การประเมินสมรรถนะการชลประทานโครงการส่งน้ำและบำรุงรักษาบางเลนด้วยดัชนี Depleted Fraction และข้อมูลดาวเทียมจาก Google Earth Engine

Assessing Irrigation Performance of Bang Len Operation and Maintenance Project using Depleted Fraction Index and Satellite-derived Data from Google Earth Engine

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บทคัดย่อ

Depleted Fraction (DF)

. . 2565-2567

(ETa) Terra Climate CHIRPS

Google Earth Engine DF

0.65 (0.5-0.7)

DF

DF 0.6 1.0

DF 0.6

ETa

: Depleted Fraction, ,

Abstract

Depleted Fraction (DF) is an indicator of irrigation performance that assesses water supply adequacy and reflects water use efficiency in irrigated schemes. This study aims to evaluate irrigation performance in the Bang Len Operation and Maintenance Project during 2022-2024 using irrigation water supply data combined with gridded monthly actual evapotranspiration (ETa) from Tema Climate and satellite-derived monthly precipitation from CHIRPS through the Google Earth Engine platform. The assessment revealed an average DF value of approximately 0.65, which falls within acceptable criteria (0.5-0.7), indicating efficient water use for crop production and balanced soil and groundwater storage in the project area. However, significant seasonal variations in DF values were observed, with dry season values typically exceeding 0.6, occasionally rising above 1.0, suggesting farmers may rely on alternative water sources such as groundwater or natural water bodies in the area. Conversely, during the rainy season, DF values were generally below 0.6, indicating excess water that may contribute to groundwater recharge or system outflow. The evaluation has limitations due to extensive aquaculture areas where ETa represents natural water evaporation rather than water productivity. This research demonstrates the potential of satellite-derived data for assessing irrigation water management performance, particularly in areas with limited field data availability. The findings can be applied to optimize water delivery plans and enhance crop production efficiency in irrigated areas.

Keywords: Depleted Fraction Index, Remote Sensing, Irrigation Water Management

1. คำนำ

(Inequity)
(Inadequacy) (Unreliability)

[1]-[3]

[4]

[5]
Depleted Fraction (DF)

[6]

(Actual Evapotranspiration, ETa)

DF
ETa
ETa

Google Earth Engine (GEE)

GEE

DF

DF
[7], [8]
GEE
[9] DF
GEE

. . 2565-2567 DF GEE

2. อุปกรณ์และวิธีการ

2.1 พื้นที่ศึกษา

(1)

371,375 269,188

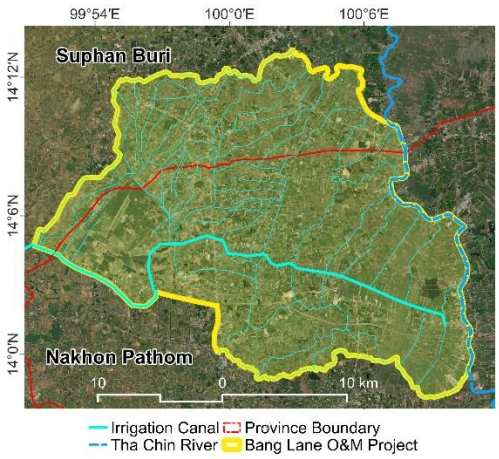
2L-LMC
-

2.2 ข้อมูลที่ใช้ในการวิจัย

1

2.2.1 ปริมาณน้ำชลประทานที่ส่งในโครงการ (Inflow)

3
2L-LMC, 8L-2L-LMC 9L-2L-LMC
. . 2565-2567 (
)
( )



รูปที่ 1

2.2.2 ข้อมูลการคายระเหยน้ำ Potential Evapotranspiration (PET) และ Actual Evapotranspiration (AET) จาก TerraClimate

PET AET TerraClimate
University of Idaho
4 . . 1958
TerraClimate
CRU (Climatic Research Unit), JRA-55 (Japanese Reanalysis), ERA5

(European Centre for Medium-Range Weather Forecasts)

MODIS TerraClimate

(4)

Google Earth Engine

PET Penman-Monteith

(mm/month) AET

Thornthwaite and Mather

(mm/month) [10]

2.2.3 ข้อมูลฝน (Precipitation) จาก CHIRPS

CHIRPS (Climate Hazards Group InfraRed Precipitation with Station data)

Climate Hazards Group (CHG) University of California, Santa Barbara 5

. . 1981 CHIRPS

(Infrared Data) NOAA Climate Prediction Center (CPC) GOES (Geostationary Operational Environmental Satellite) Cold Cloud Duration (CCD)

Global Historical Climatology Network (GHCN) WMO NOAA Climate Forecast System (CFSv2) ERA5

(mm/day)

(mm/month) CHIRPS

TerraClimate

Google Earth Engine [11]

ตารางที่ 1

ประเภท	ที่มา	ความถี่	หน่วย
(,)			
	CHIRPS Google Earth Engine		
(ETa)	TerraClimate Google Earth Engine		
(PET)	TerraClimate Google Earth Engine		

2.3 Google Earth Engine (GEE)

Google Earth Engine (GEE)

GEE

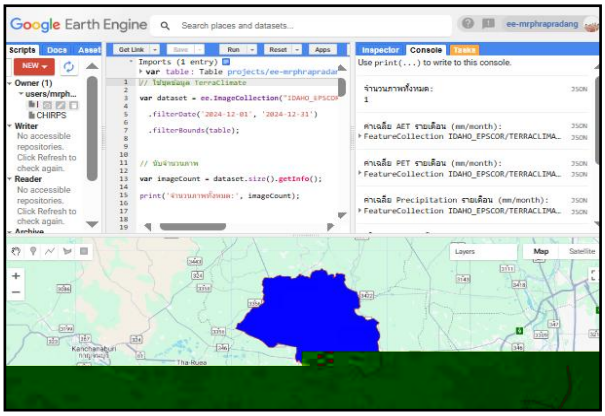
AET TerraClimate

CHIRPS (2)

GEE

JavaScript

GEE



รูปที่ 2 Google Earth Engine (GEE)

2.4 การประเมินความถูกต้องของข้อมูลจาก Google Earth Engine

Google Earth Engine

(Precision) (Accuracy)

[12] 2 PBIAS (Percent Bias)

(Correlation Coefficient, r)

CHIRPS

PET TerraClimate

ETo Penman-Monteith

( )

AET

PET AET

PET

r (Precision)

-1 1 r 1

r -1

r 0
PBIAS (Accuracy)
PBIAS DF
0 % PBIAS

(Overestimation) PBIAS DF
(Underestimation) r PBIAS
(1) (2) 2

$$r = \frac{\sum_{i=1}^{n}(S_i-\bar{S})(G_i-\bar{G})}{\sqrt{[\sum_{i=1}^{n}(S_i-\bar{S})^2][\sum_{i=1}^{n}(G_i-\bar{G})^2]}} \quad (1)$$

$$PBIAS = \frac{\sum_{i=1}^{n}(G_i-S_i)}{\sum_{i=1}^{n}S_i} \times 100\% \quad (2)$$

S_i (Station)
$\bar{S}$ (Station)
G_i (Grid) CHIRPS / TerraClimate
$\bar{G}$ (Grid) CHIRPS / TerraClimate

ตารางที่ 2 r PBIAS [13]

r	Rating	PBIAS	Rating
0.0 – 0.1	Very low	PBIAS ≤ ±10%	Very Good
0.1 – 0.3	Low	±10% < PBIAS ≤ ±15%	Good
0.3 – 0.5	Moderate	±15% < PBIAS ≤ ±25%	Satisfactory
0.5 – 0.7	High	PBIAS ≥ ±25%	Unsatisfactory
0.7 – 0.9	Very high		
0.9 – 1.0	Almost perfect		

2.5 คำนวณดัชนี Depleted Fraction (DF)

Depleted Fraction (DF)
DF
( )
( ) (3)

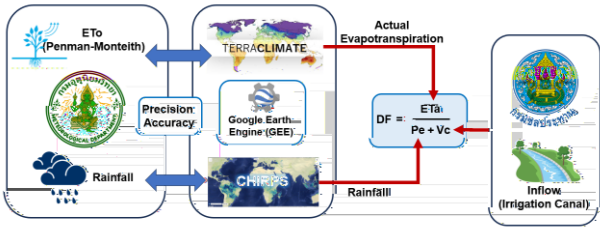
$$DF = \frac{ETa}{(Pe + Vc)} \quad (3)$$

ETa AET TerraClimate
Pe CHIRPS
Vc
DF 0.5 0.7
0.6 [6] DF 0.6

DF 0.6

ETa AET TerraClimate Pe
CHIRPS Vc

Depleted Fraction
Google Earth Engine 3



รูปที่ 3 Depleted Fraction Google Earth Engine

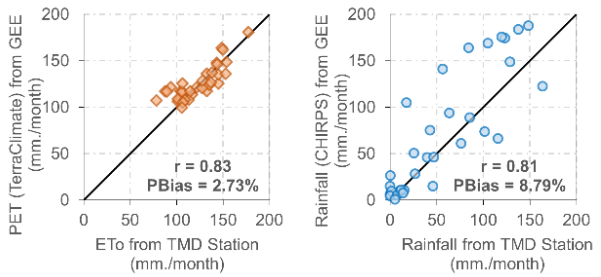
3. ผลการทดลองและวิจารณ์

PET TerraClimate
Google Earth Engine PET Penman-Monteith (4A)
PET GEE
PBIAS 2.73 % (< ±10%)
(r) 0.83
(0.7-0.9)

CHIRPS
Google Earth Engine
(3) GEE 4B
PBIAS 8.79 % (< ±10%)
(r) 0.81
(0.7-0.9)

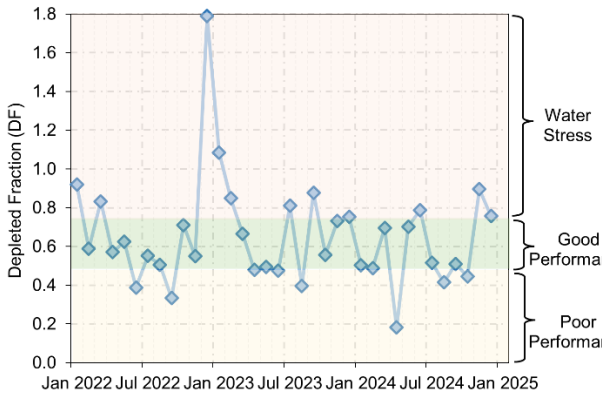
Depleted Fraction (DF)
5
. . 2565 DF
0.33 DF
1.79 . . 2566 DF

0.40 DF
1.08 . . 2567 DF
0.18 DF
0.90



(A) (B)

รูปที่ 4 GEE (A) PET (TerraClimate) ETo (B) (CHIRPS)



รูปที่ 5 DF . . 2565-2567

5 ( ) DF 0.6

(Return Flow) . . 2565 DF 1.79

ETa ( ) DF 0.6

DF 0.65 (0.5-0.7) [6]

[8] DF (> 1.0)

1) 66,704 24.78 % ETa

2) -

3) (Return Flow) DF

4. สรุปผลและข้อเสนอแนะ

Depleted Fraction (DF) Google Earth Engine (GEE) GEE 0.83 PET 0.81 GEE 15 DF [7] [9] DF (0.5-0.7) DF DF

DF

GEE

/ (Land Use/Land Cover)

Sentinel-2 10

DF

(ETa, Pe Vc)

DF

DF

ETa Pe

DF

กิตติกรรมประกาศ

13 2L-LMC

8L-2L-LMC 9L-2L-LMC

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