Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 116 (2015) 285 – 292

Procedia Engineering

www.elsevier.com/locate/procedia

8th International Conference on Asian and Pacific Coasts (APAC 2015)

# Study of Beach Erosion and Evolution of Beach Profile Due to Nearshore Bar Sand Dredging

Duc Thang Chu[a], Gen Himori[a], Yuki Saito[a], Trong Vinh Bui[b], Shin-ichi Aoki[a,*]

[a]Osaka University, 2-1 Yamadaoka, Suita, Osaka 565-0871, Japan
[b]Ho Chi Minh City University of Technology, 268, Ly Thuong Kiet, ward 14, Dist. 10, Ho Chi Minh, Vietnam

**Abstract**

The sand dredging activities may cause various physical and environmental changes such as beach erosion, evolution of beach profile, change in current and wave field. To evaluate the relationship among the volume of sand dredging, method of sand dredging, time of sand dredging, shoreline retreat and evolution of beach profile, some experiments were conducted and a two-dimensional numerical model was used. The effect of sand dredging volume on shoreline retreat was investigated by dredging various amounts of sand at one time under the same regular wave condition. The results showed that the relationship between shoreline retreat and dredging volume is nonlinear. In the other considerations, sand bar was dredged as different methods i.e. periodic sand dredging method under the same regular wave condition as well as one time dredging under different regular wave conditions. The final shoreline retreat in the last two methods was nearly equal to the first method, however, the progress of shoreline retreat was slower. After sand dredging in all cases, the beach profiles were not translated to the same original form. Infill rate of the bar after sand dredging is also discussed in term of average absolute sediment transport rate.


Peer- Review under responsibility of organizing committee , IIT Madras , and International Steering Committee of APAC 2015

*Key Words:* Nearshore bar; volume of sand dredging; shoreline retreat; beach profile; infill rate.

## 1. Introduction

Because of the increase of sand resource demand for construction, beach nourishment, navigation, sand is dredged at offshore zone. To be cost effective, in some countries, sand dredging at nearshore zone is allowable. However, dredged area close to the shore can have significant negative impacts, causing erosion of the foreshore (Price et al., 1986). On the western Black Sea coast of Turkey where sand is dredged at the near-shore zone for construction, it can be demonstrated that the project will not results in significant negative impacts or changes in physical or biological processes (Marine Habitat Committee 2000). The direct impacts are the sediment transportation from the foreshore to the dredged hole via maximum of shoreline retreat and infill rate of dredged hole. Evolution of beach profile after sand dredging can cause indirect impacts to the shoreline retreat. To quantify the physical impact such as shoreline retreat, infill rate, and beach profile evolution and suggest some countermeasures for the coastal erosion due to sand dredging in nearshore zone, a combination of theoretical, experimental and numerical analysis is carried out.

* Corresponding author. Tel.: +81-06-6879-7613; fax: +81-06-6879-7613.
*E-mail address:* aoki@civil.eng.osaka-u.ac.jp


Peer- Review under responsibility of organizing committee , IIT Madras , and International Steering Committee of APAC 2015
doi:10.1016/j.proeng.2015.08.292

**Nomenclature**

| | |
|---|---|
| $\lambda_{1,2}$ | spatial decay coefficients in zones I and II |
| $\varepsilon$ | slope related sand transport rate coefficient |
| $\kappa$ | proportionality factor |
| $\Delta y$ | maximum of shoreline retreat |
| a | width of dredged hole |
| A | scale parameter |
| b | length of dredged hole |
| B | berm height |
| d | depth of dredged hole |
| D | wave energy dissipation per unit water volume |
| $D_{eq}$ | equilibrium wave energy dissipation per unit water volume |
| $d_{50}$ | median grain size |
| h | water depth |
| $h_*$ | closure depth |
| H | wave height |
| $H_b$ | breaking wave height |
| K | sand transport rate coefficient |
| q | net cross-shore sand transport rate |
| T | wave period |
| $V_e$ | volume of sand erosion (volume per unit length) |
| $V_d$ | volume of sand dredging (volume per unit length) |
| $W_*$ | seaward limit of active profile |
| y | cross-shore coordinate directed positive offshore |

## 2. Literature review

The potential negative impacts of sand dredging to the shoreline change and infilling rate of dredged hole have been investigated so far. Kojima et al. (1986) studied the shoreline change and infilling rate in Genkai Sea in Japan. Beach profiles at and around dredged holes situated above the water depth of about 30 meters changed substantially by filing up the holes with sand that was mainly transported from the onshore side in less than 1 year. Moreover, it causes severely shoreline retreat along the coast. The change of beach profiles due to dredged holes situated at 35 to 40 meters depth is insignificant. Van Dolah et al. (1998) investigated the infill rate of six borrow holes at the offshore zone in South Carolina. The dredged holes are filled up within 5-12 years, with this time being proportional to distance from shore. Demir et al. (2004) discussed the impacts due to sand dredging at the nearshore zone via direct impacts and indirect impacts on sediment transport. The direct impact caused by the loss of sediment from the dry beach via infilling of the dredged pit. While the indirect impact is the result of modification of the nearshore wave conditions via the modified bathymetry. Chu et al. (2014) studied relationship between the shoreline retreat and sand dredging volume, sand dredging time and sand dredging methods based on the experimental study.

## 3. Methodology

### 3.1. Theoretical analysis

Bruun (1954) suggested the simple relationship for equilibrium beach profile as

$$h(y) = Ay^{2/3} \tag{1}$$

A definition sketch of the profile before and after sand dredging in the nearshore zone is presented in Fig. 1. It is common to assume that the profile retreats uniformly at all active elevations as long as the beach maintain its shape across the profile. In addition, it will be assumed that within the surf zone wave height is proportional to the local water depth with the proportionality factor, $\kappa$, i.e. $H=\kappa h$ ($\kappa$=0.78). At the breaking point, $H_b = \kappa h_*$. Referring to Fig. 1, sand dredging volume, $V_d$, is equal to the volume eroded, $V_e$

$$V_d = V_e \tag{2}$$