Peer Reviewed International Research Journal of Geography
Maharashtra Bhugolshastra Sanshodhan Patrika
ISSN : 0971-6785 {Impact Factor 3.687 (IIFS)} Vol. 33,No.2, Jul-Dec. 2016.pp 84-90

A GEOGRAPHICAL ANALYSIS OF SEISMICITY IN KOYNA REGION OF SATARA DISTRICT IN MAHARASHTRA

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Abstract:

Earthquakes are the most destructive natural that phenomena occur without any warning. It is impossible to prevent earthquakes from occurring. However, it is possible to make probabilistic seismic hazard assessments for earthquake risk: to reduce loss of life, injuries and damages. The present study based framework for systematic Natural hazard e.g. Earthquake analysis by employing historical Natural hazard data in Koyna Region of Satara district, coupling with geological, geomorphological, population, climatic, and rainfall data. The present research work, focusing on theEarthquakes in Koyna region of Western Ghat. This might be the attempt for analytical study of the seismicity in Koyna region. But natural hazards like Earthquakes are influencing human life and their activities i.e. settlement, agriculture, transportation, deforestation residing there In the present study a new approach for the forecasting of major earthquakes based on pattern informatics method in the Northeastern India, which quantifies temporal variations in seismicity. This technique does not predict the exact time and location of earthquakes, but it does forecast the regions (hot spots) where earthquakes are mostly like to occur in the relative near future.

Key Words: *Seismicity, Coupling, Probabilistic, Catastrophic*

Introduction:

Earthquakes are usually quite brief, but may repeat. They are the result of a sudden release of energy in the Earth's crust. This creates seismic waves, which are waves of energy that travel through the Earth. As we know Catastrophic events, particularly natural disasters like Earthquakes, have had devastating consequences on society not only in terms of damaged infrastructure but also in terms of impacts on citizens and economic stability in the affected region. Amongst all the Natural Disasters, One of the most destructive and terrible natural disasters that is major earthquakes. Earthquakes are one of the terrible outcomes of nature. Earthquakes cause dreadful effects like property damage by destroying houses, buildings, farms, food shortage and cause tremendous harm to human life, environment, and surroundings. For many years, disaster like earthquake loss estimation focused on property damage to structures. All other types of impacts (economic, sociological, psychological, etc.) were thrown into a grab bag category termed “indirect” or “secondary” losses. Direct property damage relates to the effects of natural phenomena, such as fault rupture, ground shaking, ground failure, landslides, tsunami, etc., while collateral, or indirect, property damage is exemplified by ancillary fire caused by ruptured pipelines, frayed electrical wires, etc., and exacerbated by loss of water services.However, the rapid growth of the world's population and its increased concentration often in hazardou s environments has escalated both the frequency and severity of disasters. With the tropical climate and unstable land forms, coupled with deforestation, unplanned growth proliferation, non-engineered constructions which make the disaster-prone areas more vulnerable, tardy communication, and poor or no budgetary allocation for disaster prevention, developing countries suffer more or less chronically from natural disasters. Asia tops the list of casualties caused by natural hazards.

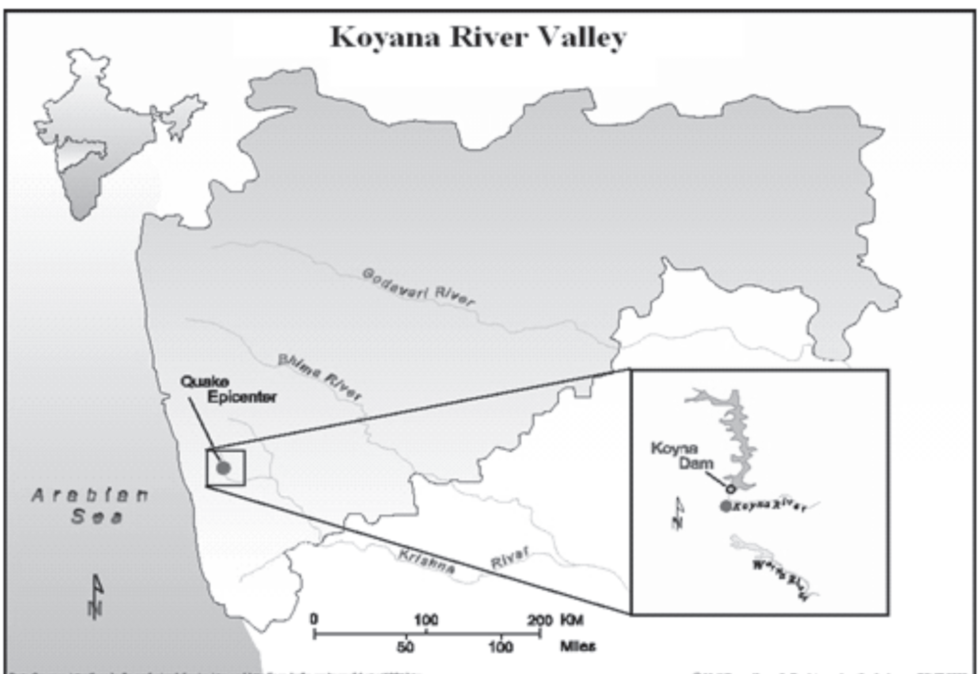
Earthquakes are the most destructive natural phenomena occur without any warning. It is impossible to prevent earthquakes from occurring. However, it is possible to make probabilistic seismic hazard assessments for earthquake risk: to reduce loss of life, injuries and damages.

The present study based framework for systematic Natural hazard e.g. Earthquake analysis by employing historical Natural hazard data in Koyna region of Satara District, coupling with geological, geomorphological, population, climatic, and rainfall data. In the present study a new approach for the forecasting of major earthquakes based on pattern informatics method in the Northeastern India, which quantifies temporal variations in seismicity. This technique does not predict the exact time and location of earthquakes, but it does forecast the regions (hotspots) where earthquakes are mostly like to occur in the relative near future. The present research work, focusing on theanalytical study of the seismicity in Koyna regionSatara District.

Study Area:

PatanTahsilSatara District varies with altitudinal gradation and distance from the equator.The Koyna region located close to the west coast of India. Koyna River which rises in Mahabaleshwar, a hill station in Sahyadri ranges. It is located in Satara district, nestled in the Western Ghats. Coordinated 17° 24′ 6″ N, 73° 45′ 8″ E. Koyna valley is the region in the Sahyadris, covering over 400 sq km in Maharashtra. The nearest town, Koynanagar is situated on the banks of Koyna river, hence the name. The famous Koyna Dam which is India's largest hydroelectric project is also nearby. The Koyna region is a highly active seismic zone Koyna, the region as unique as very severe earthquakes continue to occur there four decades after the initial spurt in activity.Average high temperature28.8°C (83.8 °F) Average low temperature13.7 °C (56.7 °F). Mean temperature range is 24°C (75°F). Rainfall in this region averages 3000–4000 mm (120–160 inches). About 200 inches of rainfall in 345 sq miles watershed above Koyana experience heavy annual rainfall (with 80% during the southwest monsoon from June to September), while the eastern slopes are drier; rainfall also decreases from south to north. As the Western Ghat mediates the rainfall regime of peninsular India by intercepting the southwestern monsoon winds.

Location Map of Study Area



Objective:

1) To study the geographical setup of the study area.
2) To analyse the seismic events of the study area.

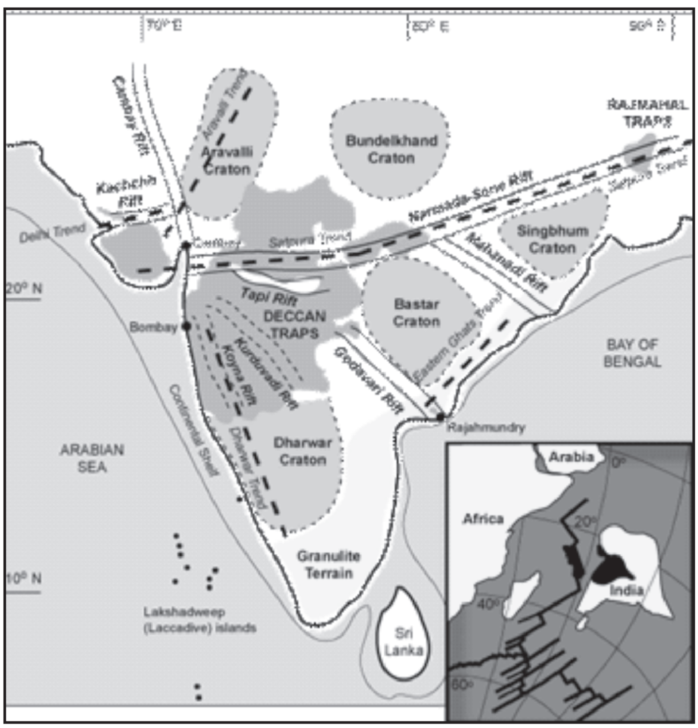
Database & Methodology:

Majority of primary data regarding earth quakeis collected through field work. e.g. Field visits, Interviews with local and officials. The secondary data will be collected through related reference books, magazines, journals, and published Govt. Report, Newspapers, Other media reportsand relegated websites.

Appropriate statistical method &cartographic technique are used for analysing representing data for obtaining the correct result.

Discussion & Result:

The Koyna Valley of Satara District in this region is not true mountains, but is the faulted edge of the Deccan Plateau. They are believed to have been formed during the break-up of the super continent of Gondwana some 150 million years ago. After the break-up, the western coast of India would have appeared as an abrupt cliff some 1,000 m (3,300 ft) in elevation.



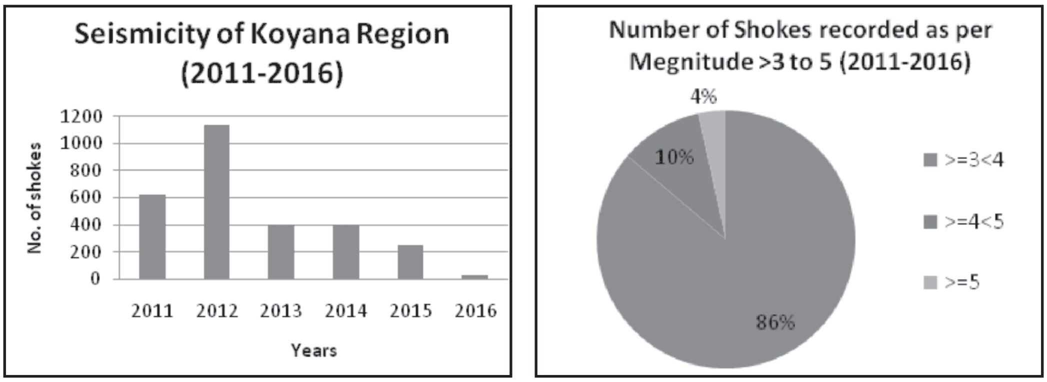
This zone is called the High Damage Risk Zone and covers areas liable to MSK VIII. The IS code assigns zone factor of 0.24 for Zone 4. In Maharashtra, the Patan area (Koynanager) is in zone no-4. The districts of Raigad, Ratnagiri and Satara are the only districts to lie in Zone IV, where the maximum expected intensity is VIII (MSK).

Koyna region is the most seismically active area in the country. The largest earthquake attributed to reservoir-induced seismicity occurred at Koyna Dam. The column of water in a large and deep artificial lake alters in-situ stress along an existing fault or fracture. In these reservoirs, the weight of the water column can significantly change the stress on an underlying fault or fracture by increasing the total stress through direct loading, or decreasing the effective stress through the increased pore water pressure. This significant change in stress can lead to sudden movement along the fault or fracture, resulting in an earthquake. Reservoir-induced seismic events can be relatively large compared to other forms of induced seismicity. Though understanding of reservoir-induced seismic activity is very limited, it has been noted that seismicity appears to occur on dams with heights larger than 330 feet (100 m). The extra water pressure created by large reservoirs is the most accepted explanation for the seismic activity. When the reservoirs are filled or drained, induced seismicity can occur immediately or with a small time lag.

Koyna region has had a long history of earthquakes. As much as 20 known earthquakes have taken place at Koyna region. The latest one being on 25th Nov. 2016. It lies in the Zone 4 of the hazard zoning.Of all of them the most severe one took place in 1967 with areas affecting to the tune of 25 kilometers.The 1967 Koynanagar earthquake occurred near Koynanagar town in Maharashtra, India on 11 December. The 6.5 magnitude shock hit near the site of Koyna dam and claimed at least 180 lives and injured over 1,500. More than 80% of the houses were damaged in Koyana Nagar Township, but it didn't cause any major damage to the dam except some cracks which were quickly repaired. There have been several earthquakes of smaller magnitude there since 1967. The deadly earthquake caused a 10–15 cm (3.9–5.9 in) fissure in the ground which spread over a length of 25 kilometers (16 mi).
Most of the Earthquakes epicenters are located in and around 20 kms from Koyna dam.Epicentrial depth of these earthquakes is between 5 km to 16 km.

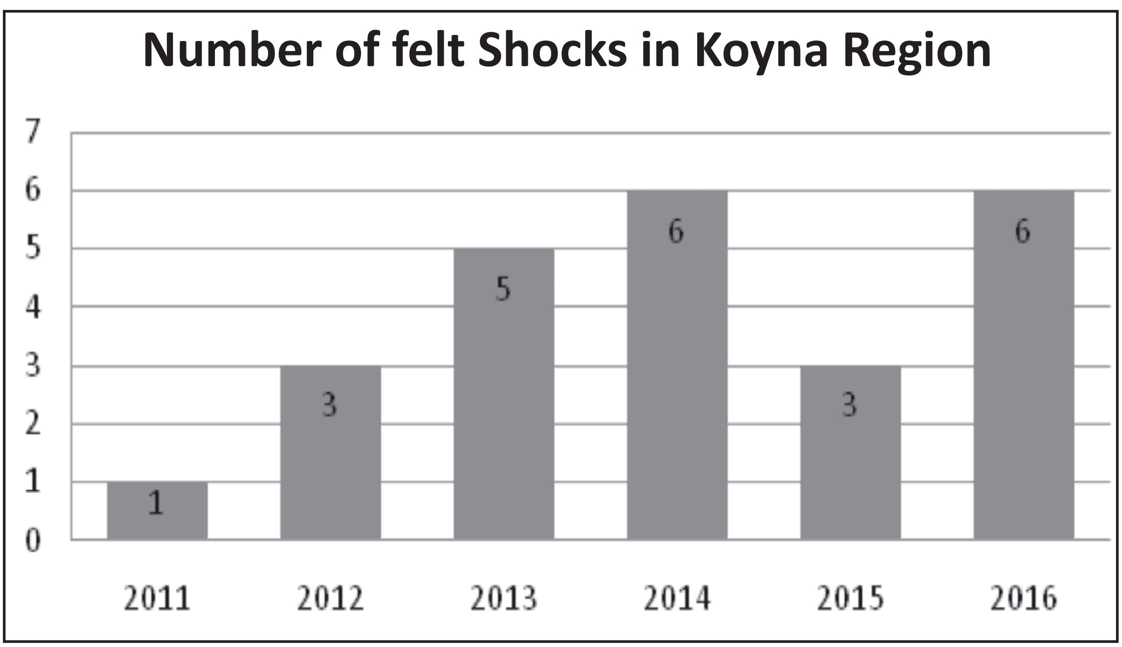
Following Fig. 1. ShowsSeismic events of six years in Koyna Region from year 2011 to 2016. It shows that there are 2841 Total No. of Shocks in six years but the 2012 having 1140 shocks.fig.2. show that the most of the Shocks Recorded As Per Magnitude <3 or small shocks i.e 2812 which is 86 % and no. of big shocks i.e Magnitude>=5 is one that is 4% of the total shocks recorded.

Sr.No.	Year	No. Of Shocks Recorded As Per Magnitude				Total No. Of Shocks
		<3	>=3<4	>=4<5	>=5	
1	2011	610	8	0	0	618
2	2012	1136	3	0	1	1140
3	2013	396	6	1	0	403
4	2014	400	2	0	0	402
5	2015	250	3	0	0	253
6	2016	20	3	2	0	25
	Total	**2812**	**25**	**3**	**1**	**2841**



1.Fig. 2.

In fig. 3. Number of felt Shocks in Koyna Region as per Magnitude>=4 year 2014 & 2016recorded many shocksi.e 6 big shocks as compare to other years.



Following Fig. 4. Showsmonthly frequency of earthquakes near Koyna Reservoir area (2011-2016) which shows that most of the earthquakes are occurred in the month of September (493), October (240) and April (260).

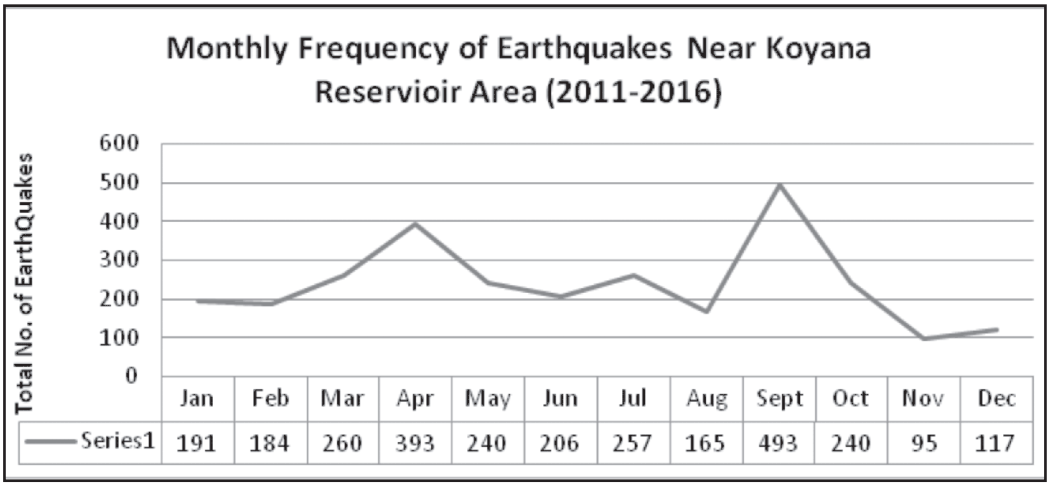


Fig. 4

However fig.5. Shows that shocks occurred at mid night at 10:00 pm to 06:00 am which is sleeping time. There after many shocks occurred at 02:00 pm to 10:00 pm.

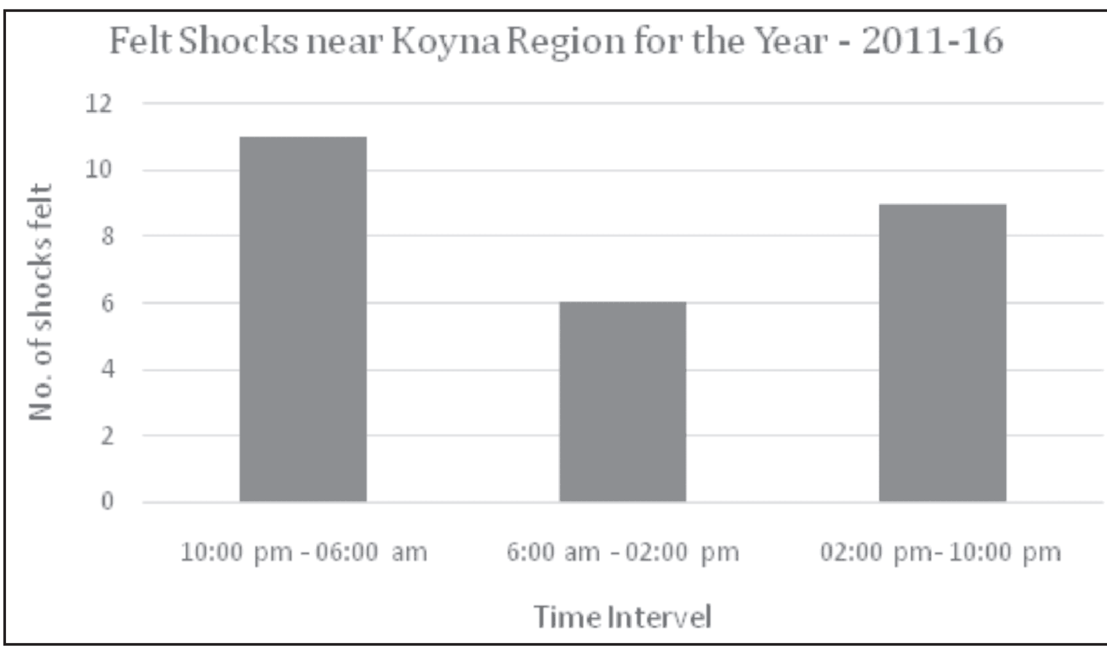


Fig.5.

Conclusion:

However, it must be stated that proximity to faults does not necessarily translate into a higher hazard as compared to areas located further away, as damage from earthquakes depends on numerous factors such as subsurface geology as well as adherence to the building codes. The earthquake at Koyna in 1967 is the largest known case of Reservoir-Induced Seismicity (RIS) in the world.

Most of the Shocks Recorded as per Magnitude <3 or small shocks i.e 2812 which is 86 % and no. of big shocks i.e Magnitude >=5 is one that is 4% of the total shocks recorded. Because of that it caused not a more harmful so its neglected by people but it is more dangerous in future. Most of the earthquakes are occurred in the month of September (493), October (240) and April (260). Most of the Shocks occurred at mid night at 10:00 pm to 06:00 am. that is dangerous for human life of the region.

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