

## Bangalore from above: An archaeological overview

Interpretations of imagery taken from aerial or space platform for archaeological purposes have been explored in many parts of the world. Their origin can be traced back to photographs taken from aerial platforms for military reconnaissance during both World Wars. The space platform is able to provide images with multi-spatial, spectral and temporal resolutions. However, it may be noted that much remains to be done to exploit the current capabilities of space imaging for archaeology.

It is often difficult to see an overall design in an archaeological site since many survive only in a ruinous state. Images taken from above give a synoptic view of the landscape, its geographical context and natural environment, and also factors that have preserved archaeological evidence. While observing from an elevated platform, scattered features come together as a unified whole and fragments acquire an identifiable pattern<sup>1</sup>.

This correspondence attempts to identify the layout of 18th century Bangalore and the ditch that once surrounded the Royal fortification, by analysing old maps and recent satellite imagery; thereby illustrating the effectiveness of perspective views in studying sites.

Kempe Gowda I, the founder of Bangalore, founded a township and raised a four-sided mud fort round it in AD 1537. He called the new fort Bengaluru Pete (Petē, pettah: Kannada 'town or city'). Bangalore was ruled by the Marathas in the 17th century and then briefly by the Mughals. In 1690, Chikka Deva Raja Wodeyar acquired this land and fortified it with an oval-shaped fort to the south of the Kempe Gowda fort. The oval fort was enlarged and built in stone in 1761 by Hyder Ali<sup>2</sup>. Cornwallis' army arrived in this area on 5 March 1791 and left in the summer of 1792. A map drawn by surveyors during that period marks a mud-walled town surrounded by a hedge and a ditch, and an egg-shaped stone fort to its south. Mathur and da Cunha have recalled the description of the hedge: the day before Cornwallis' army stormed Bangalore Pettah 'on 7 March 1791, route surveyors reconnoitred it, searching for ways to penetrate its "three-mile circumference" which was fortified with a lofty mud-wall, a thick hedge of bamboo, thorny bushes and prickly shrubs nearly a hundred yards wide, and a dry ditch'<sup>3</sup>. The

entire fortification is said to have been demolished during the days of the British Commission to accommodate the expanding old town<sup>2</sup>.

Survey of India map of Bangalore, one inch sheet 57 H/9 fifth edition (scale 1:63,360, surveyed 1911–12, 1924–25, 1st edn 1915, 5th edn 1945), was used as the base map. The IRS-P6 LISS-IV MX (date: 29 November 2003, spatial resolution: 5.8 m, spectral bands: green, red and NIR; Figure 1) image of Bangalore was registered to the base map. Plan of Bangalore (with attacks) taken by the English Army under the command of Rt. Hon'ble Earl Cornwallis, K. G., 22 March 1791 (original in British Library, reproduced in Mathur and Da Cunha<sup>3</sup>) was scanned and registered with the base map, with RMS error of 0.6 pixel. ERDAS software was used for data preparation and analysis. Common points between old maps and recent RS imagery had to be identified for registration. Road intersections were chosen since the overall layout of the grid within the town has hardly changed. A map of old Bangalore was prepared based on the 1791 map identifying all the important features (Figure 2). This map was overlaid on the satellite image. Traces of the remnants of old Bangalore and changes that have happened since then were analysed.

The hedge surrounding the town has long been replaced by the growing settle-

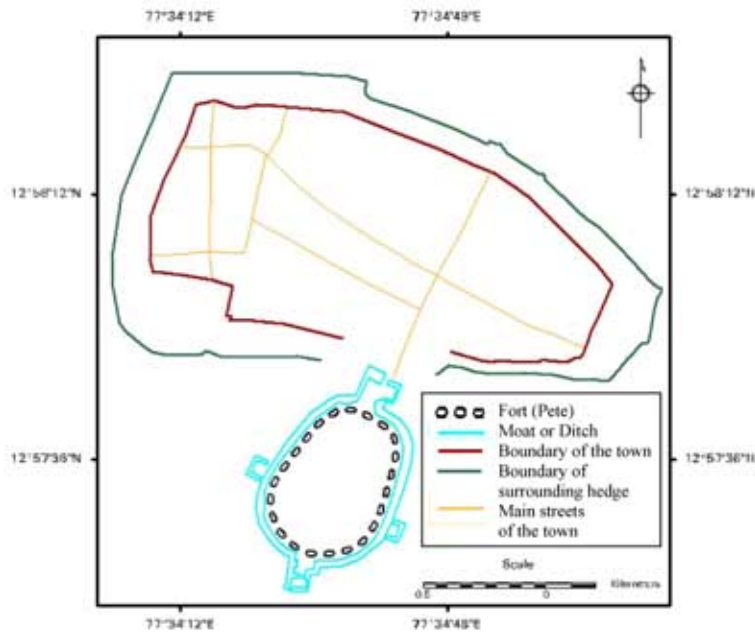
ment. It is marked on a map<sup>4</sup> of 1854, but not on the 1877 map<sup>5</sup>. Much of the grid layout of the inner roads of the township is still the same. Except for the southwest corner, the overall shape of the old town is preserved by major roads skirting the boundary. Along the north runs the Kempe Gowda Road, part of J. C. Road on the east and Mysore (elevated) Road on the south. TCM Royan Road on the west preserves the shape of the inner limit of the old hedge.

The area of the oval fort surrounded by the ditch is now built over. It was marked on a map<sup>6</sup> of 1897, but not on the SOI maps surveyed in 1911–12 and 1924–25. On the ground there is no evidence of the ditch. In the false coloured composition (FCC) image where vegetation represented by the NIR band appears red, an oval-shaped red ring south of the Pete area can be seen. This signature is of tree growth following the oval shape of the ditch.

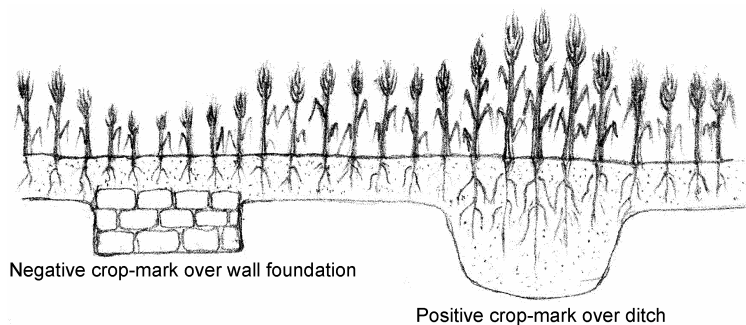
Wilson<sup>7</sup> mentions that crop-mark is one of 'four principal guises in which archaeological sites make their appearance on air photographs', the other three being buildings, earthworks, and soil-marks. The visible difference in the growth caused by buried archaeological remains is called crop-mark. If the effect of these underground archaeological features on the crop is favourable, then the plants grow taller and more copious (positive crop-marks). If unfavourable, the effect results



Figure 1. IRS-P6, LISS-IV (29 November 2003) image of Bangalore.



**Figure 2.** Features extracted from the map dated 1791.



**Figure 3.** Effects of buried archaeological features on the growth of crops.

in restrained growth (negative crop-marks; Figure 3). In either case they form patterns over the ground following the lines of the buried features, revealing their plan and layout. Positive crop-marks are caused by archaeological features formed by subtraction of subsoil, for example ditches for drainage, isolation or defence and tanks, wells and pits of all kinds. These become silted over the years and the greater depth of soil encourages roots to penetrate further to utilize moisture and nutrients that are exhausted in the upper levels. Negative crop-marks occur where tightly packed features (such as stone-walled foundations, buried streets and solid floors) obstruct the roots<sup>7</sup>.

The oval ditch marked on old maps of Bangalore has silted up over the years and is now buried under modern roads and buildings, including layouts of the present Victoria and Vanivilas hospitals, Tipu's Palace, Bangalore Medical College and

Kalasipalyam Bus Stand. The area of the ditch, working on the same principle as the above-mentioned crop-mark, holds more moisture than the surroundings, resulting in the trees growing in that area being bigger and more elaborate forming positive crop ("tree") mark. This difference in the size of trees is not evident from ground level, but synoptic view provided by the satellite image has picked up the oval shape.

The present work has shown that it is possible to register maps that were surveyed in the late eighteenth century with recent satellite images, provided one is able to identify common points in the two pictures. This study has enabled a comparative assessment of the early maps vis-à-vis modern satellite images, in order to search for features not recorded in recent maps. Remote sensing data are capable of showing signatures of historical features that were part of the landscape a

couple of centuries ago, and were dropped out of maps made subsequently. This in turn has interesting implications in using space-based observations for archaeological exploration.

The principle on which crop-marks are formed following buried archaeological features, which formed the basis of several discoveries in Britain using aerial photos, is also applicable to marks formed by tree growth. This signature can be picked up by images taken from space platforms.

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