Development Control Regulation Strategies for Disaster Management – Case Study Vishakhapatnam

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Abstract-*Nation's Economic development is influenced by Disasters mainly due to natural Calamities like Tsunami, Cyclone, Floods, etc. There will be loss not only to people, habitat, Livestock, property but also infrastructure facilities which is a great damage. Present study focuses mainly on assessment of Development control regulations with respect to disaster management with objectives involving study of different policies, Acts related to CRZ, assessment of land use regulation with respect to disaster management policies, acts and giving recommendations to mitigate disasters. For this study a case study of Hud-Hud cyclone is taken which affected east coast of India. Recommendations were given differently for Residential and Commercial areas considering Building height and abutting road width Restrictions which reduces wind tunnel effect of cyclone in those areas.*

Key words- Commercial, Damage, Development control regulations, Disaster, Hud-Hud, Land use regulations, Residential, Wind tunnel effect

1. INTRODUCTION

1.1 Background

Disaster is one of main cause which slow down development of nation or region affecting economic growth, quality of services and quality of living of people as well as infrastructure and services. Development of basic infrastructure and other various services related infrastructure needs time and fund [3]. Disaster can be classified in two main categories as natural disaster (related to natural process of earth) which is further classified in geophysical, biological, climatological and hydrological and manmade disaster [1].

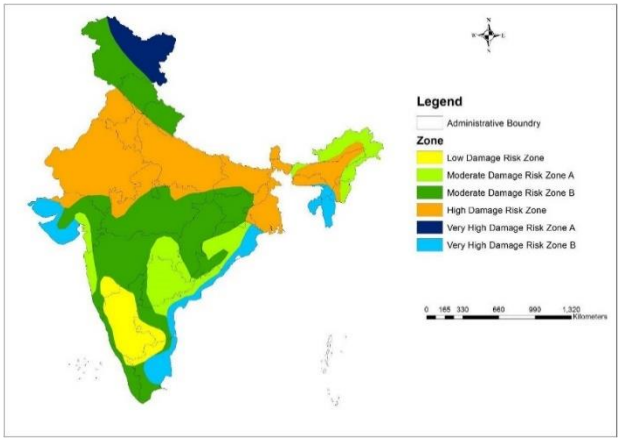


Fig.1.1- Wind and cyclone zone, Source-Maps of India

1.2 Cyclone

A tropical cyclone is cyclonic storm, non-frontal storm system which is characterised by cold air, hot air, a low-pressure centre, a spiral rain bands and strong winds rotating clock wise in southern hemisphere and anti-clock wise in northern hemisphere [4]. Frequency of cyclones affecting entire east coast of India is more than west coast of India. Span of last hundred and ten years (1891-2001) east coast was affected 103 times by cyclone and west coast was affected 48 times. October and November both months consist 58 % of total cyclones. Assessment of coastal India shows that more than 32 crore of people faced the danger and risk from cyclone and hazard related to cyclone.

Cyclone as result of wind flow and temperature difference in atmosphere was main reason for destruction of property. Andhra- Pradesh is exposed to cyclones. Earlier data shows Andhra Pradesh faced severe cyclone in two of three years gap. Mainly these cyclones are post monsoon storm (October and November). In case of severe cyclonic storms with storm surges, more than 90% of the fatalities occur due to drowning, either during the incoming water phase or during the out surges. The most common health problems include water borne diseases such as diarrhoea, dysentery, typhoid, viral hepatitis, respiratory diseases such as pneumonia and whooping cough, measles, conjunctivitis, and fever.

The major impact of cyclones can be broadly categorised as below:

1. Loss of lives, injuries and other health consequences such as epidemics, and post-traumatic stress disorders.
2. Loss of habitat.
3. Loss of cattle and damage to crops and agricultural fields.
4. Damage to public utilities
5. Disturbance and damage to the ecosystem.

Technological advancement:

Cyclone warnings are disseminated through a variety of communication media, such as, radio, television, print media, telephones, fax, telex, telegrams, police wireless network [7]. A specially designed Cyclone Warning Dissemination System which works via the INSAT satellite provides area-specific service even when there is a failure of conventional communication channels.

For the Orissa super-cyclone of 1999, the IMD sent out warnings 24 hours in advance. In contrast, accurate and detailed warnings were issued five days before Hudhud struck.

1.3 Cyclone HUDHUD

Very Severe Cyclonic Storm Hudhud was a strong tropical cyclone that caused extensive damage and loss of life in eastern India and Nepal during October 2014.Hudhud originated from a low-pressure system that formed under the influence of an upper-air cyclonic circulation in the Andaman Sea on October 6. Shortly before landfall near Visakhapatnam, Andhra Pradesh, on October 12, Hudhud reached its peak strength with three-minute wind speeds of 175 km/h (109 mph) and a minimum central pressure of 960 mbar the system then drifted northwards towards Uttar Pradesh and Nepal, causing widespread rains in both areas and heavy snowfall in the latter. Track of cyclones from last hundred years is shown

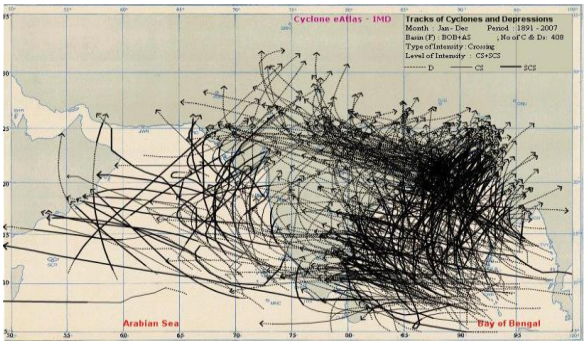


Fig1.2- Track of cyclone and depressions

2. NEED OF STUDY

Technological advances allowed governments to plan before disaster, this mainly contains moving away people from area which is going to be affected by disaster. It reduces loss of life. In 1999 super cyclone claimed life of approximately 10000 people. It is reduced because of technological advances and effective preparedness and management system but loss of property and infrastructure is not reduced. Recent cyclone HUDHUD total damage was about Rs. 8000 Crore to Rs. 21000 Crore. Loss of human life reduced but loss of infrastructure is not reduced. Safety is one of prime objective of urban planning. Study focuses on urban planning, development control regulation and disaster management relation. In recent cyclone HUDHUD Number of reported deaths was 26 but loss of livestock, agriculture field, urban infrastructure was more. This cyclone struck to the city of Visakhapatnam on 12/10/2015.

2.1 Research Question

- Does DCR has any relation in mitigating the social and economic risks caused by natural disasters?

2.2 Aim

- To assess the Development control regulations with respect to disaster management

2.3 Objectives

1. To study policies and acts related to disaster management. (policy, acts in terms of CRZ, comparative analysis of different cities)
2. To assess land use regulation with respect to disaster management policies, acts and case studies.
3. To analyse the impact of Socio-economic risk during natural disaster (Cyclone).
4. To identify the vulnerability and risks involved and strategize mitigative measures.

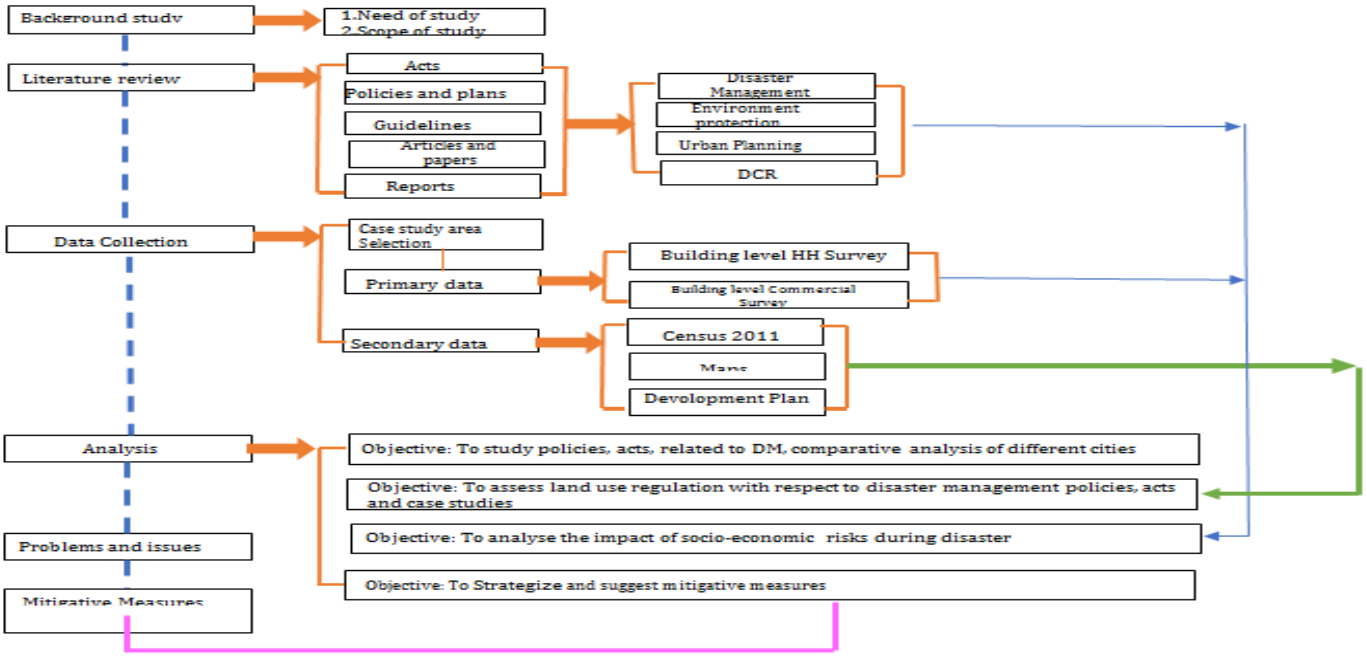
2.4 Scope of Study

1. Development control regulation of various cities. Studies and analysis related to disaster management which will be implemented in development control regulation.
2. Ward level socio-economic aspects and their relation with disaster and damage.
3. Strong wind effect after cyclone on residential and commercial areas.

2.5 Limitations

- Study related to impact of storm surge and flooding after cyclone (because of geographical condition). Less focus on industrial area. Building Condition and Damage relation

3. METHODOLOGY



4. LITERATURE REVIEW

Table 4.1-Literature reviews relating study

Sl.No	Document Source	Purpose and Result	Indicators
1	Disaster Management Act, 2005	To provide effective management of disaster. Institutional setups at National, state, district and local level and their functions.	Identification of building or places which could be used as relief centres at the time of disaster.
2	National policy on Disaster Management [3]	Policy suggest similar things which were present in disaster management act, 2005	Identification of building or places which could be used as relief centres at the time of disaster.
3	Environment Protection Act, 1986 and CRZ	Division of coastal zone in various categories like Ecological sensitive area, no development zone, no new development zone etc.	CRZ l, CRZ ll and CRZ lll categories, Hazard Line in Maps
4	NDMA urban Planning Toolkit [8]	Toolkit for various disaster (including Cyclone) and preventive measures. Hazard resistant planning, risk sensitive land use, Green belt Development	Up to date Hazard Vulnerability profiling. Maintain critical infrastructure. Identification of safe land for low income groups. Safety of all schools and health facilities
5	Critical Infrastructure and Disaster risk reduction [7]	Critical Infrastructure and its relation with socio-economic infrastructure and socio- cultural infrastructure.	Exposure level, dependence on other factors. Identification of potential risk areas.
6	ADPC safe Cities (Matara, Sri Lanka [11]	Development done by ADPC in Sri Lanka which was affected by flood and landslide.	Hazard Profiling, Hazard and Vulnerability zoning. Ward based Risk Maps
7	ADPC safe Cities (Jakarta) [12]	Development done by ADPC in Jakarta which was affected by cyclone	Risk mapping and Vulnerability analysis based on population, age, gender, Building quality etc.
8	Promoting Use of Disaster risk reduction Information in Land use Planning	Density control, site selection, land use control and designing of building regulations	Density control measures in potential risk areas. Potential risk areas
9	Andhra Pradesh state disaster management plan	Identification of risk area and plan for whole state to reduce disaster impact.	Vulnerability and Risk Assessment. Preventive measures for high and strong wind.
10	NDMA Guidelines for management of cyclone	Guidelines for cyclone management focuses on vulnerability analysis, risk assessment, probable storm surge and estimation of maximum damage	Estimation of maximum Possible damage on basis of vulnerable population, remote areas, cyclone shelters, Multiple use of public building
11	National	Plan for whole nation suggests disaster resilient land	Flood basin zoning, Hazard

	Disaster Management Plan	use pattern, flood basin zoning	Identification
12	The attributes of resilience toolkit	Exposure level, Modularity of infrastructure and services	Distance from sea shore and Infrastructure. Modularity of infrastructure and services
13	Interdependence in infrastructure system	Reduce & replace poor practice and prevent reinvention of wheel	Locating safe places for various purposes. Impact threshold

5. CASE STUDY AREA SELECTION

Visakhapatnam Metropolitan region (also known as Vizag) with a land area of approx. 1721 sq km and co-ordinates 17.6883° N, 83.2186° E is among the five major harbours in Andhra Pradesh state. The population of Visakhapatnam Urban Agglomeration is 1,730,320 (according to Census 2011). The city, which appears like a small basin, is surrounded by the Yarada hill popularly known as the Dolphin's nose (358m) on the side of the Kailasgiri hills on the north, with the Bay of Bengal forming the eastern wall [13].

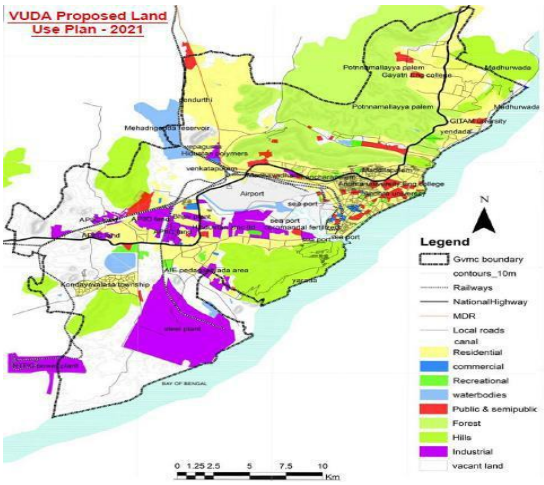


Fig.5.1 -VUDA Proposed land use

City has major problem related to flood caused by rain, cyclone or disturbance. The major flood prone areas in twin cities are the low-lying areas in the catchment areas of Velemapeta, Poorna Market, Kota Veedhi etc., in the Old City comprising of wards 1 to 20 and some parts in the 30 to 40 divisions.

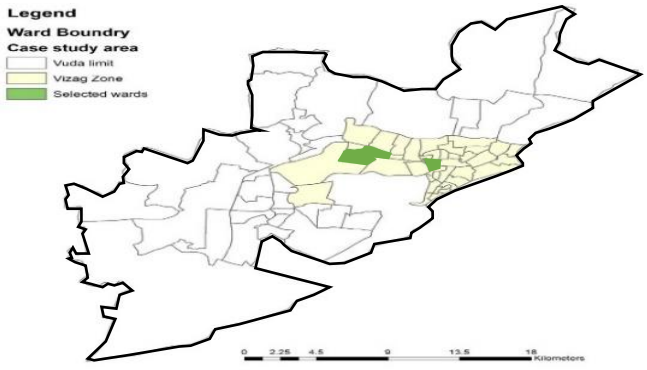


Fig.5.2- Visakhapatnam zone In GVMC

The Air Port area is a complete Flood Prone area and affects the city normal life tremendously in the Floods. The areas in the 45 to 50 divisions and the Gajuwaka are commonly affected with the flash floods which occurs during the cyclonic rains [5]. Further completion of objective related to impact of socio-economic risk further two wards from Visakhapatnam zone are selected. Criteria for selection of these wards are:

Distance from sea shore

1. Area having Commercial + residential or residential + industrial activity
2. Infrastructure related to Electricity and water supply
3. Low lying area
4. Density
5. Discussion with Officials

Fig.5.3- Base map Ward 31

Fig5.4-Base Map Ward No. 41

5.1 Data Collection

Primary Data is collected Residential and commercial buildings through Surveys consisting of 80 samples of (50-50 each), ward no. 31 and ward no. 41Secondary Data is collected from Visakhapatnam urban development authority (VUDA) master-plan, Chennai Master-plan, Kochi master plan, Census 2011 data. Town and country planning acts of different states.

5.2 Analysis

Objective l To study policies and acts related to disaster management. (Policy, acts in terms of CRZ, comparative analysis of different cities)

Various acts, policies, reports, guidelines and articles were studied to decide parameters for further study and comparison of cities. Parameters are

1. Identification of building and places which could be used during disaster for relief works or for resource distribution.
2. Identification of safe land for low income people.
3. Categorization of coastal area according to CRZ, hazard line mapping.
4. Hazard identification and its profiling, vulnerability mapping, risk mapping.
5. Exposure of critical infrastructure and services. Exposure of vulnerable section of society.
6. Hazard zoning, land-use selection according to hazard and risk mapping
7. Density control measures

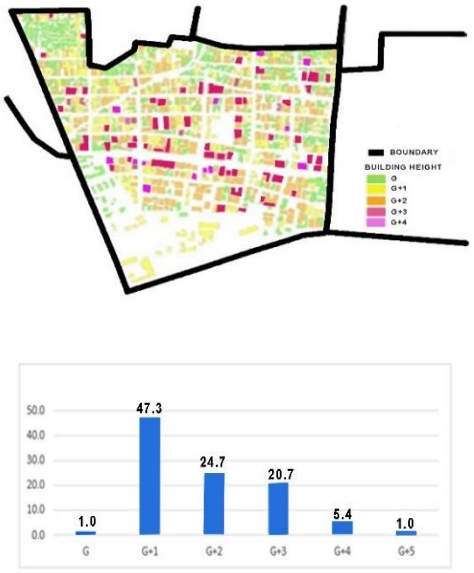
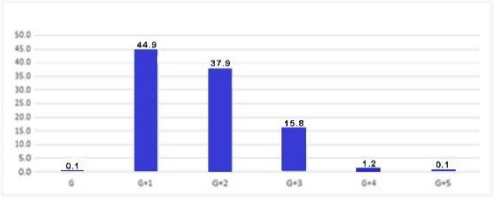
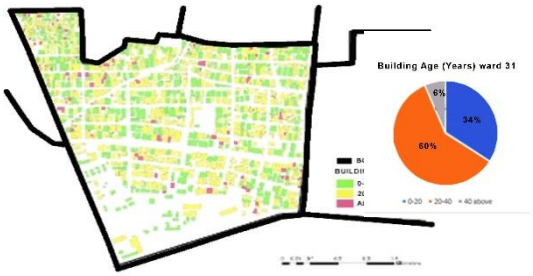
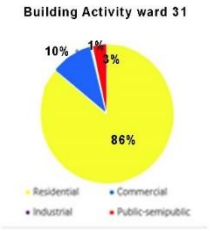
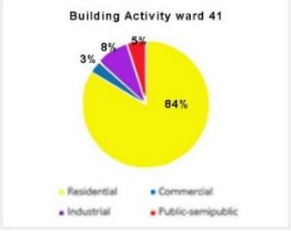
Critical Infrastructure Modularity, Identification of Area and route, mapping studies related to disaster are not considered during preparation of master plan of Visakhapatnam (2006-2021).

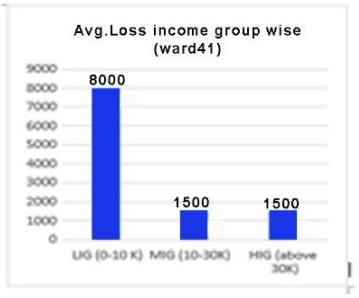
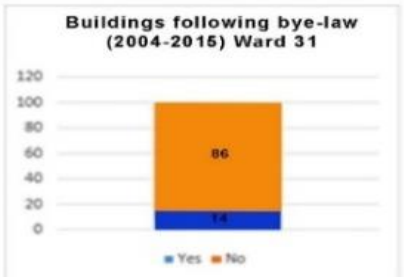
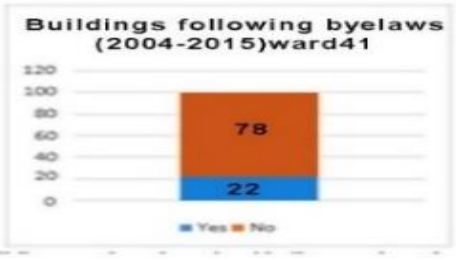
Objective ll Assessment of Development control regulation was done and some modifications were suggested for Residential, Light Industrial, Special Industrial zone, Open, public spaces, Educational buildings.

Objective lll To analyse the impact of Socio-economic risk during natural disaster (Cyclone).

Instead of taking whole ward no. 41, area having residential and industrial land-use taken for study. Remaining area is covered by activities related to transportation and defence land. Ward 31 is near railway station and it has its offices, it is also major open area in the ward. Because of its proximity to bus stand and railway station. Major road (Railway new colony road) has commercial activities other area is residential Building height and abutting road width can be regulated through proper implementation of development control regulation

Table no 5.1- Table showing differences between ward 31 and ward 41

Parameters	Ward no 31	Ward no 41
Building Height		 
Building Age		
Building Activity		

Average loss income group wise		
Buildings following bye laws(2004-2015)		

5.3 Correlation statistical analysis

Table 5.2- Correlation between ward 31 and ward 41

Correlation		Ward 31	Ward41
Building height	Damage	Moderate	Weak
		Positive	Positive
Household income	Damage	Low	Moderate
		Positive	Positive
Abutting Road width	Damage	Moderate	Moderate
		Positive	Positive

Ward 31

Ward no. 31 damage shows moderate positive co-relation with abutting road width r value of 0.56.

Damage, specially physical loss or loss to the building has relation with building height and abutting road width. These are two important elements in development control regulation. Thus change in development control regulation can reduce or increase damage to the structure

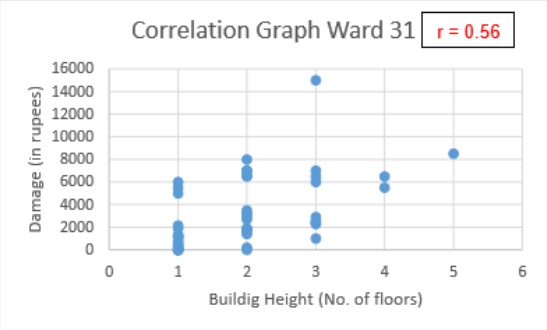


Chart 5.1: Correlation Graph of ward 31

Ward 41

Similarly, ward no. 41 damage has weak positive co-relation with abutting road width with r value of 0.39 and damage has moderate positive correlation with building height with r value of 0.45. Thus it is clear disaster risk and coping range can be reduced with proper building bye-laws which will focus on building height and abutting road width. This study is more useful for LIG people

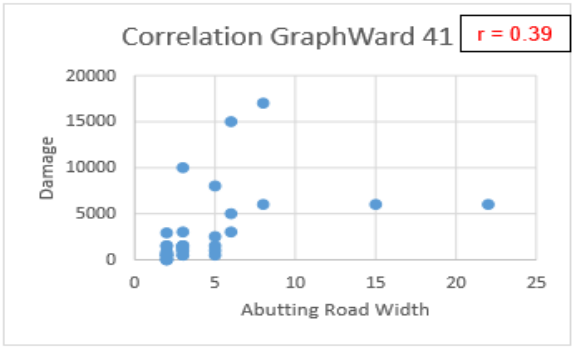


Chart 5.2: Correlation Graph of ward 41(r=0.39)

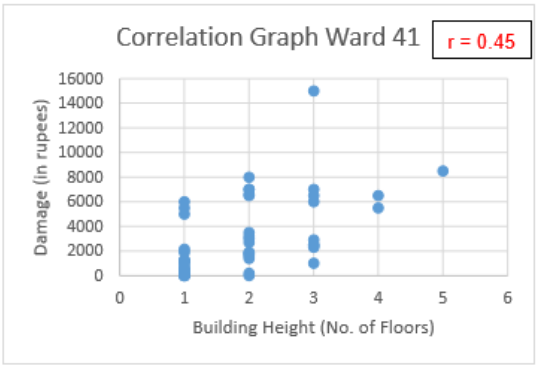
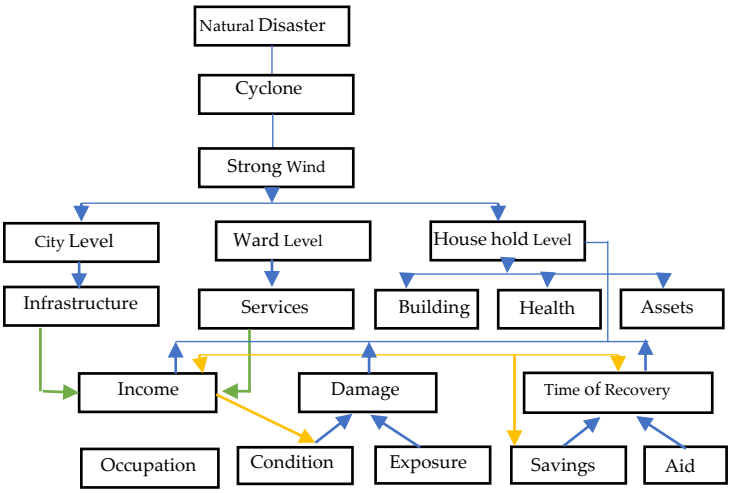


Chart5. 3: Correlation Graph of ward 41(r=0.45)

5.4 Income, damage and time of recovery



Average damage to ward no. 31 was Rs.3209 and for ward no.41 was Rs.2965, which was nearly 13% and 11 % respectively. It is looks lesser with comparison of income but both wards consist of lower income group (LIG), medium income group (MIG) and higher income group (HIG).

Lower income group was affected more than both MIG and HIG. It can be noticed in time of recovery. Less time of recovery is important.

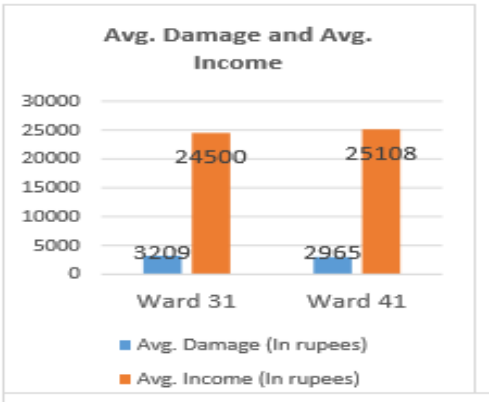


Chart 5.4: Average Damage and Average income

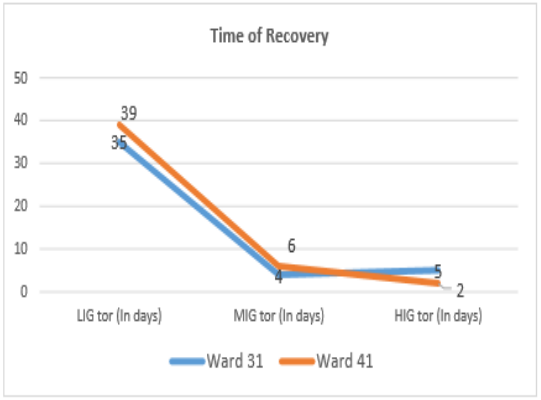


Chart 5.5: Time of Recovery

6. RECOMMENDATIONS

Residential

	Existing Condition	Modifications
1	Should follow building code.	should consider disaster aspects 1)Construction, structural aspects 2)Quality of building material
2	No allotment land for informal sector	Specific area in neighbourhood should be given to informal sector with provision of proper structure
3	Banks, community buildings, public utility buildings are permitted in residential zone	It is part of critical infrastructure thus allocation of land or permission of land use change after considering disaster risk or potential risk of particular area.
4	Parks and playground are permitted in residential land use.	These places can be used as temporary relief related activities thus evacuation plan should be made.
5	Layout regulation	Sub division of plot and construction of building near sea shore area.
		More focus of making rectangular plot division with wind direction taking under consideration.
		Consider evacuation path and resource distribution and evacuation network.
		Need of area/ location specific zoning with different FSI at different places. Changes at state level policy.

Light Industrial

	Existing Conditions	Recommendations
1	Storage of petroleum, timber, explosive and inflammable material permitted after taking permission.	Hazard mapping, Risk estimation and Provisional mitigation measures at building as well as area level should be provided.

7. CONCLUSIONS

Factors like density of area and its exposure level are other important factors which has their relation with development control regulation and their proper implementation.

Cyclone particularly wind destruction occurred on path of cyclone. Train like crest does not reduce impact of wind but create more damage because of suction effect on leeward side. [14]

Restriction on building height considering abutting road width reduces wind tunnel effect of cyclone in residential areas.

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