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# Current Movement in Benoa Bay Water, Bali, Indonesia: Pattern of Tidal Current Changes Simulated for the Condition before, during, and after Reclamation

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## ABSTRACT

Benoa Bay is a reclaimed intertidal region which has become an area of significance. Many problems appeared due to the reclamation such as local people declined (due to fishing activities disruption), social and cultural problems, and environmental degradation as well. This study aimed to determine the hydrodynamic changes which have occurred due to the development of the area. We employed a numerical method (flow model) based on the Navier-Stokes equations. In the 1995 simulation, the flow velocity ranged from 0-1.4 m.s<sup>-1</sup>. In the 2016 simulation, the flow velocity ranged from 0-1.35 m.s<sup>-1</sup>. When the reclamation was implemented, the flow velocity ranged between 0-1.2 m.s<sup>-1</sup>. We found that during low tidal condition, several areas within the bay were not covered by water due to the high rate of sedimentation and unstable sediment distribution which caused by the Benoa Bay development. It is obvious why the area within the bay will be reclaimed. Based on the simulation, the condition will get worse, if the reclamation is applied. The degradation of Benoa Bay has a big impact on the hydrodynamic pattern changes which is resulting in the other effects on circulation and biological aspects. The weakened water flows automatically disrupt the water mass transport mechanism, and if ongoing, it will threaten the marine biota.

**Keywords:** *Benoa Bay, Hydrodynamic, Numerical method, Reclamation*

## Introduction

It is necessary to establish a comprehensive understanding dealing with the exploration of coastal zones in order to avoid negative effects of any change to the system. One of the common solutions is the Modelling approach which is cheap and efficient approach. It can easily perform a variety of either assumptions or scenarios required (Crespo, 2008). The modelling approach also has the advantage in finding a solution to solve complicated problems effectively and efficiently for the hydrodynamic processes in the ocean (Cummins et al., 2012). In this case, it is applied in the hydrodynamic processes of Benoa Bay, Bali.

The Benoa Bay is a semi-enclosed water area. Water mass transport circulation in the bay depends on the mouth located between Serangan Island and Benoa Peninsula. In 1996 Serangan Island was connected by a bridge. The bridge inhibits the water circulation into the Benoa Bay (Hendrawan and Koji, 2014). Consequently the calmer hydrodynamic conditions inside generate high sedimentation rates around the mouth. It is often dredged by the Benoa Harbour management (Dharma and Candrayana, 2017).

The main focus of this study is the impact of the hydrodynamic changes due to the reclamation plan in Benoa Bay. Direct observation in the field is necessary to know the predictable effects which may occur (Hendrawan and Koji, 2014). The other attention is directed towards the physical and chemical impacts on the conditions of the waters (Discroll et al., 1998).

The changes in hydrodynamic conditions of Benoa Bay for several periods need to be simulated in order to help analyze the water mass transport mechanism, erosion-accretion, and the effects on the aquatic biota. This result of the research are meaningful in predicting the tidal current pattern changes

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