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Spatial and temporal predictions of agricultural land prices using DSM techniques.

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Agricultural land prices highly impacts land accessibility to farmers and by consequence the evolution of agricultural landscapes (crop changes, land conversion to urban infrastructures...) which can turn to irreversible soil degradation. The economic value of agricultural land has been studied spatially, in every one of the 374 French Agricultural Counties, and temporally- from 1995 to 2007, by using data of the SAFER Institute. To this aim, agricultural land price was considered as a digital soil property. The spatial and temporal predictions were done using Digital Soil Mapping techniques combined with tools mainly used for studying temporal financial behaviors.

For making both predictions, a first classification of the Agricultural Counties was done for the 1995-2006 periods (2007 was excluded and served as the date of prediction) using a fuzzy k-means clustering. The Agricultural Counties were then aggregated according to land price at the different times. The clustering allows for characterizing the counties by their memberships to each class centroid. The memberships were used for the spatial prediction, whereas the centroids were used for the temporal prediction.

For the spatial prediction, from the 374 Agricultural counties, three fourths were used for modeling and one fourth for validating. Random sampling was done by class to ensure that all classes are represented by at least one county in the modeling and validation datasets. The prediction was done for each class by testing the relationships between the memberships and the following factors: (i) soil variable (organic matter from the French BDAT database), (ii) soil covariates (land use classes from CORINE LANDCOVER, bioclimatic zones from the WorldClim Database, landform attributes and landform classes from the SRTM, major roads and hydrographic densities from EUROSTAT, average field sizes estimated by automatic classification of remote sensed images) and (iii) socio-economic factors (population density, gross domestic product and its combination with the population density obtained from EUROSTAT). Linear (Generalized Linear Models) and non-linear models (neural network) were used for building the relationships. For the validation, the relationships were applied to the validation datasets. The RMSE and the coefficient of determination (from a linear regression) between predicted and actual memberships, and the contingency table between the predicted and actual allocation classes were used as validation criteria.

The temporal prediction was done on the year 2007 from the centroid land prices characterizing the 1995-2006 period. For each class, the land prices of the time-series 1995-2006 were modeled using an Auto-Regressive Moving Average approach. For the validation, the models were applied to the year 2007. The RMSE between predicted and actual prices is used as the validation criteria.

We then discussed the methods and the results of the spatial and temporal validation. Based on this methodology, an extrapolation will be tested on another European country with land price market similar to France (to be determined).