B. Deesaeng, J. Pheunda, C. Onarsa, A. Boonsaner

Watershed Research Division,
Watershed Conservation and Management Office,
National Park, Wildlife and Plant Conservation Department
Bangkok, Thailand

Objectives

This study was attempted to assess vetiver potential for increasing groundwater recharge as well as to report soil and water balance that were taken place in various agricultural sites where the vetiver hedgerows were applied.

Study area

- Located at Yom Watershed, Northern Thailand
- Tropical Savanna (Aw)

• mean annual rainfall	1,210 mm
• mean annual evaporation	1,050 mm
• mean relative humidity	89 %
• mean daily temperature	26 °C

Study area

Parent materials	sandstone, shale, phyllite and andesitic tuff
Texture	sandy clay loam to clay
Bulk density	1.02 - 1.53 Mg m^{-3}
Porosity	42 - 66 %.
Ksat	6.7 x 10^{-5} - 3.6 x 10^{-4} ms^{-1}
Water table	deeper than 2 m

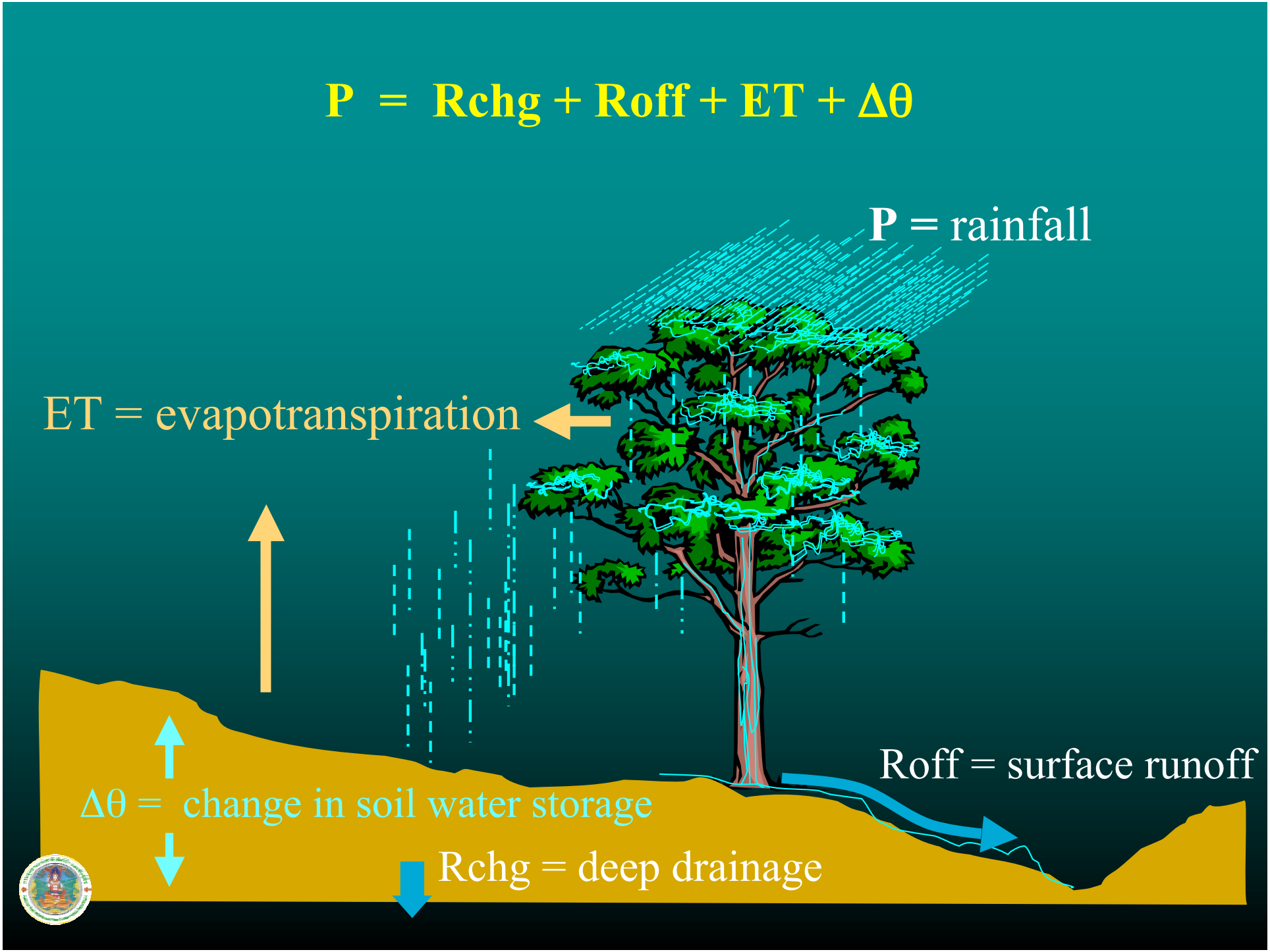
Material & Method

- 3 cultivation sites;
  - Longan (*Dimocarpus longan)*
  - Maize (*Zea mays*)
  - Soybean (*Glycine max*)
- Experiment plots established in 2004.
- Data were collected after the crops were replanted in the following year with dense vetiver hedgerows at that time.

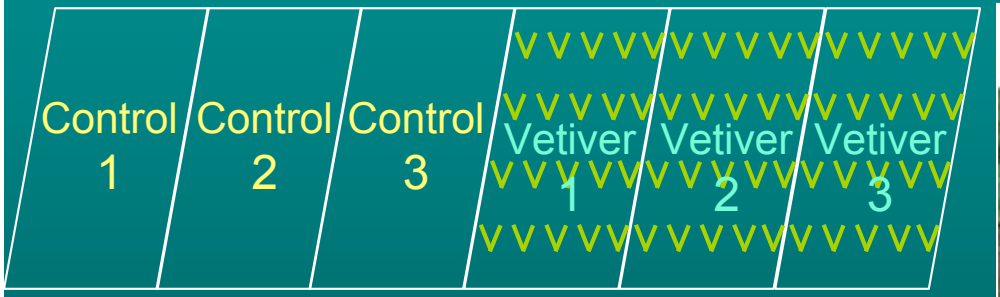

การใช้หญ้าแฝก
เพื่อการเพิ่มระดับน้ำใต้ดินในพื้นที่ต้นน้ำ
(Vetiver Potential for increasing groundwater
recharge in headwater areas)


การใช้หญ้าแฝก
เพื่อการเพิ่มประสิทธิภาพในพื้นที่ต้นน้ำ
(Vetiver Potential for increasing groundwater
recharge in headwater areas)


ng groundwater


P = Rchg + Roff + ET + Δθ
P = rainfall
ET = evapotranspiration
Δθ = change in soil water storage
Roff = surface runoff
Rchg = deep drainage

Runoff measurement



- Six runoff plots (4 x 20 m^2) were established within each selected sites
  - Three for the control plots
  - Three for vetiver added plots

Climatic measurement

8-inch standard rain gage

evaporation pan

Soil water status

- Soil-water content measurement
  - using TDR profile probe
  - at a depth of 1.50 m
  - weekly measurements

- Readings were taken at 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 130, 150 cm depths

Crop ET

Potential evapotranspiration (ETp)

$$ETp = E * Kpan$$

Crop ET (ETc)

$$ETc = ETp * Kc$$

Kpan		=	0.7
Kc of	longan	=	1.99
	maize	=	1.14
	soybean	=	1.10
	vetiver	=	0.92

Deep drainage

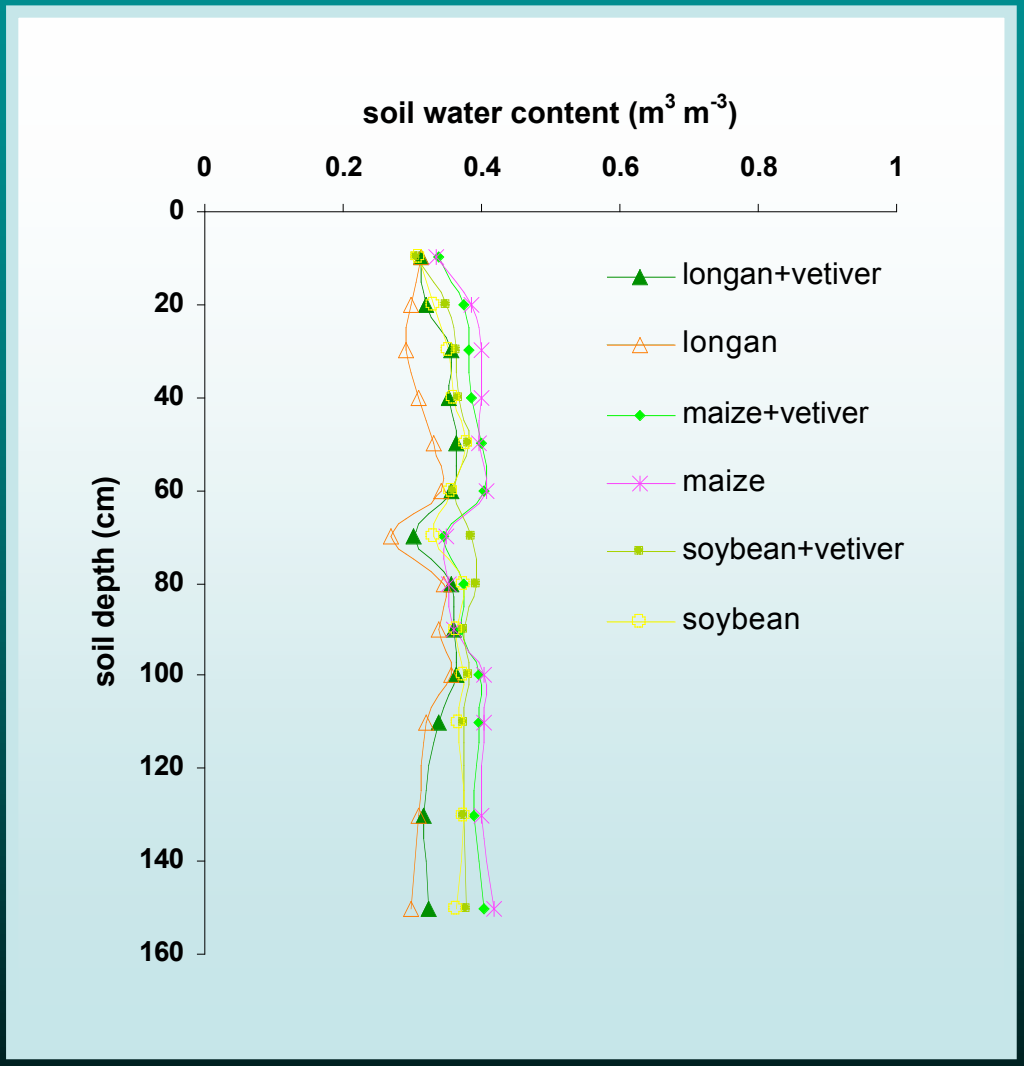
$$Rchg = P + Roff + ET + \Delta\theta$$

If the solution was found to be positive, this amount was allocated to groundwater recharge.

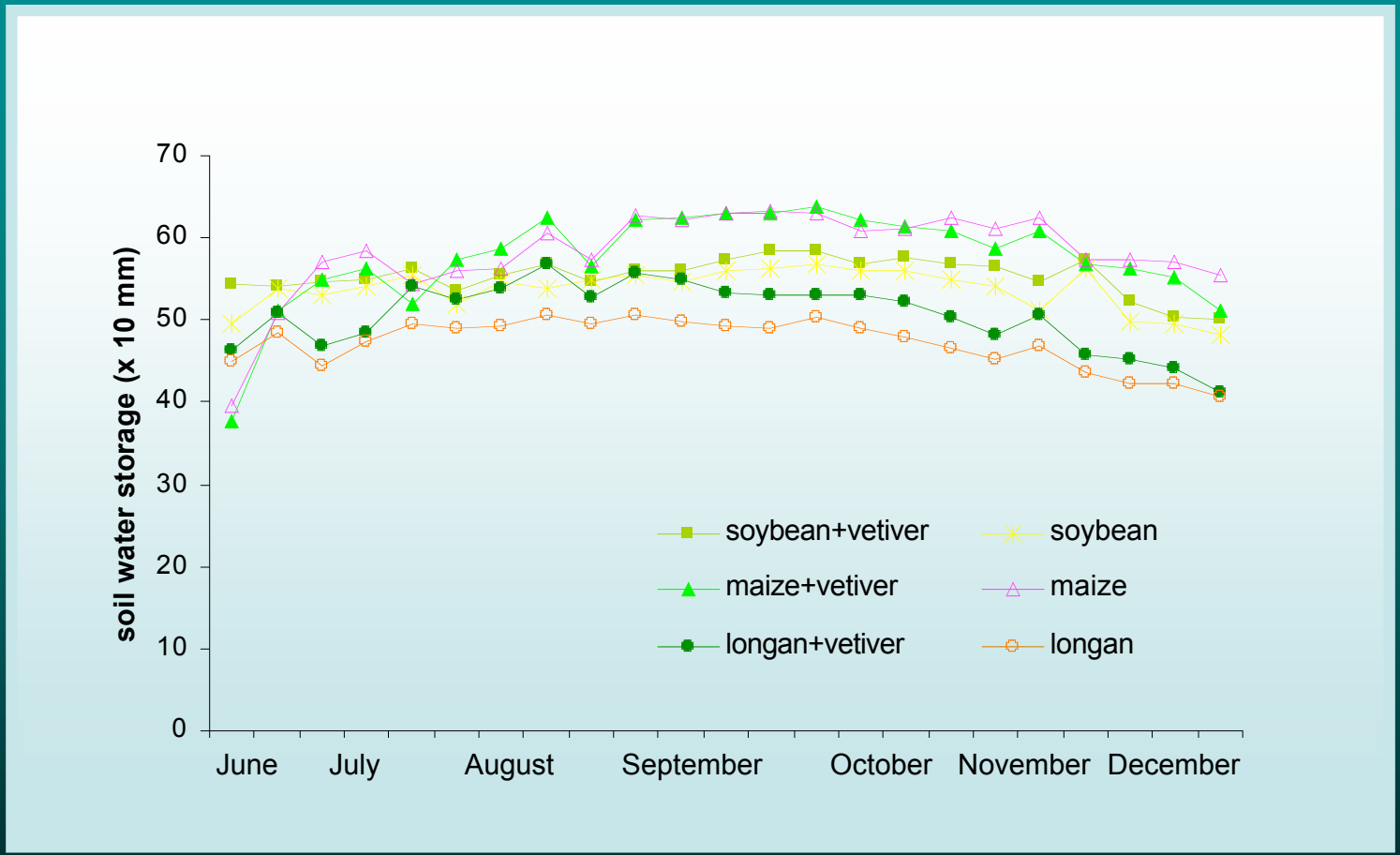
If the solution was negative, it was interpreted that there was no drainage.

Results and Discussion

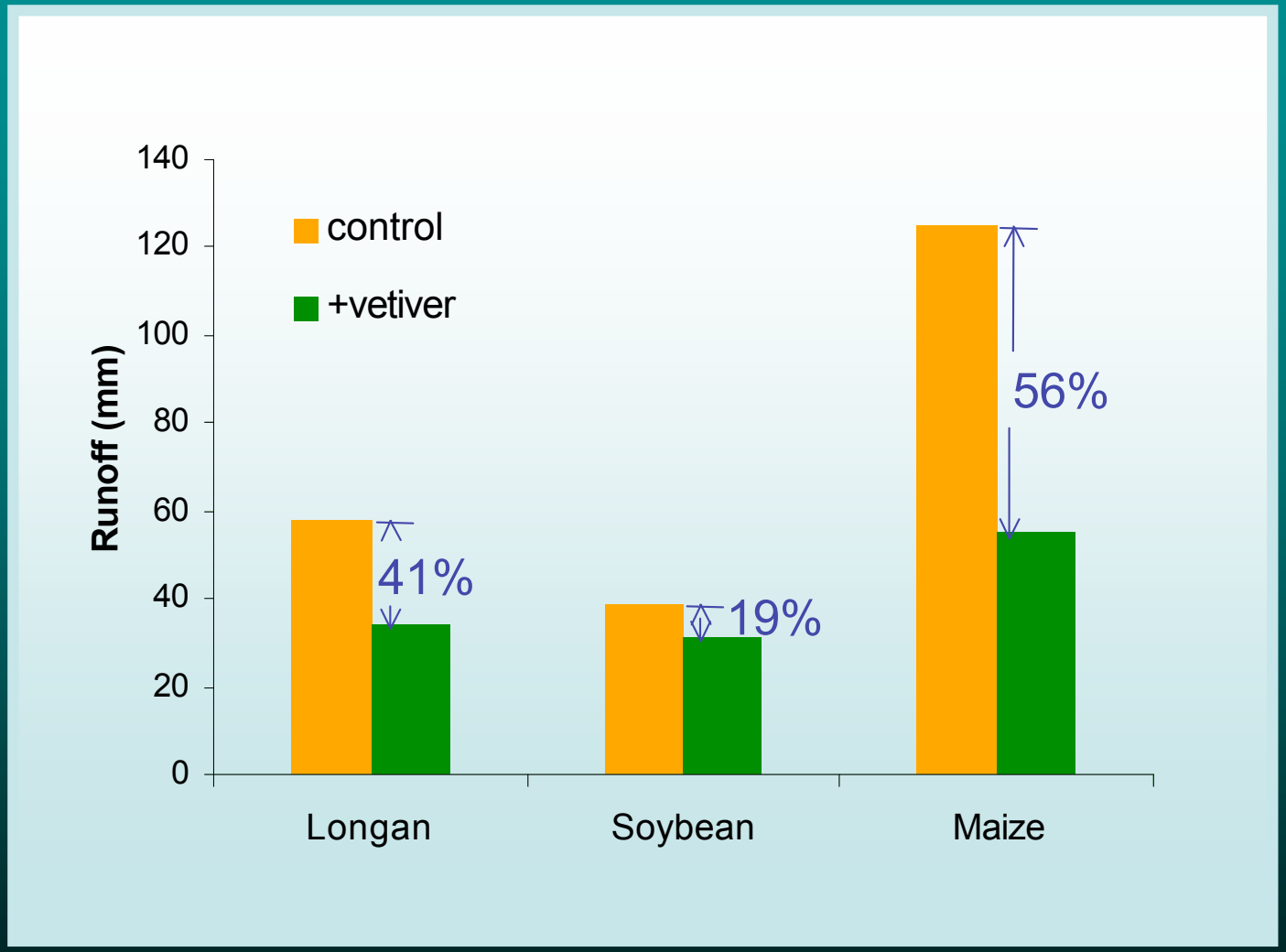
Average soil water contents along the 1.5 m-profile



Soil-water storage of 1.5 m profile



Runoff


140
120
100
80
60
40
20
0
Runoff (mm)
control
+vetiver
41%
19%
56%
Longan
Soybean
Maize

Crop ET

The accumulative evapotranspiration

	Control	+Vetiver
Longan	666.9	697.7
Maize	404.7	437.3
Soybean	408.1	442.3

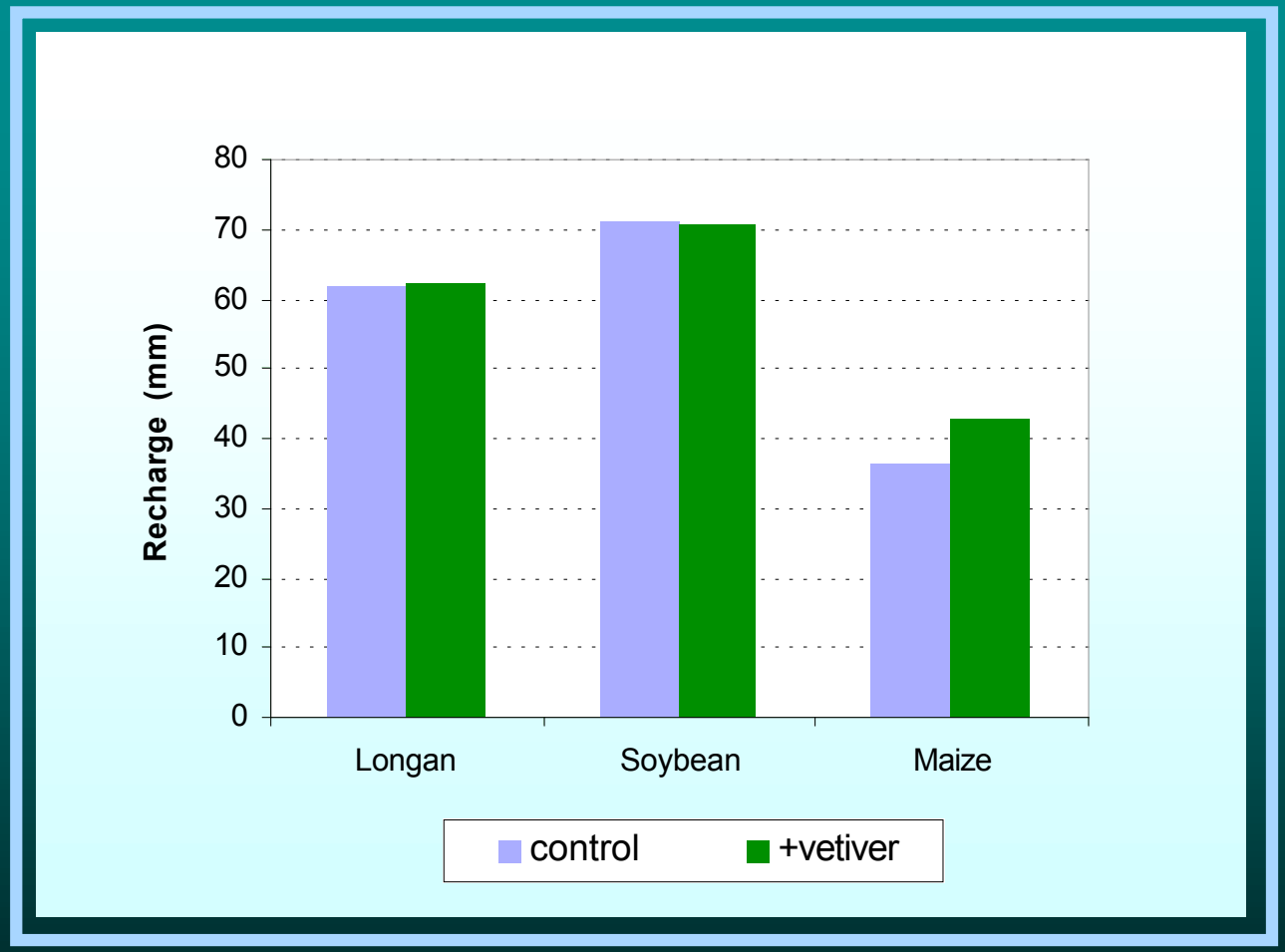
The plots with vetiver hedgerows revealed higher accumulative evapotranspiration than the control plots. The reason may come from the fact that intercrops can withdraw more water as evapotanspiration than their sole crops.

Water balance

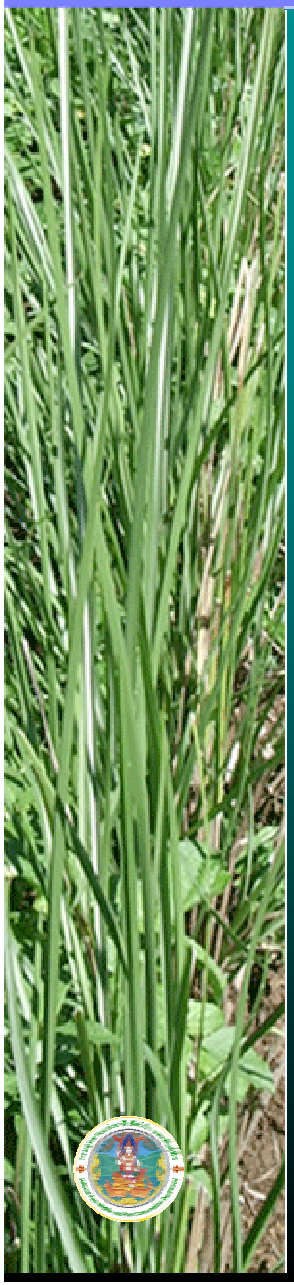
Component of the water balance equation at each site

Study sites		Rain-fall	Evapo-transpiration		Runoff		Δθ		Recharge	
sites	plots	(mm)	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)
Longan	control	1043.2	666.9	63.9	57.7	5.5	-30.0	-2.9	348.6	33.4
	+vetiver		697.7	66.9	34.2	3.3	-36.3	-3.5	347.7	33.3
Maize	control	967.4	404.7	41.8	125.3	12.9	139.4	14.4	298.0	30.8
	+vetiver		437.3	45.2	55.2	5.7	116.9	12.1	357.9	37.0
Soybean	control	1242.2	408.1	32.9	38.9	3.1	-9.0	-0.7	804.2	64.7
	+vetiver		442.3	35.6	31.4	2.5	-29.4	-2.4	798.0	64.2

Recharge


Recharge (mm)
80
70
60
50
40
30
20
10
0
Longan
Soybean
Maize
control
+vetiver

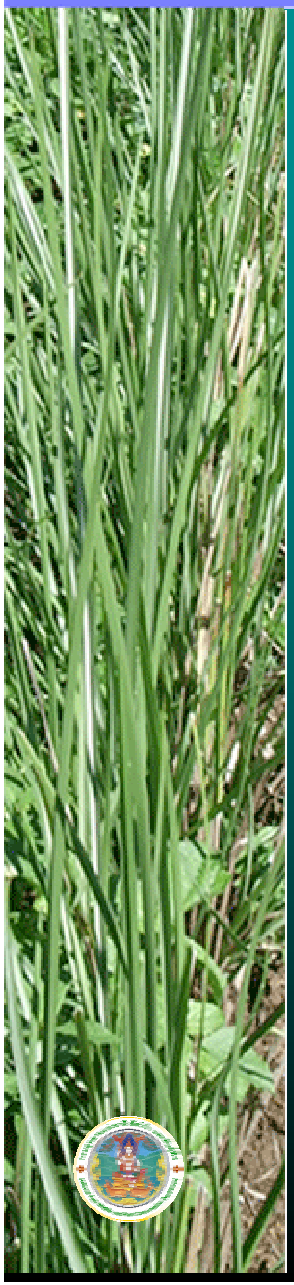
Conclusion



Vetiver hedgerows planted across cultivated slopes at Yom Watershed, Northern, Thailand were found to increase water stored in soil profile while reducing 19-56% of water loss by runoff.

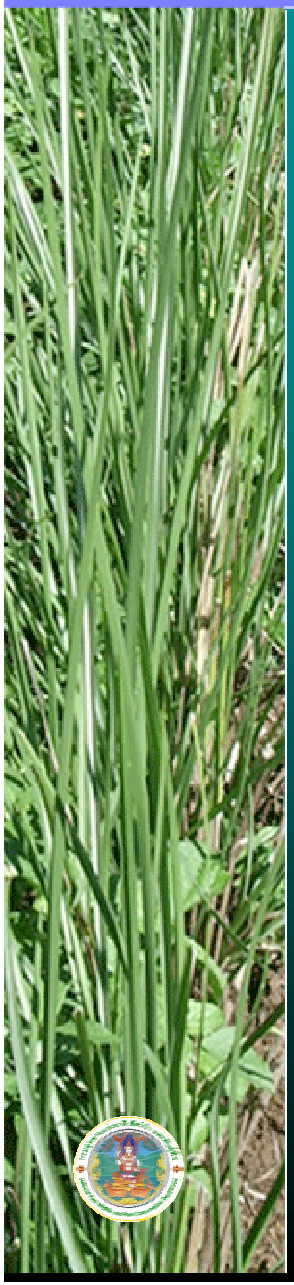
In the cropping season, the major proportion of rainfall amount was used by crops and evapotranspiration has greatly affected the water balance. Vetiver hedgerows acted as intercrops that withdrew more water compared to the sole crop. Thus, the water output as deep drainage was not obviously enhanced

Conclusion



The finding is brought to be the light conclusion that, with fine soils, low soil hydraulic conductivity, and high runoff, vetiver hedgerows could increase groundwater recharge up to 20 %.

Conclusion



Recommendation deriving from this study is that, within the headwaters areas which are normally high slope, vetiver hedgerows can be used as an effective conservation measures in agricultural practices. This may be an alternative way in watershed conservation that is similar to the function as provided by natural forest, helping watershed to store and provide water properly in quantity and timing.

Acknowledgement

- Chaipattana Foundation
- Office of the Royal Development Projects Board

Watershed Research Division,
Watershed Conservation and Management Office,
National Park, Wildlife and Plant Conservation Department
Bangkok, Thailand
bmuay@yahoo.com

สวัสดี