CHAPTER 1
INTRODUCTION

Fresh water is a vital but scarce resource. Protection of water resources from pollution is therefore of paramount importance in a global perspective, and is of significant societal and environmental concern. Water pollution originates either from point or non-point sources or from both. Point source pollutants enter water resources directly through a discrete pipe, ditch or other conveyance structures. Industrial and municipal discharges belong to this category. Non-point source pollution enters water bodies through runoff or leachate from rain or melting snow. Quantification and control of non-point sources pollution remain relatively difficult tasks as compared to those of "point" sources of pollution, because the pollutants have no obvious point of entry into receiving watercourses. In addition, non-point source emissions are typically stochastic (random) due to the impact of weather related and other environmental processes. Non-point source pollutants, irrespective of source, are transported overland and through the soil by rainwater and melting snow. These pollutants ultimately find their way into groundwater, wetlands, rivers and lakes and finally to oceans in the form of sediment and chemical loads carried by rivers. When sources of water pollution are enumerated, agriculture is listed as a major contributor, which is both cause and victim of pollution. The quest to meet the food demand of ever-increasing population dictates intensification of agricultural production through the application of irrigation, and agro-chemicals. Agro-chemicals (fertilizers and pesticides) are the non-point sources (NPS) or diffuse sources pollution, which are difficult to control unless quantified properly. Specifically agricultural areas have been recognized by the United States Environmental Protection Agency (EPA) as major national problem due to their highly polluted runoff (Browne, 1990). In India, the quality of water flowing in the streams is getting polluted due to improper and overdose application of fertilizers, pesticides, and herbicides. In this century water quality issues will continue to be of utmost concern, as good quality water becomes scarcer and human activities demand for fresh and clean water. In India, very limited research work has been carried out to quantify the water quality problem. Thus

the optimal management of fresh water resources with minimal adverse impact is essential for sustainable development and human survival.

In West Bengal, Basir Khal, which is a stream originating from Belpahari Block, augments the irrigation water supply to its command area. Its water is also used to cater to the need of surrounding urban and rural areas for domestic use besides supplying irrigation water to the command area. Therefore, assessment of quality and quantity of water available in the stream is of utmost importance. Faulty land management and agricultural practices in the catchment area cause high rate of soil erosion resulting in siltation of the stream and thereby reduction in the capacity. Highly polluted runoff water is released to this stream, which finally meets the Dulung river. Proper watershed management, which is a comprehensive term meaning the rational utilization of land and water resources for optimal crop production and minimum hazard to natural recourses could be the solution to all these problems. Accurate estimation of quantum and rate of runoff, sediment yield and nutrient loss are the key parameters for watershed management. In many instances non-availability of these data is a major handicap to start the watershed development programme.

Watershed is the unit of all planning and developmental activities at present. However, watershed being a geographically dynamic unit, its behavior (hydrologic and water quality) varies both spatially and temporarily. Hydrologic and water quality investigations are fundamental to any watershed management programme. Watershed-scale study is therefore necessary to develop management strategies for abating the agricultural NPS pollution. Accurate estimation of depth and rate of runoff, sediment and nutrient losses from remote and in accessible areas are tedious and time consuming by conventional methods. Therefore, it is desirable that for hydrologic evaluation of watersheds, some suitable methods and techniques are to be evolved to identify the areas within a watershed possessing greater potential for soil and nutrient losses and also quantifying these parameters from all parts of the watershed. So far no systematic work has been carried out to hydrologically evaluate the agricultural watersheds of eastern India, namely Kapagari and Simana watershed.

Due to unavailability of hydrologic data, a logical alternative is to estimate the hydrologic characteristics of a watershed by using geomorphologic characteristics. These geomorphologic parameters can be accurately estimated in a GIS environment in less time and in a cost effective manner. Therefore, it is planned to model the unit hydrograph parameters from geomorphologic characteristics of the study watersheds. Use of mathematical models for hydrologic evaluation of watersheds is the current trend and extraction of watershed parameters using remote sensing and geographic information system (GIS) in high-speed computers are aiding tools and techniques for it. Hydrologic/water quality models are among the best tools for analyzing water quality issues associated with land degradation by deforestation, urbanization, intensive agricultural activities etc. These models are economical, represent detailed hydrologic system, permit incorporation of spatially distributed information, represent detailed physical and biological processes and require modest empirical data gathering for calibration and validation. They also provide cost-effective means of determining best land management practices that minimize the water quality degradation on agricultural watersheds. Distributed parameter, deterministic models not only capture the physical-mathematical relationships necessary to simulate non-point source runoff, sediment and nutrient but also preserve the distribution of important spatially variable watershed characteristics. Annualized Agricultural Nonpoint Source pollution (AnnAGNPS) model (Cronshey and Theurer, 1998; Bingner and Theurer, 2003) is one such hydrologic, distributed, continuous simulation model used as a watershed analysis tool for evaluating non-point source pollution from agricultural watersheds. It is necessary to construct the database for AnnAGNPS model to simulate surface runoff, sediment and nutrient transport and evaluate the predictive capabilities of AnnAGNPS model. It is essential to identify areas in the watershed that are most susceptible to non-point source pollution. Thereafter, priorities should be fixed for the critical areas of the watershed that are more prone to pollution of surface water resources and best management practices (BMPs) should be adopted to minimize the surface water pollution from the agricultural watersheds.

Therefore, keeping the above facts in mind, the present study was undertaken to evaluate the efficacy of AnnAGNPS model for management of non-point source

pollution of surface water resources from agricultural watersheds of eastern region of India with the following objectives:

1. Development of synthetic unit hydrograph using watershed geomorphologic parameters extracted by RS and GIS.
2. Evaluation of suitability of distributed and composited curve number techniques for estimation of runoff.
3. Calibration, validation and sensitivity analysis of AnnAGNPS model for simulation of runoff, sediment yield and nutrient loss and prioritization of the critical areas of the watersheds on the basis of sediment yield and nutrient loss.
4. Development of an effective management strategy for critical areas of the watersheds for abating non-point source pollution of surface water resources.