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SHORELINE DYNAMICS FOR COASTAL EROSION IN QESHM ISLAND, IRAN

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SHORELINE DYNAMICS FOR COASTAL EROSION IN QESHM ISLAND, IRAN

By

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This Thesis Is Dedicated To My Lovely Wife and My Son

Abstract of thesis presented to the Senate of University Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

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By

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Chair: Zelina Zaiton Ibrahim, PhD

Faculty: Environmental Studies

Shorelines positions constantly change due to natural processes and anthropogenic activities. These changes could be a useful proxy for coastal erosion and accretion. Shoreline recession due to coastal erosion is a chronic problem along the coastline of Qeshm Island, Iran. Lack of shoreline change data particularly, recession data has resulted in lack of coastal development setbacks. This problem has lead to many uncertainties in sustainable coastal development plans. Coastal structures and environment have damaged because of absent of setback lines. The purpose of this research is to contribute to establish rational coastal erosion setbacks as effective tool in sustainable coastal management and development through digital shoreline change mapping, and quantification, shoreline position prediction for coastal erosion hazard areas mapping.

Multi-source shoreline data, including aerial photographs, high accuracy satellite images, geologic maps, and GPS survey data from 1956 to 2009 year were used. A

combination of geomorphologic, statistical, cartographical, and geospatial methods and techniques were applied in four phases. The first phase comprised geomorphic proxy-based shoreline definition, detection and digitization. The second phase was shoreline change mapping and quantification. Phase three consisted of statistical analysis of change data and to generate segment-based change data and shoreline dynamic maps. The fourth phase was prediction of future shoreline positions, creation of coastal erosion hazard maps, and, establishment of coastal setbacks. Six morphological shoreline classes including flat sandy beach, muddy tidal flat, rocky tidal flat, high coastal cliff, high and steep sandy beach, and low coastal cliff were identified.

From the results of the first phase it was found that the choice of a suitable geomorphic indicator was influenced by the local and regional geomorphology. The second phase results indicated that the sandy beaches were most eroded with an average recession rate of -0.72 m/yr. Coastal cliffs retreated at a rate of -0.33 m/yr. The total shoreline recession rate for the entire shoreline was estimated at -0.51 m/yr.

The research showed that around 40 percent of shoreline study is suffering from high to very high recession rate. The recession rates were used for coastal erosion hazard area mapping and the establishment of coastal erosion setbacks in phases three and four. A new combined method of Linear Regression Rate and Dynamic Segmentation was developed for shoreline position prediction and establishment of coastal erosion setbacks. This method gave several advantages. Firstly, it utilized the recession rate data of each segment for predicting the shoreline position. Secondly,

the predicted shoreline followed the geometric shape of the reference shoreline for each segment and represents a more accurate future shoreline map. The coastal erosion setback lines for next 45 and 60 years were forecasted and showed that many existing coastal structures and properties would be threatened by erosion hazard. This research proposes and used a structured method for shoreline change in morphologically inhomogeneous shorelines. It also can be concluded that accurate shoreline change mapping, quantification, analysis, and its position prediction can assist coastal communities for appropriate management of coastal erosion hazards through establishment of erosion-based coastal development setback lines.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagi memenuhi keperluan untuk ijazah Doktor Falsafah

DINAMIK PESISIRAN PANTAI BAGI HAKISAN PANTAI DI PULAU QESHM, IRAN

Oleh

ABBAS MORADI

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Kedudukan garis pesisir sentiasa berubah disebabkan proses semulajadi dan aktiviti antropogenik. Perubahan ini boleh menjadi proksi yang berguna untuk hakisan dan enapan pantai. Unduran garis pesisir akibat hakisan pantai adalah masalah kronik sepanjang pantai Qeshm Island, Iran. Kekurangan data perubahan garis pesisir khususnya menyebabkan kekurangan pembangunan penampan pantai. Masalah ini telah membawa banyak ketidaktentuan dalam rancangan pembangunan pantai yang mapan. Struktur dan persekitaran pantai telah terganggu kerana ketiadaan garis penampan. Tujuan kajian ini adalah untuk menyumbang kepada penubuhan penampan hakisan pantai yang rasional sebagai alat efektif dalam pengurusan dan pembangunan mapan pantai melalui pemetaan digital perubahan garis pesisir, kuantifikasi dan ramalan kedudukan garis pesisir untuk pemetaan kawasan berbahaya hakisan pantai. Pelbagai sumber data garis pesisir, termasuk gambar foto udara, imej satelit berketepatan tinggi, peta geologi, dan data ukur GPS dari tahun 1956 hingga 2009 telah digunakan.

Gabungan geomorfologi, statistik, kartografi, kaedah dan teknik geospatial telah digunakan dalam empat fasa. Fasa pertama terdiri daripada definisi berasaskan proksi geomorfologi garis pesisir, pengesanan dan pendigitan. Fasa kedua adalah perubahan pemetaan garis pesisir dan kuantifikasi. Fasa ketiga terdiri daripada analisis statistik data perubahan dan menjana perubahan data berasaskan segmen dan peta garis pesisir yang dinamik. Fasa keempat adalah ramalan kedudukan garis pesisir pada masa hadapan, penciptaan peta hakisan pantai berbahaya, dan, penubuhan penampan pantai.

Enam kelas morfologi garis pesisir termasuk pantai berpasir rata, pasang surut rata berlumpur, pasang surut rata berbatu, tebing pantai tinggi, pantai berpasir tinggi dan curam, dan tebing pantai yang rendah telah dikenal pasti. Daripada keputusan fasa pertama, didapati bahawa pilihan petunjuk geomorfologi yang sesuai telah dipengaruhi oleh geomorfologi tempatan dan serantau. Keputusan fasa kedua menunjukkan bahawa pantai berpasir adalah paling terhakis dengan kadar purata unduran adalah -0.72 m/tahun. Tebing pantai berundur pada kadar -0.33 m/yr tahun. Kadar jumlah unduran pantai di seluruh garis pesisir adalah dianggarkan pada -0.51 m/tahun. Kajian menunjukkan bahawa kira-kira 40 peratus daripada kajian garis pesisir sedang terjejas dari kadar unduran yang tinggi ke sangat tinggi. Kadar unduran telah digunakan untuk pemetaan kawasan hakisan pantai berbahaya dan penubuhan penampan hakisan pantai dalam fasa ketiga dan keempat.

Satu kaedah baru menggabungkan kaedah regresi linear dan segmentasi dinamik telah dibangunkan dan digunakan untuk ramalan kedudukan garis pesisir dan

penubuhan penampan hakisan pantai. Kaedah gabungan ini memberikan beberapa kelebihan. Pertama, ia menggunakan data kadar unduran setiap segmen untuk meramalkan kedudukan garis pantai. Kedua, pantai yang diramalkan mengikuti bentuk geometri garis pesisir rujukan bagi setiap segmen dan mewakili peta geomorfologi garis pesisir masa depan yang lebih tepat. Penampan hakisan garis pantai untuk 45 dan 60 tahun akan datang telah diramalkan dan menunjukkan bahawa banyak struktur pantai dan hartanah yang sedia ada akan diancam oleh bahaya hakisan. Kajian ini mencadangkan penggunaan kaedah berstruktur untuk perubahan garis pesisir di morfologi garis pesisir tak homogen. Pemetaan perubahan garis pesisir yang tepat, kuantifikasi, analisis, dan ramalan kedudukannya boleh membantu komuniti di kawasan pantai untuk pengurusan hakisan pantai berbahaya yang sesuai melalui penubuhan pembangunan garis unduran pantai berasaskan hakisan.

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I certify that a Thesis Examination Committee has met on **7th March 2012** to conduct the final examination of **Abbas Moradi** on his **Doctor of Philosophy** thesis entitled "**Shoreline Dynamics for Coastal Erosion in Qeshm Island, Iran**" in accordance with Universities and University colleges Act 1972 and Constitution of the Unversiti Putra Malaysia [P.U. (A) 106] 15 March 1998. The committee recommends that the student be awarded the degree of Doctor of Philosophy.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledge. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

_____

ABBAS MORADI
Date: 7 March 2012

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