Ain-Shams University
Faculty of Science, Geology Department

HYDROLOGIC ASSESSMENT OF WADI SUDR AND VICINITIES, SOUTH SINAI, EGYPT

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ABSTRACT

Wadi Sudr and vicinities includes three main Wadis in South Sinai running from northeast to southwest namely from north to south; Wadi Lahata (260 km^2), Wadi Sudr (743 km^2) and Wadi Wardan (1385 km^2). The study area is bounded by Longitudes 32°37'00" and 33°24'6"E and Latitudes 29°20'53" and 29°52'59"N. It is bounded in the east by Wadi El-Ariesh, in the west by the Gulf of Suez, in the north by Ayun Mousa area and by Wadi Gharandal in the south. The study area depends on groundwater as a main source for agricultural and other purposes.

The surface slopes generally towards the Suez Gulf. It is surrounded at the upstream part by a number of mountains representing the main watershed area receiving storms causing runoff. Its elevation ranges from 600m above mean sea level (in Gebel El Raha) to 916m above mean sea level (in Gebel Dahak). The sedimentary sequences are built of rock units belonging to geologic ages range from Upper Cretaceous to Quaternary. The study area is greatly influenced by several structural trends W-S, E-W, NW-SE and NNE-SSW comprising normal and reverse faults dipping 75°-85° E.

GIS techniques (by using ArcHydro Tool in ArcGIS-9.3 software) are used in the preset study to trace the basins boundaries, water divides, the drainage patterns and the morphometric parameters. The morphometric analysis and hazard degree calculations show that Wadi Wardan has highly hazard, while Wadi Sudr and Wadi Lahata are of moderately hazard. Sudr and Wardan basins are selected for simulation to explain the relationship between rainfall and runoff using **HEC-HMS** (**Hydrologic Engineering Center-Hydrologic Modeling System**). The synthetic hydrographs are constructed for both Sudr and Wardan basins, where the runoff volume of Sudr basin (743 km^2) is estimated by $2243.3x10^3$ Cubic meters, while it reaches $6260x10^3$ Cubic meters for Wardan basin ($1385km^2$). The maximum flow peak for Wadi Sudr basin reaches $95.3m^3/s$ with total excess rainfall is 3.97mm. While for Wardan basin the maximum flow peak reaches $251.1m^3/s$ and the total excess rainfall is 5.9mm.

Groundwater of the study area are available from three main aquifers belonging to Upper Cretaceous (fractured limestone), Miocene (sandstone and evaporites) and Quaternary (Wadi fill and deltaic deposits). They are mainly recharged by direct rainfall, infiltration from runoff water coming from the upstream eastern areas and the upward leakage from the deeper aquifers.

The main factors controlling the chemical characteristics, as well as its hydrogeochemical evolution are interpreted. 57 groundwater samples were collected in June 2014 for chemical analysis to determine the major and minor components.

Groundwater salinity changes widely from 1170 ppm to 14000 ppm, with an increase towards the west. The distribution of groundwater salinity is related to the well depth, distance from the shore line, absolute water level, depth of wells below the sea level and pumping rates. The higher rate of recharge in Wadi Wardan leads to less groundwater salinity, while in Wadi Lahata, where the rate of recharge is very low causing higher groundwater salinity. The temporal variation in salinity in the study area indicates an increase in the groundwater salinity -during the last 15 years- from 2000 ppm to 8500 ppm. It is attributed to over pumping and shortage of recharge by meteoric water. The geochemical classifications indicate that the chemical evolution of the groundwater from upstream to downstream areas is responsible for the change in the chemical characteristics of each aquifer. Sodium chloride (NaCl) and sodium sulfate (Na_2SO_4) are the dominant water types in the study area indicating the chemical impact of the marine and continental deposits, respectively. Most of the groundwater samples in the wells influenced by sea water intrusion. They are not recommended for irrigation under normal conditions. However, it is probably suitable for the salt tolerant crops under high permeable soils and proper irrigation management.

Isotopes analyses for ^{18}O and ^{2}H contents are carried out for selected nine groundwater samples. The groundwater samples are depleted in ^{2}H and ^{18}O to the Standard Mean Ocean Water (SMOW). They displayed an isotopic signature close to that of meteoric water with d-excess values (5.7 - 20.08 ‰) indicating present-day precipitation over the region. Moreover, the areal distribution of oxygen-18 and deuterium in the studied samples indicate that the central part of delta of Wadi Sudr has the highest depletion and surrounded by relative enriched values all the way around and toward the Gulf coast. This may reflect the evaporation effect on shallow water horizon.

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