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Title: IT in Disaster Management: A Case Study of Earthquake in Jammu & Kashmir (year 2005), India

Abstract

India has been traditionally vulnerable to natural disasters on account of its unique geo-climatic conditions. The super cyclone in Orissa in October, 1999 the Bhuj earthquake in Gujarat in January,2001 and the earthquake in North Kashmir in October 2005, underscores the need to adopt a multi dimensional endeavour involving diverse scientific, engineering, financial and social processes; the need to adopt multi disciplinary and multi sectoral approach and incorporation of risk reduction in the developmental plans and strategies that help in managing disasters more effectively.

It was in this background that the United Nations General Assembly, in 1989, declared the decade 1990-2000 as the International Decade for Natural Disaster Reduction with the objective to reduce loss of lives and property and restrict socio-economic damage through concerted international action, especially in developing countries.

The paper highlights the existing scenario of Disaster Vulnerability in the State of J&K. A detailed survey was carried out in the earthquake affected villages of Baramulla and Kupwara districts in J&K. Data has been also obtained from the Government of J&K to arrive at the closest figure in monetary terms of the total losses incurred in terms of casualties, availability of medical aid , claims and government compensation etc.

The paper calls for adopting a multi dimensional endeavour involving Government and Corporate Sectors to use the ICT facility effectively and efficiently to tackle one of the most alarming problem of the state of J&K of India .

Key Words : GIS, ICT, J&K

1. Introduction

The world is facing an increasing frequency and intensity of disasters - natural and man-made - that has had devastating impacts. As reported by the secretariat of the International Strategy for Disaster Reduction (ISDR), the last ten years have seen 478,100 people killed, more than 2.5 billion people affected and about US$ 690 billion in economic losses. Disasters triggered by hydro-meteorological hazards amounted for 97% of the total people affected by disasters, and 60% of the total economic losses.

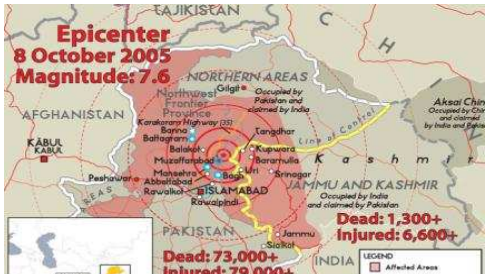


Figure 1: Epicentre of the 2005 Earthquake

Source: Centre for Excellence in Disaster Management and Humanitarian Assistance

An earthquake of severe intensity (magnitude 7.6 on the Richter scale) occurred on 8th October 2005 at 8.50.38 AM (Indian time) with epicentre at 34.432°N, 73.537°E in the Muzaffarabad Region of Pakistan Occupied Kashmir. The tremor, which lasted for 6 minutes, caused widespread death and destruction to property and communication network.

This was the deadliest earthquake in the recent history of the sub-continent, with more than 80,000 fatalities, 200,000 people injured, and more than 4 million people left homeless. The main shock was followed by more than 978 aftershocks of magnitude 4.0 and above, until October 27, 2005. The districts of Poonch, Baramulla, Jammu, Udhampur, Ramban Kathua, Srinagar, Budgam, Anantnag, Pulwama and Kupwara were the districts that had been reported to be worst affected in India Administered Kashmir. The districts of Baramulla and Kupwara were the worst affected districts, due to their proximity to the epicentre of the earthquake.

The usage of ICT specially GIS and Remote Sensing would be very effective in disaster management but its use is still very limited in the country like India, not even in highly disaster prone State like Jammu & Kashmir. With a view to reduce the impact of Disasters on human life and property it is absolutely necessary to create awareness amongst the public as well as decision makers for allocating resources for appropriate investments in technologies like GIS and Remote Sensing for Disaster Management in India.

At the global level, there has been considerable concern over natural disasters. Even as substantial scientific and material progress is made, the loss of lives and property due to disasters has not decreased. It was in this background that the United Nations General Assembly, in 1989, declared the decade 1990-2000 as the International Decade for Natural Disaster Reduction with the objective to reduce loss of lives and property and restrict socio-economic damage through concerted international action, especially in developing countries.

2. The Research Problem

The study has been carried out to analyse the impact of 2005 earthquake in the state of J&K. The factual data has been compared with the sample data to project the relief in terms of the following parameters in case an effective Disaster Management System would have been in place:

a) lives lost

b) availability of medical aid

c) claims and compensation etc.

2. Data Source

The impact of the earthquake which occurred on 8th October 2005 in the State of J&K has been dealt thoroughly by surveying the affected villages.

2.1 Data Collection

Primary Data was collected by conducting focussed group discussions and informal as well as formal interviews with the stake holders. Interactions were also held with the District Administration and with the head of Disaster Management Cell of the State. A conference on Disaster Management held in Srinagar was also attended in order to get inputs from various Government officials and Private players.

Secondary data has been collected from the internet.

Factual Data pertaining to the earthquake was collected from the office of the Divisional Commissioner, Jammu & Kashmir.

2.2 Sampling

The sample of the affected population for the direct interviews is based on the non-probability sampling method. The survey was that of a homogenous population as all members of the villages were affected by the earthquake. The total population of affected region was estimated to be around 17,00,000 souls. Keeping a confidence level of 95% and a confidence interval of 10, we arrived at the figure for sample size of about 80 souls.

2.3. Area Covered in Survey

Jammu and Kashmir is the northern-most state of India. It consists of three regions: Jammu, Kashmir Valley, Ladakh.

Srinagar is the summer capital, and Jammu, its winter capital. The State has a total area of 222,236 km^2. The population of Jammu and Kashmir is 10,143,700 (as per 2001). Jammu and Kashmir is divided into 22 districts.

The survey of earthquake affected villages was carried out in two districts of Jammu and Kashmir. These 2 districts, namely, Kupwara and Baramulla were the worst affected areas.

2.3.1 Kupwara District

Kupwara is the North-west frontier District of Kashmir Valley. The District is situated at an average altitude of 5300 feet from the sea level. The geographical area of the District is 2379 km^2.

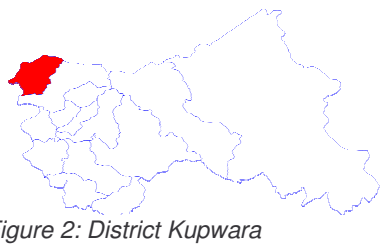


Figure 2: District Kupwara

Source: Wikimedia

The total population of the district is estimated at 640013 (Census 2001).

2.3.2 Baramulla District

Baramulla District is the largest District in entire valley both with reference to the population and area. The District is spread over an area of 4588 km^2 and its population according to 2001 projections is 11.51 Lakhs.

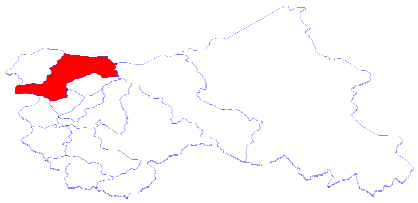


Figure 3: District Baramulla

Source: Wikimedia

3. ICT in Disaster Management

In order to reduce the risk and vulnerabilities in India the Ministry of Home Affairs, being the Nodal Ministry for Disaster Management, has taken lead on disaster management and mitigation in the country. The Ministry has drawn up a *National Disaster Management Framework* for the country. This National Framework covers the prime sectors such as institutional mechanisms at all administrative levels, disaster mitigation/prevention to be mainstreamed into the development process, envisaged legal/policy framework, early warning systems, preparedness & emergency response measures and human resource development. The Ministry has undertaken various nationwide initiatives to strengthen disaster management systems in the country.

United Nations Development Programme (UNDP) has joined hands in this effort of Government of India and is implementing GOI-UNDP Disaster Risk Management (DRM) programme in 169 most vulnerable Districts of 17 States [21.9] in India. Information coordination and management is seen as one of the major challenges in India due to the large geography and diversity of language/cultures. The GOI-UNDP DRM Programme addresses these issues very carefully by using Information and Communication Technology tools for faster response, effective decision making and develop well informed practitioners.

3.1. GIS

Making decisions based on geography is basic to human thinking. A geographic information system (GIS) is a technological tool for comprehending geography and making intelligent decisions. A good GIS program is able to process geographic data from a variety of sources and integrate it into a map project. GIS maps are interactive. On the computer screen, map users can scan a GIS map in any direction, zoom in or out, and change the nature of the information contained in the map.

3.1.2 GIS Functioning and Data Integration

A GIS makes it possible to link, or integrate, information that is difficult to associate through any other means. Thus, a GIS can use combinations of mapped variables to build and analyze new variables. For example, using GIS technology, it is possible to combine agricultural records with hydrograph data to determine which streams will carry certain levels of fertilizer

runoff. Agricultural records can indicate how much pesticide has been applied to a parcel of land. By locating these parcels and intersecting them with streams, the GIS can be used to predict the amount of nutrient runoff in each stream. Then as streams converge, the total loads can be calculated downstream where the stream enters a lake. The following figure depicts the way a GIS integrates data for making it relevant in decision-making.

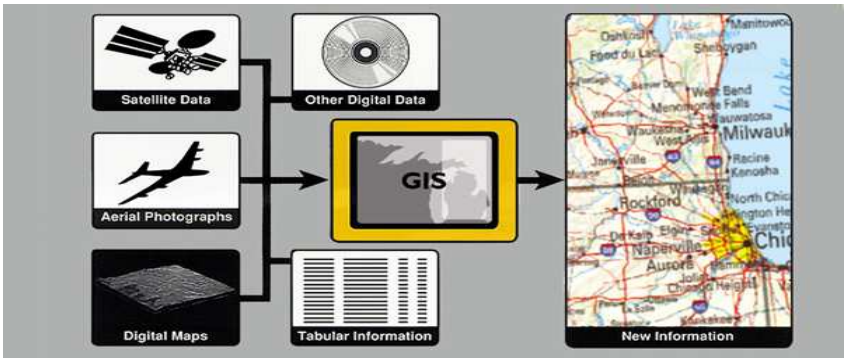


Figure 4: Data integration is the linking of information in different forms through a GIS

Source: US Geological Survey

GIS data represents real world objects (roads, land use, elevation) with digital data. Real world objects can be divided into two abstractions: discrete objects (a house) and continuous fields (rain fall amount or elevation). There are two broad methods to store data in a GIS for abstractions: Raster, Vector

A raster data type is, in essence, any type of digital image represented in grids. Anyone who is familiar with digital photography will recognize the pixel as the smallest individual unit of an image.

A simple vector map, using each of the vector elements: points for wells, lines for rivers, and a polygon for the lake.

3.1.3 GIS Tools

GIS software provides the functions and tools needed to store, analyze, and display geographic information.

Although there are now several GIS Solutions available off the shelf as well as customised, we shall be restricting our study to two most popular GIS Tools used especially in Disaster Management applications. These are – ArcGIS and ITRIS (Integrated Seismic Research and Information System)

4.0 Survey Observations

In all survey was conducted at 6 villages of the 2 districts. These are listed as below:

Table 1: Villages visited during Survey

S.No	Village	District	Approximate Distance from Epicentre of Earthquake
1	Thandipora	Kupwara	90
2	Chowkibal	Kupwara	70
3	Teetwal	Kupwara	20
4	Tanghdar	Kupwara	40
5	Panzgam	Kupwara	45
6	Uri	Baramulla	25

4.1 Casualty Figures

The 2005 Kashmir Earthquake (also known as the South Asian earthquake or the Great Pakistan earthquake) was a major earthquake entered in Pakistan-administered Kashmir and in North West Frontier Province (NWFP) near the city of Muzaffarabad, Pakistan. It occurred at 08:52:37 Pakistan Standard Time on 8th October 2005. It registered a debatable moment magnitude of 7.6 making it similar in size to the 1906 San Francisco earthquake, the 1935 Quetta earthquake, the 2001 Gujarat earthquake, and the 2009 Sumatra earthquakes.

4.1.1 The following table depicts the figures of casualties and relief obtained by the affected persons on Indian side.

Table 2: Disaster Management Cell, O/o Divisional Commissioner of Kashmir

S.No	Anantnag	Baramulla	Budgam	Kupwara	Pulwama	Srinagar	Total

Lives Lost	0	674	01	276	0	2	**953**
Amount paid @Rs. 50000	0	336.50	0.5	138	0	1	**476**
Injured	0	399	8	94	0	316	**817**
Amount Paid @Rs. 5000	0	0	0.04	5.9	0	15.8	**21.74**
Fully Damaged Homes	10	14710	44	8994	13	11	**23782**
Amount Paid @Rs. 100000	10	14642	44	8495	11.8	11	**23213.8**
Partial Damaged Homes	112	91334	10560	66887	120	5857	**174870**
Amount paid @Rs 30000	10.38	8346.63	144.29	12305.32	29.15	477.32	**21313.09**
Shelters Constructed	0	11527	0	7995	0	0	**19522**
Amount paid for Shelter Construction @ Rs. 30000	0	3548.10	0	2392.5	0	0	**5940.6**
Incentives Paid for On time Construction @ Rs. 5000	0	448.40	0	266.80	0	0	**715.2**

District wise the amount of relief provided to the people has been shown. It is clear from the figures that the Districts of Kupwara and Baramulla have been worst affected and thus the maximum relief distribution has taken place in these districts. All amounts shown in the table are in Rs. Lakhs.

4.1.2 Casualty Figures of Surveyed Area

The following table refers to the figures of casualties from among the areas that were surveyed.

Table 3: Casualties in the areas surveyed

S.No	Name of Village	District	Population	Total Lives Lost as per Official Data	Lives Lost among Sample Data Collected	Average No. of Days taken by DMA	Deaths due to Delay	% Deaths due to Delay
1	Thandipora	Kupwara	2122	0	0	0	N/A	N/A
2	Chowkibal	Kupwara	3224	0	0	14	N/A	N/A
3	Teetwal	Kupwara	2986	43	13	6	8	62
4	Tanghdar	Kupwara	2665	6	1	5	1	100
5	Panzgam	Kupwara	2944	0	0	13	N/A	N/A
6	Uri	Baramulla	111712	374	9	66	4	44
	Total		**125653**	**423**	**23**		**13**	**57**

The following chart shows the casualty figures of the six villages that were surveyed:

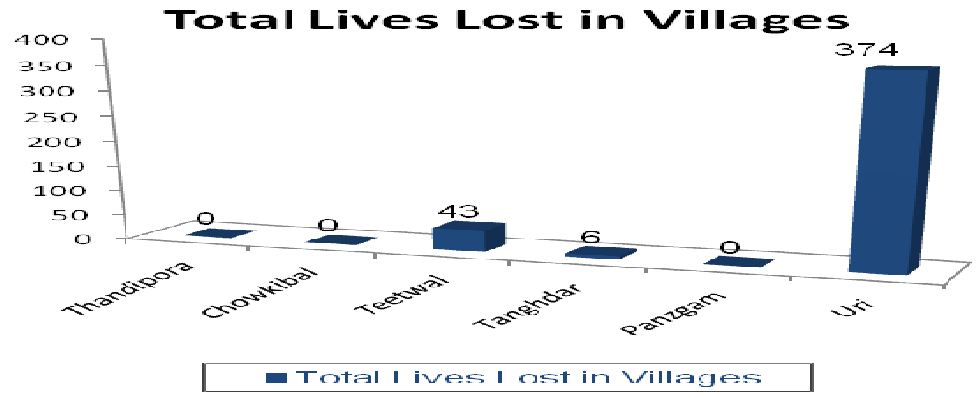
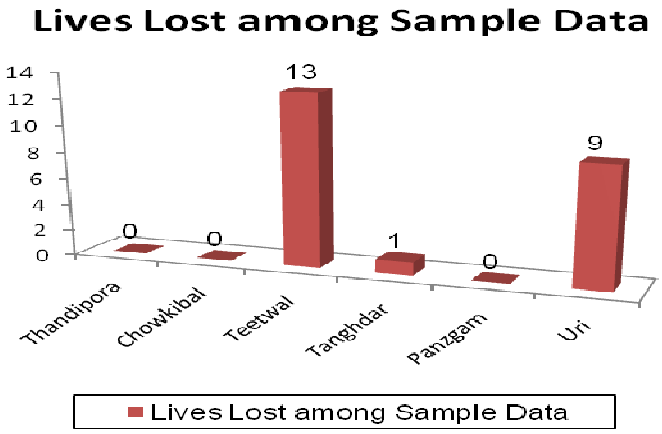


Figure 5: Figures of casualties in surveyed villages

The casualty figures of Uri and Teetwal are the highest as these were the areas closest to the epicentre of the earthquake. The total deaths that occurred in the area is 423. The total population of the six areas covered is 125653. Hence it indicates that about **0.33%** of the population died during the disaster.

The casualty figures would have been much lower if the disaster management agencies would have reached in time. Some people had to wait almost 2 months before any authorised disaster management personnel reached them.

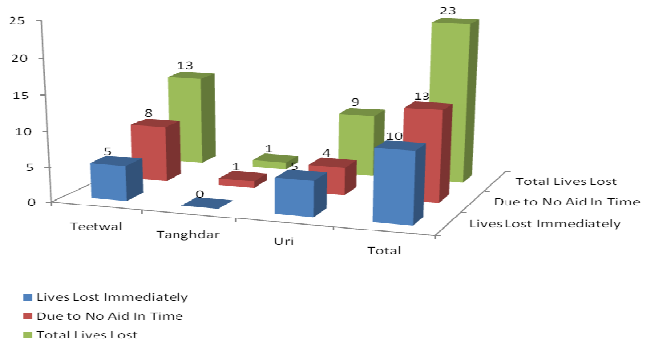


The above chart shows the casualty figure of the sample data. We could see that death figures are being recoded in Teetwal, Tanghdar and Uri whereas it is nil in other areas. We find that the collected sample figures are in line with the official records of the casualties.

4.1.3 Casualties due to Unavailability of Medical Aid in Time

The affected areas were surveyed to ascertain whether the medical aid could reach the affected persons in time or if there was any delay resulting in deaths.

From the table 4 we see that 13 deaths occurred in the three villages of Teetwal, Tanghdar and Uri due to unavailability of medical aid. The total deaths that occurred in these three areas were 23. The following figure depicts the same:



Hence 57% of deaths that occurred in the regions were actually due to non-availability of Medical and other Disaster management related aid.

5. Effectiveness of ICT(GIS) in Disaster Management

Analysis of the sample data has been done to access the impact on causalities if an effective Disaster Management System would have been in place.

5.1 Reduced Causality

In the sample data, where 80 people represent the population of earthquake affected residents on the Indian side, a minimum number of 13 lives could have been saved out of the 23 lives that were lost.

The total number of casualties due to the earthquake of 2005, on the Indian side as per official figures is 1360.

With GIS in place and the response time of the DMA (Disaster Management Agency) would have improved. It would have been possible to save a minimum of 740 more lives. This figure is arrived using the following formula:

$$\frac{\{Casualties\ due\ to\ delay\ in\ aid\ \times Total\ casualities\ that\ occurred\}}{Casualties\ reported\ during\ survey}$$

= (13/23) x 1360 = 769

Thus, **769 Human lives** would have possibly been saved if an effective Disaster Management System would have been in place.

5.2 Damage to Property

So far we had assessed the loss of life in the earthquake. Now in this section we shall examine the extent of loss caused due to destruction of homes and other property.

During the survey, the respondents were asked to indicate the estimated loss due to damage of their homes. They were also required to indicate the amount of relief/compensation amount received. The amount of relief granted to the victims have been categorised in four categories as per follows:

1. Full Damage to House: Rs 1,00,000
2. Partial Damage to House: Rs. 30,000
3. Constructing Shelter: Rs. 30,000
4. Constructing Shelter within stipulated time (Bonus): Rs.5000

Most of the respondents claimed that they had been compensated much below their losses. The Government had no system in place for the assessment of damage to the individuals.

After major earthquakes, the extent of the disaster often needs to be estimated from outside the affected area, because no information flows from the centre of the disaster. If a satellite photograph of the devastated area becomes available, the assessment of damage can be done directly. In addition, a satellite photograph of the city in question exists in the image library, a comparison between the two images, before and after the disaster, can furnish a quantitative measure of the extent of destruction.

By implementing the technique of mapping to 3D GIS the entire area, it would have been possible for the Disaster Management authorities to determine the exact position of the houses and infrastructure that existed before the disaster. Let us examine the difference in claims and the actual amount disbursed to the victims of the earthquake under study.

The following Table-4 and chart (Figure-5), shows the difference between the claim and the amount received as relief by the 80 respondents in the survey.

Table 4: Relief Amount to Victims

S.No	Description	Total Amount for 80 respondents (in Rs.)
1	Actual Damage (claimed)	41315000
2	Relief Distributed	7234000
3	Difference in amount distributed to claimed actual damage	**34081000**

By observing the trend line of the 2 graph in the below above chart, it is evident that there lies a vast difference in the actual damage (claims) and the relief amount distributed.

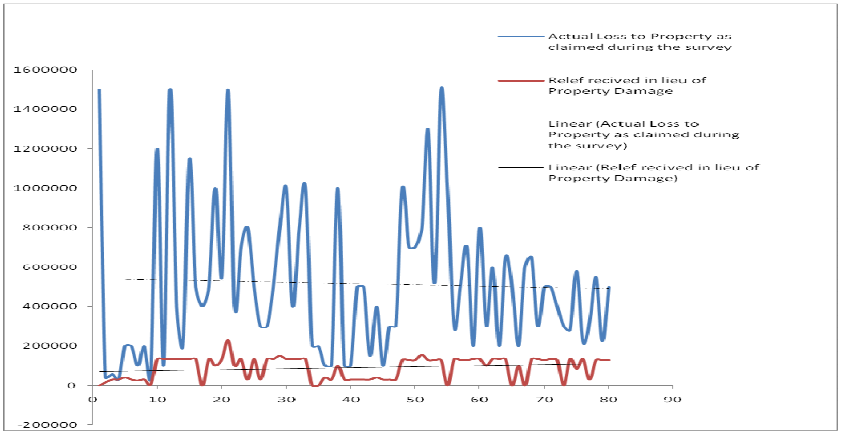


Figure 5: difference in claim and amount disbursed

The Table-4 shows the total figures pertaining to survey conducted on 80 respondents of the area. Hence for 80 of the respondents the difference in amount claimed and amount received is **Rs. 3,40,81,000** (Rs three crores forty lakhs and eighty one thousand)

The average difference for each respondent is 34081000 ÷ 80 = **Rs. 4,26,013/- (Rupees Four Lakh twenty six thousand and thirteen only)**.

From Table 4, we get the total figures of damaged property in the entire State as:

Fully Damaged Houses: 23782

Partially Damaged Houses : 174870

Total Cases **198652**

Considering that the actual number of affected people are 1,98,652 and average difference in amount claimed by each is about Rs.4,26,013.

The irony is that there is no way to determine the genuinety of the claims. In the absence of a system to verification the claims, the authorities had decided not to compensate the people but only to provide relief in a blanket fashion.

Moreover, if a proper GIS enabled disaster management system would have been in place, the authorities would have been in a better position to verify the claims and the actual victims would have been given their due rather than fake claimants and influential people of the villages.

6.0 Recommendations and Conclusion

6.1 Recommendations

The disaster mitigation programmes must be extensively taken up covering various aspects at national level to minimise the disaster damages. There should be a greater emphasis on development of new technologies in disaster mitigation. The disaster preparedness and awareness is the only effective way of mitigating the impact of future disasters.

The broad recommendations that have been arrived at from this study are as follows:

6.1.1 Disaster Management has to be a multi-disciplinary and pro-active approach. Besides various measures, institutional and policy framework, disaster prevention, mitigation and preparedness taken by the Central and State Governments in India, the community, civil society organisations and media also have to play a key role. We can march towards a safer and sustainable national development only when the development projects are sensitive towards disaster mitigation.

6.1.2 Information and Communication Technologies in the form of Internet, GIS, Remote Sensing, Satellite communication etc. are indispensable in planning and successful implementation of most Disaster Risk Reduction initiatives. However, the potential of most advanced technologies is required to be harnessed in early warning, preparedness and response systems along with adequate emphasis on building human capacities to use these tools and technologies.

6.1.3 GIS as a tool finds use not only in Disaster Management, but almost all spheres of Civil Administration across the globe. The power of decision making provided by these tools cannot be ignored for long. In order to deliver better services to its citizens, India too needs to move fast along the implementation lines of western countries with respect to GIS technologies.

6.1.4 J&K State is not very well equipped to handle disaster situations. However, concrete efforts are being made by the administration to benefit people on a larger scale. The State Government need to sincerely look into the new technologies like GIS for various pilot projects in the State. The social as well as financial benefits to the state to be derived from such technologies are numerous.

6.1.5 The costs of implementing GIS Projects are high and hence it is highly recommended to implement pilot projects in the beginning. Like other ICT Projects, the probability of failure of GIS Projects is also high; hence successful pilots should be replicated in a time-bound manner.

6.2 Conclusion

The size of the ICT implementation in Disaster Management in India is expected to be $10 billion in 10 years. This fact was stated in a business conclave during the 58th International Astronautical Congress held in 2007. The annual revenues of the ICT in Disaster Management/ GIS market are expected to grow from an estimated $4 billion to $150 billion in the next decade globally.

With more and more government agencies, private companies and individuals using ICT(GIS) and high-resolution imagery services, the market is growing by leaps and bounds.

It has been established by analytical study of the surveyed/collected data that GIS and Remote sensing can improve the quality and power of analysis of natural hazards assessment and would assist the planners in the selection of mitigation measures and emergency preparedness and response action.

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