ASSESSING THE POTENTIAL OF FLOODWATER HARVESTING IN SELECT AREA WADIS, SUDAN - USING REMOTE SENSING AND GIS

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ABSTRACT

This study focused on investigating the potential of floodwater harvesting from four ephemeral seasonal streams (wadis) in Select Area in the north of Khartoum State in Sudan. The area is subjected to severe flashfloods that resulted in huge damages in lives and properties. It aimed, in one hand, to estimate the potential runoff of the rainstorm events that could be impounded in some sites along the wadi course to prevent downstream population from the flash floods threats. And on the other hand, to site some locations that could be suitable to endow new environments for effective use of the floods waters by practising some kind of irrigated agriculture enhancement, as an example. GIS and Remote Sensing were used as assisting tools in calculating the watershed areas of the wadis and in assessing the potential sites for water harvesting systems.

INTRODUCTION

Water harvesting (WH), with its different types, is getting a new interest to be evaluated as a traditional water management experience in arid and semi-arid regions. This old technology is gaining new popularity from 1970s (Coombe and Hargreaves 1971, cited in Prinz et al. 2000). The expectation of the scale water exchanges in the coming decades brings GIS as an important and effective water resource. The growing researches in this area play a big role in the development of the technology for the achievement of better investments in the area. Water harvesting for dry-land agriculture is a traditional water management technology to store future water necessity in many and small wadis and regions of the world (Forst and Sangin 2003). In Sudan, the major part of all floods within the flood and wadis areas is related to the catastrophic storm rainfall which is the main source of the water harvesting. Rainwater harvesting was a support objective to face the threat of future water scarcity in many arid and semi-arid regions of the world (Prinz and Singh, 2000). In Sudanese watersheds, the Flash-flood is considered the most destructive impact of the flash floods at downstream areas and to give the alert to the flash floods risk areas (Al Weshah 2004).

The annual runoff of each wadi shows a potential of water volume that can be calculated, and it will be used in the water harvesting system (Fig. 4). The available data for the runoff volume estimation of each wadi were obtained from the records of the Wadi Runoff at Shambat station (the nearest meteorological station to the study area). The runoff in the seasons was divided into three categories: the first category includes the years 1988-1999 as rainy years with annual rainfall more than 130 mm, and the year 1990 as a dry year with annual rainfall less than 113 mm. The second category was the years 1990-1999 as rainy years with annual rainfall more than 130 mm, and the year 1990 as a dry year with annual rainfall less than 113 mm. The third category was the years 1988-1999 as rainy years with annual rainfall more than 130 mm, and the year 1990 as a dry year with annual rainfall less than 113 mm. The runoff was calculated by using the higher rainfall in each year, for each rainfall season.

The investigation about the water resources in the study area was dependent on the study area’s water resources. The investigation report was produced by the Sudanese General Electrification state 1995 for Khartoum water. They stated that the water resources are linked to the River Nile and to the underground resources. Four wadis are in the study area. The groundwater resources are linked only to the areas adjacent to the River Nile. The groundwater recharge from the River Nile is considered dominant (Prinz, 1996; Prinz and Singh, 2000).

MATERIALS AND METHODOLOGY

The following data and software were used in conducting the investigations of the study area:

- A Landsat TM image with resolution of 30 m for the year 2003, two contour maps with scale (1:100,000) geological and topographical maps with scale (1:50,000), and soil map with scale (1:50,000). In addition to the points of drainage, the drainage points are at the locations of the first echo of sound waves, the outcrop of the geologic units, and the ground water springs that can influence the water supply by affecting the pumping and the discharge of the water supply systems in the study area.

1. Water Volume Calculation

Fig. 4: The SRTM 90m DEM by CIAT representing the study area. The water volume carried by the wadis during the rainy season. The groundwater occurrence is significant in many parts of the study area. The investigation about the water resources in the study area was dependent on the models and procedures that could be used to develop the water harvesting system. The water harvesting system was developed using the ArcMap GIS software tool. The water harvesting system model was used for the drainage system and for the agricultural system. The model was developed using the ArcMap GIS software tool.

RESULTS

1. Localization of Potential Water Harvesting Sites

Fig. 5: The SRTM 90m DEM by CIAT showing the potential locations for water harvesting systems. The probability of occurrence (P) for each rainfall was calculated using the method recommended by FAO. The annual rainfall of the study area for the years 1991-1999 (1991: 395 mm, 1992: 362 mm, 1993: 297 mm, 1994: 287 mm, 1995: 317 mm, 1996: 340 mm, 1997: 390 mm, 1998: 320 mm, 1999: 260 mm).

The geospatial and RS investigations for the study area were done using geographical and RS investigations for the study area. Both methods were applied in the same procedure. The digital image classification, including data processing and analysis, was done in the ArcGIS GIS software tool.

CONCLUSION

The spatial distribution of the rainwater recharge by the geographic information system was used to derive the spatial distribution of the rainwater recharge by the geographic information system. The accurate and stable settlement around the new water points. A better settlement arrangement, including the water harvesting system, was achieved in the settlement arrangement, including the water harvesting system. The settlement arrangement included the water harvesting system, and it was used for the settlement arrangement, including the water harvesting system.

REFERENCES


Jeili town was the most susceptible area for floods in 1988, 1998 and 2001; it witnessed critical situations and losses of lives and houses. The last decade showed a trend of rainfall increment. Furthermore, the heavy floods are with small duration of rainfall during the rainy season as well as rainstorms with high intensity and short duration. The soil map shows that all the drainage points are within the stream bed (wadi bed) and near the drainage points.

Remote Sensing (RS) is defined as the measurement or acquisition of information of some property or phenomenon under study (WCA, 2005). The digital image classification, including data processing and analysis, was done in the ArcGIS GIS software tool.

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