การประเมินความผันแปรของประสิทธิภาพการไหลของน้ำท่าผิวดินในช่วงสถานการณ์น้ำท่วมฉับพลัน และการเปลี่ยนแปลงการใช้ประโยชน์ที่ดินโดยใช้แบบจำลอง S ในพื้นที่ลุ่มน้ำเลย

Ar h ec R ne e e da N bb rra i an. . Abbeea u nec Bh od Bh H oa d ca e e o oec S I ahe H ae oe

โยธี พิมพ์พุฒ[1] และ หริส ประสารฉ่ำ[1]

[1] *สาขาวิศวกรรมโยธา คณะวิศวกรรมศาสตร์ มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน วิทยาเขตขอนแก่น*

**Corresponding author; E-mail address: myothee65@gmail.com*

บทคัดย่อ

SWAT

( )

3

. .2545 . .2554 . .2560

. .2552

SWAT

KH.58A . .2552 R^2 NSE PBIAS

3

30% CN2

:

, SWAT,

o n

The flash flood was common problem in immerse flood season. It destroyed shelters and agricultural plain area. The causes were heavy rain from river source to river mouth and changing of land used. The purposes of this study were 1.) To apply “SWAT” model to evaluate the effective of water flowing at Loei basin, Loei province. (Khong river of Northeastern river region, Thailand) 2.) To compare water quality of flash flood occurred in year 2002, 2011 and 2017 with year 2009 effected with land used. The results were as conditional water level in daily from “SWAT” modal compared with measurement station was at KH.58A in year 2009. The reliability was at R^2 NES and PBIAS was at concessive level. The changing of soil used tendency compared with three periods of time that amplified to country side, sugar cane gardens and also rubber gardens. Especially in rubber gardens, price was increased instead of old agriculture. The water of land surface level was increased in rainy season at 30 percentage and related with CN2 increased. The minor river was water collected point and agricultural area was changed to city. This study could apply to make data decision, set land used administration, set water resource for people and for government agencies that could face with hydrology flash changed in immerse flood season.

Keywords: Flash Flood, Land Use Change, SCS runoff Curve Number 2, SWAT, Loei Basin

1. บทนำ

Soil And Water Assessment Tool

SWAT [1]

SWAT

3

2 พื้นที่ศึกษา

3

3 . .2545 . .2554 . .2560

. . 2545

1,500 . .

240 .

2

5

1

(KH.58A) 1,404 . ./

2.5

2.614

“ ”

231

(Inter Tropical

Convergence Zone: ITCZ)

Lumped-Parameter Model

(Tropical Cycloen)

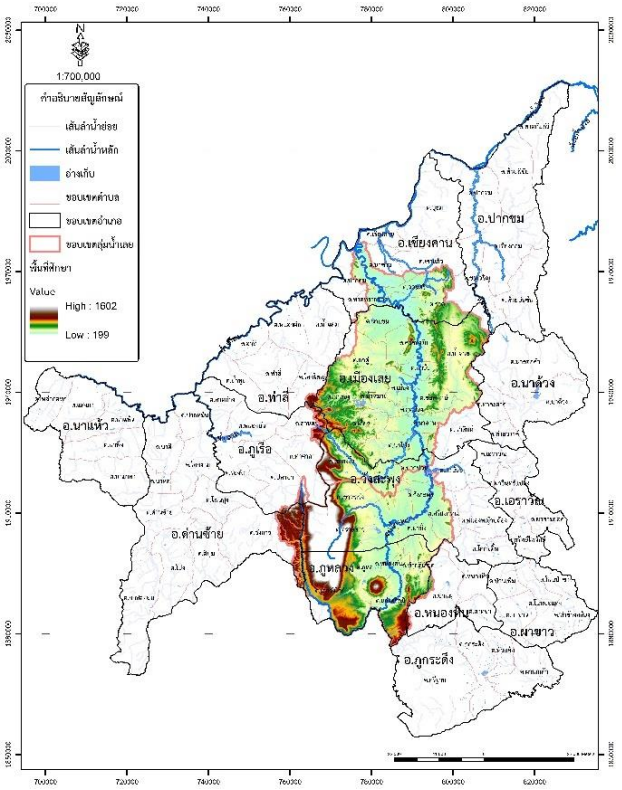
43.5

Distributed-

-1.3

Parameter Model

1,235 ./



รูปที่ 1

ตารางที่ 1 SWAT

	(. .)	
1 (Digital Elevation Model: DEM)	2558	
2. GIS	2563	
3.	2558	
4.	2545(2552, 2560	
5 (KH.58A .)	2545,2552, 2554, 2560	
6. 6	2545, 2552, 2554, 2560	
7. KH.58A	2545, 2552, 2554, 2560	

(DEM) 30 . X 30 .

(GIS)

3 วิธีการศึกษา

3,998 .

. (3,891 . .)
(107 . .)
(Soil Series)

SWAT

SWAT

15

10

. . 2545,

. . 2552 . . 2560

3.1 การรวบรวมและการจัดเตรียมข้อมูล

. .2545, . .2552, . .2554
. .2560

1

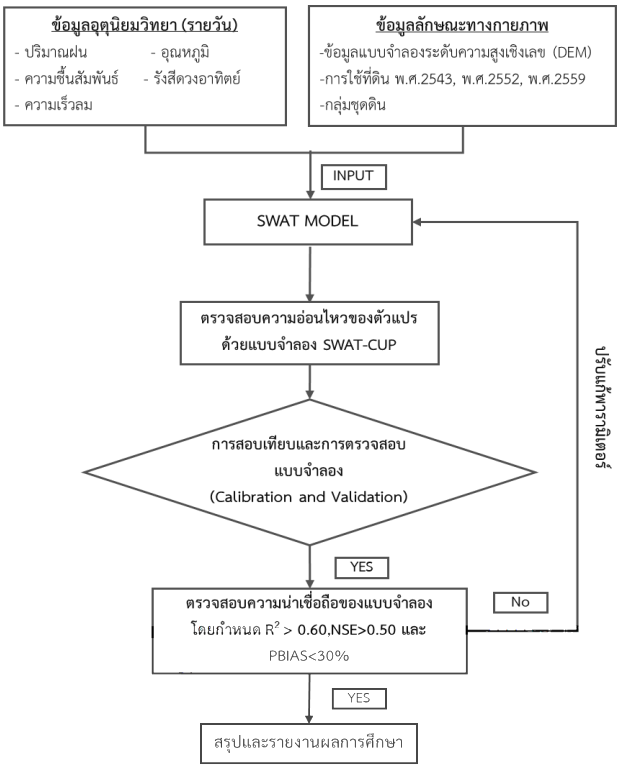
(Digital Elevation Model : DEM),
(Watershed Boundary), (Steam Line),
(Land use), (Soil Group) -
(Meteorologcal Data and Hydrological Data)
,
- , ,

6

SWAT

1

KH.58A (: . .)



รูปที่ 2

3.2 การประเมินปริมาณน้ำท่าโดยการใช้แบบจำลอง SWAT

SWAT

3 (Watershed Delineation) (Hydrologic Response Unit: HRUS) SWAT

[2-3]

100

. . HRUs

10%

(10%

HRUs)

HRUs

SWAT

5-20% [4]

2

3.3 การวิเคราะห์ความอ่อนไหวของตัวแปร

SWAT

(Sensitivity Analysis)

SWAT-CUP (SWAT Calibration and Uncertainty Procedures)

Kh.58A . .2545, . .2552, . .2554 . .2560

10 [4-5] 500

3.4 การสอบเทียบและการตรวจสอบแบบจำลอง

SWAT-CUP Sequential Uncertainty Fitting version 2 (SUFI2)

KH.58A

(Model Calibration)

[5-6] 3 R^2 (Coefficient of Determination), NSE (Nash-Sutcliffe Model Efficiency Coefficient) PBIAS (Percent Bias)

$$R^2 = \left(\frac{\sum_{i=1}^{n}(O_i - \overline{O})(P_i - \overline{P})}{\sqrt{\sum_{i=1}^{n}(O_i - \overline{O})(P_i - \overline{P})}} \right)^2 \quad (1)$$

$$NSE = 1 - \left(\frac{\sum_{i=1}^{n}(O_i - P_i)^2}{\sum_{i}^{n}(O_i - \overline{O})^2} \right) \quad (2)$$

$$PBIAS = \frac{\sum_{i=1}^{n}(O_i - P_i)}{\sum_{i=1}^{n}(O_i)} \times 100 \quad (3)$$

i , n , O_i , $\bar{O}$, P_i $\bar{P}$ SWAT-CUP (Uncertainty) 95% (95% Prediction Uncertainty, 95PPU)

R^2 > 0.60 NSE > 0.5 PBIAS < 30% [7]

SWAT 1 KH.58A 365 - 365

0 ผลการศึกษา

4.1 ผลการเปลี่ยนแปลงการใช้ประโยชน์ที่ดิน

10 2 AGRL, CASS, PAST, RICE, SUGC, FRSE, URBN, WATER, RUBR EUCA . .2545 . .2552 . .2560 SWAT . . 2545 3 (FRSE) (AGRL) (RICE) 1,440, 847 450.2 . . 36.03, 21.18 11.26

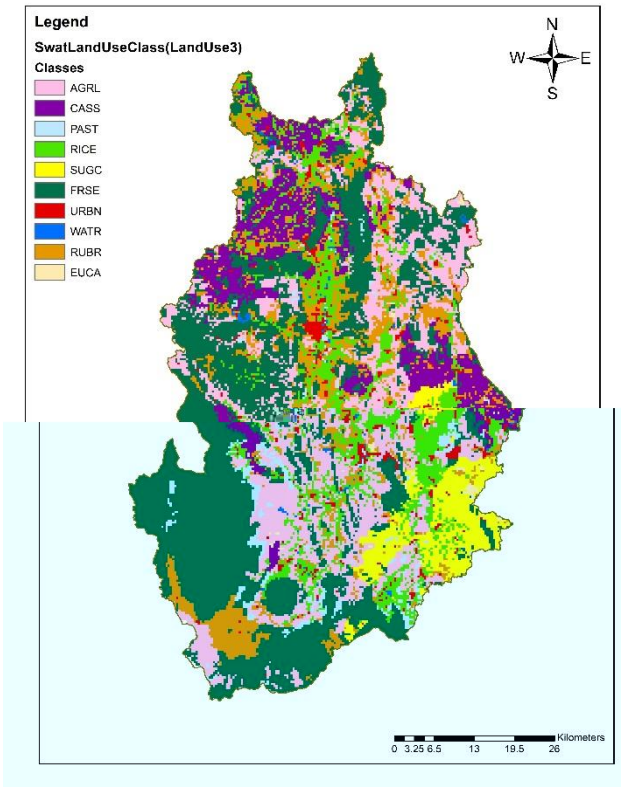
. . 2552 3 (FRSE) (AGRL) (RICE) 1,632 779.6 474.6 . . 40.82 19.50 11.87 . . 2560 3 (FRSE) (RUBR) (RICE) 1,376.5, 1,031.9 450.2 . . 34.43, 25.81 11.26 2 3 5 . .2552 . . 2545

13.29 5.42 7.93 99.15, 74.29 21.02 3 4 . .2560 . .2545

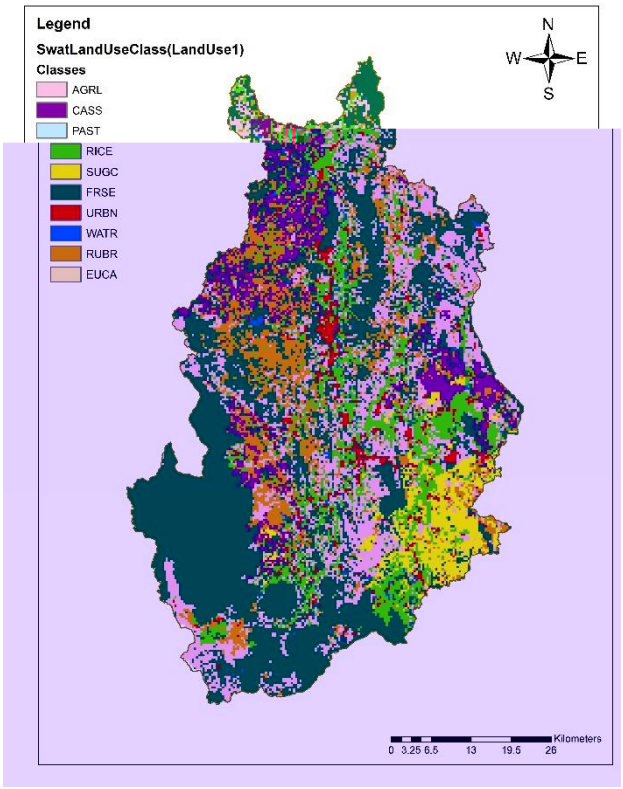
15.65 5.14 124.63 4 5 . . 2545 . .2560 . .2552 593.70, 162.72 77.96 . . 135.49, 73.59 79.27 , ,

ตารางที่ . 3

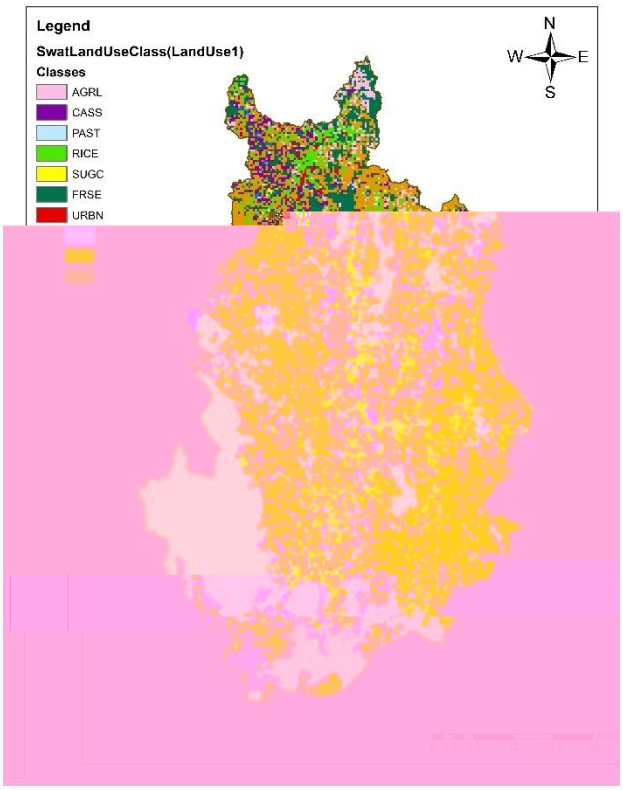
		. .2545		. .2552		. .2560	
			(. .)		(. .)		(. .)
1	(AGRL)	21.18	846.80	19.50	779.61	7.16	286.26
2	(CASS)	9.42	376.60	7.44	297.45	5.47	218.69
3	(PAST)	2.36	94.40	0.02	0.80	0.02	0.80
4	(RICE)	11.26	450.20	11.87	474.56	11.26	450.17
5	(SUGC)	5.53	221.10	4.75	189.91	9.60	383.81
6	(FRSE)	36.03	1,440.50	40.82	1,631.98	34.43	1,376.51
7	(URBN)	2.46	98.40	3.32	132.73	4.41	176.31
8	(WATER)	0.46	18.40	0.70	27.99	1.63	65.17
9	(RUBR)	10.96	438.20	11.49	459.37	25.81	1,031.88
10	(EUCA)	0.35	14.00	0.09	3.60	0.23	9.20



รูปที่ 3 . .2545



รูปที่ 4 . .2552



รูปที่ 5 . .2560

4.2 ผลการวิเคราะห์ความอ่อนไหวของตัวแปร

SWAT CUP

3

t-stat P-value

t-stat ( ) P-value

0

3

CN2.mgt, SOL_K.sol SOL_AWC.sol

ตารางที่ 3 10

1	CN2.mgt	-20.786	0.000	-0.022
2	SOL_k(..).sol	-14.714	0.000	22.000
3	SOL_AWC(..).sol	5.336	0.000	0.283
4	GW_DELAY.gw	-1.614	0.107	0.105
5	ESCO.bsn	-1.115	0.265	0.081
6	ALPHA_BF.gw	-1.100	0.271	0.103
7	RCHRG_DP.gw	-0.880	0.379	45.772
8	GWQMN.gw	0.424	0.671	0.821
9	CH_N2.rte	0.398	0.690	122.200
10	GW_REVAP.gw	0.010	0.992	2,395.000

SWAT CUP 500

10 Dotty

Plots CN2, SOL_K SOL_AWC

NSE (Objective Function)

NSE 1

NSE

CN2 SOL_K SOL_AWC

NSE

NSE

CN2 SCS Runoff curve Number

(Moisture Condition II) SOL_K

(Saturated Hydraulic Conductivity) SOL_AWC

(Soil Available Water

Capacity)

(Infiltration)

( ) CN2

SOL_K SOL_AWC

[6, 8, 9, 10, 11]

4.3 ผลการสอบเทียบและการตรวจสอบแบบจำลอง

SWAT-CUP

500 Objective Function

3

KH.58A . .2545, . .2554 . .2560 . .2552 ( )

6 9

SWAT KH.58A

. .2552 ( ) . .2545, . .2554 . .2560

4 3

5 KH.58A . .2545,

. .2554 . .2560 55.36, 80.57

60.69 . . . .2552 (35.96

. .) 19.67, 44.88 25.00 . .

35.53, 125.75 31.03

30

ตารางที่ 4 KH.58A

(. .)

	(. .)				R^2
1	2545	55.36	59.21	6.95	0.84
2	2552 ( )	35.69	31.34	13.88	0.53
3	2554	80.57	68.96	16.83	0.45
4	2560	60.69	71.24	17.38	0.61

ตารางที่ SWAT

KH.58A (. . 2545)

	(1-240)	(241-365)	(1-365)
R^2	0.47	0.86	0.84
NSE	0.83	0.72	0.85
PBIAS	-26.79%	13.69%	6.51%

ตารางที่ 7 SWAT

KH.58A (. . 2554)

	(1-240)	(241-365)	(1-365)
R^2	0.46	0.41	0.45
NSE	0.33	0.34	0.42
PBIAS	-45.60%	0.65%	-16.84%

ตารางที่ 6 SWAT

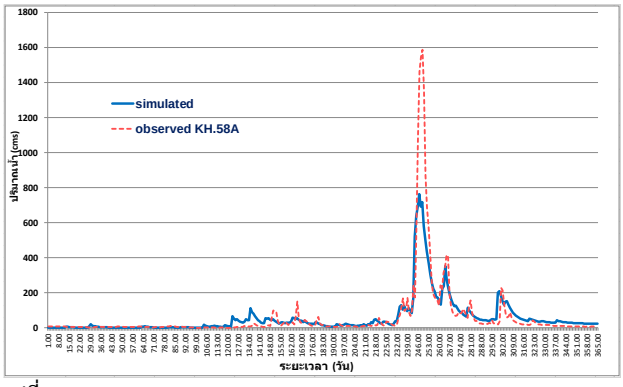
KH.58A (. . 2552)

	(1-240)	(241-365)	(1-365)
R^2	0.45	0.54	0.53
NSE	0.31	0.56	0.52
PBIAS	-44.80%	7.72%	-13.87%

ตารางที่ 4 SWAT

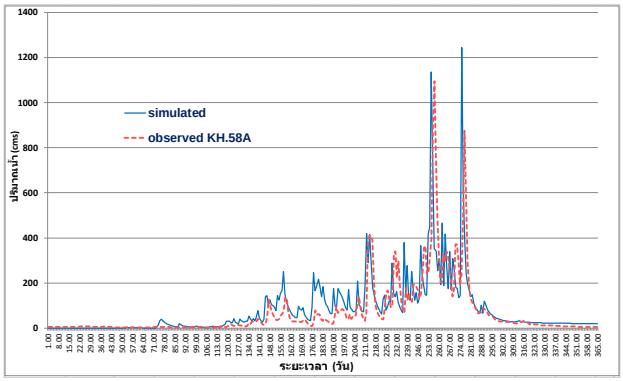
KH.58A (. . 2560)

	(1-240)	(241-365)	(1-365)
R^2	0.53	0.69	0.61
NSE	0.50	0.63	0.49
PBIAS	17.08%	11.40%	14.44%



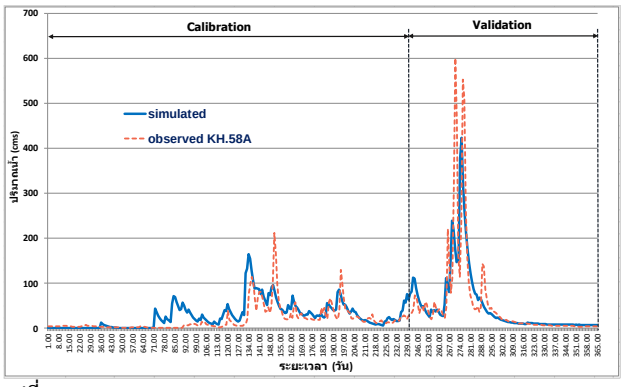
รูปที่ 6 SWAT

KH.58A (. . 2545)



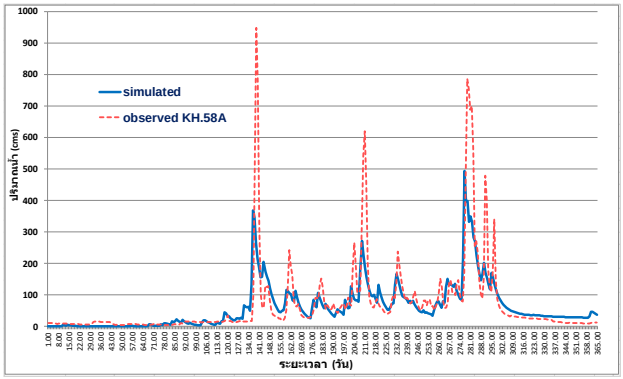
รูปที่ 8 SWAT

KH.58A (. . 2554)



รูปที่ 7 SWAT

KH.58A (. . 2552)



รูปที่ 9 SWAT

KH.58A (. . 2560)

สรุปผลและข้อเสนอแนะ

(. .2545, . .2552, . .2554, . .
2560)
3,988 . . . .2552 . .
2545

13.29 5.42
7.93
. .2560 . .2545

15.65 5.14
124.63
. . 2545 . .2560
. .2552

593.70, 162.72 77.96 . . 135.49, 73.59
79.27 , ,

SWAT
KH.58A (. .2545, . .2552, . .2554, . .2560)
CN2, SOL_K SOL_AWC

(. .2545, . .2552, . .2554, . .2560)
KH.58A . .2552 ( ) R^2, NSE PBIAS
0.45 0.31 -44.80
SWAT KH.58A . .2552 (
) R^2 NSE PBIAS 0.54 0.56 7.72 R^2
NSE PBIAS KH.58A
. .2545, . . 2554 . .2560 . .2552 ( )
3
. .2545 . .2560 R^2
0.84 0.61 . .2552 . .2554 R^2
0.53 0.45 PBIAS

SWAT
PBIAS
±30% [7]
. .2552 ( ) . .
2545, . .2554 . .2560 SWAT
55.36, 80.57 60.69 .
. . .2552 (35.96 . .)
19.67, 44.88 25.00 . . 35.53, 125.75
31.03

30

กิตติกรรมประกาศ

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2.

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