

HYDROLOGICAL CHARACTERISTIC STUDY OF MAEKLONG HEAD WATERSHED ON LAND USE CHANGES, KANCHANABURI PROVINCE, THAILAND

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Abstract

The hydrological characteristics of Mae Klong Head Watershed in response to land use changes was investigated at Linthin watershed, Kanchanaburi province, THAILAND. The hydro-meteorological and land use data were collected during 1994-2011. It was found that the average annual rainfall was 1,662.6 mm and 552.5 mm or 33.2% of this amount has become annual stream flow of which 73.5% of it occurred in the wet season and the remaining during the dry period. In 1992, forest covered 84.25% of the watershed and has increased to 92.48% in 2000 and to 97.27% in 2008. From an analysis of data, the annual flows as well as flows during wet period showed a decrease trend while those of the dry period showed an increase trend.

Key words: Streamflow, Discharge, Mixed deciduous forest, Linthin watershed

Introduction

At present, very large areas of the forest in the headwaters areas of THAILAND have been cleared due to the rapid increase in population which caused the increase in the needs of land for various purposes. In 1961, the total forest area of Thailand was about 27 million hectares covering over 53.3% of the country. Subsequently, forest areas were encroached and declined to 32.7% in 2010 (DNP, 2011; Ongprasert, 2012). The use of sloping lands for agricultural practices with no proper conservation techniques is increased. Severe soil erosion, water shortage and conflict in dry season and flash floods in the rainy season are among the serious consequences of the deforestation. One of the keys to solve the problem is forest rehabilitation in headwater areas. The better understanding of forest services is also needed, so we established the research project on the hydrological characteristics of Mae Klong Head Watershed in response to land use changes. The aims of the study are 1) to compare hydrological characteristics of Mae Klong Headwaters from the past to present, and 2) to study the relationship between hydrological characteristics and land use change in Mae Klong Headwaters.

Study Area and Methodology

Linthin watershed, a selected sub-watershed of Mae Klong headwaters, covering an area of 109 km², is located in Kanchanaburi Province in western Thailand approximately 250 km from Bangkok. Its elevation ranges from 140 to 1,046 m MSL with an average slope of 66 %. Its climate is classified by Koppen as Tropical Savanna (Aw).

It is underlain by the rock formation of Permian, Carboniferous and Devonian period. The soils are reddish brown lateritic with sandy clay loam to clay texture and A-Bt-C profile about 1.5 meters deep.

Its forest cover is of mixed deciduous type with bamboo. Some forest areas were encroached for cultivation and resettlement. Since 1998 it was bounded in National park and protected forest area, some disturbed areas were planted and some have natural succession. The forest area of the watershed tends to increase since then.

Data measurement

1. Climatic measurement; Rainfall, evaporation temperature, and relative humidity were recorded through an automatic weather station at Maeklong watershed research station operated throughout the study period(1994-2011).
2. Streamflow measurement; Chart recorder was established at Linthin Watershed outlet, and water level was measured and recorded automatically. The staff gage also installed at site and daily measured was recorded manually.
3. Landuse changes; The data of existinglanduse of the study period which divided in 3 phases; 1994-1999, 2000-2005 and 2006-2011, was obtained from the other co-project.
4. The meteorological and hydrological data during 1994-2011 were indentified and interpreted.

Results and discussion

Rainfall

The annual rainfall of Linthin Watershed was ranged from 1,250.6 to 1,937.9 mm with an average of 1,662.6 mm. An average number of rainy day was found to be 137 days of which 83 days (60.6%) and 42 days (30.7%) were found to have a record of rainfall less than 10 mm and 10-30 mm, respectively (Table 1). The wet period was from April to October and the rest of the year was dry period.

Table 1 Average daily rainfall at Linthin Watershed during April 1994 to March 2011

Rainfall amount (mm)	Rainy day (day)	% of total rainy days
<10	83	60.58
10-30	42	30.66
30-60	9	6.57
60-100	2	1.46
>100	1	0.73
	137	100

Stream flow

The annual stream flow of Linthin Watershed was found to be 60,185,277 m³ or 552,513 m³/km² or equivalent to 552.5 mm in height. It was accounted for 33.2 % of the total rainfall 73.5 % of the flow occurred in the wet period while the remaining flowed in the dry period.

The main stream of the watershed is a perennial stream. The flow rises slowly from April and then faster in June and July with the rainfall until it reaches its peak in September. At the end of rainy season, the flow starts to decrease until it reaches its minimum in March (Table 2).

Table 2 Stream flow of Linthin Watershed during wet and dry period

period	Month	Rainfall		Stream flow	
		(mm)	(%)	(mm)	(%)
Wet	April-October	1,553.1	93.4	405.9	73.5
Dry	November-March	109.5	6.6	146.6	26.5
total		1,662.6	100	552.5	100

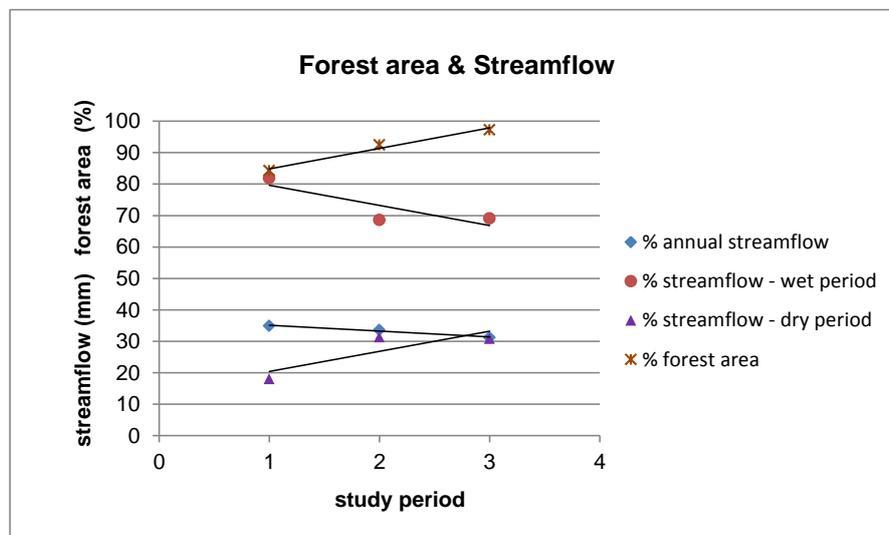
Landuse and streamflow

The forest area in the watershed during the three periods of 1994-1999, 2000-2005 and 2006-2011 has been increased from 84.25% of the total area to 92.48% and 97.27%, respectively (Table 3). The forest covers have been increased because of the seedlings of both pioneer species and native species growing in the patches of abandoned cultivated land as well as seedlings planted in forest plantation have been growing up.

The annual streamflow and streamflow during wet period tended to decrease from the first to the third phase, while those of dry period tended to increase (Figure 1). According to flow characteristics, it was found that 50% flow intervals tended to increase; they were 72 days at the first phase, 95 and 96 days in the second phase and the third phase, respectively. Increased forest area led to decrements in 5% and 1% intervals of the streamflow.

Table 3 Forest Area at Linthin Watershed during 1992-2008

Year	Forest Area		
	(ha)	(%)	(% increased)
1992	9,318.51	84.25	-
2000	10,228.92	92.48	8.23
2008	10,758.63	97.27	4.79

**Figure 1** Streamflow in response to forest area changes

Conclusion

The hydrological characteristics of Mae Klong Head Watershed in response to land use changes which was investigated at Linthin watershed, Kanchanaburi province, THAILAND during 1994-2011 shows that the increased forest area led to decrements in 5% and 1% intervals of the streamflow. The annual flows as well as flows during wet period showed a decrease trend while those of the dry period showed an increase trend.

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