5. Off-Site effect of soil erosion: A case study of the Mae Thang reservoir in northern Thailand.

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Abstract

The Management of Soil Erosion Consortium (MSEC) initiated a catchment scale study on soil erosion management in six countries in Asia, namely, Indonesia, Laos, Nepal, Philippines, Thailand and Vietnam. In Thailand, the study evaluates soil erosion in a small catchment within the Mae Thang watershed through detailed measurement at the micro-catchment scale and at a larger scale, through quantifying sediment accumulation in the Mae Thang reservoir.

Four sub-catchments were delineated in the 93-hectare catchment and equipped for hydrology and soil erosion studies. Rainfall, runoff and erosion data were collected for each sub-catchment and computed to obtain yearly means. The change in land use was assessed from field surveys in the experimental catchment and from satellite images for the whole watershed. The amount of accumulated sediments was determined by calculating the difference between the designed water storage volume of the reservoir and the storage volume obtained from a bathymetric survey undertaken in June 2002.

Observations in 2001 and 2002 indicated an annual sediment yield of as high as 26 $ha^{-1}yr^{-1}$. Variation in sediment yields among the different sub-catchments was attributed to land use and rainfall characteristics between years. Soil erosion calculated from the larger Mae Thang watershed by determining the sedimentation rate in the Mae Thang reservoir showed a much higher soil loss of 51 ha^{-1} yr^{-1}. This is rate of sediment discharge is significantly higher than the design estimate of 1.45 tha^{-1} yr^{-1} and a reservoir life span of over 100 years. Notwithstanding this, the estimated sediment discharged into the Mae Thang reservoir is similar to that that of Inthasothi *et al* (2000) using the USLE. Moreover, the study has shown a methodology which can further be refined to evaluate reservoir sedimentation and off-site effect of soil erosion.

Introduction

In late 1998, the Management of Soil Erosion Consortium (MSEC) initiated soil erosion management studies at a catchment scale in six countries in Asia, namely, Indonesia, Laos, Nepal, Philippines, Thailand and Vietnam. One objective of the project is to quantify and evaluate the biophysical, environmental, and socioeconomic effects of soil erosion, both on- and off-site (Maglinao *et al*, 2001). In addition to decreased on-site productivity, it is recognized that soil erosion leads to off-site consequences including flooding, decreases in groundwater recharge, and sedimentation and pollution of rivers and reservoirs by nutrients and pesticides. The sedimentation of reservoirs also reduces their life and irrigated service areas (Chanson and James, 1998).

In Thailand, the MSEC study site is located within the Mae Thang watershed in Phrae province, in the northern part of the country (Figure 1). The watershed covers an area of approximately 121 km^2 and drains to the Mae Thang reservoir constructed downstream (Figure 2). Construction of the dam was started in 1987 and completed in 1995. Selected specifications and characteristics of the Mae Thang dam and reservoir are presented in Table 1.

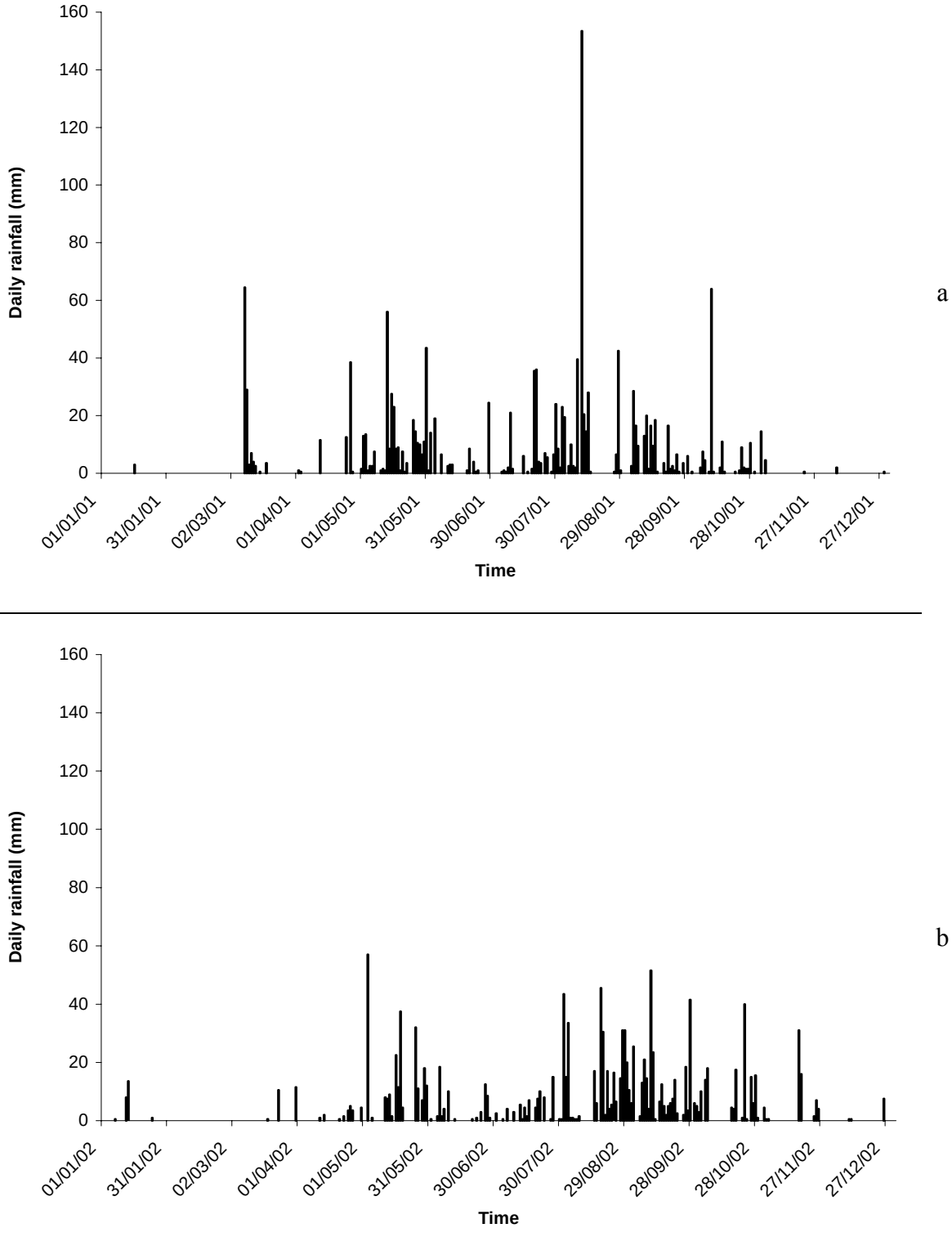
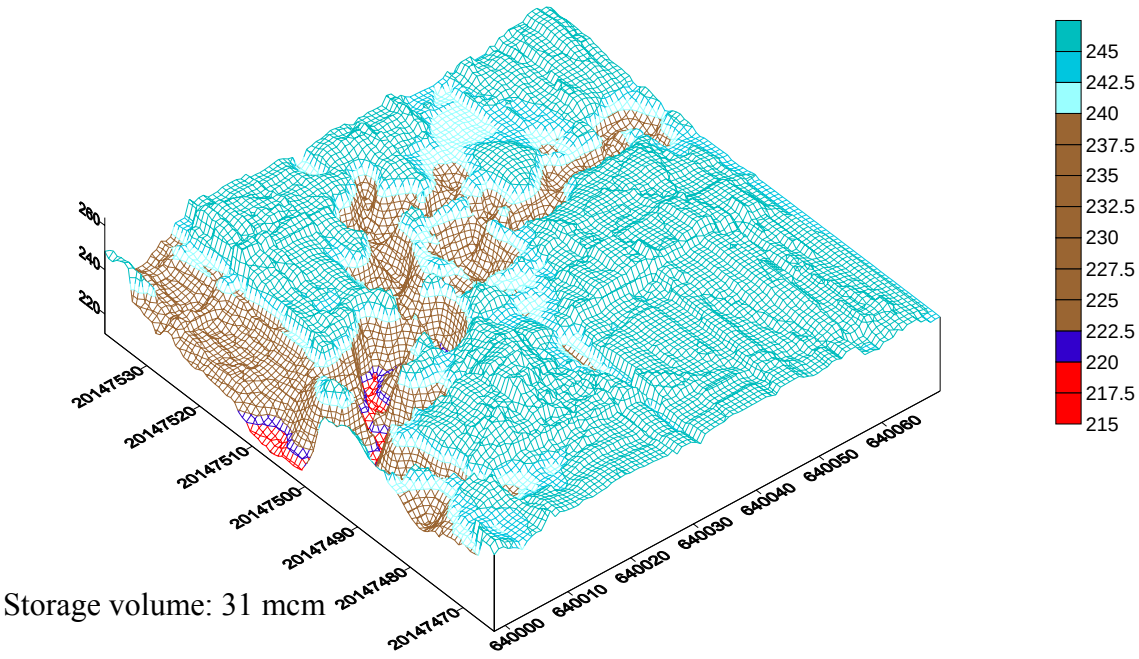
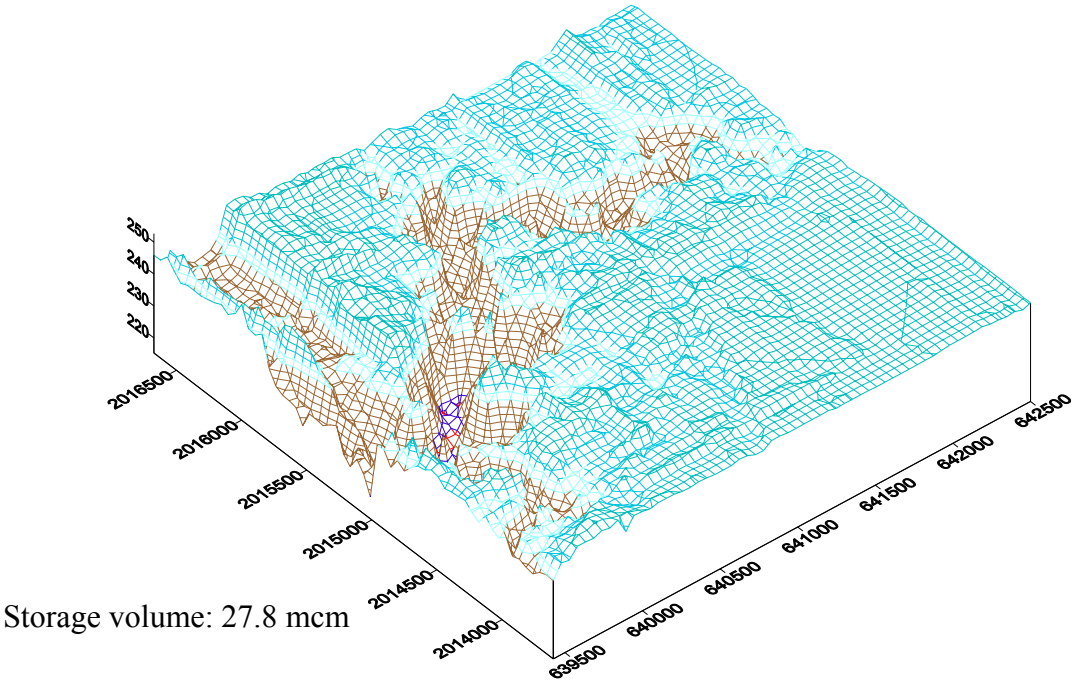


Figure 7. Daily rainfall in the catchment during 2001 (a) and 2002 (b)



Storage volume: 31 mcm



Storage volume: 27.8 mcm

Figure 8. Surfer diagram of the reservoir bottom in 1995 (above) and in 2002 (below)

Conclusion

In northern Thailand, the study evaluates soil erosion in a small catchment within the Mae Thang watershed by detailed measurements at the micro-catchment scale and on a larger scale, by determining the sediment accumulation in the Mae Thang reservoir. Observations in 2001 and 2002 show an annual sediment yield of as high as 26 $tha^{-1}yr^{-1}$. Variation in sediment yields among the different sub-catchments can be attributed to land use and to rainfall characteristics between years.

Table 4. Estimated erosion at different scale studies

	Royal Irrigation Department	**Inthasothi *et al* 2000**	**Survey June 2002 (7 years)**	**MSEC catchment (93.2 ha)**
Average soil loss ($t\ ha^{-1}\ yr^{-1}$)	1.45	50	51.2	26.4
At the catchment scale ($t\ yr^{-1}$)	17 585	605 000	620 000	321 860
Water storage volume lost ($m^3\ yr^{-1}$)	13 400	432 142	442 857	229 900
Expected life span (yr)	>100	72	70	>100

Surface area of the Mae Thang watershed = 12 100 ha
Reservoir storage volume = 31 000 000 m^3
Sediment density = 1.4 $t\ m^{-3}$

Soil erosion calculated from the larger Mae Thang watershed by determining the sedimentation rate in the Mae Thang reservoir showed a more serious situation. A soil loss of 51 $t\ ha^{-1}\ yr^{-1}$ will fill the dam with sediments in about 70 years. This is very high compared with the earlier estimate of 1.45 $t\ ha^{-1}\ yr^{-1}$ and a reservoir life span of over 100 years. Nevertheless, this figure is close to what have been estimated by Inthasothi *et al* (2000) using the USLE. Moreover, the study has shown a methodology which can further be refined to evaluate reservoir sedimentation. Chemical analysis of the sediments will likewise be useful in determining other off-site effects of soil erosion.

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