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ResearchArticle

DISTINGUISH THE ANCIENT LANDSCAPE THROUGH SPATIAL STUDIES: CASE STUDY ON YAN OYA MIDDLE BASIN (YOMB), SRI LANKA

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A R T I C L E I N F O

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A B S T R A C T

Archaeologists always consider and explore social patterns, culture, political behaviors and boundaries of ancient society by using material culture which is geographically located. They are always tries to interpret those ancient human behavior patterns according to geographical location. However, this interpretation could not be realized properly by the lack of analysis. Recent advancement of GIS and archaeology spatial analysis become more powerful tool. It is very strong argument in recent archaeology, that human behavior is patterned. Numerous spatial studies state that importance of spatial patterns when study ancient human behavior. In this paper trying to give an explanation for the spatial distribution pattern in the selected area. The area is situated in North Central province of Sri Lanka. The Yan Oya Middle Basin consists of a massive amount of ancient burials. According to the archaeological evidence, the area is belonging to the protohistoric period (1300-400 BC) In this study main focus is on the mortuary remains to belong in the proto-historic period and specifically on the megalithic burials of this period and their positioning in the archaeological landscape of the Yan Oya river basin.

INTRODUCTION

Archaeologists aim to investigate and explain the social behavior of past human life by using geographical materials (9). Hence, Geographical Information System (GIS) becomes a practical tool for archaeologists. Usage of GIS in archaeology dates back almost two decades (10). During the last few decades, archaeological GIS have become more popular among researchers. It seems, however, that although GIS is recognized as a useful tool, research has concentrated on larger-scale questions such as landscape archaeology, settlement analysis, cultural resource, and heritage management.

Archaeological GIS categorize into two major groups, which are research and management. We can divide research into two classes, which are inter and intra (regional level and locational level). Predictive modeling, catchment analysis, exploratory data analyses are common applications for intra-site analysis. On the other hand, intra-site analysis deals with the site level. Nearest neighbor analysis, Kernel density estimation, trend surface analysis, and Euclidean distance are common applications of intra-site analysis. Management, the second common application of GIS in archaeology, comprises two sub-classes, which are Database Management (DBM) and Cultural Resource Management (CRM). DBM is related to storage, maintenance, and analysis of data at both regional and site base levels and CRM.

Main focused in the study is the Research aspect of Archaeological GIS. Hence, here not discuss the Management aspect of Archaeological GIS. Therefore, here discuss the locational level of Intra-site analysis. To do this, select burial site for further analysis, namely Tammannagodella burial site in Yan Oya Middle basin, Sri Lanka.

Analyses of intra-site, artifact distributions, and the study of activity areas are the foundation of intra-site analysis in archaeology. Contained by this study here consider the distance between the burials and burial size within the burial ground (7). Hence, concern about the spatial relationship among burials. The model that systematically relates the basic variables involved in the interaction of the human groups should be of some interest to archaeologists (6,1). These variables include the size, distance, and nature of groups engaged in interaction (8).

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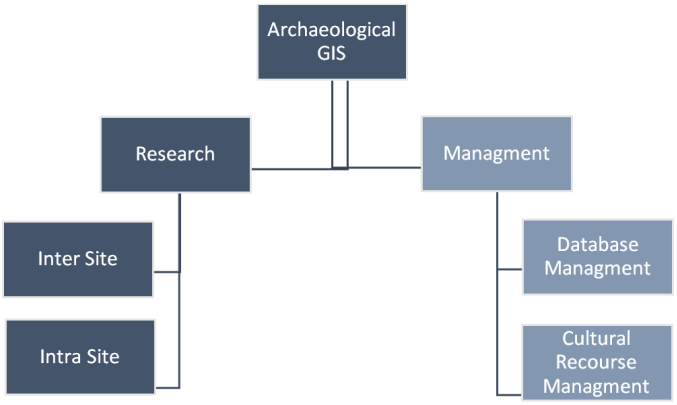

Figure 1 The method of Archaeological GIS.

Tammannagodalla Megalithic burial site

The Tammannagodalla burial site is located on left bank of the Yan Oya. It is one of the largest burial sites in this region. The overall area of the burial site is 80 KM2, which is bordered to Tammannagoda tank from West and to a rock outcrop from the East (3). One of the borders of a burial site is the parallel rock to the gravel road on which the KudaDambullaVihara is located and the other (West) border is limited to a small tank of Tammannagoda. The majority of graves could be observed in the offside of the bund of the tank (3).

Figure2 Distribution of graves at Tammannagodella burial site.

Many of the graves are submerged when the tank is full of water during North East monsoon. Many stone boards of the graves off the bund have been displaced due to the agricultural (paddy farming) activities of villagers. The road towards temple runs through the burial site and due to this some graves is under the road. It could be observed that some of the graves are destroyed due to regular maintenance of the road and excavation of drains. Only the visible graves were considered for the overall plan of the burial site and 206 individual burials were identified by the archeological study conducted in 2011 and 7 of them were excavated in 2012.

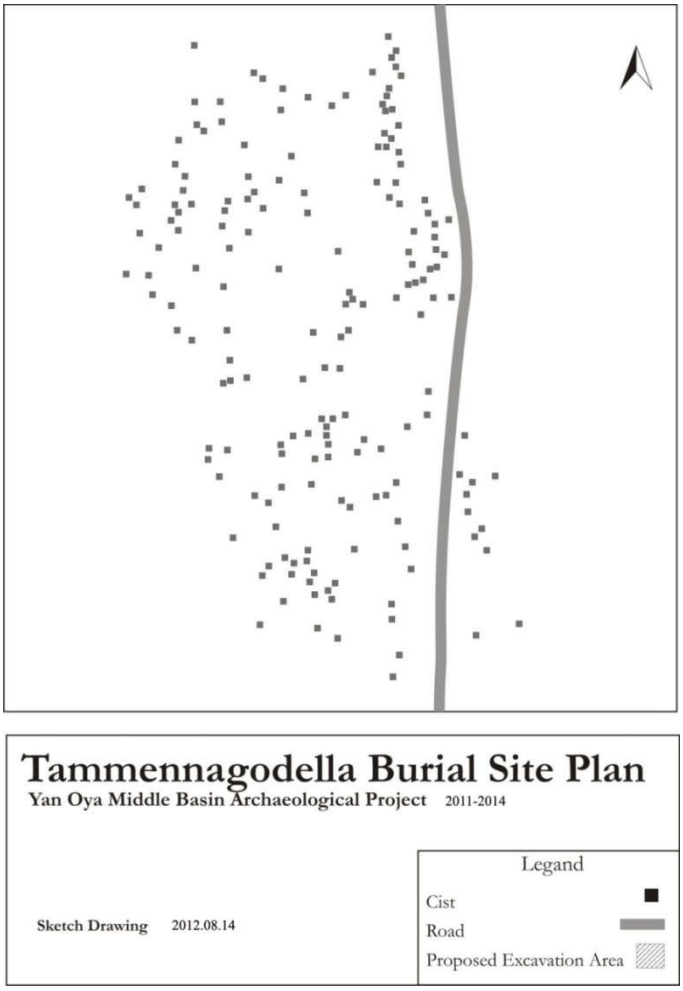

Figure 3 Site plan of Tammannagodella burial site.

Tammannagodalla burial site located off the overflow plain of Yan Oya left bank is a megalithic burial site comprising several graves. This is located off the bund of Tammannagoda tank and bordered to a rock outcrop in the east. Several archeological facts were found during the archeological exploration conducted in this area in 2011. A small Buddhist cave temple could be seen in the northern mountain of the burial site. Similarly, evidence of an ancient settlement could be observed in close proximity to this cave temple. Redware (RW), Black, and Red (BRW) potsherd are spread over the surface. This ruin of pottery suggests that this settlement belongs to the first half of the first century BC(5,13).

The surface limit of the burial was recorded with the help of visible stones of the entire burial site, which is about 80km^2. A common feature of these megalithic burials is a rectangular cist completed with four rough side stones. Some of the burial cists are covered with a capstone placed on top of the side stones or orthostatic while some of the tombs were not covered with a capstone. Similarly, some of the side stones and capstones of tombs were visible little and above the surface level. Nevertheless, some of the capstones and side stones of tombs were completed just up to the surface level. To identify

the tombs of a burial site of this kind, the aforementioned criteria can be used. Based on these characteristics the entire Tammannagoadalla burial site was recorded. To understand its horizontal distribution, the distance among burials were measured as a spatial data. Accordingly, to understand the implications of regularities of horizontal distribution of burials, nearest neighbor analysis was performed (11).

Nearest neighbor analysis

"Everything is related to everything else, but near things are more related than distant things" (15).
We can use nearest neighbor analysis to compare observed point pattern (2,6). It can provide a very simple evaluation that compares the average distance between a point and its nearest neighbor in the observed spread out. A random pattern is based on a position distribution. The nearest neighbor statistics

(R) can be expressed as:

$$R = \frac{\bar{r}_o}{\bar{r}_e},$$

R represents the nearest neighbor statistic, or mention mean of the observed nearest neighbor, and re is the expected mean distance to the nearest neighbor. Only the density of the system points determines the expected mean distance.

Density (p) is calculated as follows:

P=(n-1)/A

N is the number of point A is become as area. Those are expressed as the number of spatial units based on the value of the density. The nearest-neighbor analysis examines the distance between each point and its nearest point and after it compares these two expected values for a random sample of points from a CSR (complete spatial randomness) pattern (12). The index R describes only a part of the total pattern and can serve as a useful basis for asking questions that are more detailed about the factors that underlie the observed pattern. Therefore, archaeologist can study the distribution of sites over an ancient landscape.

One of the primary methods of point pattern analysis is tests for randomness. The most proven statistic for this is the nearest neighbor index (4). According to the nearest neighbor statistic the distribution of artifacts, Nearest neighbor, analysis has been applied from the beginning of spatial archeology to understand the regularities or isometric patterns of horizontal distributions of an archeological landscape (7,14). It has mentioned the applicability of the above technique to understand the sensitive complexities of an archeological landscape that are not visible to the naked eye. The regularities can be identified by the horizontal and vertical patterns. The previous studies of nearest neighbor analysis have mentioned three types. Namely,

Cluster patterns
Random patterns
Dispersed patterns

The nearest neighbor statistics of Tammannagodalla megalithic burial site indicates a clustered pattern of cists. This clustered pattern occurs based on the horizontal distance among cists (table 01) According to visualization of this nearest neighbor analysis results, the intensity of the concentration of large tombs are grouped towards north western side of the burial site.

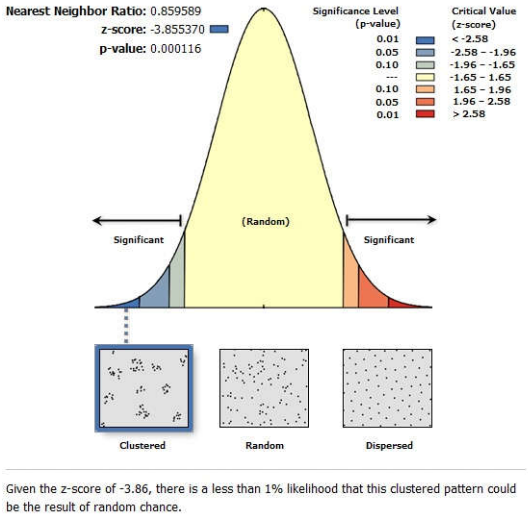

Figure 4 Results of nearest neighbor analysis at Tammanagodalla burial site.

Table 1 Results of nearest neighbor analysis at Tammanagodalla burial site.

Data set	Sample size (Number of burial)	Observed Mean Distance (m)	Expected Mean Distance (m)	Nearest Neighbour Ratio)	p-value	z-score	Distribution pattern
Tammannagodella	206	18.499075	15.649256	1.182106	0.065262	1.843459	clustered

Inverse Distance Weighted Interpolation (IDW) analysis for Tammannagodella burial site

The site consists totally of 206 graves and therefore finding a spatial pattern was really complicated.

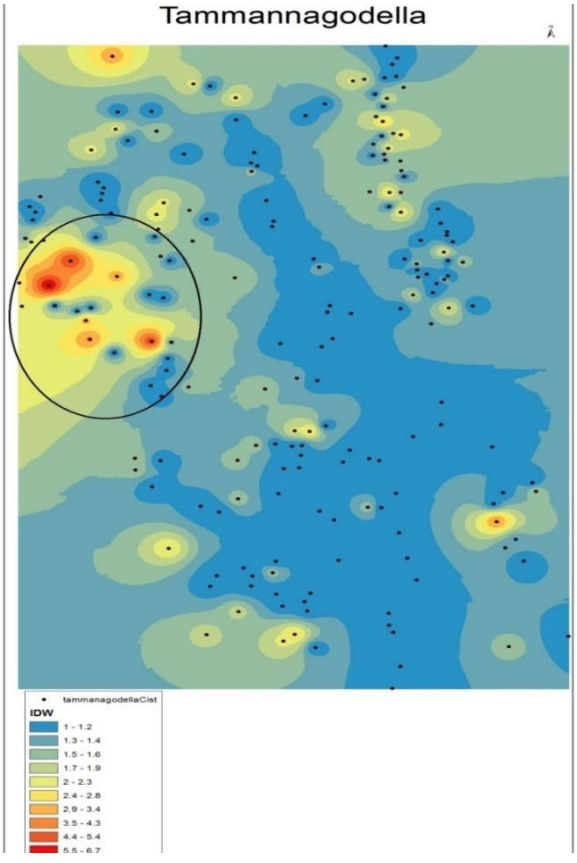

Figure 5 Inverse Distance Weightedanalysis- Tammanagodella burial site.

Based on these characteristics the entire Tammannagoadalla burial site was recorded. To understand its horizontal distribution the distance among burials and the size of the burial were measured as spatial data. The results of the above were visualized for further clarification was observed that the larger graves were placed from northwest direction. (Figure 5) the circle of the map shows more concentration of the large burials placed in northwest direction. The grave size was classified according to 4 categories. The largest category was 5.5-6.7 m^2 which is shown in red color and the smallest category was 1.00-1.2m^2 which is shown in a dark blue color. These measurements are based on the actual size of the grave. The results of the IDW analysis showed a large patch of the smallest grave distribution of the burial ground. (Figure 5)

CONCLUSION

The conclusion in terms of questions established under this study is, megalithic burial complexes can be used as a specimen with the help of spatial and predictive model to explain the social formation of megalithic burial tradition of Sri Lanka and this confirms both horizontal and vertical analytical approaches. It was evident that the different sites have different distribution patterns of burials based on their size and the distance. Further, the burial architecture within the burial complex was diverse in keeping with the size and distance of the cists. Some clues of the social hierarchy of the settlers are evident from the observed depositional pattern of burial goods.

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