Simulated Potential Oil Palm Yields: Borneo, Peninsular Malaysia, Sumatra, Sulawesi

The International Plant Nutrition Institute - Southeast Asia Program (IPNI SEAP) has been working with Indonesian plantation groups in Kalimantan over several years. One aim was to identify and develop site-specific best management practices in marginal areas with supposedly unfavorable soil conditions. Following the implementation of best management practices in these sites, crude palm oil (CPO) yield levels increased well above the national Indonesian average of 3.5 - 4 t CPO per hectare (Oberthür and Donough, 2011).

To fulfill the growing demand for palm oil and reduce the environmental consequences of oil palm cultivation, such management strategies are essential for sustainable intensification. However, to better understand the potential impact of best management practices in a specific location, it is necessary to determine site-specific, potentially attainable yield, which is mainly limited by solar radiation and water availability. As a first step towards developing a tool that assesses site-specific attainable yield, a mechanistic oil palm growth model was developed - called PALMSIM (Hoffmann et al., submitted 25.09.2013).

PALMSIM simulates, on a monthly time step, the potential growth of oil palm (trunk, roots, fronds, bunches) as determined by solar radiation from month of planting to 30 years after planting. Model performance was successfully evaluated against measured oil palm yields under optimal water and nutrient management for a range of sites across Indonesia and Malaysia. PALMSIM was then used with existing cloudiness data sets derived from satellite images from NASA (NASA, 2013) to simulate the potential yield limited by solar radiation at a resolution of 0.1 degree - for Borneo, Peninsular Malaysia, Sumatra and the Western part of Sulawesi. Results were grouped into 8 yield classes and mapped covering a total of 1.58 million square kilometers (Table).

According to the model, radiation is sufficient to support fresh fruit bunch yields above 30 t for more than 45% of the area. Particularly favorable conditions can be found on the East coast of Sumatra and the Southwest coast of Borneo. In mountainous regions, lower potential yields are simulated due to more cloud formation. Site-specific application of the model is currently limited as water limitations are not accounted for, but this will be addressed in a future version of the model.

When used together with tools such as the Suitability Mapper presented by the World Resource Institute (Gingold et al., 2012), the generated map based on PALMSIM simulations can help to identify sites that are in degraded lands yet have high potential oil palm yields. The Suitability Mapper classifies marginal

areas in groups with poor to good suitability for oil palm based on social, economic, legal and environmental (soils, rainfall) criteria. The PALMSIM model would complement such an approach and can be used as a support tool to select preferable marginal regions for surveys and land use planning for oil palm.

Table: Area and share of total area for different yield classes (fresh fruit bunches, FFB, in tons per hectare).

Yield class, t of FFB per ha	Area in km²	Share of total area in %
<10	34.161	2.3
11-15	99.353	6.3
16-20	135.835	8.6
21-25	314.740	19.9
26-30	272.897	17.3
31-35	169.334	10.7
36-40	486.108	30.8
>40	63.987	4.1

References:

Gingold, B., A. Rosenbarger, Y.I.K.D. Muliastra, F. Stolle, I.M. Sudana, M.D.M. Manessa, A. Murdimanto, S.B. Tiangga, C.C. Madusari, and, P. Douard. 2012. How to identify degraded land for sustainable palm oil in Indonesia. Working Paper. World Resources Institute and Sekala, Washington D.C. Available online at http://www.wri.org/applications/maps/suitability-mapper/

Hoffmann, M., A. Castaneda Vera, M. van Wijk, K. Giller, T. Oberthür, C. Donough, and, A. Whitbread. (Submitted 25.09.2013). Simulating potential growth and yield in oil palm with PALMSIM: Model description, evaluation and application.

NASA 2013. NASA Earth Observations. http://neo.sci.gsfc.nasa.gov Retrieved: 30.09.2013.

Oberthür, T., and C. Donough. 2011. Sustainable Intensification with Best Management Practices for Oil Palm in Marginal Environments of Southeast Asia. Tropentag. Oral Presentation. 5-7. October 2011. Bonn.