

## Urgency of Checking Fast-Increasing Risks of Land-Subsidence

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Theme: [Environment](#)

Asia-Pacific Research, October 04, 2024

*On May 1 this year a highly tragic incident on a highway in Guangdong province of China received worldwide attention. Over 20 cars fell down one after the other in very quick succession as an 18 meter section of a highway collapsed very suddenly. As many as 48 persons died while 32 were injured. A team of nearly 570 rescue persons had to be mobilized.*

Grim as this tragedy was on its own, another reason why this received widespread attention was that it had been preceded by an extensively reported study on land subsidence in China which brought to light quite alarming facts about the extent of land-subsidence in China. This study, by a team led by Zurui Ao, was published in the reputed journal 'Science' on April 18, less than a fortnight before this terrible mishap. This study titled 'A national scale assessment of land-subsidence in China's major cities' estimated that of the examined urban lands, 45% are experiencing subsidence faster than 3 millimeters per year, affecting 29% of the urban population. The most extremely affected areas, those where land subsidence is taking place at over 10 millimeters per year, occupy 16% of the examined land and this high level of subsidence affects 7% of the population.

Thus what this study tells us is that land-subsidence is by no means an isolated phenomenon and very substantial sections of people can be affected by this. Land subsidence in turn can lead to very serious mishaps, increasing risks faced by many big buildings including residential buildings and infrastructure of critical importance and above all, disruption of drainage and very significant aggravation of floods, as can be already seen in several cities.

Jakarta is often mentioned as the city worst affected by land subsidence at world level, followed by several others like Mexico, Bangkok and Ho Chi Minh City. Tokyo on the other hand provides an example of a once badly affected city which could make significant improvements by its consistent efforts.

Jakarta and Mexico provide examples of big cities which were vulnerable to land-subsidence due to basic location and structural factors but instead of being extra cautious to start with, these cities allowed the problem to worsen with careless practices such as excessive groundwater extraction. Recently Jakarta authorities have tried to restrict this, but many fear this may be a case of too little, too late.

However the problem of land subsidence is by no means confined only to urban areas. Vast agricultural plains which have experienced unsustainably high withdrawal of groundwater and lowering of water table are also highly susceptible. Areas where other fluids have been

extracted on a vast scale, including areas of huge oil wells, can also experience land-subsidence. Mining areas which are hollowed out without reclamation steps being taken become vulnerable to land subsidence. Fragile hills where big projects involving dynamite blasting and digging by very heavy machines are taken up in environments too unstable to bear this have also experienced land subsidence.

In fact four factors often combine together to create serious land subsidence (basically the lowering or sinking of earth surface).

First and foremost is the very large-scale extraction of groundwater or other ground fluids which can hollow out the land. This can take place in urban areas as well as in areas of intensive agriculture.

Secondly, there is the accumulation of very heavy loads on land in the form of high rise buildings and multi-layer transport infrastructure.

Thirdly there is the neglect of subsidence possibilities in development works and planning. The concept of the carrying capacity of land often does not even exist as each building or project is considered separately and not in terms of their overall and combined impact on land stability. Geological stability is seldom examined carefully, in terms of soil structure and other factors, for assessing the extent and type of development activities sustainable and permissible for any area, or for determining the additional stabilizing work needed while taking up or planning large-scale construction and/or extraction in any stretch of land.

What may become perhaps the biggest worry in this context in the coming years is the double whammy of sinking land and rising sea level. This is already a huge problem and an increasing worry in the Netherlands as well as coastal parts of several other countries. Many coastal and river delta areas, particularly coastal cities, have dense populations. Due to the impact of global warming and melting ice sheets, sea levels are rising. If in times of sea level rise there is also a tendency for coastal land to sink, then this can mean even higher peril and disasters for coastal populations.

Keeping in view all these factors, estimates of people likely to be affected by land subsidence of varying degrees show an increasing trend. A study supported by UNESCO estimated that by the year 2040 about one-fifth of all people at world level, or close to 2 billion people, are likely to be affected by land-subsidence to a lesser or greater extent.

These vast numbers of people will not only face increasing risks and difficulties in normal times; in addition they will face higher harm from disasters like floods, sea-storms and earthquakes.

Hence we need to give much more attention to reducing these risks. Countries like China, USA, Netherlands, Mexico and Iran where this problem has become most serious need to be extra cautious. India is also generally counted among those countries where land-subsidence problem is already serious. Significant land-subsidence incidents have been reported here from time to time from big cities, mining belts and those parts of the Himalayan region which have experienced indiscriminate construction work and extensive deforestation.

Recharging of emptying aquifers and stabilization measures including soil treatment are often recommended for affected areas. While these certainly have their role, what is even

more important is to take on a very extensive scale all those precautions which are necessary to avoid the risk of land subsidence, or which are necessary to prevent further accentuation of moderate levels of land-subsidence that have already occurred.

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