

**A FRAMEWORK FOR CRITICAL INFRASTRUCTURE
MANAGEMENT WITH THE FOCUS ON DISASTERS:
CASE STUDY APPROACH**

Pitigala Liyana Arachchi Ishani Shehara

(198017F)

Degree of Master of Philosophy

Department of Civil Engineering

University of Moratuwa

Sri Lanka

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Thesis submitted in partial fulfilment of the requirements for the degree Master of
Philosophy in Civil Engineering

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DECLARATION

I would like to declare that this work is my own research proposal and this proposal does not include without acknowledgment of any material which have previously published or submitted for a Degree or Diploma in any other university or institute of higher learning and to the best of my knowledge and believe it does not comprise of any material previously published or written by another person except where the acknowledgment is made in the text.

Signature:

Date:

UOM Verified Signature

.....10.10.2022.....

P.L.A.I. Shehara

I have supervised the research study of the above mentioned candidate

Signature of the Supervisor(s):

Date:

UOM Verified Signature

20/10/2022

.....

Dr. C.S.A. Siriwardana

ABSTRACT

The significance of Critical Infrastructure and the important focus to enhance their level of resilience capacity is defined by the Sendai Framework for Disaster Risk Reduction developed for 2015-2030. Furthermore, Goal 9 defined by the Sustainable Development Goals calls for creating resilient infrastructure and enhancing their capacity level. Accordingly, the resilience enhancement of the Critical Infrastructure can be delivered by elements of Multi-Hazard Early Warning, which is a strategical concept of Disaster Risk Reduction mechanism. This strategical integration to resilience enhancement can be more effective with the novel technological implementation of Early Warning dissemination. In the research study, main concern is towards development of a strategical resilience assessment framework for Critical Infrastructure management in Sri Lanka. Along the focused research scope, the Transportation Infrastructure sector was focused on framework development. Transportation sector has a wide concern in which their performance on operation depends highly on the level of capability of adapting and recovering from a disaster incident.

From the global level developed frameworks, the Australian Critical Infrastructure Resilience Strategy was identified as the basis for the resilience framework development. Based on this framework the integration of community, organizational and technical infrastructure resilience aspects were identified as the key basis. From the initial literature review, the parameter identification was undertaken and initial parameter selection was undertaken. Here, the community resilience aspects were determined through field survey in which overall 393 responses were collected. The organizational resilience aspects were determined through telephone interviewing in which 1004 responses were collected. The technical infrastructure resilience aspects were determined using field studies and focus group meetings. The identified parameter from the literature review and the initial literature survey was categorized and filtered under the expert opinion survey. For the quantification of the resilience capacity, the quantification of each of indicator aspects were considered. Here, the Analytical Hierarchical Process was applied to capture the weights for the each

identified parameter through expertise determination. Through this, the relationships among each variable aspects were considered for the determination of resilience level. With this, the applicability was determined using a case study in Amaragedara South Grama Niladari division in Bulathsinhala Divisional Secretariat division. The key summary output of the framework implication in regional level aspects can be incorporated into the planning stage of the Disaster Management system in the country.

Key Words: Critical Infrastructure (CI), Natural hazards, Resilience, Transportation sector, Multi-Hazard Early Warning (MHEW)

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TABLE OF CONTENTS

List of Figures.....	xii
List of Tables.....	xvii
List of Abbreviations.....	xxii
1 Introduction & Thesis structure.....	1
1.1 Background Overview.....	1
1.1.1 Introduction.....	1
1.1.2 Disaster Damage to Critical Infrastructure at Global Level.....	4
1.1.3 Disaster Damage to Critical Infrastructure at Sri Lankan Level.....	8
1.1.4 Disaster Management Concern in Critical Infrastructures.....	11
1.1.5 Critical Infrastructure Resilience.....	12
1.2 Research Problem.....	13
1.3 Research Scope.....	15
1.4 Objectives.....	18
1.5 Research Significance.....	19
1.6 Thesis Outline.....	20
2 Literature Review.....	21
2.1 Significance of Critical Infrastructure.....	21
2.2 Understanding Critical Infrastructure Resilience.....	25
2.3 Global Frameworks Related to Resilience of Critical Infrastructure.....	27
2.4 Disaster Risk Reduction Strategies.....	30
2.5 Multi-Hazard Early Warning Mechanism.....	31
2.6 Technological influence in incorporating DRR strategies.....	33

2.7	Concern on Resilience Aspects of Critical Infrastructure with DRR Concepts	39
2.8	Community Resilience.....	40
2.8.1	Introduction to Community Resilience.....	40
2.8.2	Significance of Community Resilience.....	41
2.8.3	Community Resilience Assessment Frameworks.....	42
2.9	Organizational Resilience.....	45
2.9.1	Introduction to Organizational Resilience.....	45
2.9.2	Importance of Organizational Resilience.....	46
2.9.3	Organizational Resilience Assessment Frameworks.....	47
2.10	Transportation Infrastructure Resilience.....	48
2.10.1	Introduction to Transportation Infrastructure Resilience.....	48
2.10.2	Importance of Transportation Infrastructure Resilience.....	49
2.10.3	Transportation Infrastructure Resilience Assessment Frameworks....	53
2.10.4	Identification of Parameters in the Planning Stage of Transportation Infrastructure.....	58
2.10.5	Identification of Parameters in the Designing Stage of Transportation Infrastructure.....	61
2.10.6	Identification of parameters in the Operations and Maintenance Stage of Transportation Infrastructure.....	66
2.11	Approaches for the Quantification of Resilience Capacity.....	68
2.11.1	Weighted Sum Model (WSM).....	69
2.11.2	Analytical Hierarchical Process (AHP).....	70
2.11.3	Analytical Network Process (ANP).....	72
2.11.4	Fuzzy set theory.....	73
2.11.5	Summary.....	74

3	Methodology.....	75
3.1	Introduction.....	75
3.2	Examining the Community Resilience Level through Community Field Survey.....	77
3.2.1	Questionnaire Survey Development	77
3.2.2	Study Area Selection and Sample Selection	77
3.2.3	Field Data Collection	81
3.2.4	Analysis of the Collected Data	82
3.3	Examining the organizational resilience level through the First Responder Survey.....	122
3.3.1	Introduction.....	122
3.3.2	Selection of the Sample	122
3.3.3	Questionnaire Survey Development	123
3.3.4	Data Collection	123
3.3.5	Overall Response Summary.....	124
3.3.6	Stakeholder Analysis and Prioritization.....	127
3.3.7	Examining the Stakeholder Perception Level.....	148
3.3.8	Identification of Stakeholder Behaviour	163
3.3.9	Identification of Key Stakeholders	181
3.4	Examining Existing Mechanisms for Critical Infrastructure Management	190
3.4.1	Identification of Dependencies and Interdependencies	190
3.4.2	Identification of Critical Infrastructure affecting from Floods	191
3.4.3	Identification of Infrastructure Dependencies and Interdependencies	192

3.4.4	Development of Causal Loop Diagrams for Selected Critical Infrastructure Systems	194
3.5	Case Study Overview on Transportation Infrastructure Resilience Strategies in Sri Lanka	198
3.5.1	Infrastructure Planning Stage.....	198
3.5.2	Infrastructure Designing Stage.....	199
3.5.3	Infrastructure Operations and Maintenance Stage	201
3.6	Framework Development to Integrate CI Management through DRR Strategies	202
3.6.1	Introduction.....	202
3.6.2	Infrastructure Resilience Frameworks for Transportation Sector.....	203
3.6.3	Community-Based Resilience Parameters	205
3.6.4	Parameters Determining the Organizational Resilience	208
3.6.5	Parameters Determining the Infrastructure Resilience	211
3.6.6	Outline of the Framework.....	216
3.6.7	Pilot Opinion Survey.....	219
3.6.8	Identification of Systematic Behaviour of the Parameters	221
3.7	Resilience Capacity Quantification	228
3.7.1	Determination of Measurable Scale.....	228
3.7.2	Evaluation of Resilience Measures through the Analytical Hierarchical Process	249
3.7.3	Determination of Resilience Score	259
4	Discussion.....	265
4.1	Introduction.....	265
4.2	Examining the Applicability with Case Studies	268
4.3	Further Research Focus	277

5	Conclusion.....	278
6	Recommendations	280
7	Limitations.....	281
8	References	282
	Annex 1: Hazard matrix	310
	Annex 2: Community field survey	318
	Annex 3: Summary of responses analysed through community field survey	321
	Annex 4: Flow chart development	327
	Annex 5: Questionnaire survey-first responders	328
	Annex 6: Sample detailed ahp evaluation sheet	333
	Annex 7: Sample detailed calculation for weight determination	341

LIST OF FIGURES

Figure 1. Variation of Natural Hazards each year	1
Figure 2. Reported Mortality based on disaster category	3
Figure 3. Damage to Education Facilities due to Natural Hazards	6
Figure 4. Damage to Road sector due to Natural Hazards	7
Figure 5. Damage to Health Facilities due to Natural Hazards	8
Figure 6. Comparison of CI damages in 2016 and 2017	9
Figure 7. Damage to Mahamodara Teaching hospital by 2004 Indian Ocean Tsunami incident	10
Figure 8. Peraliya railway damage	10
Figure 9. Overview of Sendai Framework for Disaster Risk Reduction.....	12
Figure 10. Damage to roads in Southern province from 2021 floods	16
Figure 11. Damage to road segments in Pitigala, Southern province in May, 2021 floods	16
Figure 12. Damage road segments in Batticaloa and Ampara from 2004 Indian Ocean Tsunami	16
Figure 13. Damage on Southern Expressway due to landslides.....	17
Figure 14. Infrastructure criticality hierarchy	21
Figure 15. Example of inter-dependencies among CI sectors	23
Figure 16. Different dimensions of resilience	26
Figure 17. The resilience life cycle during a disaster	26
Figure 18. Defining Infrastructure Resilience concept.....	27
Figure 19. Australian Critical Infrastructure Resilience Strategy	29
Figure 20. Critical Infrastructure Resilience strategy.....	30
Figure 21. Responses on most modes of receiving Early Warning alerts in Tsunami	33
Figure 22. Digital Platform Usage	34
Figure 23. Usage of Twitter in past disaster incidents	35
Figure 24. Representation of Technological Platforms with the Past Disaster Incidents	38

Figure 25. Basic elements of community resilience.....	40
Figure 26. Community Resilience aspects	41
Figure 27. CoBRA conceptual framework.....	43
Figure 28. Community resilience framework in Sri Lanka.....	44
Figure 29. Organizational resilience conceptual representation.....	45
Figure 30. Organizational resilience conceptual model	46
Figure 31. Resilience principle.....	48
Figure 32. Inter dependencies among transportation infrastructure with other infrastructure sectors	50
Figure 33. Pavement deterioration due to high temperature	50
Figure 34. Damaged Road Network in Dominica following 2017 Hurricane Irma ..	51
Figure 35. Damage to Biloxi-Ocean Springs Bridge from 2005 Hurricane Katrina.	51
Figure 36. Damage to ramp in Mobile Bay and Pascagoula, Mississippi from 2005 Hurricane Katrina	51
Figure 37. New Zealand resilience framework	54
Figure 38. The FHWA resilience framework.....	55
Figure 39. The PIARC framework	56
Figure 40. AASHTO framework.....	57
Figure 41. Benefits of increasing resilience planning	58
Figure 42. Resilience planning process	59
Figure 43. Evacuation zone maps-Milnthorpe	59
Figure 44. Evaculane shoulder pavement markings and signage in Texas	60
Figure 45. Asset criticality and exposure maps.....	60
Figure 46. Cement concrete geo-cell pavements	61
Figure 47. Before and after conditions of placing cement concrete geo-cell pavement	61
Figure 48. Raised seawall acting as a flood barrier	62
Figure 49. Application of Geo-synthetic Reinforced Soil (GRS) technology Abutment for Bridges	63
Figure 50. Typical geo grid for use in bridge construction	63
Figure 51. Geo-synthetic Container Revetment	63

Figure 52. Rock Revetment	64
Figure 53. Slope stabilization technique	64
Figure 54. Sea wall construction in Bahamas	64
Figure 55. Vegetated berms	65
Figure 56. Flood protection wall	65
Figure 57. Raised roads in Sunset Harbor, Miami Beach, FL.....	65
Figure 58. Pavement maintenance life cycle	66
Figure 59. Design of drainage channel to divert the waterway	68
Figure 60. Debris screen at culvert in Norway	68
Figure 61. Rating scale for the AHP comparison	71
Figure 62. The ANP structure (Büyüközkan et al., 2004).....	73
Figure 63. Basic approach of the research study.....	76
Figure 64. Main districts of the study locations	79
Figure 65. Bulathsinhala DS division.....	80
Figure 66. Wattala DS division	80
Figure 67. Colombo DS division.....	80
Figure 68. Data collection during community field survey.....	82
Figure 69. Gender profile	83
Figure 70. Category of age distribution.....	83
Figure 71. Occupation category	84
Figure 72. Triangular fuzzy number.....	91
Figure 73. Summary of the methodology.....	91
Figure 74. Parameters considered community trust level	92
Figure 75. Community trust level variation	96
Figure 76. Most trusted authorities responsible for EW dissemination	97
Figure 77. Most trusted authority based on the age category	98
Figure 78. Authority trust level based on the age.....	98
Figure 79. Efficient modes of EW dissemination	117
Figure 80. Community response based on gender categorization.....	117
Figure 81. Information flow in MHEW mechanism	122
Figure 82. An overview of telephone survey	123

Figure 83. Overall response rate.....	124
Figure 84. Gender category variation	125
Figure 85. Age category variation	126
Figure 86. Outline of the questionnaire survey	133
Figure 87. Location distribution of responders	135
Figure 88. Mapping of the first responder categories.....	141
Figure 89. Top prioritized categories of stakeholders	145
Figure 90. Overview of MHEW dissemination mechanism	151
Figure 91. Polynomial relationship among the variables	160
Figure 92. Approach to develop the conceptual framework	164
Figure 93. Relationship among the stakeholder levels and the activity list concentration	171
Figure 94. Initial conceptual framework development.....	172
Figure 95. Ideal conceptual model development.....	173
Figure 96. Conceptual model application for Indian Ocean Tsunami incident.....	175
Figure 97. Conceptual model application on Meethotamulla garbage dump collapse	176
Figure 98. Conceptual model application on cyclone Fani	177
Figure 99. Methodology for the Identification of Key Stakeholders	183
Figure 100. Communication network model developed for droughts.....	185
Figure 101. Communication network model for Tsunami	186
Figure 102. Communication network model for landslides	186
Figure 103. Communication network model for floods	187
Figure 104. Communication network model for cyclones	187
Figure 105. Top ranked stakeholders based on centrality values	188
Figure 106. Network model developed with the for Tsunami based on SOPs.....	188
Figure 107. Methodological approach.....	191
Figure 108. Impact on Telecommunication system failure	194
Figure 109. Impact on Transportation system failure	195
Figure 110. Impact on Health system.....	195
Figure 111. Impact on Emergency Services.....	195

Figure 112. Impact on Water supply system	196
Figure 113. Impact on Electrical power system	196
Figure 114. Impact on whole CI system.....	197
Figure 115. Landslide hazard zonation map	198
Figure 116. Evacuation routes and places in Galle	199
Figure 117. Landslide protection barriers, Southern Province, Sri Lanka	199
Figure 118. Landslide mitigation measures in Badulla area	200
Figure 119. Resilient culvert designs at the Southern Expressway	200
Figure 120. Drainage paths at the slopes	201
Figure 121. Routine maintenance in Southern Expressway	201
Figure 122: Basic outline of the framework.....	203
Figure 123. Causal Loop Diagram for community resilience parameters.....	223
Figure 124. Causal Loop Diagram for organizational resilience parameters	225
Figure 125. Causal Loop Diagram for infrastructure resilience parameters	227
Figure 126. Competence level of evaluators	250
Figure 127. Decision making scale for resilience level.....	263
Figure 128. Main road distribution in Amaragedara South GN division	269
Figure 129. Main road distribution in Bulathsinhala DS division.....	270
Figure 130. Field examination.....	271
Figure 131. Decision making scale for resilience level in Amaragedara South GN division	276

LIST OF TABLES

Table 1. Overview of the destruction caused by recent disaster incidents	2
Table 2. Disaster Damages to Critical Infrastructure	5
Table 3. Critical Infrastructure damages in 2017 landslides	8
Table 4. Transportation infrastructure asset classification	17
Table 5. National definitions of Critical Infrastructure	22
Table 6. Critical Infrastructure sector identification	24
Table 7. Critical Infrastructure Resilience (CIR) definitions	25
Table 8. Global frameworks on CI resilience.....	28
Table 9. Usage of modern platforms	37
Table 10. Summary of Community Resilience Assessment Frameworks	42
Table 11. Summary of Organizational Resilience assessment frameworks.....	47
Table 12. Climate change impacts.....	49
Table 13. Disaster damage to the transportation infrastructure system.....	52
Table 14. Transportation infrastructure resilience assessment frameworks.....	53
Table 15. Example inspection program.....	67
Table 16. Types of condition surveys.....	67
Table 17. Numeric comparison scale	70
Table 18. Number of Comparisons	71
Table 19. Random Consistency Index (RI) values	72
Table 20. Question classification	77
Table 21. Study area selection matrix	78
Table 22. Summary of Responses	82
Table 23. Information on disasters	87
Table 24. Overview of parameters	88
Table 25. Research Approaches	89
Table 26. Case Processing Summary	92
Table 27. Fuzzy Correspondences	93
Table 28. Frequency Table	93
Table 29. Average of the Weighted Score value.....	94
Table 30. Population density	94

Table 31. Rural and Urban Level – Decision Matrix	95
Table 32. Variation patterns of the trend lines	95
Table 33. Authority trust level.....	99
Table 34. User Interaction Level	102
Table 35. Disaster focused Mobile Applications	103
Table 36. Mobile applications in Maldives, Sri Lanka and Indonesia	105
Table 37. Population Densities.....	106
Table 38. Software summary.....	107
Table 39. Fuzzy correspondence values	107
Table 40. Frequency table – Level of usefulness	108
Table 41. Average weighted score value.....	108
Table 42. Decision matrix	109
Table 43. Frequency table	109
Table 44. Average Weighted Score value	110
Table 45. Decision matrix	110
Table 46. Overview of Communication Modes	114
Table 47. Key Parameters of Early Warning Mechanism	115
Table 48. Internal Consistency Determination	116
Table 49. Classification of urban and rural level basis	118
Table 50. Response based on Urban and Rural level	118
Table 51. Calculation method of Mean score and sentiment score.....	119
Table 52. Perception mean score determination.....	120
Table 53. Sentiment mean score determination	120
Table 54. Decision making summary.....	121
Table 55. List of parameters checked through the survey.....	123
Table 56. District coverage of the responders	124
Table 57. Occupation category variation.....	126
Table 58. Stakeholder classification models	129
Table 59. Stakeholders related to Disaster Management mechanism	131
Table 60. Criteria selection	132
Table 61. Systematic random sampling.....	134

Table 62. The response rate of the questionnaire survey	135
Table 63. The rating scale for the parameters	136
Table 64. Categorization basis	138
Table 65. Case processing summary	139
Table 66. Reliability statistics	139
Table 67. Internal consistency acceptable ranges.....	140
Table 68. Fuzzy operations.....	143
Table 69. Fuzzy operations model.....	143
Table 70. Setting fuzzy prioritization	143
Table 71. Topmost prioritized first responders with the highest frequency level ...	147
Table 72. Key stakeholder categories and their responsibilities	149
Table 73. Research based approaches	153
Table 74. Definition of the indicators.....	154
Table 75. Parameters examined through the questionnaire.....	154
Table 76. Mean score determination	158
Table 77. Sentiment score determination	158
Table 78. Decision making consideration	159
Table 79. Patterns of the trend lines	159
Table 80. Trust behaviour variation comparison.....	161
Table 81. Developed Conceptual frameworks related to Disaster Management	165
Table 82. Definition of the terms	166
Table 83. Stakeholder categorization	168
Table 84. Identified authorities in each of the stakeholder levels	169
Table 85. Activity list based on different stakeholder levels in Disaster Management Cycle	170
Table 86. Expertise Background	178
Table 87. Network characteristics	182
Table 88. Identified stakeholders for each category.....	184
Table 89. Identified Critical Infrastructure affected by floods.....	192
Table 90. Dependencies and interdependencies of Critical Infrastructure systems in terms of damage incurring.....	193

Table 91. List of Transportation Infrastructure resilience frameworks.....	204
Table 92. Extent of community resilience parameters	205
Table 93. Community resilience parameters	207
Table 94. Organizational resilience parameters	209
Table 95. Organizational resilience parameters	210
Table 96. Infrastructure resilience parameters	214
Table 97. Framework Summary	216
Table 98. Expertise background	220
Table 99. Community information sharing rating scale	229
Table 100. Rating scale for reducing service disruptions.....	230
Table 101. Rating scale for managing service disruptions.....	231
Table 102. Rating scale for community partnerships	232
Table 103. Rating scale for emergency preparedness	234
Table 104. Rating scale for strong relationships	236
Table 105. Rating scale for effective risk management	237
Table 106. Rating scale for improved planning	238
Table 107. Rating scale for infrastructure planning	240
Table 108. Rating scale for infrastructure designing.....	242
Table 109. Rating scale for infrastructure operations and maintenance	245
Table 110. Collection details	249
Table 111. Parameters used in the consistency check.....	251
Table 112. Consistency determination from rating scale	251
Table 113. Consistency determination	251
Table 114. Weights for community information sharing parameters.....	253
Table 115. Weights for reducing service disruptions parameters	253
Table 116. Weights for managing service disruptions parameters.....	253
Table 117. Weights for community partnerships parameters.....	254
Table 118. Weights for community resilience parameters	254
Table 119. Weights for emergency preparedness parameters	255
Table 120. Weights for effective risk management parameters	255
Table 121. Weights for improved planning parameters	256

Table 122. Weights for response and recovery parameters.....	256
Table 123. Weights for organizational resilience parameters	256
Table 124. Weights for infrastructure planning parameters	257
Table 125. Weights for infrastructure designing parameters	257
Table 126. Weights for infrastructure operations and maintenance parameters	258
Table 127. Weights for parameters for infrastructure resilience.....	259
Table 128. Rating scale definition.....	264
Table 129. Community resilience weights	266
Table 130. Organizational resilience weights	267
Table 131. Infrastructure resilience weights	268
Table 132. Hazard risk profile.....	271
Table 133. Community resilience score	272
Table 134. Organizational resilience score	272
Table 135. Infrastructure resilience score	273

LIST OF ABBREVIATIONS

<u>Abbreviation</u>	<u>Description</u>
AASHTO	American Association of State Highway and Transportation Officials
AHP	Analytical Hierarchy Process
ANP	Analytical Network Process
CABARET	Capacity Building in Asia for Resilience EducaTion
CCA	Climate Change Adaptation
CI	Critical Infrastructure
CI	Consistency Index
CIP	Critical Infrastructure Protection
CIR	Critical Infrastructure Resilience
CLD	Causal Loop Diagrams
CoBRA	Community Based Resilience Analysis
CR	Consistency Ratio
CRITIC	CRiteria Importance Through Inter-criteria Correlation
DEWN	Disaster and Emergency Warning Network
DM	Disaster Management
DMC	Disaster Management Centre
DOM	Department of Meteorology
DRR	Disaster Risk Reduction
DS	Divisional Secretariate
ELECTRE	Elimination and choice expressing the reality

EOP	Emergency Operation Procedures
ESCAP	Economic and Social Commission for Asia and Pacific
EW	Early Warning
FEMA	Federal Emergency Management Authority
FHWA	Federal Highway Administration
FL	Florida
GIS	Geographic Information System
GN	Grama Niladari
GRS	Geo-synthetic Reinforced Soil
MAUT	Multi-Attribute Utility Theory
MCDM	Multi-Criteria Decision Making
MHEW	Multi-Hazard Early Warning
NBRO	National Building Research Organization
NGO	Non-Government Organizations
NIPP	National Infrastructure Protection Plan
OECD	Organization for Economic Co-operation and Development
PDNA	Post Disaster Need Assessment
PPD	Presidential Policy Directive
PTWC	Pacific Tsunami Warning Centre
RDA	Road Development Authority
RI	Random Consistency Index
SDG	Sustainable Development Goals
SFDRR	Sendai Framework for Disaster Risk Reduction

SLP	Sri Lanka Police
SMART	Simple Multi-Attribute Ranking Technique
SMS	Short Message Service
SNA	Social Network Analysis
SOP	Standard Operation Procedures
UNDRR	United Nations office for Disaster Risk Reduction
US	United States
USAID	United States Agency for International Development
USD	United States Dollars
WSM	Weighted Sum Model