The numerical modelling of runoff and groundwater recharge plays an important role in water resource management. The methodologies developed for these simulations should represent the key physical processes, and be applicable in a wide variety of climates for routine simulations using readily available field information. This paper describes the development of a Soil and Landuse based rainfall-runoff and recharge Model (SLiM) based on Rushton's method – a single soil layer groundwater recharge model, which was itself an improvement of the Food and Agriculture Organization of the United Nations (FAO) method. SLiM contains the concepts of the excess water of soil moisture deficit (the amount of water added to the soil system when soil becomes free draining) and the bypass runoff (a part of rainfall becomes overland runoff directly without infiltrating into soil when rainfall intensity is high enough). It is a simple method but can well represent both runoff and potential groundwater recharge processes based on the temporal and distributed soil moisture condition that is a function of the readily available catchment characteristics, such as rainfall, potential evapotranspiration, soil moisture condition, topography, soil types, crop types and growth, and the base flow index. Based on this method, a GIS code was developed to make it easy to be applied in a catchment. The case study in the Eden Valley, UK, shows that SLiM can estimate both runoff and recharge. SLiM is suitable for investigating the climate change landuse change on the runoff and recharge processes; it is transferable to other catchments in the temperate and semi-arid climates, and can be easily integrated into other environmental process-based models due to its simplicity.