Landscape agronomy at the watershed scale: comparing two complementary methods dealing with the agricultural systems architecture

Davide Rizzo, El Ghali Lazrak, Marc Benoît

Published on *IALE 2013 European Congress* (http://www.iale2013.eu)

Landscape agronomy at the watershed scale: comparing two complementary methods dealing with the agricultural systems architecture

Authors and Affiliations:

Rizzo D. [1*]., Lazrak E.G. [1], Benoît M. [1]

[1] INRA UPR 055 SAD-ASTER, F-88500, France

* Corresponding author

Email:
ridavide@gmail.com [1]

Abstract:

Agriculture is challenged by large scale issues, like impacts of land system changes on the preservation of environmental resources, urging agronomy to evolve. Landscape agronomy has been proposed as new perspective to address these issues (Benoît, Rizzo et al. 2012). It stressed the need for developing spatially-explicit modeling and assessment of agricultural activities at spatial levels encompassing the farm and its contexts. In line with this, we aimed at comparing two empirical studies whose common purpose was to characterize the landscape organization of agricultural land uses within a hydrological spatial framework. In particular, primary catchments were aggregated or segmented according to land use dynamics, stressing out the role of crops and meadows dynamics at different stream order levels (see Strahler, 1957). Both studies had thus to face difficulties at retrieving datasets to describe agriculture at wide spatial levels over long periods.

The first study assessed land use dynamics and their potential impact on water quality for the Meuse and Moselle watersheds (24,000 km^2, NE France). TerUti data (French Ministry of Agriculture) were analyzed at the primary catchment (hereafter PC) scale, as mapped by the Rhin-Meuse Water Agency (funding body and project partner). Return times of 11 land use classes, 9 of which agricultural, were described for each PC with a five-year window, sliding over the period 1981-2010. A preliminary data-mining using CarottAge (Mari & Le Ber 2006) oriented the successive analyses of land use trajectories, performed with R packages (Gabadinho et al. 2011, Housson et al. 2012). Hierarchical clustering on principal component was then used to aggregate the 16 PC on homogenous land use trajectories.

The second study aimed at generalizing a time-space clustering method based on hidden Markov models for the Yar PC (60 km^2, NW France). The method, currently implemented as

research software (ArpentAge, Mari et al. 2013), was originally developed to tackle detailed, yet highly work-demanding long-term surveys (Lazrak et al. 2009). Maps used to segment the Yar catchment derived from satellite images and distinguished 3 agricultural land uses, out of 6 total classes, over 12 successive years (Corgne, 2004). Such a coarse thematic resolution was due to limits in the remote sensing data interpretation. Despite that, major agricultural dynamics were unveiled, shedding new light on the role of agricultural activities in eutrophication issues that threaten this watershed.

In summary, both studies provided an example of advances in observational capabilities and modeling methods of landscape agronomy. More generally, they provided also insights in the land system architecture (Turner II et al. 2013). Indeed, eliciting the study of subtle (agricultural) land use changes by using watershed spatial elements can meet expectations of local and regional resource managers for decision-making spatially-explicit supports.

References:

Benoît M, Rizzo D, Marraccini E, Moonen AC, Galli M, Lardon S, Rapey H, Thenail C, Bonari E, 2012. Landscape agronomy: a new field for addressing agricultural landscape dynamics. Landscape Ecology 10, 1385–1394. doi: 10.1007/s10980-012-9802-8

Corgne S, 2004. Driving factors for pluri-annual changes of winters bare soils. A hierarchization in the Yar watershed area, Brittany. Norois Environnement, aménagement, société 17–29. doi: 10.4000/norois.713

Gabadinho A, Ritschard G, Müller NS, Studer M, 2011. Analyzing and Visualizing State Sequences in R with TraMineR. Journal of Statistical Software, 40(4), 1-37. URL http://www.jstatsoft.org/v40/i04/.

Husson F, Josse J, Le S, Mazet J, 2012. FactoMineR: Multivariate Exploratory Data Analysis and Data Mining with R. R package version 1.20. http://cran.r-project.org /web/packages=FactoMineR

Lazrak EG, Mari J-F, Benoît M, 2010. Landscape regularity modelling for environmental challenges in agriculture. Landscape Ecology 25:169–183. doi: 10.1007/s10980-009-9399-8

Mari J-F, Le Ber F, 2006 Temporal and spatial data mining with second-order hidden markov models. Soft Comput 10:406–414. doi: 10.1007/s00500-005-0501-0

Mari J-F, Lazrak EG, Benoît M, 2013. Time space stochastic modelling of agricultural landscapes for environmental issues. Environmental Modelling & Software (accepted)

Strahler AN, 1957. Quantitative analysis of watershed geomorphology. Transactions of the American Geophysical Union 38 (6): 913-920.

Turner II BL, Janetos AC, Verburg PH, Murray AT, 2012. Land system architecture: Using land systems to adapt and mitigate global environmental change. Global Environmental Change. doi: 10.1016/j.gloenvcha.2012.12.009

Date and time:
Monday, 9th September 2013 - 16:15 to 16:30
Attachment:
rizzoetalfigure.pdf [2]

Source URL: http://www.iale2013.eu/landscape-agronomy-watershed-scale-comparing-two-complementary-methods-dealing-agricultural-systems

Links:
[1] mailto:ridavide@gmail.com
[2] http://www.iale2013.eu/sites/default/files/abstract_attachments/rizzoetalfigure.pdf