibited by law. According to the UDA, L.A law, whether there are legal prohibitions available for marshy land filling, actually there is no legal framework for controlling adjoining land uses especially which are located closer to the high density housing development. From this it is supposed that the relevant authorities should make legal provision especially in high density housing development.



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The next highlighted response comes under table 4.1.1.1 section 1.1 – 1(v) “Within the distance easily accessible from the site above mentioned 1.1 – 1(IV). Strictly speaking this is not an Environmental legislation. From this the possible impacts for the environmentally important sites from the housing scheme development can be examined. Even though the responding value is 1 some characters associated with this section seem to be problematic in Site no,133 - Kesbepana (Unawatuna, Galle except site no 129 –Paragon village (Habaraduwa).

Kesbepana Tsunami Village is located adjacent to the land of Rumaswala as described earlier in the section 1.1-1(II). Because it consists of several medicinal indigenous plants and fauna species, this site is shown as an important Environmental sensitive area based on this section also.

In the earlier discussion, it was suggested to introduce legal background to control the development in adjoining lands of ESA. In this section it has been extended further. Here it is supposed to check the accessibility to that ESA from the housing scheme. Because easy accessibility will lead to more activities and more associations which will increase unfavorable impacts to the living and non living components in ESA.

The next highlighted respond comes from the section 1.1-1(viii) site no 129 and 86. In these sites, although respond value has been 1 some characteristics associate with this section seems to be problematic. Site no 129 – which is the Paragon Village been discussed under this section. Because one side of this site is bounded by Wakgalmodara Ela with the distance of 14 ft from the mean water level. At present houses which are locate at the edges tries to expand their house premises by filling this canal. This canal separates housing scheme and marshy land. This canal helps to drain out water and control flooding. But now the water handling capacity of the Ela is reduced and even at one- two hour rain site is quickly got flood.

Whether this Ela not declared under this section ordinance, characteristic of this situation, associate with this ordinance. According to the L.A act clearance must be obtained from L.A before start a particular development. At that time, the relevant agent of the authority should identify this matter properly. Interviews with the Grama Niladari of that area indicate that due to the emergency situation during at that tsunami time, the above procedure was not properly followed.

Site no 86 – Godadeni kanda (Walahanduwa Watta, Akmeemena, Galle), is located adjacent to the environmentally sensitive man-made water body. Earlier land use of this water body is marshy land. Recently that land had been excavated and converted in to a small tank . Because this tanks is located adjacent to the site solid waste and waste water generated by the housing scheme direct in to the tank. Now Eutrophication can be seen in the tank water.

The tank was constructed after constructing the housing scheme. At the stage of setting out to construct the tank, attention should have been made on the surrounding land uses in prospective manner.



Image: 4.1.1.3 Godadenikanda Man made water detention lake

Section 1.1- (XI-I / Xi – II) is focused on “Natural Wetland/ Marshy Land/ Lagoon Availability locating less than 100m from the site boundary”.

When focusing on the table, it has been observed from the total fifteen number of sites eight number of sites were located in the above mentioned ESA. In addition it is observed sides of some sites were bounded by the ESA. Further certain sites are not bounded but it is located within the 100m distance.

Population is increasing day by day. Demand for the land is rapidly increasing. This trend directly made impacts to the Environmental Sensitive Land use. When locating human settlement especially high population density land uses like housing schemes it is necessary to concern on surrounding Environmental Sensitive areas. From the Environmental Sensitive Land uses particular areas have been reserved, Preserved, conserved by government declarations, laws and legislations. Except these lands certain Environmental Sensitive land uses which do not come under above government declarations but also important for that area. By Creating unsuitable conditions to that areas create unfavorable living conditions to the surrounding area for human as well as fauna and flora associate with this. As a result these bad impacts will spread out for kilometers if it is not prevented.

4.1.2 Followed Planning Regulations at the site planning

“Guideline for Housing Development in Coastal Srilanka” has presented the planning regulations for construction within the coastal zone defined by the coast conservation department. According to that, all these sites are located more than 4 km away from the coastal zone in Galle District. Coastal zone is defined as 300m land ward from mean high water sea level and 2km sea wards from mean low water sea level. Except that, if any water body connected to the sea, perpendicular to the mean low water sea level it is affected 2km strait amongst the water body to the land ward. Because our selected sample sites of this study do not come under this area, in the questionnaire section 1.2 (Planning Regulations) 1 and 2 all got positive answers all over 15 sites.

This matter can badly affect the people’s livelihood. From this study it has been discovered that distance to the coastal zone was maintained more than required. It creates issues regarding accessibility to the people’s earlier occupations especially for the fishing community.

No	Factors	Question number	Site Number														
			86	87	108	109	122	129	130	133	134	137	138	T.V	176	177	179
1	Compliance with legislation																
1.2	Followed Planning Regulations at the site planning	3	0	0	0	1	1	0	0	0	1	0	1	1	0	0	0
		4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		6.(i)	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1
		6.(ii)	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1
		6.(iii)	0	0	1	0	1	1	0	1	0	1	1	1	1	1	1
		6.(iv)	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1
		7.(i)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		7.(ii)	7	8	6	7	7	11	7	8	10	6	8	9	9.8	9.8	10
		7.(iii)	3,1	3,2	3,2	3,2	3,2	3,3	3,2	3,3	3,3	3,2	3,3	3,2	3,2	3,2	3,2
		7.(iv)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		8(i)	1	1	0	1	1	0	0	0	0	0	1	1	1	1	1
		9.(i)	1	1	0	1	1	1	0	0	0	1	1	1	1	1	1
		9.(ii)	1	1	0	0	0	1	0	1	0	0	1	1	1	1	1
		10.(i)	4,0	4,0	4,0	4,0	4,0	4,0	3,0	4,0	3,0	3,0	4,0	4,0	4,0	4,0	4,0
		10.(ii)	4,1	4,1	4,1	4,1	4,1	4,1	4,1	3,0	4,0	3,1	3,1	4,1	4,1	4,0	4,0
		10.(iii)	4,0	4,0	4,1	4,0	4,0	4,0	3,0	4,0	3,0	4,0	3,0	4,0	4,0	4,0	4,0
		10.(iv)	4,0	4,0	4,0	4,0	4,0	4,0	-	4,1	-	-	4,0	4,0	4,0	4,0	4,1
		10.(v)	4,0	4,0					4,0	-	4,0	-	-	4,0	4,0	4,0	4,0
		11.(i)	0	0						0	1	0	0	1		1	1
11.(ii)	1	1					1	0	1	0	0	1		1	1		

Table 4.1.2.1- Questionnaire Survey Results

4.1.2.1 Residential Zones for housing Resettlement

The purpose of the Section no 3 of the table is discussed regarding the earlier land use of the selected site. When looking out the above table, it can be observed from the total numbers of fifteen sites, ten sites are located in non residential area. According to the NHDA guideline when selecting particular location for housing development that site should be located within an area demarcated for residential land use.

Site Number	Land Use	Land Use Category
86	Rubber Land	Crop Land
87	Rubber Land	Crop Land
108	Coconut cultivated marshy land	Marshy Land
122	Filled low line land	Marshy land
129	Paddy land	Paddy land
130	Filled low line land	Marshy land
133	Paddy land	Paddy land
137	Earlier Cemetery land	Social Infrastructure
176	Marshy land	Marshy land
177	Marshy land	Marshy land
179	Marshy land	Marshy land

Table 4.1.2.2- Earlier Land uses of the site

According to the NHDA guideline, before start a new housing development, project proponent should be submitted details regarding the location for preliminary planning clearance to the relevant local authority. Site no 86, 87 belong to crops land category and 137 come under social infrastructure category. If it is possible to have the planning clearance for those three sites, it is problematic to get planning clearance to the balance seven sites. But when looking out the section 5 it can be observed that all the sites had obtained the preliminary planning clearance for every housing development.

At the real situation people resides in these seven facing many problems like flooding, overflowing toilet pits, drinking water problems, skin diseases, and pest problems. Regarding this matter will be broadly discussed in detail in future sections.

Analyzing these facts it can be understood that, due to the emergency situation some mistakes were made at the time of providing planning clearance.

4.1.2.2 Size of the Housing Unit & House Distribution

The purpose of section 4 of the table is discussed regarding floor area or size of the housing units. According to the NHDA guideline minimum floor area should be 500 sqft. The table

clearly shows that all the sites have satisfied this requirement. But in certain sites some families are not satisfied with the size of the floor area laid down by NHDA. This is Because the family sizes are different. Some families has more than seven members. Fishing community families has more family members. In 2005 a particular family consist two adults and five children after ten years now all children are grew up and become adults. If particular family has more females also need more space because they require more privacy comparing with family which has more males.

In a multi housing development project, at the design stage it should be consider the households numbers and male- female composition also. When providing houses among families also should consider this matters properly.

At a discussion with the people, it was felt there was no proper mechanism for distribute houses among families. The Unconventional methods, briberies and personal links influenced to distribution of houses in an equitable manner.

So it is important to introduce proper mechanism with implementing authority for house distribution in equitable manner among families.



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4.1.2.3 Site Space Utilization

Section 6 of the table is discussed regarding the way of total land space utilization in the site. According to the NHDA guide line, following land uses categories should be allocated the following percentages of space from the total space.

6. (i). Housing neighborhood facilities	=< 65%
6. (ii) Common area	>= 10%
6. (iii) Road street, Foot paths and drainage	>= 10%
6. (iv) Social infrastructure	>= 5 %

When looking out the table site no 134, 137, 86, 87 shows negative responds. Site no 134 – korahedigoda watta, Eddunkele Ahangama is really problematic site under this section. This site not satisfies the NHDA guideline requirement at all in land utilization. This site is located in mountain slope around 5 km away from the earlier residences of the resettles. The people in this site are too much suffering because of the poor infrastructure facilities. Accessibility to the public infrastructure specially transportation is dominant problem prevailing here.



Image: 4.1.2.1. Access road –Addunkele H.S

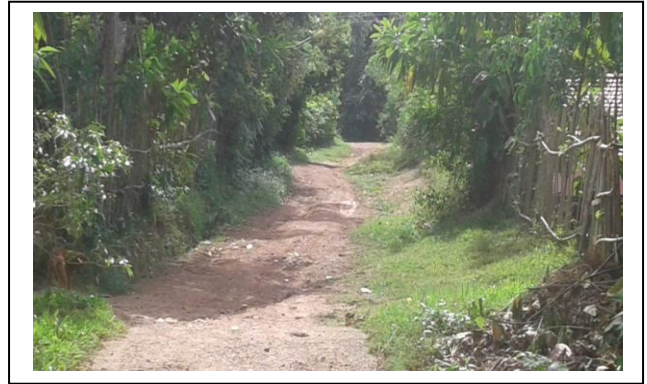


Image: 4.1.2.2. Internal road –Addunkele H.S

Sub section 6(iii) and 6(iv) show number of negative responds form several sites. Section 6(iii) discuss regarding the space allocated for the roads and drainage facilities. At the planning stage of the site it appears here space allocation for those facilities was followed properly, although it was not seem now. The main reason for this is people expand their legal boundary by altering their boundaries by acquiring the lands allocated for roads.



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Image: 4.1.2.3. Acquired road space –Paragon village Housing Scheme

Same problem arise for the land allocated for social infrastructure also. (Discussed under section 6(iv)). It appears that land allocated for the social infrastructure not done properly at the site planning stage. In most sites land allocated for this purpose is not sufficient for even building erection. Most lands available were bare land. Nearer land have been acquiring this lands, and this has made the lands useless.

This situation can be controlled to a certain extent by establish a “Site Governing Authority Team” among resettles and there by protect the public properties.

4.1.2.4 Land Plot Sizes

The purpose of section seven of the table is to discuss the land plot size. From the all fifteen number of sites, no any site comes under project area which is declared by Government as “Special Project”. (In the declared special project areas standard minimum plot size -6 Perches can be reduce more.) So all sites minimum lot size higher than 6 perches. Further all the sites located in the non urban area.

But people are dissatisfied with the plot size specially around 6-7 perches. Because they do not have enough space for handling solid waste and waste water. This is a critical problem in area where L.A doesn't collect the solid waste. Certain sites don't have enough space for black water (toilet effluent) management also.

When designing the minimum plot size, facilities available for handling solid waste and waste water in the area should be taken in to the consideration. Due to the poor accessibility gully browsers don't have access to the certain sites. At the beginning the L.A collected wastes in most sites. But due to distance to the site is not tolerable, gradually this collection was stopped.

If there is enough space, solid wastes can be dump in their home premises. So when deciding the land plot size first it is needed to check services in the area available for handling solid waste.

When land plots are very smaller, another big issue is houses are located very closer to each other. This affects the privacy of the families in bad manner. As a result unacceptable relationships, conflicts between families occur.



Image: 4.1.2.4,5. Limited front and side space Galgegedara watta Hosing scheme, Habaraduwa



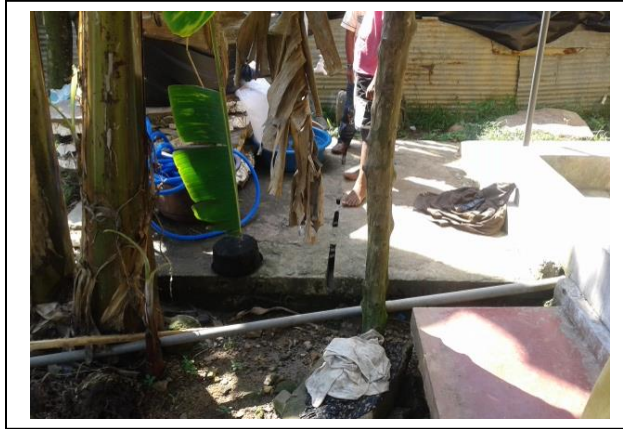
Image: 4.1.2.6 Small Space Between Housing Unit – Godadenikanda Housing Scheme

4.1.2.5 Building, Street lines and Rear Space

Section 8,9 & 10 are discussed will regard to road facilities. Section 8 (i) discuss will regard to building line. The table clearly shows that of fifteen out of six sites were negative respond. This indicates that form the center of the road building is available in less than 12.5 m (NHDA, standard for building line in any class road) This is a local road which was constructed as site access road by project developer.

Regards building line there has been no public dissatisfaction or any negative comments because these roads are provide access only to the housing sites. Most of this site internal road network not linked to the main road except at the main entrance. Section 9 discuss regarding the front and rear spaces. According to the standard front space from the street line should be more than 3ft.

section 9(i) in the table shows that out of fifteen four sites were showed the negative respond. Section 9 (ii) in the table shows four negative responds. This part discuss regarding the rear space.



(Image: 4.1.2.7 Rare Space – Malapal Watta H.S) (Image: 4.1.2.8 Rare Space- Addunkele H.S)

Front space is very much important for this people for parking and for front vegetation to reduce environmental heat. Rear space is important for handling solid waste and stock fire woods, water, materials need for their employments. The rear space is important for Specially for fishing community to handling fishing nets. Normally six perches land plots are suitable for urban areas. The income of the urban people is higher than the income earned by the people in the village. Urban people mostly use L.P gas and electricity for cooking and pipe born water for drinking. Therefore additional space is not necessary stock material. This resettled people can't afford this cost like urban people. These housing sites don't have continuous water supply. Therefore each house has to stock when water supply is available periods. So when deciding the front and rear spaces, the living pattern, employment and income level of people should be taken in to consideration.

4.2. Services

This section discusses on the available services in the sites and the level of services. Under this section it is going to mainly discuss about Water supply, Solid waste management, and Waste water treatment and sewage disposal mechanisms.

4.2.1 Water Supply

According to the NHDA guide line safe drinking water by pipe water supply system or by protected well system or by ground water form tube wells should be provided for the resettlement sites in Srilanka. Regarding the quality and quantity of the water the project proponent should be made concurrence with the National water supply and drainage board (NWS&DB).

Service	Site Number															
	86	87	108	109	122	129	130	133	134	137	138	T.V	176	177	179	
2. Water Supply	1.(i)	1	1	1	1	1	1	1	0	1	1	1	1	1	1	
	1.(ii)	1	1	0	1	1	0	0	0	0	0	0	0	0	0	
	1.(iii)	0	0	0	1	0	1	0	0	1	0	0	1	1	1	
	1.(iv)	1	1	0	1	1	0	0	1	0	0	0	0	1	0	
	1.(v)	1	1	1	0	0	0	0	0	0	0	0	0	1	0	
	2.(i)	1	1	1	1	1	1	1	1	0	0	1	1	1	1	
	2.(ii)	1	1	1	1	1	1	1	1	0	0	1	1	1	1	
	2.(iii)	(i)	(i)	No	(i)	(i)	No	(i)	No	No	No	No	(i)	No	No	
	2.(v)	yes	yes	No	No	No	No	No	No	No	No	No	yes	No	No	
	2.(vi)	Yes	Yes	No	No	No	No	No	No	No	No	No	yes	No	No	
	2.(vii)	(iii)	(i)	No	(j,ii)	(l,ii)	(iii)	(i)	(i)	No	No	No	(l,ii)	(i,ii)	(i,ii)	
	2.(viii)	NO	NO	NO	NO	NO	NO	(i)	yes	No	NO	NO	NO	NO	NO	
	2.(ix)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
	2.(x)	NO	NO	NO	NO	NO	NO	NO	NO	yes	NO	NO	NO	yes	yes	
	2.(xi)	NO	NO	NO	NO	NO	NO	NO	NO	yes	NO	NO	NO	(ii,iii)	NO	
	2.(xii)	NO	NO	NO	NO	NO	NO	NO	NO	(ii)	(ii),(iii)	NO	NO	(ii)	NO	
	2.(xiii)-I	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
	2.(xiii)-II	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
	2.(xiii)-III-I	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
	2.(xiii)-III-II	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
2.(xiii)-III-III	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		
				NO												

(Table 4.2.1.1- Questionnaire Survey Results)

First Section 2.1.1 (i-iv) of the table is discussed regarding the water sources available in the site for drinking and domestic uses. The table given below shows the available water supply sources and level of supply for the total fifteen number of sites.

No	Water Source	From total 15 of sites
1.(i)	NWS&DB Supply	14
1.(ii)	Central system pump spring water from well to overhead tank and distribution.	4
1.(iii)	Tube well water	7
1.(iv)	Individual spring water well	7
1.(v)	Natural water body	4

(Table 4.2.1.2- Modes of Water Supply)

According to the above table NWS&DB met the water requirement of the 14 sites except one site the number of the site 134. This doesn't get water supply because of the problematic location.(It is discussed in earlier paragraphs also. People of this site suffer a lot due to the lack of infrastructure facilities)

Even though 14 sites get water supply from NWS&DB, people are not satisfied with this service at all. Main reason is, in people's words, "Not a continuous water supply available throughout the day".



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Section 2.(iv) of the above table shows the results regarding sustainability of water supply. Of the fifteen sites, only 3 sites had the sustainable water supply. But there are several issues arise in that three sites at present.

4.2.1.1 Water Pressure and Internal water supply systems

When take the above three sites, they are located in hilly areas. Water pressure of the NWS&DB supply not sufficient to pump water to hillsides. As solution, those sites have ground storing and pumping system. Water is pumped to over head tank located in highest location of the site and then distribute among housing units. NWS&DB supply water to that ground storage tank.

The Ground storage facility has been arranged internally by a society named "Water Society". This society is independent of NWS&DB. Now the main problem prevailing in these three sites is collecting money from the customers who use water. The role of the water society is to collect

money and settle the water bill, bear maintenance costs and pay wages to the pump operators. The Pump operator is selected from resettled people.

Because water society is not a legally recognized body, money collecting is not happened in effectively. Because officers are selected form resettled people they are not powerful to handle this process especially because of the private links. So when water bill not paid at the correct time NWS&DB disconnect the water supply to the ground storage.

If this type of arrangement exists in any resettlement site for water supply, the NWS&DB should be directly involved to the maintenance, operation and collecting money without giving the duties and responsibility to the other party.

Site, no 133 Kesbepana has problem regarding the water pressure and flow velocity. When Compared to the other sites, this site has multi story two building which consist of 24 housing units. Each building consists of 5 floors. The upper flow don't have sufficient water pressure and velocity. (Section 2. (I,II)). According to the NHDA guide line water standard pressure head should be more than 5m and velocity should be more than 0.6 ms.

Standard water pressure and water velocity, should be maintained at the top floor of the multi story housing complex.



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(Image:4.2.1.1. Kesbepana Multistory Scheme)



(Image: 4.2.1.2 GodadeniKanda Ground Sump)

4.2.1.2 In Site Water Storage facilities

According to the NHDA guideline, a site should have water storage which is sufficient for one day use. From that total required storage, 30% should be as an elevated storage.

Section 2.(iii) in the table discuss regard the water storage facility in the site. At the beginning time only site no 129 and 130 had tanks for water storage. After several years, these tanks were disappeared.

In certain sites, where land plots are a little larger, are dug wells for private use. Sometimes those wells are shared with others during the dry season. Apart from this, some public wells are available in certain sites for secondary use like washing and bathing purposes.

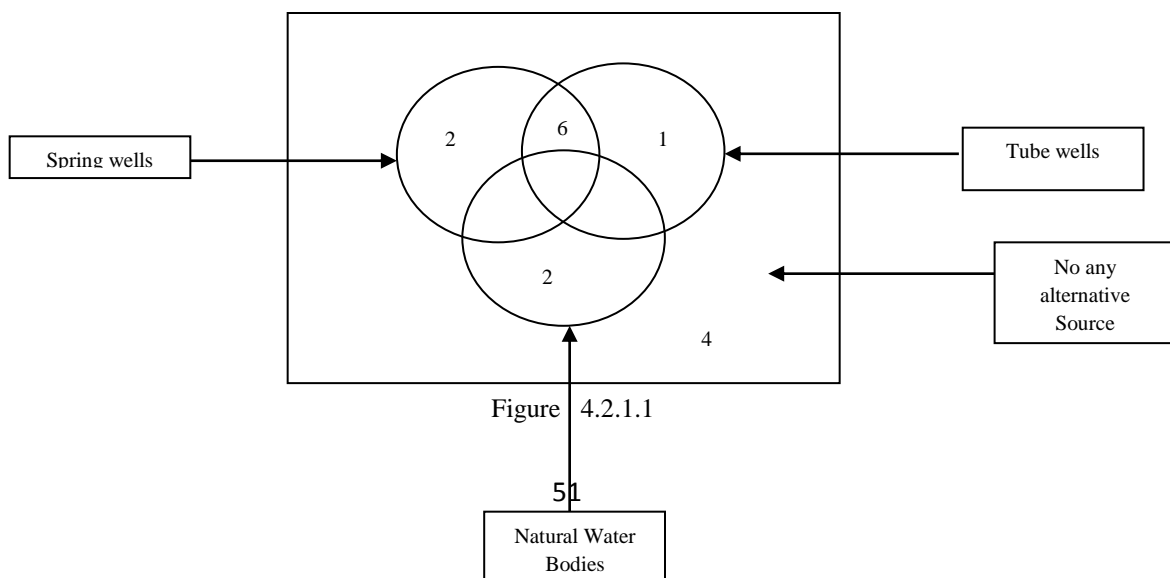
Places where ground water is not suitable for any purpose face a severe problem during the water off periods. These people has to go a few kilometers for water. Site no 129 which is paragon village face this problem severely. When there is long continuously water off periods give up their homes and temporary staying in the relations home. Some people purchased small tanks around 500 L capacity for storage water during water off periods. But this amount of water not sufficient even half day use when the house hold size is large.

Six sites have water storage ability. Site no 86, 87 and Turkey village have ground sump and overhead tank. But available storage capacities for one day site use not sufficient to full fill water demand.(Table Section 2.(iii))



Further the ratio of over head storage capacity to Ground storage capacity which is available at those sites do not full the NHDA standard. According to the NHDA guideline, over head tank should be able to store 30% from the total required water volume for one day use. The balance is stored in ground storage. (Table Section 2.(v)).

4.2.1.3 Alternative water sources available in the site.



From the above fifteen site 10 sites have alternative water sources. The important thing is that the sites are filled wetlands, marshy land or low line land, 99% ground water can be only used for secondary purpose. For the primary water uses they have to take water from outside. Of the total 4 sites don't have any alternative sources even for secondary uses. They wait for the water browsers supplied by L.A during the water off periods.

Another prevailing severe problem is the water quality changing throughout the year. During certain dry periods of the year water is supplied by L.A and NWS&DB Fe^{+3} and chlorine concentration is very much higher. So at that time people had to purchase bottled water from outside for drinking purpose. (Table section 2. (vii)). It is very important to introduce guide line to ensure the water quality throughout the year is at drinkable level.

4.2.1.4 Water reusing and Rain water harvesting Practices

Water is a scared resource for the resettlement sites. Water supply is available for limited period of time per day in most sites. Sometimes it may be one or two hours per day. So resettles have to collect water sufficiently for day today requirements. Whether it is a limited resource, scare resource, water conservation practices, maximum utilization practices are not functioning in an acceptable manner.

When focus the table section 2 (viii), except one site, no 133 – kesbepana, other all sites doesn't follow the water recycling practices.

Most this people use once used water for washing specially vegetable, rice, water finished water for watering ornamental plants, vegetable plants. Water discharge from washing clothes is also used for watering vegetable, fruits plants in the home garden. To control high sulfur concentration in water used for washing clothes they excavated a soakage drain along the plant beds around 3ft width between drain and planting beds.

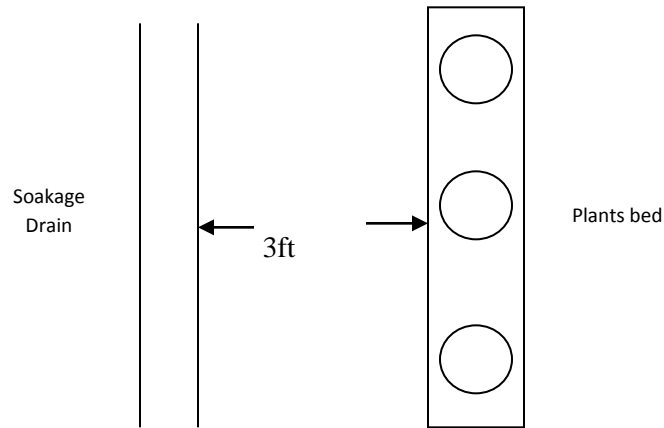


Figure 4.2.1.2

Due to the scarcity of water site number 134 and 179 try to utilize the water as much as possible by using it for secondary purpose once already used water. These two sites are in elevated locations. Comparing with the other sites in these sites ground water table is higher. These people don't have knowledge of indigenous methods which can be applied for gray water treatment. Most sites are filled wetlands, Because ground water table in higher levels, demand to the water for watering plants is lower. But the method for grey water collecting and water recycling should be introduced to those sites because of high water table, ground water can be easily polluted and can impact on the hygienic conditions.

4.2.1.5 Two water taps of water supply

Most of the resettlers try to depend on the portable water supplied by the NWS&DB for even secondary uses. When the stocked water is finished then they habit to use alternative water sources like spring well, tube well or natural water body. They are not in habit of using both piped born portable water and alternative water sources in joint manner. The main reason for this is access to alternative water sources is a little bit hard.

Through NHDA guideline, if an overhead tank is to introduce to each site to stock ground water and distribute among housing units for secondary purposes then the demand for the NW&DB water supply be reduced in to a certain level. In most sites ground water quality is not suitable for primary use. The resettlers therefore can have two taps one is for primary use and another for secondary use. As a result people can be satisfied from the limited water supply from NWS&DB for drinking purpose only. Section 2.(ix) is discussed regarding the availability of two water taps

in each housing units for primary use and secondary use. According to the results in the table, this type of option is available in any site at present.

4.2.1.6 Rain water Harnessing

Rain water harvesting is good a solution for water scarcity in hilly sites where ground water table is lower or ground water is not suitable for even secondary uses. Even of it is not mentioned in the NHDA guide line, fifteen out of three sites have rainwater harvesting vessel made of cement. The availability of rain water harvesting tank in sites as percentage from total number of sites it is 27%.



(Image: 4.2.1.3,4. Rainwater Harvesting Tank Addunkele & Korahedugodawatta H.S)

Harvesting rainwater in the vessel is used for washing purpose specially to use for toilets, watering home gardens and ornamental plants.

Further it indirectly support for control flash flood by holding considerable amount of water from the rain. Normally the capacity of this tank around 1500l. If there is 50 housing units with average plot size around 7 perch, the water holding capacity of two acre land is 65000 liters.

Some issues can arises in the site of locating of rainwater harvesting tanks. In one site several number of this tanks were demolished due to mosquito breeding.

This tank should be located in the difficult to shade facades of the home premises. If the tank is properly exposed to the sun light, because of its antiseptic abilities, the possibility of developing microorganisms , insect breeding can be reduce in to certain level. Further it is help to create

favorable micro climate because heat is decreased in the surrounding area, when water in the tank absorbs the surrounding heat. Section (2.xi) discuss regarding this factor.

All the rain water harvesting tanks are “Ground Tanks”. Most of the tanks are directly connected to the toilet and washing places. No artificial pressure is need for water distribution. Pressure generated from the water height in the tank used to distribute water among pipe network.

NHDA guideline is suggested here according to this guideline each and every housing unit should be provided a rain water harvesting tank at resettlement. Indirectly this is help to reduce the cost of energy for water treatment, pumping for secondary purposes.

One central rainwater harvesting tank is built in Godadenikanda Tusnami Resselment site, no 86 in an elevated location. This tank is earlier marshy land. After establish the housing scheme, it is converted in to water tank. This tank mainly sustain from rainwater. It helped to control runoff water speed and it is further worked as water detention pond for down side flood control.

This will help to maintain ground water table at a higher level. At the beginning period this tank was used for washing and bathing purposes. At present due to the improper water management, water eutrophication occurred. The main reason for this is fertilizer adds to the upside rubber cultivation dissolve in rain water and agglomerates in the tank. Because a high Nitrogen, Phosphorus, Potassium eutrophication occurs.

When locating central rainwater harvesting tank it is needed to locate at the correct place with defined catchment. When define the catchment, it should control the agglomeration of domestic waste substances, Sewage, fertilizer. For that it is needed a mechanism to stop the first rain water add to the tank. Because this water contained so much organic, polluting substances. Further it is needed to locate the tank where everyone can have the visual and thermal advantages.

4.2.2 Solid waste Management

	Service	Site Number															No of Sites	
		86	87	108	109	122	129	130	133	134	137	138	T.V	176	177	179		
2.2	Solid Waste Management	1.(i)	0	0	0	1	1	0	1	1	0	0	1	1	0	0	0	6
		1.(ii)	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	3
		1.(iii)	0	0	1	0	0	1	0	0	0	1	0	0	1	1	1	6
																1		5
		1.(iv)	0	0	1	0	0	0	0	0	1	0	0	0	1		1	2
		1.(v)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	2
		1.(vi)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2
		1.(vii)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		2.(viii)	0	0	0	0	0	0	0	0	0	0	(ii)	0	0	0	(ii)	2
		3	ii	ii	ii	iii	ii	ii	i	iii	0	iii	ii	ii	ii	ii	ii	ii

(Table 4.2.2.1- Questionnaire Survey Results)

4.2.2.1 Domestic waste disposal methods

Handling solid waste is another prevailing big problem in the site. Following table shows as percentages sites using methods for garbage disposal. According to the values from total 40 % is collected by local authority. At the beginning this had functioned properly. But with the time level of providing services reduced. At present L.A solid waste collection is not happening properly specially sites which are located far away from the nearest town. Main reason is the distance not tolerable for daily collection.

No	Method	No of Sites
1.(i)	Collect by Local Authority.	6
1.(ii)	Personally disposed to solid waste collection point or disposal yard.	3
1.(iii)	Garbage dumps individually at the home garden.	6
1.(iv)	Individual composting process in function.	5
1.(v)	Central composting project in the site handle the whole solid waste generation.	2
1.(vi)	Individually or collective manner provide garbage for outside project.	2

(Table 4.2.2.2- Percentages of Solid Waste Disposal Methods)

If it is so people should have to personally dispose solid waste on collection points or disposal yard personally. As percentage it is 20 %. But the problem arises regarding these collecting points. When this problem was discussed with the neighborhood of the site, it was revealed that the solid waste collection points are not nominated by L.A. Most of these places were junctions or beside road bear land. When people are on the way to work they have the habit of dispose their garbage in to these places. But it is created very unpleasant situation around that locations. Always neighbors made objections. This is one dominant reason for conflict among resettled community with the inhabitants.

4.2.2.1.1 Individual Home Base Composting

From the total of fifteen sites only five sites had been provided composting bins. As percentage it is 33%. At present it is not functioning well. The reason for this is directly link with land plot size. Because the land premises are small when pleasing that at the premises, it creates bad odor. Lechate generated in the bin make the premises unpleasant. Flies, Rats are attracted and they make the home premises dirt.

4.2.2.1.1.2 Central Composting Point



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Central composting system is a better solution for solid waste management. There are two types of central composting points available in use. First one is “On site composting point” and second one is “Outside composting point”. Mostly second one is conducted by L.A of the area. This outside composting project functions properly because it is governed by L.A funded by annual budget. Section (1.iv) shows the percentage of solid waste supply for outside composting project.

But “On site composting” is very effective to increase the productivity of land interns of home gardening. When onsite composting point in particular site, site people can easily provide their garbage to that point. At there, sorting the waste in to biodegradable waste and non biodegradable waste. Non biodegradable waste certain compounds like plastic bottles and other plastic parts can be directly sold outside. Bio degradable items use for composting.

At the beginning this type of process functioned in Kotigala Watta – Atanikiththa, Imaduwa, site no 179. In site plan there is one location separated for this activity. One person among the resettles was selected for this task. First two years this was functioned well. D.S office provided

vegetable seeds to resettles. Compost generated from the unit is purchased to use as soil conditioner for home gardening. The person who was working in the unit was paid by 60 housing unit from each, per one month Rs 200.00. Beside that money generated from selling compost to the site also extra income for that person. From both income sources that person earned 18,000.00 per month. After two years the seeds quality given by D.S office reduced and vegetable plants were destroyed. This happened several times, the home vegetable cultivation failed. Income from selling composting also reduced. Then composting unit collapsed due to the lower income for the worker.

At that time there was demand for organic farming vegetables produced in the sites. Outside People tend to purchase vegetable from the site specially feeding for their Children.

Section 1.(iv) shows the percentage of supply solid waste for onsite composting units. One site is proving solid waste for outside composting project and one site was composting their garbage themselves at the beginning. Now they are also provide their garbage to outside composting project.

4.2.2.1.1.3 Integrated bio gas generating, composting, animal husbandry and organic farming activity.



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According to the NHDA guide line, it is instructed to establish commercial level waste recycling centers for large housing schemes. This was understood after discuss with the resettles in big housing schemes, If the bio gas generating system can be integrated with composting system, it will be more advantage and it will an additional earning source.

All these sites not available any central or individual biogas generating system. Waste is good source of energy. If site is facilitated by biogas plant it will help to distribute bio gas among housing units as fuel for specially cooking. Because it is environmental friendly activity, on the other side it is good for environment. Unit Methane generated form solid waste positively contribute to global warming twenty one times comparing with the unit of carbon dioxide.

On the other side, if bio gas use instead of using of L.P gas or electricity for cooking will reduce indirectly amount of carbon dioxide emission to the atmosphere.

For proper functioning of the biogas plant, it is needed cow excretes because methogenic bacteria is common in the cow urine. If animal husbandry activity can be integrated with this system, it will help to increase the income while supporting to the biogas production process.

So integrated animal husbandry, biogas, composting production process with organic farming unit at resettlement site will help to sustainably solve big problem in solid waste management while it encourage the use of waste as resource for energy production. When establishing this type of units, specially should be considered on the volume of solid waste generation at the site.

4.2.3 Waste Water Treatment Mechanism

In all these sites, there are any large scale industries or self employment activities, which are generating considerable amount of waste water. But considerable amount of domestic grey water is generated there. Except one site, site no 133- Kesbepana Tsunami Housing scheme, other all don't have any grey water treatment methodology (94% of the site don't have any proper mechanism). Because from the total fifteen sites eight sites are located on filled wetland or marshy land. The generated waste water end up by disposing in to natural water body. Some housing units habit to dispose their grey water in to home premises. Because of these activities there is high potential risk on public health because of polluting higher ground water table.

Kesbepana tsunami housing scheme has a constructed wetland with collecting system for gray water recycling. After recycling this water is released in to the natural water canal. At the beginning time this treatment plant functioned well. But due to improper maintenance, at present wetland is not functioning properly. Without proper treatment water discharge in to the natural water canal now.

So each and every site, specially should introduce proper grey water treatment system at the site designing stage with the proper maintaining procedure.

4.2.4 Sewage disposal Mechanism

The following chart shows the sewage disposal mechanisms engaged in fifteen sites.

No	Disposal Mechanism	No of Sites
(i)	Septic tank followed by soakage pit	14
(ii)	Septic tank followed by soakage drain field	2
(iii)	Septic tank followed by Evaporation Mound	1
(iv)	Septic tank followed by soakage Discharge to water body	1
(v)	Individual Septic tank evacuate by gully browser	3
(vi)	Central Septic tank evacuate by gully browser	1
(vii)	Central collection system, treatment and dispose	1

(Table 4.2.4.1- Percentagewise Sewage Disposal Method)

From the above methods fourteen sites (93%) use the method of septic tank followed by soakage pit. Normally this method can be engaged when the ground water table is in lower levels with a permeable soil condition. From the above fourteen sites, eight sites are filled wetland, marshy land or earlier paddy land. Water table is normally around 1-3 ft. so this method is not suitable for this ground condition. At present eight sites suffer from fecal contamination. At even a small rain also toilet pits over flow. Most Sites use precast tanks as soakage and septic tank. Because of the high water table most of the tank placed some part of the tank above the ground level. Even a little rain, compounds in the soakage pit and septic tank mixed with the rain water. Because these areas are the lower terrain comparing with the surrounding, no any water flow to the outside. Because water stagnation, fecal compounds remain and create risk on public health.

Except the septic tank followed by soakage drain fields, evaporation mounds are practiced in those site. The same problem mentioned above method also prevailing in these two methods also. All the sites which use soakage drain fields, evaporation mound has higher water table.



(Image 4.2.4.1: Soakage Drain Field)



(Image 4.2.4.2: Evaporation Mound)

In Kesbepna Tsunami housing scheme, a rear type of evaporation mound was found. That mound is cultivated with fruit and vegetable trees.

For sites which have higher water table, there should have proper sewage collection system, treatment system up to standards and disposal method. If it is not possible there should have central or individual septic tank evacuated by gully browser. Central septic tank, which can be easily evacuated, is the better solution compared with the individual tanks. At present in Dikkumbura village and Addankete, housing scheme only have individual septic tanks. At over flow season using gully sucker they evacuated individual tanks and unload that sewage in to big dug well at the outside.

According to the NHDA guideline, these methods should be properly introduced with clear instruction considering the site soil condition. It seems not functioning properly at the project implementation stage.

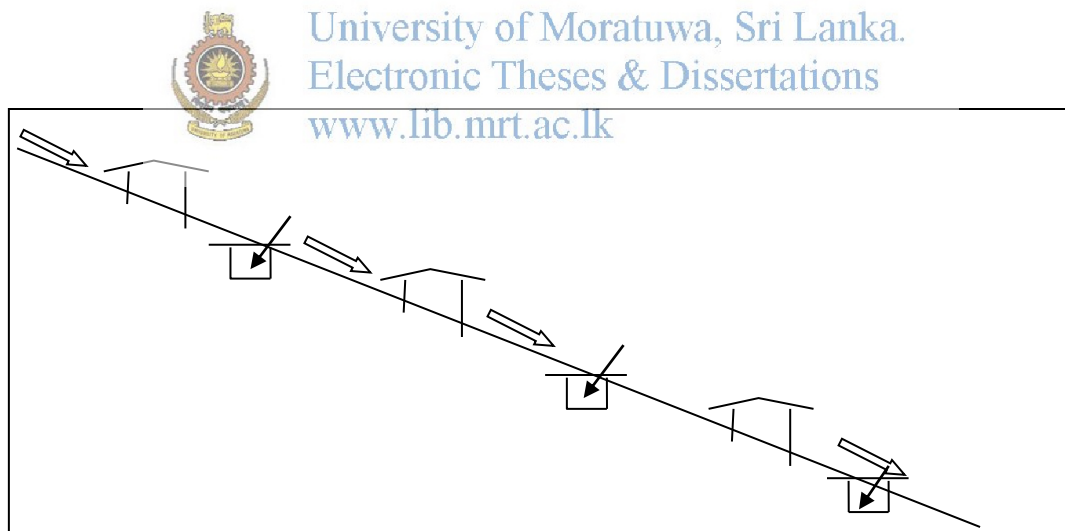
4.2.4.1. Over Flow Soakage Pits

Over flow of soakage pits is a big issue in these resettlement sites. According to the NHDA guideline, septic tank should be located at least 5 m away from the nearest building. Section 2.4 – 1.1 (viii) in the table is discussed regarding this matter. According to this, space is not maintained at all in any site. Normally it is around 1.5 m away from the kitchen. Small land plot size is the main reason for this problem. Because septic tank is located close, at the spilling time it creates abig issue for the public health.

From the total number of sites 11 sites as percentage 73% during the rainy season, toilet pits overflow. At the table section 2.4.4 shows the results regarding this matter.

During the rainy season water table goes above the top of the soakage pit. Then through the connected pipe, water with fecal compounds back to the scouting pan and it leaks in to the bathroom and spread inside the house also. Because so many toilets are attached to the house this is a sever issue for residents. If commodes were provided without scouting pans this situation could have been controlled in to certain extent.

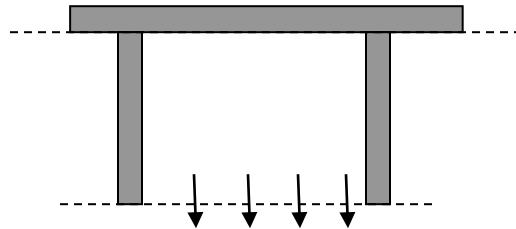
Except the above cases, another problem is found in the housing schemes which are located on slope of the hilly area. As example , Addunkele- Ahangama can be considered. Because there is no proper drainage network, storm water collect in top of the hill totally drains out through the home gardens. When it is flow, because soakage pits are not properly capped, suddenly it is filled and over flow. When water stock starts form the top and goes down to the bottom of the hill, soakage pits overflow and mixed with that storm water.



(Figure 4.2.4.1- Water draining pattern in KorahedigodaWatta H.S)

According to the terrain design of the soakage pit should be changed. If high water flow through the terrain, soakage pit should have concrete cover inside from top to bottom with properly sealed top cover.

In all fifteen sites there is no sewage treatment system applied. But this facility requirement is high. Because it is the sustainable solution. Central collecting tank evacuated by gully browser is the alternative. But it is not sustainable because in this area, there is no waste water treatment plants to dispose.



(Figure 4.2.4.2- Propose Soakage pits for H.S in Slopes)



(Image 4.2.4.2: Paragon Village & Malapalwatta High Ground Water Table)

4.2.4.2 Depth of water table Ground water quality

(i) Legend

2	Depth of water table
2.(i)	Fecal Contamination
2.(ii)	Eutrophication
2.(iii)	Direct risk on water and public health

(Table 4.2.4.3- Legend of following table rows)

(ii) Ground water Table

Site no	86	87	108	109	122	129	130	133	134	137	138	T.V	176	177	179	%
2	180ft	180ft	1.5ft	8ft	25ft	1.5ft	6ft	2ft	100ft	2.5ft	0.5ft	8ft	3ft	7ft	7ft	
2.(i)	0	0	1	0	1	1	0	1	0	1	1	0	1	1	1	60%
2.(ii)	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	20%
2.(iii)	0	0	1	0	1	1	0	1	0	0	1	0	1	1	1	53%



(Table 4.2.4.5- Ground Water Table)

4.3. Physical Features

4.3.1 Thermal comfort and greenery maintenance

According to the NHDA guideline, resettlement site should have sustainable designs. Sustainable designs mainly focus on three goals.

4.3.1.1 Shading devices requirement for open spaces

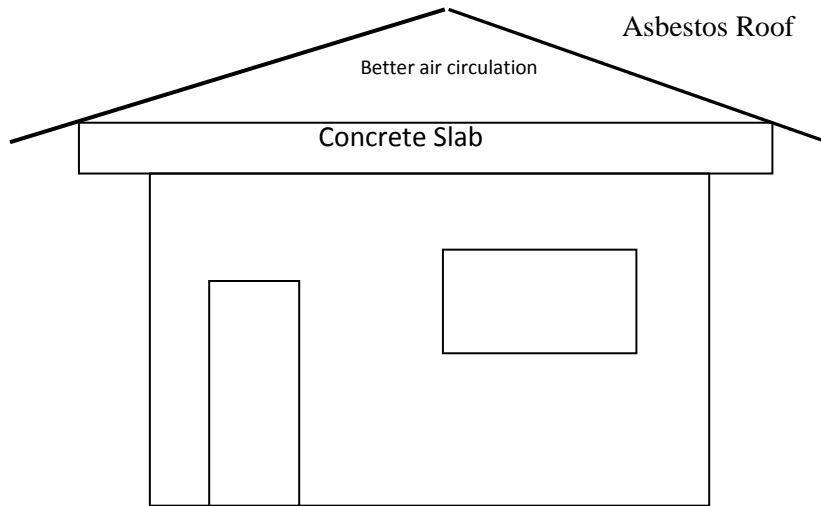
Trees are important devices for reduction of the heat. Because Sri Lanka is tropical country, environmental heat is very high. Energy efficient site planning layout can reduce the environmental heat. Because around trees a micro climate is generated. When Water evaporate through tree leaves it absorbs the surrounding heat. But when growing trees at the home premises it is necessary to consider on air circulation pattern. Planting programs should be conducted within the home premises without making obstruction to the air flow from the tree cover.

This matter concern on the site planning and resettlers should be allowed to maintain and enhance the open area vegetation cover.

The Section 3.1.1(i) in the table shows the result of this matter. Of the total sites fourteen sites were equipped with shading trees. Mango, avocado, jack trees are dominant. At the beginning planting programs were conducted by AGA offices. Section 3 shows which sites had plants as result of planting programs. The 87% of the sites got plants from planting programs. Apart from this residents themselves purchase different plants form agri shops and farms.

But site no 129 and 130 don't gett plants from planting programs. Limited space in the home premises and high ground water table discourage them for home gardening.

Site no 130- mihiranwaththa also doesn't followed planting programs. They are not affected by heat. Because these homes has two roof. The down concrete slab is roofed by asbestos roof. Site air circulation is better. Better air circulation between asbestos roof and concrete slab lower the heat of the house inside.



(Figure 4.3.1.1- Two Roof Covers on Houses of Mihiranwatta Hosing Scheme)

Except one or two housing units in one site other all housing units in all sites bounded by live fences. Live fences extend the site greenery area while shading the roads and pathways. In some sites live fence was plantain trees. Plantain trees created shades and cool pathways. So people tend to use bicycle and majority go on walks to have the public transportation from main road. They don't use taxis or hire three wheels to go to the main road, if they haven't their own one. Section 3.1.8 show the results regarding the energy efficient transport modes usage in the site. According to that 100% sites have live fence with shady pathways. Actually this condition in the site has been built up by the resident.



(Image 4.3.1.1 & 2: Karanketiya Housing Scheme – Big Front vegetation in Large Plot Sizes)



(Image 4.3.1.3: Shady Pathways in Kesbepana Tsunami Housing Scheme)

4.3.1.2 Building orientation and Air circulation.

According to the NHDA guide line, at the site planning stage building orientation should be selected to avoid the sun. But at the site planning stage this was not considered at all. But if this was considered short façade of the house should be oriented on the east and west.

But most shady environment rich in air circulation. As percentage it is 87%. Table Section 3.1.1 (v) discussed this matter.

If the internal roads and paths direct to the wind flow direction, it allows the wind to comes through the road to the interior the site.

When locating the doors and windows, the wind direction was not considered at all to proper penetration wind through the housing unit at all. Section 3.1.1 (v) shows the results regarding this matter.

4.3.1.3 Quality of construction and material usage.

The following table shows the materials used for house construction

No	Material	Number of sites.
(i)	Cement Blocks with cement mortar	13
(ii)	Clay Bricks with cement mortar	1
(iii)	Compressed earth soil blocks with cement mortar	0
(iv)	Other	1

(Table 4.3.1.1 Construction materials used for wall construction)

For house construction, two sites site no 137 and Turkey village are the sites. Turkey village used clay brick and cement motor for wall construction. Site no 137 – Malapala andarawatta, used totally different new method which is new for Srilanka. The house walls of the site was constructed using panel which is made of GI mesh and rig form. That panel is motored by cement.



(Image 4.3.1.4 & 5: Wall Constructed using Rig form Coated GI Mesh in Malapalawatta H.S)

The following table shows the materials used for doors and windows.

No	Material	Number of sites.
(i)	Wood	12
(ii)	Aluminum	1
(iii)	Concrete frames with wood	2
(iv)	Other	0

(Table 4.3.1.2 – Materials used for doors & windows preparation)

Using green building concepts for selecting materials for house construction is important. Low energy embodied materials like clay bricks, compressed earth soil block are good for the environment. Because total energy required for unit production of that items are lower comparing with the others. Carbon foot prints of these materials also low.

At the same time for windows and doors made by wood indirectly contribute to the carbon sequestration. For the sustainable design this concept should be involved in the guideline.

The main problem of prevailing in these sites is the quality of construction. Because of the lower quality of constructions foundations sink, walls are cracked, wall plasters are uprooted. Because of using low quality woods for manufacturing door and widows are decayed.

4.3.3. 1 Affected by flood

All the selected sites in the sample are in the Galle district. They belongs to the down tropical wet zone. Normally rainfall intensity more than 3000 mm per year. Except February, March and April there is rain in the other months throughout the year.

Of the fifteen sample sites eight of sites have been constructed on filled low line lands. Only of the eight sites six are frequently flooded even in a little rain. These eight sites get flooded at least four times per year. Section 3.3.(i) discuss regarding this matter.

Selecting low line lands as location for resettlement create sever problems. The project proponent and project approving agency should be deeply concerned in selecting site.

4.3.3.2 Storm water management

Within the site drainage condition, capacity as well as the outside drainage condition and capacity is important in storm water management. The NHDA guide line gives different size of drainage designs and types with different heights. In certain sites drainage capacities are not sufficient to because the water catchment area has not been studied well. Section 3.3.(v), (vi) has discussed regarding the ability of water handling capacities by the drainage networks.

	Drain type	From total number of sites.
01	Inside drainage capacities not sufficient	9 - (60%)
02	Outside drainage capacities not sufficient	6 - (40%)

(Table 4.3.3.1 – Drainage Capacities)

4.3.3.3 Seepage water intensity

There is no drainage network found in any of the site, which can give opportunities to increase seepage water intensity.

According to the NHDA guideline, there should be porous surface in front and rear space of court yard and drainage net work also. But this type of method not functions in any of the sites.

Apart from the mentioned above,, there are some faults found in the drainage network maintenance. Because drain has not been leveled during construction stage, in certain locations of the drain water is stagnated. In addition siltation also visible in these areas.

The lack of maintenance system has also creates health, odor and mosquito problems also.

It is essential to introduce site maintenance system among residents. Their work can be rotation work so everyone can participate in this work.

4.3.3.4 Slope stability

Unstable slopes are found in site no 86, 87 in Godadenikanda Tsunami housing schemes. Terrain slope is more than forty five degrees. In some locations of these two land slips are found.

4.4 Infrastructure Facilities

4.4.1 Accessibility to the Infrastructure

The chart below gives information about the distance between the fifteen sites and public institutions. First column of the following chart mentioned the maximum distance should keep from the resettlement sites to the public institution according to the NHDA guide line. In the second column the three distance categories has been developed for data analysis. The third column mentioned the number of sites come under each distance category

When consider about the results distance to the each institution from the site is not in satisfactory level.



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Institution	Distance	No of sites
I. School (D < 1km)	D = < 1km	10
	2 km >= D > 1km	1
	D > 2 km	4
II. Hospital (D < 2km)	D = < 1km	1
	2 km >= D > 1km	4
	D > 2 km	10
III. Govt. Dispensary	D = < 1km	4
	2 km >= D > 1km	4
	D > 2 km	7
IV. Post Office... (D < 1km)	D = < 1km	9
	2 km >= D > 1km	1
	D > 2 km	5
V. Police Station/Post (D < 2.5km)	D = < 1km	1

	2.5 km \geq D > 1km	1
	D > 2.5 km	13
VI. Religious place (D < 1km)	D = < 1km	9
	2 km \geq D > 1km	4
	D > 2 km	2
VII. Market (D < 2km)	D = < 1km	1
	2 km \geq D > 1km	5
	D > 2 km	9

(Table 4.4.1.1- Distances to the Public Institution from the site)

Certain sites contain more than 200 numbers of housing units. The majority of the sites are located far away from the main road. They don't have proper access to the main road. Most access roads are not in good condition. When a discussion was done with the residents, they expect bus service which would go through at least closer to their residences.

4.4.1.1 Education and Health Facilities

If it is not possible to find the location with closer proximity to the above institutions, at least nursery and primary school up to grade 5 could be established within or closer the site. Because small children find the difficulties to travel long distances. Grown up children are able to afford long-distance.

At the same time government dispensary should locate within or near to the site when the government hospital is located far away.

4.4.1.2 Religious Places

At the site planning stage, the land should be allocated for religious purposes. The size and type of the religious place such as temple or Buddha chamber or mosque must be decided considering the size and type of the community. At the beginning it was not there. With the involvement of the residents, by their own funds, they constructed themselves Buddha chamber in the most sites. This element helps to keep the social harmony among communities.

4.4.1.3 Police Station/post

Distance to the police station is important specially resettling the coastal community. Compared with the inland communities, coastal communities are totally different in their living style, culture and disciplines. Most of them are hot tempered. Even for a small reason may create big conflicts, shouting and quarrelling. After the resettlement, Closer housing units make this situation more critical.

At the same time most of the young male generation is addicted to alcohol. At present these places become hubs of selling narcotic drugs, Gunja and others substitutes. They have relationships with the underworld also.

Because of this situation, when police station located in far away, as controlling unit there should have police post. For small communities like housing units less than 25 housing units at least should have a room for police officer to stay at least two or three days per one week in the site. Further Locate the G.N office of the village in the site and allow G.N to continue his works will be more helpful to control problems among community.

4.4.1.5 Market Place



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The table shows 93% (14 number) sites are located more than 1km away from the Market place. Of this, residents of nine sites have to go more than 2 km for the market place. Considering the demand from the community, space for weekly fair can be allocated within the site. This will make it easy for the villagers to sell their production and also for the residents of the site to buy whatever they need. Because these days' people pay more attention on low fertilizer, low pesticides intensive organic foods there will be a big demand that foods from outside also.

4.4.2 Road Network

			86	87	108	109	122	129	130	133	134	137	138	T.V	176	177	179	% from Total
4.2	Road condition and capacity	1.(i)	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	20
4.3	Distance to the public transport mode from the site	3.(i)	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	93
4.4	Access to the earlier lively hood pattern	4.(i)	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	27
4.5	Energy efficient transport mode usage.	5.(i)	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	27
		6.(i)	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	20
		7.(i)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	7

(Table 4.4.2.1- Questionnaire Survey Results)



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Section 4.2.1.(i) of the above table from the total of fifteen sites (20%) only three site have the road network to meet the demand of the traffic flow. At the beginning there was proper road width available according to the UDA regulations. But after several years, people built more housing units with temporary materials at the same space when their families are expanded. This is common in site no 176- Addunkele , Atanikitha Imaduwa. It is obvious that people encroached space allocated for road by altering boundary because of the scarcity of space in their housing premises. This phenomenon was found in the other site as well.

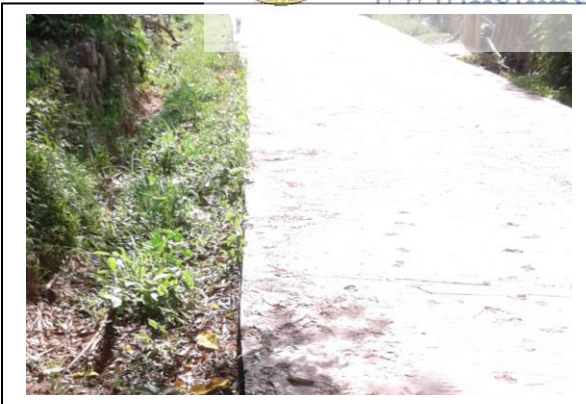


(Image 4.3.1.4: Temporary House Build in House Premise- Addunkele H.S)

Another problem in these sites is road sides are not back filled after road concreting. As a result there is a big gap between concreted part and ground level. This is caused to occur accidents when people travel by motor bikes and bicycles at nights. Further this reduced the width of the road also. Normally concrete length is 8ft – 10 ft. The allocated land width for road is 15ft – 20 ft. Because of this situation at present even two vehicles can't cross each other in most locations of internal road network.



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(Image 4.3.1.5 & 6 : Not Backfilled Road sides in Addunkele H.S)

The chart below shows condition of the road since the starting period. From the total 80% roads are not in the satisfactory condition. At the beginning 73% of the roads were in good condition. But within a period of 8 years road became usable.

No	Status	Number of Sites
i	Acceptable since starting period to present	3
ii	Acceptable at starting period, but present not acceptable	11
iii	Not acceptable at all since starting period to present	1

(Table 4.4.2.2- Road Condition History)

There are two reasons for this situation. First it can be attributed the lower quality construction. Second is there have been not proper drainage network. So water drain out through the road.

Therefore during the construction stage a proper monitoring system consisting a third consultant party should be introduced to guide the contractor to do high quality construction. Further the owners of the house unit should be involved in the construction work. So that any mistake can be rectified at the construction stage.

Further during the stage of using the housing scheme, it should be introduced a proper management system to properly maintain the schemes.

4.4.2.1 Distance to the public transportation mode

According to the NEDA guideline, distance between housing site and public transport mode should be less than 1km. Of the total of fifteen sites, fourteen sites (93%) have satisfied this requirement. Above table section 4.3 shows the survey result regarding this matter.

4.4.2.3 Access to the early lively hood

Section 4.4 of the above table shows the results of regarding this matter. Of the total of fifteen sites only 3 sites have easy access to their earlier livelihood. From the total resettles about 40% are engaged in fishing or related works. Fishing people should go to their boat yards at early morning around 5.00 am -6.00am. if the site in which fishing people live are located within a distance of 1km, because it is so early when the time of fishermen going to their occupation, public transportation not available. So they have to use their own push bicycle or motor bike to go for their work. Because of this, some fishing people give-up their jobs and they are engaged in other jobs.

4.4.2.2 Energy efficient transport modes

The majority of people in the site tend to use public transportation. They have to use bicycle or walk until they reach the places where public transportation is available. Shady pathways in the site encourage residents for this. Because all these sites are located at least 500 m away from the main road, no any impact from the main road traffic. Further fatal accident has not been reported until present.

4.5. Land use

4.5.1 Earlier land use of the site

Of the total of fifteen sites eight were marshy or Low line lands earlier.

Site No	Earlier land use
86	Rubber
87	Rubber
108	Marshy
109	Residential
122	Marshy
129	Marshy
130	Marshy
133	Paddy Land
134	Residential
137	Residential
138	Marshy
T.V	Residential
176	Marshy
177	Marshy

(Table 4.5.1.1- Earlier Land Use of the sites)

In these sites, there is no any site which blocked the animal migration path or become obstruction to their behavior. But thirteen sites are identified as the snake roaming areas. Of these sites, seven sites have reported snake attacks and two of the sites have reported fatal accidents.

4.5.2 Natural Resource Consumption

Of the fifteen sites, the people in fourteen sites (93%) use fire wood as cooking fuel. Degraded tree parts, branches supplied from surrounding areas, waste generated from coconut woods production are the main sources of fuel for these people. They obtained 40% this fuel from forest available located closer to residences.

At the same time of the total five sites (33% from total sites) use ground water by dig boreholes for secondary purpose like washing, bathing purposes.

Following chart shows the fuel usage for cooking.

No	Fuel	Percentage
(i)	Fire wood	93%
(ii)	Kerosene	27%
(iii)	L.P Gas	73%
(iv)	Electricity	60%
(v)	other	0%

(Table 4.5.2.1- Fuel for Cooking)

The NHDA guideline does not make any provision for the use of passive energy sources like solar power, wind power. Because of the sacristy of the fossil fuel cost per unit is increasing day by day. By products generated from the burning of fossil fuels are carbon dioxide, carbon monoxide, lead pollute the atmosphere which affect to the quality of water. Carbon dioxide affects the global heat and carbon monoxide causes the depletion of the ozone layer.

From the guideline it is essential to highlight the importance of using non fossil fuel oriented energy sources for the housing units.

The NHDA guideline mentions the importance of mini forest cultivation for fuel wood is good initiative. But unfortunately it is not practiced in any sample sites.

4.5.3 Pesticide Usage

The use of any pesticide or weedicide has not been found in any of the sites. The practicing of spraying smoke drive away mosquitoes has been reported from certain sites.

4.5.3.1 Self employment and small scale industries

There is no any large scale industries in any sites. Certain families in certain sites run small scale industries such as production of bites, sweets, packet the blended species. So there is no any considerable amount of solid waste and waste water generation in the site which can be affected to the public.

People in the sites engage in self employment specially buying and selling. They purchased fruits, sweets, fish, from the Pettah in wholesale manner and sell in retail to the local towns.

4.6. Social Factor



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From the total fifteen sites, in six only have the same ethnic composition. Only three sites have same religious composition. Chart shows the survey results regarding that.

6	Social Factors		86	87	108	109	122	129	130	133	134	137	138	T.V	176	177	179
6.1	Ethnic Composition concerned when residing at the site at beginning	2	Not	Not	Not	Not	Not	Not	yes	yes	yes	yes	yes	Not	yes	Not	Not
6.1.2	Religious Composition concerned when residing at the site at beginning	3	Not	Not	Not	Not	Not	Not	yes	Not	Not	yes	Not	Not	yes	Not	Not

(Table 4.6- Questionnaire survey results)

Different ethnic composition or religious composition not at all reasoning to occur the conflicts in the site.

4.6.1 Available Social network

From the very inception of the site, with the involvement of G.N of the village community base society called “Prajamula Samithiya” was established in each of the fifteen sites. This society has been developed to overcome to problems prevailing in the site. The main task of this society is to find the solutions for water scarcity. Site no 134 Korahedigoda watta, addunkele site developed a society called “Jala Samithiya” specially for water problem,

Some resettles who were there from the very beginning joined societies like “ Maranadara Samithiya” and “ Grama Snawaradana samithiya” which were available in the villages at that time.

At present, unfortunately all the societies developed by the site member are dormant. This may due to the arguments, conflicts between members of the society. Most of these societies are activated during the donations receiving periods only.

4.6.2 Causes of arise social problems and issues

1. Problem arise in handling solid waste

This problem arise due to the several reasons. They are as follows, size of the land plot is small, not regularly collection of solid waste by L.A , people have problems in stock solid waste. The people tend to dispose solid waste in to the not nominated disposal point. Sometimes it may a junction or bare land. People who are living around that point made objections and made conflicts between two parties.

2. Problems arise in handling domestic waste water and sewage.

In certain sites domestic waste water generate at the home is disposed in to the site main drainage network or home premises. Because home premises is small if it is disposed in to the home premises it is flowed to the adjoin home premises also. Sites which have higher water table is suffering from this problem well.

In some sites due to the small space in the home premises, it was provided one sewage disposal tank for two or three housing units. At the spilling time, septic tank located housing unit has to suffer a lot with neighbors' sewage.

3. Informal relationship between men and women in different families.

Because the housing units in sites are located very closer to each other, cause to less the privacy of the families. This is reason to occur very close relationships between men and women. At the bigining, many conflicts occurred. With the time, both subjected parties shifted to the other location.

At present there are no any conflicts. With time people who generated the problem were disappeared.

4. Alterations of the house boundary

With the limited space available in the home premises, the residents difficult to manage their day today works. So they tend alter their home boundary by acquiring space allocated for road and adjoining lands. This tendency prevail among people who had right of deed for their housing units. Deeds were not given doesn't have this problem.



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5. Prostitution and drug selling

After resettlement, accessibility to the earlier livelihood was a big problem for males of the families. The majority of them were engaged in fishing. They had to travel a long distance to the boat yard from their new homes early in the morning. At so early time, there were no any buses. As a result they had to give up or change their jobs. Females start to do jobs because income was less. After 2007, with the rapid development of tourism, females found jobs in tourist hotels. As a result of that certain amount of female were engaged in prostitution because it is easy money making method. With the time shades of this problem influence to sites also. Now certain sites become secret centers of prostitution and even drug selling also.

6. Scarcity of water

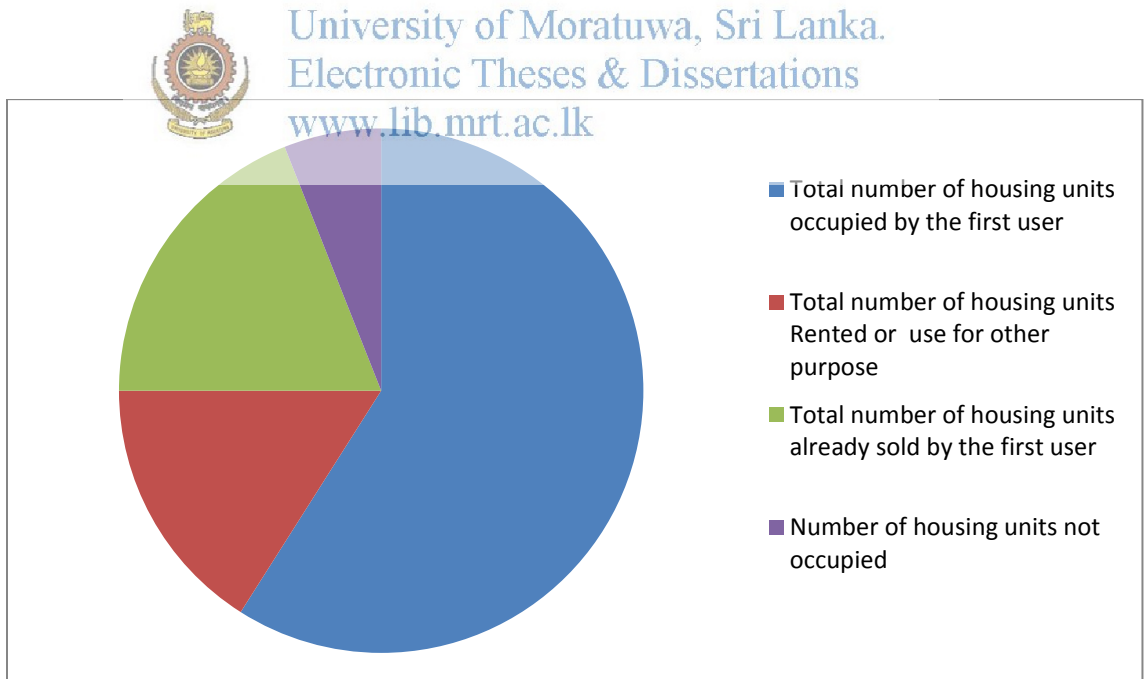
Scarcity of water, not sufficient water pressure for the upper side, supplying time is limited to the certain period of time per day is the prevailing problems in the site.

Because of this problems some of resettled families have give up their housing units and again settled in earlier places. Certain families went to new locations nearer to the town area.

Following chart shows the behavior of shifting housing units.

No	Matter	Amount
i	Total number of housing units in the settlement?	885
ii	Total number of housing units occupied by the first user?	59%
iii	Total number of housing units already sold by the first user?	19%
iv	Number of housing units willing to sell by the first user?	17%
v	Total number of housing units Rented or use for other purpose	16%
vi	Number of housing units willing to sell by the next user?	6%
vi	Number of housing units not occupied?	6%

(Table 4.6.1- Shifting behavior of residents in all fifteen numbers of housing schemes)




(Table 4.6.2- Shifting behavior of residents in all fifteen numbers of housing schemes)

CHAPTER 5


SUMMARY OF SUGGESTIONS


No	Aspect	NHDA Guidelines	Suggestions from the Research
01	Site Selection	<p>*Project Proponent focused to have CCD permission.</p> <p>*Presented restrictions for housing development in Coastal belt.</p>  <p style="text-align: center;">University of Moratuwa, Sri Lanka Electronic Theses & Dissertations www.lib.mrt.ac.lk</p>	<ol style="list-style-type: none"> 1. Project proponent should be persuaded to focus on environmental legislation. 2. Project proponent should be persuaded to check the accessibility nearby ESA areas, historically important sites or any other important site which can be affected in high population density in housing schemes. 3. Totally Prohibit selecting filled paddy, marshy, low line lands due to any circumstances for high density housing schemes. 4. L.A should effectively involve in approving suitable locations by considering all relevant matters.
02	Planning regulations at site planning	<p>*Approved for housing development in an area demarcated for residential land use.</p>	<ol style="list-style-type: none"> 1. Stop providing the approval for housing development in non residential, ESA or adjoining areas by violating rules and regulations by the L.A. 2. Avoid the faults which occurrence in resettlement due to the emergency. (Need pre-preparedness in L.As especially in coastal areas)
03	Size of the housing unit	<p>*Minimum size of the floor area is 500 ft² and should not be less than 500 ft²</p>	<ol style="list-style-type: none"> 1. At the design stage the family size and the gender composition should be considered. 2. Determine the sizes of housing units considering the sizes of families.


			<ol style="list-style-type: none"> 3. Create a Guideline for house sizes considering size of family which can be used in emergency occasions. 4. Proper mechanism and that mechanism implementing Authority should be developed for the house distribution among households.
04	Site Space Utilization	<p>*NHDA should provide percentages of land allocation for roads, common area, social infrastructure and housing neighborhood properly.</p>  <p>University of Moratuwa, Sri Lanka Electronic Theses & Dissertations www.lib.mrt.ac.lk</p>	<ol style="list-style-type: none"> 1. Develop a control mechanism to control Land encroached by residents to expand their home premises from lands allocated for roads, drainage and social infrastructure facilities. 2. Sufficient land area should be allocated for social infrastructure 3. Create internal site governing team among resettles with the involvement of GN to maintain and protect communal properties
05	Land plot size	<p>*Plot size 6 – 12 perches for town areas and 10-12 perches for individual dwellings.</p> <p>*Minimum plot size can be 6 perchs if water supply, sewage disposal and other facilities available for the site with the approval of L.A.</p>	<ol style="list-style-type: none"> 1. 80% of the 6 – 10 perches plot sized lands have limited water supply, no sewerage disposal methods and not regular solid waste collection, therefore; <ul style="list-style-type: none"> - Required continuous water supply, sewage treatment system and solid waste management system. - Required enough space for storing fishing equipments - Minimum lot size should be between 10 – 12 perches.
06	Building line, Street line and	<p>*Guide line provides values (refer Literature review)</p>	<ol style="list-style-type: none"> 1. The N.H.D.A guideline should be revised regarding the size of front and rare spaces to considering the income levels and facilities


	space facilities		<p>available in the area.</p> <p>2. Multi story buildings are not a successful solution at the housing resettlement.</p>
07	Water supply	<p>*It should have concurrence with NWS&DB in terms of quality and quantity of water supply.</p>	<ol style="list-style-type: none"> 1. Ensure the continuous water supply throughout the day. 2. Ensure the water pressure of 5m pressure head or more than that in upper flows of the multi story buildings and housing schemes which are located at the hilly areas. 3. Responsibility of Supply of water for the end point of housing unit should be taken by the NWS&DB. 4. Should ensure the water storage capacity of site which is sufficient for at least one day use. From that 30% should be in elevated tank and 70% in ground water tank (According to the NHDA guide line) 5. Maintain the quality of the water throughout the year in same manner. 6. Introduce two water taps one for portable water from NWS&DB and other from ground water for secondary purposes 7. Ensure the alternative sustainable water source specially in locations where ground water is not suitable for any use. 8. Introduce awareness programs for effectively reuse water, recycling, and rain water harvesting.





			<p>9. Every housing unit should provide individual rainwater harvesting tank and water distribution pipe network.</p> <p>10. Rain water harvesting tanks should be located in the difficult to shade locations of the home premises</p> <p>11. If possible introduce central rain water harvesting tank to collect rain water at the site. Ex- GodadeniKanda H.S</p>
08	Solid waste management	<p>*Should provide proper garbage disposal system</p> <p>*Supposed domestic level composting projects.</p>  <p>*For large housing schemes, commercial level central composting units.</p> <p>*Adequate access should be provided to collect garbage at the site.</p>	<p>1. Home base – individual composting of solid waste is not a successful attempt due to bad odor and limited space available in the home premises. Therefore central on site composting unit should be introduced, integrates with the bio gas generating system, organic farming and animal husbandry activities.</p> <p>2. This unit should be introduced to the resettlement sites with a management team which is selected among the resettled community with the supervision of LA.</p> <p>3. For small communities, several communities joined together and can create composting unit. The location should be selected with the agreement of all join parties.</p>
09	Waste water treatment (gray water disposal)	<p>*Different waste water treatment methods introduced.</p> <p>*Highlight the importance of the waste</p>	<p>1. Central waste water treatment plant should be provided for the areas where ground water level is high.</p> <p>2. Proper maintenance and management system should be introduced to the waste water treatment plant for continuous functioning.</p>

		water treatment method.	
10	Sewage disposal mechanism	<p>*Different sewage disposal mechanisms introduced</p> <p>*Individual Septic tank should be at least located 5m away from the house.</p>  <p>University of Moratuwa, Sri Lanka Electronic Theses & Dissertations www.lib.mrt.ac.lk</p>	<ol style="list-style-type: none"> 1. Sewage treatment plant or central septic tank which can be easily evacuated by gully-browsers should be proposed for the higher Water table available areas. 2. Enough space in the home premises should have to locate septic tank at least 5m away from the house. 3. The sites where only the soakage pits available (without septic tank) should be properly capped the surface of the pit and cover inside up to bottom. 4. Soakage pits should not be located in the rain water draining out routes.
11	Physical features	<p>*Site building orientation for avoidance of sun.</p> <p>*Site and building orientation to encourage air movement</p> <p>*Shading devices requirement for open space.</p> <p>*Green space requirements for heat gain reduction</p>	<ol style="list-style-type: none"> 1. At the design stage, it should be concerned well on the building orientation. 2. At the design stage it should be allowed to come wind to the site through road and pathways. 3. Door and windows should be placed in proper locations which may help air to penetrate through the housing unit. 4. Should have more space in front and rear space of housing unit for growing more trees 5. Live fence extending the site greenery area further. 6. Continuous shaded pathways should be provided until to public transport facilities available.

12	Material Usage and quality of construction	*Extended levels of qualities should be maintained comparing with the normal construction.	<ol style="list-style-type: none"> 1. Qualified third consultancy party should be appointed to monitor the quality of construction, material quality and construction standards at the construction stage. 2. Suppose to use low energy embodied materials and carbon sequestration materials for house construction. (Wood for Door and windows and Roof)
13	Flood mitigation and storm water management	<p>*Different drain size, types provided for site drains</p>  <p>University of Moratuwa, Sri Lanka. Electronic Theses & Dissertations www.lib.mrt.ac.lk</p>	<ol style="list-style-type: none"> 1. Should be strictly prohibited of selecting low line lands for housing resettlement. 2. At the site design stage, it is need to indentify the site catchment area. According to the maximum water quantity possible to occur at the site, site drainage network should be designed. (Past 25 years weather pattern should be studied) 3. If the secondary drain capacity is not sufficient to manage total water quantity, fix a water pumps for evacuation water at the emergency situations. 4. Site management society should be created and responsibilities of maintenance and monitoring should be provided. Maintenance team and monitoring team can be selected among residents and this team can be periodically changed which makes everyone can participate to the monitoring and maintenance.

14	Seepage water intensity	*Suppose pours spaces in front and backside of premises of housing unit	<ol style="list-style-type: none"> 1. Ensure to enable Guideline facilities in the layout design of court yards. 2. Bottom slope of the drainage network should be properly maintained and bottom surface should be leveled to stop water stagnation.
15	Accessibility to the infrastructure	Refer table 4.4.1.1  <p style="text-align: center;"> University of Moratuwa, Sri Lanka Electronic Theses & Dissertations www.lib.mrt.ac.lk </p>	<ol style="list-style-type: none"> 1. At the selection of site, try to select the location, which has easy accessibility to schools, hospitals, police station, religious places, market within standards distances. 2. If not considering the size of the community nursery and primary schools up to grade five should be established in or nearer to the housing scheme. 3. Government dispensary should be established in or nearer to the housing scheme. 4. Sub Police post should be established with required facilities in or nearer to the site. 5. Religious places should be established within the site. 6. Small market places or bazaar should be established at the site.
16	Road Network	*Road width drainage line and side pavements are decided considering the number of housing plots. *Distance to the public	<ol style="list-style-type: none"> 1. Sides of the concrete roads should be backfilled by soil up to the surface level of the concrete. 2. Land allocated for road encroached by extending home premises should be controlled with the involvement of G.N

		transpiration network from the site should be less than 1km.	<ol style="list-style-type: none"> 3. Third consultancy party involved at the construction period to monitor the quality of construction. 4. Proper drainage system should be established beside roads which enable road more durable. 5. Except internal road network, external road condition and size also should be considered in selecting location for the site. Especially road condition between main road and site also should be in good condition.
17	Accessibility to the earlier lively hood.	 <p>University of Moratuwa, Sri Lanka Electronic Theses & Dissertations www.lib.mrt.ac.lk</p>	<ol style="list-style-type: none"> 1. Provide motor bikes or push bikes considering the distance to the boat yards from the site for fishermen by easy payment loan scheme. 2. Prices of motor bike should be reduced by negotiate with the Government to remove government import taxes. 3. Bikes should be provided under the legal boundaries which can't be sold to the other party after getting the ownership until several years.
18	Earlier Land use	*Introduce mini manmade forest to the sites for use as fuel woods	<ol style="list-style-type: none"> 1. Filled marshy lands, low line lands, paddy lands totally prohibited as locations for housing resettlement. 2. Site should not be a barrier or obstruction for animal migration path. 3. High density housing schemes should not be located near which makes easily access to the government preserved forest, botanical gardens,

			<p>historically important sites.</p> <p>4. If possible, try to introduce mini manmade forest to the sites for use as fuel woods.</p>
19	Develop social networks	 <p>University of Moratuwa, Sri Lanka. Electronic Theses & Dissertations www.lib.mrt.ac.lk</p>	<p>1. With the involvement of G.N, develop active “Prajamula Samithi” in the site for management of the site and welfare of people.</p> <p>2. Encourage resettles to join to the societies like “Maranadara”, “Gramasanwardana” Samithi already available in the village.</p> <p>3. This community should not be allowed to behave as isolated manner. Make them move with the villagers and governed under village leading respectable persons already living in the village.</p>
20	Peacemaking and conflict resolution		<p>1. Allocate space for G.N office in the site and relocate earlier G.N office in to the site at the beginning of the site</p> <p>2. Allocate space for an office for the police officer to stay at least three days per week to control conflicts among people, illegal activities which happen in the site.</p> <p>3. Plan resettlement sites for small community instead of planning for large community.</p>

CHAPTER 6

CONCLUSION & RECOMMENDATION

6.1 Conclusion

For this research, of the eighty nine tsunami resettlement sites in the Galle District, fifteen problematic sites were selected for the collection of data. This data was analyzed in chapter four of this research.

According to the knowledge and understanding obtain from the data analysis; two stages have been identified for the resettlement. They are as follows,.

1. Stage of preparation
2. Stage of functioning.

At the stage of preparation, shall involve the selection of suitable location, design and construction. For the stage of preparation a success of following matters shall be taken in to consideration. They are as follows,

1. Best selection of location
2. Sufficient land plot Size
3. Monitoring activities by the qualified third party
4. Establish Small Communities

Best site selection is the most important factor for resettlement to be success. The major factor has contributed to the failure of the selected sites in this research are the people who were resettled in the site face a problem of having access to their earlier livelihood, higher ground water table, lower accessibility to the infrastructure and limited time of water supply. Further involvement of Local authority was poor due to the emergency situation arise after the Tsunami. As a result selected sites drove the resettlers to the worst problems. New technologies, software like Arc GIS were not used for site selection. As a result, they were unable to find strategic location for the sites.

Second important factor is the land plot size was not in satisfied. This is important matter for physical and social aspects of the peoples' life. To generate urban life in the rural

areas with lower facilities and service create so many problems. Regarding the small land plots, people in the urban area don't have any problems. Urban areas are prosperous of infrastructure facilities and services. Resettlement sites should have a minimum plot size of 10 – 12 perches. Physically small land plots affected of handling solid waste, waste water and storing equipments for the livelihoods. Socially it is affected to keep the privacy of the families.

Third matter directly related with the quality of construction. At the houses, roads and all other constructions the most important matter is quality of the construction and durable outcome. Qualified independent third party monitoring team should be in the site to monitor the activities in the site during construction stage.

3. Period of functioning

The second site failure occurs during the functioning period. Proper management is the important matter for successful functioning of the site. Management and monitoring should direct all activities in the site in to the correct path. Mechanisms in managing internal water supply systems, composting projects, waste water treatment facilities, monitoring the site maintain are main responsibilities which must be carried out. It is Important of appoint qualified management team among member of the resettled community for the sustains of the site.

4. Small Communities

The Important finding obtained from this research is that the resettlement sites should be planned for small community instead of plan for large community. This is helpful to maintain peace and Social harmony among the resettles as well as villagers. A small community doesn't have big team power comparing with the large one. Requirement of the quantity of facilities for small community is lesser. It can be easily fulfilled. For small resettlement, there is no need for big land spaces. Medium size lands can be easily found with sufficient infrastructure comparing with the big lands.

Finally, according to the research study which has been done up to now, it is suggested to improve the NHDA guideline considering the suggestions which have been made in the

summery. This improvement of the NHDA guideline will direct process of resettlement in to the correct way.

6.2 Limitation of Research Study

This research study is mainly biased on environmental and environmental related physical aspects only. It does not focus on the economic and social aspects of the communities very much. Physical, environmental, Economic, Social aspects are very much important in planning settlement. Requirement of Physically feasible, economically viable, socially Acceptable, Environmentally compatible settlement plans are “Must” to overcome the present prevailing problems in the resettlements. Majority of the suggestions which are generated in this research in the perspective of Environmental Acceptability, Reduce, Reuse, Recycle (3R) and eco friendly development.

Involvement of Physical, Social and Economic Perspectives from the experience which had been gained within the period of ten years of Tsunami Resettlement Site will be helpful to produce more practical and comprehensive guideline.



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6.3 Recommendation for Future Research Directions

As discussed in the above section limitations of this research study are based on environmental aspect. But several research could be done considering social, economic, Physical aspects from ten years experience in Tsunami resettlement sites.


In addition, it has also been founded that small communities is better than large communities. But it is need to do research on the optimum land plot size per one resettlement.

Further it has been suggested in this research that minimum plot size of the housing unit should be at least ten to towel preaches. But according to the available facilities, the magnitude of facilities and frequency of supplying services, Occupation, Number of members in the family, gender composition that minimum plot size should be changed. Guideline for different minimum plot sizes concurrence with the available facilities and it is magnitude and frequency, will be helped to the layout planners to decide the minimum land size according to the location of resettling at the emergency situations.



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