

# **Latur earthquake – Selection of sites for rehabilitation of the affected villages in Latur and Osmanabad districts of Maharashtra, India: A remote sensing based study**

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A study was carried out by the Department of Space to identify alternate sites to relocate the earthquake-affected villages of Latur and Osmanabad districts of Maharashtra, using Indian Remote Sensing Satellite (IRS)-1B data in conjunction with collateral and field data. Maximum damages have been observed in the zone of major lineaments and around their intersections. A map on 1:50,000 scale showing alternate sites for relocating the affected villages was prepared by integrating information derived from satellite, collateral and field data and the same was provided to the Government of Maharashtra.

AN earthquake of magnitude 6.4 on Richter scale occurred in the early hours of 30 September 1993, resulting in serious damages to the houses and loss of human life and cattle population in parts of Latur and Osmanabad districts of Maharashtra. The epicentre of the earthquake has been identified close to village Killari in Latur District (Lat. 18°02'N; Long. 76°34'E). In the context of this natural calamity, identification of suitable/safer sites to relocate the affected villages had become essential.

A study was undertaken by the Department of Space to identify sites for relocating the affected villages, using data from the Indian Remote Sensing Satellite (IRS)-1B (Figure 1). Collateral and field information were also used.

## *Satellite data analysis*

IRS data (on 1:50,000 scale) were analysed to identify the following information:

- Major lineaments of significance from earthquake point of view (zones of weakness in earth's crust).
- Fractures and joints which are important from the point of view of locating groundwater source for drinking water purposes.
- Geomorphological units for assessment of depth to bed-rock.
- Wastelands.

The following collateral data were used:

- Information on epicentres received from National Geophysical Research Institute, Indian Meteorological Department and other sources.
- Historical record on seismic data.
- Reports from Collectors of Latur and Osmanabad districts on damage to the villages.
- Geological maps published by the Geological Survey of India and Survey of India topographic maps.
- Existing literature on seismicity and geological structures in the area.
- Newspaper reports on various aspects after the earthquake.

The following field observations were made to supplement the analysis:

- Degree of damage to villages in terms of collapse of houses was evaluated.
- Significant changes in geological features after the earthquake were looked for. Ruptures on the ground and formation of 'horst' at a distance of about 2 km from Killari village towards Northwest were noticed.
- Fall of water table in borewells to the tune of 50 to 70 ft was noticed in the vicinity of the ground rupture.
- Smell of H<sub>2</sub>S (hydrogen sulphide) gas was sensed from borewells near the ground rupture after the earthquake, which stopped by the end of October 1993.
- Electric/telephone poles in the vicinity of ground rupture have either fallen or tilted.
- RCC structures were unaffected.

## *Findings*

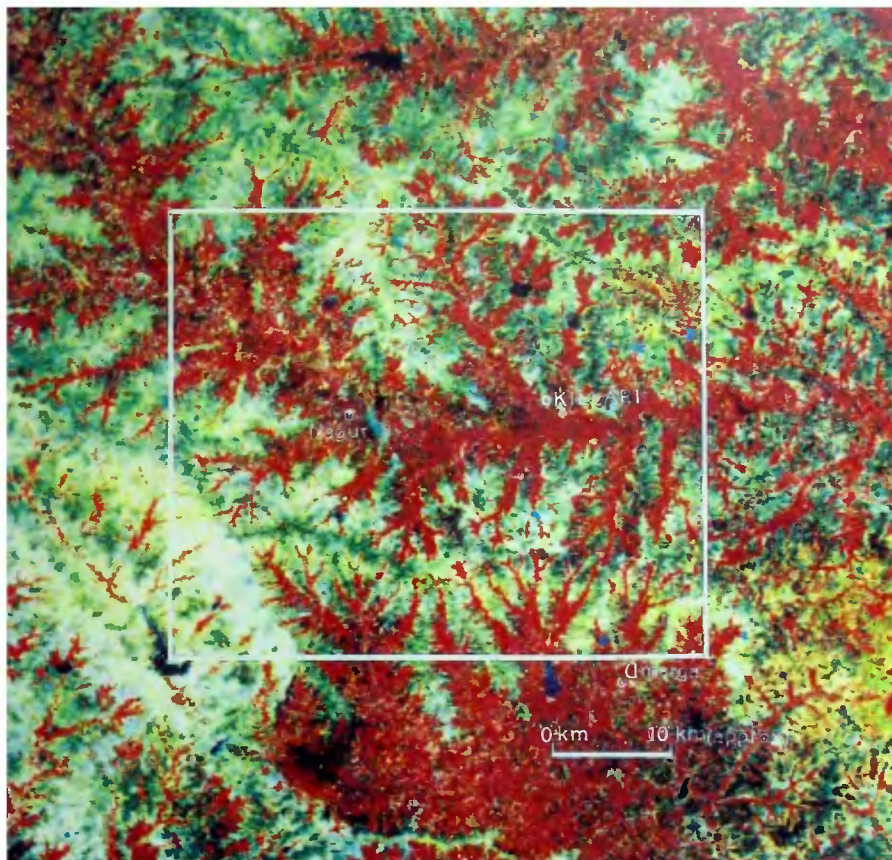
Some of the important findings are as follows:

- Maximum damages to the villages have been observed to be in the zone of major lineaments (weak zones in the earth's crust) and around their intersections. Accordingly, the intensity of earthquake has also been greater along these lineaments.
- Based on the damage, four isoseismal lines (VI to IX) according to the Modified Mercalli (MM) scale have been drawn. These lines show correlation not only with major lineaments but also with geomorphological units.

## *Criteria adopted for selecting alternate sites for rehabilitation of earthquake-affected villages*

Based on integrated analysis of information from satellite, collateral and field data, the following criteria were arrived at and adopted for selection of suitable sites for rehabilitation of the affected villages:

- Away from major lineaments.



**Figure 1.** Indian Remote Sensing Satellite-1B (IRS-1B) image of February 1989 covering parts of Latur and Osmanabad districts, Maharashtra. Box shows the area covered in the study.

- Bed-rock at shallow depth and preferably on elevated areas.
- Wastelands to be used, as far as feasible, for relocation of villages in order to safeguard good agricultural lands.
- Areas along river-beds with deep soils and alluvial cover and those coinciding with major lineaments are to be avoided since such areas are prone to liquefaction during high-magnitude earthquakes.
- Close to favourable groundwater zones and existing agricultural activity.

- Existing infrastructural facilities to be used/linked.

#### *Recommendation*

Based on the criteria mentioned above, alternate sites have been recommended for relocation of the affected villages as shown in Figure 2. A map on 1:50,000 scale showing suitable sites for relocating the affected villages was provided to the Government of Maharashtra.

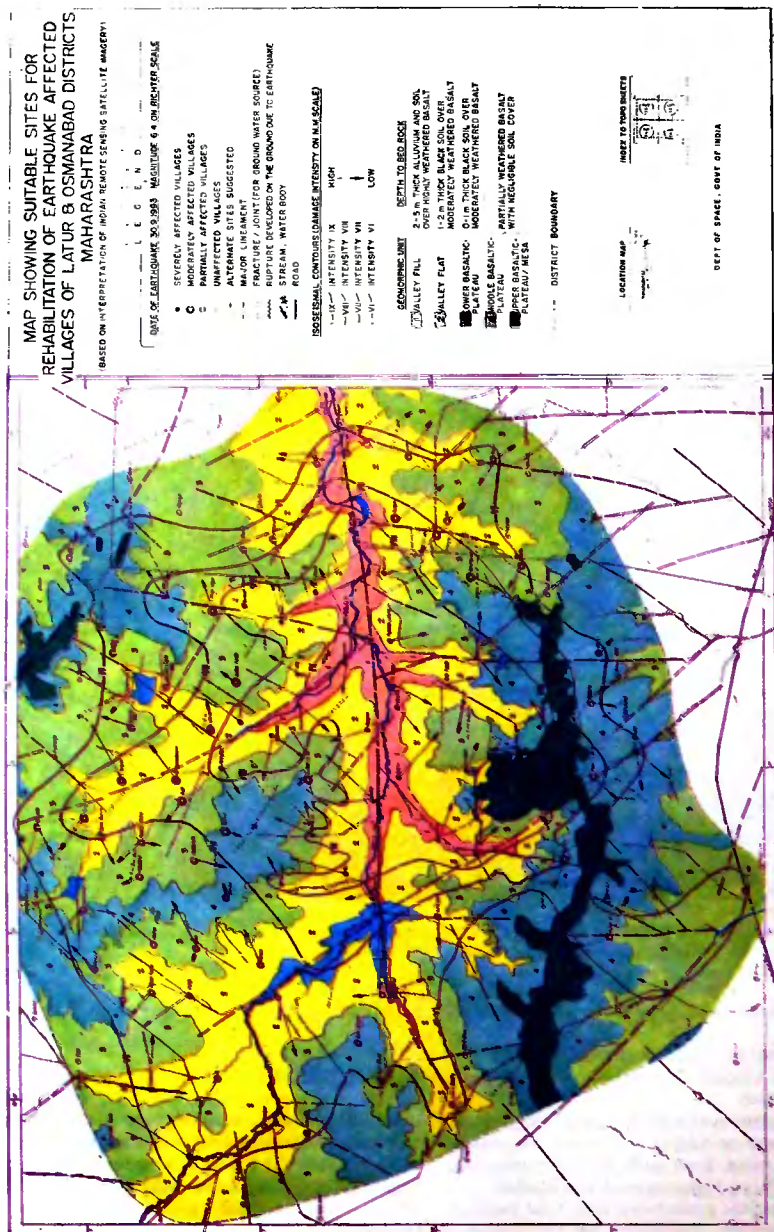


Figure 2. Map showing suitable sites for rehabilitation of earthquake-affected villages in Latur and Osmanabad districts, Maharashtra.