

# Success story #6

## From policy to people - Land subsidence in the Mekong Delta

### The problem

The Mekong-Delta has been farmed for many generations and is one of the principle agricultural regions of Viet Nam, contributing 50 percent of total food output and 90 percent of rice exports, as well as 70 percent of fruit and 65 percent of aquatic products. Although productivity is still high, it is at risk from multiple threats and any decline in output would have severe consequences not just for the region but for the country as a whole. Land subsidence is one of these threats. Research data indicates that the Mekong-Delta sinks at an average rate of about 1.0 cm per year bringing it closer to sea level, which currently rises at 4 mm per year in the south of Viet Nam.

Subsidence is the sudden sinking or gradual downward settling of the ground's surface with little or no horizontal motion. The definition of subsidence is not restricted by the rate, magnitude, or area involved in the downward movement. It may be caused by various natural processes or by human activities, such as excessive ground water extraction and is amplified by loading the ground with infrastructure and buildings. The composition of different natural and man-made drivers of land subsidence varies from place to place. This process is not yet completely understood and further research is expected to clarify the anthropogenic factor of land subsidence.

The impact of land subsidence on various aspects of human life is quite evident and visible all over the Mekong-Delta. Effects include an increase in river-induced floods; erosion; salt water intrusion from the sea; instability of buildings (tilting, cracks); and the damaging and breaking of drinking water, sewerage, and drainage pipes. In the long run, low-lying areas will be submerged permanently. None of these effects are desirable.

Identifying ways to reduce land subsidence and activities to mitigate these adverse effects are currently under consideration; however, there has been little action thus far.

### Gaps in the Policy Framework on Land Subsidence

The phenomenon of land subsidence as amplifier of the impacts of climate change on the Mekong-Delta has only recently entered the focus of discussions of policy makers, academics and donors in Viet Nam. For this reason, a factual

data basis that will help fully understand causes and mechanisms has yet to be established. Likewise, the policy framework on land subsidence in Viet Nam reveals certain gaps and overlaps that need to be revised.

A first problem is that a clear definition of the term 'land subsidence' is lacking in Viet Nam's relevant key legislation, leading to confusion and overlaps with terms used for other phenomena, such as e.g. landslides or river bank erosion. For example, the Law on Natural Disaster Prevention and Control states that "Natural disasters include typhoons, [...], landslides and land subsidence due to floods or water currents, water rise, seawater intrusion, [...], and other types of natural disaster." The law clearly applies a wrong definition for the term (in Viet Namese: sụt lún đất), as land subsidence is not caused by floods or water currents and the law may actually refer to river bank erosion or landslides on mountain slopes. It might be advisable to include land subsidence as a contributing factor to disasters as slow subsidence does not constitute a disaster by itself.

Effective policy frameworks on land subsidence typically divide the aspects of the phenomenon into five distinct steps (Figure 1). In the following, selected shortcomings identified in the existing policy framework of Viet Nam are discussed:



Figure 1: Aspects of effective policy on land subsidence

**Measuring:** There are no detailed regulations on land subsidence observation. It is not mandatory to measure land subsidence for any agency. Frequency of data collection, scale (point density) and dynamics (in- or decrease of velocity), identification of high velocity areas, as well as standard products (maps, tables, frequency of updating) are not prescribed in legally binding documents. For example, the Law on Surveying and Mapping provides for surveying and mapping as well as forecasting, warning, prevention and control of natural disasters, however, the observation of land subsidence is not mentioned.

**Understanding the causes:** No institutions are currently officially mandated to investigate the reasons for land subsidence on a permanent basis. Some research is done on a voluntary basis or in the context of stand-alone activities. MONRE and its related departments are currently preparing a larger project to determine the drivers of land subsidence.

**Understanding the consequences:** The Law on Natural Disaster Prevention and Control (Law 33/2013/QH13) mentions research regarding the impact of natural disasters as part of the national natural disaster prevention and control plan. The plan has to include assessments of natural disaster risks and impacts that constitute a part of the risk. If “land subsidence” is included in the hazards covered by the law, it should be clear that research on impacts of land subsidence will be part of the national natural disaster prevention and control plan.

**Mitigation:** This aspect is already integrated into the Law on Water Resources (prohibition of groundwater abstraction if it causes land subsidence). However, implementation of this aspect of the law is, in the Mekong-Delta, unfeasible as most rural households depend on ground water as their main source of water.

**Adaptation:** Land subsidence cannot be controlled very easily and the main coping strategy will most likely be adaptation. A key in developing counter strategies would be forecasts of flooding, erosion, and salt water intrusion. These forecasts should be done by considering other factors such as sea level rise by hydrologists at the Ministry of Agriculture and Rural Development (or an assigned office under the ministry). The product would be a legally binding forecast of land subsidence to be used by other institutions. This will include land-use planning, irrigation, and the construction of infrastructure, businesses, and private dwellings. The consideration of official land subsidence data should be integrated into the respective laws (meteorology and hydrology, land, irrigation, natural disaster prevention and control, and construction).

## FPP contribution

The land area of the Mekong Delta is sinking at different rates across the region. In urbanized areas, land sinking is faster than in agricultural crop areas. The temporal and spatial resolution of collected data has to be sufficiently detailed to understand these trends.

Why is land sinking? Why is it sinking faster in cities? Why is it not slowing down in most places? Research identified some aspects causing land subsidence, but government, development partners, and researchers do not yet understand the contribution of different drivers and the patterns across the Delta.

Land subsidence is only one factor influencing development in the Mekong Delta. Climate change related sea level rise, reduced sediment load of the river caused by up-stream dam construction and sand mining, the proliferation of dikes reducing floods and urbanization, are other significant factors. Together, these developments will have grave consequences for the people living in the Delta.

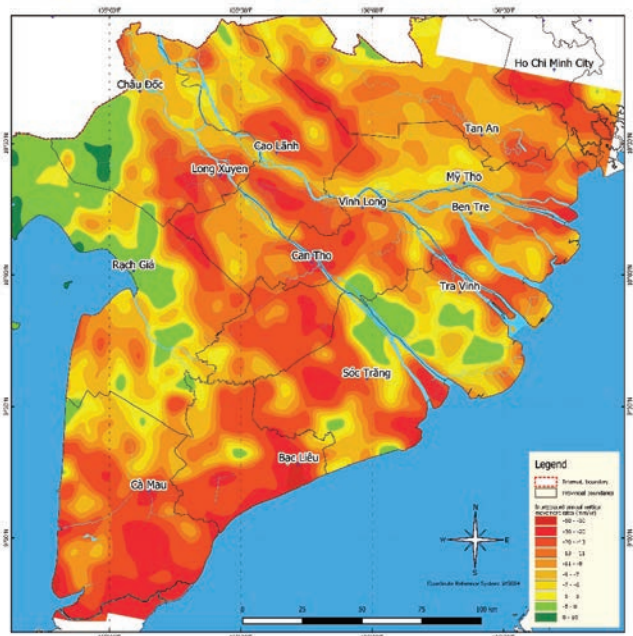
Co-Financed by Switzerland and Germany and implemented by MOC and GIZ, the “Mekong Urban Flood Resilience” programme (FPP) in its phase two has targeted to tackle urban climate resilience in three Mekong-Delta provinces via a holistic, integrated approach. Part of the programme was the execution of innovative research and the collection of basic data on ground subsidence in the Mekong-Delta. This research was conducted partly in close collaboration with the German Federal Office of Civil Protection and Disaster Assistance (BBK) and the German Federal Institute for Geosciences and Natural Resources (BGR). The generated knowledge was then channeled to the national level with the objective to serve Government leaders as factual evidence in support of decision-making and policy formulation processes. A detailed publication on the land subsidence research results are presented in a separate publication.

The activities of the FPP tackle the impacts of land subsidence at several of the logical steps presented in Figure 1. For example, the programme activities related to flood modelling help better understand the consequences of land subsidence. The work undertaken on drainage tariff roadmaps and city drainage master planning, early warning and disaster risk management helps cities and residents to adapt and “live with” the unavoidable consequences of land subsidence. However, the bulk of activities on land subsidence itself serves the improved measuring as well as a gaining a better understanding of the causes of ground subsidence. In that regard, a number of ground-breaking insights were made possible and impressive results were achieved.

**KEY INSIGHTS:**

- ➔ On average, the land masses of the Mekong-Delta sink downwards at a rate of 1 cm per year, amplifying the impacts of sea level rise substantially.
- ➔ Urban areas sink at faster rates than rural areas.
- ➔ Urban areas show an average vertical downward movement of 2-4 cm per year.
- ➔ Rural areas sink at a rate of 0.5-1 cm per year.

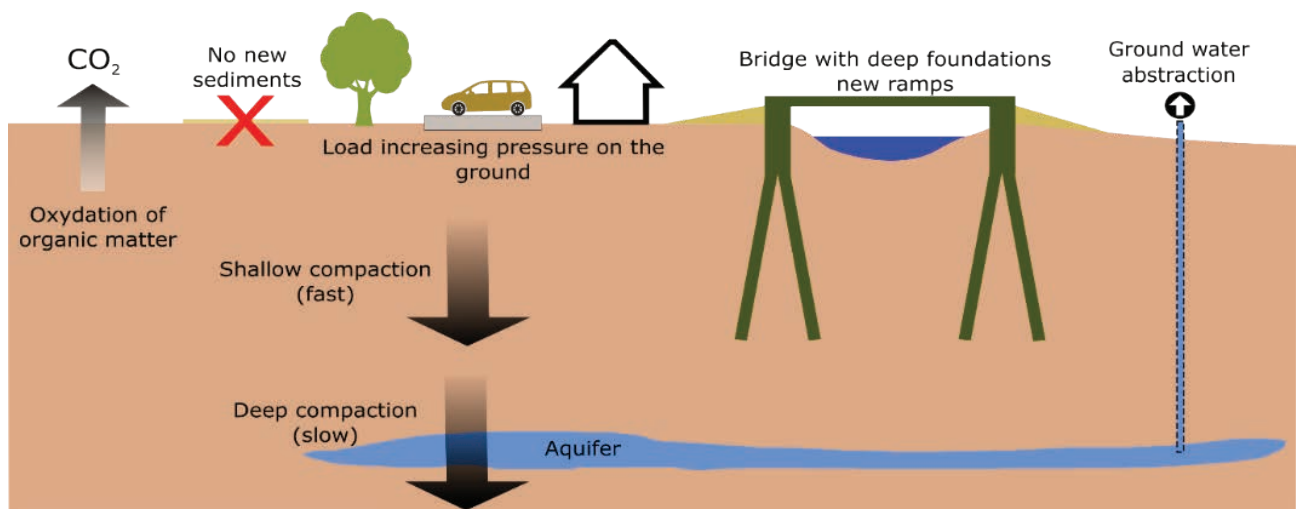
1. With the objective to contribute to improved measuring of land subsidence, ground motion data were collected, filtered, analyzed and interpolated. 750,000 measuring points were identified across the delta and satellites recorded elevation for each point once every 8 days for a 4-year period, resulting in a data series of 135 million values with a much higher spatial and timely resolution than previously available data. Figure 2 presents the strongly smoothed output from satellite measurement-based calculations generalizing vertical ground movements. Green areas in the northwestern part of the map (mostly Kien Giang province, including the area around Rach Gia city) show very little ground movements. These places are mostly rocky mountains, which are regarded to be much more stable with respect to vertical movements than the alluvial soils in other parts of the Mekong Delta. By and large the research results confirm findings from previous research, though they contain much more detail and allow more convincing conclusions.



**Figure 2: Vertical movements in the Mekong Delta, simplified interpolation**

2. With the objective to help better understand the causes of land subsidence in the Mekong-Delta, contributions to ongoing research efforts were made through the satellite data survey. Collected data reveal that there are significant differences in vertical movement rates in the Mekong Delta. Some areas show strong downward movement while in others it is relatively moderate. At the local level, different

buildings in the same area move at substantially different rates. Science suggests a combination of natural and anthropogenic drivers responsible for the observed land subsidence (Figure 3).



**Figure 3: Drivers of land subsidence**

Most rural households in the Mekong-Delta rely on ground water as primary source of water for household, business and agricultural activities. Data about the volume, locations, and sources of groundwater abstraction in the Mekong-Delta are unreliable and insufficient, making a correlation with observed land

subsidence rates difficult. All previous models and studies on the impact of groundwater abstraction on land subsidence in the delta are invariably built on a significant degree of assumptions, which may or may not reflect reality on the ground.

#### KEY RESULTS:

- Upstream dams and surface sealing through human settlements reduces the capacity of land masses to naturally replenish with sediments carried downstream.
- Uncontrolled and excessive ground water extraction is a key anthropogenic driver for ground subsidence in the Mekong-Delta.
- Buildings and infrastructure add load to the soil and accelerate subsidence rates in urban areas.
- Using the data sets generated, future hydro-geological studies of underground aquifers and the dynamics of ground water extraction will be able to better target areas of interest.

### FPP approach

To ensure sustainability in the implementation of its activities, FPP II applied a uniquely integrated advisory approach that gathers concrete experiences on the ground and channels these from local to central government levels in order to provide practical evidence for central level policy formulation. FPP II successfully established close linkages between national and provincial levels. Provincial experiences and requirements for policy were presented to the central level and advocacy was carried out to support policy amendments and changes.

In addition the approach also emphasized cross-exchange of experiences and the sharing of lessons-learned on a horizontal level (province-to-province, city-to-city) leading to effective learning and high motivation through a healthy spirit of competition.

On provincial level, the FPP II way of working involved the establishment of inter-departmental work groups headed by each provinces PPC and managed by DOC. The work groups comprised leaders and technical officers of all relevant local government agencies, including the provincial line departments for construction, environment, agriculture, planning, health and finance as well as provincial statistical offices, provincial hydro-meteorological stations and city-level authorities. All programme activities were planned and steered by each

provincial work group, ensuring a unified approach, common goals and an open exchange of information among involved stakeholders. Working meetings between each work group and FPP II advisors were held in regular intervals at high frequency, ensuring high efficiency in output creation and quick decision-making and approval procedures.

The work on province level commenced with the development of programme implementation plans with each work group and their approval by the PPC. Through these plans, roles and responsibilities were clarified, availability of budget for implementation and further operations of work groups and, for example, technical systems could be assured.

Policy dialogues at provincial level, but also between the provincial and the national levels ensure that all relevant stakeholders gain a sound understanding of the issues at hand, and that national policies are based on the experiences and capacities of the provincial governments. Specifically through the development of guidelines and supporting central-level authorities in the development of laws, decrees and regulations, the lessons learned on a provincial level gained sustainability through institutionalization in national laws, targets, codes and regulations. Through influencing urban planning and budgets on the provincial level, impacts went beyond the mere implementation of technical systems.

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