

THEME 7

SOCIAL IMPACTS/ RISK MANAGEMENT

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INTRODUCTION

Flooding has been recognized as one of the most popular and common damaging natural hazard faced by many countries. Sea level rise, intense cyclonic weather, precipitation, climate change predictions and urbanization encroachment into flood plains lead to increasing flooding threats globally including developed nations. The frequency, distribution and causes of the floods over the last three decades have been analyzed and the results reveal a five-fold increase in the number of floods per year.

Uses of satellite images, Remote Sensing (RS) and Geographic Information System (GIS) have made substantial contribution in flood mapping and assessment of flood damages significantly. This study will focus on remote sensing application with the help of GIS towards flood inundation mapping and flood protection measures based on the natural surface and geological features available in the vicinity.

Recording extreme events, with high return periods, by the installed gauges and equipments are also sometimes demanding. In the developing countries, the density of gauging stations is very low and thus any flood prediction or risk assessment model tested in the developed countries faces acute shortage of ground data when applied. Remote sensing is a reliable way of providing synoptic coverage over a wide area in a very cost effective manner. It also overcomes the limitation of the ground stations to register data in an extreme hydrological event. In addition multi-date imageries equip the investigators with an additional tool for monitoring the change or reconstruct progress of a past flood.

This research covers firstly, the analysis of Landsat satellite images for identification of flood inundation, secondly the generation of runoff which contributes to the flood and finally potential geological features which may save water underground temporarily and the quantity of runoff which can be reduced by the identified potential geology of the area.

HIGHLIGHTS

The general objective of this research is collection of data for a identified flood event through mostly open sources, development of criteria to analyze the problem and proposing innovative solutions.

Specific objectives of the study are as follows:

- Identification of flood extent using Remote Sensing & GIS
- Flood Inundation Map using satellite imagery and determination of most flood prone basin
- Recognition of most runoff contributed sub catchments and estimation of runoff
- Identification and demarcation of potential karstic limestone geological features which may store or retain the flood water underground and evaluation of possible flood reduction by utilizing them

METHODOLOGY

The methodology has been built on three pillars : Digital Elevation Model (DEM), Remote Sensing (RS) and Hydrology. The data for the first two are from open sources while a combination of open source and

a mathematical model were used to obtain the data for the hydrological analysis.

The methodology is briefly explained using a flow chart shown in Figure 1.

RESULTS

Drainage network was derived using DEM obtained from Shuttle Radar Topography Mission (SRTM). SRTM Digital Elevation Model tiles to cover the whole country were mosaiced and sinks were filled to get the flow directions and then flow accumulation. The drainage network and the consequent delineation of catchments derived are shown in the Figure 3.

Results of the Landsat ETM+ satellite image analysis with the band composite shown in the Table 1 exhibit the flooded area in the Figure 4.

As a result of the flood inundation map it is clear that, the most of the flood affected areas fall under Chao Phraya River Basin (CPRB).

Simple Water Balance equation was applied to the upper catchment of CPRB to calculate the runoff.

The landsat 7 ETM+ images were analyzed to view the soil and geological features areas and compared with the geological map. In addition, the drainage network was reviewed for any interpretation of underlying geology of the region. The comparison is shown in Figure 5.

CONCLUSION

The results clearly show that Chao Phraya river basin is the most flood prone catchment in Thailand. According to the catchment delineation the area of Chao Phraya river basin is 156,432 km² which is almost one third land area of the country.

As a case study, the 2011 catastrophic flood event analysis reveals that 74 % of the runoff is generated during the months of August and September and 66% of the total runoff is contributed by the Yom and Nan basins which are the two upper right basins of CPRB.

This study focused on natural geology of the region for utilization as flood protection measures. There are few potential limestone regions found in the upper catchments. The area-wise limestone availability is 7.6% of the upper catchments. In addition, the location of these features is away from the higher runoff generated areas. Due to these facts, there is no significant contributions by the available geological features towards flood protection.



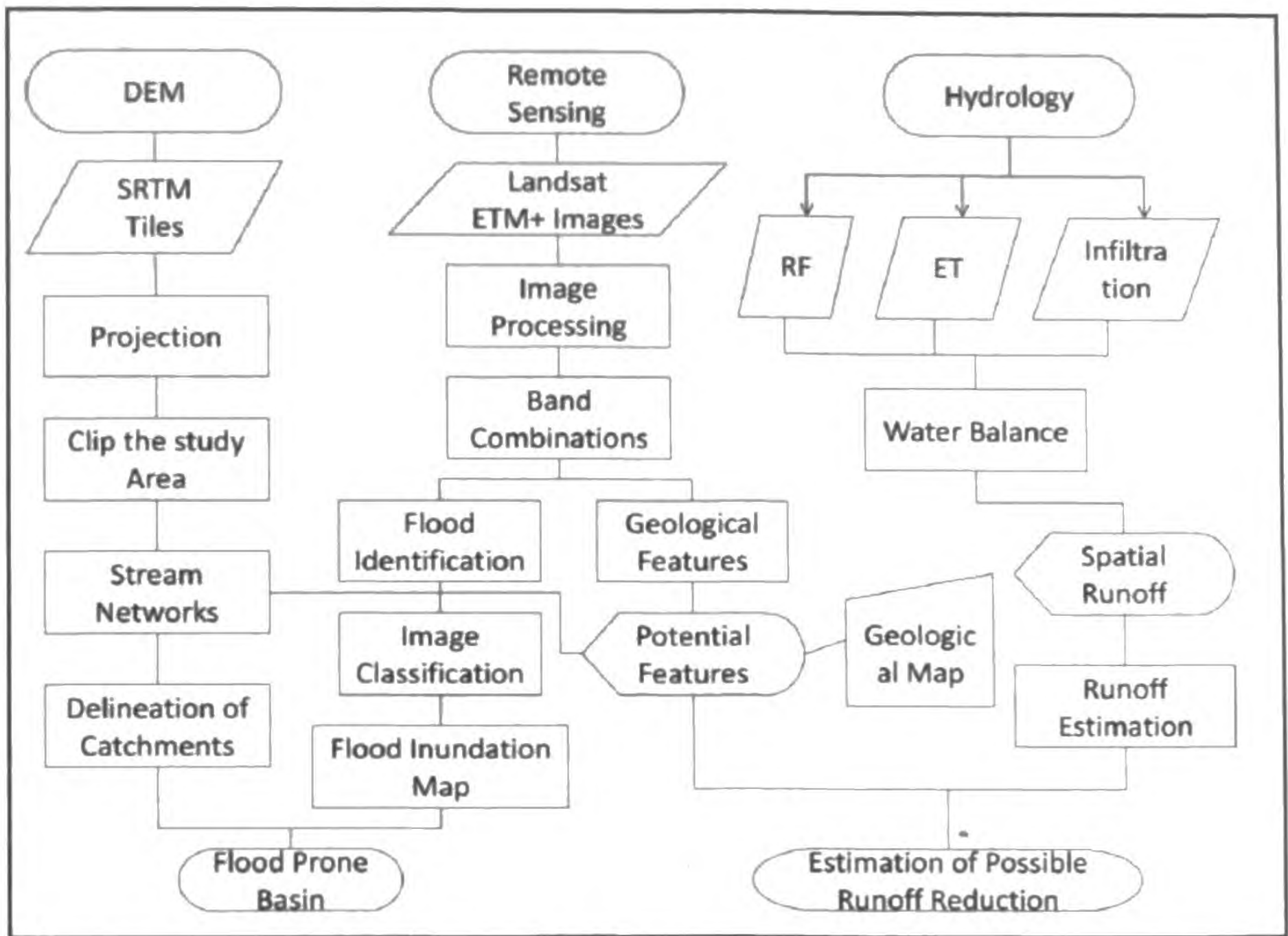


Figure 1: Flow Chart describing the process of Methodology

The Water Balance was applied to the upper catchment of CPRB

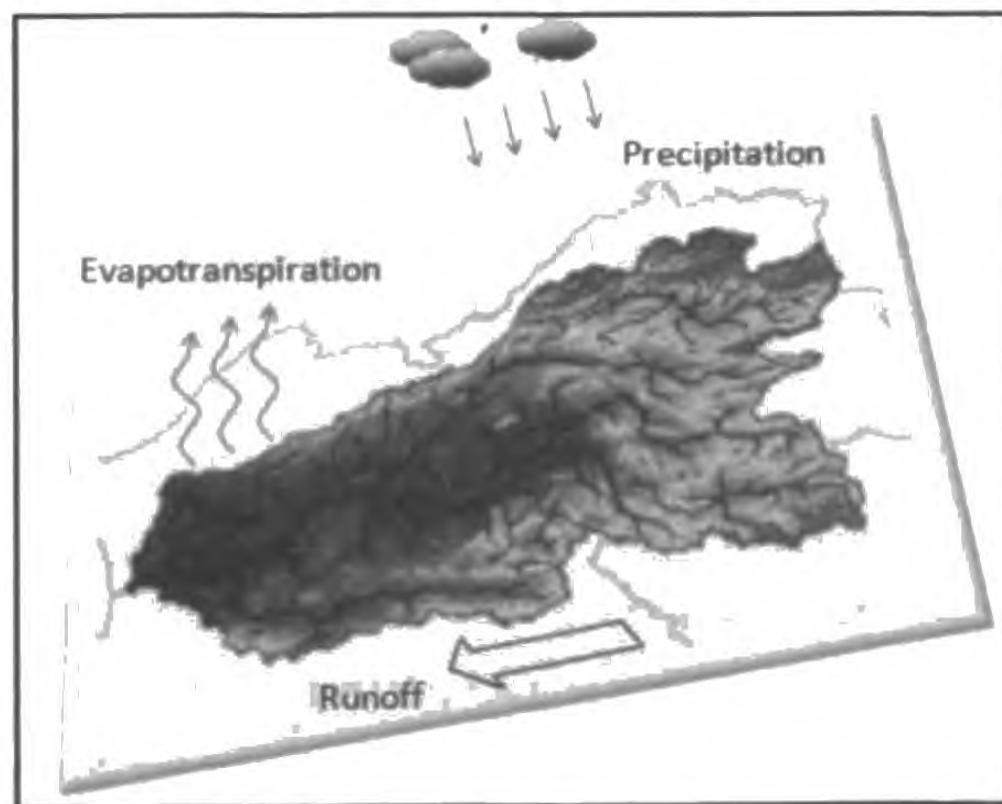


Figure 2: Water Balance

Simple Water Balance Equation:

$$Q_i = P - ET - I$$

Equation(1)

Infiltration Model used:

$$I = B_0 e^{-cT} \text{ for } T = 0$$

$$I = A + B e^{-c(T-1)} \text{ for } T > 0, (T \in \mathbb{Z})$$

Equation(2)

The Drainage Network and the Catchment delineation are shown in the following figure.

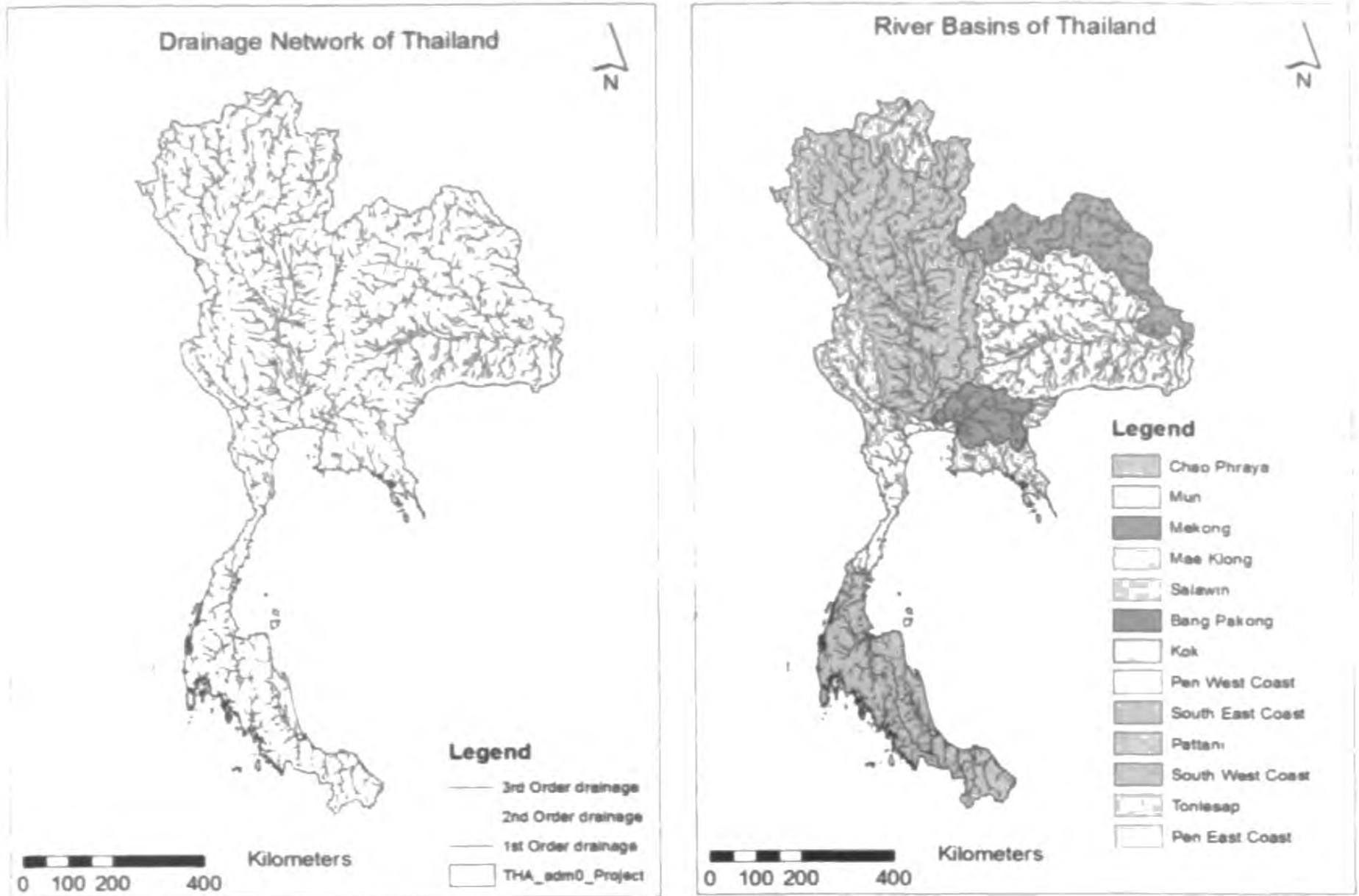


Figure 3: Drainage Network & Watersheds

The Band composite for Red Green and Blue (RGB) used for Landsat 7 ETM+ satellite images were as follows:

Table 1: RGB Band composite for flood inundation

Landsat ETM+ Band	Wave length (μm)	Band Composite
Band 4	0.77 - 0.90	R
Band 5	1.55 - 1.75	G
Band 3	0.63 - 0.69	B

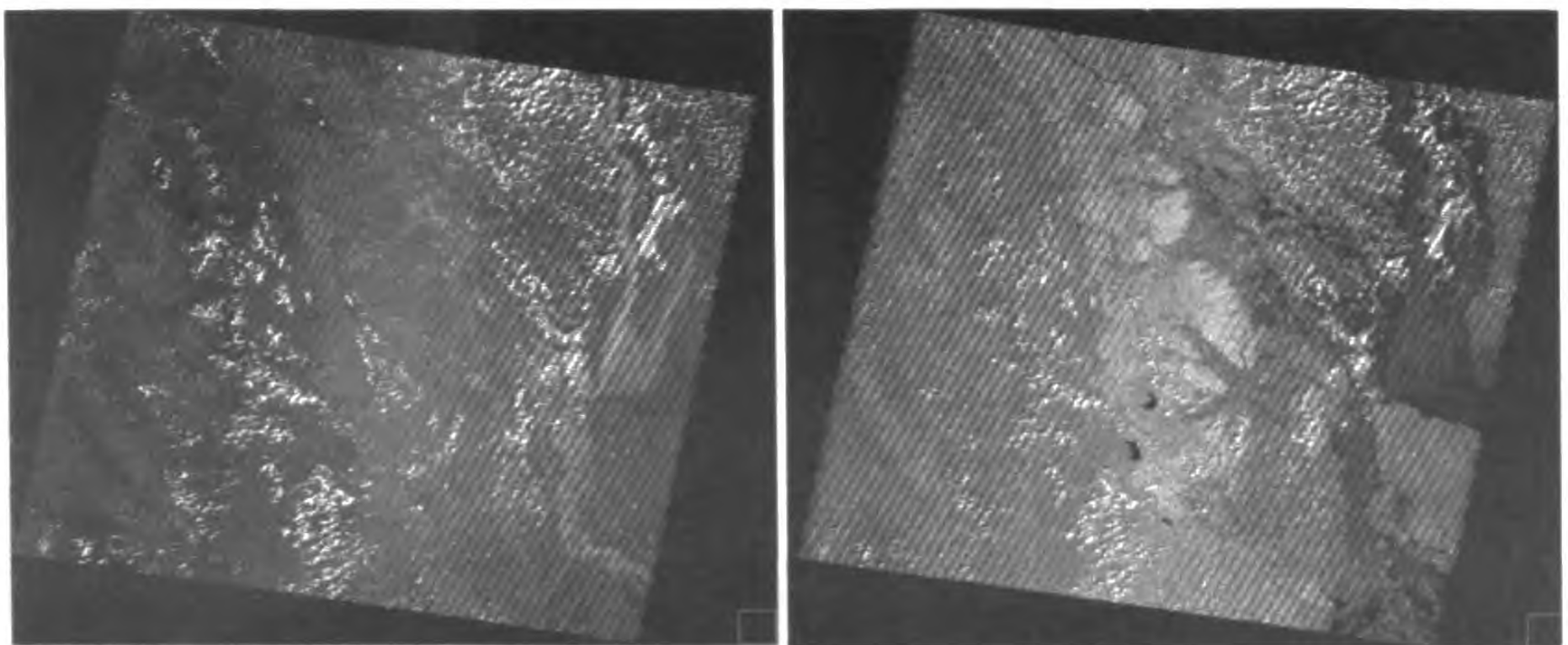


Figure 4: True colour and RGB: 453 band combinations of same satellite image

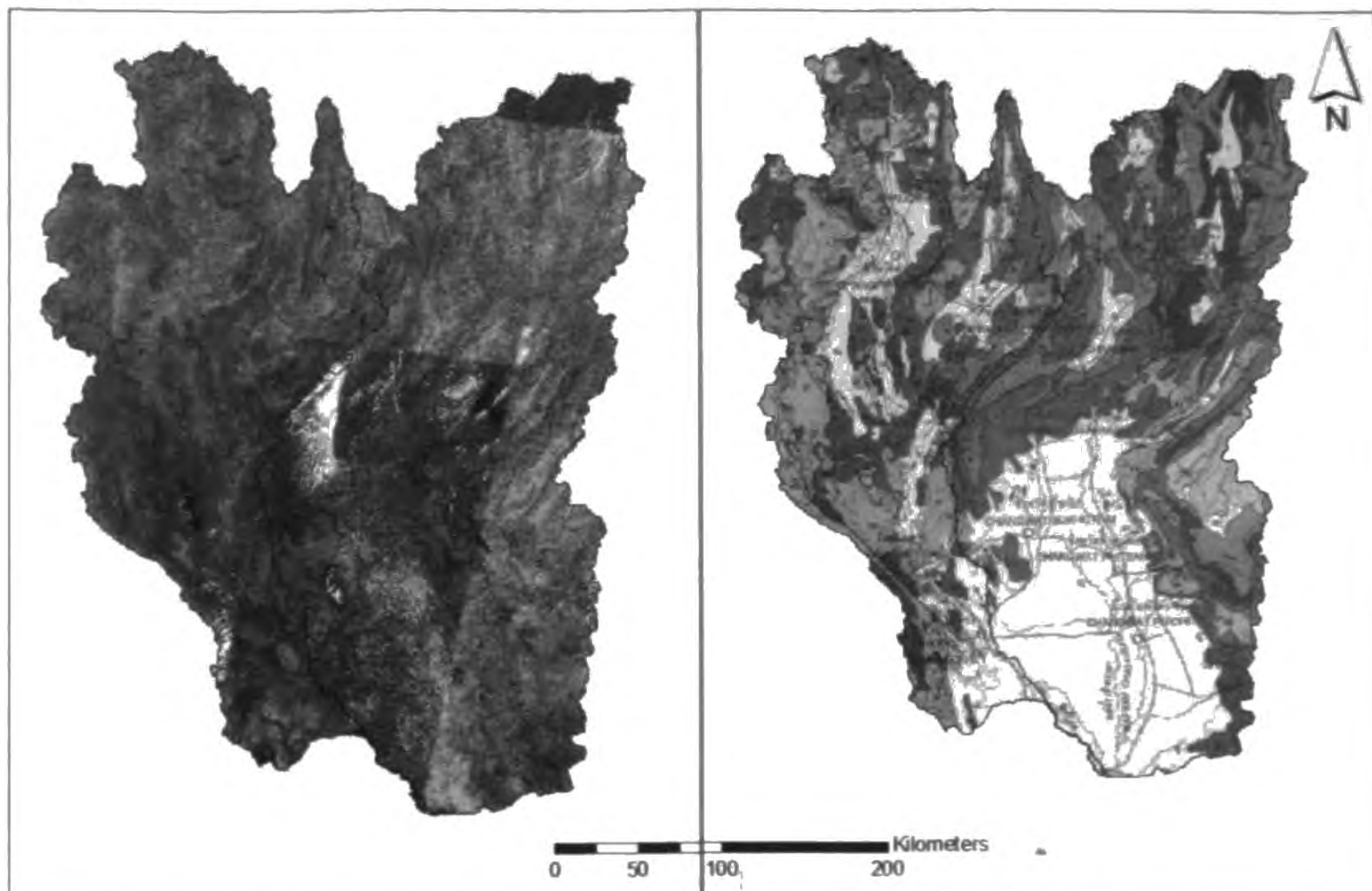


Figure 5: Landsat ETM+ image with RGB:742 band combination and geological map of upper catchments

Possible runoff reduction scenarios

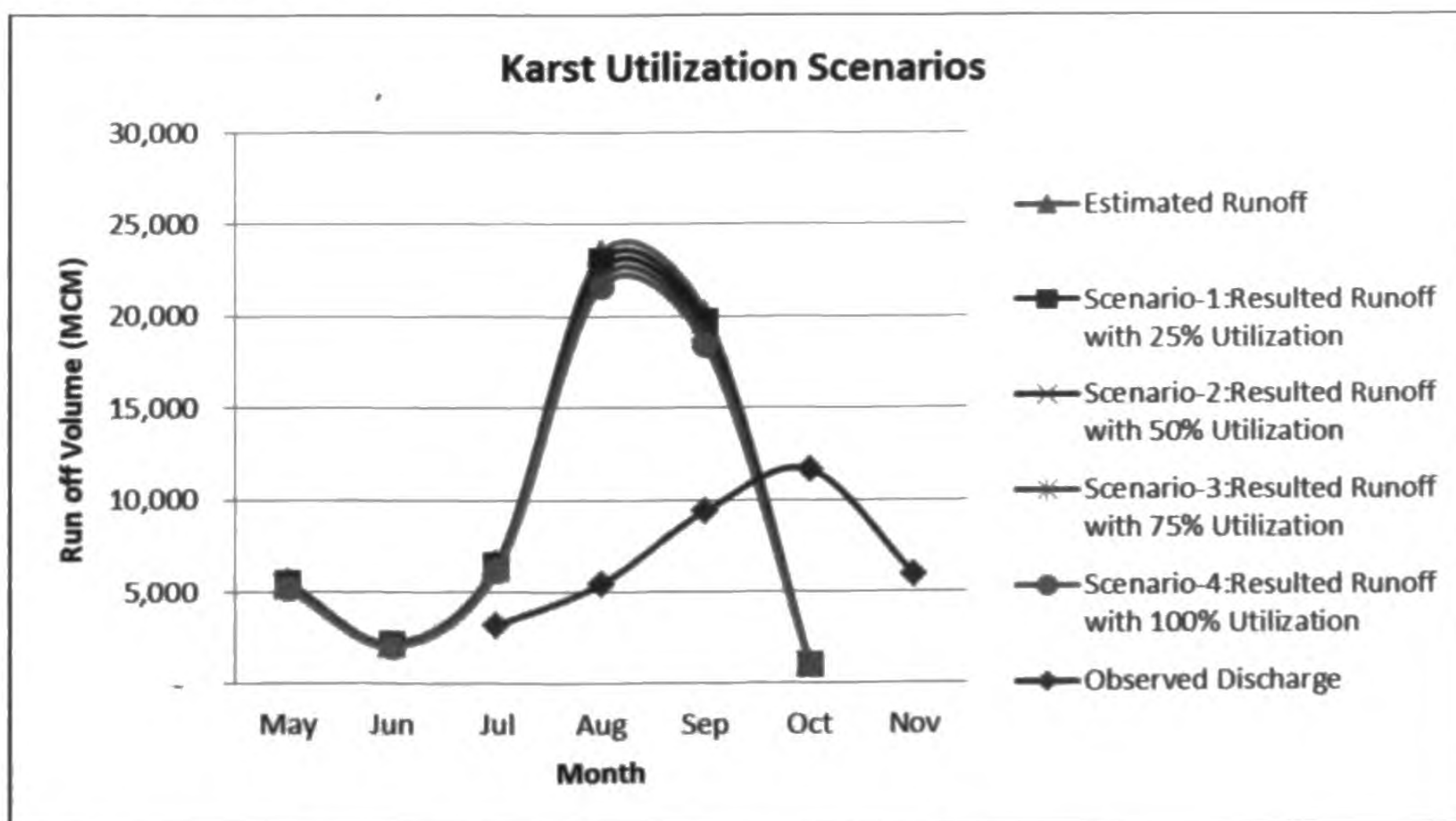


Figure 6: Possible runoff reductions using limestone karst utilization