

# Environmental Impacts of Land Subsidence in Urban Areas of Indonesia

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## SUMMARY

Land subsidence is natural-anthropogenic hazard affecting several large urban areas in Indonesia, i.e. Jakarta, Bandung and Semarang. Geodetic based results from various techniques (e.g. Leveling, GPS and InSAR) show that land subsidence rates in all three cities generally have spatial and temporal variations, and their magnitude is in average about 5-10 cm/year and can reach up to about 20 cm/year at certain locations and times. This type of silent hazard is mainly caused by the combination of excessive groundwater extraction, natural consolidation of alluvium soil, load of constructions and tectonic activities. In general, information related to characteristics of land subsidence is important for urban spatial planning and development activities, environmental management, and risk assessment efforts. Therefore, systematic and continuous monitoring of land subsidence in urban areas is obviously needed and critical to the welfare of the peoples. The impact of land subsidence in urban areas of Indonesia can be seen already in the field in forms of cracking and damage of housing, buildings and infrastructure; wider expansion of (riverine and coastal) flooding areas, malfunction of drainage system, changes in river canal and drain flow systems and increased inland sea water intrusion. In general, land subsidence phenomena will increase the maintenance and rehabilitation costs for the affected environment, buildings and infrastructures. It also badly influences the quality of living environment (e.g. health and sanitation condition) and (social and economic) life in the affected areas. This paper concentrates on the environmental impacts of land subsidence in those three large cities in Indonesia, namely Jakarta, Bandung and Semarang. Related mitigation and adaptation efforts that have been implemented are also discussed and analyzed.