World Academy of Science, Engineering and Technology
International Journal of Energy and Environmental Engineering
Vol:8, No:10, 2014

Assessment of the Effects of Water Harvesting Technology on Downstream Water Availability Using SWAT Model

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Abstract : In hydrological cycle there are many water-related human interventions that modify the natural systems. Rainwater harvesting is one such intervention that involves harnessing of water in the upstream. Water harvesting used in upstream prevents water runoff on downstream mainly disturbance on biodiversity and ecosystems. The main objectives of the study are to assess the effects of water harvesting technologies on downstream water availability in the Woreda. To address the above problem, SWAT model, cost-benefit ratio and optimal control approach was used to analyse the hydrological and socioeconomic impact and tradeoffs on water availability of the community, respectively. The downstream impacts of increasing water consumption in the upstream rain-fed areas of the Bilate and Shala Catchment are simulated using the semi-distributed SWAT model. The two land use scenarios tested at sub basin levels (1) conventional land use represents the current land use practice (Agri-CON) and (2) in-field rainwater harvesting (IRWH), improving soil water availability through rainwater harvesting land use scenario. The simulated water balance results showed that the highest peak mean monthly direct flow obtained from Agri-CON land use (127.1 m3/ha), followed by Agri-IRWH land use (11.5 mm) and LULC 2005 (90.1 m3/ha). The Agri-IRWH scenario reduced direct flow by 10% compared to Agri-CON and more groundwater flow contributed by Agri-IRWH (190 m3/ha) than Agri-CON (125 m3/ha). The overall result suggests that the water yield of the Woreda may not be negatively affected by the Agri-IRWH land use scenario. The technology in the Woreda benefited positively having an average benefit cost ratio of 4.2. Water harvesting for domestic use was not optimal that the value of the water per demand harvested was less than the amount of water needed. Storage tanks, series of check dams, gravel filled dams are an alternative solutions for water harvesting.

Keywords : water harvesting, SWAT model, land use scenario, Agri-CON, Agri-IRWH, trade off, benefit cost ratio
Conference Title : ICWRRED 2014 : International Conference on Water Resources and Renewable Energy Development
Conference Location : Paris, France
Conference Dates : October 30-31, 2014