MODEL-BASED APPROACH ON WATER–FOOD–ENERGY NEXUS WITH BIOMASS FOCUS

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NOTATIONS

Sets and indices

I	set of production units under the agricultural sector i
J	set of crop product j
K	sets of treated biomass k

Parameters

P_j	crop production
C_j	price of crop demand
F_i	freshwater flowrate per unit production
C_{FW}	unit cost of freshwater (m^3)
f_j	carbon factor per unit production
C_{COe}	unit cost of carbon emission (tonne)
$b_{po,t}$	biomass by-product for treatment
$C_{b,t}$	cost of biomass by-product treatment
C_k	price of treated biomass
E_{pi}	electricity demand for crops water pumping
C_E	energy tariff

e_i	demand of energy in nutrients form
F_{FW}	freshwater demand
w_{max}	maximum freshwater flowrate limit
w_i	water demand per production unit
A_i	land area per production unit
atot	total land area used for agriculture production units
amax	maximum land available for agriculture production
E_i	water pumping energy per production unit
etot	total water pumping energy used for agriculture production units
ntot	total energy in nutrients form required by agriculture production units
D_j	minimum crops demand
A_j	land area per crop product
A_{tot}	total land area used for crop production
f_{IP}	carbon factor for crops
CO_{elimit}	carbon emission limit
A_{PO}	area used for palm oil plantation
f_b	biomass factor for palm oil crops
b_{po}	biomass by-product produced
$b_{po,c}$	biomass used for combustion

Decision Variables

P_j	crop production
F_i	freshwater flowrate per unit production
P_k	biomass amount for treatment

INTRODUCTION

The rapid growth of population, industrialisation, and urbanisation globally has led to increased demands for water, food, and energy resources [1]. This will result in limited resources being constrained due to competing needs; therefore, ensuring the sustainability of the scarce resources available is important. Water-food-energy (WFE) nexus was introduced in 2008 at the World Economic Forum that targets for integrated management of the three different fields to achieve the UN (United Nations) Sustainable Development