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GIS IN MODELLING THE VIKING AGE ENVIRONMENT IN TAIPALSAARI, SOUTHERN KARELIA

Abstract

This paper describes the possibilities of GIS (Geographic Information Systems) in archaeology. GIS-analyses have been used to study the relationship between prehistoric settlement and environmental resources. The Iron Age sites of southern Karelia and Savo, especially the Taipalsaari area, are given as examples.

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Introduction

In my study I have described the locations and environments of the Late Iron Age sites in Eastern Finland and defined the environmental resources that were available in the catchment areas. By using GIS I have analyzed the environmental factors such as soil, fertility, vegetation, topography and distance from the Iron Age sites to eskers and bodies of water. I have tried to distinguish the essential environmental factors from random variation. One of the goals was to recognize different activity areas and to make inferences on the economics of the sites.

The research area covers southern Karelia and southern Savo. The Late Iron Age sites of this area are included in the environmental study. The most numerous sites are cup-stones (86) and the locations of stray finds (60); besides these there are hillforts, burial grounds, dwelling sites and hoard finds (57 in total).

The two main research areas are the Mikkeli-Juva (map sheet 3142) and the Taipalsaari-Lappee (map sheet 3134) regions with their 64 Iron Age sites and stray finds. Some analyses have also been made in the most important cup-stone area in the Kerimäki-Savonlinna region (map sheet 4122/4211). The area of each region is 1200 km^2. (Fig. 1). I use in this paper the Taipalsaari-Lappee area as an example of my studies.

The Taipalsaari-Lappee region is located in the southern part of Lake Saimaa. The sites in that area consist of two Viking Age cremation cemeteries, three hillforts, four stray find locations and two possible dwelling sites. Besides these there are several cairns in the area.

This study is a part of the Ancient Lake Saimaa -project of the Dept. of Archaeology at the Helsinki University. One of the purposes of the project is to study the relationship between prehistoric settlement and environment.

GIS-method

Geographic Information Systems GIS (Fin. paikkatietojärjestelmä) combines numerical maps and databases. Basically, GIS is a layered representation of spatial data. Each layer represents one geographical or environmental factor, e.g. the height above the sea level or the soil type. One can combine these maps with data imported from different databases, for example a database of archaeological sites.

GIS allows one to describe, analyze, compare and mathematically transform multiple spatial distributions. With GIS it is also easy to visualize the results. It is a useful tool for those who are investigating the environment, locations and distributions of different entities and have problems in handling continuous, three-dimensional spatial data. GIS has many applications which help mod-

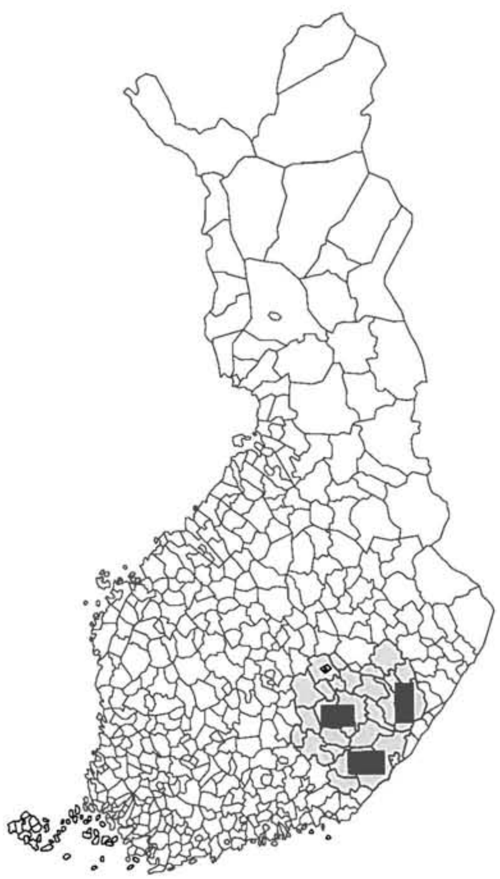


Fig. 1. Research area. The map sheets 3134, 3142 and 4122/4211 are marked with dark areas.

elling such things as innovations, settlement and activity areas. (see e.g. Gaffney & Stančič 1991, 29–32; Kvamme 1992, 77–84; Lock & Harris 1992, 88–92; Star & Estes 1990).

In the 1980–1990's GIS has been utilized in archaeology both in research and in the management of archaeological resources. In the USA predictive models have been created by using GIS in order to be able to plan archaeological surveys in large areas which are under powerful land use and where the investigations have to be made quickly. (see e.g. Altschul 1990, 226–238; Warren 1990, 201–215). It has been used in surveys covering thousands of square kilometers as well as in intra-site spatial analyses.

The Taipalsaari-Lappee, Mikkeli-Juva and Kerimäki-Savonlinna areas have been analyzed by a raster-based GIS-program called Idrisi. In a raster GIS-program spatial data are represented by a large grid of cells. Each cell represents the value of a variable in a small region, for example 50 x 50 meters. The study material consists of the following numerical maps: some of them were received from different institutes, others were digitized at the Department of Archaeology (Table 1). The resolution of these maps is 25 x 25 or 50 x 50 meters.

Data from the archaeological database concerning the research areas (f.ex. find material, site location etc.) were imported to Idrisi and overlaid with numeric map layers. The observations were divided into three groups: dwelling sites/cemeteries, hillforts and stray finds. Different environmental factors, such as areas and distances, were calculated with Idrisi. The resulting data were exported to the SAS statistical program for further analyses.

Studying the environmental factors with GIS

The areas with different soils, fertility classes and forest types have been calculated within radii of 0.5, 1, 3 and 12 km surrounding the archaeological sites. The distances from the sites to important environmental elements like eskers and bodies of water were also calculated. The advantages of the Idrisi-program are the speed and accuracy of calculations and especially the ease of computing a reference value from the whole background of the map. For instance, in the Mikkeli-Juva area the average distance from the nearest esker to the dwelling sites, cemeteries and hillforts is 2500 m, and 1300 m to the locations of stray finds. The mean distance from all the non-site raster pixels (50 x 50 meters) to the nearest esker is 2800 meters. It is quite obvious that the relation of the stray find locations to the eskers differs significantly (Chi-square test, $p<0.001$) from the background area.

The proportion of the fine-grained soils — especially silt — is higher near the dwelling sites and cemeteries at 0.5–1 km radius than in the large background area. (Fig. 2). These fine soils are also more fertile than the same soil textures farther away from the sites. The difference begins to smooth at the 3 km radius. The more fertile tills are situated at a distance of 3–5 km from the sites. This indicates that they were available but did not directly affect the location of the dwelling sites and cemeteries. As for the environment of the hillforts, no such pattern emerges.

The situation is not as simple as the abovementioned where stray finds are concerned: stray finds form a group that is much more heterogeneous than those of the dwelling sites, cemeteries

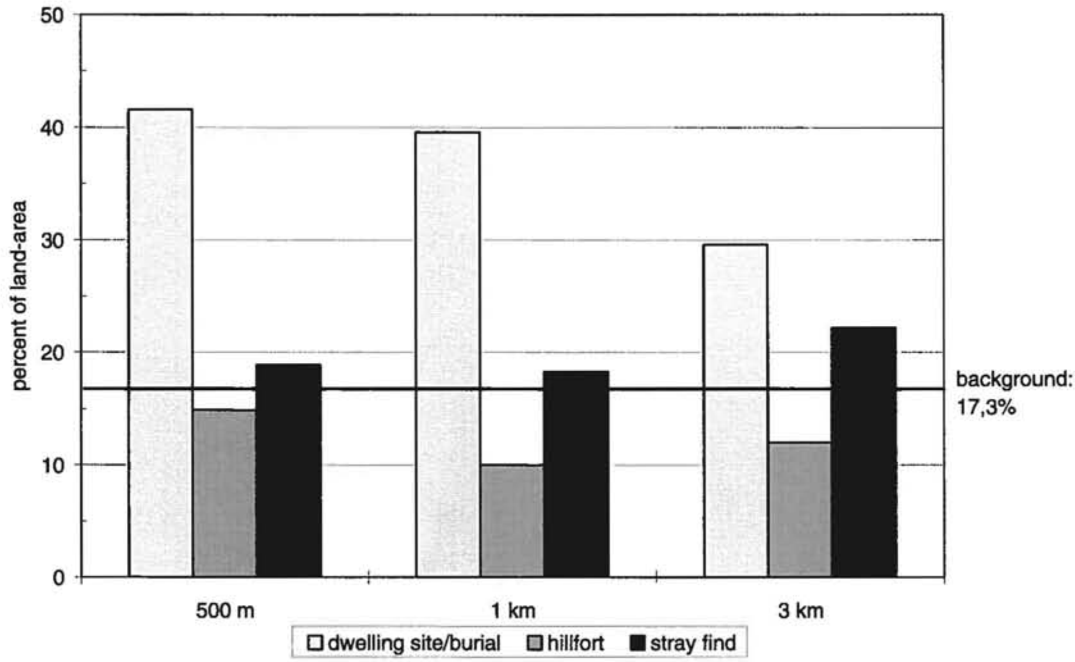


Fig. 2. Percentages of fine soils in the surroundings of the sites of the Taipalsaari-Lappee region.

and hillforts. For example, the environments of those stray finds which consist of ornaments or which are situated less than 2 km away from archaeological remains are very similar to the environments of the dwelling sites and burial grounds.

Fertility map

The fertility of the environments of the Iron Age sites has been studied by interpolating the results of soil analyses made by Geological Survey of Finland (GTK) and Agricultural Research Centre (MTTK). The correlation between fertile, fine-grained soils and Iron Age sites in the Taipalsaari area (3134) can be seen in Fig. 3. Within a radii of 500 meters from the sites the soils are six times more fertile on an average than the soils in the backgound area of 1200 km².

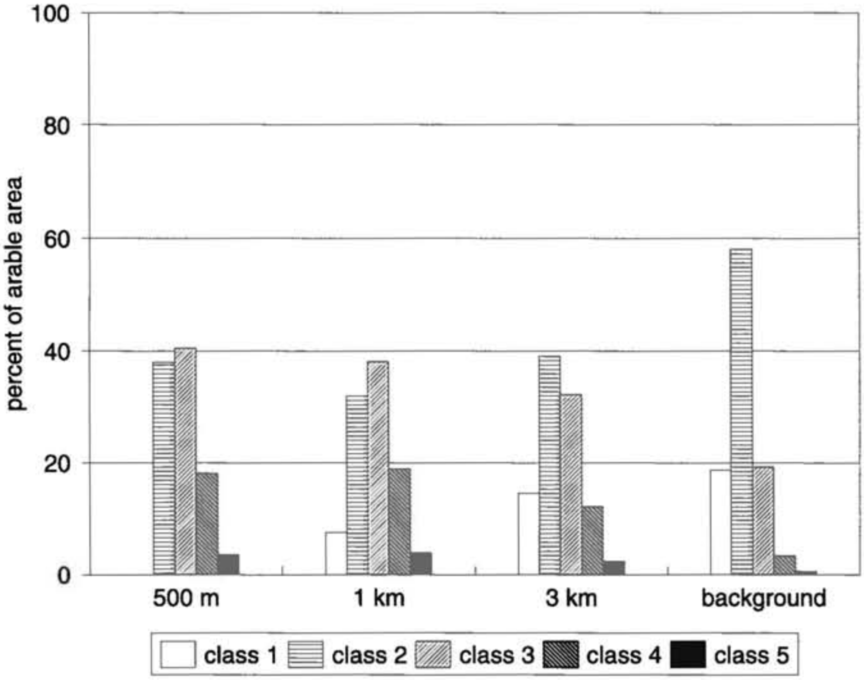
The importance of fertility can also be detected in the environments of the sites which are situated over 500 meters away from the nearest 11th century shore. In the Taipalsaari and Mikkeli areas there are 8 sites which are not bound to the shore (distance >500 meters) and they are situated in close proximity to the most fertile areas. In these cases fertility has obviously been the primary factor that has directed the activities.

Favourability map

With GIS it is possible to combine different thematic maps by using arithmetical and logical operations and thus create new variables. As an example, I have combined some of the most important environmental factors such as
- high fertility
- distance to bodies of water 1–499 meters
- fine soils

in order to create a so-called favourability map (Fig. 4). It shows the number of favourable elements in each raster pixel in the Taipalsaari-Lappee area. The map shows that cemeteries, dwelling sites and stray finds are situated close to the most favourable areas, while the locations of the hillforts are clearly different.

In the same way it is possible to model the best areas for swidden cultivation by combining the factors that are supposed to be favourable for swiddening.



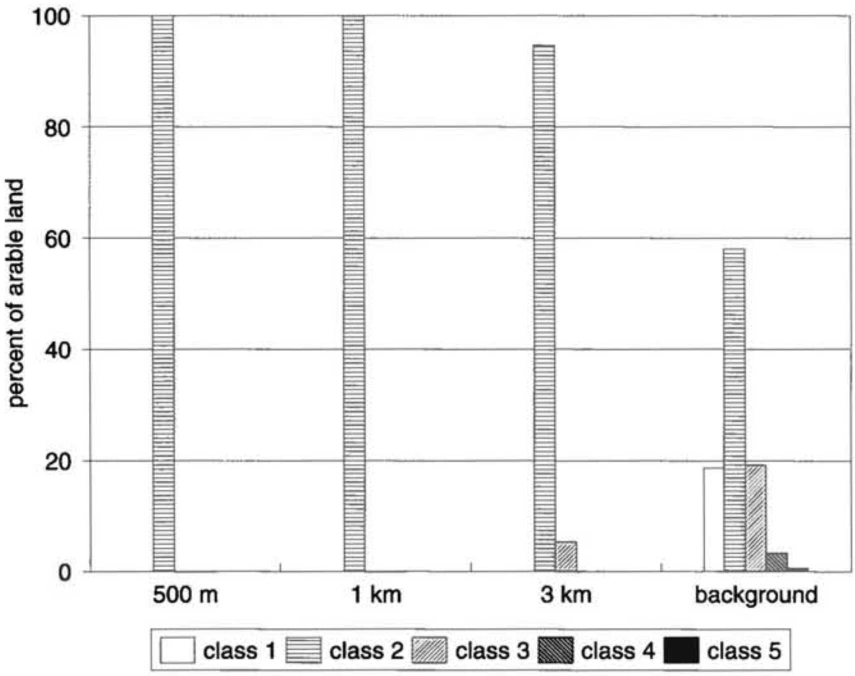


Fig. 3. Percentages of fertility classes in the surroundings of the sites of the Taipalsaari-Lappee region. Above: dwelling sites, burials and stray finds; below: hillforts.

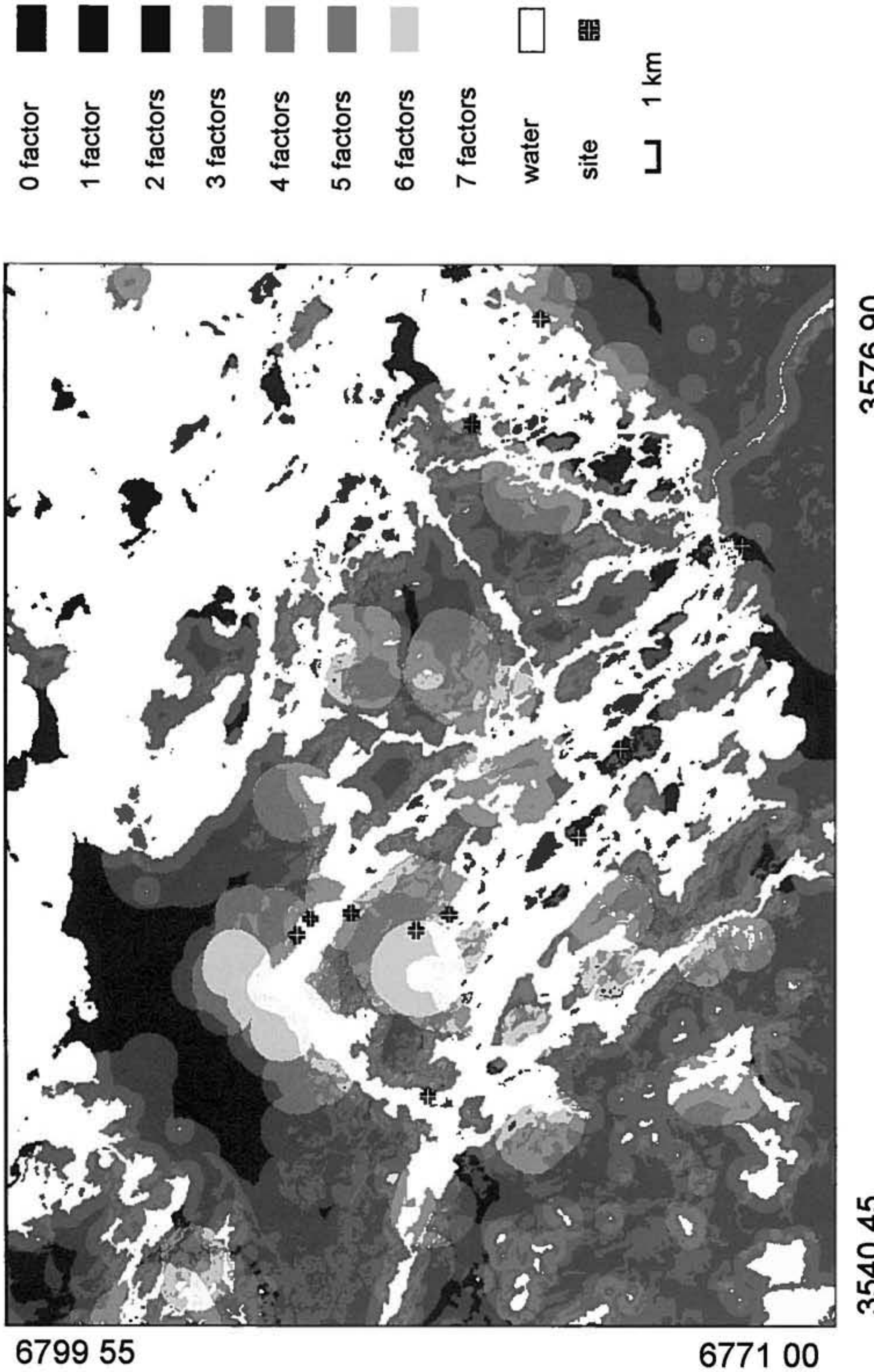


Fig. 4. Favourability map (3134).

Table 1. Numeric material.

Numeric material	Data source
Soil map 3134	Geological Survey of Finland (1:100 000) and digitized from soil maps (1:20 000)
Rock map 3134	digitized from rock map (1:100 000)
Fertility map of fine soil types (Ca, K, Mg, P) 3134	derived from the soil analyses of the Agricultural Research Centre (MTTK)
Fertility map of till (Ca, K, Mg, P) 3134	derived from the soil analyses of Geological Survey of Finland (GTK)
Forest classification of the municipality of Taipalsaari	derived from Landsat satellite image, Finnish Forest Research Institute (METLA)
Supra- and subaquatic areas 3134	digitized from the topographic maps (1:20 000)
Digital elevation model 3134 02 and 3134 05	Map Centre (Karttakeskus)
Water; lakes, streams and ponds 3134	digitized from the topographic maps (1:50 000)
Field map 3134	digitized from the topographic maps (1:50 000)
Several thematic maps based on the archaeological observations made in 1992 in the immediate surroundings of Vammonniemi cremation burial 3134 05 and 3134 06.	digitized according to the observations made during the fieldwork (1:5000)

Conclusion

This paper gives a short presentation of the GIS methodology. With GIS it is possible to calculate easily different environmental variables, combine them to models describing the prehistoric environment, and visualize and test these models statistically.

The conclusion of my study on the Viking Age settlement in Taipalsaari is that the most important environmental factors for settlement are fine soils, close relation to bodies of water and high fertility. The pollen analysis made in Taipalsaari Laukniemi suggests that swidden cultivation and cattle-breeding were practised in the area during the Late Iron Age (Vuorela & Kankainen 1993). The combination of the environmental factors seems to indicate that suitability for cattle breeding has been more important factor than suitability for cultivation when choosing the place of the dwelling site.

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