Crop & Tree Water Use in 2 Mae Chaem Sub-Watersheds

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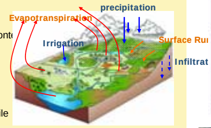
LITERATURE REVIEWS

The Soil Water Balance module of DSSAT 4 computes waterbalance on a daily basis. Processes directly affect water content in the soil profile throughout the simulation season (Ritchie, 1985) using the equation:

$$\Delta S = P + I - EP - ES - R - D$$

Where		
ΔS	=	Changes in soil water conte
P	=	Precipitation
I	=	Irrigation
EP	=	Transpiration
ES	=	Soil Evaporation
R	=	Surface Runoff
D	=	Drainage from Soil Profile



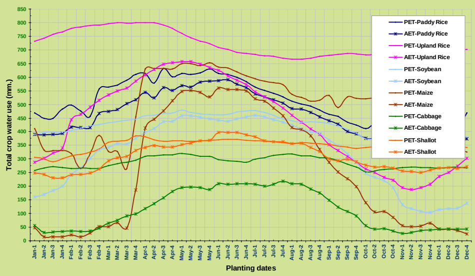
Crop Water Use or Evapotranspiration (ET), is the water lost to the atmosphere by: evaporation, and transpiration. Evaporation is loss from open bodies of water and soil, whereas transpiration is loss from plant surfaces

Water stress during critical growth periods reduces yield and quality of crops. (Al-Kaisi, M.M. and I. Broner, 1992)

Agriculture represents 70% of global water use (FAO, 2005), making it an important part of water resource management and affecting the water balance landscapes of all scales.

METHODOLOGY

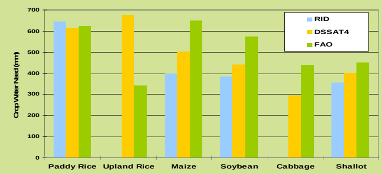
Tools	Data	Output
DSSAT	**Crops** → GC (Genetic Coefficient): Paddy Rice, Upland Rice, Maize, Cabbage, Carrot, Shallot; CC (Crop Cutting): Paddy Rice (4 plots.), Upland Rice (4 plots.), Cabbage (2 plots.), Carrot (1 plot.), Soybean (2 plots.), Maize (4 plots.), Shallot (4 plots.); MP (Management Practices): Followed GC and CC sites. **Climate** → Max Temperature, Min Temperature, Rainfall (Update data 2001-present). **Soil** → Collecting followed GC and CC plot, Analysis in Laboratory	Crop Water Use
MS Excel	**Secondary data** Crop water use by RID, FAO; Evapotranspiration of various types of land use by reference 4	Tree & LU types ET
ArcMap	**Spatial Data** Land Use Map by ICRAF, Chiang Mai 2002; Forest types Map by ICRAF, Chiang Mai 2004	Crop & tree water use in MK and MS



Graph 1 shows the use of DSSAT 4 to simulate economic crop development in 2 sub-watersheds of Mae Chaem (Mae Kong Kha & Mae Suk). Crops include paddy rice, upland rice, maize, soybean, and shallots; planting dates were simulated weekly during the year.

Simulation results show water use rates of each economic crop when simulated 1) using management practices used by farmers in the area; 2) for planting dates in each week of the year.

The potential evapotranspiration of all crops is higher than actual evapotranspiration in both sub-watersheds. This means there is a deficit in the quantity of water used in these sub watersheds, so yield should vary according to crop water use, soil properties and management levels.

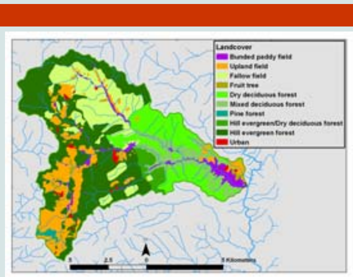


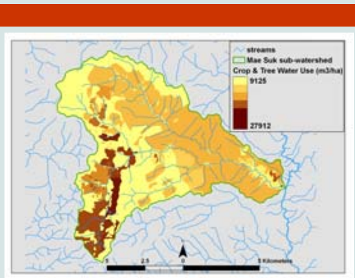
Graph 2 crop water use from 2 different source compared with results from DSSAT Model

Simulated data are compared with crop water use data from secondary sources, such as Royal Irrigation Department (RID) and Food and Agriculture Organization (FAO) in Graph 2.

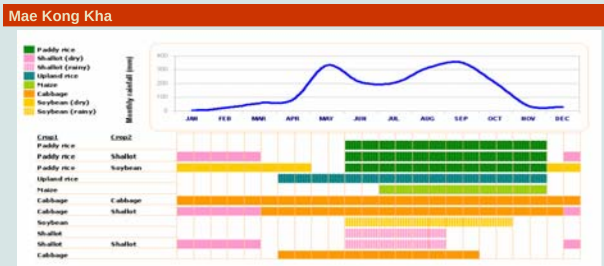
Crop water use of all crops are generally similar, except upland rice is higher than FAO data. This simulation uses genetic coefficients for long-season upland rice, which may be different from FAO.

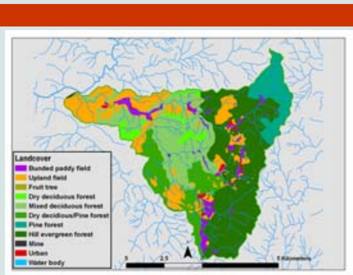
Mae Suk

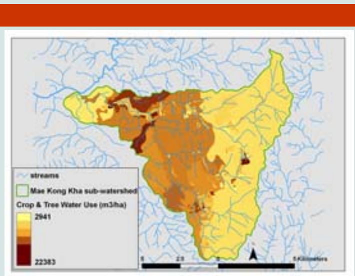




Mae Kong Kha







Picture 1 Results of average rate of crop & Tree water use (m^3/ha) from 2 sub-watersheds

Simulated data by DSSAT model and existing data of crop & tree water use from various sources (RID, FAO, Pukngam (2001), Boonyawat S., et al.(2002)) are used to calculate overall water use (m^3) and water use rate (m^3/ha) of each sub-watershed (picture 1). Mae Suk sub-watershed shows a situation where intensive agriculture is booming. Crop water use is rising due to complex cropping patterns, many crop types, sprinkler irrigation, and few bare soil periods during the year. Mae Kong Kha consumes about 23 million-m^3 per year less water than Mae Suk. Moreover, intensive agriculture areas use more water than forest.

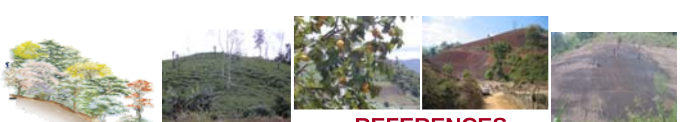
CONCLUSIONS

The model's minimum dataset for a single year can be used to simulate water balance and other model outputs for that year. But in order to forecast future crop yield and water balances, DSSAT needs at least 10 years of basic climate data.

Estimated water loss from crop and tree use in study areas can be calculated from model output data and existing secondary data in the area.

Results can be used to support water management and planting decisions, and help avoid drought periods and water conflict situations.

Water Balance can be used to evaluate impact of water loss from intensive agriculture on watershed functions.



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