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# Relative performance evaluation of LiDAR and Cartosat DEMs for surface rainwater harvesting site identification

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**Abstract:** Surface rainwater harvesting (RWH) sites gather and store rainwater that otherwise would flow into the ocean. A variety of RWH structures are employed for this purpose. Identifying a site for an RWH structure is challenging, especially in inaccessible and forested areas. Poor selection of these sites leads to wastage of resources, besides the purpose remaining unfulfilled. The surface elevation data plays a critical role among various information commonly used to find suitable locations for RWH structures. Traditionally, low-resolution digital elevation models (DEMs) have been employed for this purpose. Light Detection and Ranging (LiDAR) elevation data, characterized by higher spatial resolution and accuracy even in the presence of vegetation are becoming widely available now, showing high potential for siting these structures.

This study compares the performance of LiDAR and traditionally employed low-resolution and low-accuracy DEMs (Cartosat DEM in this paper, also called CartoDEM) for siting surface RWH structures (viz Gabion and Check dam). We also analyse the effect of different LiDAR DEM resolutions on the accuracy of identifying RWH structures. An airborne LiDAR-derived DEM, originally in sub-meter resolution, is aggregated to 10-m and 30-m DEMs, which are then compared with 30-m CartoDEM for RWH siting. The criteria for selecting a RWH structure is based on the work done by Roy et.al (2022). Seven thematic layers, including runoff, lithology, soil type, geomorphology, land use, land cover, stream order, and slope, are integrated into the GIS environment using Analytical Hierarchy Process (AHP), a multi-criteria decision-making technique. A pairwise comparison is made between the seven layers and the relative weights are evaluated to prepare the suitability maps for Gabion and Check dam. The generated suitability maps at different resolutions are validated using manually identified on-ground locations across the study area.

It is observed that CartoDEM misses some stream pixels, where suitable sites for Gabion and Check dam may be located. In contrast, LiDAR-derived DEMs reproduce all stream pixels, thus minimizing the chance of missing a suitable site. In addition, the stream network derived from CartoDEM shows a noticeable offset (approximately 30 m) from the on-ground stream network, which is traced manually. The locations of suitable RWH sites, generated using DEMs, are compared with reference data containing 59 field locations. The LiDAR DEMs at 10-m and 30-m resolutions report an accuracy of 95% and 81%, respectively, whereas the CartoDEM has an accuracy of 39%. Besides the poor resolution and low vertical accuracy, the non-penetration capability of optical-imagery-based DEM (CartoDEM in the present paper) is also responsible for the inferior performance. The comparison highlights the shortcomings of the low-resolution DEMs and shows the potential of LiDAR DEMs for locating suitable RWH structures even in forested areas. The outcomes of this research have important implications for selecting suitable DEMs for identifying RWH sites, thus leading to saving resources and fulfilling the intended purpose.

## REFERENCES

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