

# P budget calculations of German farmland and resulting manure surpluses in livestock hotspot regions

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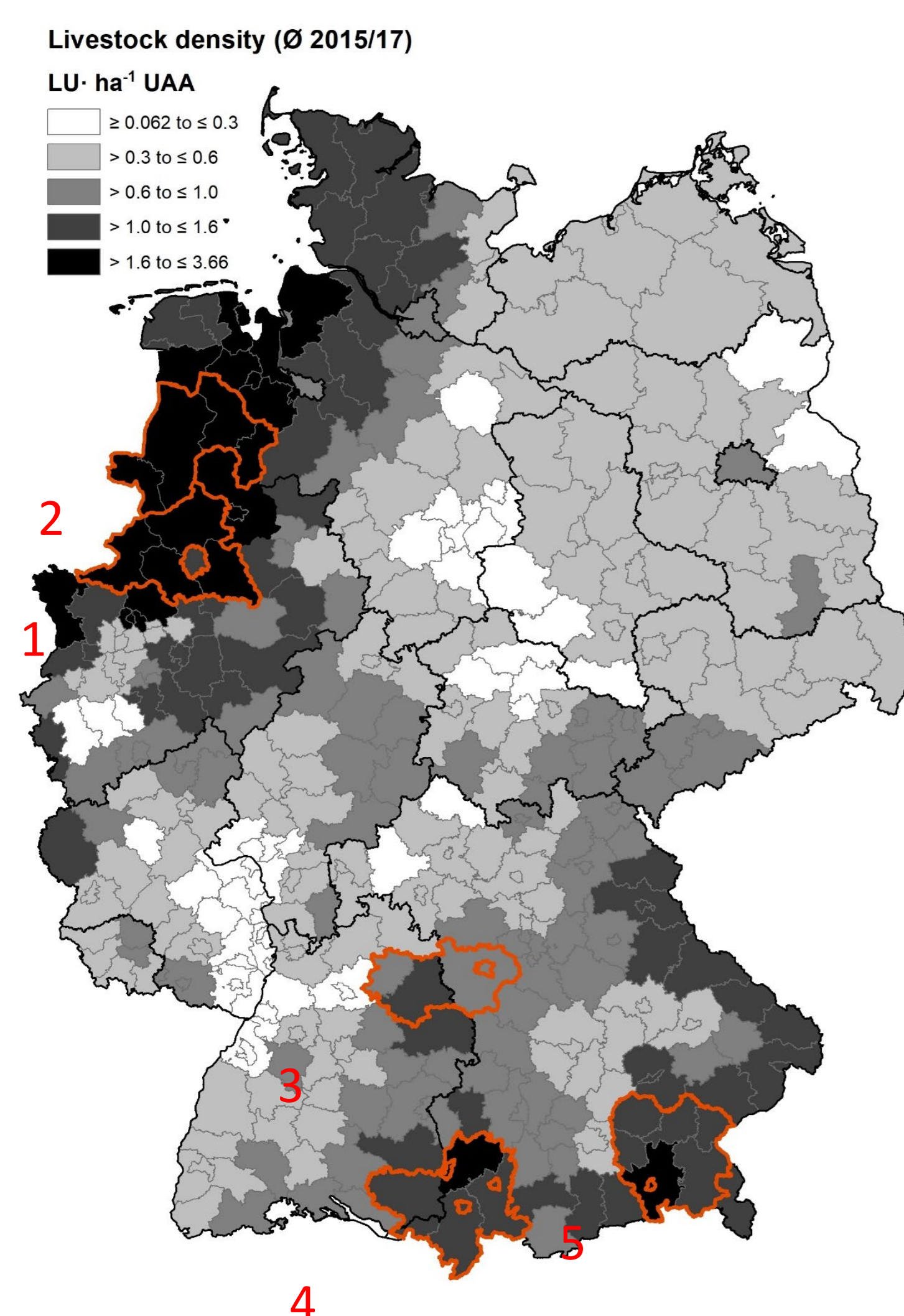
## Background and Objectives

The livestock sector in Germany is characterized by regionally specialized managing systems. Livestock and further the biogas production is concentrated in the northwest and the south east regions, resulting in locally high amounts of manures (livestock excreta and digestates). The research work described here aims at 1.) the budgeting of soil P on district level, and further 2.) the assessment of regional surplus of P in agricultural systems, in order to evaluate strategies for regionally decentralized manure nutrient management such as interregional transport or manure processing systems.

## Methods

- Calculation of P budgets at district level for 1995 to 2017 based on the methodology for regionalized N soil surface budgets
- Activity data on cropping area, yield, animal numbers mainly based on official statistics and identical to N soil surface budgets
- Data on regional distribution of P mineral fertilizer are not available, therefore same approach like for N mineral fertilizer to assess the regional application of mineral P fertilizer  
(Accordingly to Häußermann et al. 2019)
- Coefficients for P removal via harvested products and P excretion, manure fresh mass per animal place are based on key data of the German Fertilizing Ordinance (2020)
- Definition of five „manure hotspot regions“ (livestock, anaerobic digestion) in Germany for detailed analysis (figure 1)

Figure 1: Livestock density on district level in Germanies „hotspot regions“ (1: Münsterland, 2: Vechta-Cloppenburg, 3: Hohenlohe/Franken, 4: Allgäu, 5: Südstbayern) of livestock sector chosen for detailed analysis within this project



- Organic fertilizer application is limited by the German Fertilizing Ordinance (max 170 kg N/ha and medium soil-P-content)
- Data sets published at the end of the last millennium indicate very high P contents in soils of the hotspot regions (figure 2).
- Current data on the regional distribution of soil P content classes and thus on the further uptake capacity of phosphorus were not available
- Two phosphorus depletion scenarios (scen. 1: P-supply 20% below harvest withdrawal, scen. 2: P-supply 50% below harvest withdrawal) were calculated.

Figure 2: Frequency distribution of the contents of DL-soluble phosphate in 1994 soil samples from the agrarian intensive area from South Oldenburg (P soil content classes LUFA Oldenburg, 1992)

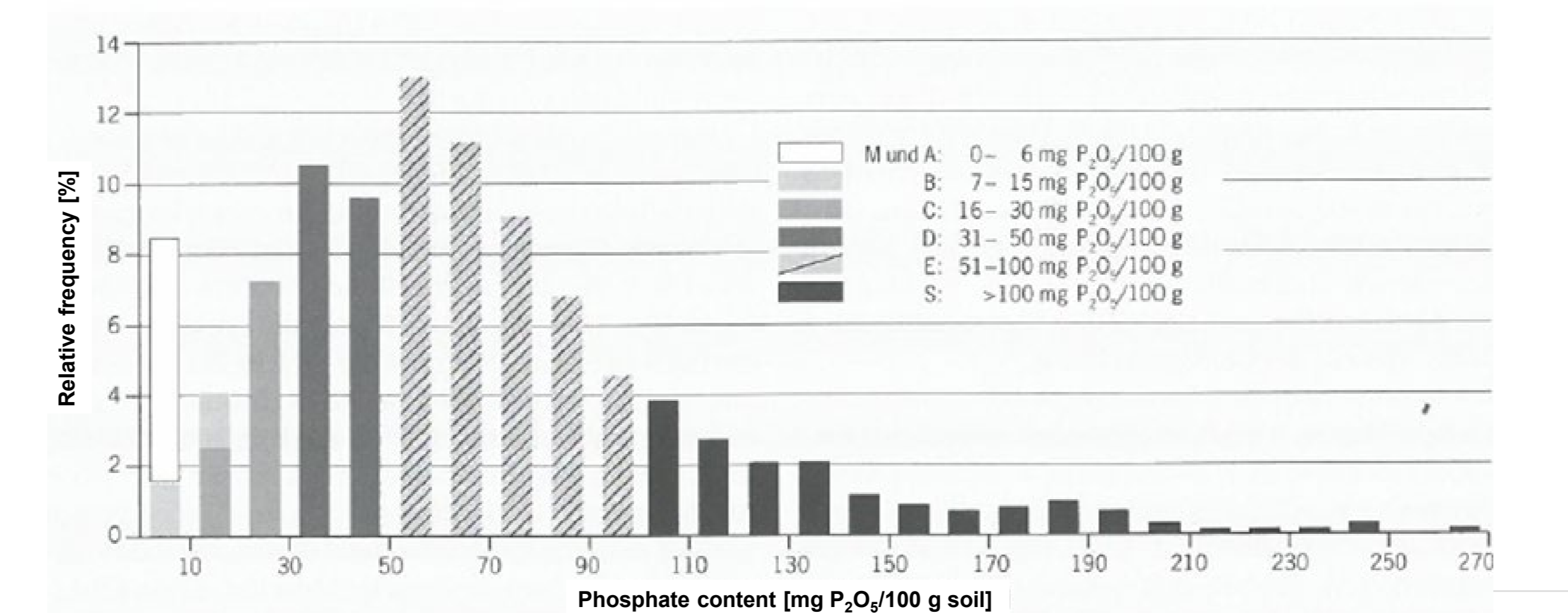
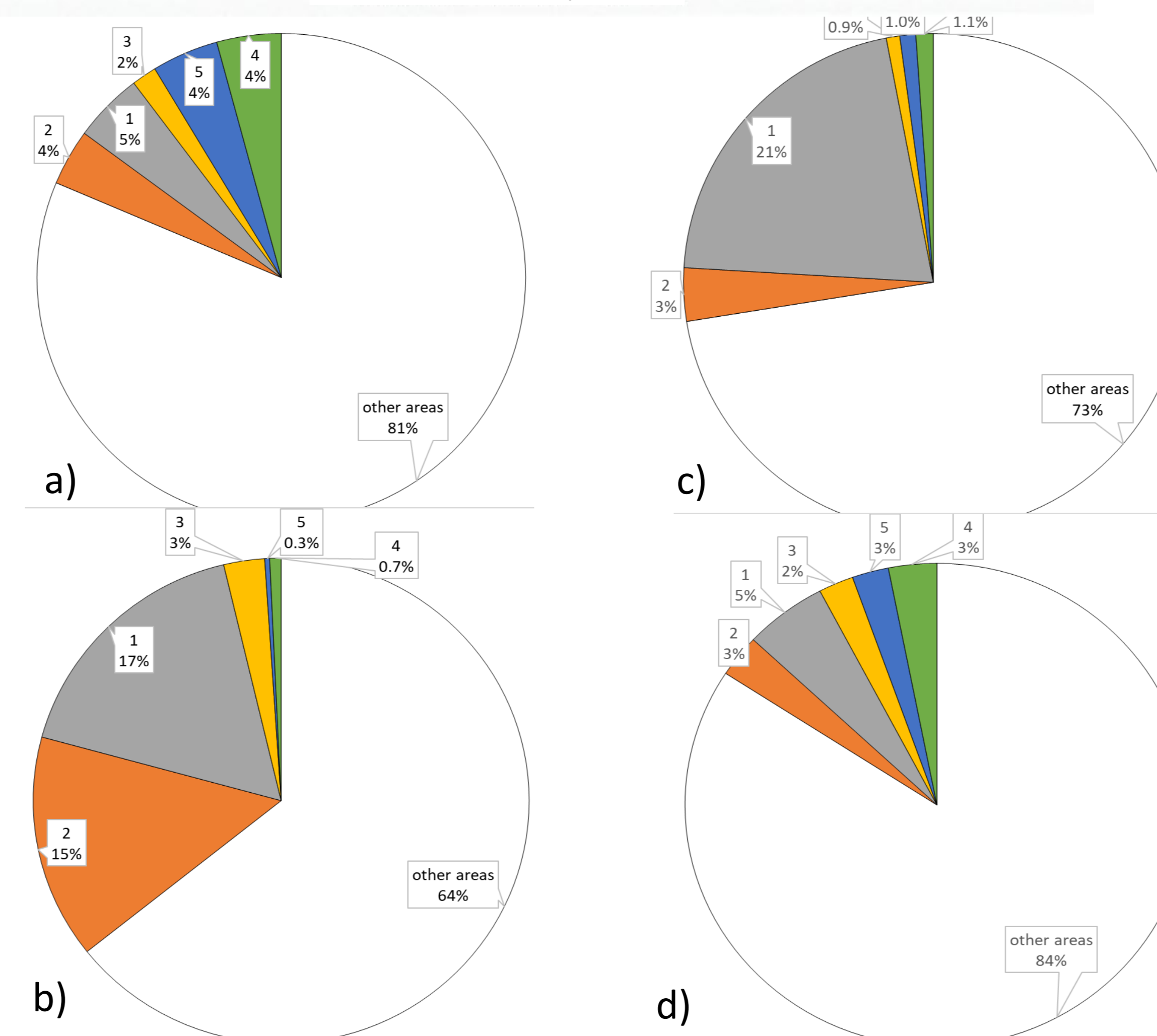


Figure 3: Share of P in manures differentiated for a) cattle, b) pigs, c) laying hens, and d) digestates from energy crops in „manure hotspot regions“ from German totals (mean 2015/2017)



## Results & Conclusions

- 2.8 of 13.0 m livestock units (LU) or 22% of the entire livestock in Germany were kept within these five „manure hotspot regions“ in 2017
- The „hotspot regions“ account for 1.55 m of 16.7 m ha or 9.3% of utilised agricultural area (UAA)
- P in livestock manure and digestates add up a total of 260,321 t, of which 56,948 t accrue within the „hotspot regions“ (in cattle manure 27,090, in pig manure 18,824, in laying hen manure 2,731, and in digestates from energy crops 8,303 t P) (figure 3)
- P-surplus under P-depletion scenario 1 and 2 accounts for 28.463 t P or 41,704 t P in livestock manure and digestates from energy crops resp.
- This in turn corresponds to 19.8 m t raw manure (of approx. 220 m t) or to 28.8 m t for scenarios 1 and 2 resp. (table 1)
- Results underpin the urgent need for a more ambitious manure nutrient management towards decentral approaches

Table 1: P surplus and corresponding livestock manure and digestate quantities in the five hotspot regions (mean 2015/2017)

| Region             | P-Surplus in t P p.a. |         | Amount of manure in Mio. t FM p.a. |         |
|--------------------|-----------------------|---------|------------------------------------|---------|
|                    | Scen. 1               | Scen. 2 | Scen. 1                            | Scen. 2 |
| Münsterland        | 6.922                 | 9.846   | 4.6                                | 6.6     |
| Vechta-Cloppenburg | 14.667                | 18.317  | 9                                  | 11.2    |
| Hohenlohe/Franken  | 968                   | 2.775   | 0.8                                | 2.2     |
| Allgäu             | 3.534                 | 5.886   | 3.2                                | 5.4     |
| Südstbayern        | 2.372                 | 4.88    | 2.2                                | 4.4     |

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