



Socio-economic aspects of climate-soil-vegetation interactions in hydrological processes in the northeastern region of India

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The predominantly hilly northeastern region of India, having an area of 255, 090 km², is inhabited by various tribes. The region is endowed with rich water resources, but their indiscriminate use has rendered them in a fragile state. The region receives about 510 km³ of water as rainfall at an average of 2450 mm, annually. There are two major rivers viz. Brahmaputra and Barak, draining an area of 194.4 and 78.1 thousand km² with an annual runoff of 537.2 and 59.8 km³, respectively. The climate-soil-vegetation interactions in hydrological processes in the region are strongly influenced by the anthropogenic factors such as, shifting cultivation, land tenure system, small land holdings, free range grazing, urbanization and lack of finance. The total sediment yield from the region is 601 million tones of soil and 685, 99, 511, 22, 14, 57 and 43 thousand tones of N, P, K, Mn, Zn, Ca and Mg through runoff. The problem has been further aggravated by other socio-economic factors mentioned above. A long-term multidisciplinary study was undertaken on micro-watersheds on hill slopes varying from 32% to 48%. The land use systems were, livestock based (fodders and grasses), forestry, agriculture, horticulture and shifting cultivation. The results obtained showed that the groundwater recharge was 39.5%, 23.2%, 39.4%, 36.7% and 8.3% of the rainfall in above land use systems, respectively. There were significant interactional effect of land use and rainfall on the groundwater recharge. Groundwater recharge by rainfall depends on the infiltration rate, which is either downward or lateral. The vegetation type and density is mainly influenced by the amount of rainfall and human interven-

tions, besides other climatic factors such as temperature. Precipitation, vegetation and groundwater quantity and quality are interlinked. The low groundwater recharge in the shifting cultivation was due to minimum land cover. The mean values of base flow and surface flow were 104.6 mm and 31.0 mm in the new land use systems as against 241.7 mm and 560.1 mm in shifting cultivation. During the study, the rainfall varied from 1992 mm to 2770 mm per annum and the base flow, surface flow and groundwater recharge varied from 16.0 to 200.4 mm, 54.0 to 205.6 mm and 426 to 957 mm, respectively. The groundwater recharge was 21.4% of the precipitation during the year when the annual fall was 1992 mm and 34.6% when the rainfall was 2770 mm. Sediment transfer largely depended upon the relative influence of erosion by rainfall and flood events, and stabilization by vegetation.. The total sediment yields (soil and nutrients) from different micro-watersheds varied significantly and found to be influenced by soil, vegetation and precipitation. Maximum sediment yield was 36.2 t ha⁻¹ from shifting cultivation and minimum of 0.11 t ha⁻¹ in agriculture land use system. Highest sediment yield was found from shifting cultivation, followed by horticulture, forestry, grasses and agriculture land uses, respectively. Infiltration recharge is one of the main components of the groundwater balance, reflecting surface water conditions. So, the precipitation, soil and vegetation and their interactional effects play a great role in surface and base flows, infiltration and groundwater recharge.