CHAPTER 1

INTRODUCTION

1.1 Purpose and Scope

Every year, thousands of people all over the world are loosing their lives in natural disasters, which are quite costly to the world economy both in humilian affairs and in economical aspects. Natural disasters have major direct and indirect economic and socio-economic effects in addition to the physical destruction that may occur. Furthermore, the impact of these disasters are higher in developing countries than in developed countries due to the fact that the developed countries had already created disaster mitigation and disaster preparedness programs.

Disasters are natural hazard events in which a natural phenomenon or a combination of natural phenomena such as earthquakes, mass movements, floods, volcanic eruptions, tsunamis etc., can cause many loss of lives and damage to the property. Almost no portion of the earth’s surface is free from the impact of natural hazards. Due to increasing population densities and uncontrolled or not well-planned development, especially in developing countries, more and more people are affected by disasters. High precipitation, the deficiencies of infrastructure and lack of disaster plans and hazard maps are paid off by human lives in Turkey.

Disasters have both immediate and long-term implications. Plans formulated for disaster prone areas should therefore cover both these contingencies. It should also be remembered that a disaster might initiate a chain of severe hazards in addition to the direct impact damage.

Over the past two decades, many scientists have attempted to assess landslide hazards and produced maps portraying their spatial distribution. However, up till now there has been no general agreement on the methods or even on the scope of these investigations (Brabb, 1984, Carrara, 1983, 1989, 1993).

Despite the methodological and operational differences, all methods proposed are founded upon a single basic conceptual model. This model requires first the identification and mapping of a set of geological-geomorphological factors which are directly or indirectly correlated with slope instability. It then involves both an estimate of the relative contribution of these factors in generating slope failure, and the classification of the land surface into zones of different hazard degree (Carrara, 1993).

Experience gained from hundreds of surveys carried out in different parts of the world has demonstrated that well trained investigators are able to detect and correctly map many or most of the landslides occurring in an area by applying aerial-photograph interpretation techniques and systematic field checks (Rib and Liang, 1978). However, old, dormant landslide bodies, are generally intensively modified by farming activity or covered by dense vegetation and thus, they cannot be readily identified and correctly classified. This introduces a factor of uncertainty that cannot be readily evaluated and explicitly incorporated in the subsequent phases of the analysis, being largely dependent on the skill of the surveyor, and the quality and the scale of aerial photographs and base-maps used. There, onwards the power of spatial data manipulation and use of multivariate statistics in a GIS environment arouses.

A further step towards hazard zonation would require the identification of the conditions leading to the slope failure, their systematic and consistent mapping, and evaluation of their relative contributions to the mass movements in the area. In fact, the causes of each slope failure are many, complex and sometimes unknown. Conversely the geological - geomorphological factors, which are both relevant to the prediction of landslide hazard that are mappable at an effective cost over a wide region are not as many yet (Carrara, 1989).

All these methods have significant advantages and drawbacks. The main advantages of the geomorphological approach lie in the capability of a skilful surveyor to estimate actual and potential slope failure, taking into consideration a large number of factors detected in the field or on the aerial-photographs. In addition, local or unique slope instability conditions can be identified and assessed. The major drawback of the approach concerns the high subjectivity characterizing all phases of the geomorphological investigation. The degree of uncertainty associated to the different phases of the mapping operations cannot be evaluated. Likewise it is difficult or sometimes impossible to compare landslide hazard maps produced by different surveyors.

The purpose of this thesis is to generate and evaluate a concise system of landslide hazard assessment procedure. With the intention of this goal few assumptions are to be made such as, the rainfall and earthquake are considered as triggering factors at which the outcomes of the system proposed should be considered with these triggering events. Furthermore, due to the small size of the area the effects of both precipitation and earthquake will be uniform through the study area, due to this fact they are not considered for the analyses.

In landslide hazard analysis it is also aimed that, (a). data set should be easily accessible and simple; (b). the system should be objective; (c). the system should be data-driven with minimal expert interaction and (d). the system should be simple and be easily implemented and used by novice users

The studies are initiated with an extensive review of the previous works carried on Landslide Hazard Assessment, that is presented in Chapter 2. The definitions, methodologies, contributions of remote sensing and review of available models in geographic information systems are considered. The geology of Asarsuyu Catchment constitutes Chapter 3 which is involved in regional geological setting, identification of lithological units, the North Anatolian Fault Zone and the earthquakes of the region. Types of input data and data production stage are given in Chapter 4. Every single parameter map and the methodologies to create these maps are explained. A total 13 sets of parameter maps are produced and used. The foundations of landslide attribute databases are also created in this chapter. Following the data production stages landslide related databases are analyzed in detail in Chapter 5. The comparisons of polystats and fuzzystats databases in 4 different periods, investigation of photo-characteristics database and evaluation of the parameter map values of landslide databases constitute the major issues. The core of this thesis is formed by the investigation of the available and newly produced hazard assessment procedures, which are presented in Chapter 6. Finally the results are discussed and conclusions are given.

1.2. Geographical Setting

The study area is located in the northwestern part of Turkey, in the area between Bolu and Düzce cities (Figure 1.1). The area is geographically defined as the catchment of Asarsuyu stream (Figure 1.2). The extents of the coordinates of Asarsuyu Catchment is defined as 4520500 N, 351500 E in the northwestern edge and 4506750 N, 372500 E in the southeastern edge in Universal Transverse Mercator projection with 36 North zone in European 1950 Mean Datum by International 1909/1924 / Hayford 1910 ellipsoid. The catchment is covered with six 1:25.000 scale topographical maps, that are G26-a3, G26-b3, G26-b4, G26-c1, G26-c2 and G26-d2 sheets. The catchment has an ellipsoidal form extending in east-west, having a maximum length of approximately 20 kilometers and the approximate width is 10 kilometers, also covering approximately 200 square kilometers.

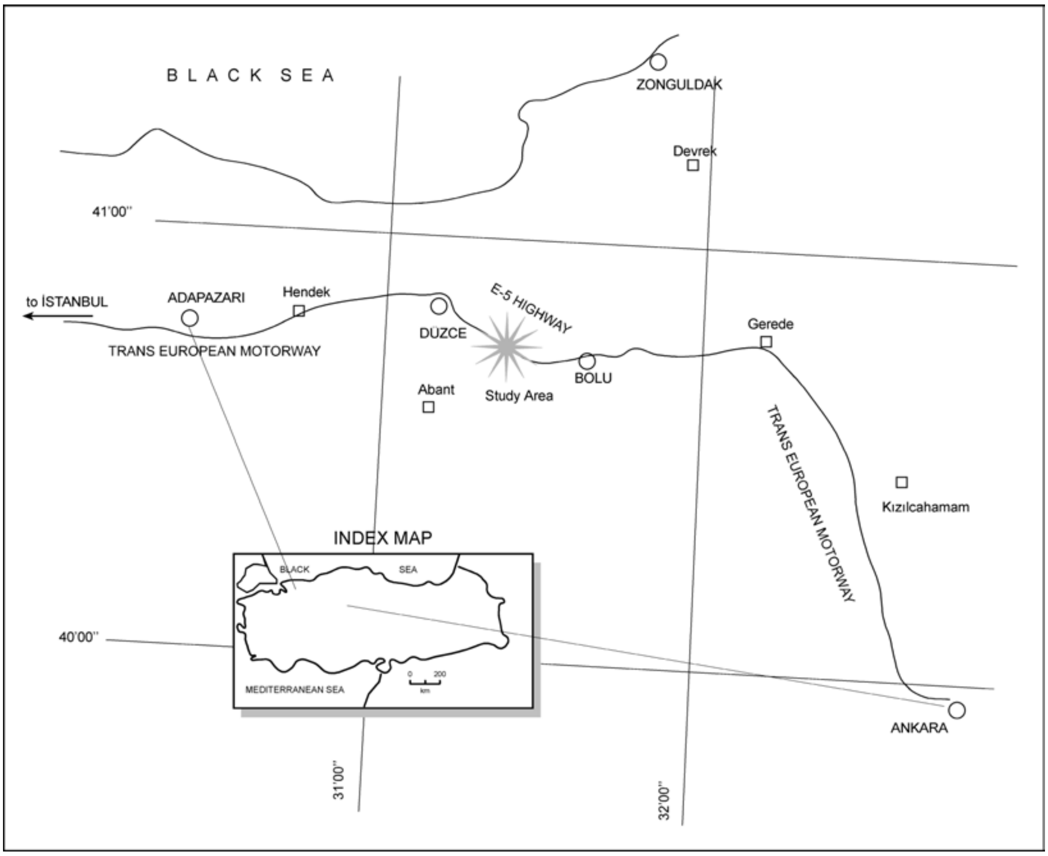

Figure 1.1. The geographic setting of the study area.

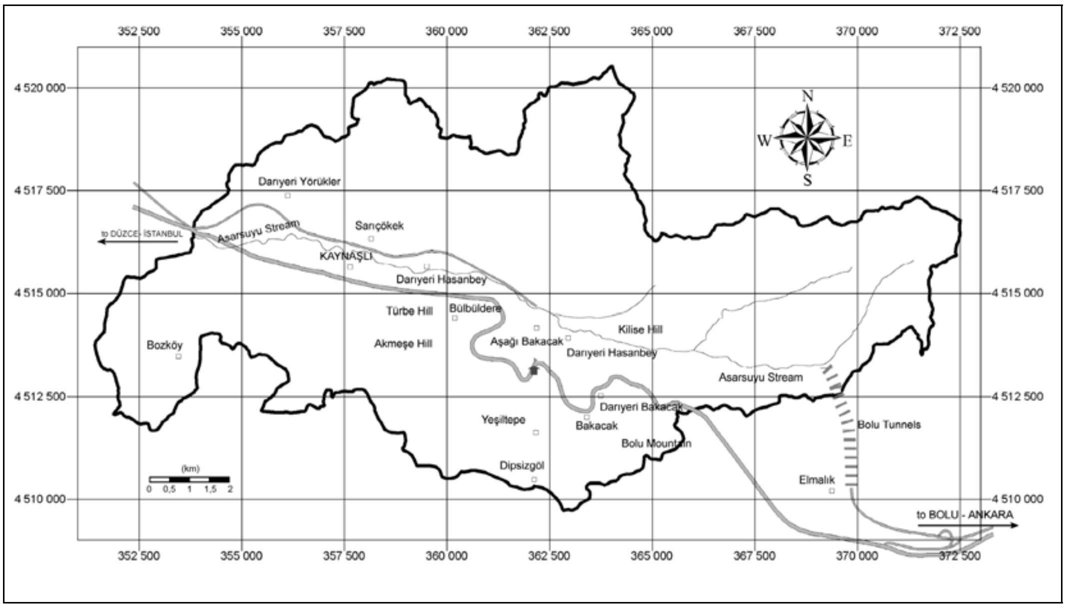

Figure 1.2. The outline of Asarsuyu catchment with important reference locations.