VIETNAM NATIONAL UNIVERSITY-HCMC
HCMC UNIVERSITY OF TECHNOLOGY

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INFORMATION OF THE DISSERTATION

Dissertation's title: **Study on the development of scour hole at river confluences and propose solutions to minimize adverse impacts - applied to the confluence area of the Hau River and Vam Nao River.**

Major: **Natural Resources and Environmental Management** Major code: **9850101**

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Summary of new academic and theoretical contributions of the thesis:

The Vietnamese Mekong Delta (VMD) is a young delta, a low-lying area filled by river alluvium, with a dense network of rivers, many islets, and weak riverbed geology, so the riverbed is easily affected. There are twenty-three deep scour holes along the Tien and Hau rivers. These scour holes are mainly seen where the river rapidly narrows, where two rivers meet (river confluence), or where the river curves on a concave bank. A prominent illustration of this is the erosion hole that forms at the confluence of rivers. The development of this kind of scour hole is affected by a number of morphological elements, including the hydrodynamic regime, radius of curvature, and confluence angle. Of particular importance is the intricacy of the hydraulic regime at the confluence of two river branches. The bank slope will either become steep or the river bank will erode into a frog-like shape as the deep scour holes get wider and closer to the shore. At this point, the landslide mass reaches its limit and collapses. As a result, research on the growth of scour holes is required in order to find long-term, sustainable solutions to reduce erosion and bank collapse. According to these pressing concerns, the thesis, ***"Study on the development of scour hole at river confluences and propose solutions to minimize adverse impacts - applied to the confluence area of the Hau River and Vam Nao River"*** was conducted. Its objectives were to analyze the flow structure at the river confluence, identify the factors that lead to the evolution of scour holes, predict the development trend of scour holes, and then suggest suitable solutions to minimize adverse impacts on the riverbank in this area.

The following is a summary of the thesis's novel ideas and findings:

- Determine the flow velocity field in each vertical layer using the 3D mathematical model, focusing particular attention to the velocity layer close to the bottom (which influences the bottom's ability to erode). In 2018, the surface layer velocity was 2.1 m/s, besides the bottom layer velocity was 1.7 m/s.

- The secondary flow on the scour hole's cross-section (CS) is analyzed. It is shown that the secondary flow has two cell components, which are two circles flowing in opposite directions. In comparison to the left circle flow, which has a velocity of less than 0.2 m/s and 0.4 m/s at CS1 and CS2, respectively, the right circle flow has a significantly higher intensity (velocity of roughly 0.8 m/s at CS1 and nearly 1 m/s at CS2). **When the secondary flows combine with the main flow, a helical flow is formed, which has a significant impact on the growth of the scour hole in two directions (affecting the river bank).**

- Determine the relationship between the right circle flow's scale (distance from My Hoi Dong (MHD) bank) and the flow rate between Chau Doc and Vam Nao. The investigation of the scour hole's growth towards the MHD bank is another innovative aspect of the research. Based on the determined discharge from the two river branches, this information will assist researchers in forecasting the development trend of this scour hole. This relationship can be described using two correlation equations:

$B1 = -130{,}45a + 480{,}85$ (for CS1);

$B2 = -111{,}01a + 361{,}06$ (for CS2).

- Furthermore, the trend of the circular flow movement is found to be harmful to the MHĐ bank. The scenario indicates that the Vam Nao discharge is 30% lower than it was in 2018, bringing the distance B2 closer to the MHĐ bank by 40 meters.. No prior research has been done on this result.

- Determine the bottom sediment flow rate and the bottom stress field. Based on the results, the critical stress (τ_{cr} =0.05 N/m^2) throughout the entire area is significantly smaller than the bottom stress (τ_b), which is larger than 0.5 N/m^2. The region of the scour hole has a high concentration of the bottom sediment flow (above 45 kg/s/m). The scour hole's right wall and upstream side both have positive "Gradient" qb, indicating that it grows upstream and spreads to the MHĐ bank's right side.

- Determining the primary factors influencing the evolution of confluence scour holes: The morphological characteristics of the bent river and hydraulics (the proportion of discharge on each confluence branches) are two features that influence the development of scour holes in this region.

- Provide suitable remedies to reduce the negative impact of scour hole development on river banks. The solutions suggested here encompass both structural and non-structural options. wherein the employment of rock gabion revetments at the base of the bank is the proper structural solution.