Chapter 3
Land Subsidence in Ho Chi Minh City and the Mekong Delta Region, Vietnam:
Causes, Challenges, and Solutions

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ABSTRACT

Land subsidence and its consequences are at an alarming level in the Southern and low-lying areas of the Mekong Delta. This chapter will discuss the situation of groundwater uses and urban development activities that caused the negative impacts of land subsidence and sea level rise in Ho Chi Minh City and the Mekong Delta region of Vietnam. The PSInSAR technique was applied for land subsidence monitoring and showed that an average subsidence rate at 15 mm/year which is 5 times greater than the effects resulting from the rise of sea level. This implies that land subsidence coupled with sea level rise have been as a major factor contributing to increasing the depth of annual flood and causing inconveniences to the daily lives of residents that suffered waterlogging of between 0.4 – 0.5m. Apart from the restriction of groundwater abstraction, rainwater harvesting – an alternative water sources – is a humanitarian engineering solution to minimize groundwater extraction which in turn to prevent from flood risks caused by land subsidence and the rise of sea level.

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INTRODUCTION

Land subsidence and its consequences have posed profound challenges in many Asian megacities over the past decades. Particularly, land subsidence coupled with sea level rise have been identified at an alarming level in low-lying areas and coastal cities such as Jakarta, Bangkok, Ho Chi Minh City, Manila, and Tokyo (Erkens et al., 2015; Anh Cao et al., 2021). This phenomenon has increasingly drawn much attention from academies and managers because of triggering serious flood risks and causing infrastructure damage and economic loss.

Ho Chi Minh City, a megacity with a total area of 2,095 km^2 and more than 9 million of inhabitants, is the hub of socio-economic development with a fast urban expansion and rapid development of industrial, commercial, and service activities. The Vietnamese Mekong Delta region is a rice bowl of Vietnam and a home to 18 million people. This region occupies a total area of 4 million ha, and has witnessed a fast population growth, urbanization and land use changes over the past several decades. However, both Ho Chi Minh City (HCMC) and Mekong Delta (MD) are subsiding due natural and human-induced factors. Naturally, these areas locate at the soft soil and the low elevation of the land, rivers and canals form a complex network that is affected by tide. In addition, due to the geographical location, this delta system is also one of the most vulnerable areas to global climate change and SLR. Several evidence from human impacts are demonstrated in the relation between land subsidence, land use change and sea level rise. The rapidly developing urbanization since 1990 has led to increase in built-up areas and constructions zones at a very low elevation. Especially, the major factors can be caused land subsidence such as extensive conversion of prime agricultural areas into industrial parks and residential areas with high building density on soft soil, as well as the groundwater use was in a large scale for socio-economic development activities resulting the decline of water table (>20m from 1990 until now) which caused the deformation of soil making the ground level goes down each year. As a result, the impacts of the land subsidence and SLR have been increased frequency of tidal flooding that residents in these areas suffered waterlogging of between 0.4 – 0.5m. Many projects have been implemented in flood prevention plan of provinces/cities authorities such as: mapping land deformation, determining control measures on groundwater extraction in areas severely affected by land subsidence and modifying the impacts of the land subsidence and SLR in the master plan of 2030 vision in order to achieve the sustainable urban development.

Results derived from mapping land deformation by using the PSInSAR technique contribute to demonstrate the directly impacts towards urban infrastructure and show that an average subsidence rate at 15 mm/year can be considered as greater 5 times than the effects resulting from rising sea level. This problem pointed out the land subsidence coupled with sea level rise have been as a major factor contributing to increasing the depth and duration of annual flooding for the MD and coastal metropolitan cities including HCMC, Can Tho and adjacent delta areas.

The purpose of this paper is to discuss the situation and causes of land subsidence as well as the impacts of land subsidence and SLR in the context of urbanization and climate change. PSInSAR technique is deployed for monitoring land subsidence and mapping land deformation in HCMC and the MD region of Vietnam. Furthermore, the relation between land subsidence, groundwater uses, and urban development activities will be also elucidated. Some measures are proposed as humanitarian engineering solutions to enhance the resilience and adaptive capacity for the ongoing subsiding and the rise of sea level in these areas.