Assessment of Rainwater Harvest Potential in Samaru Area of Zaria, Kaduna State, Nigeria, Using Geoinformation Technology

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Abstract

The water need of Samaru community for human and agricultural consumption is on the rise due to increase in population and human activities. At the moment, one of the problems hampering the attainment of food security in the country is the low level of irrigation. This is because, during the rainy season, water is usually in abundance while the reverse is the case during the dry season, with the consequence that all season farming cannot be practised. One of the strategies that could be used to ensure stable supply throughout the year for irrigation and domestic purposes is the installation of rainwater harvesting systems that can harvest rainwater from different layers/surfaces, and channel harvested water into storage facilities. This study therefore utilizes Geoinformation technology to demonstrate the rainwater harvesting capacity of Samaru Area, Google Earth Pro imagery was georeferenced and buildings (rooftops), roads and open space/ground were digitized. The area of each catchment was calculated using utility tool in Arc GIS 9.3software.These areas, together with their runoff potentials, annual rainfall data, were used to calculate the harvestable rainwater or volume of rainwater. The harvestable rainwater from the rooftops, roads and open spaces were estimated at 990,146.166 cubic metres, 129,586.486 cubic metres and 1,182,540.789 cubic metres respectively. The simulation for distribution of this harvested (stored) rainwater for domestic use was done using the rationing and the rapid depletion method. This volume of water can support a population of 74,770 (estimated) living in Samaru. It was finally concluded that the implementation of rainwater harvesting project in Samaru will be the best approach to surmount the scenario of water scarcity in all aspects, whether it is from the financial point of view or from optimum utilization of land surface. Therefore, water is a highly precious natural resource always high in demand in Samaru and thus, rainwater harvesting in Samaru is highly recommended.

Keywords: *Rainwater Harvesting (RWH), Rooftops, open spaces, Catchment area, and Runoff Coefficient*

1.0 Introduction and Background

Water is one of the most important natural resources and is vital for all living

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organisms and major ecosystems, as well as for human health, food production and the economic development of a nation. Due to increasing human population, the use of water for various purposes such as domestic, industrial development, hydropower generation, agriculture, recreation and environmental services has increased considerably over time.

Rainfall in most parts of Nigeria is confined to a few months in a year and maximum river flows occur during this period. During the dry months, the river flows dwindle to a fraction of their flows and some streams dry up altogether. During this period, the water becomes limited owing to adverse weather (e.g. evaporation from profound sunlight) and factors like exponential growth population, consumption habit of the population, extent of the land mass, industrialization, etc. Thus, the rate of drawing water from the water table is completely in excess of the rate at which the water table gets recharged by natural means (i.e. rainwater). As a result of this, the water table is decreasing drastically thereby leading to drying up of wells, boreholes, rivers, lakes and the likes. The rainy season flows cannot be fully utilized during that short period. Therefore, it is necessary to find ways of storing and recycling rainwater.

Rainwater harvesting(RWH) is the deliberate collection of rainwater from a surface known as catchment and its storage in physical structures or within soil profile. More precisely, Rainwater Harvesting can be defined as the process of concentrating rainfall as runoff from a larger catchment area to be used in a smaller target area Bakir and Xingnan (2008). Rainwater may be harvested from roofs, ground surfaces as well as from ephemeral watercourses. The different harvesting structures for rainwater and importance of rainwater are well documented in Gould (1992); (Gould and Nissen-Petersen, 1999; and ITDG (2010).

Rainwater harvesting systems are simple and can be adopted by individuals. They provide high quality water, soft and low in minerals, improve the quality of ground water through dilution when recharged to ground water, and reduces soil erosion in urban areas. Also, in saline or coastal areas, rainwater provides good quality water and, when recharged to ground water, it reduces salinity and also helps in maintaining balance between the fresh and saline water. In Islands, due to limited extent of freshwater aquifers, rainwater harvesting is the most preferred source of water for domestic use in the desert, where rainfall is low (Baker and Xingnan, 2008).

Different approaches have been adopted by numerous authors to demonstrate the potential of RWH using geospatially related technologies (Bakerand and Xingnan, 2008; Tripathi and Pandey, 2005; Sharman, 2010; and Munyao, 2010). Sharma (2010), estimated volume of rainwater harvested only for eight hostel areas in NIT campus in India. The volume was calculated using annual rainfall, runoff coefficients and catchment areas data. Catchment areas of the different hostels and institutional departments are measured. This measurement was done manually with the help of reinforced fibre tape which is the simplest technique known as "tape survey". For those places which were not accessible on land, area measurement was done by using the ruler from the toolbox of "Google Earth". Sharma (2010) used two methods of distribution of harvested rainwater (rapid depletion method and rationing method). Finally, the cost for construction of tank was calculated. Also, Munyao (2010) used GIS and remote sensing with primary data sets such as rainfall, runoff index, slope, landuse and landcover and the socioeconomic development of the area under consideration. ILWIS, a GIS software package, was used to derive all the key spatial layers that were used for various analyses.

Also, the Revolutionary Government of Zanzibar (2007) presented a report on the

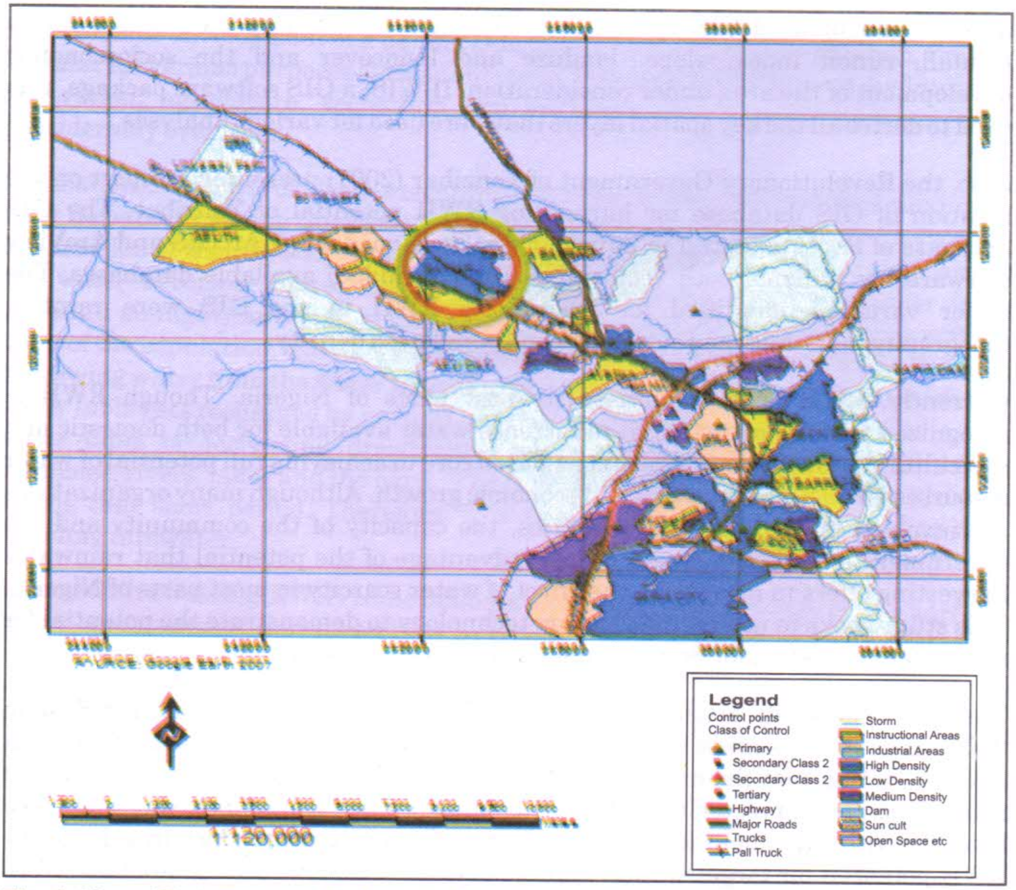

Fig. 1: Map of Zaria Province in Kaduna State, Nigeria (Samaru Area is depicted in coloured concentric circles)

2.0 Methodology

The execution of this study was carried out in four basic steps as shown in Fig. 2.

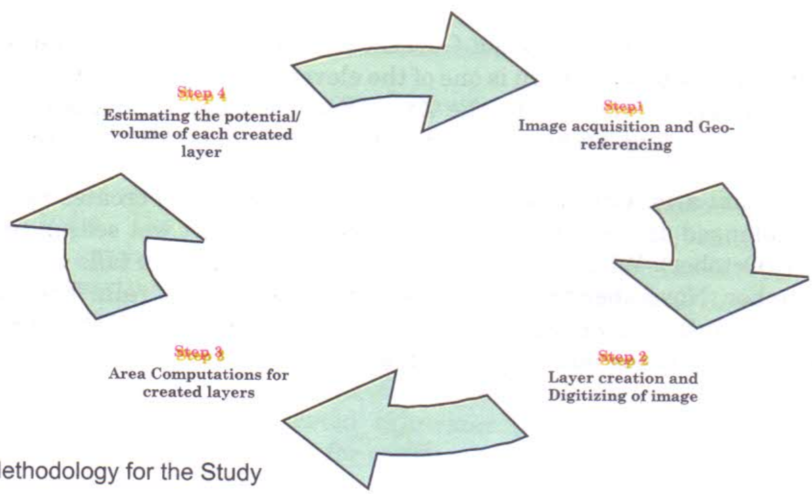

Fig. 2: Methodology for the Study