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A 'reflexive' multi-stage survey methodology for historical landscape research in Central India: fieldwalking, local knowledge, and satellite imagery as archaeological site prospection and mapping tools in the Sanchi Survey Project

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Abstract
This paper evaluates the relative usefulness of systematic v. unsystematic fieldwalking, local knowledge frameworks and satellite imagery as archaeological prospection and mapping tools for the Sanchi Survey Project (SSP) in Central India. Whilst the satellite imagery proved helpful as a supplementary site-prospection and mapping tool during later phases of the project, initial site identification was more effectively facilitated through ground-based explorations, and a 'reflexive' approach that included a sensitivity to local memory and the continued currency of archaeological sites in today's socio-ritual landscape. Set within discussions on the role of the local in 'reflexive' field methodologies, and broader public archaeology debates, the paper stresses the importance of local perceptions of place and history in the development of a regionally specific research design.

Introduction

This paper evaluates the relative usefulness of systematic v. unsystematic fieldwalking, local knowledge frameworks and satellite imagery as archaeological prospection and mapping tools for the Sanchi Survey Project (SSP), a multi-stage landscape project in central India, aimed at relating diachronic socio-ecological and ritual landscape patterns to the histories of urbanism, land-use, and broader forms of human:non-human:environment engagement from the late centuries BC to mid' first millennium AD[1,2,3]. Although the project was initiated in 1998, remote-sensing was only introduced in 2003 as a means to aid mapping and to test a subset of imagery as a potential tool for archaeological prospection. This represented one of the earliest such attempts in South Asian archaeology, prior to the launch, in 2006, of freely available datasets such as Google Earth which has prompted several investigations of the relative pros and cons of such imagery[4,5,6]. However, despite the obvious benefits of freely available satellite imagery for archaeology, and in particular low-budget or public archaeology endeavours, in a region with otherwise restricted access to detailed mapping resources, the Google Earth imagery has its limitations as a primary site-prospection tool[7]. This includes unpredictable resolution across any one study area, lack of choice with regards image-collection date, and lack of access to raw datasets. Even the high resolution Quickbird imagery provided by Google Earth for selected areas suffers from heavy quality-

degradation due to the compression techniques used. As a result, even lower resolution Ikonos imagery usually provides a better tool for site prospection[7].

However, as argued here, just because satellite imagery is available, does not always make it the best starting point for primary site prospection in areas with varied geological and vegetation zones or with high levels of local engagement with the archaeological landscape. Secondly, given the high costs of commercial datasets, it is important to choose carefully, ideally having tested a preliminary subset of imagery prior to making a final commitment to larger datasets. The steps taken in this regard for the SSP are explored in this paper, with particular emphasis on how satellite imagery-utilisation related to the project's wider biography. I will begin by outlining the broader theories and methods of landscape archaeology that informed the project's research design, later discussing the locally-specific historical, geographical and cultural variables that undermined the effectiveness of a 'ready-made' methodological template. Steps taken towards the development of 'reflexive' methodologies for documenting, mapping and organising landscape data, including the incorporation of local perspectives of place and history, contribute to discussions on the role of the local in 'reflexive' field methods[8,9] and broader public archaeology debates.

The development of European survey methodologies: a one-way tract?

The history of survey methodology has customarily been presented within a three-phase framework that mirrors broader paradigm-shifts within the discipline as a whole. Cherry's[10] well-known study begins thus with the unsystematic, text-driven 'topographical studies' or 'exploratory travels' of nineteenth century Greece and Italy, focussed on large public monuments with the surrounding landscape being treated as 'blank spaces'[10]. The 'improved' 'extensive reconnaissance' surveys of the 1960s coincide with a wider set of theoretical shifts involving the recognition of entire landscapes, as opposed to single monuments, as the minimum foci of archaeological enquiry. However, their extensive geographical focus is associated with biases in coverage and representativeness, and a perpetuation of the traditional focus on monumental sites. The 'intensive' and 'systemic' surveys of the 1980s, which form the third stage in Cherry's scheme[10], sought to eliminate such biases throughout problem-oriented research designs, maximising survey coverage over discrete areas, and model-building for testing patterns outside the study area[11,12]. Systematic survey transects, and geophysical and satellite remote-sensing techniques allowed for the identification of 'non-site' data[13] and archaeologically less visible sites often missed by extensive field-walking.

Although Cherry's[10] three-stage model usefully highlights the mutual linkages between the theories and methods of landscape archaeology and changing resolutions of archaeological knowledge, it is by no means a universally applicable model. First, the development from extensive to intensive or unsystematic to systematic methods, and the introduction of statistical sampling and geophysical techniques, is typically presented as a unilinear progression towards an ideal standard to which all projects should strive. Some commentaries[14, 15] are particularly disparaging towards low-budget, small scale projects, with others[10] questioning whether the low resolution they provide justifies the effort at all. Although many such problems have been remediated by the use of cheap handheld GPS

technology, remote-sensing, and freely available satellite imagery such as Google Earth[4,5], and whilst the detection of 'non-site' data is generally attributed to the development of systematic survey techniques[13,14,16], it should be stressed, however, that developments in archaeological ethics and public archaeology have led to greater recognition of the veracity of the local voice[9]. For many parts of South Asia, the detectability of broader 'non-site' categories such as 'associated landscape' data[17,18], cult-spots or unpainted rock-shelters, is less dependent on 'advanced' reconnaissance technologies than on engagement with local traditions of ancestral memory, attachment to place and intergenerational identity. As argued later, in the SSP study area, the outright abandonment of extensive methodologies would have obscured important sections of the archaeological dataset. Given the predominantly western European / north-American context of much of the aforementioned survey-methodology discourse, it is clearly important to acknowledge the regionally-specific cultural, ecological and historical criteria out of which other survey traditions emerge.

Survey archaeology in South Asia

These points may be illustrated through a brief, albeit by no means comprehensive, examination of survey archaeology in South Asia, the earliest formal examples being those of Alexander Cunningham[19]. Unsystematic, text-driven and covering vast areas, Cunningham's region-by-region exploration sought to identify major sites described in the Classical sources and Buddhist Chinese pilgrims' records, and are akin to Cherry's 19th century Greek and Italian 'exploratory travels'[10]. Similarly, Cherry's second, 'extensive reconnaissance' phase correlates roughly with the settlement distribution studies that proliferated in South Asia from the 1980s onwards, the two most oft-cited examples being those of Erdosy and Lal[20,21]. Both deal with changing settlement patterns between the Chalcolithic and Iron-Age periods in the Gangetic valley, whilst others focus on Harappan and post-Harappan settlement distributions in Saurashtra[22], Cholistan and adjoining areas[23,24,25]; and Chalcolithic contexts in Maharashtra[26], Rajasthan[27] and South India[28]. All such studies focus primarily on habitational settlements to the exclusion of ritual or 'non-site' data, whilst Lahiri et al's[29] multi-phase survey over a discrete area near Delhi take a more diverse approach, as does Chakrabarti et al's[30] study of inter-regional trade-routes between the Gangetic plain and the Deccan.

Various attempts were made to reduce coverage biases associated with extensive exploration over large areas: in Saurashtra, Possehl[22] stratified a total area of 12 x 15 km into sampled topographical zones, with a similar approach followed in Cholistan[23]. However, intensive gridding methods at this early stage were precluded by restricted availability of detailed maps, aerial photography and satellite imagery. Erdosy and Lal followed a 'village-to-village' surveying strategy, whereby modern habitations provided identifiable orientation points for transect-based exploration over a surrounding 10-to-12 km radius[20,21]. The large study areas, 1200 km^2 in Erdosy's case[20], led to an over-representation of visually prominent mounds as opposed to more heavily ploughed mounds or hillside settlements. Additional biases were introduced by the widely spaced transects (up to 5 km), with only 150 sites identified over 5100 km^2 in Lal's case[21]. Further problems stem from the fact that both studies' central hypotheses regarding linkages between urbanisation and iron metallurgical developments are based on inferences regarding phase-by-phase changes in site location

and surface pottery distributions, without sufficient consideration of how such evidence can be distorted by site-formation and post-depositional processes[31,1].

Examples of more intensive, systematic surveys with smaller study areas include the Vijayanagara Metropolitan Survey[32,33], which used 20 m-spaced transects in the hinterland of the 14th-16th century city site. Follow-up studies with a deeper chronological focus in and around Kadebakele in the Tungabhadra valley combined surface collection, topographic mapping and excavation to document changing settlement patterns from Neolithic hilltop to early-historic river plain locations[34]. The Maski Archaeological Research Project in Northern Karnataka[35] similarly focussed on settlement transitions from the Neolithic to early-historic over a discrete area of 64km², whilst combined systematic and non-systematic survey and geoarchaeological sampling in mid-eastern Karnataka has shed new light on changing Neolithic-to-Megalithic landscape dynamics[36].

In Orissa, combined intensive survey and excavation in and around the early-historic cities of Sisulapalgarh[37] and Kaundinyapura[38], sought to relate intra-site manufacturing and consumption practices to hinterland settlement patterns, and regional and inter-regional trade networks. At Kaundinyapura, a 6.5 hectare study-area was divided into a 20x 20 m grid, with each square sampled randomly for systematic surface collection. More intensive still was Fogelin's survey at Thotlakonda, Andhra Pradesh which, unusually for South Asia, sought to achieve 'full coverage' over an area of 7.3 km², with an additional 0.6 km² explored unsystematically[39]. Resulting in the documentation of 134 'sites', the study aimed to assess the spatial and temporal links between a single Buddhist site and its immediate archaeological setting. Although the wider manifestation of these patterns beyond the spatially restricted study area thus remains unknown, the resulting dataset is important for assessing text-driven theories regarding modes of interaction between monastic and lay populations, and offers useful parallels to similar, although more broadly dispersed patterns documented during the SSP[1,2,3,40,41]. In recent years, other projects similarly focussed on historical socio-economic, agrarian and religious landscape dynamics have proliferated, from those dealing with Buddhist contexts[6,42,43,44,45,46], to those more aligned with later Hindu traditions[47,48,49].

Extensive v. intensive survey
Despite sharing similar historiographic trajectories, in many cases South Asian and European surveys call for quite different levels of resolution. In South Asia, where vast areas have with few recent exceptions, remained undocumented archaeologically, the most viable and justifiable aim, is often, as with Cunningham's early surveys[19], the establishment of a broad skeletal outline which can be later be filled in through more systematic investigations. Similarly, Erdosy and Lal's surveys sought to identify settlement types representative of each chronological phase, rather than claiming quantitative accuracy[20,21]. While systematically documented site data over a smaller area would produce more representative data for testing patterns further afield, this approach did not fit with the projects' broad-scale objectives. Erdosy himself stresses that transparency over individual strategies and aims is more important than 'blindly' applying probabilistic sampling strategies so as to bestow 'an

unwarranted gloss of accuracy to data which will already be heavily biased due to the vagaries of preservation'[20]. Similarly, recent studies of long-distance, diachronic trade routes do not justify exhaustive documentation of micro-regional data within spatially or temporally discrete areas[30].

Additional environmental, academic, political and cultural variables may also reduce the effectiveness, or indeed rationale, of systematic survey methods. In contrast to most European contexts where surface-based chronologies can be readily calibrated by reliable stratigraphic ceramic sequences, the limited availability of such resources in many parts of South Asia[50], together with restrictions over test-trenching and augering, can offset the advantages of systematic sampling strategies[1]. Further, costly and labour-intensive transect-based methods are often being beyond the means of small-scale, low-budget surveys[51,52]. Finally, restricted access to aerial photography and high-resolution maps was until recently a deterrent against intensive gridding methods[22].

Since 2006, various projects have capitalised on the availability of free satellite imagery such as Google Earth with varying aims and results[4,5,6].. In Northwest India, the Rakhigarhi[53], and Ghaggar Hinterland Surveys[54], through the use of remote sensing and GPS-based mapping enabled calibration of earlier village-to-village survey data[23,24]. The revised dataset included many previously undocumented sites, and revealed major inconsistencies and errors with regards locational (sometimes up to several km) and quantification, thus shedding new light on models of Late and Post Harappan urban transformation. The SSP's use of a range of commercial datasets prior to these developments represented an early attempt to assess the usefulness of satellite imagery as a site prospection and mapping tool [1,55]. However, the simple existence of remote-sensing resources does not always make them the best starting point for primary reconnaissance, especially as the free Google Earth data is of inconsistent quality across any one study area[4]. As discussed below in relation to the SSP, dense forest coverage across much of the study area meant that satellite imagery only became useful after an initial stage of ground-based survey[55].

Towards an 'reflexive' survey methodology

Whilst the aforementioned environmental and bureaucratic variables are usually presented as negative factors, a key argument here is that sensitivity to local cultural practices can be positive shaping factors for a specifically South Asian survey design[1,56]. For example, despite using unsystematic 'village-to-village' surveying methods, Lahiri et al overcame the 'site-based' focus of earlier surveys, by highlighting the culturally-specific underpinnings of their methodology[29,56]. Whilst sharing traits with other extensive methods, the 'village-to-village' method reflects conditions peculiar to the Indian countryside, with the tendency towards settlement continuity, the reinstallation of archaeological material as objects of worship, and the commemoration of ancestral links between modern and ancient settlements, all making the configuration of modern villages a suitable basis for exploration[1]. In such contexts, a sensitivity to local knowledge, and in particular the close relationship between local perceptions of the divine and places of assumed antiquity can contribute as much, sometimes more, to the reconnaissance process, as remote-sensing. Not only does such an approach allow for a degree of compromise between extensive and systematic

methodologies, but it also sets the 'village to village' survey apart from the generic 'extensive' survey. The resulting methodology is of relevance therefore to widespread recognition of the importance of the local or 'folk' perspective for 'reflexive' excavation[8,9,] and survey methods[57,58,59], and more general discussions within archaeological ethics and public archaeology of the need for collaboration with local communities[60].

Elsewhere I have argued that the methodological shortcomings of the early Gangetic valley surveys, are exacerbated further by a general lack of integration between the theories and methods of landscape studies, and a failure to acknowledge the potential strengths of localised research designs that capitalise on local cultural practices[1]. Further, despite lengthy accounts of European sampling strategies and statistical spatial analyses, both Erdosy and Lal[20,21] perpetuate traditional polarisations such as 'ritual' v. 'secular'[61], or 'cultural' v. 'natural'[3,62] categories and spheres of action, and thus despite a shift of emphasis from monuments to settlements, simply replace one narrow category with another. The resulting distribution-maps are organised according to the periodisation of habitational settlements and associated pottery to the exclusion of all other site-types. Ironically therefore, despite using landscape-oriented methods, such studies remain rooted in a 'site-based' modality, just as early extensive surveys in Europe represented changes in 'techniques and methods rather than in theory and metaphysics'[16]. Further, by excluding non-settlement data from the focus of enquiry, religio-ideological and political based models of early-historic state-formation and urbanisation in the Gangetic valley[63] lack empirical corroboration as provided elsewhere by more integrated landscape studies that help to challenge traditional centralised models of state[1,3,44].

The Sanchi Survey Project: a multi-stage landscape methodology

The SSP's primary site-prospection and mapping (Stage I) took place over two six-month seasons in 1998/99 and 2000/01. In 2002-5 (Stage II), four additional field-seasons sought to improve existing datasets and test earlier hypotheses using new methodologies. Particular emphasis was placed on diachronic human:non-human:environment interaction through ground-based mapping of water-resource systems, geological dating of dam and reservoir deposits and hydrological and climate data analysis[64], whilst database redesign, remapping at selected sites, and satellite remote-sensing were other key foci of enquiry. The latter aided the mapping process, ameliorated the GIS data-quality, and enabled ground-based site representativeness during Stage I to be tested against visibility levels within a sub-set of different satellite imagery[41,55].

The study area covered approximately 750km[2], extending for a 10-15 km radius around Sanchi hill (Figure 1). The outer boundaries were defined by a combination of local topography, and the configuration of four previously documented Buddhist sites that form a rough circle around the study-area[65]. Re-exploration of these sites formed the starting point for Stage-I-reconnaissance, followed by exploration within the intervening landscape. Following an adapted version of the 'village-to-village' survey method described above, modern settlements (approximately one village per 2km[2]) provided the foci for a combination of informant-led, systematic and non-systematic exploration in, around and between each village.
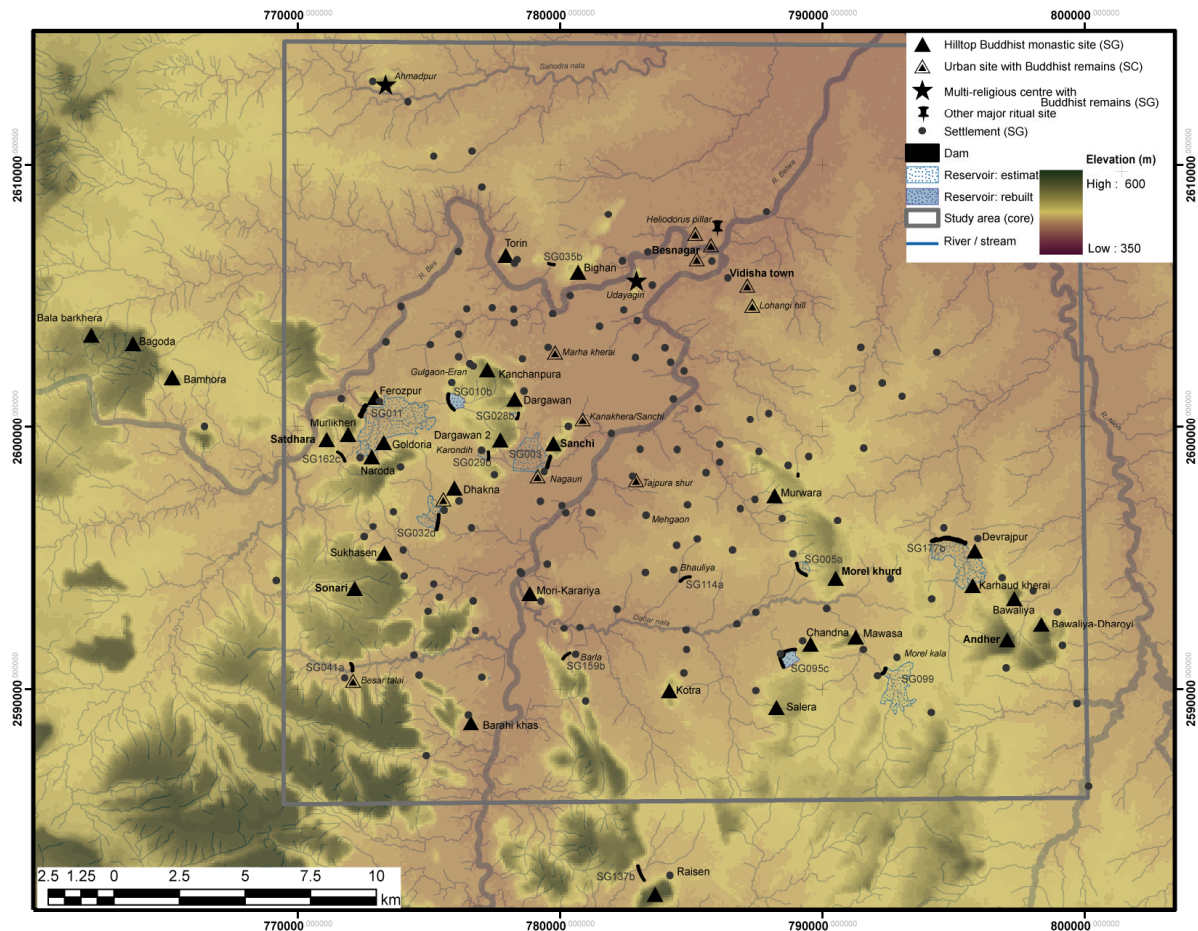
FIGURE 1: SSP Study area and key archaeological sites

Aerial photography and satellite imagery were not utilised during Stage I due to restricted access to the former and the prohibitive expense of the latter. However, a range of satellite imagery with different spatial and spectral resolutions was purchased during Stage II with three major objectives: i) evaluating the applicability of satellite imagery as a prospection and landscape analysis tool against the survey results collected during Stage I; ii) supplementing ground-based site mapping; and iii) improving the quality of existing survey data. The following datasets were purchased over two phases, with an intermediary field season aimed at determining which image-sets best met the project's needs: Corona, KFA, Landsat ETM, Iconos, co-registered pan and multispectral (MS) Quickbird, and Shuttle Radar Topography Mission (SRTM) elevation data (Table 1; Figure 2).

Purchase Stage	Sensor	Spatial (m)	Bands	Date of Collection	Area km2	Comments
1	Corona KH4B	3	1	23/11/1970		Unrectified
1	Corona KH4B	3	1	23/11/1970		Unrectified

1	Corona KH4B	3	1	23/11/1970		Unrectified
1	Corona KH4B	3	1	23/11/1970		Unrectified
1	Corona KH4B	3	1	23/11/1970		Unrectified
1	KFA	5	3	27/05/1989	2120	Orthorectified
1	Landsat 5	30	7	03/10/1992	21000	Orthorectified
1	Landsat ETM+	30	8	01/10/2000	6108	Orthorectified
1	Landsat ETM+	15	1	01/10/2000	6108	Orthorectified
1	Quickbird MS	2.4	4	12/10/2002	25	Georeferenced
1	Quickbird pan	0.6	1	12/10/2002	25	Georeferenced
1	Quickbird MS	2.4	4	13/12/2002	95	Georeferenced
1	Quickbird pan	0.6	1	13/12/2002	95	Georeferenced
1	Radar	90	1	21/02/2000		DEM
2	Quickbird MS	2.4	4	13/12/2002	25	Georeferenced
2	Quickbird pan	0.6	1	13/12/2002	25	Georeferenced
2	Ikonos MS	4	4	08/08/2001	49	Georeferenced
2	Quickbird MS	2.4	4	05/06/2005	106	Georeferenced
2	Quickbird pan	0.6	1	05/06/2005	106	Georeferenced
2	Landsat ETM+	30	8	01/06/2004	21000	Orthorectified
2	Landsat ETM+	15	1	01/06/2004	21000	Orthorectified

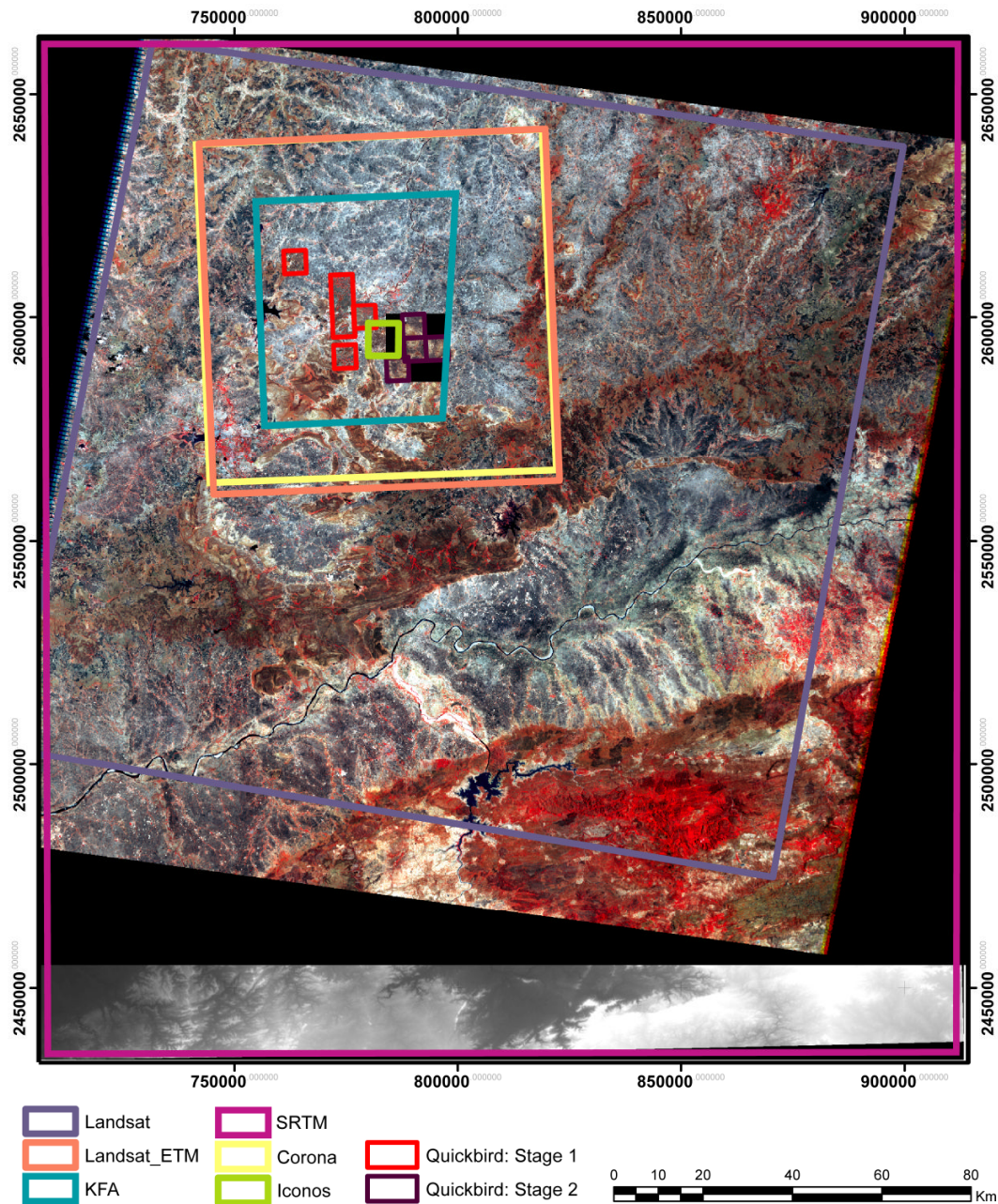**TABLE 1:** Satellite imagery Purchased in 2003-4

FIGURE 2: Satellite imagery purchased in Stage II

Satellite imagery: Overview

The 1969-1970 Corona imagery, with a ground resolution of c. 3 m, was of particular interest as it reflected a landscape unaffected by the many modifications brought about by subsequent construction, quarrying, tree-planting, canalisation, mechanical ploughing and irrigation activity; similar assumptions have informed more recent survey-based investigations in Gujarat[5].

Overall the KFA imagery was disappointing due to camera aberrations or atmospheric distortions. It was of limited use for either reconnaissance or mapping purposes, contrary to expectations that the 5 m resolution would reveal a range of natural and cultural features,

particularly given that the imagery was taken in low vegetation conditions during May.

The Landsat ETM imagery displayed a range of different landscape features despite its relatively low spatial resolution. Two sets of imagery, collected in October and June respectively, were purchased. The former was of limited use for detecting mounds and palaeochannels due to high vegetation and soil moisture levels in the post-monsoon season, whilst the imagery collected in the dry summer months yielded more positive results. Overall the Landsat imagery was helpful for creating geological and soil maps.

A sample of Ikonos multispectral imagery was purchased for selected areas known to contain a range of sites documented on the ground during Stage I. The aim was to test the imagery's utility for mound detection, as well as determining the appropriate resolution characteristics for future reconnaissance exercises. Imagery collected in early May was chosen so as to capitalise on reduced crop height and increased soil colour-differential on mounded areas. The Ikonos imagery did independently reveal settlement mounds, verified against the original Stage I survey data. The large size of these sites meant that they were potentially detectable in the Landsat ETM imagery also[55].

A selection of co-registered pan and multispectral (MS) Quickbird imagery was purchased primarily for site reconnaissance and mapping in the hilly regions, with variable, but generally positive results. The sensor characteristics of the SPOT imagery were simulated from the Quickbird imagery using two techniques: degradation of 0.6 m pan imagery to 2.4 m, and extraction of the first principal component of the MS bands[55]. The spatial resolution of the pan imagery was high enough for identification, in shadow, of wires between pylons. Modern hard and soft detail field systems were easily identified and even narrow scrub field boundaries were visible. However, in some areas, particularly the sandstone hillocks, the imagery was over-saturated.

The 90 m resolution Shuttle Radar Topography Mission (SRTM) elevation data, freely available from NASA, was useful for creating digital terrain models, and for extracting contours. The latter were helpful for checking earlier estimates regarding reservoir areas and volumes, calculated during Stage I by relating historical water-balance data to ground-based observations[40,41].

Satellite imagery as a reconnaissance and mapping tool
A preliminary pilot project was carried out in 2003/4 in order to test a sample of satellite imagery prior to committing to a larger purchase order. A 'blind' examination of the high resolution imagery led to many false leads, with many 'potential' archaeological features, on inspection, turning out to be trees, electrical pylons or quarry pits. When assessed against archaeological sites already documented during Stage I, the imagery, generally speaking, proved to hold more potential as a supplementary mapping aid than a primary site detection tool. However, its relative effectiveness in either capacity varied enormously according to topography and vegetation cover: in the hilly zones many settlements and Buddhist monastic sites are obscured by dense vegetation, while in the open plains, most of the sites that are suitable for satellite prospection such as settlement mounds or dams, were already visible from surrounding hilltops during Phase I[1,55]. Further, many sites which rarely show

up in satellite imagery, such as hillside settlements, rock-shelters, springs or 'natural' shrines, are more readily detected through a sensitivity to the ongoing currency of archaeological sites within the present-day socio-ritual landscape[1]. This phenomenon can help to ensure enduring 'visibility' of less tangible archaeological sites which in other regions are more susceptible to destruction by heavy industry and intensive agriculture.

Furthermore, many of the caveats used to highlight the ineffectiveness of extensive surveying methods relate to regions where surface sites are susceptible to destruction by heavy industry and intensive agriculture. In the SSP area the prevalence of traditional shallow ploughing methods – rarely exceeding 15 cm in contrast to up-to-1 m depths reached by modern mechanical ploughing - and the relatively slow pace of industrialisation, has contributed towards high levels of archaeological visibility, although the proliferation of stone-quarries and tree plantations since the early 2000s is fast threatening this situation. Finally, in contrast to regions such as Mid-West America or Western Asia where heavy alluvium can obscure sites[14], the relatively narrow extent of river sedimentation in the Sanchi area has supported high archaeological 'obtrusiveness'[66].

Site documentation and mapping
During Stage I, archaeological sites and features were plotted as single co-ordinates using a handheld Geographical Positioning System (GPS) and coordinated with a relational database, discussed later. The lack of wider polygon-based information impaired effective representation of site areas and intra-complex positioning. This problem was redressed during Stage II by: i) using satellite imagery to ameliorate mapping methods; ii) overhauling the project database and GIS structure[55]; and iii) using a new computer-based GPS for direct on-site digitisation and mapping that enabled sites to be digitised as single points, linear features or polygon outlines. In contrast to single Latitude-Longitude readings provided by older equipment, the new technology allowed for spatially-accurate representation of site areas, with resulting settlement distribution maps for example providing a much clearer indication of total zones of occupation (Figure 3)[1]. Selected sites were remapped in this way during Stage II, with supplementary mapping provided by Total Station and Kite Aerial Photography (KAP) methodologies[41,64].

FIGURE 3: Settlements represented in polygon form with corresponding six-tier site hierarchy (SG level)

The high-resolution satellite imagery, particularly Quickbird, provided a supplementary tool for small-scale mapping by means of direct polygon-based representation of previously documented features such as mounds and architectural complexes[1]. Topographical survey was also carried out around selected reservoir sites, with contour mapping at intervals of 1 m providing a check on earlier calculations regarding reservoir area and volume, and inferences about land-use[41,64]. The SRTM satellite imagery also generated high resolution contour data which provided the background mapping for individual site plans. Despite a close degree of concordance between the satellite imagery and GPS data, an offset of approximately 20 m between site-plans and Quickbird satellite imagery - a minor error margin over a 750 km[2] study area - reflects the inherent error margin of hand-held GPS technology, with further errors related to the projection system of the satellite imagery[1,67].

Database structure

During Stage I, survey data were entered into a basic, tri-tabular relational database: i) the first contained site information at a broad, 'site-complex' level. The Sanchi complex, for example, included the Buddhist hilltop site, the dam in the valley below, and the settlement remains on Kanakhera and Nagauri hills[1]. Details about these smaller groupings were stored in the second 'site' table, including categories such as 'settlement', 'stupa complex', 'temple

remains', 'dam' *etc.* A third table included details of associated sculptural and architectural fragments, with additional tables for ceramics and other surface finds. Problems with the grouping of individual sites and the drawing of boundaries between and around them, were redressed during Stage II. Whilst decisions regarding where one site begins and another ends commonly draw on architectural and topographical divisions such as walls or cliffs, history and epistemology are key influencing factors. Thus, the decision to include the dam and the Buddhist monuments at Sanchi within a single archaeological complex drew on wider evidence for the role of water management in Buddhist monastic governmentality[2,3,40,41,66], the repetition of related inter-site patterns across the study-area, and general recognition of the 'entangled' nature of human:non-human relationships[62,3]. Chronological divisions, together with the changing site usage and custodianship, however, are less easy to determine. For instance, should the clusters of prehistoric rock-shelters on the edges of Sanchi hill and related sites be considered as part of the same site grouping as the hilltop Buddhist complex only when they show evidence for monastic reoccupation[1,3]? Further, although information about phasing and ritual affiliation was stored in the sculpture and ceramics tables, there were serious limitations when it came to establishing complex chronological and denominational sequences based on different types of evidence, much of it no longer in its primary context, or else published elsewhere.

The Stage II-database redesign thus sought to reduce bias regarding boundary delineation between and within site groupings, without losing sight of more 'obvious' topographical trends. To this end, the number of key tables increased from three to four, with a downward migration from the most general to most specific spatial resolution (Figure 4)[1]. The first table deals with the broadest site level, renamed here as 'Site Group' (SG), and including four main functional types: i) settlements, ii) hilltop ritual sites, iii) reservoirs, and iv) background landscape, the latter referring to isolated sites, particularly temples and cult spots, that bear no obvious spatial relationship to larger settlement or ritual centres. The second table comprises individual SG components referred to as 'Site Clusters' (SC) including 'settlement', 'tank' or 'temple', at least one of which is included in every SG. Each SC contains at least one 'Site', described in the third table, with types including 'settlement pile', 'temple base' or 'natural shrine', whilst the fourth table comprises individual 'Installations' (I-) such as architectural or sculptural remains. Many ritual structures listed at the SC or S level derive some or all of their dating and cultic information from Installations currently stored at a separate location[1]. Thus, whilst each Installation is listed according to its current findspot, an additional field in the Installation table indicates the Site no. of its original context, when known; and although the more detailed Sector-by-Sector maps reflect the current location of Installations (Figure 4), many of the Phase-by-Phase maps illustrating diachronic patterns in the ritual landscape[1,67] reflect the inferred original context of Installations.

Numerous sub-tables accommodated multiple dating criteria, changing ritual affiliations through time, and records of site visits. This level of complexity reflects the SSP's multi-type, multi-phase focus, with each site operating at different spatial resolutions: some site-categories relate to whole architectural compounds, others to individual sculptural fragments. Database design thus needed to withstand queries geared at both an intra-site and regional landscape-based resolution, as well as queries based on changing ritual

affiliations, both temporally and spatially, at any of the four main site levels. This necessitated several linked 'update query' tables stored in separate databases, so that whenever changes were made at the Installation level, to dating or ritual affiliation, for example, related information at the other three levels would automatically be updated. Given the rich discourse on survey methodology and research design, the paucity of critical engagement with this element of database design is striking; more discussion of how database-design might better reflect shifting paradigms of landscape research is clearly needed, particularly given, on the one hand,the growing recognition of the 'entangled' nature of human:non-human:environment interactions[62,3] and, on the other, the mutual link between archaeological categorisation and conservation, with those sites that fall outside ASI-determined boundaries remaining unprotected from destructive quarrying, agricultural or industrial activities[1].
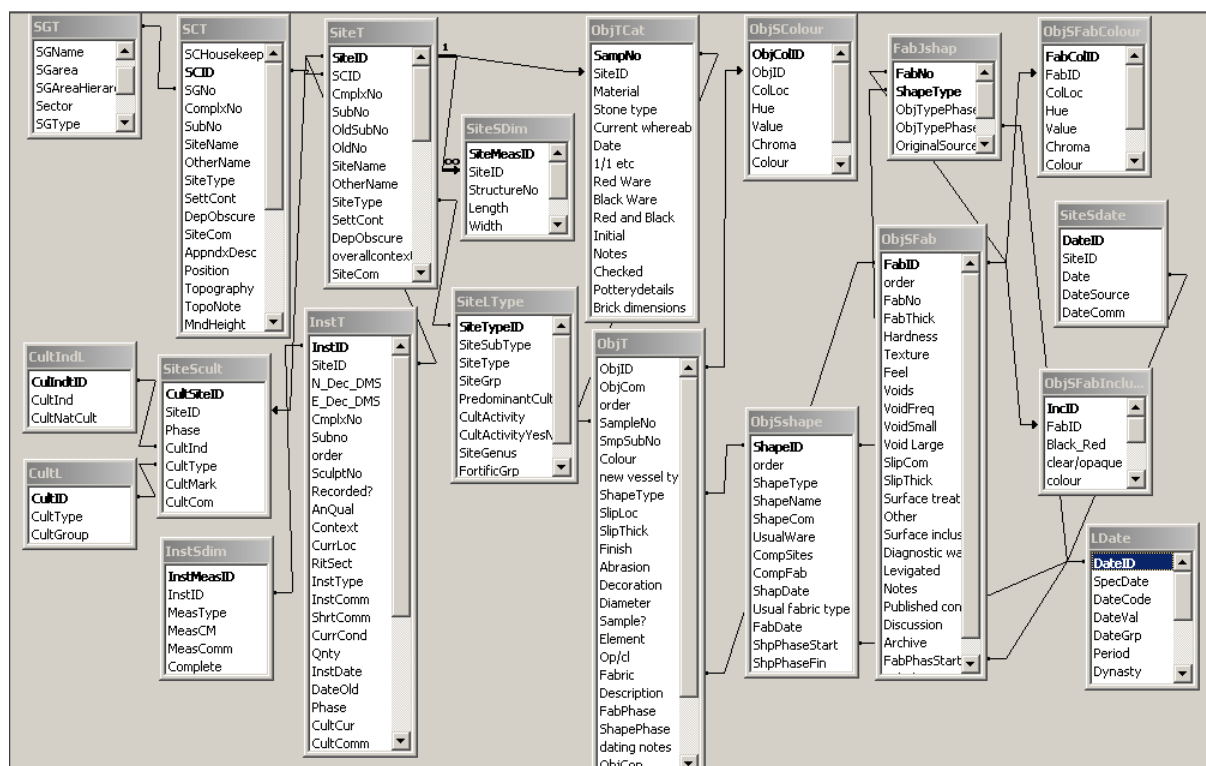
FIGURE 4: SSP Database table structure

Geological zones and geographical sectors: a 'stratified' survey methodology
Whilst acknowledging the mutual interdependence between local environmental and cultural variables, and archaeological methods and results, as well as conservation patterns, four additional steps were taken towards achieving an 'improved' village-to-village survey that transcended the site-based focus traditionally associated with extensive surveys: i) keeping the survey area small enough to allow for maximisation of survey-coverage, without detracting from the broader regional perspective; ii) following a stratified survey strategy; iii) bringing the 'village-to-village' survey in line with theoretical movements that have led to a broadened definition and interpretation of 'sites' and their interrelationship in the landscape;

and iv) incorporating present-day perceptions of the cultural landscape into the survey design.

The distribution of several well-defined geological zones, together with local drainage patterns, provided the basis for the identification of four major Geographical Sectors[1] which enabled a 'stratified' exploration strategy and by extension a transparent means for modelling site typology as well as variations in reconnaissance methodology, against environmental factors[22]. In the flat plains where earthworks such as settlement mounds and dams are highly visible, especially from surrounding hilltops, transects were separated by 50-100 m, depending on seasonally-fluctuating levels of visibility and obtrusiveness[1]. Stage I reconnaissance largely took place during winter (October-February), when low crop height enabled unhindered field-walking, and favourable soil conditions such as high moisture-content, dark hue and increased pliability due to recent ploughing, maximised surface site detection. Visibility levels drop during February-March due dense crop coverage, and further still in the post-harvest months (March-June) due to dry, cracked soil conditions.

Different reconnaissance methods were required in the hilly zones where all-year vegetation cover reduced visibility, especially in the northern and western sectors where there is less deforestation than in the eastern hills. However, there is already low visibility in all three areas due to the high reuse value of ancient sandstone building materials, with hillside settlements rarely consisting of more than disturbed wall outlines. However, most of these hills are small enough for systematic exploration between identifiable points and, depending on forest cover, transects were usually separated by 5-30 m.

Over 1100 potsherds were collected, mainly from ploughed mound surfaces, as a means of supplementing dates provided by sculptural and architectural evidence[1]. Other surface finds included terracotta fragments, iron slag, microlithic tools and coins. Collection strategy varied according to geographical sector and geological zone, with ploughed mounds presenting the least difficulty for systematic collection methods.

'Sites' in the landscape

Another step towards maximising site representativeness involved the incorporation of theoretical revisions regarding the definition of archaeological enquiry and recognition of the mutual link between survey data quality and working 'site' definition. Conventional definitions have involved an agreed ratio between artefact density and area, e.g., 'five artefacts per square metre'[68]. The SSP followed Dunnell and Dancey's less rigid definition: 'a virtually continuous spatial distribution of material over the landscape with highly variable density characteristics'[16]. This approach avoids focusing on a single type or period of site, but rather views the landscape as a fluid entity in which categories such as 'ritual' and 'secular' or 'past' and 'present' play an implicitly interlinked role. Thus, while the SSP yielded a wide range of site-types, it was only when viewed within the context of an 'entangled' human:non-human:environment framework that they provided the empirical basis for addressing the project's principal research questions regarding the economic and religious modes of interaction between monastic and non-monastic sections of society[1,2,3].

Buddhist monastic sites

Sanchi, and four neighbouring Buddhist sites[65] provided the primary orientation for exploration within the surrounding landscape. These sites consist of *stūpas*, monasteries and temples, most of which have undergone extensive Archaeological-Survey-of-India-(ASI)-restoration. Many less well preserved structures remained unmapped and often extend far beyond the ASI-protected site boundaries which, generally speaking, follow those defined during Cunningham's time. This applies as much to 'Buddhist' remains as to wider aspects of the landscape such as the dam below Sanchi hill[1,40], for example, which notably has escaped ASI-protection. The thirty additional Buddhist sites documented during the SSP contained similar remains in varying states of preservation, and miscellaneous buildings such as storerooms or refectories possibly connected with lay personnel. Five main monastery-types were identified, including semi-structural adapted rock-shelters[1,67,69], while *stupa* classification ranges from small cairn-like structures to large 30 m-diameter monuments, as at Sanchi[70,71].

All site prospection during Stage I followed either transect, or local informant-based exploration. During Stage II, high-resolution satellite imagery introduced a supplementary mapping tool, although its effectiveness varied hugely according to topographical sector[41,55]: relatively high forest cover in the western and southern hilly sectors, and limited differentiation between stone structures and their background sandstone surface, reduced visibility levels of small cairn-like *stupas* within the Quickbird imagery. By contrast, *stupas* in the eastern hilly sector were easily detectable due to superior site preservation as well as localised deforestation[1]. Many of the simple, single-roomed monastery types, surviving only as sandstone boulder outlines, were more difficult to distinguish from their sandstone backgrounds than the larger, platformed and courtyard monasteries, which even in densely vegetated areas, showed up due to their monumental scale and highly angular wall formation[1,69].

Dams and other water-resource structures

A group of 17 ancient dams were first documented during Stage I[1,40,41,66]. Visible from nearby hilltops, they survive as pronounced earthworks with intact stone facing, traversing up-to-1-km-wide-valleys. During Stage II, previous morphological and hydrological studies were supplemented by geological dating[64], and improved mapping[41], while a range of satellite imagery was assessed for its suitability as a dam-prospection tool. Many previously documented dams showed up in the Landsat, KFA and Quickbird imagery, while some palaeochannel activity, useful for supplementing earlier hydrological analyses, was identified in the Quickbird imagery[55]. SRTM data, together with Total Station mapping, enabled contour generation for supplementing Stage I calculations regarding reservoir areas and volumes[41]. Other water features documented during Stage I included 'excavated' domestic tanks and wells, which comprised one of the most consistently identifiable features in the Quickbird satellite imagery[1].

Settlements

Two types of habitational settlements, numbering 145 in total, were documented during Stage 1: i) low settlement mounds distributed throughout the fluvial plains, formed of denuded mud-brick, and sometimes overlain by modern villages. Albeit similar in nature and formation to Near Eastern *tell* sites[72], they are generally of lower height (average 1-6 m) and area; ii) hillside settlements, often adjacent to modern villages, and surviving as clusters of denuded stone structures[1].

Both site-types were associated with different surface finds as well as collection and reconnaissance methods. While mounds are visually prominent features in the landscape, hillside settlement detection was dependent on a combination of systematic exploration, as used recently for example to locate rock-art sites in South India[73], local leads, and as discussed later, local traditions whereby sites with perceived antiquity are granted sacred status. Many previously identified mounds showed up easily in the high-resolution Quickbird and Corona imagery due to their lighter hued, ceramic-rich soils; similar observations have been made in Gujarat[5] and Syria[74,75]. Mound identification was thus one of the few areas for which satellite imagery might have been a useful site-prospection tool during Stage I. By contrast, hillside settlements were generally obscured by dense vegetation cover and poor colour differentiation between denuded sandstone structures and their natural sandstone background.

Temple sites and sculpture fragments

Site documentation included over 1000 individual sculpture and architectural fragments, many of which were still under worship in village shrines. These were distributed over a total of 313 find spots (Figure 5), approximately one-third of which constituted *in situ* architectural or sculptural components of actual temples, or in close proximity to temple mounds or foundations. The other two-thirds bore no obvious link to a nearby temple, in which case context either remained unknown, or was inferred on the basis of art-historical linkages to provenanced material. Stage-II-satellite remote sensing generally proved unhelpful as a potential site-prospection tool for such sites due to generally disturbed and dispersed nature of portable remains, but as discussed later, were more easily detected, during Stage I, through a sensitivity to the ongoing, albeit often transformed, currency of ancient temples and sculptures in today's religio-cultural landscape.
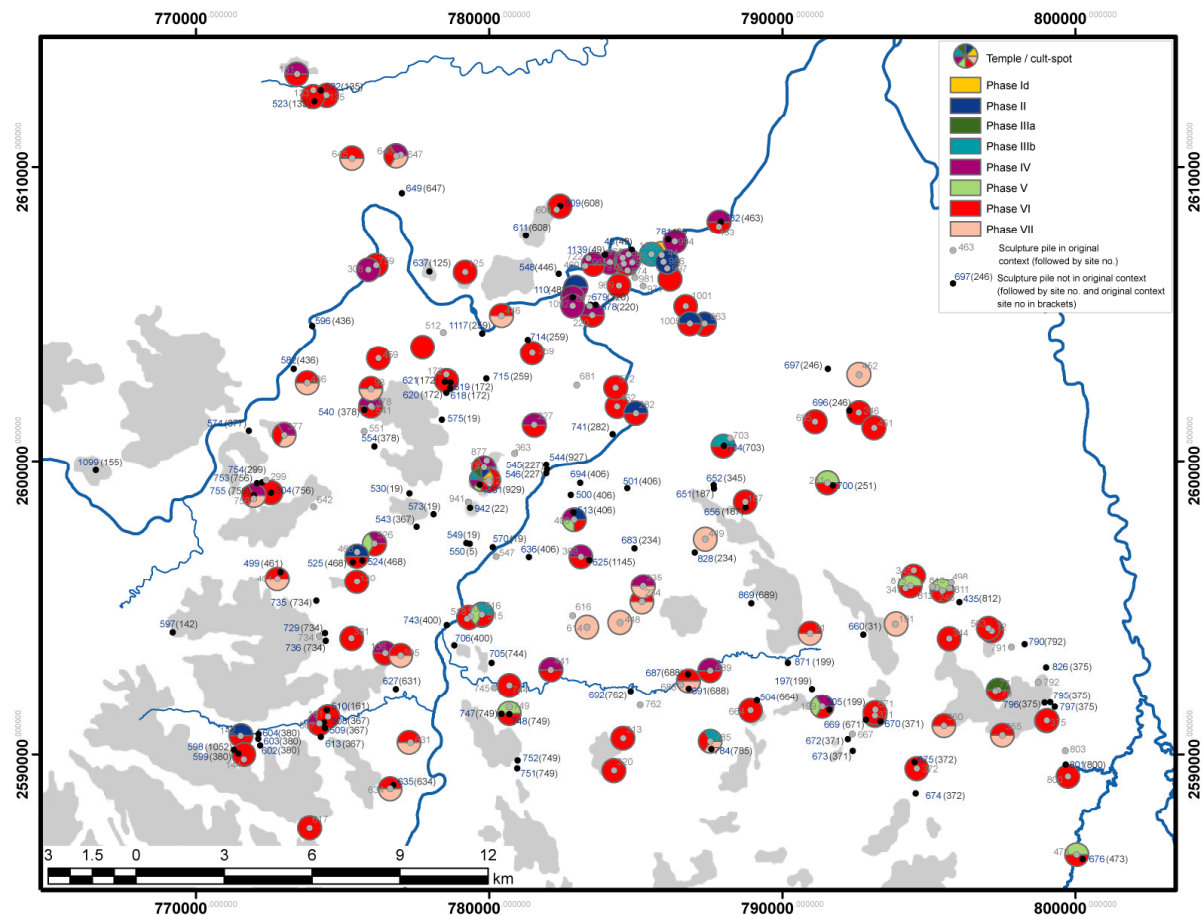
FIGURE 5: Cult spots and temples, with sculpture piles (in original context and out of original context)

'Non-monumental' sites

The project was informed by recognition of the 'non-site' as the minimum unit of archaeological enquiry[13,14,16], which in addition to less tangible remains such as faint structural outlines, or stone tool scatters, included also unpainted rock-shelters, prominently shaped rocks and sacred trees, many of which continue to play an important role in local ritual practices. The *visual* dimension of the archaeological landscape, in particular the issue of intervisibility between key ritual sites, also informed the survey methodology. However, despite parallels with 'phenomenological' approaches to European prehistoric landscapes[76], the application of ready-made models was avoided. Instead sanction for emphasising the importance of 'divine seeing' (*darśana*) of stupas within and between sites drew on textual and epigraphical accounts of *stupas* not just as repositories of the Buddhist relic but as containers of a 'living presence' which projects the power of the Buddha, the *dharma* and respected monks into and across the surrounding space[1,70,71,77].

Local memory and archaeological survey methodology

The initial point of call on any one survey day was the village itself where archaeological material is often kept, either in houses, or in the case of sculptural and architectural remains, on public shrine-like platforms[1]. The latter range from small collections of heavily

eroded fragments to large piles of sculptures and temple parts from ruined Hindu, Buddhist or Jaina structures datable from second-century BC to 12th-century AD, but reduced to rubble during the Muslim conquests of the 13th century AD. Despite canonical prohibitions against the reinstallation of damaged sculptures, these makeshift shrines reflect a transformation from 'high' Orthodoxy to 'folk' religious practice[56,80], and occasionally of iconography and gender also, as illustrated by documented cases during the SSP of male images such as Viṣṇu being worshipped as a goddess[1]. Such examples highlight problems of formal art-historical classification whereby designations based on 'original' iconographic dispensations can obscure centuries of revised ritual identity and practice[78,79].

The practice of worshipping ancient remains occurs not only in villages but throughout the countryside wherever archaeological sites are located by locals. Such sites, ranging from ancient settlements to wells, temples and sculptures, are commonly staked out from the surrounding landscape by prominent trees and coloured flags hoisted onto high poles, with sculptures and stones daubed with red paint to indicate their status as objects of worship (Figure 6). Occasionally such shrines are devoid of sculptures, consisting only of cairn-like piles of unhewn stones, or platforms set into the roots of trees[1,3].

The continued currency of ancient remains in present-day religio-cultural practice has important implications for both archaeological and environmental conservation in the face of increasing threat from destructive industries. Similar observations have been made for Southeast Asia[81], whilst for northern Europe, Fredengren[82] highlights the importance of embracing local religious beliefs or 'spiritualism' when it comes to heritage and environmental conservation practices, drawing on Northcott's[83] argument that places with perceived religious or sacred status are more likely to be respected and cared for. However, rather than reflecting a community of avid conservationists, these sites are marked out because of their ongoing association with place-bound deities and tutelary spirits, believed to occupy ancient settlements long after their abandonment[1,80]. Some such sites, referred to here as 'Memory sites' (Figure 6)[1,3], lack corroborating archaeological evidence for habitational occupation, and yet are associated with collective memories of significant past events, or are perceived to form part of ancestral village territory. The degree to which these sites parallel wider evidence for the use of 'self-manifest' (*swayaṃbhu*) images, ancestral legends, vision and dreams to legitimise modern land claims[3,84], requires testing through focussed ethnographic research. However, since these commemorated places can be seen from considerable distances, they provide important visual orientation points even without fieldwalking or remote-sensing, thus supporting wider calls for the explicit incorporation of local 'folk' practices into South Asian landscape research-design[56]. Further, since many such shrines also commemorate 'non-site' material, such as strangely shaped stones or rock-shelters, or are situated in otherwise inaccessible places, they are easily missed by systematic sampling methods, remote-sensing, or widely spaced transect-based exploration.
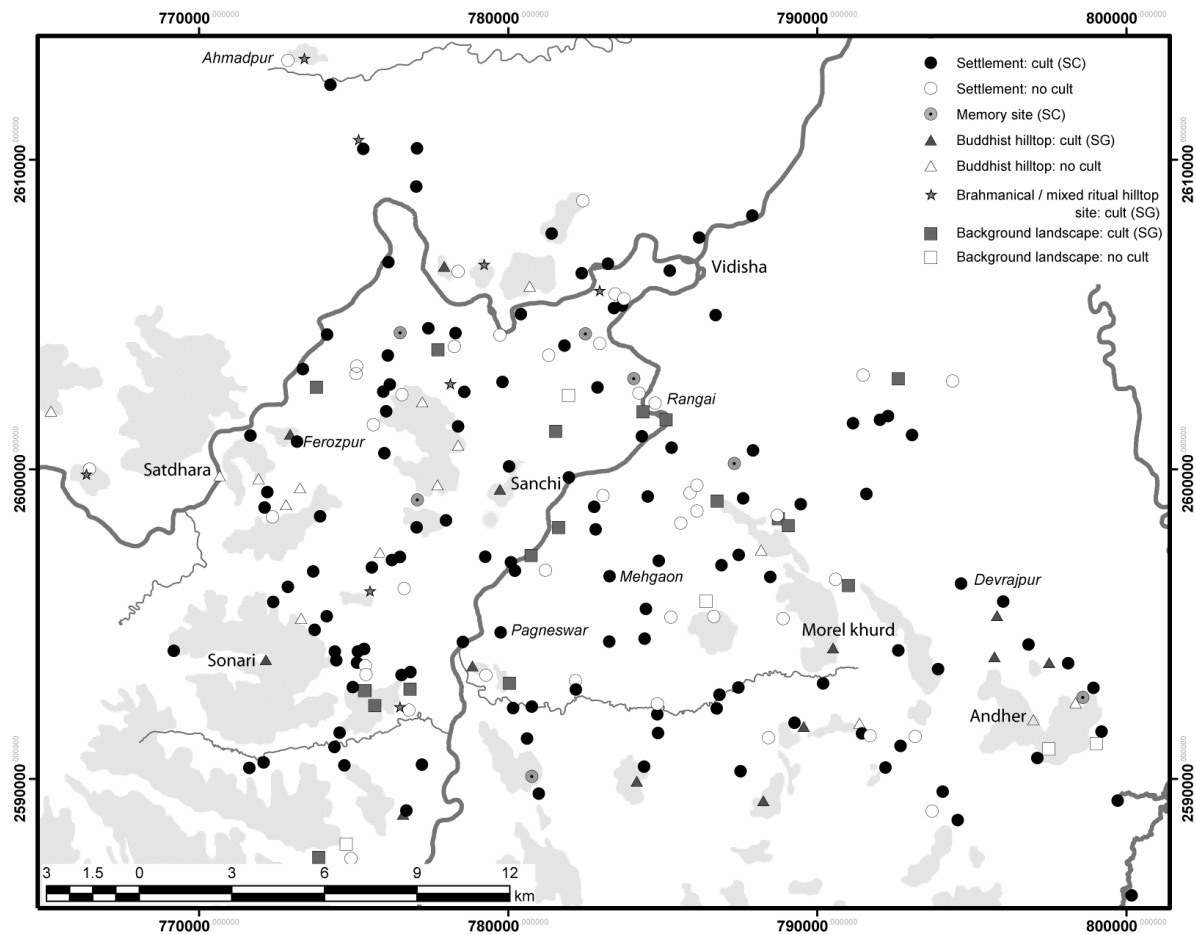
FIGURE 6: Archaeological sites commemorated as modern cult spots and 'memory sites'

These observations are useful for illustrating the mutual linkages between the biography of archaeological material in Sanchi's contemporary landscape, archaeological visibility levels and, by extension, the reconnaissance process as a whole. A 'reflexive' methodology that included a sensitivity to the interwoven trajectories of the geographies of the past and the present was thus crucial to the success of the SSP, as it allowed a middle course to be steered between systematic and extensive methods of exploration, with the configuration of commemorated sites aiding prospection over areas unfeasibly large for systematic methods, whilst at the same time enabling greater coverage than would be possible through conventional extensive methods.

I would argue therefore that criticisms of informant-driven methods, cast as unreliable and perpetuating an overly 'site-based' level of enquiry[85], are less valid for regions where local knowledge remains strong and in particular where the configuration of 'non-monumental' sites such as caves, prominent rocks, or 'natural' shrines can impact as, if not more, powerfully on local perceptions of place and history as do 'conventional' archaeological sites. This is not to suggest that local information should play more than a supplementary role to systematic, transect-based exploration, especially given that archaeological knowledge and 'site' definition varies hugely not only according to age, experience, social position and

occupation, but also to the sectarian affiliation of ancient ritual sites, with Hindu remains holding much greater currency than Buddhist sites in the present-day cultic set up[1].

Conclusion

In this paper I have outlined some of the archaeological, cultural and ecological variables that informed the SSP research design at various stages of its development. Whilst sharing aspects of other extensive survey methodologies, it does not fit easily within unilinear evolutionary schemes which, reflecting largely European and North American contexts, place the intensive/systematic survey as the inevitable culmination of a series of flawed methods. I argue that by making explicit the regional underpinnings of the 'village-to-village' survey, it is easier to strike a balance between extensive/unsystematic and intensive/systematic methods. The resulting research design facilitates effective analysis of diachronic human:non-human:environment relationships over culturally defined areas whilst avoiding some of the biases associated with 'traditional' extensive methods. A second point is that as confirmed during Stage II from preliminary comparisons between a range of satellite imagery and previously documented archaeological sites, significant datasets would have escaped detection if remote-sensing had been relied on as a primary reconnaissance tool during Stage I. Whilst the satellite imagery proved helpful as a supplementary site-prospection and mapping tool during Stage II, initial site identification was more effectively facilitated through time-consuming ground-based explorations, and a 'reflexive' approach that included a sensitivity to local memory and the continued currency of archaeological sites in today's socio-ritual landscape.

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