Field Navigation Mobile App – Agroecological zoning of the Mato Grosso do Sul state – ZAE/MS

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Thematic Session: Pedometrics guidelines to systematics soil survey

Abstract

Obtaining primary soil data to support zoning studies is rare in Brazil. Navigation and adequate location of defined sampling points are limitations in the application of sampling design statistical techniques in large areas. The development of an mobile app, based on a platform of geographic information system for orientation and adequate location of sampling points, presented facilities compared to traditional navigation techniques in the field.
Keywords: soil survey; pedrometrics; sample design

Introduction

Zoning studies are a traditional instrument of planning and ordering. Zoning studies may have various aspects, its land use and occupation are widely applied in urban and rural areas.

Due to the lack of data on natural resources in Brazil at compatible scales (=>1:100,000), these studies are traditionally based on secondary data. This zoning study is entirely based on the use of primary soil data and of pedometric techniques and it presented some new challenges.

Despite the advances made in the preparation of soil surveys, particularly with the adoption of digital soil mapping, either for attributes or for soil classes, the exact location and access by statistical techniques to predefined sampling points has been a great challenge.

This work presents the solution adopted in the Agroecological Zoning of the State of Mato Grosso do Sul (under development by Embrapa in partnership with the State Government) for navigation and access to description points and soil samples gathering.

Methodology

The environmental covariates used to classify were selected from an initial set of 25 covariates. From this set, the variables were selected by eliminating the ones with high correlation (nonlinear correlation above 95%) to avoid the collinearity effect. In a second stage, among the categorical variables, those with high similarity were identified. Afterwards, the most important variables were ranked using the “Importance” function of the Randon Forest algorithm. The final set were composed of eight covariates. The morphometric variables related to the terrain were obtained through the R software with the R-Saga package, from the Digital Elevation Model (NASA JPL, 2020).

Categorical maps of the main geomorphological compartments of the state were additionally used, in addition to the lithology, based on the geological map (IBGE, 2021), vegetation (IBGE, 2021), soils (IBGE, 2021) and geodiversity (CPRM, 2009).

The sampling points were obtained through the geographically distributed stratified random sampling technique. Spatial restriction of a distance of less than 250m from the access roads available in the information plan of the basic cartographic material was used to favor access to the points. Latin Hypercube Conditioning method available in the R software (R Core team, 2020) was used in this procedure.

The first challenge in browser development was planning all the content (information layers and their features). The information layers, the form of presentation, display scales and symbologies used were defined in this stage. The entire set of basic information, including the basemap, consists of a satellite image and needs to be configured individually. The set is later encapsulated to enable its operation in offline mode since in areas with large geographic coverage and far from municipal headquarters internet connection is normally not available.

The municipal division with the location of the respective municipal headquarters, the access roads, individualized by type of pavement and jurisdiction, the hydrography and the mapping of categorical covariates already used in the definition of the sampling design were used as support information layers. This happened in this construction to facilitate access to predefined sampling points in the sampling design.

The application for field navigation was developed using ArcGis Explorer. All steps are performed in ArcGis Pro and the generated files are encapsulated for loading in the ArcGis Explorer software in this construction.

Results and discussion

Relevant aspect to be considered in the sampling design refers to the possible concentration of points in top elevation areas associated with water dividers, preferred location of most access roads. Thus, performing geographically distributed adjustments to the sampling plan with the adoption of toposequences was totally satisfactory for navigation and sampling (Figure 1).

Therefore, the indication of the spatial location of the soil samples corresponds to the spatial distribution of the covariates.

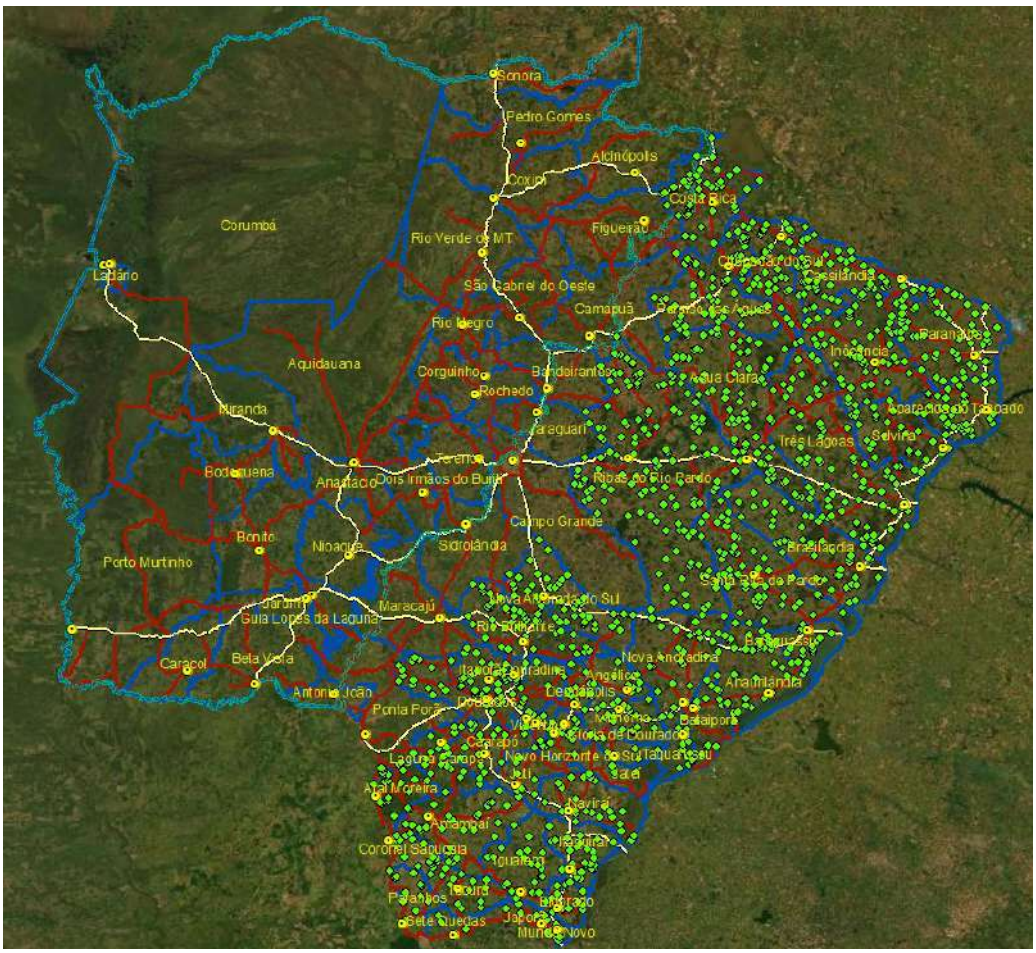

Figure 1. Sampling design for Agroecological Zoning of Mato Grosso do Sul state – Phase 3.

The standardization of maximum and minimum viewing scales of information layers in the file inserted in the application is associated with the need for visual details necessary for full navigation and with the size of the file generated for encapsulation. Though its size is limited by the mobile device hardware characteristics.

The standard area to be covered must be taken into account in the file development to be into the application used for field navigation. This area should be determined by maximum zoom scale desired. The scale must be suitable for navigating visual detail that can be identified by standard and alternative access to sampling points and the size of the file to be encapsulated.

Two example screens of the navigation application for mobile devices are presented below. It shows the navigation screen with the estimated location of points, the basic map used for navigation and in another a list of information layers enabled for support and information.

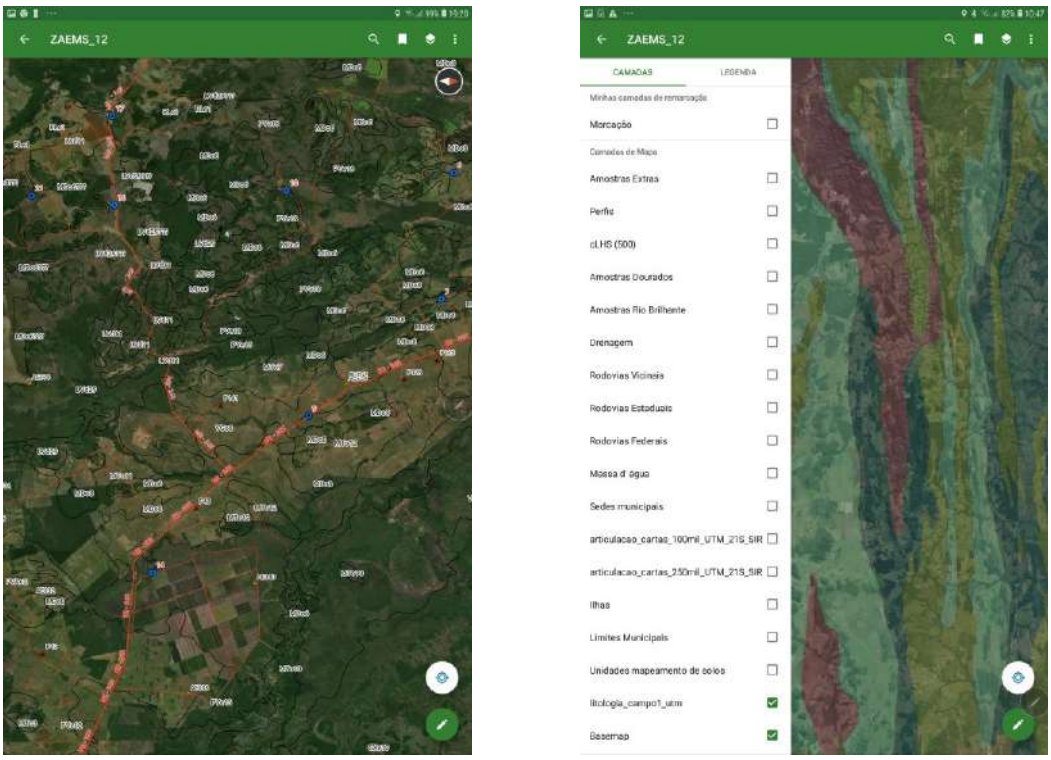

Figure 2. Navigation mobile appscreens.

Conclusions

Field Navigator use enabled the adoption of the sampling statistics technique since the main challenge encountered was orientation difficulty and sampling points access.

This difficulty was consolidated by the use of traditional global positioning system devices associated with outdated altimetric bases and satellite images in printed media.

The application overcame the traditional techniques difficulties which incorporated a high time consumption, navigation uncertainty and accessbility difficulty of alternative routes.

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