MEASURING SDG 11.5: AN EVALUATION APPROACH TO URBAN DISASTER RESILIENCE OF KOCHI CITY

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Abstract

Fast-growing cities are inevitable realities of the modern world. Urban disaster resilience is an inexorable goal in the pathway to urban sustainability. A well-structured historical timeline exposed the evolution of the concept of disaster risk reduction in a systematic manner. Acquainted with previous traditional literature on SDGs, this paper presented a conceptual framework for this work. The primary goal of this study is to assess the safety and sustainability of urban human settlements in the Kochi metropolitan area using the sustainable development goal 11.5 indicator. An assessment method to apply the index of urban disaster risk reduction and resilience has been derived through the localization of indicators. This SDG 11.5 indicator was estimated with the quantification and evaluation of local data, which was collected from Kochi. Secondary data tools were used for the data collection. The application of this SDG 11 index reveals that disaster loss in Kochi has decreased over the years, but the estimated disaster economic loss is immensely high. Additionally, it was perceived that programs, policies and action plans on disaster management and resilience in this urban area are strengthening. This research shed light on several effective measures to realize the aim of a disaster-resilient and sustainable Kochi.

Key-words: *Disaster Resilience; Disaster risk reduction; Sustainable Development Goal 11.5; Localization of indicators; Kochi Metropolitan area.*

Introduction

Many facets of sustainable development are exemplified in the global action plan developed by United Nations General Assembly in 2015, known as the 2030 agenda for sustainable development. Sustainable development goals are an intrinsic section of this global agenda which is adopted by all United Nations member countries. The majority of the worldwide population is living in cities, so the accomplishment of the goal of sustainable urbanization is the most appropriate opening action to realize the sustainable development of the world. Therefore, this capability of cities is admitted by the United Nations through the inclusion of sustainable development goal 11 in this global agenda. Sustainable development goal 11 is to make cities and human settlements safe, inclusive, resilient, and sustainable.

Disaster defined as a serious disruption of the functioning of a community or a society at any scale due to hazardous events influenced by conditions of exposure, vulnerability and capacity steering to one or more of the following: human, material, economic and environmental losses and impacts (United Nations office for disaster risk reduction, UNDRR)[26,14]. The repercussions of disasters and hazards on urban livelihoods and natural environment systems have long been witnessed worldwide. Urban areas are highly vulnerable to these natural disasters because cities are the hub of people and infrastructure in a defined small region. As per the UNISDR report, the exposure of the urban population to earthquakes will rise from 370 million to 870 million and cyclones will increase from 310 million to 680 million by 2050[25]. Sea level rise and coastal flooding will badly affect the coastal urban area assets, which are estimated to incur a loss of US$35,000 billion by 2070[25]. Climate change is a crucial factor that increases the severity of these disasters. Cities located in coastal areas are highly vulnerable to these natural hazards. High congregation of people and structures in urban areas intensifies the impact. So, urban disaster resilience needs strong attention to reach this sustainable

development goal. Sustainable development goal 11 includes sustainable development goal eleven target 11.5 to fulfill the goal of disaster resilience through disaster risk reduction.

1.1. Major global policy frameworks and initiatives for disaster risk reduction and resilience

Disasters that happened worldwide in the 1960s, like the Buyin-Zara earthquake in Iran, Earthquake in Yugoslavia, Skoplje, Hurricanes in Dominican Republic, Haiti, Cuba and Jamaica boosted the need for vital initiatives to reduce disaster impacts[22]. So, it led to the creation of the United Nations Disaster Relief Office (UNDRO) in 1971[22]. It was the first significant step in the evolution of the goal of disaster risk reduction in the world (fig 1). In 1989, United Nations General Assembly declared the International Decade for Natural Disaster Reduction (IDNDR) from 1990-1999[22]. It developed an International Framework of Actions for the International Decade for Natural Disaster Reduction and embarked on guiding principles for humanitarian relief, preparedness and prevention as a follow-up from relief concepts to rehabilitation and development[22]. United Nations Office for Disaster Risk Reduction (UNDRR) was formed in 1999[20]. After the formation, an International Strategy for Disaster Reduction (ISDR) was developed in 2001[22]. UNDRR focused on the implementation of an international strategy for disaster risk reduction. It acted as the secretariat of the ISDR system. International Strategy for Disaster Risk Reduction (ISDR) is a global framework created within the United Nations to stimulate action for reducing risks of natural hazards, social vulnerability and related technological & environmental disasters. After this establishment, the major focus was changed from disaster risk management and prevention strategy to disaster risk reduction. Section IV of the Millennium Declaration, named 'Protecting our common future' proclaimed by the United Nations in 2000, presented an objective "to strengthen cooperation to reduce the number and effects of natural and man-made disasters"[16]. The Johannesburg plan of action implemented in the World summit on sustainable development held at Johannesburg, South Africa, in 2002 aimed to integrate and promote disaster risk reduction into development planning and activities[22]. This action plan stated "an inclusive, multi-hazard, integrated strategy to consider the factors of risk assessment, vulnerability and disaster management, including prevention, mitigation, preparedness, response and recovery. Before the Hyogo framework, this plan of action put forward a holistic development plan focused on the significance of disaster risk reduction.

Red Cross and Red Crescent developed an agenda for humanitarian action declared in the International Conference held in December 2003, which contains goals and actions to "reduce the risk and impact of disasters and strengthen preparedness & response mechanisms"[7]. It was a remarkable action made by the largest humanitarian network in the world. Istanbul programme of action was developed in 2011 to boost the productive capacities of Least Developed Countries (LDCs) for attaining their sustainable development. It motivates the LDCs to combine and execute disaster risk reduction in their national action plans and policies[22]. United Nations Conference on Sustainable Development held at Rio de Janeiro, Brazil, presented the outcome document 'The future we want' includes Chapter V-A, which explains disaster risk reduction[22].It also discussed future action plans post validity time period of the Hyogo framework in 2015 and advised & motivate member countries. The discussions at the Rio+ 20 conference ended in the declaration of the Sendai framework. United Nations adopted the outcome document 2030 Agenda for sustainable development with 17 sustainable development goals and 169 targets in 2015. This document also put forward a vital step in this journey by including disaster risk reduction and resilience to accomplish the goal of sustainable development.

United Nations developed three international frameworks for reducing global disaster risk. First World Conference on Natural disaster reduction held in Yokohama, Japan, in 1994 by the UN developed the Yokohama Strategy and plan of action for a Safer World[23]. This was the first internationally accepted document that imparted guidelines for preparedness, prevention and mitigation of natural disaster impacts. This strategy promoted a worldwide proactive culture for the

Fig 1: Historical landmark of the concept of disaster risk reduction

Source: Author

prevention of disasters. It encourages the focus on community participation and community-based approaches to reducing disaster risk and vulnerabilities. Hyogo framework for action: Building the resilience of Nations and communities to disasters was adopted by the United Nations at the second world conference on disaster reduction held at Hyogo, Japan in 2005[24]. It was a 10-year action plan valid from the year 2005 to 2015. The key objective was to reduce the disaster risk, ensure a safer world and realize the goal of disaster resilience for vulnerable communities. The priority of focus was changed from coping capacities and mitigation actions to disaster risk preparedness and prevention. This plan of action heeds the prominence of the goal of disaster resilience through disaster risk reduction. This approach is also known as the Total Disaster Risk Management Approach (TDRM) since it combines existing disaster risk reduction knowledge and proficiency with disaster management. The third United Nations World Conference on disaster risk reduction held in Sendai,

Japan, introduced the Sendai framework for disaster risk reduction for the period of 2015 to 2030[17]. Sendai framework presents an advanced plan of action than the Hyogo framework that includes the small, large, sudden and slow onset of disasters due to natural and man-made hazards and related technological, environmental and biological hazards. The set of targets and priorities aims to considerably reduce disaster risks, loss of lives & livelihoods, health, physical, social, cultural, economic, and environmental infrastructures, and assets of people, communities, and countries through the execution of integrated and inclusive policies and initiatives that stimulate resilience by hindering new disaster risks and reducing existing ones over the next 15 years. SFDRR introduces a framework in this modern world, so it addresses ongoing issues like climate change, global warming, and emerging globalization and envisages introducing new technologies and developing proficiency in early warning systems and risk prediction. Yokohama, Hyogo and Sendai frameworks present a holistic, integrated and inclusive approach to reducing disaster risk and attaining disaster resilience. Considering Hyogo frameworks, 146 governments joined in the review of Hyogo Framework Action through the online HFA Monitor, but only 136 countries presented reports[5]. So, follow-up and implementation of these frameworks by the countries are imperative to realize the goal.

1.2. Conceptual support

The conceptual framework elucidates the various concepts connected to the assessment index is intended to estimate (Eslamian,2021)[4]. The goal-oriented framework is selected for this study. The framework is goal-based and groups into different themes, targets and target-oriented indicators to attain the goal. This is mainly used to assess the progress in achieving goals and targets.

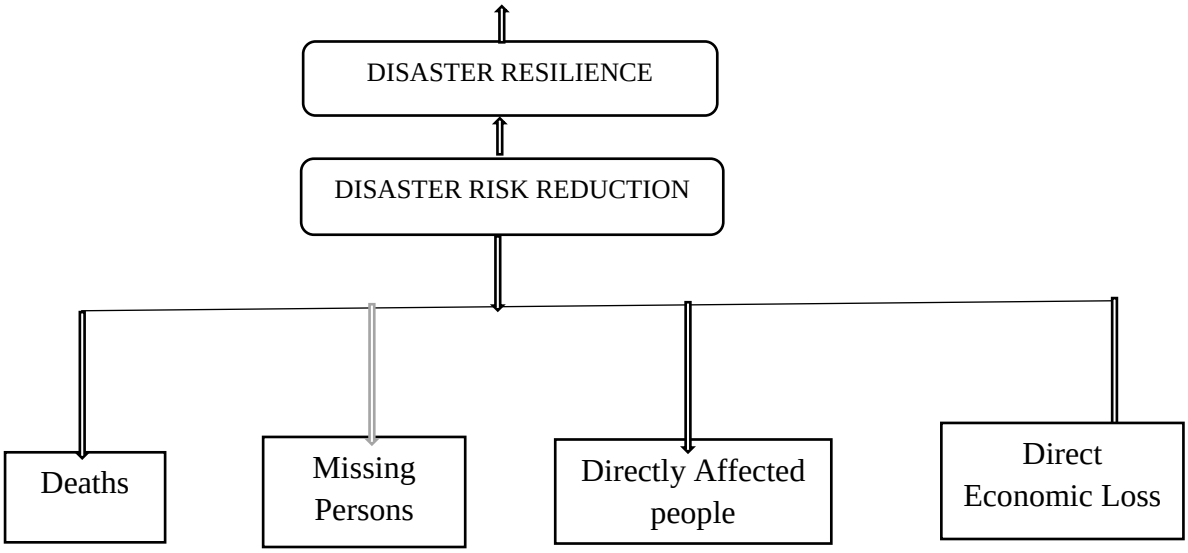


Fig 2: Conceptual structure of Sustainable Development Goal 11.5 target

Table 1: Definitions to understand the major concepts

Concepts	Definitions
Disaster risk reduction	Disaster risk reduction is a policy objective of disaster risk management intended to prevent new disasters, reduce existing ones and manage residual risks, all of which contribute to strengthening resilience and thereby achieving sustainable development.[26]
Deaths	The number of people who died during the disaster or directly after as a result of the hazardous event.[20]
Missing Persons	The number of people whose whereabouts have been unknown since the hazardous event. It includes assumed dead people for whom there is no physical evidence, such as a body, and for which an official/legal report has been filed with competent authorities.[20]

Directly Affected People	The number of people who have endured an injury, illness, or other health effects; who were evacuated, displaced, relocated, or have suffered direct damage to their livelihoods, economic, social, cultural, physical and environmental assets. [20]
Direct Economic Loss	The monetary value of total or partial damage of physical assets in the affected area. Direct economic loss is nearly equivalent to physical destruction.[21]
Disaster Resilience	The ability of a system, community or society exposed to hazards to withstand, resist, absorb, adapt, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and reconstruction of its necessary basic structures and functions through risk management.[26]
Urban Sustainable Development	A sustainable city is a city where attainments in social, economic, and physical development are made to last and where there is a lasting supply of natural resources that depends on development. Furthermore, a sustainable city maintains lasting security from environmental hazards that may threaten development achievements by allowing only for acceptable risk[18,6]

Source: Secondary data[26,20,21,18,6]

Sustainable development goal 11.5 target exposed the close interrelationship between the concepts of disaster risk reduction, disaster resilience and Urban sustainable development (fig 2). According to the globally accepted framework of sustainable development goal 11, SDG 11 .5 target can be assessed by calculating disaster risk reduction. It can be identified by calculating the sum of variables like direct death due to disaster and missing and affected people caused by the disaster. The monetary value of direct economic loss can also be estimated to measure this indicator.

Successful disaster risk reduction moulds resilient communities while assuring that vulnerability is not increased through any type of development activities and externally induced initiatives (Begum et al., 2014)[1]. According to sustainable development goal 11.5, disaster risk reduction is the means to gain the goal of disaster resilience. So, disaster resilience underpins the index of disaster risk reduction to achieve the sustainable and resilient development of urban areas. United Nations Office for Disaster Risk Reduction (UNISDR) proposes disaster risk reduction as a policy objective to invigorate disaster resilience and, finally, to attain sustainable development. A development strategy cannot be considered sustainable if it is not resilient (Perrings, 2006)[15]. So, resilience and sustainable development are well-connected concepts. Urban sustainable development and resilience are explicated as correlated concepts in various policy documents like the New urban agenda of 2017 and UN-Habitat reports[2]. Disaster resilience, interpreted as the capacity to adapt and transform, is linked with urban sustainability. The direct transformation from low urban sustainability to high urban sustainability can be gained through better-managed and reduced disaster resilience (Elmqvist, T, 2019)[3]. Disaster risk reduction boosts disaster resilience and would lead to accomplishing the challenging goal of sustainable urban development.

Development of urban areas should be implemented through sustainable and resilient pathways, and it would gradually lead to the goal of disaster risk reduction and resilience. So, the United Nations tried to impart the significance of this concept to the coming generation through the introduction of SDG 11.5. Kochi metropolitan area is the largest and most populous urban agglomeration in Kerala. Being an ancient coastal city and major commercial hub of Kerala, disaster resilience of Kochi city is inevitable. So, it is imperative to study the human and economic disaster loss of Kochi city over the last five years. Analysis results exposed the severity of the impact of disasters on this metropolitan city. This study would be incredibly beneficial to frame a disaster-resilient plan for the city.

2. Materials and methods

2.1. Study Area

Kochi metropolitan area is located around the city of Kochi in Ernakulam district in the state of Kerala, India. As per the Census 2011, the total area of the Kochi metropolitan area is 843.84 km2 and the registered population is 2,119,7242. The area consists of Kochi municipal corporation, eight municipalities, 42 census towns, and two outgrowths 2. Eight municipalities are Perumbavoor, Angamaly, Aluva, Paravoor, Kalamassery, Thripunithara, Eloor and Thrikkakara 2. Kochi is gifted with backwaters, small islands, coastal areas, a variety of linguistic and ethnic communities, shopping malls, monuments and unique geographical spots. Kochi is the 17th million-plus urban agglomeration in India2. It is the commercial capital of Kerala and the second most important port city of India's western coast12. Ernakulam district of Kerala holds a coastal belt of 46 Km and covers 12 coastal villages12. All coastal villages are part of the Kochi metropolitan area. Kochi is one of the significant coastal urban areas of Kerala. Kochi metropolitan area enjoys a warm tropical climate, which is dependent on seasons.

As per SDG Urban India Index 2021, Kochi city attained 38th position after the city of Trivandrum in the ranking of SDG 1113. So now, the sustainability of this major city is questionable. Making cities and human settlements safe, inclusive, resilient and sustainable persists as an ineluctable issue in this present world. Kochi metropolitan area is a dominant commercial hub and port city of Kerala, so the disaster resilience of this city is a crucial ineludible goal to achieve sustainable urban development.

2.2. Data Collection

The primary step of this paper was to collect secondary data and collate information. Disaster loss data (from 2017 to 2021) and population data (from Census, 2011) were collected as the basic database for this study with huge support from the disaster management authority, Ernakulam district of Kerala, India. Disaster Management Authority is the department of the government of Kerala that gathers data on human and economic disaster losses and provides a list of people who need financial assistance to recover from the disaster impact. They have authorized accumulated data on disaster loss in one district. These data will be used to calculate indicators of urban disaster resilience.

3. Methodology

Sustainable development goal eleven indicator 11.5 was selected to estimate the safety and disaster resilience of cities and human settlements based on the SDG indicators Metadata Repository managed by United Nations- Department of Economic and Social Affairs (UNDESA) (https://unstats.un.org/sdgs/metadata)[19]. Localization of indicators is necessary for the assessment of SDG 11.5 in the Kochi metropolitan area. The localization of indicators means the adoption of a set of Sustainable Development Goal indicators that can be locally applied directly or can be changed based on local features, whereby using these Sustainable Development Goal indicators on the basis of completely knowing the 2030 Agenda and incorporating the real situation of Kochi metropolitan area.

Table 2: United Nations SDGs and Localisation of indicators

Target 11.5	By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to the global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.[20]	
Indicator 11.5.1	Number of deaths, missing persons and	Adopted the original indicator

	persons affected by disaster per 100,000 people[20]	Number of deaths, missing persons and persons affected by disaster per 100,000 people
Indicator 11.5.2	Direct disaster economic loss in relation to global GDP, including disaster damage to critical infrastructure and disruption of basic services[21]	Localized the original indicator
		Direct disaster economic loss in relation to state GDP, including disaster damage to critical infrastructure and disruption of basic services

Source: Secondary data[20,21]

To assess the SDG indicator 11.5.1, the number of deaths, missing persons and persons affected by disaster per 100,000 people were taken as the basis for analysis. The result of equation 1 was used to estimate indicator 11.5[27].

$$\mathbf{F(X)} = \sum_{i=1}^{n} \frac{X_i^{\alpha}}{(P_i/W)} \quad ; \ (\boldsymbol{i} =, \mathbf{12, 3} \ldots \boldsymbol{n}) \qquad \mathbf{(1)}$$

F(X) represents three values per year; the number of deaths, that is direct deaths during or after disasters, missing persons due to disasters and people affected by disasters per 100,000 people. X represents the sum of the statistical number of deaths caused by disasters of all kinds, missing people due to disasters and people affected by disasters. α represents the types of disasters like floods, earthquakes, landslides, etc. *i* stands for the year and P*i*/W denotes the weight of the population. P*i* represents the total population of various years and W is 100,000 people.

For assessing SDG 11.5.2, the proportional relationship between disaster economic losses and Gross Domestic Product (GDP) in the state is estimated. The calculated result of equation 2 is applied to analyze the indicator 11.5.2[27].

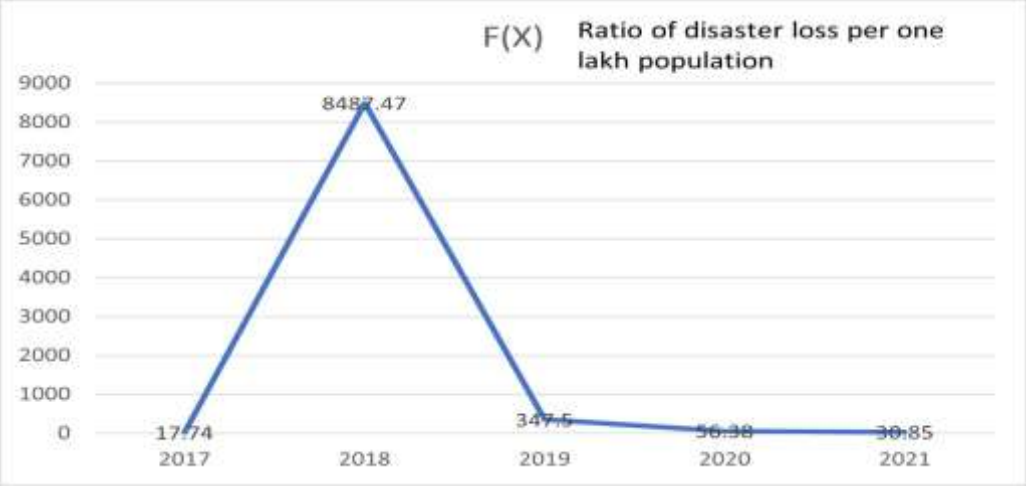
$$\boldsymbol{P(i)} = \frac{\sum_{j=1}^{n} \boldsymbol{cost_{disaster}(i,j)}}{\mathbf{GDPi}} (\dot{\boldsymbol{l}} = \mathbf{1, 2, 3} \ldots \ \boldsymbol{m}) \qquad \mathbf{(2)}$$

where P(i) stands for the proportion of disaster economic loss to the GDP of the state. Cost disaster denotes the economic losses due to disasters; (i, j) represents the j disaster that happened in the year i.

4. Results and Findings

As per Sustainable development goal 11.5, city disaster comprises of mainly two factors: meteorological factors and geological factors. Kochi metropolitan area is dominantly affected by meteorological disasters like heavy rain, flooding, intense lightning, cyclone and strong winds. Geological disasters like landslides caused the death of one person in Kochi metropolitan area in 2021, but heavy rain triggered a landslide. Coastal issues like coastal erosion also hit the coastal zones under this urban area. Meteorological disasters are only exerted to find the result of disaster loss indicators in the Kochi metropolitan area. SDG indicator 11.5.1 was assessed with equation (1) and results are presented in Figure 3.

Figure 3: Ratio of disaster loss per one lakh population in Kochi metropolitan area



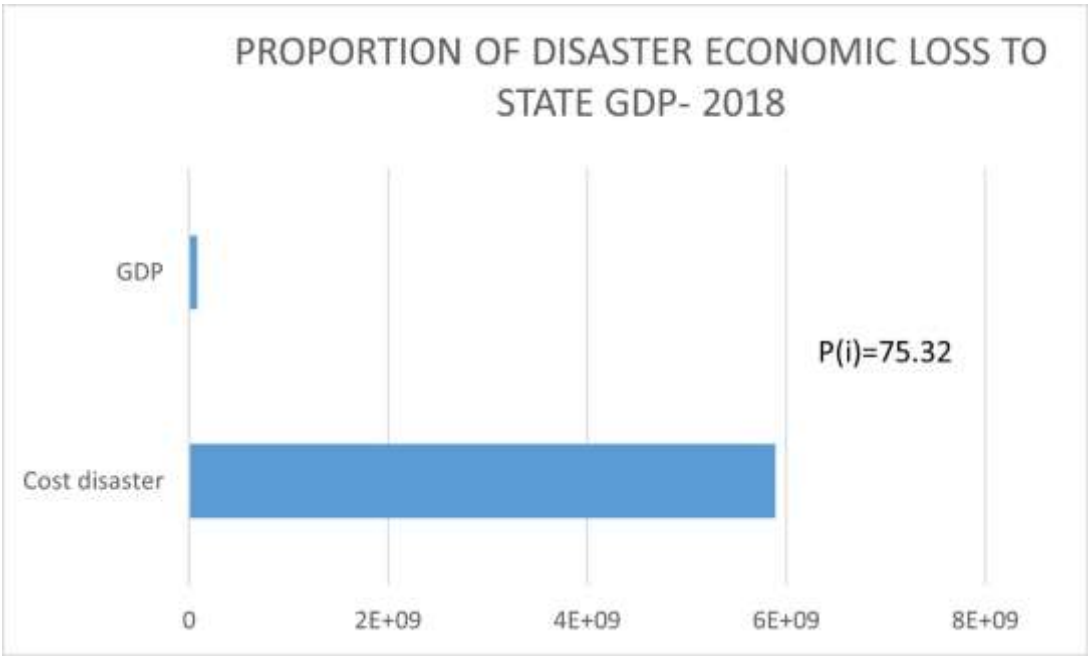
Source: Author

There are no missing persons due to disasters in Kochi metropolitan area, so the missing persons are not included in this calculation. By the calculation of equation (1), the summation of the ratio of disaster loss per one lakh population from 2017 to 2021 is 8909.09; it is the ratio of disaster loss per one lakh population over these five years in the Kochi metropolitan area.

The disaster economic loss in Kochi metropolitan area for the year 2018 was only available with the disaster management authority, Ernakulam district. So, the quantitative result of the disaster economic impact of the year 2018 was assessed, which was the year with the highest ratio of disaster loss per one lakh population. The result is shown in figure 4.

The quantitative results based on SDG 11.5.1 and 11.5.2 indicator shows that Kochi metropolitan area is significantly affected by meteorological disasters. Water logging due to heavy rain is the prevalent issue in this area. Heavy rain triggered flooding and damaged this area severely in the year 2018. Assessment of indicator 11.5.2 explained that disaster economic loss due to disaster was 75.32 times higher than the gross state domestic product of Kerala in 2018. Before the year of 2018, disaster loss in Kerala was in utmost low ratio when compared to all other ratios. After the worst affected flood of 2018, disaster loss in Kerala is decreasing gradually.

Figure 4: Proportion of Disaster Economic Loss to State GDP of Kochi metropolitan area in 2018.



Source: Author

The death happened due to flood, lightning, and heavy rain, which caused a landslide and strong winds. Cyclone Ockhi and cyclone Tauktae hit the coastal areas under Kochi metropolitan area in 2017 and 2021, respectively. It affected the coastal people intensively. One notable finding was derived from these facts was disaster economic loss was considerably higher than human disaster loss in Kochi. So, disasters have strong impacts and influence on the safety of human settlements and sustainable development of the Kochi metropolitan area.

5. DISCUSSION

Kochi metropolitan area is a vulnerable area to disasters. The Flood of 2018 can be considered an exceptional year that created enormous disaster economic losses and a large number of affected people in this area. Otherwise, disaster losses in this urban area are considerably decreasing over the years. Climate change is the crucial reason that induced these disasters. Table 3 indicates the change in the rainfall pattern in Kerala.

Table 3: Actual and Expected Rainfall in Kerala

Year	Normal expected rainfall (in millimeter)	Actual rainfall (in millimeter)
2017	2721.5 mm	2446.5 mm
2018	2900.3 mm	3503 mm
2019	3107.6 mm	2911.3 mm
2020	2864.4 mm	2965.6 mm
2021	2875.2 mm	3482.9 mm

Source: Secondary data[7,8,9,10,11]

Kerala received low total actual rainfall (sum of seasonal rainfall south-west monsoon, north-east monsoon and pre-monsoon rainfall) that was 2446.5mm against the normal rainfall of 2721.5mm in the year 2017[7]. From the year 2018, the total actual rainfall shows a notable increase in Kerala. The actual total rainfall was 3503 mm in 2018 when the normal rainfall was 2900.3 mm[8]. Kerala received the actual excess rainfall of 3107.6 mm against the normal rainfall of 2911.3 mm in 2019[9]. The actual total rainfall of 2020 was 2965.6 when compared to normal rainfall of 2864.4[10]. In 2021, a significant increase in actual total rainfall was experienced, which was 3482.9 mm, against the normal rainfall of 2875.2 mm[11]. So, it is evident that Kerala witnessed a drastic change in the case of total rainfalls over these years. It can be considered as a noticeable reason which induced the intensity of these disasters in this metropolitan city. Economic Review 2021 report of government of Kerala highlighted the major issues of Kochi city as water logging due to heavy rain , poor drainage systems and poorly planned constructions[11]. These obstacles increase the intensity of the disasters in this city[11]. Two cyclones (Cyclone Ockhi and Tauktae) also severely affected the coastal areas of Kochi in these years. Climate change is an inevitable factor which aggravates the disasters in this area. But the impact of these disasters is reducing eventually. So, disaster management and resilience are considered to be strengthening in Kochi.

Operation Break Through Project is one of the noteworthy disaster management programmes implemented in the Kochi metropolitan area to control water logging. This project was introduced and inspired by the success of Operation Anantha, which was executed in Trivandrum city and targeted to fix blocked drains, and build new drains to deviate water flow out to Vembanad lake and widens canals. Authorities have also executed various programmes to protect the coastal areas. Construction of tetrapod in cheriyakadavu of chellanam grama panchayath to control sea erosion and construction of cyclone shelters in pallipuram of Kochi taluk and Thuruttippuram Vadakkekkara grama panchayath in Paravoor taluk are the significant programmes to secure coastal zones of Kochi. Early Warning Systems have been completed in 7 taluks and formed an Inter-Agency Group (IAG), a joined platform for the functioning of non-governmental agencies in 5 taluks (Aluva, Kanayannur, Kochi, Kunnathunad, Paravoor) under this city area. Disaster management authority conducted various capacity-building programmes for disaster risk reduction. Disaster management authority is facilitating a 24 hours disaster distress helpline to assist people. These action plans and programmes surpassed the disaster resilience of the Kochi metropolitan area. More efficient disaster management

programmes would be highly beneficial to realize the goal of disaster resilience and sustainable development of the urban area.

Sustainable development goal 11.5 indicator is used for carrying out a study to assess the disaster resilience of urban areas by estimating disaster risk reduction. Disaster risk implies the disaster human loss and economic impacts. While considering sustainable development goals to estimate disaster resilience, the SDG 11.5 indicator alone cannot be considered a comprehensive study. To conduct a detailed, in-depth, systematic and complete analysis on disaster resilience based on sustainable development goals, a study with SDG 1.5, SDG 2.4, SDG 3d, SDG 4a, SDG 9.1, SDG 13.1 and SDG 15.3 indicators are essential. SDG 11.5 solemnly performs as a globally accepted urban study indicator to assess urban disaster resilience and evaluate the sustainable development of cities.

Provide training to volunteers and the existing workforce in rapid and effective disaster response.Develop regional policies and programs to strengthen the coping capacities of the people.Facilitate more drainage pumping stations to reduce the impact of flooding and prevent waterlogging . Ensure the stock of sufficient disaster preparedness equipment. Widens the canals to increase water flow capacity. Avoid conversion of wetlands into dry lands for residential and public purposes and strictly follow the rules on the conversion of wetlands. Enhance the regional multi-hazard early warning mechanisms. Ensure financial assistance to all affected people in a specified time frame.Provide counselling to ensure psychological support to highly vulnerable people to strengthen their mental health.Invest in sustainable urban planning and infrastructure.Strengthen global mechanisms for sharing experiences and adopting best disaster-related practices, disaster risk reduction and preparedness strategies from other countries. Enable the public for prompt and efficient disaster preparedness and response.

6. Conclusion

An old port city known as the `Queen of Arabian Sea' and a major spice trade centre of Kerala has emerged as the most established and well-developed trading centre of Kerala over long years of history. In the present century, cities are highly vulnerable to disasters. Lack of proper and systematic planning in urban development, overcrowding and insufficient infrastructures intensifies the disaster impact and vulnerability. So, urban disaster risk reduction and resilience are crucial to fulfilling the goal of sustainable urban development. Kochi metropolitan area is vulnerable to growing disasters caused by climate change impacts. Decrease in disaster loss is evident over the years, but disaster economic loss faced was exceptionally high. Action plans and programs are invigorating the resilience of Kochi, but more disaster management and resilient plans are imperative to overwhelm these growing challenging situations. Kochi, as a coastal and commercial hub city, requires extensive study to develop the city in a sustainable and resilient manner. Sustainable development goal 11.5 indicator as an international framework would be beneficial to evaluate the reality in a systematic way and to get global attention.

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