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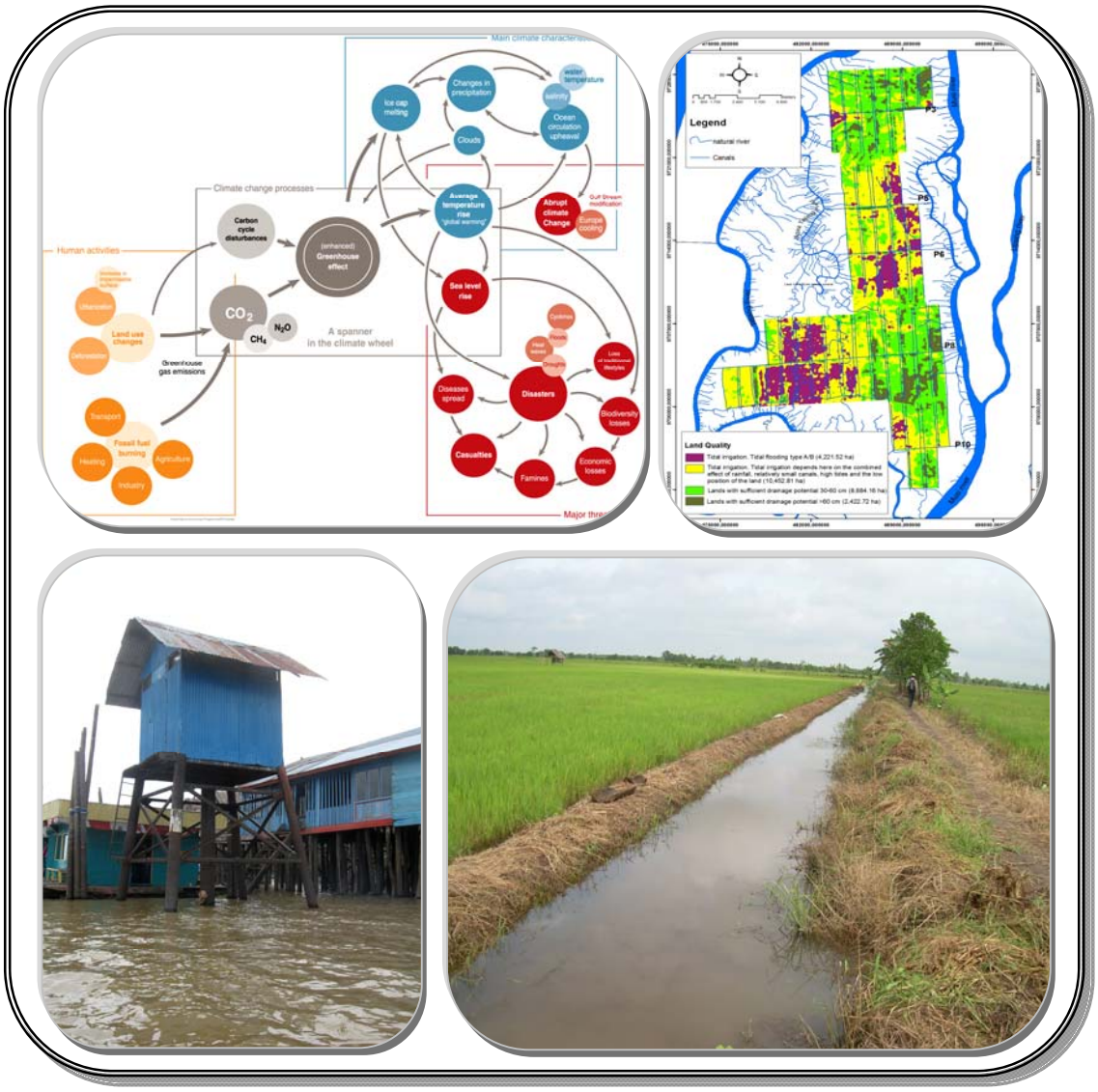


## Effects of Climate Change and Land Subsidence on Water Management Zoning in Tidal Lowlands Case Study Telang I, South Sumatra


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Master of Science Thesis
by

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## SUMMARY

Indonesia has large lowland areas with an estimated area of about 34 million ha, out of which about 20 million ha is tidal lowland. The other 13.4 million ha concern predominantly non-tidal lowlands along rivers and inland swamp areas. Almost 4 million ha of the tidal lowlands in Indonesia have been reclaimed, partly by spontaneous settlers (2.5 million ha) and partly by the Central Government (1.5 million ha).

Development in the lowlands of Sumatra and Kalimantan started in the early twentieth century by spontaneous migrants, or even centuries earlier when considering the role of indigenous people. Lowland reclamation by the government began in 1930s. Large-scale government-sponsored lowland development peaked during the 1970s and 1980s, driven by the transmigration programme, whereby major reclamation projects were implemented in order to settle farmers from the overcrowded isles of Java, Bali and Madura. Recently, one of the main objectives of tidal lowland development and management is to contribute to the required increase in food production through intensification of existing reclaimed lowland areas to support food self-sufficiency.

Water management zoning in tidal lowlands is one of the strategies to design and implement proper water management. Water management zoning is defined as zones of certain areas that have similar water management based on their physical characteristics. The issue of climate change on water management zoning is very crucial to be analysed, since it may have important influence on the success of the agricultural sector in tidal lowland. Land subsidence is often considered being a minor influence in developing water management, whereas it may play an important role in determining water management in tidal lowland.

This study is dealing with the effects of climate change and land subsidence on water management zoning in tidal lowlands. In general, some results of this study may be used to support development of lowlands and particularly can be used for tidal lowland development in Indonesia, including some measures to be taken to deal with predicted climate change and land subsidence. This research focuses on three main aspects i.e. water management zoning, climate change and land subsidence in relation with sea level rise contributing to hydro-topography, salinity intrusion and drainage capability. Head loss in the main systems was analysed using DUFLOW modelling studio, while thematic parameters of physical characteristics support to water management zoning (hydro-topography, drainability, soil types, salinity intrusion, and existing land use) were analysed by ArcGIS model builder. Data for the study were based on the conditions in the Telang I areas, South Sumatra.

Results of land subsidence in Telang I were calculated or modelled in compartments of soil in each layer. Samples were taken from two locations representing category A and B or B/C in hydro-topographical conditions of the standard classification of tidal lowland areas in Indonesia (secondary block P8-12S and P6-3N). As expected, results of the model show that land subsidence has a relation with groundwater fluctuation, where it varies from 0.3 – 0.7 cm per year. In low areas where the groundwater level is near the surface level land subsidence is about 0.3 cm per year, while for higher areas it is about 0.7 cm per year. Land use of these two areas is dominantly rice field. From the results it can be concluded that land subsidence during the beginning of the reclamation period is

higher than after a long period of reclamation. During the reclamation period when soil was not ripe yet, lower groundwater allows oxidation conditions where the soil is more porous and becomes ripe. In the present conditions when the soil has already ripened, land subsidence trough shrinking, compaction or other processes becomes slower. It was also clear that land subsidence during a dry period is higher than during a wet period along a year.

Salinity intrusion during dry periods in the present situation reaches until 10 km from Bangka Straits (mouth of Musi River) or only in the north parts of Primary 3 of Telang I. This result is almost identical with the observation of salinity intrusion using the moving salinity method. With assumption of sea level rise of 2 mm/year and increase of 1-2 mS/cm of salt concentration due to climate change, salinity can intrude until 25 km from mouth of Musi River in the coming 25 years.

Based on modelling, analysis, results and evaluation for the study area, it can be concluded that the effect of climate change and land subsidence on water management zoning in the future is significant. These significant effects can be positive and negative impacts to development of tidal lowlands in the study area particularly and in Indonesia generally. From the analyses it also can be concluded that land subsidence has more effects to water management zoning by lowering the land elevation than sea level rise, which nowadays became a big issue all over the world.

Water management zoning in the wet season is fully dependent on the tidal fluctuation and rainfall which is also related to the hydro-topographic condition, tidal irrigation and drainability. Sea level rise and land subsidence make the potential of tidal irrigation larger and significant. The area with tidal depth of 0-25 cm or > 25 cm will increase. This condition changes water management zoning from dryland crop in the present condition to wetland rice tidal irrigation, and from tree crop to dryland crop due to its potential drainage. In the dry season, the positive effects of sea level rise and land subsidence also increase the tidal irrigation area, meaning that so many areas can be cultivated with double rice crop. However, there would be negative effects of sea level rise or climate change in general, where the salt concentration becomes higher and salinity intrusion becomes deeper. Salinity intrusion will have a negative effect to the crop growth if it stays more than 3 months in the field. Areas with tidal irrigation and salinity intrusion less than 3 months can still be cultivated with double rice crop in a year and will not hamper their growth. Salinity intrusion consequently will also change water management zones in the future. Long period of salinity intrusion and crop type also have to be taken into account when determining future water management zoning.

Prevention efforts to reduce or even avoid land subsidence are needed to overcome any negative impact which may occur in the future, while for climate change it need wider or even global concern to minimize or to reduce its rate. Therefore, structural and non structural measures are needed.

*Keywords:*
*Sea level rise, land subsidence, water management zoning, hydraulic modelling and GIS modelling*