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Original Research

Impact of climate change on sediment yield for Naran watershed, Pakistan

Farooq Azim [a,*], Abdul Sattar Shakir [b], Habib-ur-Rehman [c], Afshan Kanwal [d]

[a] Centre of Excellence in Water Resource Engineering (CEWRE), University of Engineering & Technology (UET), Lahore, Pakistan
[b] CEWRE, UET, Lahore, Pakistan
[c] Department of Civil Engineering, UET, Lahore, Pakistan
[d] Government College University, Lahore, Pakistan

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ABSTRACT

In this paper, the site-specific impact of climate change on sediment yield has been assessed for the Naran watershed, Pakistan. Observed data has been gathered for period 1961–2010 and HaDCM3 GCM predictors of SRES scenarios A2 and B2 have been downloaded. Future precipitation and temperature time series have been statistically downscaled for time horizon 2011–2040 and 2041–2070. Downscaled data show both increasing and decreasing changes with respect to the observation. Potential sediment yield for future related to climate change has been simulated. The results show that the both snowy and monsoon seasonal stream discharges are expected to increase. This will lead to increase in annual suspended sediment yields. Percentage-wise, a less discharge and more sediment yield are expected during the early summer. The study concluded that the climate change and variability are influencing the watershed, and suspended sediment yield is likely to increase in the future.

1. Introduction

Sediment yield, usually expressed as metric short tons (MST) per annum, is a weight of soil that passes through a stream with water at the outlet of a watershed. Million tons of sediment depart from watersheds every year, a significant portion deposit at the bottom of reservoirs and continuously reduce the water storage capacity (Chenaoui & Remini, 2014). Sediment discharge is sensitive to climate change and a range of human activities within its watershed. Studies have revealed that climate change could significantly affect soil erosion rates, streamflows and sediment yield (Michael et al., 2005; Shrestha et al., 2013). Zhang et al. (2014) have also evaluated future climate change impacts on hydrological and sediment transport processes for Cobres basin, Portugal and confirmed increasing concerns. Zhu et al. (2008) have assessed the change in sediment discharge from −0.7% to 13.7% as a result of changes in precipitation from −0.7% to 17.8% and temperature variation of 0.03–2.4 °C in the catchments.

Depending on various greenhouse gases (GHG) emissions scenarios, climate models estimate that the global mean atmospheric temperature will likely to rise 1.8–4.0 °C by end of this century (IPCC, 2007). While, IPCC has pointed out the significant potential impact of climate change is increased soil erosion rates and the amount of suspended sediment discharge in rivers. The actual response of suspended sediment discharge in a specific place varies because of physical characteristics of the watershed and human activities (Zhang & Nearing, 2005). Several climate change studies for the river basins have projected a likely increase in the basin's mean temperature and annual precipitation. Eastham et al. (2008) conducted a study to investigate the likely climate changes in the Mekong basin by the year 2030, and the results show an increase in the basin's mean temperature by 0.79 °C and a 13.5% increase in annual precipitation.

According to Walling (2008), for understanding the implications of future reservoir development, there is a need to evaluate the site-specific possible changes in the sediment loads and their effects. Past studies of impacts of potential climate change have generally focused on discharge (Hoanh et al., 2007; Kingston et al., 2011). The potential changes in stream sediment discharge should be seen as an important requirement for effective watershed management.

The aim of this research is to assess the impact of possible climate changes on the suspended sediment yield in Naran watershed. This paper focuses on evaluating the key climatic changes and to simulate the suspended sediment yield that originates through water erosion

* Corresponding author. Postal Address: House 57, Block H3, Wapda Town, Lahore, Pakistan. Tel.: +92 3344223810.
E-mail address: fac_2002@hotmail.com (F. Azim).

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from the watershed. Reliable predictions of the quantity and rate of runoff, and sediment transport from watersheds into rivers are needed to help decision makers in developing management plans for better soil and water conservation measures (Setegn et al., 2010).

2. Study area

The Naran watershed shown in Fig. 1 is located in the northern part of the KPK province of Pakistan. This watershed comprises of

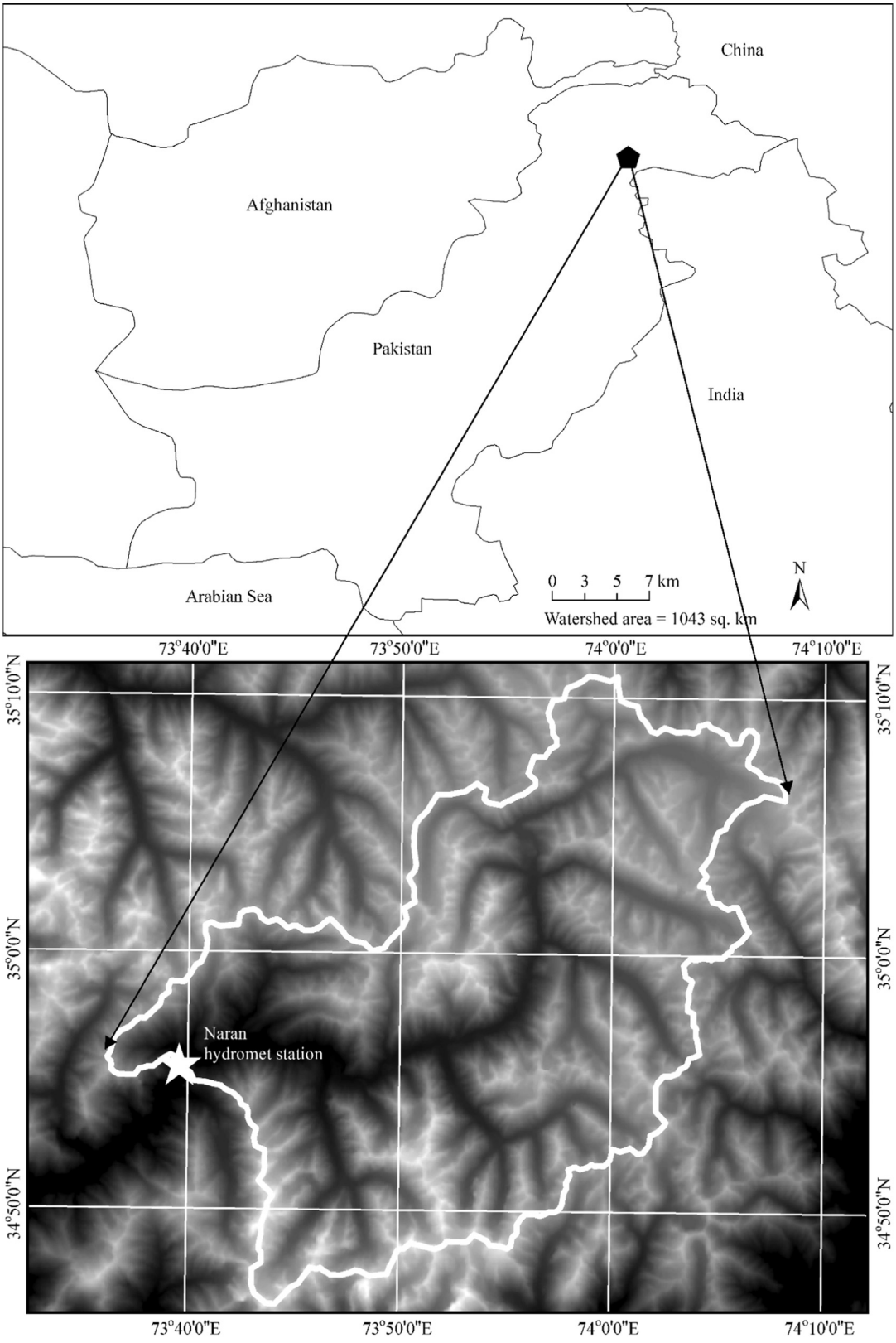

Fig. 1. Location map of Naran watershed, Pakistan.