CHAPTER ONE

INTRODUCTION

1.1 STATEMENT OF PROBLEM

The Cameron Highlands Hydroelectric Scheme has four small run-of-river power stations and one regulated run-of-river power station (Jor station). The daily energy generation of the four small power stations is generally dependent upon the daily streamflow. The intake of each of the run-of-river stations is designed to draw in river flow up to a certain discharge rate and to have any extra flow to be spilled over the intake weir. The regulated run-of-river Jor station has a small storage reservoir (Ringlet reservoir) upstream of its intake making possible daily and weekly regulation of the inflow for peaking operation.

Land use activities in the Cameron Highlands area have resulted in accelerated soil erosion process and an increase in stream sediment load. The adopted operation practice for the run-of-river stations in Cameron Highlands is to reject and not to draw in streamflow which is heavily silted so as to minimise damage to the mechanical components of the generating unit. The sediment load in the streamflow in Cameron Highlands is usually high after a rainstorm event. This results in river water not being diverted to the power stations for power generation. Moreover, spillings of water over the intake weir of the run-of-river stations are noted to be increasingly frequent during the raining season.

1.2 AIMS AND OBJECTIVES OF STUDY

The main aim of the study is to examine and assess the impacts of land use changes on hydroelectric power generation in Cameron Highlands. The study has the following objectives.

- To examine growth of the land use activities in the Cameron Highlands area during the period 1964 to 1998 in term of increase in acreage of development
- To examine effects of the land use changes on annual runoff of Sungai Telom and Sungai Bertam
- To examine effects of the land use changes on suspended sediment load in the rivers in the hydroelectric catchment.
- To examine effects of the increase in suspended sediment load and the change in river runoff (as a result of land use changes) on annual energy output of hydro stations in Cameron Highlands.

This study is one of the five sub-studies of a research project jointly carried out by the Institute of Postgraduate Studies and Research of the University of Malaya, TNB Research Sdn. Bhd. and TNB Engineers Sdn. Bhd. to develop a Hydroelectric Catchment Management Information System for the Cameron Highlandss-Batang Padang Hydroelectric Scheme. The five sub-studies are shown in the appendix.

1.3 BASIS FOR STUDY

The study considered that the changing land use in the Cameron Highlands catchment would not result in significant change to the amount of rainfall distribution within the catchment. However land use change and rainfall together

would have significant impact on the streamflow and the stream sediment load of Sungai Telom and Sungai Bertam. The relation between annual river runoff and annual rainfall and the relation between streamflow and stream suspended sediment load would be affected by the change in land use. The annual runoff/annual rainfall correlation and the streamflow/suspended sediment concentration correlation would hence give different results at different periods of time of the land use change.

The operation/generation of the power stations of Cameron Highlands Hydroelectric Scheme is wholely dependent on the streamflow of Sungai Telom (including flow diverted from Sungai Plau'ur) and Sungai Bertam. The alteration of streamflow and stream sediment load caused by the land use change would therefore affect energy generation of the power stations. The relationship between the annual generation output and the annual mean streamflow/runoff for a power station would thus be affected and would periodically vary due to the change in land use.

In ensuring minimum abrasive damage to the power station's turbines by sediment particles, the stream sediment content and concentration is often a decisive factor on the suitability of the stream water for use in the operation of the run-of-river stations in the Cameron Highlands scheme. A comparison of the trends in the land use, sediment load and energy output data would give indication of impact of the land use change on energy output.

1.4 SCOPE OF STUDY

The scope of study is briefly outlined as below:

a) To review pertinent studies, literatures, reports and other technical/research papers.

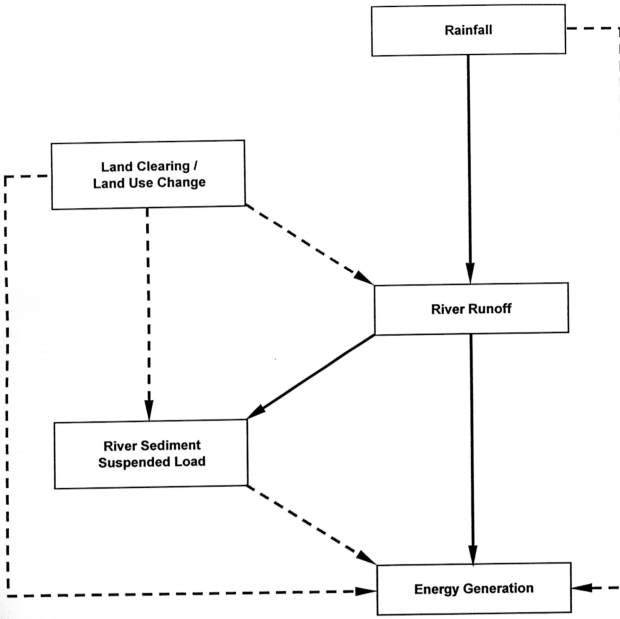
b) To collect the following data for the period between 1964 and 1998 from the relevant organisations/corporations.

- Land use data for the Cameron Highlands catchment
- Rainfall data for the Cameron Highlands catchment
- Streamflow data of Sungai Telom and Sungai Bertam
- Suspended sediment load data of Sungai Telom, Sungai Bertam, Sugnai Kial, Sungai Habu and Sungai Ringlet.
- Annual generation data of Robinson Falls, Habu and Sultan Yussuf (or Jor) Power station.

c) To compile, process and conduct analysis of data including:-

- Comparison of annual mean flow of Sungai Telom and that of Sungai Bertam at different time periods.
- Comparison of average suspended sediment load of Sungai Telom and that of Sungai Bertam at different time periods.
- Comparison of average annual energy output of Robinson Falls, Habu and Sultan Yussuf (Jor) Power Station at different time periods.
- Review of the trends in land use change, annual mean streamflow, stream suspended sediment load and power station's annual energy output.

Figure 1.1 shows a diagrammatic summary of the scope of the data analysis.



Note:

- - - - indicating impact but no correlation between variables

——— indicating impact with correlation between variables

Figure 1.1: Diagrammatic Summary Of Scope Of Data Analysis

1.5 ORGANISATION OF THE THESIS

In this thesis, the objective and the scope of the study are presented in Chapter One. A review of the literature in the field of interest and a description of the study area and the hydroelectric scheme are given in Chapter Two. The methods of study and data collection are described in Chapter Three. The land use change and its effects on mean runoff and suspended sediment are analysed and discussed in Chapter Four. The operational aspect and analysis of annual energy generation of Habu, Robinson Falls and Jor power station are presented in Chapter Five. The results of the analysis are also discussed. The implications of the future development proposed in the Cameron Highlands Structure Plan, issues of catchment management, mitigation measures, conclusion and some suggestions for future works are presented in Chapter Six.