



Kerala Floods 2018

Enquiry into Causes and Risk Mitigation Strategy

(Published Under Section 18 (2) (h) guidelines of Disaster Management Act 2005, for prevention, mitigation, capacity building and preparedness to combat the adverse impact of floods)

Report Prepared by
Dr. CG Madhusoodhanan
Dr. KG Sreeja

Report Submitted by
Centre for Disaster Management
Lal Bahadur Shastri National Academy of Administration, Mussoorie

Report Submitted to
National Disaster Management Authority, New Delhi

August 2020

Kerala Floods 2018: Enquiry into Causes and Risk Mitigation Strategy

(Published Under Section 18 (2) (h) guidelines of Disaster Management Act 2005, for prevention, mitigation, capacity building and preparedness to combat the adverse impact of floods)

Report Prepared by

Dr. CG Madhusoodhanan
Dr. KG Sreeja

Report Submitted by

Centre for Disaster Management

Lal Bahadur Shastri National Academy of Administration, Mussoorie



Report Submitted to

National Disaster Management Authority, New Delhi



August 2020



Published Under

“Section 18 (2) (h) guidelines of Disaster Management Act 2005, for prevention, mitigation, capacity building and preparedness to combat the adverse impact of floods”

© LBSNAA-2020

About the Publication

This research study was sponsored by NDMA, coordinated by CDM, LBSNAA and the field study was conducted by Dr. CG Madhusoodhanan and Dr. KG Sreeja

Prepared by

Dr. CG Madhusoodhanan and Dr. KG Sreeja

Submitted by

Centre for Disaster Management (CDM), Lal Bahadur Shastri National Academy of Administration (LBSNAA), Mussoorie

Submitted to

National Disaster Management Authority (NDMA), Govt. of India, New Delhi

Layout Design

B C Branding Solutions

Visual Credits

Cover Design : Salil Mohandas

Cover Photo : IWMI

Artwork : Radha Gomati

Disclaimer

The views expressed in the research study are the outcome of results obtained from the field study. CDM, LBSNAA encourages the use, reproduction and dissemination of this publication for personal study and non-commercial purposes only with proper acknowledgment of NDMA, LBSNAA & CG Madhusoodhanan and KG Sreeja.





Abhiram G. Sankar, IAS

Director,
Centre for Disaster Management

DIRECTOR'S MESSAGE

Given its unique geographical and geological condition, India is vulnerable to various natural disasters. Incidents of flood, drought and other natural disasters pose a tremendous challenge to the society in general and administration in particular. Each disaster heightens the sense of urgency to equip ourselves better in coping and managing them. In this context, the training of civil servants in Disaster Management assumes critical significance. The Disaster Management Act 2005 has made the role of administrators pivotal in disaster management in India. Hence it is essential that the administrators are well-versed and equipped in the various aspects of disaster preparedness and management.

As the present COVID crises has shown there is a need to move from the paradigm of responding to disasters to one of building resilience against disasters in all aspects of governance. A key challenge to administrators is to establish standard operating procedures and protocols for immediate and effective response as well as for better preparedness in the future. It gives me immense pleasure to note that Centre for Disaster Management, LBSNAA is bringing out the report on the causes and administrative responses during the Kerala Floods of 2018 sponsored by the National Disaster Management Authority (NDMA). This report is based on an intensive study into the multiple causes and multi-level administrative responses to the unprecedented calamity of the Kerala floods of 2018. It provides insights into the challenges and potentials before the administrators in dealing with such calamities of extreme nature in the times of climate change. The study team also proposes mitigation strategy and preparedness measures for flood calamities in India in keeping with the Disaster Management Act 2005 and the Sendai Framework for Disaster Risk Reduction 2015-30.

I hope this volume will enhance the knowledge base and contribute to policy-making in disaster management in the country, and will be a valuable resource for both the trainees and the administrators in the field.

(Abhiram G. Sankar)





ACKNOWLEDGEMENT

We would like to express our sincere gratitude to the Centre for Disaster Management, LBSNAA and the National Disaster Management Authority, Govt. of India for providing the opportunity to study the Kerala Floods of 2018. We are extremely happy to express our gratitude to Shri C Sridhar IAS, Deputy Director Senior, LBSNAA and Director CDM, for his invaluable support, guidance and creative suggestions on each chapter of this report.

We are grateful to Shri Raghuraj M Rajendran IAS, former Director, CDM, for critical and inspired suggestions and the idea of death audit to assess the last mile connectivity during the floods of 2018.

We would like to express our heartfelt gratitude to Shri. Anil K Sinha, former IAS and Advisor, CDM, LBSNAA for his exceptional energy and companionship during the field visit, critical suggestions and guidance throughout the study. His constant support was invaluable for bearing with the difficult times during the study.

We express our sincere thanks to the CDM, LBSNAA faculty especially Dr. P.K. Singh, Mr. Rao and all other staff for their generous support and help throughout the study.

This study would not have been completed without the support of the Member Secretary, KSDMA and the hazard analysts at the KSDMA and the Districts, Revenue and Disaster Management Department, all the District Administrations especially Wayanad, Ernakulam, Thrissur, Idukki, Pathanamthitta, Thiruvananthapuram, Kottayam, Kannur, Malappuram and Kozhikode, all the DDMA's and DEOCs, former and current DCs, Kerala Government Department officials of the Kerala Water Authority, Water Resources Department, LSG Department, Agriculture, Animal Husbandry, Land Revenue Commissioner, Forest Department, Fisheries, Kerala State Electricity Board Ltd., Kerala Police, Dam Safety Organisation, Institute of Land and Disaster Management to name a few.

We also express our sincere thanks to the Secretaries of various Government Departments for their time and assistance with the study and Dr. Joy Elamon, Director, Kerala Institute of Local Administration for sharing experiences and documents on the LSG involvement during the disaster.

We are extremely thankful to the Indian Navy and Indian Air Force for their warm welcome and sharing of their valuable association during the disaster.

We are extremely thankful to the Honourable Health Minister Smt. KK Shailaja and Adv. VD Satheesan MLA for their valuable time, and for sharing of experiences.



We express our gratitude to all the individuals, volunteers and NGOs who have shared their invaluable experiences and memories of the floods. We would like to thank all media houses, online and offline, for their truthful and assiduous covering of the floods and landslides and documenting of them for the future.

We would like to express our sincere thanks to the District Administrations and CDS, Thiruvananthapuram for arranging for our stay and travel during the field visits.

We thank our team members Mr. Shailendra Rai, Mr. Joe John and Mr. Sagar Valsan for their rigour and enthusiasm in undertaking the extensive field work, for collecting and compiling enormous data and information and providing valuable insights during the entire course of the study.

We would like to thank Mr. Abhay Vishnu for carrying out the computational work and preparing charts for the project.

We also thank our family and friends for their constant support during difficult times and sharing of their insights especially Dr. Mini Raj, Dr. Manju Vasudevan, Ms. Radha Gomati, Mr. C. Jayaraman, Dr. Amruth, Dr. Narayanan, Mr. MP Shajan, Mr. Himanshu Thakkar and Mr. Noble Paikada.

Above all, we would like to express our admiration to all the people of Kerala who have bravely overcome this disaster through constant struggle and hope.

Dr. CG Madhusoodhanan

Dr. KG Sreeja



CONTENTS

Director's Message	iii
Acknowledgment	v
Contents	vii
List of Figures	x
List of Box items	xi
List of Tables	xii
Abbreviations	xii
Technical acronyms	xiii
Executive Summary	xiv
Chapter 1 Kerala Floods 2018: Background and objectives	1
1.1 Background of the study and objectives	1
1.2 Major events during Kerala floods 2018 - Timeline	2
1.3 Research Approach: Data and methodology	3
1.4 Relevance and need for the study	3
1.5 Organisation of the report	5
Chapter 2 The Kerala Flood 2018: Understanding the causes	6
2.1 Introduction	7
2.2 Monsoon 2018: Hydro-Meteorological Analysis	8
2.2.1 Drivers of extreme rainfall during 2018 monsoon	11
2.3 Changes in land and waterscapes of Kerala	15
2.4 Impact of river sand mining and tidal influences during Kerala floods	17
2.5 Changes to human settlement and built-up extent	20
2.6 Landslide incidents in Kerala	20
2.7 Impact of dams and reservoir operations during the floods of 2018	23
2.7.1 Operation of dams before the floods of 2018	23
2.7.2 The Chalakudy River Basin	23
2.7.3 Multiple flood events in 2018 - The Chalakudy basin	24
2.7.4 Experiences in the Chalakudy basin during Kerala flood 2018	27
2.8 Concluding remarks	29
Chapter 3 Disaster Management Mechanism in Kerala in the context of Floods 2018	30
3.1 Introduction	31
3.2 Kerala State Disaster Management Rules, Policy and Plan	32
3.3 Administrative system and resources for disaster management	34
3.4 Flood hazards and vulnerability of the state	36
3.5 District Disaster Management Authority and District Disaster Management Plans	38
3.6 The Orange book of Disaster Management 2019: post-flood updated SOP and ESFP	46
3.7 Concluding remarks	48
Chapter 4 Administrative responses before, during and after the floods of 2018	50
4.1 Introduction	51
4.2 State in Disaster Management during the Kerala floods 2018	51
4.2.1 Preparedness and Early Warning in 2018	51
4.2.2 Rescue and relief operations, communication and co-ordination	59
4.2.3 Post-flood damage assessment and recovery	62
4.2.4 Post-flood lessons and recommendations for better preparedness and DM	66
4.3 District Disaster Management Preparedness and Responses	69



4.3.1 District 1: Wayanad	69
4.3.1.1 Preparedness and Early Warning in 2018	72
4.3.1.2 Rescue and relief operations, communication and co-ordination	77
4.3.1.3 Post-flood damage assessment and recovery	78
4.3.1.4 Challenges/ recommendations based on Wayanad DDMA experience	79
4.3.2 District 2: Pathanamthitta	81
4.3.2.1 Preparedness and Early Warning in 2018	82
4.3.2.2 Rescue and relief operations, communication and co-ordination	84
4.3.2.3 Post-flood damage assessment and recovery	85
4.3.2.4 Recommendations based on Pathanamthitta DDMA flood experience	86
4.3.3 District 3: Alappuzha	87
4.3.3.1 Preparedness and Early Warning in 2018	88
4.3.3.2 Rescue and relief operations, communication and co-ordination	90
4.3.3.3 Post-flood damage assessment and recovery	93
4.3.3.4 Recommendations based on Alappuzha DDMA flood experience	93
4.3.4 District 4: Idukki	94
4.3.4.1 Preparedness and Early Warning in 2018	94
4.3.4.2 Rescue and relief operations, communication and co-ordination	98
4.3.4.3 Post-flood damage assessment and recovery	98
4.3.4.4 Recommendations based on Idukki DDMA flood experience	99
4.3.5 District 5: Thrissur	101
4.3.5.1 Preparedness and Early Warning in 2018	101
4.3.5.2 Rescue and relief operations, communication and co-ordination	104
4.3.5.3 Post-flood damage assessment and recovery	106
4.3.5.4 Recommendations based on Thrissur DDMA flood experience	107
4.3.6 District 6: Ernakulam	108
4.3.6.1 Preparedness and Early Warning in 2018	108
4.3.6.2 Rescue and relief operations, communication and co-ordination	111
4.3.6.3 Post-flood damage assessment and recovery	115
4.3.6.4 Recommendations based on Ernakulam DDMA flood experience	115
4.4 Panchayat level disaster preparedness and responses	117
4.4.1 Preparedness and Early Warning at the Panchayat level in 2018	118
4.4.2 Rescue and Relief operations, communication and co-ordination	120
4.4.3 Post-flood damage assessment and recovery	124
4.4.4 Challenges faced by the panchayats in Disaster Management during 2018 floods	125
4.5 Death Audit: Efficacy of warnings and last mile connectivity during the floods	127
4.5.1 Death during Kerala Floods 2018: A state level analysis	128
4.5.2 Death during Kerala Floods 2018: House visit sample analysis	129
4.6 Concluding remarks	131
Chapter 5 Spontaneous volunteerism and social media during the floods: Social capital of Kerala	134
5.1 Introduction	136
5.2 Context of Volunteerism	136
5.3 Fishermen in rescue during Kerala floods 2018	137
5.3.1 The trajectory of involvement	137
5.3.2 Challenges in spontaneous volunteerism: Experience of fishermen rescuers	140
5.3.3 Recognising and mainstreaming the fishermen rescuers: The post-flood scenario	141
5.3.4 Concerns and caveats to fisher volunteerism	142



5.4 Participation of youth in Kerala floods	144
5.5 Kudumbashree initiatives and voluntary activities during and post floods of 2018	146
5.6 The role of social media in disaster management	149
5.6.1 During and after floods	150
5.6.2 Fake news, controversies and conspiracy theories	153
5.6.3 Challenges Identified and Lessons Learnt	155
5.7 Policy recommendations in volunteerism in DM	157
5.8 Concluding remarks	158
Chapter 6 Decision making in an uncertain world: Risk mitigation strategies for future flood disaster preparedness, warnings and management	160
6.1 Introduction	161
6.2 Challenges for the DM institutions for flood disaster management	161
6.3 Essential requirements of DM institutions at local level for Flood Disaster Preparedness	163
6.4 Strategies for future disaster risk reduction	164
6.4.1 Impact based Early Flood Forecast and Warning System	164
6.4.2 Flood Severity Index Map for Kerala - Identifying disaster hotspots	166
6.4.3 Reforming reservoir management to address novel challenges of climate change	169
6.4.4 Strategies for landslide associated disaster risk reduction	170
6.4.5 Short-medium-long term action plans for disaster risk reduction	171
6.5 Concluding remarks	172
Chapter 7 Major findings and Policy Recommendations	174
7.1 Major findings and challenges identified for Disaster Management in the state	175
7.2 Policy Recommendations and way forward	181
7.3 Concluding remarks	187
APPENDIX 1	188
APPENDIX 2	189
STUDY TEAM	198



List of Figures

Figure 1.1	Loss of human life due to Kerala Floods 2018	1
Figure 1.2	Time-line of events that constitute the Kerala Floods of 2018	2
Figure 1.3	Graphical representation of the research methodology	4
Figure 2.1	Monsoon Rainfall over India 2018 - District wise excess and deficit along with extreme rainfall events..	10
Figure 2.2	Daily Rainfall across various rainfall stations in Kerala during July-August 2018	12
Figure 2.3	Satellite INSAT-3D image on 15th August 2018 at 5.30 pm	13
Figure 2.4	Major drivers of extreme rainfall over Kerala during 2018.	14
Figure 2.5	Loss of forest land and cover in India (1930-2013) and Kerala (2000-2013)	16
Figure 2.6	Decline of paddy lands and wetlands in Kerala over the past 6 decades	17
Figure 2.7	Purappillikavu regulator-cum-bridge in the downstream of Periyar River	19
Figure 2.8	High and low tides during August 2018 at Cochin	19
Figure 2.9	Spread of human built-settlement extent in Kerala over the past 2 decades and the hotspots of flood impact .	20
Figure 2.10	Source and type of landslides in the districts of Kerala, 2018	22
Figure 2.11	Dams and diversions in the Chalakudy River Basin	25
Figure 2.12	Water overtopping the spillway shutters of the Poringalkuthu Reservoir on 26th July 2018	26
Figure 2.13	Overtopping of Poringalkuthu Dam on 16th August, 2018	27
Figure 2.14	Chalakudy Town on 17th August 2018	28
Figure 3.1	Organizational chart of SEOC, KSDMA, Kerala	35
Figure 3.2	Flood and landslide vulnerability maps of Kerala developed as part of the KSDMP, 2016	37
Figure 3.3	Communication flowchart during disasters between the various administrative levels	39
Figure 3.4	Structure of DDMA in Thrissur district with suggested Expert Panel	42
Figure 3.5	The Incident Command System - with suggested expert panel aid	45
Figure 4.1	Warning issued by IMD on 14th August 2018 at 13 hrs IST for 5 days	55
Figure 4.2	Warning issued by CWC on 9th August 2019, post 2018 floods	56
Figure 4.3	Distribution of IMD and WRD rain gauges in the state	57
Figure 4.4	Sectoral losses due to Kerala floods 2019 in the various districts	70
Figure 4.5	Percentage share of the selected districts in various household and public losses and damages at the state level due to the floods of 2018 Data	71
Figure 4.6	Multiple Hazard Zonation map of Wayanad from NCESS, 2015	72
Figure 4.7	Village level distribution of affected households in Wayanad and the locations of the major landslides	73
Figure 4.8	Preparedness measures initiated by the Wayanad DDMA	74
Figure 4.9	Graphic representation of ineffective warnings in the Wayanad district	76
Figure 4.10	Government forces and vehicles involved in rescue in Wayanad.	78
Figure 4.11	Glimpses of rescue and damages in Wayanad during floods 2018	80
Figure 4.12	Hazard prone areas of Pathanamthitta district	82
Figure 4.13	Village level distribution of affected households in Pathanamthitta and the locations of the major landslides	83
Figure 4.14	Flood vulnerability map of Alappuzha and the extensive drainage network of the district.	88
Figure 4.15	Flood affected villages in Alappuzha district according to severity	89
Figure 4.16	Logistics of rescue in Alappuzha district during August 2018	92
Figure 4.17	Major hazard susceptibilities of Idukki district	95
Figure 4.18	Village level distribution of affected households in Idukki and the locations of the major landslides	96
Figure 4.19	Sudden rise in water level in the Periyar river at Vandiperiyar due to the release of water from Mullaperiyar on 15th August 2018	97



Figure 4.20	Idukki during the flood/ landslide disaster of 2018	100
Figure 4.21	Major hazard susceptibilities of Thrissur district	102
Figure 4.22	Village level distribution of affected households in Thrissur and the locations of the major landslides	102
Figure 4.23	River water level at Arangali in the Chalakudy River 15th- 16th August 2018	104
Figure 4.24	Glimpses of the disaster and rescue from Thrissur district	105
Figure 4.25	Distribution of rescue team personnel in Thrissur	105
Figure 4.26	Major hazard susceptibilities of Ernakulam district	108
Figure 4.27	Spatial distribution of affected households in Ernakulam	109
Figure 4.28	Upstream dams that opened as given by DDMA, Ernakulam and the network of dams upstream of Ernakulam	110
Figure 4.29	Details of rescue forces deployed.	111
Figure 4.30	Glimpses of disaster, rescue and relief in Ernakulam district	116
Figure 4.31	Distribution of panchayats examined for their DM activities	118
Figure 4.32	Intimation of hazard at the panchayat level in Wayanad district	123
Figure 4.33	State wide distribution of (a) causes of deaths among b) gender, c) age group , d) districts and e) time period	128
Figure 4.34	House visit sample distribution of (a) causes of deaths among b) gender, c) age group , d) districts and e) time period .	129
Figure 4.35	Diverse causes of flood related deaths	130
Figure 4.36	Occupational profile of deceased persons from various causes a) flood and b) landslide	130
Figure 4.37	Time of death a) flood and b) landslide	131
Figure 4.38	Efficacy of warnings	131
Figure 5.1	Number of boats involved rescue from each district and types of boats used in rescue operations	139
Figure 5.2	Modus operandi adopted by fishermen for rescue operations.	141
Figure 5.3	Transportation of boats to the flooded regions, search and rescue by fishermen and damaged boats during Kerala Floods 2018..	143
Figure 5.4	Diverse ways in which Kudumbashree volunteers helped during the floods	149
Figure 5.5	Rescue and Relief platform developed by Kerala IT Mission with the help of volunteers	153
Figure 6.1	Key components of Integrated EWS	165
Figure 6.2	Conceptual model - real time forecast and warning system	166
Figure 6.3	Number of affected households during 2018 and 2019 Kerala floods and merged map at village level	167
Figure 6.4	Village level Flood Severity Index of Kerala based on affected households during 2018 & 2019 floods	168
Figure 6.5	Incidents of role of dams in aggravating the flood situation over the past two decades in India	170

List of Box items

Box 2.1	Monsoon Drivers: Internal Dynamics and Climate Change	8
Box 2.2	Climate change on water resources of India	9
Box 2.3	Internal Dynamics: Indian Ocean Dipole	15
Box 2.4	Wetland Ecosystems - Flood Risk Reduction	16
Box 2.5	Floods and wetland conversions - Kuttanad Ramsar Site	18
Box 2.6	Unique Runoff Generation Mechanisms in the Western Ghats	21
Box 4.1	IMD warning during Floods of 2018	54
Box 4.2	Clean Kerala Company: A post-flood initiative for Waste Management	64
Box 4.3	Rebuild Kerala Initiative	65



Box 4.4	How Wayanad prepared for Landslides	75
Box 4.5	Learning from the experience: Invoking DM Act for better preparedness	81
Box 4.6	Inter-State Issues in DM- Decisions on water releases from Mullaperiyar dam	99
Box 4.7	Digital Ernakulam	113
Box 4.8	The story of Chekkutty that came out of the floods	114
Box 5.1	Fuelling the fishermen volunteer efforts: Involvement of District Administrations	142
Box 5.2	Relief Collection and Distribution Drives: The volunteer way	145
Box 5.3	Kudumbashree Mission: An initiative for poverty eradication and woman empowerment	147
Box 5.4	How technology helped to overcome manually impossible tasks: New initiatives - Start-ups in rescue operations	152
Box 5.5	Emergence of a state-of-the-art rescue mass master plan - outcome of Kerala flood disaster : An innovative model for mass rescue operations in India	154
Box 5.6	Volunteerism in Disaster Management: Through the eyes of an Administrator	155
Box 5.7	Need for Volunteer Framework and SOPs	156

List of Tables

Table 2.1	Weekly rainfall departures in Kerala during June- September 2018	7
Table 2.2	Landslide events in the state during 2018	22
Table 2.3	Existing Projects and Storage in the Chalakudy Basin	24
Table 3.1	Chronology of institutionalization of Disaster Management in Kerala	31
Table 3.2	District level officers in the DDMA appointed at the discretion of the State	41
Table 3.3	Details of reservoirs and related DM measures extracted from various DDMPs	42
Table 4.1	Cumulative losses and damages during the monsoons from May 29th 2018	53
Table 4.2	Warning received during the floods of Kerala	54
Table 4.3	Details of central forces deployed in rescue during the Kerala floods 2018	60
Table 4.4	Details of helicopter deployment in the state	61
Table 4.5	Dates on which warnings were received by the Kuttanad panchayats	121
Table 5.1	Activities undertaken by Kudumbashree units during and post-Floods 2018	148

Abbreviations

ASHA	Accredited Social Health Activist
CAG	Comptroller and Auditor General
CM	Chief Minister
CMG	Crisis Management Group
CHC	Community Health Centre
CMDRF	Chief Minister's Disaster Relief Fund
CWC	Central Water Commission
DDMA	District Disaster Management Authority
DDMP	District Disaster Management Plans
DEOC	District Emergency Operations Centre
DA	District Administration
DC	District Collector
DM	Disaster Management
DMD	Disaster Management Department
DRR	Disaster Risk Reduction
ESFP	Emergency Support Functions Plan
EWS	Early Warning System
FD	Forest Department



FSI	Flood Severity Index
GP	Grama Panchayat
HDI	Human Development Index
HVRA	Hazard, Vulnerability and Risk Assessment
IDRN	India Disaster Resource Network
ILDM	Institute of Land and Disaster Management
IMD	India Meteorological Department
INCOIS	Indian National Centre for Ocean Information Services
ISGN	Indian Seismic and GNSS (Global Navigation Satellite System) Network
JWRB	Joint Water Regulatory Board
KILA	Kerala Institute of Local Administration
KSDMA	Kerala State Disaster Management Authority
KSDMP	Kerala State Disaster Management Plan
KSEBL	Kerala State Electricity Board Ltd.
KWA	Kerala Water Authority
LSG	Local Self-Government
NDMA	National Disaster Management Authority
NDMP	National Disaster Management Plan
NDMS	National Disaster Management Services
NDRF	National Disaster Response Force
NERC	National Emergency Response Centre
NGO	Non-Governmental Organisation
PHC	Primary Health Centre
RKDP	Rebuild Kerala Development Programme
RKI	Rebuild Kerala Initiative
SDMF	State Disaster Mitigation Fund
SDRF	State Disaster Response Force
SEOC	State Emergency Operations Centre
SHG	Self Help Group
SOP	Standard Operating Procedure
SRC	State Relief Commissioner
TN	Tamil Nadu
UNDP	United Nations Development Programme
VHF	Very High Frequency

Technical acronyms

Flood related

WL	Warning Level
DL	Danger Level
HFL	High Flood Level

Reservoir related

MWL	Maximum Water Level
FRL	Full Reservoir Level

Water flow/storage related

m ³ /sec	cubic meter per second (cumec)
ft ³ /sec	cubic feet/sec (cusec)
Mm ³	million cubic meters (10 ⁶ m ³)
m/sec	meter/sec





Centre for Disaster Management
Lal Bahadur Shastri National Academy of Administration, Mussoorie
&
National Disaster Management Authority, New Delhi