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By

Louise K. Comfort

QUICK RESPONSE RESEARCH REPORT #74

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This publication is part of the Natural Hazards
Research & Applications Information Center's ongoing
Quick Response Research Report Series.
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SELF ORGANIZATION IN DISASTER RESPONSE AND RECOVERY: The Maharashtra, India Earthquake of September 30, 1993

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Submitted to the Natural Hazards Center, University of Colorado at Boulder in partial fulfillment of the requirements for a Quick Response Grant, March 23, 1995.

SELF ORGANIZATION IN DISASTER RESPONSE AND RECOVERY: The Maharashtra, India Earthquake of September 30, 1993[1]

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Introduction

This report presents findings from a Quick Response study of self organizing processes in disaster response generated by the Maharashtra, India Earthquake of September 30, 1993. Self organizing processes are spontaneous efforts to bring order into a chaotic environment (Kauffman, 1993). Such processes have been observed repeatedly in disaster environments, but we have not understood the dynamics of these processes sufficiently to support and guide them in constructive ways. Observation of these processes in the Indian disaster context is especially interesting because India, as a developing country, has not made an extensive investment in emergency planning, preparedness, or organizational structure to support disaster response.

Since earthquakes occur without warning and generate unexpected consequences for the affected communities, the systems of organizational response that emerge following such a sudden, destructive event are largely nonlinear. That is, they do not follow predictable models and their evolving form is dependent upon the initial conditions in which the event occurred. Such nonlinear systems are complex, dynamic, and difficult to assess using standard forms of social science measurement. In order to understand the dynamics of such systems more clearly, this inquiry explores a new methodology for identifying the major characteristics of a complex, disaster response system, using the Maharashtra Earthquake as a case study.

Research Questions:

In designing this research, I posed three principal questions:

1. To what extent did self organizing processes evolve in response to the Marathwada, India Earthquake, September 30, 1993?
2. What conditions facilitated or hindered the evolution of these processes under the urgent conditions of disaster operations?

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[1] I acknowledge, with thanks and appreciation, my colleague, Dr. Sharayu Anantaram, Department of Sociology, S.N.D.T. University, Bombay, India, for her assistance in the conduct of this research and particularly for her skills in the Marathi and Hindi languages.

3. What consequences did self organizing processes have for the transition from response to recovery among the communities of the affected region?

To answer these questions, I sought to accomplish four research objectives. They are:

1. To identify the number of organizations, their stated goals in disaster reponse, the pattern of interactions among them, and the types of transactions performed in the evolving system of disaster response and recovery operations in the Maharashtra Earthquake

2. To explore, in particular, the role of nonprofit organizations in this disaster response system

3. To document critical stages for communities in transition from response to recovery following disaster

4. To assess the validity of the N-K system in measuring the evolution of a complex, dynamic system of disaster response and recovery

Methodology

This study represents the first field test of Kauffman's (1993: 175-209) concept of an N-K complex system to an actual disaster environment. It investigates whether these concepts will yield more consistent, valid measures of the evolving disaster response and recovery system. This study identifies the following measures for the organizational response and recovery system that evolved during and after the Maharashtra Earthquake:

1) N = number of organizations participating in disaster response
2) S = source of support for organization's response and recovery activities -- public, private, nonprofit
3) T = types of transactions/exchange among participating organizations
4) K = estimated number of interactions among participating organizations
5) P = shared goal of organizations, or 'bias for choice' in actions
6) D = duration of interactions among organizations

By carefully identifying these six characteristics for organizations participating in disaster response operations, it is possible to construct a profile of the evolving system, noting points of entry and exit into disaster operations by participating organizations and relationships of interdependency and support among the set. This profile will reveal patterns of communication and coordination that enable organizations to span jurisdictions

and function at several levels of abstraction and geographic location simultaneously.

Three types of data were collected for this study. First, in collaboration with Dr. Anantaram, I collected documentary sources providing background analysis and in-depth inquiry regarding multidisciplinary aspects of the disaster from both public and independent professional organizations. These reports include extensive analyses such as survey done by the TATA Institute of Social Sciences, Bombay, the reconnaissance reports of the Earthquake Engineering Research Institute and the World Bank, as well as official reports from the offices of the District Collectors in Latur and Osmanabad and the Preliminary Report of the State of Maharashtra on disaster operations.

Second, we conducted a survey of managers and/or policy makers of organizations that were engaged in disaster response and recovery activities. The survey was designed to include a representative sample of 48 policy makers of public, private, and nonprofit organizations. Since disaster response operations were conducted through the administrative structure of governmental organizations, the sample included policy makers at positions in the interdependent levels of administrative service: village, taluka, municipal, district, and state. At the village level, villages were selected by degree of damage. The State Government of Maharashtra established three categories of damage for the distribution of relief and priorities for disaster assistance. Category A included villages that sustained five or more deaths and extensive damage to most of the houses, rendering them uninhabitable. Category B included villages that sustained 1 to 5 deaths and damage to approximately 50% of the houses. Category C included villages that suffered no deaths, but heavy damage to less than 50% of the housing. Each jurisdictional level was characterized by different patterns of interaction with its constituents. The unit of analysis in this study is the organization; the unit of observation is the individual respondent who played a representative policy-making role within the organization.

Third, we carried out a content analysis of 14 newspapers, 6 in English and 8 in Marathi, to check and corroborate findings from the survey, as well as to provide a more detailed account of the context of disaster operations and the conditions under which the participating organizations functioned.

These three types of data provide a detailed profile of the disaster response system that evolved following the Maharashtra Earthquake. In important respects, this system evolved not according to a predesignated plan, but on the basis of quick assessment of needs, interactive communication with multiple participants, and within the framework of an established administrative structure and shared humanitarian values.

Presentation of Findings

At 3:56 a.m. on September 30, 1993, a magnitude 6.4[2] earthquake struck the Marathwada region of Maharashtra State in Central India. The epicenter of the earthquake was near the village of Killari in Latur District, with a population of 12,264 and 2,847 homes. Fortunately, many people were still awake at that hour, celebrating a religious holiday for the Hindu god, Shiva. Yet, the earthquake caused extensive damage and loss of life. In Killari, for example, 1,220 persons were killed, 1,282 injured, and all 2,847 homes were destroyed.[3] Out of 936 villages in Latur District, 817 were damaged, as well as 374 villages in adjoining Osmanabad District. Official reports listed a total of 7,582 dead, 21,849 injured, and 30,000 families or 175,000 people rendered homeless by the earthquake.[4] Table 1 presents a comparative assessment of damage for the Latur and Osmanabad Districts. Figure 1 presents that data graphically.

The initial social, economic, and technical conditions in the Latur and Osmanabad Districts prior to the earthquake shaped the dynamics of the evolving disaster response system. The two districts are located in an agricultural area that is moving gradually toward more productive, marketable crops and a higher standard of living for its inhabitants. Yet, most of the population live in conditions of extreme poverty. Approximately 80% of the people in the area earn their living through agriculture, with more than 50% of the population earning less than $250 per year. The literacy rate is low, approximately 55% for men; 35% for women; 10% unreported. The population is primarily Hindu, with a small proportion of Muslims in Osmanabad. Houses are primarily built of stone, held together with mud. Wealthier homes have wooden beams that create a stronger structure for connecting the ceilings to the walls. Roads are primitive, with some of the villages connected only by dirt roads that turn to impassable mud during the rainy season. Commerce is beginning to develop in the largest city, Latur, and signs of increasing literacy and economic development are also evident, but the economic and social needs of the area under normal times are great. Tables 2 and 3

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[2] The magnitude of the earthquake was estimated at Mb = 6.3 and Ms = 6.4 Richter scale by the US Geological Survey. The earthquake was reported as M6.5 in the press. India Today, October 11, 1993:54.

[3] Survey of People Affected by the Earthquake in the Latur and Osmanabad Districts (1993): Joint Action Group of Institutions for Social Work Education. Final Report, February 1994. Tata Institute of Social Sciences, Bombay, India:142.

[4] A Preliminary Report by the Government of Maharashtra. Bombay, 1993.

Table 1

A COMPARATIVE ASSESSMENT OF DAMAGE BY DISTRICT, MARATHWADA EARTHQUAKE, September 30, 1993

	Latur		Osmanabad		Total	
Type of Damage	N	%	N	%	N	%
Total number of villages	936	57.1	704	42.9	1640	100
Number of villages severely damaged	817	68.6	374	31.4	1191	100
Number of homes severely damaged	85,000	58.6	60,000	41.4	145,000	100
Number of dead	3,726	49.1	3,856	50.9	7,582	100
Number of injured	6,283	40.4	9,283	59.6	15,566	100
Number of cattle dead	1,083	51.6	1,017	48.4	2,100	100
Number of cattle injured	8,345	64.0	4,699	36.0	13,044	100

Source: A Preliminary Report of the September 30, 1993 Earthquake. Government of Maharashtra, Bombay, India, 1993.

Figure 1

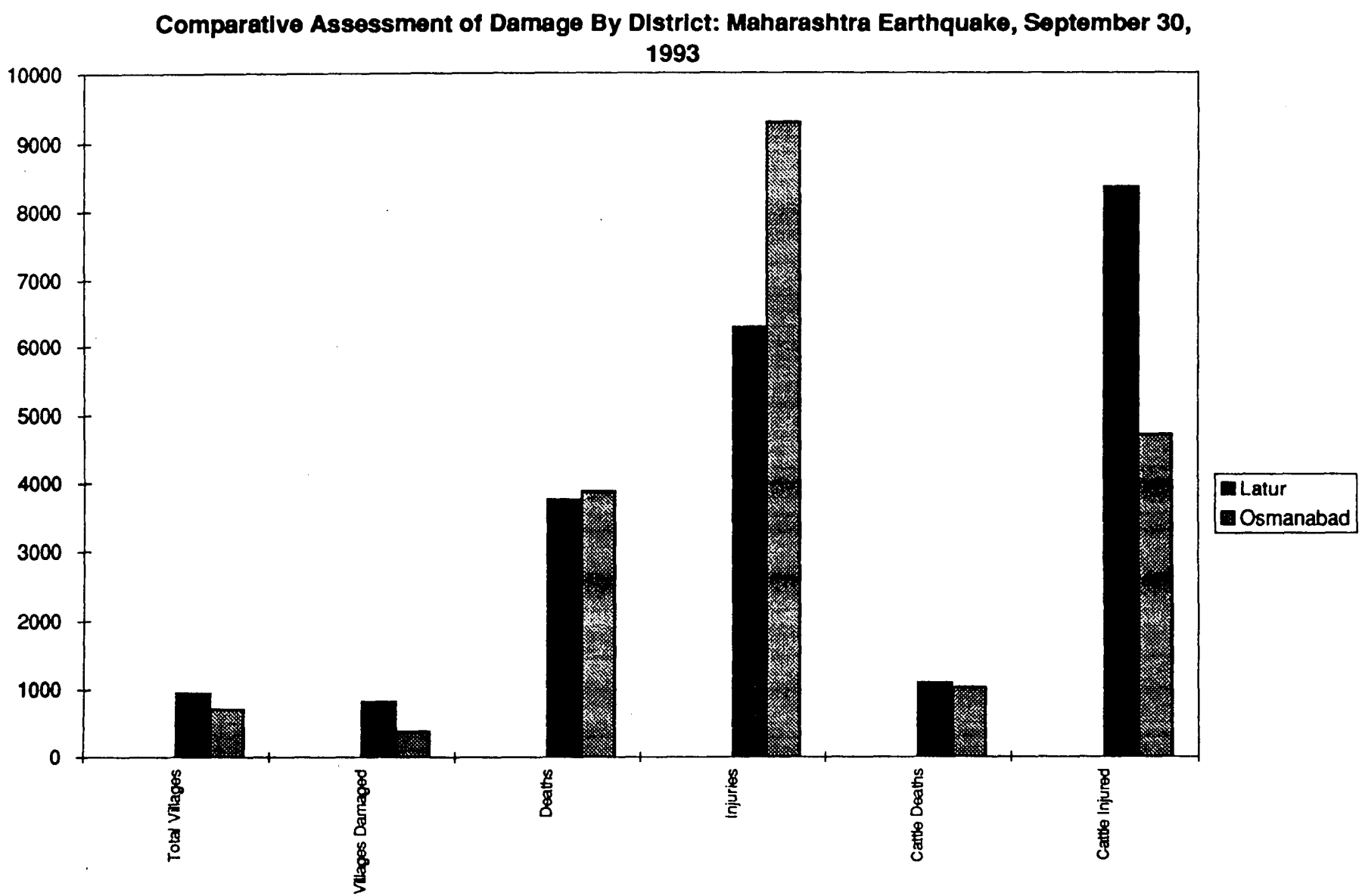

Comparative Assessment of Damage By District: Maharashtra Earthquake, September 30, 1993
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Total Villages
Villages Damaged
Deaths
Injuries
Cattle Deaths
Cattle Injured
Latur
Osmanabad

Table 2

INITIAL CONDITIONS: CHARACTERISTICS OF LATUR DISTRICT

Physical and Administrative:

Latur District was separated from Osmanabad District in August, 1981.

1. Total area of District: 7,157 square kilometers

2. Total number of talukas (subdistricts): 7
   Latur, Ahmedpur, Chakur,
   Renapur, Udgir, Nilanga, Ausa

3. Total number of villages: 936

Social:	N	%
1. Total population:	1,677,000	100.0
2. Urban population:	342,000	20.0
3. Rural population:	1,335,000	80.0
4. Scheduled castes*, number and percent of total population:	228,600	18.0
5. Scheduled tribes*, number and percent of total population:	31,750	2.5
6. Literacy rate, total population:	968,690	58.0
7. Proportion male literates	629,590	65.0
8. Proportion female literates	339,100	35.0
9. Sex ratio (number of females per 1,000 males):	944	

Occupational:	N	%
1. Agricultural:		
a. Landholders	258,428	39.4
b. Landless laborers	256,672	39.1
c. Livestock, forestry	5,057	0.8
2. Non-agricultural		
a. Trade & commerce	36,207	5.5
b. Other manufacturing	23,145	3.5
c. Other trades & services	76,734	11.7
Total number of workers:	656,243	100.0

SOURCE: Government of India, Census of India, 1991.
Centre for Monitoring Indian Economy, 1985.

*Scheduled caste people are members of the formerly 'untouchable' caste, who are now regarded as equal members of the Indian society, but who are still seriously disadvantaged by their low socioeconomic status. Scheduled tribes are indigenous peoples who are also disadvantaged by low socioeconomic status.

Table 3

INITIAL CONDITIONS: CHARACTERISTICS OF OSMANABAD DISTRICT

Physical and Administrative:

1. Total area:	7,567 square kilometers
2. Total number of talukas (subdistricts): Tuljapur, Kalamb, Omerga, Bhum, Paranda Osmanabad	6
3. Total number of villages	704

Social:

	N	%
1. Total population	1,275,000	100.0
2. Urban population:	193,000	15.0
3. Rural population	1,082,000	85.0
4. Scheduled caste* population (Number and percent of total):	190,500	15.0
5. Scheduled tribe* population (Number and percent of total)	12,700	1.0
6. Literacy rate in district	561,000	44.0
7. Percent male literacy	364,650	65.0
8. Percent female literacy	196,350	35.0
9. Sex ratio (number of females per 1,000 males)	943	

Occupational:

	N	%
1. Agricultural:		
a. Landholders/cultivators	214,496	40.5
b. Landless laborers	217,527	41.1
c. Livestock, forestry	6,069	1.1
2. Non-agricultural:		
a. Trade & commerce	18,029	3.4
b. Other manufacturing	14,022	2.6
c. Other trades & services	59,282	11.3
Total number of workers:	529,425	100.0

SOURCE: Government of India, Census of India, 1991.
Centre for Monitoring Indian Economy, 1985.

*Scheduled caste people are members of the formerly 'untouchable' caste, who are now regarded as equal members of the Indian society, but who are still seriously disadvantaged by their low socioeconomic status. Scheduled tribes are indigenous peoples who are also disadvantaged by low socioeconomic status.

Figure 2

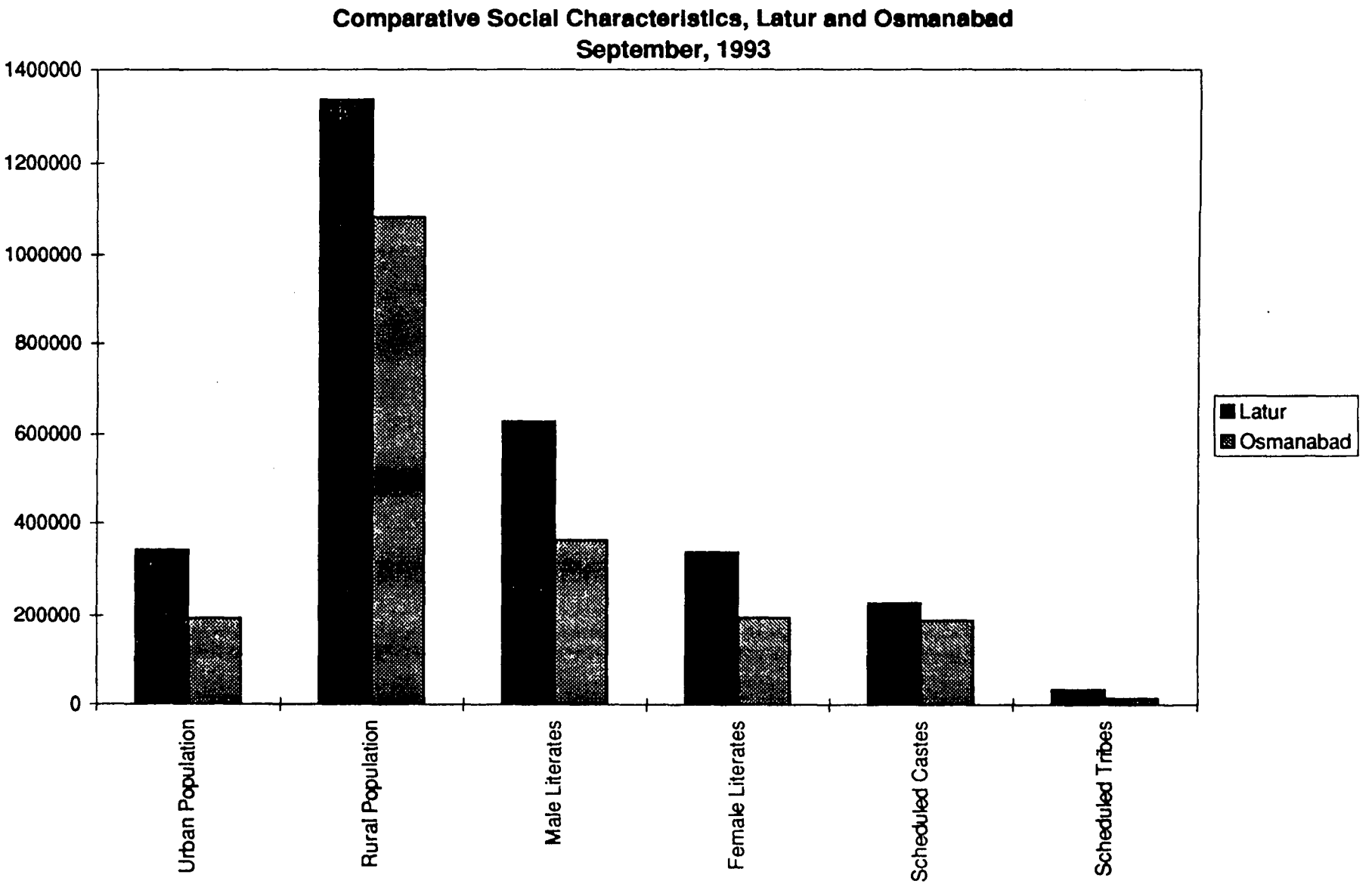
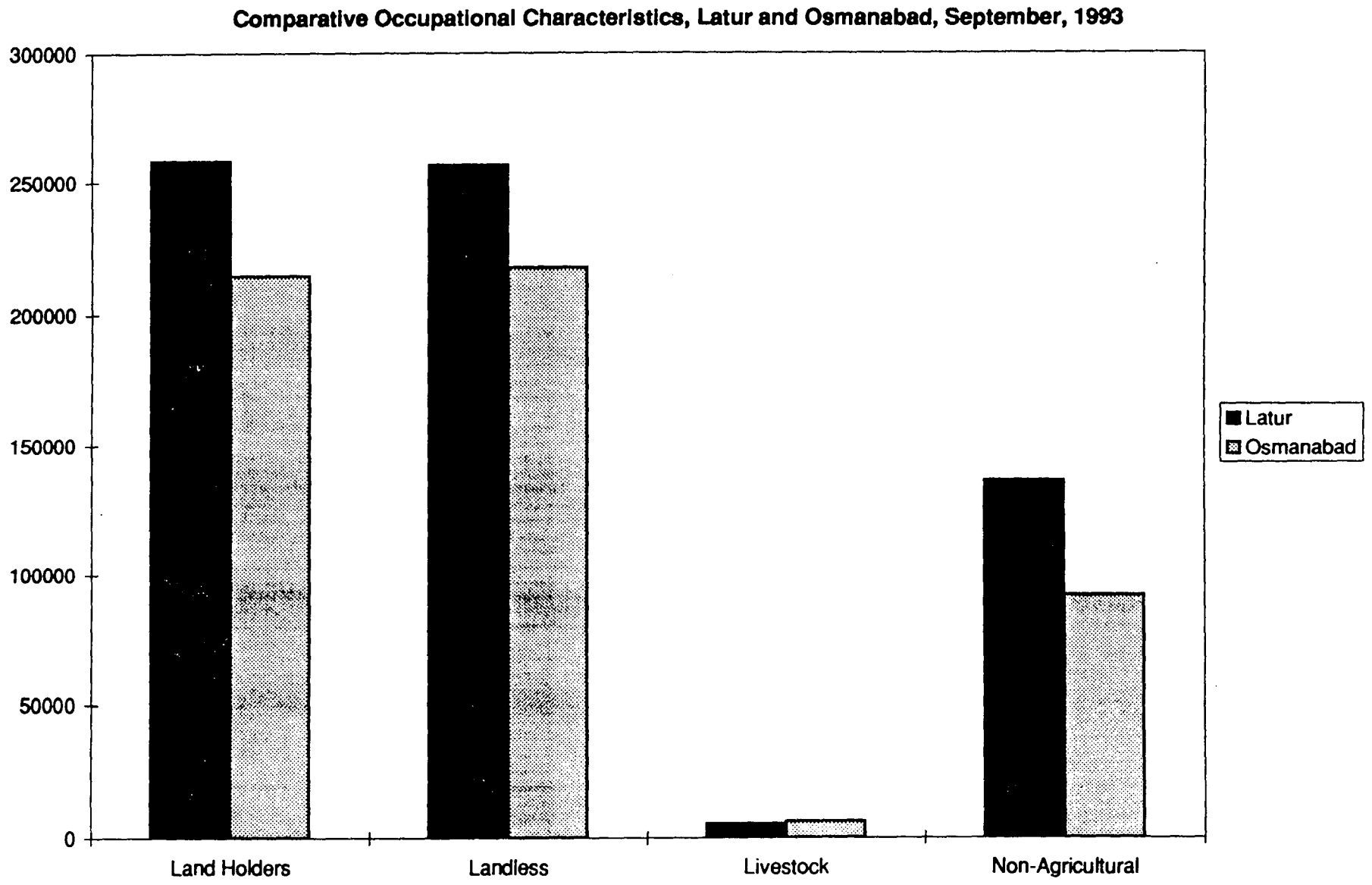

Comparative Social Characteristics, Latur and Osmanabad
September, 1993
1400000
1200000
1000000
800000
600000
400000
200000
0
Urban Population
Rural Population
Male Literates
Female Literates
Scheduled Castes
Scheduled Tribes
Latur
Osmanabad

Figure 3


Comparative Occupational Characteristics, Latur and Osmanabad, September, 1993
300000
250000
200000
150000
100000
50000
0
Land Holders
Landless
Livestock
Non-Agricultural
Latur
Osmanabad

present data on primary characteristics of the Latur and Osmanabad Districts. Figure 2 shows the comparative social characteristics of Latur and Osmanabad, and Figure 3 shows the comparative occupational characteristics, that is, the means by which the population earned its living, of the two districts at the time of the earthquake.

In this context of rural poverty and need, a surprisingly effective disaster response system evolved to meet the needs of the population of the area following the earthquake. Using the methodology of the N-K system, we sought to define the major characteristics of this dynamic system. First, we identified the organizations that participated in disaster response organizations through a review of articles reported in English, Hindi, and Marathi newspapers. While this list may not be comprehensive, it represents the major organizations, and types of organizations, that participated in disaster operations.

Table 4 presents the identified disaster response system, **N** = 119 organizations, as derived from the media analysis. In the total response system, the critical role of nonprofit organizations is shown, representing 81, or 68.1% of all organizations identified in news reports as participants in the disaster response system. Public organizations represented 32, or 26.9% of the organizations identified in the comprehensive disaster response system, and private organizations represented the smallest group, 6, or 5% of the participants in the disaster response system. International organizations (23), both public and nonprofit, make up 19.3% of the total response system, showing links between India and wider sources of funding and support. Table 5 shows the Indian national organizations by funding source, and Table 6 presents the data for international organizations. Figure 4 shows the total disaster response system graphically by type of funding, and Figure 5 shows the graphic comparison of national and international organizations in the disaster response system by type of funding: public, private, or nonprofit.

Table 7 presents the characteristics of the sample drawn for the survey of practicing managers and/or policy makers engaged in disaster response operations. The sample represents three important characteristics of the disaster response system: 1) the interdependent administrative structure which served as a framework for disaster operations; 2) policy-makers from villages that suffered varying degrees of damage; and 3) the types of organizations that engaged in disaster response and recovery activities. Forty-eight respondents representing forty-three organizations participating in disaster response and recovery operations were interviewed over a period of six months, December, 1993 to May, 1994. The survey was preceded and informed by observations made by Dr. Anantaram in an initial exploratory trip to Latur in November, 1993. Table 8 presents the sampling distribution by organization and funding source/jurisdiction.

Table 4

Total Disaster Response System Identified from Print Media Sources, Marathwada Earthquake, September 30, 1993

Public	Nonprofit	Private
1. General Hospital	1. Medecins sans Frontieres	1. CNN
2. Railway Hospital	2. UNICEF	2. BBC
3. Ambajogai Medical College	3. International Red Cross	3. Artificial Limbs Manufacturing Association, Kanpur
4. Britain/UK	4. Japanese Red Cross	4. Institute of the Physically Handicapped, New Delhi
5. Netherlands	5. Rotary Internat'l	5. Worth Industries, Vellore
6. Pakistan	6. French Search and Rescue team	6. trader organizations
7. Kuwait	7. OXFAM	
8. Algeria	8. International Committee of Red Cross	
9. Singapore	9. World Vision	
10. China	10. Terre des Hommes	
11. U.S.	11. Lutheran World Service	
12. Government of India	12. Caritas	
13. State Government of West Bengal	13. EERI	
14. State Government of Gujarat	14. National Geophysical Research Institute, Hyderabad	
15. State Government of Rajasthan	15. Indian Materials Elliptical Department	
16. State Government of Andra Pradesh	16. Asdaram Trust	
17. Bank of India	17. AWARE	
18. Indian Army, 60 companies	18. Balaji Mandir Trust,	
19. Prime Minister's Relief Fund	19. Bhagwan Mahavir Viklany	
20. Chief Minister's Relief Fund, Maharashtra	20. Handicapped Trust	
21. Maharashtra Civil Defense Unit, Bombay	21. Help India	
22. Police Department, Killari	22. Indian Red Cross, National Headquarters	

Public

23. State Transport, Maharashtra Department of Tourism
24. Maharashtra Health Dep't
25. Forest Department
26. Irrigation Department
27. Telephone Department
28. Electricity Board
29. Buildings & Communication s Department
30. National Cadet Corps, Cadets, 38th Maharashtra Battalion
31. National Cadet Corps, Cadets, Sangameshwar College
32. Bank of Maharashtra

Nonprofit

23. Indira Beti Trust
24. Institute to Help Physically Handicapped
25. Jain Social Group
26. Jan Kalyan Samiti (Peoples' Welfare Committee)
27. Latur District Traders Association
28. Lions Club
29. Madhav Sathe Trust
30. MHADA , Maharashtra Housing and Development Association, Resettlement Plan
31. Maheshwari Bhuvan
32. MANAVLOK (Marathwada Navnirman Lokayat 33. Mangal Karyalaya
34. Manaswini - women's wing of MANAVLOK
35. Morari Bapu Trust
36. National Service Scheme (NSS)
37. Ramakrishna Mission
38. Rashtra Sevika Mandal
39. RSD - Rashtriya Seva Dal, Pune
40. Rashtriya Swayamsevak Sangh
41. Red Cross, Kerala
42. Red Cross, Rajasthan

Nonprofit

43. Red Cross,Andra Pradesh
44. Rotary Club of Bombay
45. Rotary Club of Solapur
46. Sadbhavana, Solapur (Good Will)
47. Savali
48. Secturam Trust
49. Seetaram Seva Trust
50. Sevashrana
51. Stree Adhar Kendra from Pune
52. Solapur Sanjeevani Trust, Bombay
53. Subayata Samiti
54. Sudhu Vasvani
55. Swapna Bhuri
56. YUVA from Bombay
57. Balaji Mandir
58. Kumar Mahavidyalaya
59. N.S.B.X.
60. Vishwa Hindu Parishad - Bajrang Dal
61. Baldan Tarun Mandal
62. Sub-Ordinate Engineers - M.S.E.B.
63. Home Guards -
64. Girls' Backward Caste Hostel
65. Congress Party 66. Youth Congress 67. BJP - Bhartiya Janta Party
68. RSS - Rashtriya Swayamsevak Sangh

Nonprofit

69. Shiv Sena Party
70. Solapur Sahakari Hospital
71. Wadia Hospital
72. ESIS Hospital
73. Dhanarajgiri Hospital
74. Ashwini Hospital
75. Shirgopikar Hospital
76. Valasankar Hospital
77. Bhavani Hospital
78. Bhalachandra Blood Bank
79. Vivekanand Hospital
80. Dr. Vaishmpayan Memorial Medical College
81. Karnataka Health Institute

Table 5

National Organizations Involved in Disaster Response Identified from Print Media, Marathwada Earthquake, September 30, 1993

Public	Nonprofit	Private
1. General Hospital	1. National Geophysical Research Institute, Hyderabad	1. Artificial Limbs Manufacturing Association, Kanpur
2. Railway Hospital	2. Indian Materials Elliptical Department	2. Institute of the Physically Handicapped, New Delhi
3. Ambajogai Medical College	3. Asdaram Trust	3. Worth Industries, Vellore
4. Government of India	4. AWARE	4. trader organizations
5. State Government of West Bengal	5. Balaji Mandir Trust,	
6. State Government of Gujarat	6. Bhagwan Mahavir Viklany	
7. State Government of Rajasthan	7. Handicapped Trust	
8. State Government of Andra Pradesh	8. Help India	
9. Bank of India	9. Indian Red Cross, National Headquarters, New Delhi	
10. Indian Army, 60 companies	10. Indira Beti Trust	
11. Prime Minister's Relief Fund	11. Institute to Help Physically Handicapped	
12. Chief Minister's Relief Fund, Maharashtra	12. Jain Social Group	
13. Maharashtra Civil Defense Unit, Bombay	13. Jan Kalyan Samiti (Peoples' Welfare Committee) 14. Latur District Traders Association	
14. Police Department, Killari	15. Lions Club	
15. State Transport, Maharashtra Department of Tourism	16. Madhav Sathe Trust	
16. Maharashtra Health Dep't	17. MHADA, Maharashtra Housing and Development Association, Resettlement Plan	
17. Forest Department	18. Maheshwari Bhuvan	
18. Irrigation Department		
19. Telephone Department		

Public

20. Electricity Board
21. Buildings & Communications Department
22. National Cadet Corps, Cadets, 38th Maharashtra Battalion
23. National Cadet Corps, Cadets, Sangameshwar College
24. Bank of Maharashtra

Nonprofit

19. MANAVLOK (Marathwada Navnirman Lokayat
20. Mangal Karyalaya
21. Ramakrishna Mission
22. Rashtra Sevika Mandal
23. Manaswini - women's wing of MANAVLOK
24. Morari Bapu Trust
25. National Service Scheme (NSS)39. RSD - Rashtriya Seva Dal, Pune
26. Rashtriya Swayamsevak Sangh
27. Red Cross, Kerala
28. Red Cross, Rajasthan
29. Red Cross, Andra Pradesh
30. Rotary Club of Bombay
31. Rotary Club of Solapur
32. Sadbhavana, Solapur (Good Will)
33. Savali
34. Secturam Trust
35. Seetaram Seva Trust
36. Sevashrana
37. Stree Adhar Kendra from Pune
38. Solapur Sanjeevani Trust, Bombay
39. Subayata Samiti
40. Sudhu Vasvani
41. Swapna Bhuri
42. YUVA from Bombay
43. Balaji Mandir
44. Kumar Mahavidyalaya
45. N.S.B.X.

Nonprofit

46. Vishwa Hindu Parishad - Bajrang Dal
47. Baldan Tarun Mandal
48. Sub-Ordinate Engineers M.S.E.B.
49. Home Guards - 50. Girls' Backward Caste Hostel
51. Congress Party 52. Youth Congress 53. BJP - Bhartiya Janta Party
54. RSS - Rashtriya Swayamsevak Sangh
55. Shiv Sena Party
56. Solapur Sahakari Hospital
57. Wadia Hospital
58. ESIS Hospital
59. Dhanarajgiri Hospital
60. Ashwini Hospital
61. Shirgopikar Hospital
62. Valasankar Hospital
63. Bhavani Hospital
64. Bhalachandra Blood Bank
65. Vivekanand Hospital
67. Dr. Vaishmpayan Memorial Medical College
68. Karnataka Health Institute

Table 6

International Organizations Involved in Disaster Response Identified from Print Media, Marathwada Earthquake, September 30, 1993

Public

1. Britain/UK
2. Netherlands
3. Pakistan
4. Kuwait
5. Algeria
6. Singapore
7. China
8. U.S.

Nonprofit

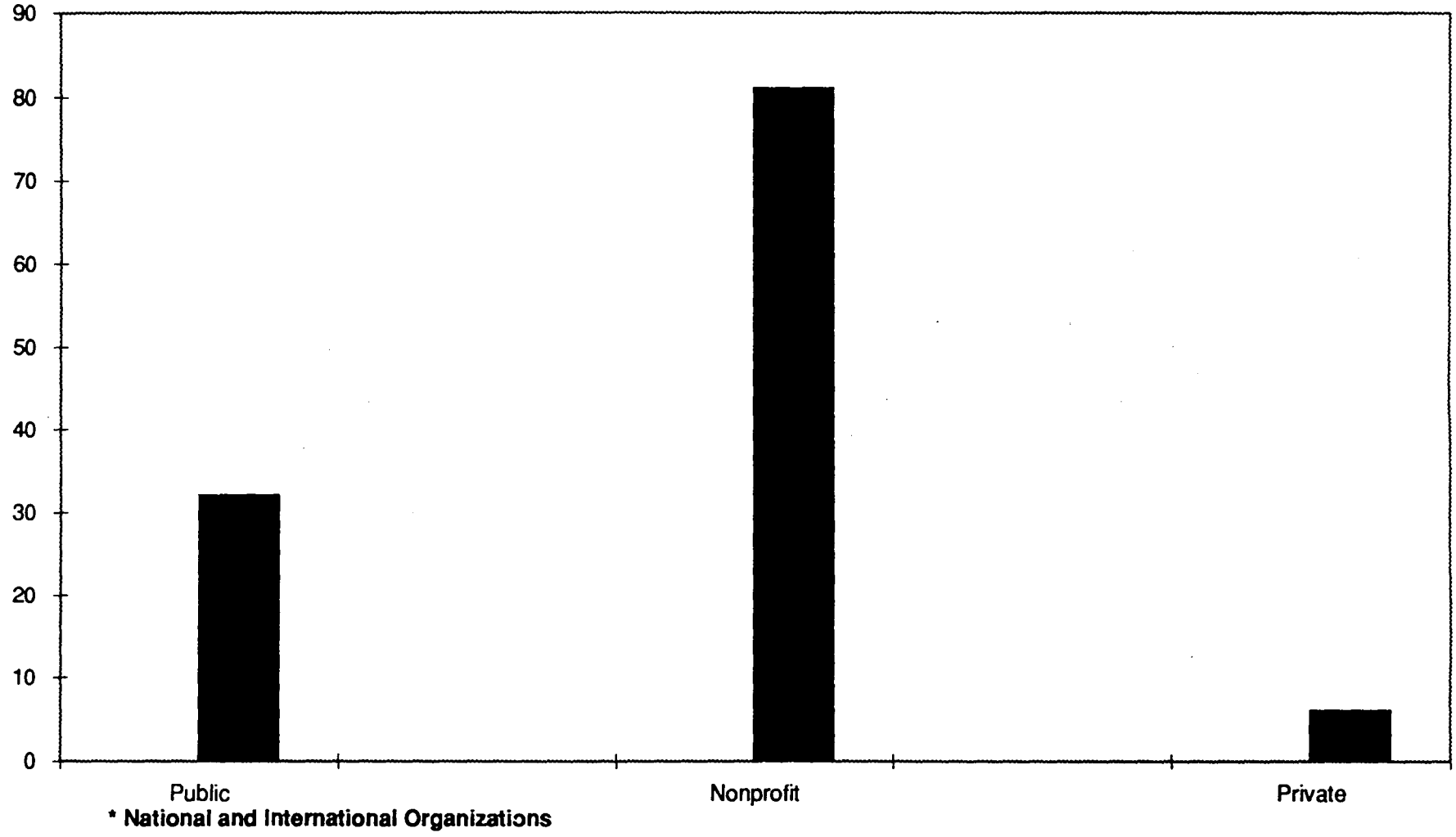
1. Medecins sans Frontieres
2. UNICEF
3. Japanese Red Cross
4. International Red Cross
5. Rotary Internat'l
6. French Search and Rescue team
7. OXFAM
8. International Commitee of the Red Cross
9. World Vision
10. Terre des Hommes
11. Lutheran World Service
12. Caritas
13. EERI

Private

1. CNN
2. BBC

Figure 4

Total Disaster Response System
Marathwada Earthquake, September 30, 1993*



*** National and International Organizations**

Figure 5

International and National Organizations Involved in Disaster Response
Marathwada Earthquake, September 30, 1993

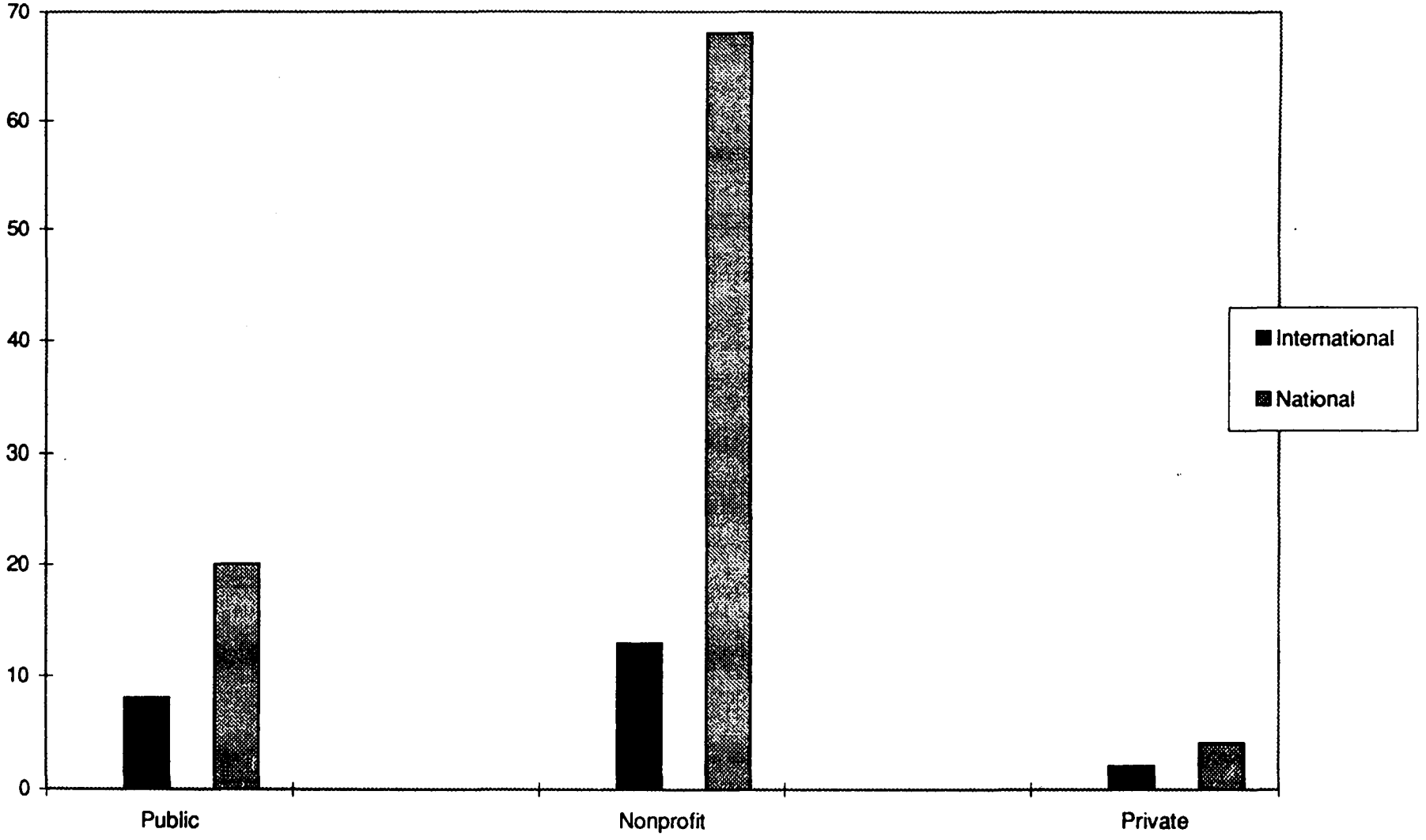


Table 7

SAMPLE CHARACTERISTICS, SURVEY OF ORGANIZATIONAL RESPONSE, MARATHWADA, INDIA EARTHQUAKE, September 30, 1993

Type of Organization:

	Respondents		Organizations	
	N	%	N	%
Public organizations:				
Village:	12	25.0	12	27.9
Municipal:	2	4.2	2	4.7
Taluka (Sub-district):	1	2.1	1	2.3
District level:	4	8.3	3	7.0
State Level:	5	10.4	5	11.6
Nonprofit organizations:	19	39.5	17	39.5
Private organizations:	3	6.3	2	4.7
Other/Individual:	2	4.2	1	2.3
Total:	48	100.0	43	100.0

Total voluntary organizations identified working in Latur and Osmanabad Districts: 76 - sample: 17, approximately 22%

Sex:

	N	%
Men:	38	78
Women	10	22
Total respondents:	48	100

Location of Interview:

	N	%
Latur District	19	39.6
Osmanabad District	11	22.9
Solapur	8	16.7
Bombay	8	16.7
Other	2	4.2
Total	48	100.0

Religion:

Predominantly Hindu, although population in the earthquake-affected villages was 10.2% Muslim in Latur and 8% Muslim in Osmanabad. Forty-five out of forty-eight, or 93.7%, persons interviewed were Hindu.

The levels of administrative jurisdiction reveal the interdependent boundaries of the system; nonprofit organizations cross jurisdic- tional boundaries and focus on specific needs or tasks.

Table 8

Sampling Distribution by Organization and Funding Source

Organization	Funding Source	N: of Interviews
1. Rashtra Seva Dal	NPO/Humanitarian	1
2. Former Untouchables	Other	1
3. Savali	NPO	1
4. Manavlok	NPO	1
5. Individual	Public/State	1
6. Jan Kalyan Samiti	NPO	2
7. Solapur General Hospital	Public/NPO (Mixed)	1
8. N.M. Wadia Charitable Hospital	Private/NPO (Mixed)	2
9. Indian Red Cross	NPO	1
10. Tarun Bharat	Private	2
11. I.A.S. District Collector (Solapur)	Public/District	1
12. I.A.S. District Collector (Latur)	Public/District	1
13. Voluntary Org. Coordination Comm.	NPO/District Level	1
14. I.A.S. District Collector (Osmanabad)	Public/District	1
15. Person (interview #17)	Other	1
16. Deputy Sarpanch, Sastur	Public/Local	1
17. Village Council, Killari	Public/Local	1
18. School, Koral (interview #20)	Public/Local	1
19. Village Level Worker	Public/Local	1
20. Sarpanch, Koral	Public/Local	2
21. Health Department, Omerga	Public/Local	1
22. I.A.S. Municipal Commissioner	Public/Municipal	1
23. Indian Administrative Service	Public/National	1
24. Tata Relief Committee	NPO/State Level	1
25. Subdistrict Manager, Tahsildar	Public/Municipal	1
26. Pardhewadi Vikasmandal	Public/Municipal	1
27. Sarpanch, Village Salegaon	Public/Local	1
28. Patil (police), Village Udatpur	Public/Local	1
29. Sarpanch, Village Nadihattaraga	Public/Local	1
30. Sarpanch, Village Pardhewadi	Public/Local	1
31. Deputy Sarpanch, Village Killari	Public/Local	1
32. Ramakrishna Mission	NPO/Religious	1
33.Society for Promotion of Area Resource Cntr.	NPO/National Level	1
34. Shiv Sena Party, Legislative Assembly	Public/National*	1
35. Regional Mental Hospital	Public/National*	1
36. Nari Prabodhan Manch	NPO	1
37. SOS Village	NPO/International	1
38. Western Coalfields	Private	1
39. Sarvoday Medico Educational Society	NPO	1
40. Action for Welfare and Rural Awakening	NPO	1
41. Indian Red Cross Society	NPO	1
42. Swaminaryan Temple Trust	NPO/Religious	1
43. Gov't of Maharastra, Chief Secretary	Public/State	1
44. Gov't of Maharashtra,EQ Rehabilitation Cell	Public/State	1
Total Interviews		48

*Functioning at the State Level

In constructing the sample, we overrepresented public organizations to include the five interdependent levels of administrative responsibility as well as the three categories of damage from each of the heavily affected districts, Latur and Osmanabad. By specifically including these elements in the design of a small sample, we assured a more representative, and thus more independent, distribution of responses than by random selection. At the village level, respondents were selected by function within the village structure, representing different units of performance in village governance.

Since the study focused particularly on the role of voluntary organizations in disaster response, we included in our sample respondents from the various types of voluntary organizations. The Voluntary Organizations Coordination Committee, formed at the request of the Latur District Collector, identified 76 voluntary organizations engaged in disaster response, relief, and recovery activities in the Latur and Osmanabad Districts.[5] The sample included 17 voluntary organizations, 22.4% of this total. Nonprofit organizations create an important dynamic in disaster operations, as they cross jurisdictional boundaries and focus on specific needs or tasks. Their actions, in turn, generate constructive response from the wider population and indeed from the disaster-affected people they seek to serve. The high proportion of voluntary organizations engaged in response to this disaster had an important effect in stimulating innovative means of coping in local conditions.

Table 9 presents the distribution of goals reported by respondents for the work of their respective organizations in disaster response and recovery. The largest proportion of respondents, 45.8% stated humanitarian goals of protection of life and property as their primary basis for action. The second highest proportion, 22.5%, reported political/administrative goals of returning order to the damaged communities. Health-related goals represented a small, but significant proportion, 12.5%. Figure 6 presents a graphic distribution of goals reported for disaster response.

The disaster response system performed a range of transactions reported by respondents from participating organizations. Table 10 presents the distribution of types of transactions, or disaster response activities, performed by organizations reported by jurisdictional levels and funding sources. Interestingly, respondents from public organizations at state, district, municipal, and local levels of jurisdiction reported that 20 - 30% of

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[5] Computerized print-out of voluntary organizations engaged in disaster response and relief operations, provided by Nalin Sheth, Chair, Voluntary Organizations Coordination Committee. Interview, Latur, India, December 23, 1993.

Table 9

Distribution of Goals Reported by Organizations
Participating in Disaster Operations:
Marathwada Earthquake, September 30, 1993

	N	%
Religious	2	4.17
Political/Administrative	11	22.92
Economic	2	4.17
Humanitarian	22	45.83
Health-Related	6	12.50
Social:		
a)Women's Groups	2	4.17
b)Caste Groups	1	2.08
c)Individuals	2	4.17
Total Goals:	48	100.00

Figure 6

Distribution of Goals Reported by Organizations Participating in Disaster Operations: Marathwada Earthquake, September 30, 1993

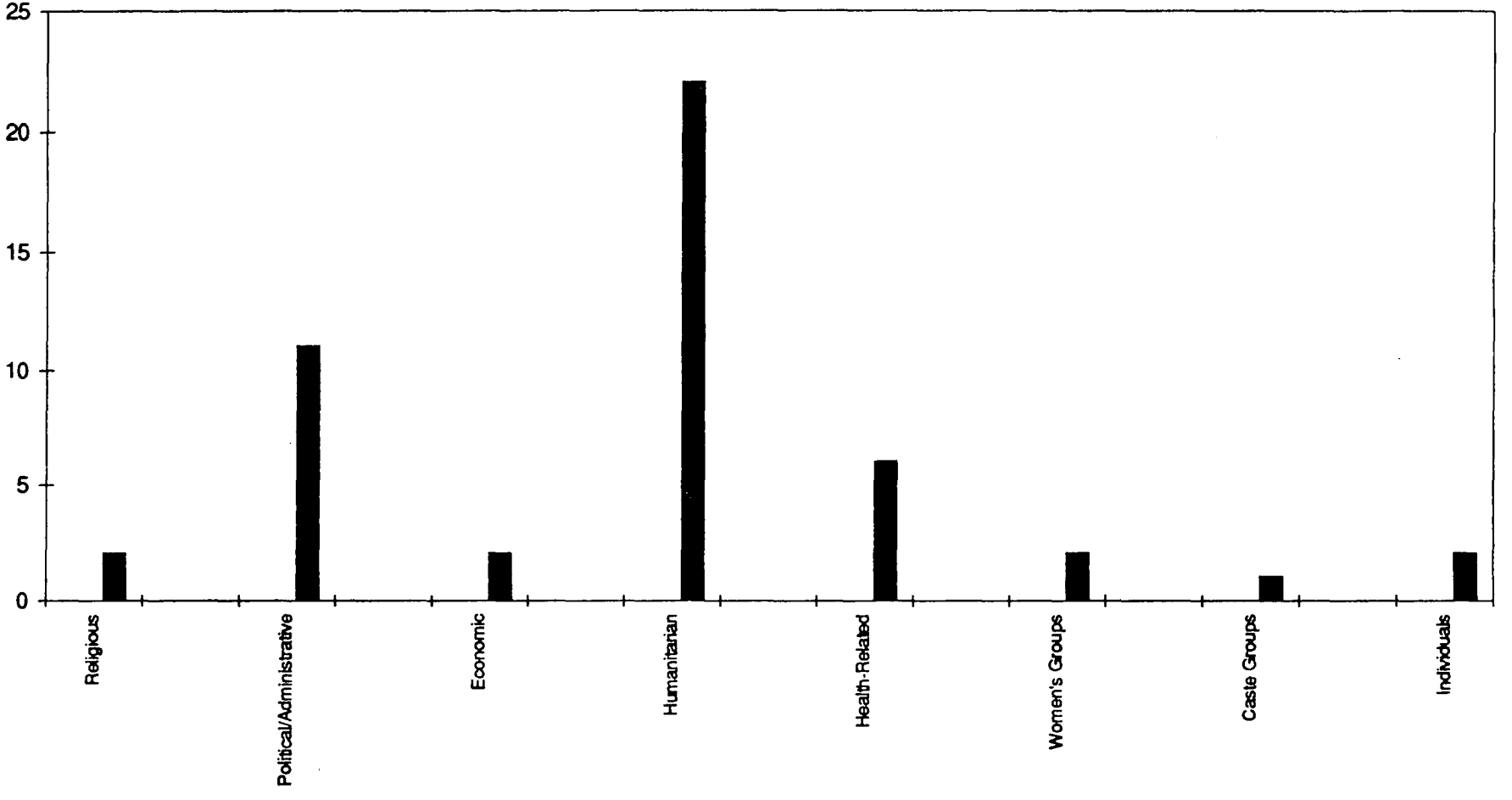


Table 10

Frequency Distribution of Types of Transactions Performed in Disaster Response Reported by Primary Funding Source

					Public													
	State		District		Municipal		Subdistrict		Local		Nonprofit		Private		Mixed		Other		Total	
Type of Transaction	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Search and Rescue	1	4.17	0	0.00	1	5.26	1	16.67	7	12.73	2	2.13	0	0.00	0	0.00	0	0.00	12	4.41
Medical/Health Care to Injured	3	12.50	2	7.14	2	10.53	0	0.00	3	5.45	12	12.77	0	0.00	29	93.55	1	16.67	52	19.12
Extraction/Cremation of Dead	0	0.00	2	7.14	2	10.53	1	16.67	2	3.64	6	6.38	0	0.00	1	3.23	0	0.00	14	5.15
Communication/ Coordination	7	29.17	6	21.43	5	26.32	0	0.00	13	23.64	11	11.70	6	66.67	1	3.23	3	50.00	52	19.12
Damage/Needs Assessment	1	4.17	2	7.14	1	5.26	2	33.33	7	12.73	5	5.32	1	11.11	0	0.00	2	33.33	21	7.72
Disaster Relief: Food, Water, Shelter, Clothing, Household Goods	2	8.33	7	25.00	8	42.11	1	16.67	8	14.55	24	25.53	0	0.00	0	0.00	0	0.00	50	18.38
Logistics/Transportation	4	16.67	5	17.86	0	0.00	0	0.00	3	5.45	2	2.13	0	0.00	0	0.00	0	0.00	14	5.15
Recovery/Reconstruction: Housing, Sanitation, Agriculture	5	20.83	4	14.29	0	0.00	1	16.67	7	12.73	20	21.28	2	22.22	0	0.00	0	0.00	39	14.34
Educational: Restoring Schools	1	4.17	0	0.00	0	0.00	0	0.00	5	9.09	7	7.45	0	0.00	0	0.00	0	0.00	13	4.78
Social: Women, Children, Widows	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	5	5.32	0	0.00	0	0.00	0	0.00	5	1.84
Total Transactions	24	100.00	28	100.00	19	100.00	6	100.00	55	100.00	94	100.00	9	100.00	31	100.00	6	100.00	272	100.00

Percentages are calculated by column total.

Table 11

Frequency Distribution of Types of Transactions Performed in Disaster Response Reported by Primary Funding Source

	Public																			
	State		District		Municipal		Subdistrict		Local		Nonprofit		Private		Mixed		Other		Total	
Type of Transaction	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Search and Rescue	1	0.37	0	0.00	1	0.37	1	0.37	7	2.57	2	0.74	0	0.00	0	0.00	0	0.00	12	4.41
Medical/Health Care to Injured	3	1.10	2	0.74	2	0.74	0	0.00	3	1.10	12	4.41	0	0.00	29	10.66	1	0.37	52	19.12
Extraction/Cremation of Dead	0	0.00	2	0.74	2	0.74	1	0.37	2	0.74	6	2.21	0	0.00	1	0.37	0	0.00	14	5.15
Communication/ Coordination	7	2.57	6	2.21	5	1.84	0	0.00	13	4.78	11	4.04	6	2.21	1	0.37	3	1.10	52	19.12
Damage/Needs Assessment	1	0.37	2	0.74	1	0.37	2	0.74	7	2.57	5	1.84	1	0.37	0	0.00	2	0.74	21	7.72
Disaster Relief: Food, Water,Shelter, Clothing,Household Goods	2	0.74	7	2.57	8	2.94	1	0.37	8	2.94	24	8.82	0	0.00	0	0.00	0	0.00	50	18.38
Logistics/Transportation	4	1.47	5	1.84	0	0.00	0	0.00	3	1.10	2	0.74	0	0.00	0	0.00	0	0.00	14	5.15
Recovery/Reconstruction: Housing,Sanitation, Agriculture	5	1.84	4	1.47	0	0.00	1	0.37	7	2.57	20	7.35	2	0.74	0	0.00	0	0.00	39	14.34
Educational: Restioring Schools	1	0.37	0	0.00	0	0.00	0	0.00	5	1.84	7	2.57	0	0.00	0	0.00	0	0.00	13	4.78
Social: Women, Children, Widows	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	5	1.84	0	0.00	0	0.00	0	0.00	5	1.84
Total Transactions	24	8.82	28	10.29	19	6.99	6	2.21	55	20.22	94	34.56	9	3.31	31	11.40	6	2.21	272	100.00

Percentages are calculated by total transactions.

Figure 7

Frequency Distribution of Types of Transactions in Disaster Response by All Organizations, Marathwada Earthquake, September 30, 1993

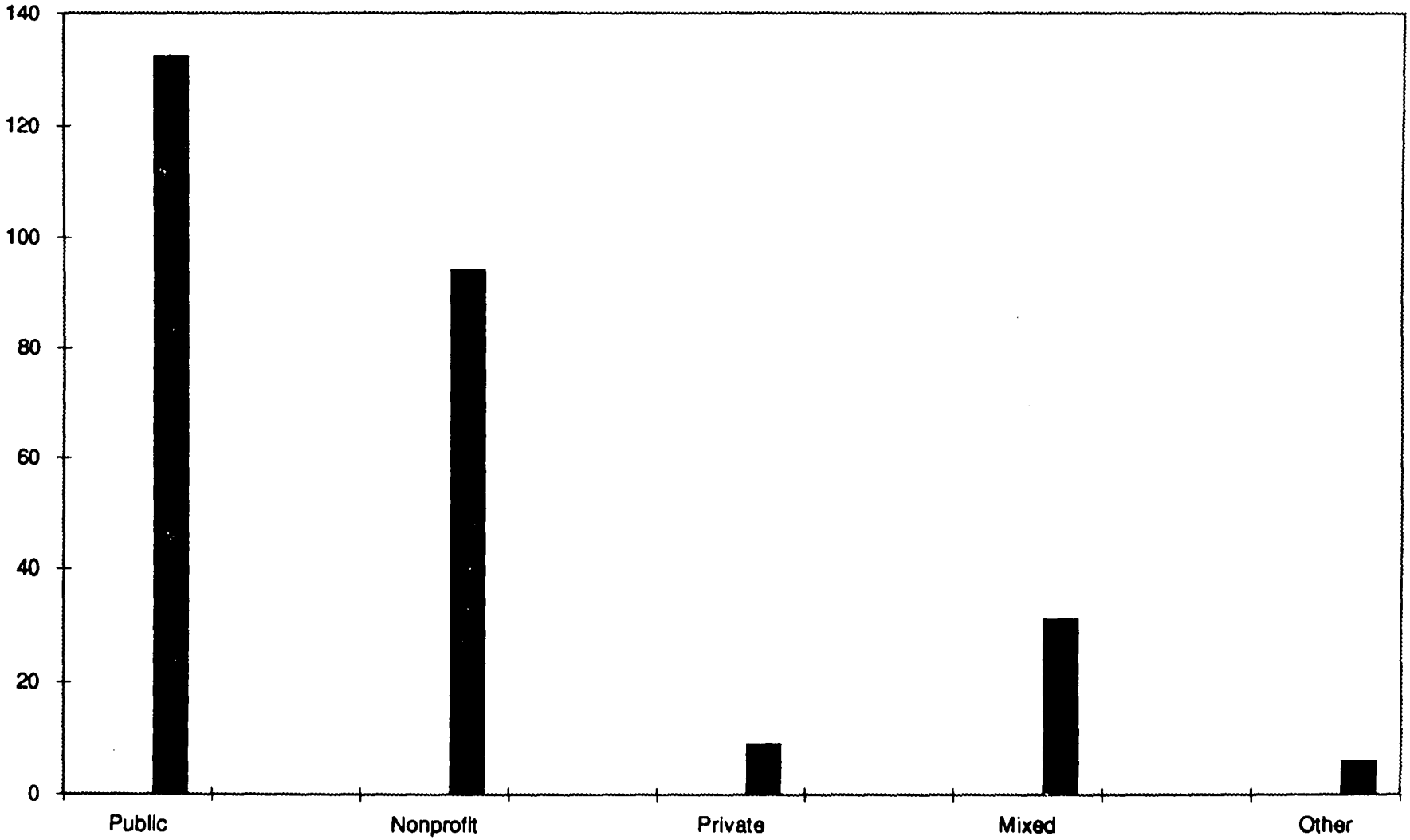
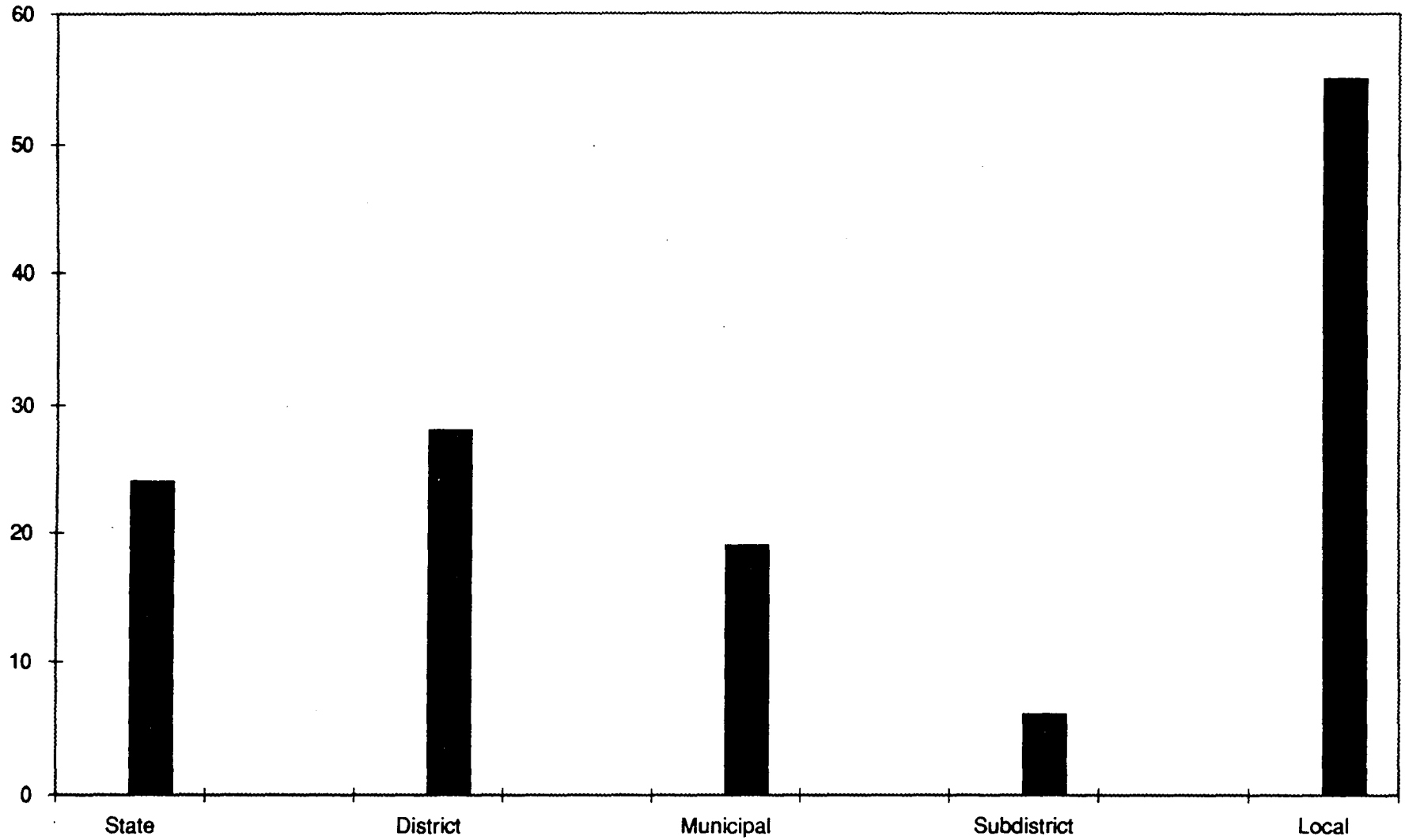


Figure 8

Frequency Distribution of Types of Transactions In Disaster Response by Public Organizations, Marathwada Earthquake, September 30, 1993



their transactions involved communication and coordination of response operations. This finding documents the primary role of governmental agencies in coordinating the response effort through interjurisdictional communication and support. Nonprofit organizations reported the highest number of transactions in providing direct disaster relief, 25.5%, and secondly, in reconstruction, 21.3%. Private organizations, only six of the 119 organizations in the total response system, were involved primarily in communication (media organizations) and reconstruction. Table 11 presents the same distribution of transactions with percentages calculated by total transactions. This table shows that public organizations performed nearly half, or 48.4% of the total transactions reported in disaster response, while nonprofit organizations performed more than a third, or 34.6%, of the total number of reported transactions. Figure 7 shows the distribution of transactions by type of organization, and Figure 8 shows the breakdown of transactions performed by public organizations by jurisdictional level.

The interactions among organizations participating in the disaster response system reveal clusters of dense interactions and also gaps in performance. Table 12 presents the distribution of interactions among organizations engaged in disaster response, with percentages calculated by column, and Table 13 presents this same distribution with percentages calculated by total interactions. Governmental organizations each jurisdictional level interacted most frequently with organizations of other types, and accounted for 52.6% of the total interactions. Medical/health organizations, although interacting highly with other medical/health organizations, accounted for nearly 22% of the total interactions. Nonprofit or charitable organizations tended to work more independently, nonetheless accounted for 19.7% of the total interactions among organizations in the disaster response system. Combined, these three types of organizations clearly shaped the response process, accounting for 94.2% of the total interactions reported by the respondents to the survey.

Discussion

Three conditions had a powerful effect upon the capacity on the emergence of a disaster-response system in this rural, poor region of India. First, in 1988, the Government of India invested in a national satellite communications system, and located downlinks to the National Satellite in the offices of the District Collectors. This communications system allowed multi-way communications between the State of Maharashtra offices in Bombay and other district and state offices in India.[6] Using the satellite system as the base communications network, computer links

[6] Praveen Pardeshi, District Collector, Latur. Interview, December 22, 1993.

Table 12

Frequency Distribution of Interactions Between Organizations in Disaster Response

	Medical/ Health		Governmental		Political		Charitable/ NPO		Educational		Humanitarian/ Religious		Professional		Commercial		Other		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Medical/Health	16	72.73	7	12.73	3	27.27	4	7.41	1	20.00	1	20.00	2	50.00	4	30.77	0	0.00	38	21.97
Governmental	4	18.18	34	61.82	6	54.55	36	66.67	3	60.00	2	40.00	0	0.00	4	30.77	2	50.00	91	52.60
Charitable/NPO	2	9.09	11	20.00	2	18.18	12	22.22	1	20.00	0	0.00	0	0.00	4	30.77	2	50.00	34	19.65
Educational	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	50.00	0	0.00	0	0.00	2	1.16
Humanitarian/ Religious	0	0.00	0	0.00	0	0.00	1	1.85	0	0.00	1	20.00	0	0.00	0	0.00	0	0.00	2	1.16
Professional	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	1	1.82	0	0.00	1	1.85	0	0.00	0	0.00	0	0.00	1	7.69	0	0.00	3	1.73
Other	0	0.00	2	3.64	0	0.00	0	0.00	0	0.00	1	20.00	0	0.00	0	0.00	0	0.00	3	1.73
Total	22	100.00	55	100.00	11	100.00	54	100.00	5	100.00	5	100.00	4	100.00	13	100.00	4	100.00	173	100.00

Percentages calculated by column totals

Table 13

Frequency Distribution of Interactions Between Organizations in Disaster Response

	Medical/ Health		Governmental		Political		Charitable/ NPO		Educational		Humanitarian/ Religious		Professional		Commercial		Other		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Medical/Health	16	9.25	7	4.05	3	1.73	4	2.31	1	0.58	1	0.58	2	1.16	4	2.31	0	0.00	38	21.97
Governmental	4	2.31	34	19.65	6	3.47	36	20.81	3	1.73	2	1.16	0	0.00	4	2.31	2	1.16	91	52.60
Charitable/NPO	2	1.16	11	6.36	2	1.16	12	6.94	1	0.58	0	0.00	0	0.00	4	2.31	2	1.16	34	19.65
Educational	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	1.16	0	0.00	0	0.00	2	1.16
Humanitarian/ Religious	0	0.00	0	0.00	0	0.00	1	0.58	0	0.00	1	0.58	0	0.00	0	0.00	0	0.00	2	1.16
Professional	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	1	0.58	0	0.00	1	0.58	0	0.00	0	0.00	0	0.00	1	0.58	0	0.00	3	1.73
Other	0	0.00	2	1.16	0	0.00	0	0.00	0	0.00	1	0.58	0	0.00	0	0.00	0	0.00	3	1.73
Total	22	12.72	55	31.79	11	6.36	54	31.21	5	2.89	5	2.89	4	2.31	13	7.51	4	2.31	173	100.00

Percentages calculated by total number of interactions.

operated between the cities of Solapur, Omerga, Latur, and Osmanabad. Within the cities, microwave links established two-way communication among city offices involved in disaster response. Within the villages, volunteers manned wireless stations to connect them with the larger network.[7] Using this communications network, the Chief Secretary of the State Government of Maharashtra established a "hot line" that connected him to all villages in quake-affected areas.[8]

Second, the Indian Administrative Service (IAS) has established a professional corps of educated public administrators that share a common background of professional training, accept a common set of responsibilities towards developing the capacities of the citizenry in their jurisdictions, and represent a strong presence of the national government in state and local jurisdictions. Most officers have also had some experience with disaster response as part of their IAS training.[9] The IAS provided a national pool of trained professional administrators from which emergency assistance during disaster operations were drawn. Within two days of the earthquake, 32 secretaries of I.A.S. rank were reassigned to disaster response. Chief Secretary Raghunathan, Maharashtra State, coordinated their work and assigned their tasks in disaster response.[10] Four additional collectors were assigned to the two most heavily affected districts (two to Osmanabad and two to Latur). All tahsildars, or local subdistrict administrators, from neighboring districts of Nasik, Pune, and Amararati were summoned to work on disaster response.[11]

Third, the strong Hindu tradition of humanitarian values provided a core set of widely shared beliefs that reinforced actions to help others. This philosophical approach underlay many of the actions taken by individuals and voluntary groups to assist the victims of the disaster in the villages of Latur and Osmanabad.[12] It contributed substantively to the high degree of participation by individuals in voluntary organizations, and the high proportion of voluntary organizations represented in this disaster

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[7] Interview, Dineshkumar Jain, I.A.S., District Collector, Solapur, India, December 22, 1993.

[8] Lokasatta, Marathi daily. Bombay, India: October 4, 1993.

[9] Dinesh Kumar Jain, District Collector, Solapur. Interview, December 22, 1993.

[10] Lokasatta, Marathi daily, Bombay. October 8, 1993.

[11] Lokasatta, Marathi daily, Bombay, October 5, 1993.

[12] Dr. Eknath Godbole, Cardiologist and Attending Physician, N.M. Wadia Hospital, Solapur. December 21, 1993.

response system.

These three conditions created a structure of communication channels and shared values through which information could flow rapidly among participating decision makers.

Conclusions

The Maharashtra Disaster Response provides a very interesting example of an evolving complex system. Five conclusions can be drawn from these findings:

1. The Indian national satellite communications system and its extended network of wireless and ham radio transmission provided sufficient technical structure for communications processes to support the rapid evolution of a complex disaster response system.

2. The Indian Administrative Service, using the technical information structure, provided sufficient organizational structure to hold and exchange information among the wider set of participating agencies and jurisdictions.

3. The classic goal of protecting life and property in disaster served as focus for disaster response operations and bounded the evolving response system. This goal was reinforced by the strong participation of nonprofit voluntary organizations who were committed to humanitarian aid and of religious organizations who were committed to humanitarian ideals.

4. The flexibility shown by the leadership in public, nonprofit, and private organizations, which may be a characteristic shaped by limited resources, combined with the advanced technical communications capacity and humanitarian goals of the response system to create a remarkable set of conditions that favored the development of self organizing systems at the community level in response to needs generated by the Marathwada Earthquake.

5. Self organization constitutes an important element in the process of transition from response to recovery following disaster, and requires timely, accurate information, communication, and administrative processes to support it.

SOURCES

In addition to the set of semi-structured interviews used for this study, other documentary materials provided insight and information regarding the evolving disaster response process. These sources include the following:

Official Reports:

1. 30th September 1993 Earthquake, District Osmanabad: A Status Report on Relief & Rehabilitation of the Earthquake Victims in Omerga Taluka, District Osmanabad, Maharashtra. District Collector, Osmanabad. October 30, 1993. Osmanabad, India.
2. 30th September 1993,03:54 hours, Latur: A Comprehensive Note on Latur Earthquake. Vimilendra Sharan, Omprakash Gupta, Sanjay Sethi under the guidance of Shri Praveensingh Pardeshi, Collector, Latur; Shri Anil Diggikar, Assistant Collector (Rehabilitation) Latur, December 13, 1993. Latur, India.
3. Government of Maharashtra. 1993. Preliminary Report, 30th September 1993 Earthquake, Maharashtra State. Bombay, India.
4. Tata Institute of Social Sciences. 1994. Survey of People Affected by Earthquake in Latur and Osmanabad Districts (1993): Joint Action Group of Institutions for Social Work Education. Bombay, India. Final Report. February.
5. World Bank. 1994. Report on Marathwada Earthquake. Aide Memoire: India Maharashtra Emergency Earthquake Reconstruction Credit Appraisal Mission (4-29 January 1994). Draft, January 27, 1994.
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7. Earthquake Rehabilitation Cell, Goverment of Maharashtra. 1994. Rehabilitation Action Plan for Persons Affected by Land Acquisition. Bombay, India: 19 March.
8. Osmanabad Collectorate. 1993. Earthquake Relief Report of Osmanabad District. Statement showing Relief Operations Work in Earthquake Affected Villages of Omerga Taluka.
9. Monthly Report, October, 1993. Center for Monitoring the Indian Economy. Bombay.

Reports, Voluntary Organizations:

1. Voluntary Organisations Co-ordination Committee, (Earthquake Relief). C/O Nalin H. Sheth, Opp. Suhana Hotel, Latur 413 512. List of voluntary organizations by name, phone, contact person, activity, village adopted, help needed, rehabilitation. 8 pp. Fall, 1993.
2. Government of Maharashtra. 1993. A Villagewise Profile of NGOs Operating in Osmanabad and Latur Districts for the Long-term Rehabilitation of the Earthquake Affected. 6 pp.
3. Government of Maharashtra. 1993. List of Donor Agencies by Village, Latur and Osmanabad District.

4. Voluntary Organisations Co-ordination Committee. Report on Earthquake Relief. October 14, 1993.
5. Correspondence between the Community for Human Development, Bombay, India and Nalin Sheth, Chair, Voluntary Organisations Coordination Committee re: Earthquake Relief. November 8, 23,24; December 8, 1993. [Shows interaction between Bombay headquarters and local Latur field office.]
6. Desai, N.K. 1993. Report of Earthquake Relief Work, Indian Red Cross Society, Solapur District Branch. Solapur, India: Indian Red Cross Society.
7. Indian Red Cross Society, Solapur District Branch. 1993. Annual Report, 1992-1993. Solapur, India.
8. Indian Red Cross Society, Solapur District Branch. 1993. Statement showing Receipt and Distribution and Stock of Relief Material from 4-10-93 to 31-20-93. Solapur, India.
9. Assistance Gained from Voluntary Organisations for Earthquake Victims. (11 Voluntary Organisations.
   1) N.S.U.I. (National Students Union of India) Students' Wing of Congress Party (right wing pol. party)
   2) R.S.S. Rashdriya Swayamsevak Sangha (right wing)
   3) B.J.P. Bharatiya Janata Party (A.V.B.P. - Students' Wing of B.J.P.) (right wing)
   4) Vishwa Hindu Parishad - Bajrang Dal. (voluntary org.)
   5) Balidan Tarum Mandal - voluntary organization (altruistic)
   6) National Cadet Corps (NCC) - 38 Maharashtra Battalion
   7) NCC - Sangameshwar College
   8) Sub-Ordinate Engineers - M.S.E.B. Maharashtra State Engineering Board
   9) Bank of Maharashtra
   10) Home-Guards (Indian equivalent of Civil Defense; engage in rescue operations)
   11) Backward Caste Girls Hostel
10. Nursing Staff Working for Earthquake Victims who were admit ted to Solapur General Hospital, October, 1993.
11. Ramakrishna Mission, Khar, Bombay. General Report, April 1992 - March, 1993. Brief Report of Work done for Maharashtra Earthquake Relief and Rehabilitation.

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1. Earthquake Engineering Research Institute. 1993. The Killari Earthquake of September 30, 1993. Bombay, India and Oakland, CA.
2. Place Wise List of Patients Affected Due to Earthquake. October 30, 1993. [Given to us in Latur by Nalin Sheth in December, 1993.] List prepared by the Voluntary Organizations Coordination Committee, at the request of the Latur Collector ate. Latur.
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6. Poptani, Dr. December, 1993. General Statistics for Earthquake Related Patients Treated in N.M. Wadia Hospital, Solapur.
7. N.M. Wadia Hospital. 1993. List of Voluntary Organisations Providing Relief to Patients at the Hospital, by Organisation and Type of Relief, October, 1993.
8. List of Rural Hospitals outside Solapur and Adjoining Talukas with government-appointed physicians.
9. List of positions at N.M. Wadia Charitable Hospital: positions approved (22); positions filled (21); positions vacant (1).
10. Vigne, Jacques. 1993. Counselling the Quake Hit: A French Psychiatrist in Latur. October.
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1. The Times of India. Bombay, India. October 1, 3, 7, 1993.
2. The Hindustan Times. New Delhi. October 1, 2, 1993.
3. The Statesman. Calcutta. October 1, 2, 3, 5, 6, 7, 10, 1993.
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