Impact Assessments of Distribution of Government Funds for House Damages in Five Selected Districts of Sri Lanka

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Project Summary

Background: The Government of Sri Lanka spends considerable development funds on the reconstruction of houses damaged during various disasters. The National Disaster Relief Services Centre (NDRSC) of the Ministry of Disaster Management is the national entity responsible for providing financial assistance for disaster relief and for disaster-affected households to reuild their damaged houses. Every year, the NDRSC allocates funding to the District and Divisional Secretariats to coordinate and monitor the reconstruction process.

Methods: This study analyzed the hazard-resilient features of the rebuilt houses, beneficiaries' consideration of hazard-resilient features and their benefits during reconstruction, and current resilience response policy. The research was conducted between 2008 and 2012 in communities affected by natural disasters in five districts in Sri Lanka: Batticaloa, Colombo, Matale, Matara, and Polonnaruwa. Data collection

methods included a beneficiary household survey using structured questionnaires and a detailed technical survey of beneficiary houses built during the above period.

Findings: Houses reconstructed in the study area had not incorporated most disaster-resilient features and hence were not disaster resilient. Most of the beneficiaries had little or no awareness of resilient features and rarely considered them during reconstruction.

Conclusions: Existing government guidelines for reconstruction of houses damaged by natural disasters should be modified to increase awareness and adoption of disaster-resilient features. This action would help move Sri Lanka from response to resilience.

1 Introduction

The Government of Sri Lanka spends a considerable amount of development funds to reconstruct houses damaged by various disasters, including floods and high winds. The National Disaster Relief Services Centre (NDRSC) of the Ministry of Disaster Management is the national entity responsible for providing financial assistance for disaster relief and for disaster-affected households. Each year, the NDRSC year allocates funding to District and Divisional Secretariats to coordinate and monitor reconstruction.

This study analyzed the hazard-resilient features of the rebuilt houses and beneficiaries' consideration of hazard-resilient features during reconstruction, as well as the need for a change in resilience response policy. The research was conducted between 2008 and 2012 in communities affected by natural disasters in five districts: Batticaloa, Polonnaruwa, Matale, Colombo, and Matara.

2 Project Outputs and Outcomes

The research identified existing government assistance for disaster-affected housing reconstruction and gaps that need to be addressed to improve hazard-resilient construction. The study found that many households used construction materials and methods that are not suitable disaster-vulnerable areas. Most of the areas where houses were rebuilt were in areas prone to floods, landslides, and high winds. Because of limited funds from the government, many households provided labor, building materials, and money to rebuild their houses. It was found that 23.3% of households were not aware of housing construction regulations, and 30.7% of households and 32.1% of draftsmen had no knowledge about disaster-resilient features. Actions needed to ensure construction of hazard-resilient houses were also identified through this study.

3 How Did You Go about Achieving the Outputs/Outcomes?

Data collection methods included a beneficiary household survey using structured questionnaires and a detailed technical survey of beneficiary houses built between 2008 and 2012. Quantitative and qualitative data were collected and analyzed using the SPSS statistical package. Primary and secondary data were used for statistical analysis. The basic analytic unit of the study was the household. Districts were prioritized based on the financial assistance provided for housing reconstruction between 2008 and 2012. Batticaloa had the most houses damaged by flood during the period. Colombo was

selected to analyze urban disaster impacts. Matale is the district most vulnerable to landslides. Matara was selected to represent coastal disasters and floods and landslides in the south of the country. Polonnaruwa is subject to floods, some of them the result of the area's ancient irrigation system (NDRSC Annual Report, 2014) and high/strong winds. Households were randomly selected from these five vulnerable districts.

Primary data were collected from household beneficiaries using a structured questionnaire. In collaboration with the National Building Research Organisation (NBRO), the national agency mandated to conduct building research in Sri Lanka, the NRDC developed and pretested the questionnaire, which was finalized with the help of the Sri Lanka Red Cross Society (SLRCS). Interviews and observations were done by Disaster Relief Service Development Officers recruited at district and divisional level and monitored by the NDRSC. The data collectors received a 3-day training in hazard-resilient housing construction with the technical support of NBRO. NDRSC also conducted field-level training on data collection methodologies for social science research. The questionnaire included basic household information and information on the impact of disasters on housing units, relocation, the assistance process, beneficiary contributions, hazard-resilient features of the houses, and safety and health issue of the households.

Secondary data on house damages were collected for each year from 2008 to 2012. Data on financial allocations were collected from the NDRSC and relevant District and Divisional Secretariats. The collected data were analyzed using the SPSS statistical analysis package.

4 What Did You Learn?

Basic Housing Characteristics

Rubble/masonry was used to rebuild the foundations of 77.7% of the houses destroyed by disasters, concrete for 9.0%, and brick for 6.8% (table 1).

Table 1. Main materials used to rebuild house foundations

District	Rubble/ masonry	Brick	Concrete	Brick/ concrete	Other
Batticaloa	188	40	2	3	15
Colombo	11	2	1	0	0
Matale	83	3	25	12	1
Matara	164	1	34	9	4
Polonnaruwa	92	1	0	1	0
Total	**538**	**47**	**62**	**25**	**20**

To build the walls of their houses, 87.1% of the households used brick or hollow cement blocks, 55.7% used brick, 31.4% used hollow cement blocks, and 12.9% used pressed soil blocks, mud, cadjan/palmyra, planks, metal sheets, or tin, materials that are not strong enough to be resilient to disasters (table 2).

Table 2. Main materials used to rebuild walls

District	Brick	Kapok	Hollow cement blocks	Pressed soil blocks	Mud	Cadjan/ palmyra	Planks/ metal sheets/ tin	Other
Batticaloa	133	22	60	3	3	12	15	0
Colombo	1	0	11	0	0	0	0	0
Matale	67	7	36	1	9	1	0	0
Matara	89	9	110	0	1	0	0	3
Polonnaruwa	99	0	2	0	1	0	0	0
Total	**389**	**38**	**219**	**4**	**14**	**13**	**15**	**3**

For the rebuilt floors, 81.8% of the affected houses used cement, while 18.2% used mud, sand, and other materials. These materials may absorb and hold water and are not suitable for flood-vulnerable areas (table 3).

Table 3. Main floor materials

District	Cement (rendered)	Cement (non-rendered)	Mud	Sand	Other
Batticaloa	147	42	6	58	0
Colombo	2	5	3	0	1
Matale	58	47	12	2	6
Matara	61	113	31	4	0
Polonnaruwa	29	57	1	0	0
Total	**297**	**264**	**53**	**64**	**7**

The main roofing materials used were tile (34.5%) and asbestos (47.0%). The rest of the respondents used metal/tin sheets, cadjan, palmyra, or straw, which are vulnerable to strong winds and heavy rain (table 4).

Table 4. Main roofing materials

District	Tile	Asbestos	Concrete	Metal sheets/ tin	Cadjan/ palmyra/ straw	Other
Batticaloa	152	20	5	31	26	1
Colombo	0	7	1	3	0	0
Matale	34	58	4	24	0	1
Matara	40	139	9	10	4	0
Polonnaruwa	0	84	0	2	0	0
Total	**226**	**308**	**19**	**70**	**30**	**2**

Location and Position of Reconstructed Houses

The location and position of the reconstructed houses were analyzed to determine the disaster impacts on the housing units affected during the 5-year research period in the selected districts. Most (28.2%) of the 880 houses studied were located in flood-prone areas, 9.8% were in areas exposed to high wind, and 8.2% werein areas affected by landslides. However, 37.8% of the beneficiaries responded "No perception on orientation" of their reconstructed houses; this response was highest in Polonnaruwa (14.9%) and Matara (12.3%) (table 5).

Table 5. Disasters common in areas where the houses are located

District	Floods	Landslides	Cyclones/ high winds	Other	Don't know	No response
Batticaloa	196	17	4	10	20	0
Colombo	11	0	2	0	1	0
Matale	9	22	17	6	72	0
Matara	31	28	62	12	109	1
Polonnaruwa	2	5	1	0	131	0
Total	**249**	**72**	**86**	**28**	**333**	**1**

Land for Rebuilding

Households interviewed said they rebuilt their houses on cut slopes (16.8%, mainly in Matale and Matara, which are prone to landslides), reclaimed land (34.5%), close to marshy land/low-lying areas (3.7%), on old landfills/pits/quarries (4.5%), and on the disaster-affected sites (27.0%, of which 50.3% were in Batticaloa District) (table 6).

Table 6: Land on which houses were rebuilt

	Cut slope	Reclaimed land	Close to a marshy land/low-lying area	Disaster-affected site	Old landfill/ pits/ quarries	Other
Batticaloa	22	57	15	153	2	0
Colombo	0		0	11	0	0
Matale	25	52	2	49	1	3
Matara	97	67	6	22	0	76
Polonnaruwa	4	125	10	2	1	1
Total	**148**	**304**	**33**	**237**	**4**	80

Satisfaction with Relocation

Less than one-half of the 365 sampled houses (41.7%) were reconstructed in the areas where beneficiaries had been relocated. The study analyzed beneficiaries' satisfaction

with the relocation and found that 16.9% were not satisfied at all (77.4% of these 62 households from Batticaloa District) 26.7% were slightly satisfied, 35% were moderately satisfied, and only 0.8% were extremely satisfied (table 7).

Table 7. Satisfaction with relocation

Disaster	Not at all satisfied	Slightly satisfied	Moderately satisfied	Very satisfied	Extremely satisfied	No response
Batticaloa	48	45	31	1	0	13
Colombo	1	0	0	0	0	1
Matale	7	14	59	2	2	15
Matara	6	39	39	3	0	37
Polonnaruwa	0	0	1	0	1	0
Total	**62**	**98**	**130**	**6**	**3**	**66**

Beneficiary Contributions

The study analyzed contributions beneficiaries had made to the reconstructed houses to assess the adequacy of the government relief assistance provided. Of the 880 sample households, 12.5% contributed labor, 5.2% contributed construction materials, and 8.7% made monetary contributions. Of these households, 83 contributed both labor and money, 46 contributed both labor and building materials, and 92 provided all labor, materials, and money (table 8). Altogether, 37.6% of the households (331) provided labor, 18.9% (166) provided building materials, and 29.1% (256) provided monetary contributions. The significant contributions from the beneficiaries for the reconstruction indicates insufficient government allocation.

Table 8. Beneficiary contributions to rebuilt houses

District	Labor	Labor, materials	Labor, materials, money	Labor, money	Materials	Materials, money	Money	No response
Batticaloa	41	19	11	17	27	3	52	13
Colombo	0	0	0	0	0	0	0	0
Matale	6	8	43	20	0	0	25	0
Matara	63	19	29	15	1	0	1	0
Polonnaruwa	0	0	9	31	0	0	0	0
Total	**110**	**46**	**92**	**83**	**28**	**3**	**78**	13

Awareness of Housing Regulations

Knowledge of regulations for constructing disaster-resilient houses is important for adherence. However, 23.3% of the households that rebuilt their disaster-destroyed houses were not aware of these regulations, 43.3% were slightly or somewhat aware of

the regulations, and only 5.1% were moderately or completely aware of them (table 9). Lack of awareness of the regulations may be the main reason that disaster-affected households do not consider or implement housing regulations and building codes in their construction. Only 9.4% received approval from local authorities for their house plans.

Table 9. Awareness of housing planning regulations

District	Not at all aware	Slightly aware	Somewhat aware	Moderately aware	Extremely aware	Don't know	No response
Batticaloa	29	110	49	11	3	42	5
Colombo	5	3	0	3	2	1	0
Matale	38	44	21	4	2	9	16
Matara	79	92	34	18	2	22	35
Polonnaruwa	54	27	1	0	0	5	56
Total	**205**	**276**	**105**	**36**	**9**	**79**	**112**

Beneficiaries' knowledge of hazard-resilient housing methods is a significant factor in determining whether they incorporate resilient features in their reconstructed houses. Of the households surveyed, 25.7% did not know about hazard-resilient housing design methods. While 30.0% knew about them, only 8.2% reported having moderate to complete knowledge; 32.4% of the households in the study did not know that draftsmen play an important role in planning and regulating housing construction (table 10).

Table 10. Awareness of hazard-resilient housing design methods

District	Not at all aware	Slightly aware	Somewh at aware	Moderately aware	Extremely aware	Don't know	No response
Batticaloa	40	102	38	17	5	25	10
Colombo	2	6	3	1	2	0	0
Matale	32	53	34	14	0	4	8
Matara	88	76	25	20	13	17	40
Polonnaruwa	45	18	2	0	0	17	63
Total	**207**	**255**	**102**	**52**	**20**	**63**	**121**

Resilient Features Incorporated in the Reconstructed Houses

The study assessed the hazard-resilient features that surveyed households had incorporated into their rebuilt houses. Raised foundations are important to keep flood water out of houses and to resist damage to other parts of houses in flood-prone areas. Table 11 shows that 63.2% of the households had raised the foundations of their rebuilt houses to some extent. Only 15.6% of the houses in this study were raised moderately to extremely to prevent water getting in. In 15.1% of houses, raised foundations were not visible, and 6.0% of the households in flood-prone areas never raised their foundations to meet the standard.

Table 11. Raised foundation of the reconstructed houses

District	Not at all	To a certain extent	To some extent	Moderately	Extremely	Not visible
Batticaloa	14	114	46	45	19	12
Colombo	4	3	5	1	1	0
Matale	7	52	22	2	0	13
Matara	8	62	37	13	11	66
Polonnaruwa	4	40	11	2	3	3
Total	**37**	**271**	**121**	**63**	**34**	**94**

A raised floor is vital in flood-prone areas that is vital to prevent extrusion of water from a house, but 10.1% of the households surveyed had not raised their floors at all, 55.7% had raised the floor to a certain extent to cope with floods, and 18.2% had raised the floor to a moderate or recommended level. Most of these houses remained prone to disasters (table 12).

Table 12. Raised floors in the reconstructed houses

District	Not at all	To a certain extent	To some extent	Moderately	Extremely	Not visible
Batticaloa	20	87	53	53	22	14
Colombo	5	2	2	1	2	2
Matale	7	47	23	4	0	13
Matara	13	66	32	13	14	70
Polonnaruwa	18	29	8	3	2	2
Total	**63**	**231**	**118**	**74**	**40**	**101**

Plinth beams are another important feature of disaster-resilient houses. They allow houses to withstand soil conditions and strengthen the foundation. Only 500 (56.8%) of the houses surveyed in this study had plinth beams, including 173 houses in Matara, 146 in Batticaloa, and 107 in Polonnaruwa; 70% of the rebuilt houses in Polonnaruwa had plinth beams, 57.9% of the houses in Batticaloa, and 56.3% of the houses in Matara.

The plinth beam was raised moderately to completely above flood level in 15.6% of the reconstructed houses surveyed, somewhat above flood level in 47.3%, not visibly above flood level in 37.1%, and to any extent in 86.5% of the houses constructed in the disaster-affected areas. Only 19.3% of the houses in this area were sufficiently raised from a moderate to extreme level, while 65.6% of the houses built on reclaimed land were raised a certain extent, and only 12.8% were raised sufficiently. There was a significant relationship between the plinth beam being above flood level and the house position (table 13).

Table 13. Plinth beam above flood level, by house location

House location	Not at all	To a certain extent	To some extent	Moderately	Extremely	Not visible
Cut slope	16	12	17	4	4	51
Reclaimed land	29	68	35	17	8	38
Close to marshy land/low-lying area	3	10	6	6	1	5
Disaster- affected site	25	75	44	36	14	13
Old landfill/pits/ quarries	3	4	3	0	0	3
Other	1	2	4	1	1	32
Total	**77**	**171**	**109**	**64**	**28**	**142**

The principle materials of the foundations, walls, floors, and roofs were analyzed to understand the strength and resiliency of the housing units reconstructed by the government. The study found that 76% of the houses used rubble or masonry for their foundations. Of these houses, the majority (76.7%) were in the rural study area. Concrete and bricks also were used by 20.7% of the sampled houses (table 14).

Table 14. Main foundation materials, by location

Location	Rubble/ masonry	Brick	Concrete	Brick/ concrete	Other
Urban	13	1	1	0	0
Semi-urban	35	11	1	0	6
Rural	412	32	55	24	14
Total	**460**	**44**	**57**	**24**	**20**

Walls were constructed with bricks and hollow cement hollow blocks in 90% of the reconstructed houses, reflecting the common production and use of these materials in Sri Lanka. This is a positive direction toward disaster resilience. However, 39% of the houses were built with pressed soil, mud, cadjan, palmyra, planks, or metal/ tin sheets, which are not resilient to disasters (table 15).

Table 15. Main wall materials, by location

Location	Brick	Kapok	Hollow cement blocks	Pressed soil blocks	Mud	Cadjan/ palmyra	Planks/ metal sheets/tin	Other
Urban	4	0	11	0	0	0	0	0
Semi-urban	22	1	22	0	0	4	6	0
Rural	322	30	153	1	13	9	6	3

Total	348	31	186	1	13	13	12	3

The main materials used for floors of the sampled houses was cement (81%), both rendered (%) and non-rendered (48%). Plastering with non-rendered cement can increase water absorption, which allows the development of a fungal layer and is therefore not disaster resilient (table 16).

Table 16. Main floor materials, by location

Location	Cement (rendered)	Cement (non-rendered)	Mud	Sand	Other
Urban	2	8	4	0	0
Semi urban	37	10	1	6	1
Rural	215	214	47	49	6
Total	**254**	**232**	**52**	**55**	**7**

Among the materials used for roofing the reconstructed houses were asbestos and roofing tiles, used in 80.3% of the houses, followed by metal or tin sheets (11.9%) and cadjan/palmyra/straw (4.7%) (table 17).

Table 17. Main roofing materials, by location

Location	Tile	Asbestos	Concrete	Metal sheets/tin	Cadjan/palmyra/ straw
Urban	1	10	1	2	0
Semi-urban	20	16	1	8	10
Rural	161	252	15	58	17
Total	**182**	**278**	**17**	**68**	**27**

Retaining walls are essential to avoid damage to houses on cut slopes or in landslide-prone areas. The study found that 53% out of 530 household responses said they had not built a retaining wall and only 5.5% of the houses had retaining walls with moderate to extreme levels. At this stage the research did not focus on the strength of the retaining walls, but only collected data on whether the houses had retaining walls (table 18).

Table 18. Retaining walls

District	Not at all	To a certain extent	To some extent	Moderately	Extremely
Batticaloa	147	27	10	10	0
Colombo	4	0	1	0	1
Matale	30	48	17	2	1
Matara	84	94	19	10	5
Polonnaruwa	18	2	0	0	0

Total	**283**	**171**	**47**	**22**	**7**

Surface area drainage systems are important to reduce landslides and decrease soil erosion. Out of 758 responses from five districts, 53% did not have surface drainage systems, and only 5.5% had surface drainage systems to a moderate to extreme extent (table 19).

Table 19. Well-connected surface drains

District	Not at all	To a certain extent	To some extent	Moderately	Extremely	No response
Batticaloa	204	20	19	2	6	2
Colombo	7	3	2	0	1	0
Matale	48	54	22	8	1	0
Matara	97	120	34	16	8	0
Polonnaruwa	47	33	4	0	0	0
Total	403	230	81	26	16	2

Sheets fastened to reapers are an important disaster-resilient housing feature, especially in areas prone to high/strong winds and cyclones. Roofs made with tin sheets/asbestos or similar roofing material need to be tied with the reapers. Out of 740 responses, 11% of houses had not tied their sheets to the reapers at all, and only 22% had fastened their sheets to the reapers to a moderate to sufficient level. All five districts in the study had a similar pattern, as there was no significant relationship in the SPSS analysis (table 20).

Table 20. Sheets fastened to the reapers

District	Not at all	To a certain extent	To some extent	Moderately	Extremely	Not visible
Batticaloa	48	28	50	48	2	34
Colombo	1	5	2	1	1	4
Matale	13	37	30	23	6	16
Matara	20	68	86	26	8	59
Polonnaruwa	3	31	36	54	0	0
Total	**85**	**169**	**204**	**152**	**17**	**113**

Properly braced roofs are more resilient to cyclones and strong winds. Of the study sample households, 19% of them had properly braced roofs, 14% had not braced the roofs at all, and in 172 houses, it could not be identified whether the roofs were properly braced. Table 21 shows that 28% of the houses reconstructed from Polonnaruwa District, 16% from Batticaloa District, 10% from Matale District, and 8% from Matara District braced their roofs properly. The variation among the districts indicates that the perception of the need to brace roofs properly differs geographically (table 21).

Table 21. Roofs properly braced

District	Not at all	To a certain extent	To some extent	Moderately	Extremely	Not visible	No response
Batticaloa	77	60	38	38	0	16	0
Colombo	5	4	0	0	0	5	0
Matale	22	47	32	12	2	17	0
Matara	23	59	36	13	10	124	1
Polonnaruwa	18	36	15	30	2	10	0
Total	**145**	**206**	**121**	**93**	**14**	**172**	**1**

Safety and Health

Disability access is an essential aspect of social inclusion and is indirectly related to vulnerability to disasters. Therefore, it is important to consider it in the reconstruction process. Table 22 shows that 45% of the study population had not included disability access in their reconstructed houses, and only 3% of households had included disability access. Of that 3%, 24 of the 25 households were from Batticaloa District.

Table 22. Disability access

District	Not at all	To a certain extent	To some extent	Moderately	Extremely	Not visible
Batticaloa	194	5	6	22	2	11
Colombo	5	1	0	0	0	0
Matale	53	2	0	0	0	63
Matara	41	3	2	1	0	208
Polonnaruwa	42	12	2	0	0	64
Total	**335**	**23**	**10**	**23**	**2**	**346**

While safe toilet waste pits are not directly related to disasters, they are important for household health. Table 23 shows that only 13% of the houses surveyed had waste pits, and 20% had no toilet waste pits at all. There was a significant variation in this indicator among the districts, with 22% of houses reconstructed in Batticaloa District and only 2.4% in Polonnaruwa District having waste pits.

Table 23. Toilet waste pits

District	Not at all	To a certain extent	To some extent	Moderately	Extremely	Not visible	Total
Batticaloa	93	40	28	50	4	30	245
Colombo	8	1	2	0	0	3	14
Matale	16	31	42	22	3	18	132

Matara	13	15	13	14	5	213	273
Polonnaruwa	31	28	21	2	1	38	121
Total	**161**	**115**	**106**	**88**	**13**	**302**	**785**

The study found that 39% of the houses reconstructed with government assistance had kitchens inside the house, while 61% had kitchens outside. Over 60% of kitchens were located inside the house in Matale and Polonnaruwa districts, but less than 30% in Matara and Batticaloa had this feature (table 24).

Table 24. Kitchen located inside the house

District	Yes	No	Total
Batticaloa	68	181	249
Colombo	7	7	14
Matale	99	35	134
Matara	57	225	282
Polonnaruwa	94	52	146
Total	**325**	**500**	**825**

5 Immediate Impact

The study identified the existing system of handling house damages, the process of reconstruction, gaps and issues for disaster resilience, and action needed to construct hazard-resilient houses. The NDRSC has already initiated the hazard-resilient model of housing construction in all districts. It expects to increase and popularize the construction of hazard-resilient houses and has tried to empower local authorities to improve and expedite the building approval process to achieve the resilient features.

Officers involved in relief activities received sound knowledge and understanding of disaster-resilient housing in the training conducted under the NDRSC. These officers could be used to monitor disaster-resilient reconstruction of houses and train grassroots-level beneficiaries.

6 Future Impact

The findings of this study can be used to revise guidelines for construction of hazard-damaged houses to incorporate disaster-resilient construction features. Sustainability may be maintained by incorporating the recommendations of the study into circulars and guidelines. This action can help move the nation from response to resilience and achieve the “Safer Sri Lanka” vision of the Ministry of Disaster Management. The long-term intended (impact) outcome is the use of government funds for efficient and effective construction of hazard-resilient houses.

7 Conclusions

Houses constructed using government funds over 5 years in the districts covered by the study were not disaster resilient. Many of the households surveyed had used materials and methods to construct floors, walls, and roofs that cannot withstand high wind and heavy rain. Most of the reconstructed houses are in areas prone to floods, landslides, and high winds.

Because of limited funds from the government, disaster-affected beneficiaries contributed labor, building materials, and money to rebuild their houses. However, about one-quarter of the households surveyed was not aware of housing construction regulations or disaster-resilient building features.

Existing guidelines should be changed to incorporate disaster-resilient construction features. These guidelines for disaster-resilient construction features, site selection, use of building materials, methods of construction, general technical knowledge, and waste management should be issued to beneficiaries of government disaster assistance and masons and laborers who are involved in construction. Indirect beneficiaries who are not eligible for house damage compensation could also be made aware of the concept of resilient houses. The officers of the NDRSC should receive more technical knowledge about resilient houses to act as change agents at the grassroots level. It is important to share the information with the SLRCS and other development partners involved in construction of disaster-damaged houses. Finally, proper monitoring and evaluation will be needed to ensure improvement in the disaster resilience of houses in disaster-prone areas.

8 Implications for the Future

The Action Plan of the Sri Lanka Comprehensive Disaster Management Plan (SLCDMP) has already incorporated provisions for further research in the issue addressed by this study. With awareness and capacity building, professionals and the wider community can adapt disaster-resilient housing models.

References

Ministry of Disaster Management, Sri Lanka. (2014). Comprehensive disaster management programme. Colombo: Ministry of Disaster Management.

National Disaster Relief Services Centre, Sri Lanka. (2012). Annual report. Colombo: Ministry of Disaster Management.

United Nations International Strategy for Disaster Reduction (UNISDR). (2009). Hyogo frame work for action 2005–2015: Building the resilience of nations and communities to disasters. Geneva: ISDR.

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No parts of this questionnaire should be modified without consent of the author

Appendix 1. Questionnaire

FISCHE # 1 **Ref No:**

Official Use Only

Interviewers Name:								Date:			
Designation:			Affiliated Agency:								
District:			Division:								
GN Division:			Village Name:								
GPS Location:	**N:**				**E:**						
Location of the land	Urban (1)		Semi Urban (Periphery)		Rural (3)		Estate (4)		Coastal (5)		
House is located on UDA declared area?	Yes (1)		No (2)								
Supervisor checked (Should be signed by a nominated Asst Director of NDRSC)											
Data entered to the system by/date											

SECTION 1 – HOUSEHOLD INFORMATION

#	***Names of all People who usually live in this household (HH)***	***Relationship to head of HH***	***Gender***	***Marital ctatus***	***Age class***	***Ethnicity***	***Religion***	***Level of education (5 years and over)***	***Employment status***	***Average monthly expenses of the HH (Rs.)***	***Duration of residence in residing GN***	***Samurdhi beneficiaries in the house (Please √)***
	1	2	3	4	5	6	7	8	9	10	11	12
1												
2												
3												
4												
5												

13. TENURE / OWNERSHIP						
13.1 Ownership the land						
13.2 Registration type of land						
13.2 Land size			13.2.1 Perches		13.2.2 Acres	
13.3 Land Value (Rs.)	13.3.1 Present value (Rs.)				13.3.2 Pre disaster Value	
14. SENTIMENTAL VALUES OF THE LAND						
14.1 Why is this land valuable for you and your family? (*Examples: Easy access to services and Facilities, infrastructure facilities, inheritances, access to livelihood etc.*)						
14.2 Are you satisfied with your current land use?	1) Not at all satisfied	2)Slightly satisfied	3)Moderately satisfied	4) Very satisfied	5) Extremely satisfied)	99) No response
14.3 Are you satisfied with your current land location?						
14.4 Are you satisfied with its land extent (size)?						
14.5 Are you satisfied with your land rights?						
15. SELLING YOUR PROPERTY						
15.1 Would you ever consider selling your land? (explain)	1) No, not considered		2) No, but considered		3) Yes	99) No response
15.2 Have you mortgaged your property? (Example, to get a loan, etc.) (Explain)	1) No, not considered		2) No, but considered		3) Yes	99) No response
15.3 Are you aware the restrictions regarding what you can do on your land? (Urban areas only) (explain)	1) Not at all aware	2) Slightly aware	3)Somewhat aware	4)Moderately aware	5)Extremely aware	99)No response

16. BASIC HOUSING CHARACTERISTICS – (house affected by disaster)

16.1 Year of construction	
16.2 Principal material of construction	
16.2.1 Wall	
16.2.2 Floor	
16.2.3 Roof	
16.2.4 Foundation	
16.3 Type of structure	
16.4 Usage	
16.5 No of Rooms	
16.6 Availability of toilet	
16.7 Type of toilet	
16.8 Source of drinking water	
16.9 Principal type of lighting	
16.10 Principal type of cooking fuel	

17. DISASTER IMPACT ON HOUSING UNIT

Impact on	**17.6 Type of damage**	**17.7 Year of impact / 17.8 -Type of disaster**					**17.9 Actual Rehabilitation cost (Rs.)**				
		2008	2009	2010	2011	2012	2008	2009	2010	2011	2012
17.1 Foundation											
17.2 Wall											
17.3 Floor											
17.4 Roof											
17.5 Other (specify.....)											
17.10 Impact on housing is assessed by? (who)		1) GN	2)TO(DSD)	3) TO(LA)		4) TO(NHDA)		5) NDRSC (DSD)		9) other	

18. RELOCATION						
18.1 Are you satisfied with the land provided by the Government to relocate?	1 (Not at all satisfied)	2 (Slightly satisfied)	3(Moderately satisfied)	4 (Very satisfied)	5 (Extremely satisfied)	99 (No response)
18.2 If you are not relocated yet, what are the reasons? (Explain)						

19. ASSISTANCES (RELIEF/COMPENSATION) PROCESS							
19.1 Who provided the assistances?	1) Own sources	2) DSD	3)NDRSC	3) Other Govt. Agency	4) NGO/INGO	5) Relatives	9) Other
19.2 Financial Assistances provided (as what)							
19.3 Who monitored the onsite construction process?							

19.4 Receipt of Cash grants:	**19.5 Date/Year**	**19.6 Amount (Rs.)**	Remarks (Please explain if the respondent is displaced multiple times during 2008-2012
19.7 1st Installment (Rs.)			
19.8 2nd Installment (Rs.)			
19.9 3rd Installment (Rs.)			

19.10 Who received the above cash grant?	1) Head of the HH	2) Member of the	9) Other (Specify)	

20. BENEFICIARY CONTRIBUTION	
20.1 Contribution provided (as what)	

20. **PERCEPTION TOWARDS DISASTERS MANAGEMENT** (Please use the scale in the column to answer the followings)	Increase substan-tially (1)	Somewhat increase (2)	No change (3)	Somewhat decrease (4)	Substantially decrease (5)	Don't know (6)	No response (99)
20.1 *How great is the threat of disasters in your location?*							
20.2 *Are there any effective local early warning systems in place? (Systems which alert all sections of the community?*							
20.3 *Are there effective DM coordination systems in place? (Systems which could coordinate all the stakeholders*							
20.4 Do the preparedness measures have been identified?							
20.5 Do the stakeholders in the area identified mitigations measures?							
20.6 Are you aware of hazard-resilient housing design methods and construction?							
20.7 Do you know any craftsman's who aware the designs and							

20.8 If you wanted to incorporate hazard resilient features into your							

22. CHECKLIST (Condition of the present house built/repaired or reconstructed after the disaster) – observe and ask questions as relevant

#	Item/Description						
22.1	**Conformity to regulations:**						
22.1.1	Are you aware of the housing and planning regulations?	1) Not at all aware	2) Slightly aware	3)Somewhat aware	4)Moderately aware	5)Extremely aware	99)No response
22.1.2	Was the house plan approved by the LA (for urban areas only)?	1)Yes	2)No				
22.1.3	Have you considered the clearances from other relevant Authorities (NBRO, CEA, RDA, SLLRDC, CCD, DoA, etc., if applicable)?	1) Not at all considered	2) Slightly concerned	3) Somewhat concerned	4) Moderately	5) Extremely concerned	99)No response
22.1.4	The square area of the house meets at least 500ft^2 minimum.	1)Yes	2)No				
22.1.5	The house has at least one lockable room (with door) (minimum area should be 11m2 and 3m width).	1)Yes	2)No				
22.1.6	The sizes and heights of rooms (internal) conformity with UDA regulations (2.4 m at mid-point and the lowest height at any point should be 2.1 m).	1)Yes	2)No				
22.1.7	Is there land to expand the house horizontally or vertically?	1) No, not at all	2) To a certain extent	3) Yes. To some extent	4) Yes, Moderately	5) Yes. Extremely	99) Not visible
22.1.8	A minimum width of 3 m is available for access.	1)Yes	2)No				
22.2	**Plot:**						
22.2.1	The plot size conforms to the minimum statutory requirement (150m^2 = 6 perches); 1 perch=25.3m^2.	1)Yes	2)No				
22.2.2	The rear space (2.25m) and space in front (3m) conform to regulations (urban areas).	1)Yes	2)No				
22.2.3	Surface water does not stagnate within the plot	1) Never	2) Rarely	3) Occasionally	4) A moderate	5) A great deal	99)No response
22.2.4	The plot boundaries are clearly defined by markers/posts/fences/walls etc.	1) Never use	2) Almost never	3) Occasionally	4) Almost every time	5) Frequently	6) Not visible

#	Item/Description						
	Please use the scale in the column to answer the followings:	***1) No, Not at all***	***2) To a certain***	***3) Yes. To some extent***	***4) Yes, Moderately***	***5) Yes. Extremely***	***6) Not visible***
22.2.5	Retaining walls are properly constructed for proper drain off (only for cut slope and landslide areas).						
22.2.6	Well-connected surfaces drainage systems are present.						
22.2.7	Proper waste water disposal system are present.						
22.2.8	Soil erosion control are present.						
22.3	**Site:**						
22.3.1.	House is positioned on….	1) Cut slope	2) reclaimed land	3) close to a marshy land/low lying area	4) on disaster affected site	5) old landfill/ pits/quarries	9)Other
22.3.2	Orientation of the house is positioned to reduce the impact of	1) Floods	2) Landslides	3) Cyclone/high winds	4) other	5) Don't know	99)No response
22.3.3	Adequate safe space provided between the house and the cut slope. (The minimum distance shall be equal to the height of the retaining wall, if present) – (applicable only for landslide/cut slope)	1)Yes	2)No				
22.3.4	No branches or bushes touching house or overhanging the	1)Yes	2)No				
	Please use the scale in the column to answer the following:	***1) No, Not at all***	***2) To a certain***	***3) Yes. To some extent***	***4) Yes, Moderately***	***5) Yes. Extremely***	***6) Not visible***
22.4	**Land preparation:**						
22.4.1	Minimal disturbance to ground and supported cuts to retain slopes						
22.5	**Foundation:**						
22.5.1	Raised floor level (refer design drawings if available)						
22.5.2	Raised foundation						
22.5.3	No cracks in the plinth, below windows at openings on external walls at corners						
22.5.4	Top plinth is above the known flood level (apply only for flood prone areas)						

#	Item/Description						
22.5.5	There is a plinth beam at least 450 mm above ground level.	1)Yes	2)No				
	Please use the scale in the column to answer the followings:	***1) No, Not at all***	***2) To a certai n***	***3) Yes. To some extent***	***4) Yes, Moderately***	***5) Yes. Extremely***	***6) Not visible***
22.5.6	There is no sign of rising dampness						
22.6	**Superstructure:**						
22.6.1	Framed structure with reinforced concrete columns (refer to design drawings if available)						
22.6.2	Beams are free of structural cracks						
22.6.3	Columns are free of structural cracks						
22.6.4	Re enforced concrete slabs (roof) are free of structural cracks						
22.6.5	Re enforced concrete slabs (floor) are free of structural cracks						
22.6.6	Re enforced concrete plinth beam included (for house in coastal zone)						
22.6.7	Re enforced concrete ring beam included (for house in cyclone prone area)						
22.6.8	The load bearing walls on upper floor have adequate structural support						
22.6.9	Gable band provided along top of gable wall to provide strength						
22.7	**Walls:**						
22.7.1	Walls are provided with proper framing.						
22.7.2	Walls arecstiffened at openings using lintel/sill beams.						
22.7.3	Walls are of adequate thickness – 200mm (exterior), 150 mm	1)Yes	2)No				
	Please use the scale in the column to answer the Following:	***1) No, Not at all***	***2) To a certain extent***	***3) Yes. To some extent***	***4) Yes, Moderately***	***5) Yes. Extremely***	***6) Not visible***
22.7.4	Walls are free of structural cracks; (diagonal, vertical, horizontal).						
22.8	**Floor**						
22.8.1	Floor is free of structural cracks.						
22.8.2	Floor areas are properly level.						
22.8.3	Toilet/bathroom floors are properly sloped to effectively drain surface water.						

#	Item/Description						
22.8.5	Parts of floors do not produce a hollow sound when tapped.						
22.8.9	Maximum Floor Area Ratio (FAR) conforms with regulations (for UDA area it shall be 412.5 m^2 for 6 perch land).	1)Yes	2)No				
	Please use the scale in the column to answer the Following:	***1) No, Not at all***	***2) To a certain extent***	***3) Yes. To some extent***	***4) Yes, Moderately***	***5) Yes. Extremely***	***6) Not visible***
22.9	**Roof**						
22.9.1	Roof structure is connected to the main structure.						
22.9.2	Properly connected gable wall to structure and roofing to gable wall.						
22.9.3	Roof covering properly connected to roof structure.						
22.9.4	Pitch of the roof is in accordance with recommended standard for roof type (tile: >20˚ asbestos: >10˚).	1)Yes	2)No				
	Please use the scale in the column to answer the Following:	***1) No, Not at all***	***2) To a certain extent***	***3) Yes. To some extent***	***4) Yes, Moderately***	***5) Yes. Extremely***	***6) Not visible***
22.9.5	Roof does not dip.						
22.9.6	Roof trusses are properly braced (if the location is in cyclone prone areas, inspect carefully).						
22.9.7	Roof components (roofing material, purlins, rafters, wall plate) are firmly fastened to each other.						
22.9.8	Roofing sheets/tiles are properly lapped in both directions						
22.9.9	Roofing sheets are properly bolted at the crown (not valley) of corrugations to supporting purlins.						
22.9.10	All timber roof members are in good quality duly treated or painted.						
22.9.11	No evidence of water leaks at the roof, at valley gutters and other locations.						
22.9.12	Sheets are fastened to the reapers at every 1.5m or closer spacing in both directions.						
22.9.13	Minimum 3 no's of GI "J" bolts were fixed per purlin per sheet	1)Yes	2)No				
22.9.14	Mortar restraining bands were provided at 1.2m intervals at gable ends and 1.5 m intervals at elsewhere.	1)Yes	2)No				

#	Item/Description						
	Please use the scale in the column to answer the followings:	***1) No, Not at all***	***2) To a certain extent***	***3) Yes. To some extent***	***4) Yes, Moderately***	***5) Yes. Extremely***	***6) Not visible***
22.10	**Fixings**						
22.10.1	Door and window frames properly anchored to structure						
22.10.2	Timber frames and sashes are free of cracks and sapwood						
22.10.3	Timber frames & sashes are free of rot, insect attack, and decay/deterioration						
22.10.4	Door and window shutters are not excessively warped						
22.10.5	Doors and windows open and shut without getting stuck						
22.10.6	No evidence of dampness in walls due to leaks in embedded pipes						
22.10.7	Waste water lines are correctly sized and fitted						
22.10.8	Clearances from electrical lines (high tension – 4.5 m & low tension 2.5m from the roof top)	1)Yes	2)No				
22.10.9	Clearances from electrical lines (high tension – 2.5 m & low tension 1.5m from the roof edge)	1)Yes	2)No				
	Please use the scale in the column to answer the followings:	***1) No, Not at all***	***2) To a certain extent***	***3) Yes. To some extent***	***4) Yes, Moderately***	***5) Yes. Extremely***	***6) Not visible***
22.10.10	Earthing or grounding of equipment is present (surge Protection/lightning attester).						
22.10.11	Fuses or circuit breakers (such as the Miniature Circuit Breaker – MCB) are installed.						
22.11	**Safety and health**						
22.11.1	Disability access has been provided to house and all rooms (If a member of the family is disabled).						
22.11.2	Toilet/waste water pits comply with the standards (at least 18 m away from a well or other drinking water source; at least 5 m from the nearest building; at least 10–20 m from any other soakage pit).						
22.11.3	Is the kitchen located inside the house?	1) Yes	2) No				
22.11.4	The toilet is attached,	1) Yes	2) No				

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No parts of this codes should be modified without consent of the author

Codes for columns 2–11

Column 2 - *Relationship to the head of HH*	**Code**	**Column 3 - Gender**	**Code**	**Column 4 - *Marital status***	**Code**	**Column 5 - *Age class***	**Code**	**Column 6 - *Ethnicity***	**Code**
Head of the HH	1	Male	1	Never married	1	>5	1	Sinhalese	1
Wife/husband	2	Female	2	Married (registered)	2	5-18	2	Sri Lanka Tamil	2
Son/daughter	3	Did not respond	99	Married (customary)	3	19-59	3	Indian Tamil	3
Son/daughter in law	4			Widowed	4	60 & Above	4	Sri Lanka Moor	4
Grandchild	5			Divorced	5	Did not respond	99	Malay	5
Parents	6			Legally separated	6			Burgher	6
Other relative	7			Separated (not legally)	7			Sinhalese (Indigenous)	
Domestic servants	8			Did not respond	99			Other	9
Boarder	10							Did not respond	99
Other	9								
Did not respond	99								
Column 7 - *Religion*	**Code**	**Column 8 - *Level of education (5 years and over)***			**Code**	**Column 9 – *Employment status***	**Code**	**Column 10 - *Average Monthly expenses of the HH (Rs.)***	**Code**
Buddhist	1	Never Attained			1	Government employee	1	Less than 3,000	1
Hindu	2	Up to Grade 1			2	Semi-government employee	2	Between 3,000 and 7,500	2
Islam	3	Up to Grade 2			3	Private sector employee	3	Between 7,500 and 10,000	3
Roman Catholic	4	Up to Grade 3			4	Self-employee	4	Between 10,000 and 15,000	4
Other	9	Up to Grade 4			5	Employer	5	Between 15,000 and 20,000	5
Did not respond	99	Up to Grade 5			6	Unpaid family worker	6	Between 20,000 and 25,000	6
		Up to Grade 6			7	Pensioner	7	Above 25,000	7
Column 11 - *Duration of residence in this land*	**Code**	Up to Grade 7			8	Other	9	Did not respond	99
Since birth	1	Up to Grade 8			10	Did not respond	99		
Less than 1 year	2	Up to Grade 9			11				
Less than 5 years	3	Passed GCE – O/L			12				
Less than 10	4	Passed GCE – A/L & above			12				
Above 10 years, but not since birth	5	Special education Unit			13				
		Did not respond			99				

Question 13.1 – Ownership	Code	Question 13.2 – Registration type	Code
Owned by the head of HH	1	Paraweni (fully owned)	1
Owned by a member of HH	2	Viharagam/Dewalagam	2
Rent free	3	Jayaboomi/Isurboomi/Swarnaboomi/Ranbima	3
Rent/lease	4	Other (specify) ……..	9
Permit land	5	Did not respond	99
Encroached	6		
Other (specify) ……..	9		
Did not respond	99		

Codes for question 16.2.1 to 16.10 & 19.2 and 19.3

Q: 16.2.1	Code	Q: 16.2.2	Code	Q: 16.2.3	Code	Q: 16.2.4	Code	Q: 16.3	Code
Brick	1	Cement (rendered)	1	Tile	1	Rubble/masonry	1	Single house	1
Kapok	2	Cement (non-rendered)	2	Asbestos	2	Bricks	2	Annex	2
Hollow cement blocks	3	Mud	3	Concrete	3	Concrete	3	Row house	3
Pressed soil blocks	4	Wood	4	Metal sheet/tin	4	Brick/concrete	4	Hut/shanty	4
Mud	5	Sand	5	Cadjan/palmyra/straw)	5	Other (specify)	9	Other (specify)	9
Cadjan/palmyra	6	Other (specify)	9	Other (specify……..	9	**Q: 16.7**	Code	**Q: 16.8**	**Code**
Plank/metal sheet/tin	7	**Q: 16.5**	**Code**	**Q: 16.6**	**Code**	Water seal	1	Protected well within the plot	1
Other (specify)	9	One	1	Exclusively for the HH	1	Pour flush	2	Protected well outside the plot	2
Q: 16.4	**Code**	More than one	2	Not having a toilet but sharing with another HH	2	Pit	3	Unprotected well	3
Residential only	1			Not having a toilet but sharing with another HH	3	Bucket	4	Tube well	4
Residential/commercial	2			Common/public toilet	4	Other (specify)	9	Main line (NWSDB)	5
Other (specify)	9			Other (specify)	9			Tank/river/canal	6
Q: 16.9	**Code**	**Q: 16.10**	**Code**	**Q. 19.2**	**Code**	**Q. 19.3**	**Code**	Other (specify)	9
National grid (electricity)	1	Firewood	1	Cash - direct	1	TO (DSD)	1		
Electricity (mini hydro)	2	Gas	2	Cash thru (bank)	2	TO(LA)	2		
Kerosene oil	3	Kerosene	3	In kind contribution	3	TO (NHDA)	3		
Solar	4	Electricity	4	Labor (unpaid)	4	GN	4		
Generator	5	Sawdust/paddy	5	Labor (aid)	5	NDRSC officer	5		
Other (specify)	9	Other (specify)	9	Other (specify)	9	Other (specify)	9		