Assessing the impact of farm ponds on agricultural resilience and economic outcomes: a drone-based analysis in Bandlapalle, Andhra Pradesh, India

Stutee Gupta*, Runjhun Chandra, Rajiv Kumar and M. A. Fyzee
National Remote Sensing Centre, Indian Space Research Organisation, Hyderabad 500 037, India

The present study uses drone-based survey to evaluate the effectiveness of farm ponds in Bandlapalle village. One hundred three farm ponds across 13.7 sq. km were mapped using high-resolution drone data. Pond boundaries were delineated from ortho-rectified images, and water storage capacities were calculated using surface area and depth derived from a digital elevation model (DEM). The results showed an average pond depth of 2.73 m and a total water storage capacity of 27,810.30 cubic metres. The cost–benefit analysis demonstrates farm ponds' economic advantages, with significant electricity cost reductions compared to tubewell irrigation. The stored water could irrigate approximately 25.03 ha of paddy and 62.72 ha of groundnut, resulting in an additional income of ₹500,600 for paddy and ₹1,034,880 for groundnut. The present study emphasises the value of integrating drone technology with geospatial tools for effective farm pond monitoring and management. It offers a scalable solution to improve water security and agricultural resilience in drought-prone regions, with important implications for watershed management policies and rural development programmes.

approximately 60% of the agricultural land is rainfed, farm ponds have become essential for improving water security in semi-arid and drought-prone regions. Studies in states like Maharashtra, Andhra Pradesh, and Telangana have shown that farm ponds significantly enhance crop productivity by providing supplementary irrigation during critical growth stages[5]. Several government initiatives have promoted the widespread adoption of farm ponds. These efforts aim to improve water availability for irrigation, increase farmers' income, and build resilience against climate variability[6].

Knowledge about the storage capacity and geometrical characteristics is crucial for a better understanding and managing water resources in the context of climate change[7]. Farm ponds face several technological and resource challenges that hinder their widespread study. Due to their small size, the hydrographical databases often fail to capture these ponds, and their impacts on watershed processes remain unclear[8]. Additionally, the lack of standardised global data and geospatial tools to assess the area and volume of these ponds further complicates large-scale analysis. Resource limitations, such as funding and policy focus, often prioritise larger water bodies or centralised irrigation systems, neglecting the potential of farm ponds to enhance local water management and agricultural produc-