UNIVERSITI PUTRA MALAYSIA

DYNAMIC APPROACH IN PREDICTING LAND PRODUCTION POTENTIAL FOR RUBBER: CASE STUDY IN EAST AND NORTHEAST THAILAND

(VOLUME I: TEXT)

SOMJATE PRATUMMINTRA

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by

SOMJATE PRATUMMINTRA

Thesis Submitted in the Fulfilment of the Requirements for the Degree of Doctor of Philosophy in the Faculty of Agriculture Universiti Putra Malaysia

June 2000

Dedicated
to
My Parents

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Doctor of Philosophy

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Due to environmental limitations in Thailand, rubber tree has been introduced to non-traditional areas, which have poor conditions for tree growth. Land evaluation (LE) techniques are required to solve the problems in locating land suitable for rubber. However, these are limited by some missing parameters. This study aimed to develop a crop model to predict maximum potential rubber yield, and to quantify parameters for water balance equation which has not been done in Thailand before. Twenty three soil profiles in different climatic conditions in the eastern Thailand were chosen to establish a reliable production potential model. This model was then applied to predict the land suitable for rubber production in the Northeast Thailand.

The FAO crop model, termed as Radiation-thermal Production Potential (RPP) was used to estimate the potential yield from climatic data. It was found that the estimated yield was poorly correlated with the actual rubber yield. Water balance equation was then introduced to quantify soil physical parameters to be incorporated into the model. The results indicated that: (1) crop evapotranspiration in the East Thailand averaged around 3.4 mm day^{-1} for mature rubber (>10 years old) and 4.5 mm day^{-1} for immature rubber; (2) the easily available fraction of soil water (p) was 0.75, and was not influenced by soil texture; and (3) crop coefficient value (Kc) changed throughout the year. The Kc changes from 0.48 to 1.08 depending upon the season and maturity of the tree. The Kc values and percentage of the available water storage were related to the leaf fall period and were used to correct the KLAI factor in the crop model. The leaf fall season is considered as the month following the month when the available water storage becomes less than 25% when the KLAI was 0.6183 (0.7 of the maximum value). During the leaf fall period, the KLAI was 0.4415 (0.5 of the maximum KLAI value). This method of calculating production potential is called Water Limited Production (WPP). It was found that the yield estimated by the WPP was highly correlated with the actual rubber yield (R=0.74-0.93). The loss of tapping days was calculated and this was applied to validate the WPP model. This improved model is called as Maximum Production Potential (MPP). The yield estimated by the MPP was also highly correlated with the actual yield (R=0.81-0.94). Upon application of this model in Northeast Thailand, the dry season was found to be longer than before the model was applied.

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

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Dihadkan oleh masalah alam sekitar, getah ditanam di kawasan bukan tradisi di Thailand. Keadaan dikawasan itu tidak baik untuk tumbesaran getah. Teknik penilaian tanah telah digunakan untuk menyelesaikan masalah tersebut dan mengesan kawasan yang sesuai untuk getah. Walau bagaimanapun, pengendaliannya telah dihalangi oleh ketiadaan beberapa data. Kajian ini bertujuan menyediakan satu model tanaman untuk meramal potensi pengeluaran getah maksimum disamping mengkuantiti parameter untuk parsamaan keseimbangan air. Kajian seperti ini belum pernah dijalankan di Thailand sebelum ini. Sebanyak 23 profil tanah di wilayah iklim berbeza di timur Thailand telah dipilih untuk

menyediakan satu model pengeluaran yang tepat. Model ini kemudianya digunakan untuk meramal kesesuaian tanah untuk pengeluaran getah di timur laut Thailand pula.

Model tanaman FAO yang bernama "Radiation Production Potential (RPP)" telah digunakan untuk mengira potensi hasil daripada data iklim. Walau bagaimanapun, hasil yang dikira melalui RPP berbeza dengan hasil getah sebenar.

Kemudian persamaan keseimbangan air telah diperkenalkan kedalan model untuk mengkuantiti parameter fizik tanah. Keputusan menunjukkan: (1) evapotranspirasi tanaman (ETc) untuk getah matang (>10 tahun) dan belum matang di wilayah timur Thailand masing-masing bernilai 3.4 dan 4.5 mm $hari^{-1}$; (2) bahagian air tersedia (p) untuk getah ialah 0.75 dan ianya tidak dikawal oleh tekstur tanah; dan (3) nilai koefisien tanaman (Kc) berubah mengikut musim. Nilai Kc bagi musim luruh (Mac) ialah 0.48, manakala bagi musim pembentukan daun (April ke Jun) ialah 0.58-0.98. Kc semasa matang ialah 1.08 dan Kc di peringkat akhir pengeluaran (November) ialah 0.83. Nilai Kc dan % storan air tersedia (AWS) berkait rapat dengan waktu luruh dan ianya digunakan untuk memperbaiki faktor KLAI model tanaman ini. Nilai KLAI bagi LAI maksimum (3.8) ialah 0.8333. Musim luruh berlaku selepas storan air tersedia bernilai <25%. Di dalam musim luruh, KLAI bernilai 0.4415 (50% daripada nilai KLAI maximum). Sebelum itu, nilainya ialah 0.6183. Kaedah yang mengira potensi pengeluaran ini disebut sebagai "Water

Limited Production (WPP)". Hasil getah yang dikira melalui kaedah ini berkorelasi tinggi dengan hasil sebenar (R = 0.74-0.93).

Kehilangan hari menoreh telah dikira deripada indeks harian dan ini telah digunakan untuk mengesahkan model WPP. Model yang diperbaiki ini disebut sebagai "Maximum Production Potential (MPP)". Anggaran hasil oleh model MPP juga berkorelasi tinggi dengan hasil getah sebenar (R = 0.81-0.94).

Akhiraya, model ini digunakan keatas tanah getah di wilayah timur laut Thailand. p bernilai 0.75 dan Kc yang sedia ada telah digunakan untuk penentuan keseimbangan air. Didapati musim kemarau bertambah lama. Dengan menggunakan pengkalan data yang dikeluarkan oleh model tanaman ini, satu peta MPP telah disediakan untuk digunakan oleh petani di timur laut Thailand.

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