Appendix S1 for: *Visualizing land-use and management complexity within biogeochemical cycles of an agricultural landscape*

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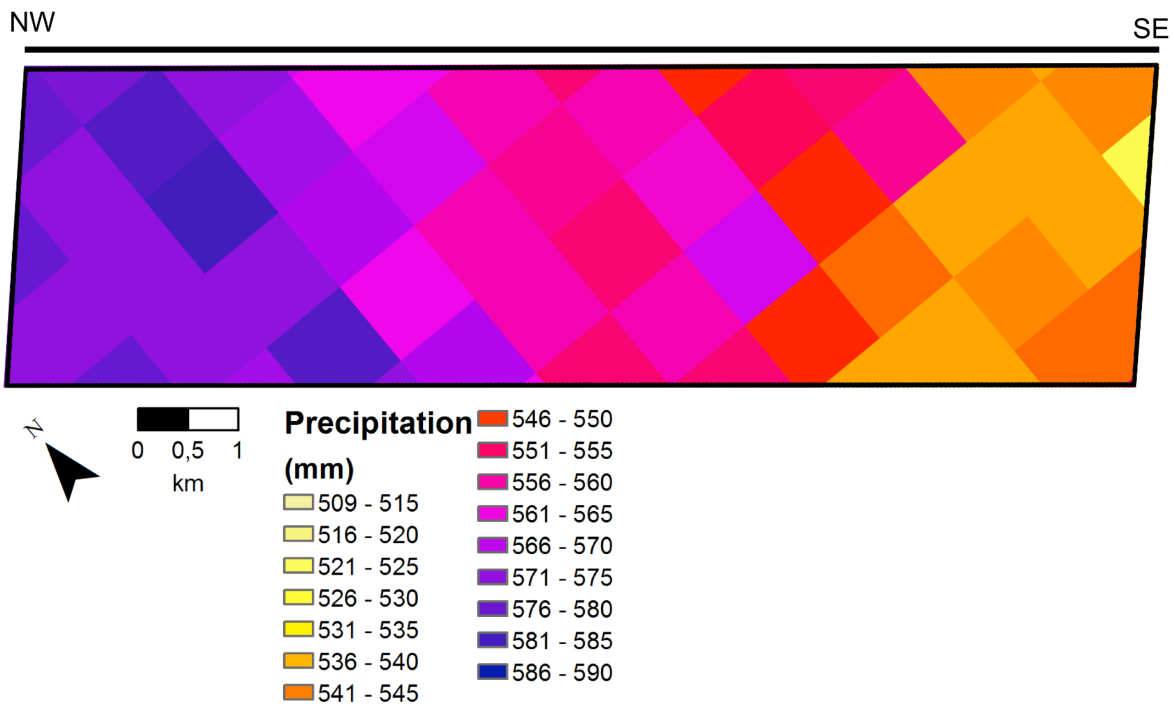

Fig. S1: Annual mean precipitation (mm) based on data from 1981 to 2010 indicates a precipitation gradient of around 45 mm from NW to SE (WebWerdis, Deutscher Wetterdienst, Offenbach am Main 2012). A multi-stage modeling procedure was used to derive the gradient and no weather station was located within the sampling area.

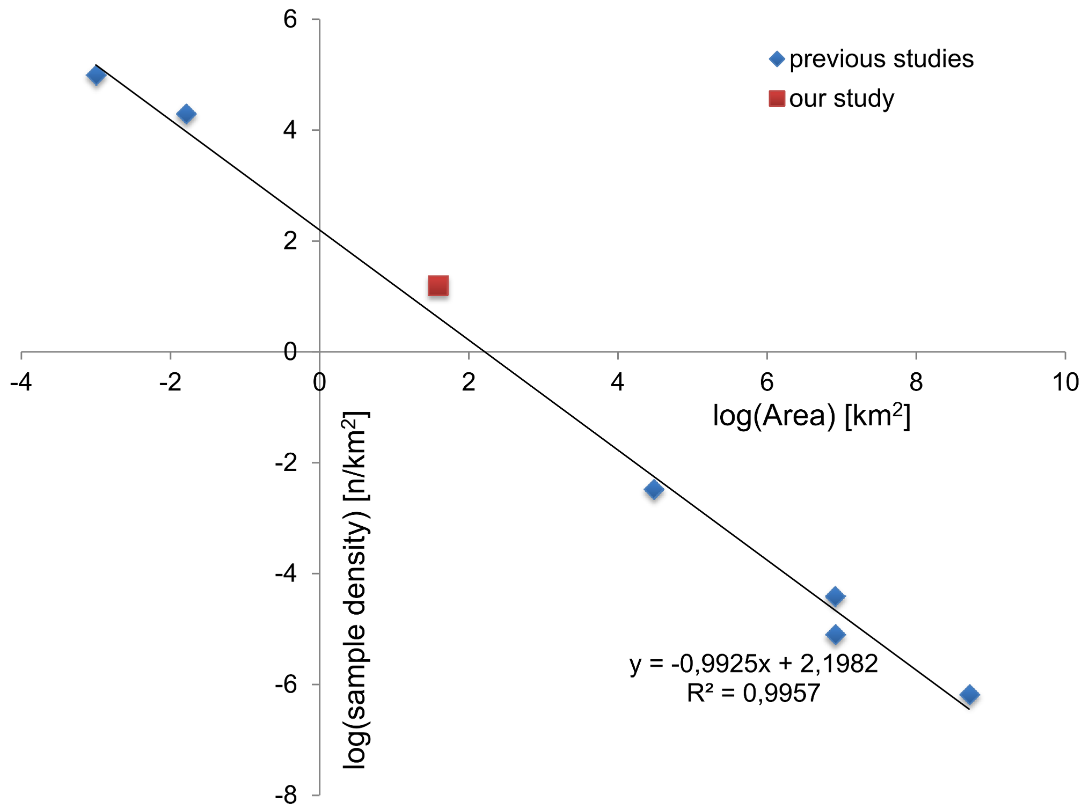

Fig. S2: Comparison of sampling densities vs total sampling area for selected studies (Kendall and Coplen 2001, West et al. 2008, Ehleringer et al. 2008, Brooks et al. 2012, Rascher et al. 2012, Bai et al. 2013) with this study. Sampling density is defined as the logarithm of the number of samples *n* per 1 km^2 (log(n/1 km^2)) vs. logarithm of total sampling area in km^2 (log(area)).

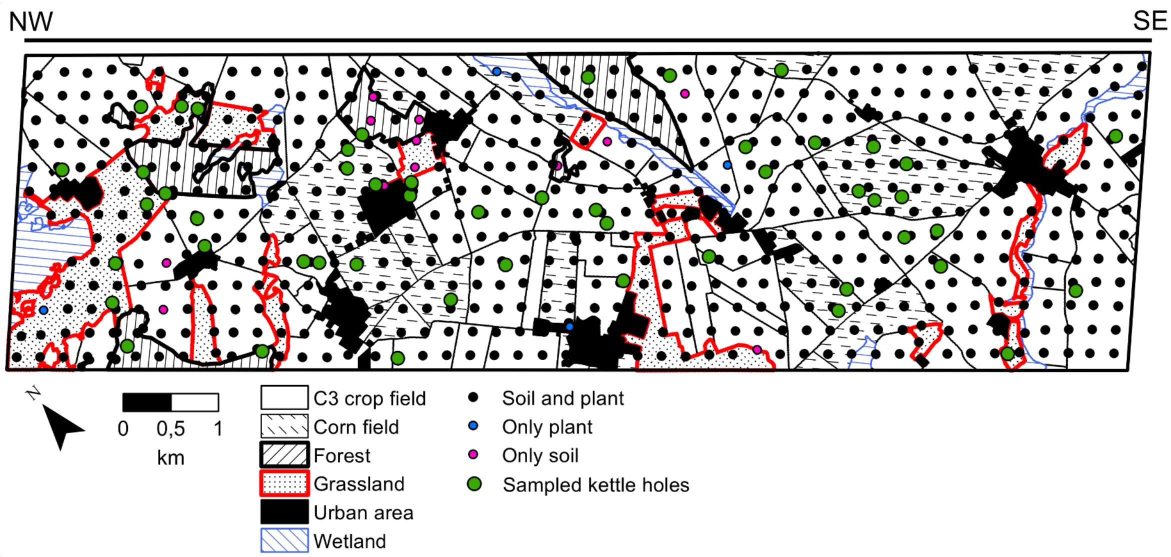

Fig. S3: Positions of sampled plants, soils and kettle holes within the arable, grassland and forest land-use type. Wetlands are defined as >1 ha and thus are not considered to be kettle holes.

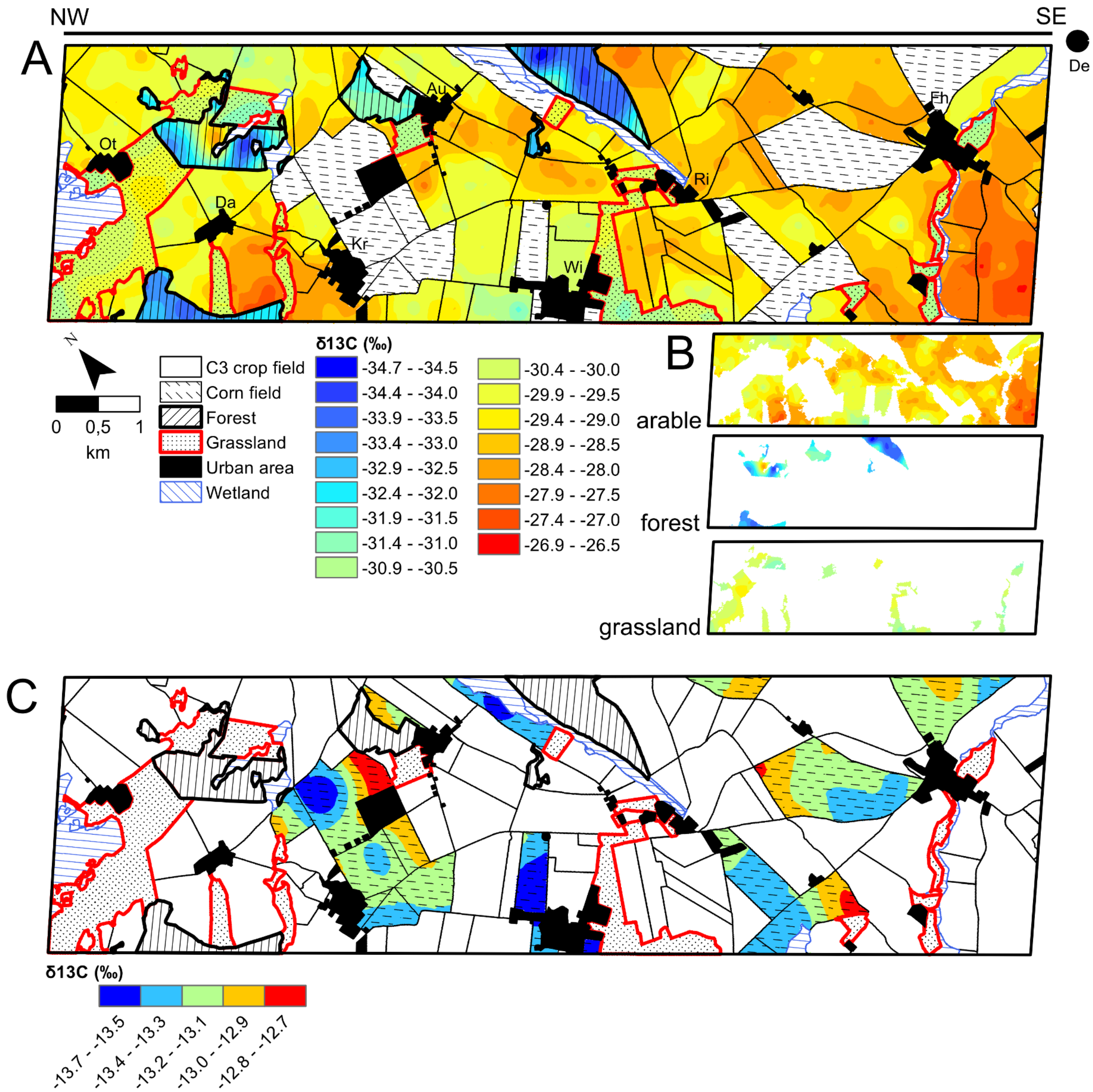

Fig. S4: Isoscapes (A) of $\delta^{13}C$ (‰) for C_3 plants sampled from the three land-use types using ordinary kriging. Interpolation was performed first for each land-use type independent of other types. The three isoscapes were then compiled into one overall isoscape using a common scale. Grasslands are highlighted with red borders and forests with black borders The area interpolated to generate each land-use type isoscape is shown in B using the same scale. Areas not interpolated include wetlands >1 ha and urban areas. The isoscape of corn (C_4 plant) has its own scale due to isotopic differences between C_3 and C_4 plants (C).

$\delta^{13}C$ pattern of C_3 plants are equivalent to WUE_i pattern. C_3 crops show a depletion in ^{13}C from SE to NW. This is in contrast to beech and dandelion, which show the contrasting pattern and are more enriched in the NW and in the center. Corn (a C_4 species) shows no clear trend.

Table S1. Tukey's HSD test on $\delta^{13}C$, $\delta^{15}N$, $\Delta\delta^{15}N$ of plants and soils and on $\delta^{13}C$ and $\delta^{15}N$ of 6 kettle hole sediments for each land-use type giving differences (in ‰) ± SE and p values.

Land-use and isotope	Difference (‰)	p value
$\delta^{13}C_{soil}$		
arable-forest	-0.5 ± 0.1	< 0.01
arable-grassland	-1.0 ± 0.1	< 0.01
forest-grassland	-0.5 ± 0.2	< 0.01
$\delta^{13}C_{plant}$		
C_3 crops-beech	-3.4 ± 0.2	< 0.01
C_3 crops-dandelion	-1.3 ± 0.2	< 0.01
beech-dandelion	+2.2 ± 0.2	< 0.01
$\delta^{15}N$ soil		
arable-forest	-5.3 ± 0.2	< 0.01
arable-grassland	-1.4 ± 0.2	< 0.01
forest-grassland	+3.9 ± 0.3	< 0.01
$\delta^{15}N$ plant		
crops-beech	-8.0 ± 0.4	< 0.01
crops-dandelion	-1.4 ± 0.4	< 0.01
beech-dandelion	+6.6 ± 0.5	< 0.01
$\Delta\delta^{15}N$		
crops-beech	-2.8 ± 0.5	< 0.01
crops-dandelion	0.0 ± 0.4	0.99
beech-dandelion	+2.8 ± 0.6	< 0.01
$\delta^{13}C$ sediments		
arable-forest	-0.1 ± 0.2	0.98
arable-grassland	+0.2 ± 0.5	0.89
forest-grassland	+0.1 ± 0.7	0.98
$\delta^{15}N$ sediments		
arable-forest	+4.0 ± 1.0	< 0.01
arable-grassland	-0.8 ± 0.8	0.58
forest-grassland	+3.2 ± 1.2	0.02

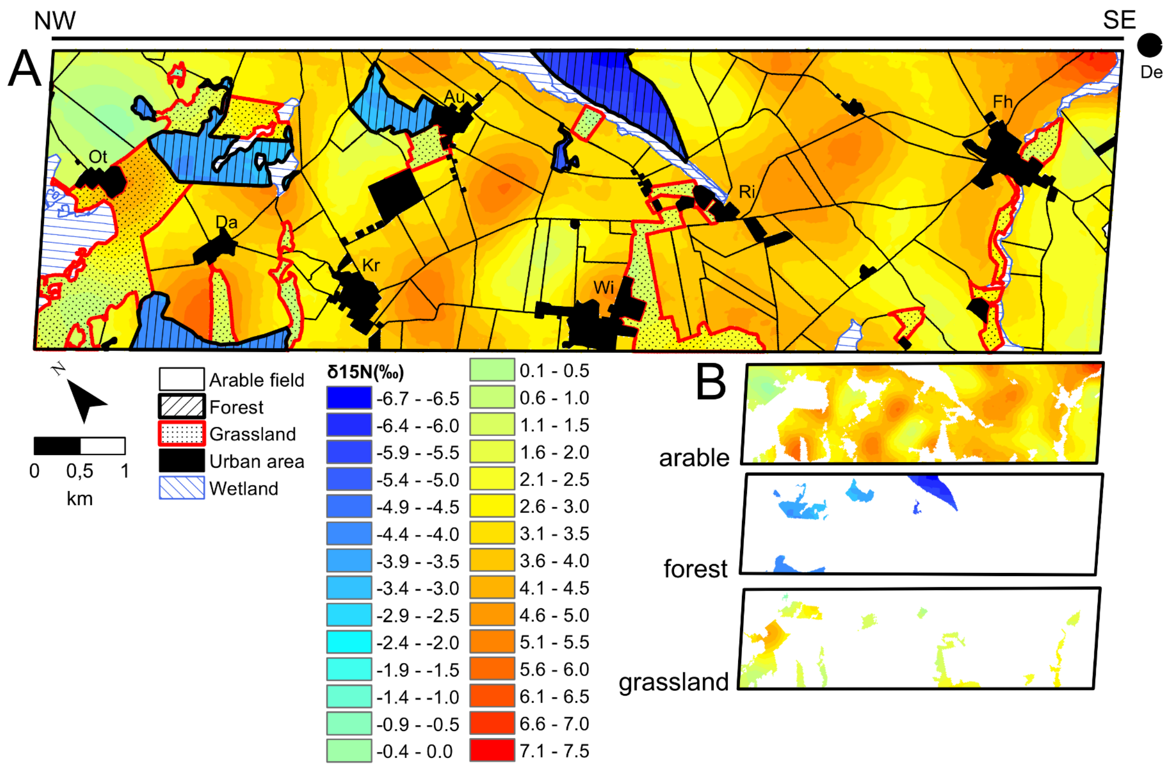

Fig. S5. Isoscapes (A) of δ^{15}N (‰) for plants sampled from the three land-use types using ordinary kriging. Interpolation was performed first for each land-use type independent of other types. The three isoscapes were then compiled into one overall isoscape using a common scale. Grasslands are highlighted with red borders and forests with black borders. The area interpolated to generate each land-use type isoscape is shown in B using the same scale. Areas not interpolated include wetlands >1 ha and urban areas. This isoscape is in a general agreement with the $\Delta\delta^{15}$N indicating that the ^{15}N plant isotopic composition is more dominant than the soil one. Crops are most enriched ranging from -0.2 to +7.3 ‰, but show no clear pattern. However in the SE part, this pattern has changed a little bit (more red colors). Dandelion with +0.7 to +4.5 ‰ is less enriched compared to crops. Beech is depleted in ^{15}N with -6.7 to -3.1 ‰.

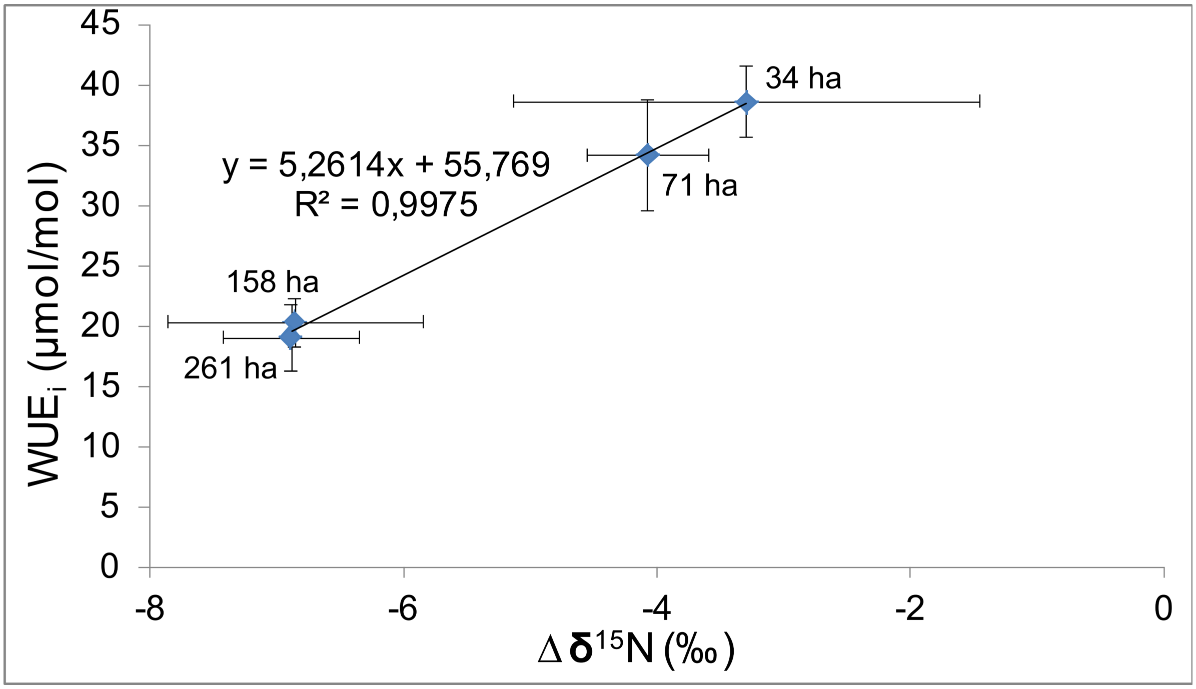

Fig. S6: WUE_i (µmol/mol) vs. $\Delta\delta^{15}N$ (‰) ± SE for our four forests stands. We see differences between smaller forests, which have a closer N cycle ($\Delta\delta^{15}N$ closer to 0) and are more water-use efficient compared to larger ones. There is a linear relationship (r^2=0.99) between WUE_i and $\Delta\delta^{15}N$ with a slope of 5.3.

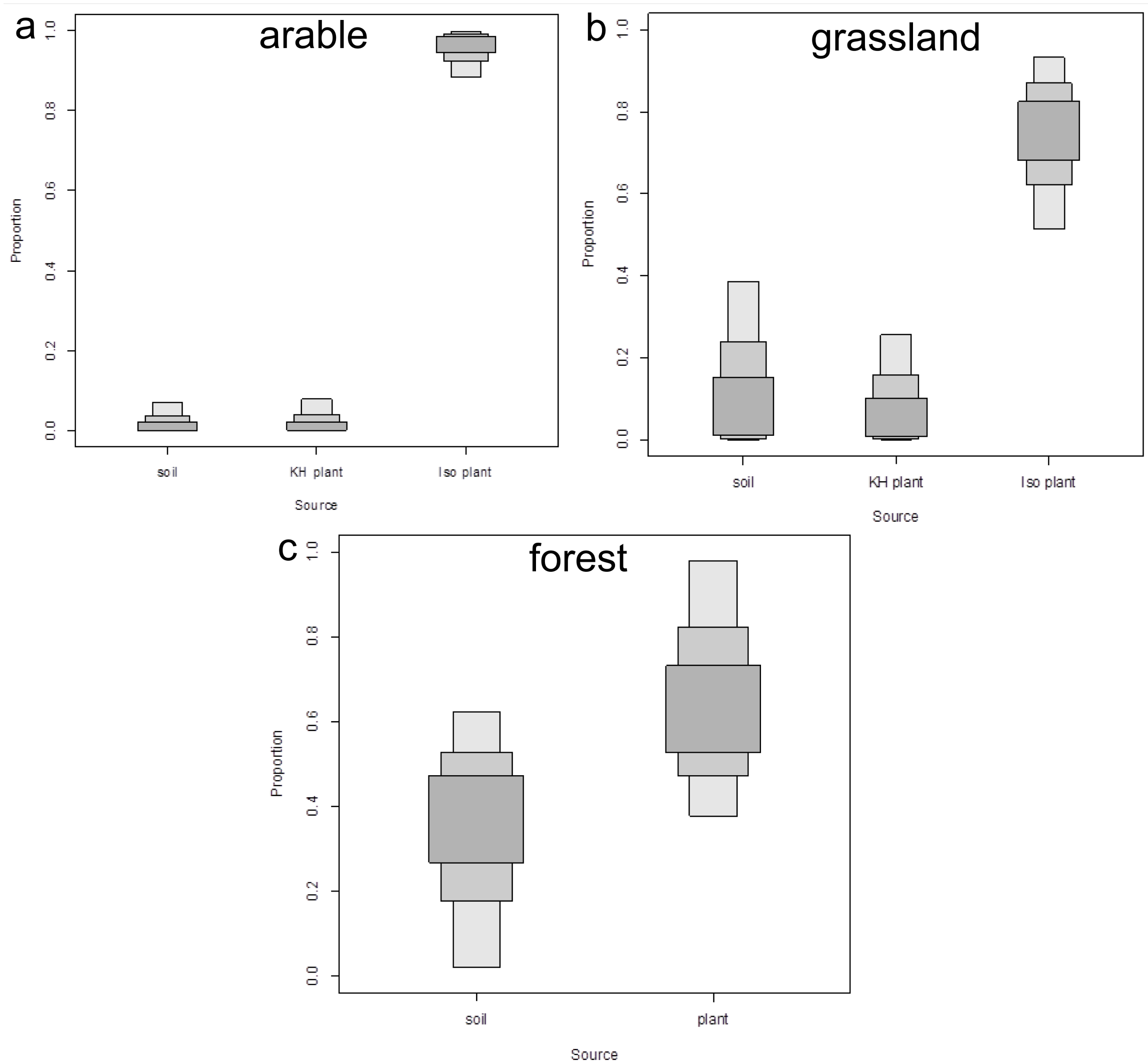

Fig. S7a-c: Mixing model results. Range of $\delta^{13}C$ and $\delta^{15}N$ sediment partition (95, 75, 25 % credibility intervals). For ‘soil’ we took for each kettle hole the mean values of at the most four closest soil samples provided that the land use did not change and the positions remained in the same fields for kettle holes located in arable fields. Kettle holes located in arable fields (a) with KH plant = *phalaris arundinacea*; Iso plant = mean value of sampled C_3 crops (see Table 2). Kettle holes located in grasslands (b) with KH plant = *phalaris arundinacea*; Iso plant = mean value of sampled dandelion. Kettle holes located in forests (c) with Plant = closest beech.

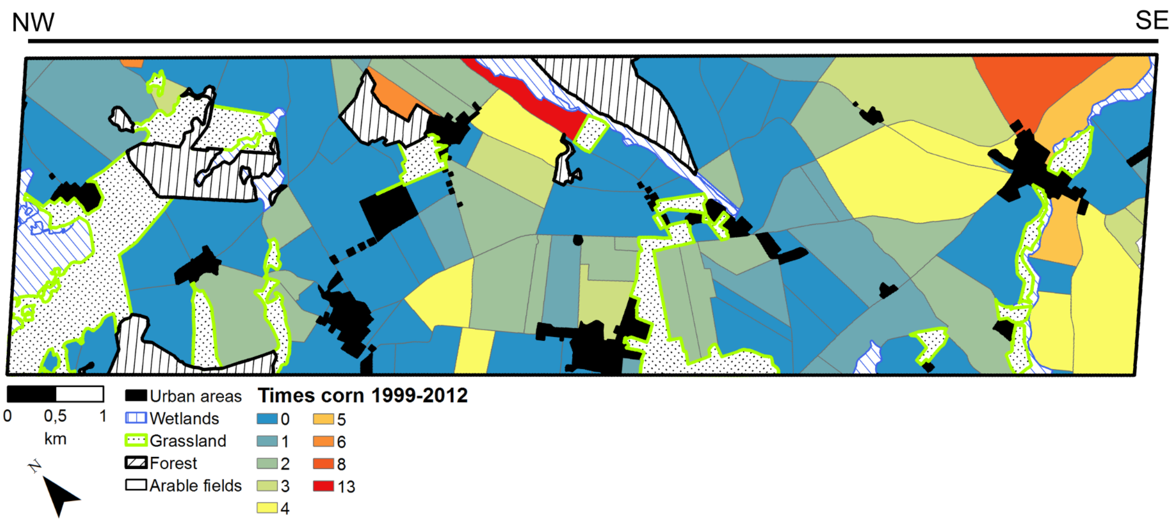

Fig. S8. Cultivation of corn from 1999 to 2012 on the fields in the sampling area. Corn was dominant in the east and in the center, where we have slightly enriched $\delta^{13}C_{soil}$ values. (Research Station, Dedelow and Department of Landscape Information Systems (yrs. 2006 to 2012): InVeKoS, Ministry for Infrastructure and Land Planning, Brandenburg (yrs. 1999 to 2005)).