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Assessment of the impact of land use and land cover change on runoff characteristics of Lake Chini Catchment (Malaysia) using SWAT: a preliminary study

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Background and Scope of Research

Agricultural land use in Malaysia has been influenced by the implementation of policies that gave priority to agricultural development as a means to economic growth. These policies positively influenced the Malaysian oil palm industry but negatively affected other agri-sectors. Agricultural or crop diversification is already practised in Malaysia, however it is not fully developed. Several studies undertaken by CFF indicate clearly that further efforts should be made and there is still scope to diversify agriculture on both peninsular and insular Malaysian lands.

Crop diversification exercises have already been carried out with publically available information and tested in specific key coastal areas of Malaysia with the aim of nation-wide upscaling. AquaCrop model has been used to generate seasonal potential production for a selection of alternative crops (bambara groundnut, soybean, and quinoa) and APSIM for annual oil palm production simulation. The effectiveness of crop diversification strategies on the reduction of sediment runoff, nutrients and pesticides fluxes should then be assessed over large areas and possibly at catchment scale. This assessment can be carried out using the spatially distributed Soil and Water Assessment Tool (SWAT) model.

We are undertaking this study at a national level by coupling complementary areas of research, including the hydrology, quality of superficial waters and climate. We present very preliminary results from a study which has been conducted to assess the hydrological impact of land use /land cover (LULC) and land management practices in the last four decades for the Tasik Chini catchment using SWAT and publically available datasets.

Methods

Study area: Lake Chini

- it is an alluvial riparian swamp system;
- humid equatorial climate (rainfall 2000 - 3000 mm)
- second largest freshwater natural lake in Malaysia;
- total catchment area of 5200 ha;
- has recreational value, as well as cological;

importance in terms of its biodiversity;

- possesses natural landscapes and social–cultural attractions;
- a number of number of economic anthropogenic stressors and land use changes have affected the lake catchment during the last 50 years: conversion from primary to secondary forest in the 60s and from forested areas to agriculture areas along with mining and logging activities in the last 20 years.

Completed steps:

- Crop modelling exercises for exploration of crop diversification potential in coastal and inner areas - CFF
- Collection of publicly available data (including local climate datasets) – CFF, UNMC
- Analysis of land use and land cover data quality (namely consistency of land use and cover (LULC) change – CFF, UNMC
- Analysis of soil data/properties and calculation of necessary input soil parameters
- Setting up of SWAT model – CFF, UNMC

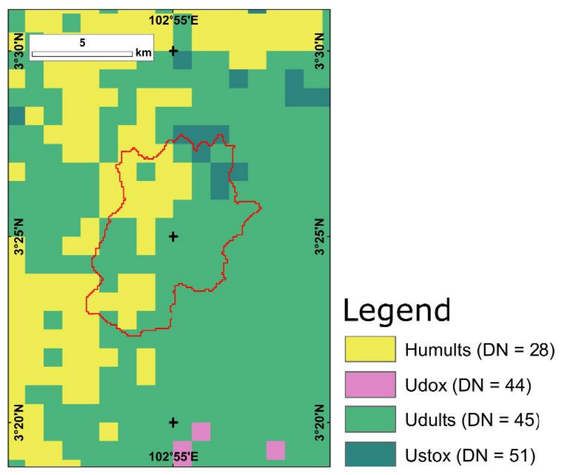
Work in progress

- Field data collection (runoff, river discharge, water quality data) - UKM
- integration of crop production prediction into SWAT for calibration – CFF, UNMC
- Calibration of the model and estimation of LULC change impact on the Lake Chini – CFF, UNMC, UKM

SWAT Inputs

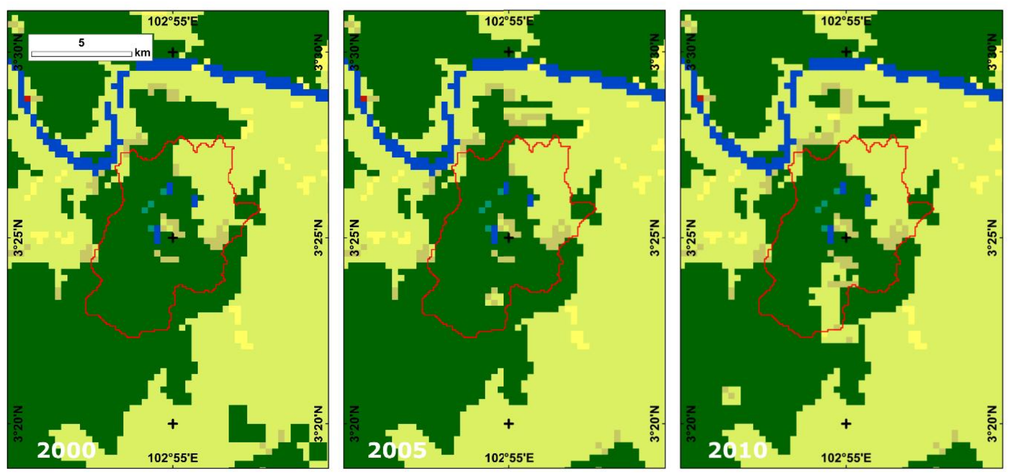
Soils

SoilGrids1km
Source: soilgrids.org/index.html



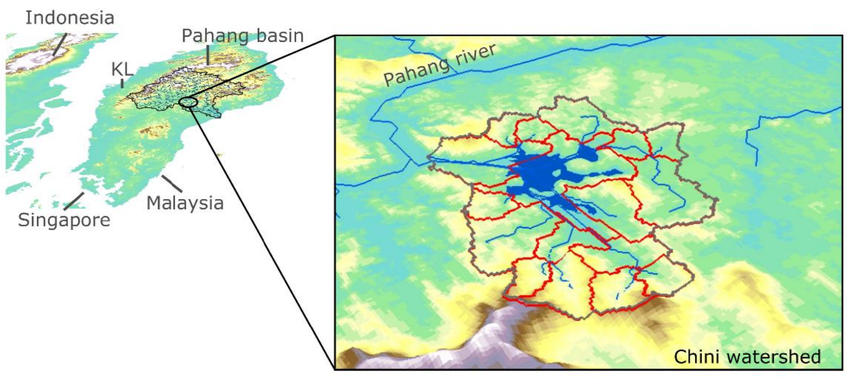
Land Use / Land Cover

ESA Climate Change Initiative - Land Cover
Source: maps.elie.ucl.ac.be/CCI/viewer/



Digital Terrain Model

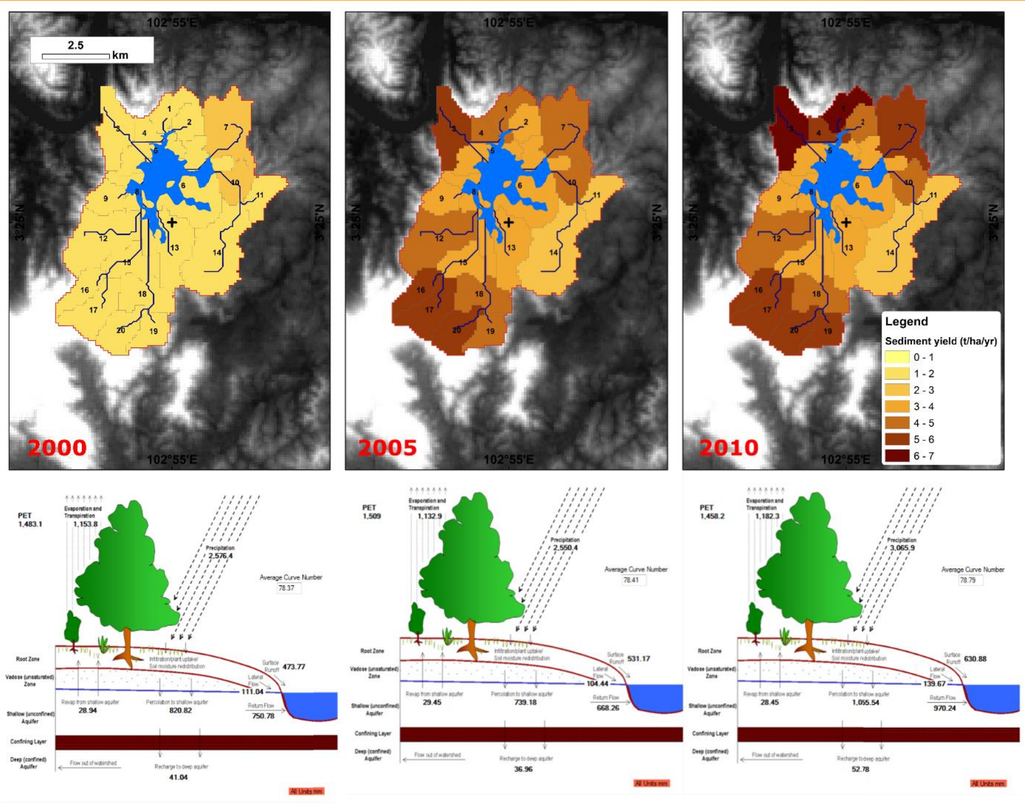
SRTM 90m Digital Elevation db v4.1
Source: srtm.csi.cgiar.org/



Weather Data

National Centers for Environmental Prediction (NCEP), Climate Forecast System Reanalysis (CFSR) was completed over the 36-year period of 1979 through 2014
Source: http://globalweather.tamu.edu/

Preliminary Results



Hydrology

hydrological system of the whole Chini catchment has changed: superficial runoff and sediment yield increased during the investigated periods.

Global land cover dataset

two dataset have been checked: MODIS Land Cover (MCD12Q1) v5.1 and CCI Land Cover (CCI-LC) - Climate Research Data Package (CRDP). Even if the MCD12Q1 dataset has higher temporal resolution CCI-LC showed more land cover change consistency. This dataset will be then used for further analysis at national scale.

Soils

SoilGrids1km demonstrated to be a good source of information even if quite a number of SWAT input parameters need to be derived during model setting up.

Model

- The model is still under construction and field-based data will be collected for model calibration and validation.
- Crop modeling exercises on underutilised crops are actually running and will be used as input model data

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This project has been carriedout within the CFF CropBASE program (www.cffersearch.org)