German fertiliser legislation – current and future rules on phosphorus: effect on transport need for animal manure

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Agenda

1. Introduction
2. Present and future regulations of the german fertiliser ordinance
3. Effects of phophorus concentration in soil
4. Need of transport for animal manure (AM)
5. Need for further action

Introduction: Development of national P surplus

Reduction of surplusses since 1970/80

- N from >150 kg ha^{-1} a^{-1} to approx. 100 kg ha^{-1} a^{-1}
- **P_2O_5 from approx. 30 kg ha^{-1} a^{-1} to below 10 kg ha^{-1} a^{-1}**

National P balance (van Dijk et al. 2015)

- Netherlands: 23 kg P ha^{-1} a^{-1}
- Belgium: 22 kg P ha^{-1} a^{-1}
- Germany: 1.7 kg ha^{-1} a^{-1}, but P surplus of approx. 20 kg P ha^{-1} a^{-1} in regions with high density of animal production, i.e. in the north-west
- Hot spots: Accumulation of P in soils during the last decades due to over-fertilisation with animal manure (Tóth et al. 2014; Römer, 2014; Trott, 2010)

Rules of the current fertiliser ordinance (2006) regarding phosphorus fertilisation - I

- **Soil analysis:** every 6th year, for fields langer than 1 ha, except for exclusively grazing livestock which produces less 100 kg/ha*a of N-excretion
- **Determination of fertilising needs:** for each field/management unit (plant needs, expected yield and quality, soil borne nutrients)

Rules of the current fertiliser ordinance (2006) regarding phosphorus fertilisation - II

- **Balancing in- and export of phosphorus:** an excess of 20 kg P_2O_5 $*ha^{-1}*a^{-1}$ is permitted (averaged over a 6-year period and over the complete agricultural estate); In soils with low concentrations on phoshorus (VDLUFA-supply level A-C) this limit value may be exceeded
- **Duty of documentation:** Data on soil analyses, nutrient concentration of applied organic fertilisers, nutrient balances including calculation data necessary for this (not necessarily referring to the individual field)
- **De-minimis-limit for duty of documentation:** < 10 ha agricultural land, additionally extensively cultivated areas

Rules in the draft of fertiliser ordinance (2015) concerning phosphorus fertilisation - I

- **Soil analysis:** every 6th year, for fields larger than 1 ha, except for exclusively grazing livestock which produces less 100 kg/ha*a of N-excretion
- **Determination of fertilising needs:** for each field/management unit determination of P-requirements of crop in relation to expected yield and quality, available P in soil and fixation of P; from supply-level D according to VDLUFA upwards, P-fertilisation should not exceed P-export by crops over a three year's period; federal state authorities are free to further limit or completely prohibit P-fertilisation completely in case of water pollution due to phosphorus

Rules in the draft of fertiliser ordinance (2015) concerning phosphorus fertilisation - II

- **Balancing in- and export of phosphorus**: an excess of 10 kg P_2O_5 ha^{-1}*a^{-1} is permitted (averaged over a 6-year period and over the complete agricultural estate); soils poor on phosphorus may not receive additional P-fertilisation
- **Duty of documentation**: Determination fertilizer need of crop, data on soil analyses, nutrient concentration of applied organic fertilisers, nutrient balances including calculation data necessary for this (not nececcarily referring to the individual field)
- **De-minimis-limit for duty of documentation:** < 30 ha agricultural land, additionally extensively cultivated areas

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Concentration of soil-P in german topsoils in different regions

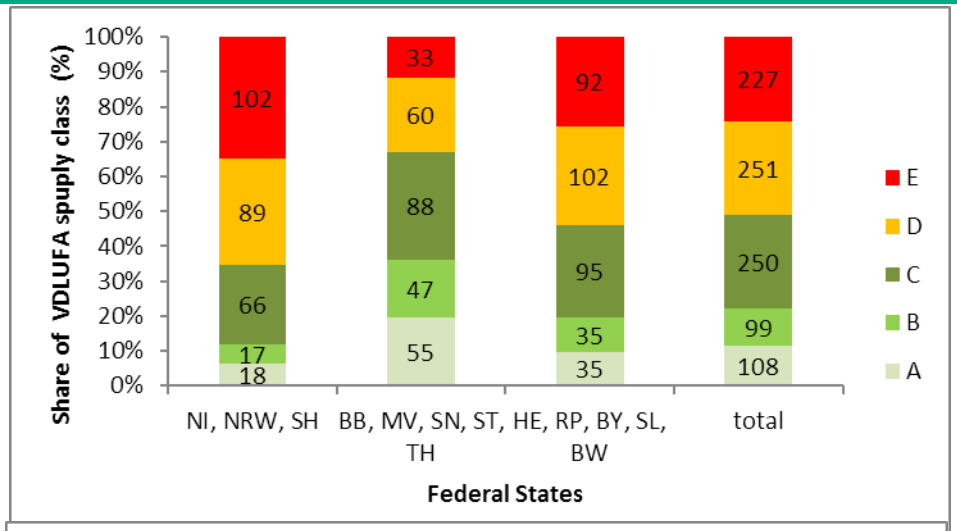

Figure 1a: allocation of geo-referenced LUCAS-topsoil data to VDLUFA-soil supply classes (1997) **arable land**, n = 935

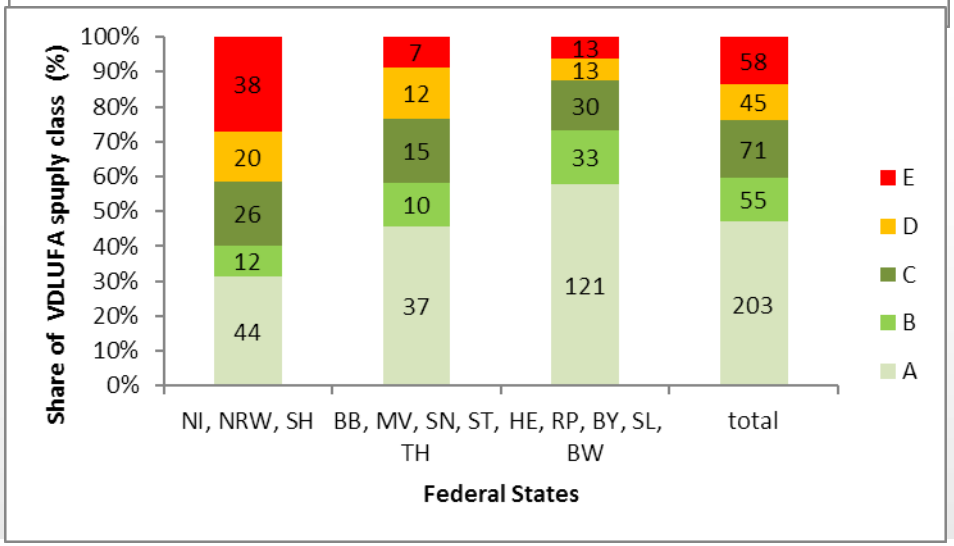

Figure 1b: allocation of geo-referenced LUCAS-topsoil data to VDLUFA-soil supply classes (1997) **grassland**, n = 432

Reference: POlsen-soil data from LUCAS topsoil database (Tóth et al, 2013), conversion in PCAL according to Schick et al. (2013), allocation to VDLUFA-(Association of German Agricultural Analytic and Research Institutes e. V.) supply classes (1997)

Allocation of animal population density per community to LUCAS TOPSOIL sample points

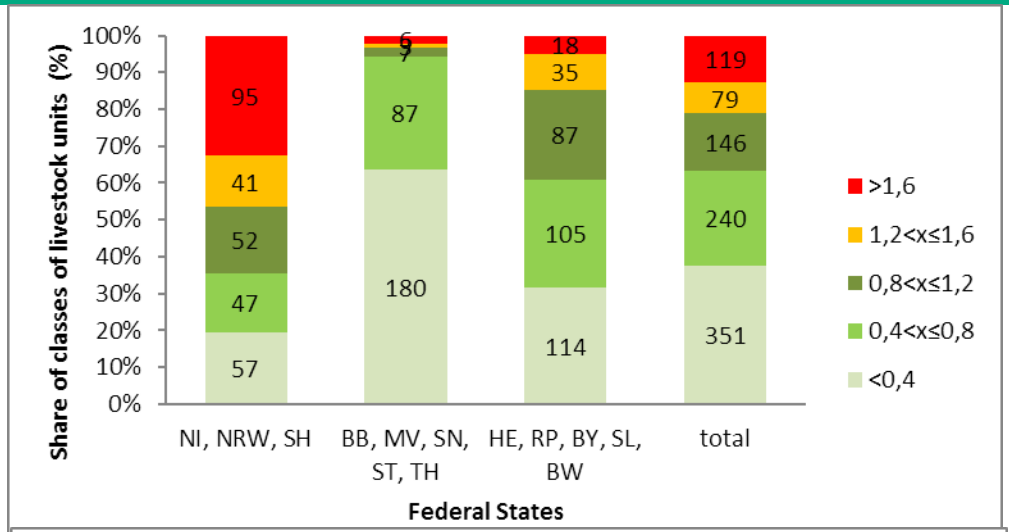

Figure 2a: Allocation of density of animals determined per community to geo-referenced LUCAS-topsoil data, **arable land**, n = 935

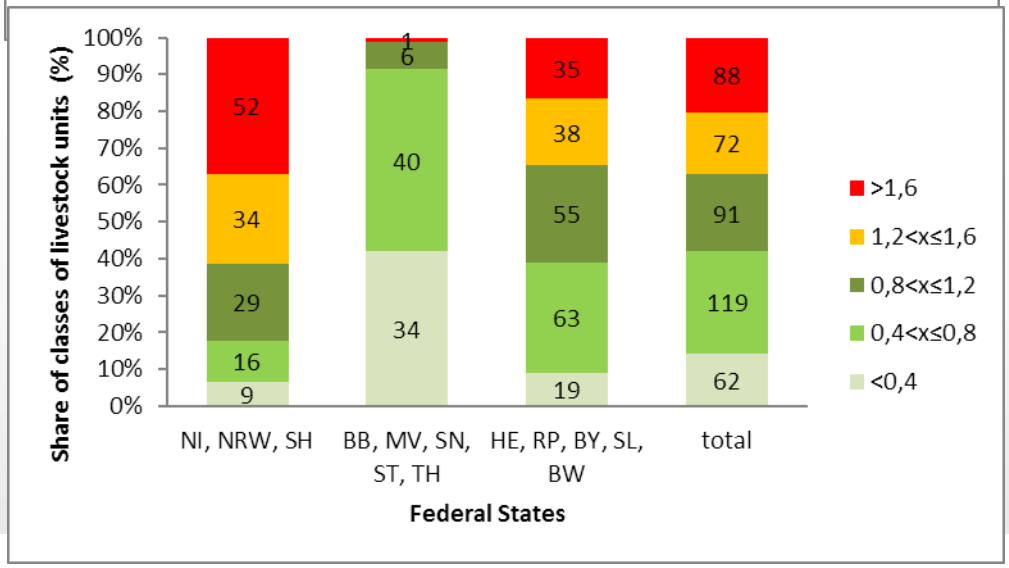

Figure 2b: Allocation of density of animals determined per community to geo-referenced LUCAS-topsoil data, **grassland**, n = 432

Reference: livestock units, without poultry manure - GENESIS Online (2010), Thuenen-Atlas (2016)

Allocation of P-balances on community level to LUCAS TOPSOIL sample points

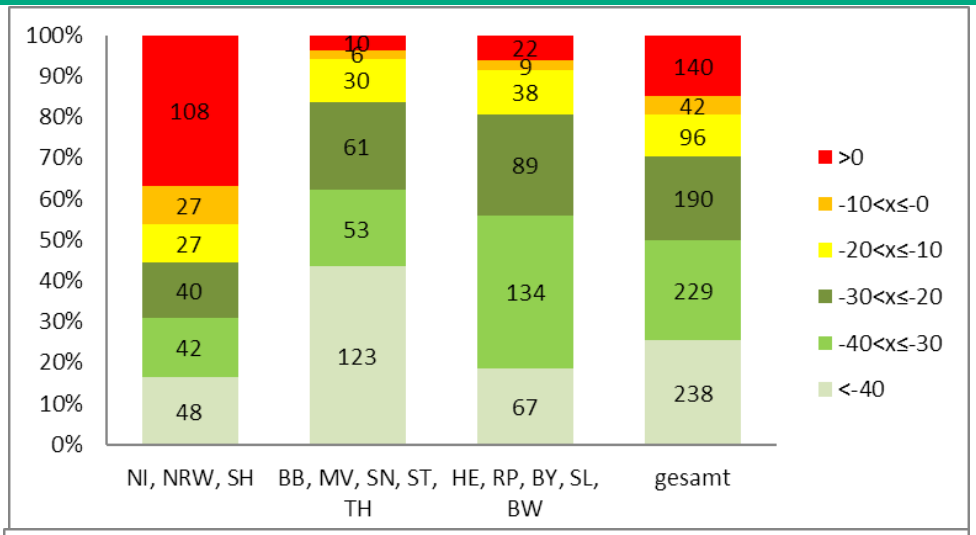

Figure 3a: Allocation of P-balances (without mineral fertilisers) determined per community to geo-referenced LUCAS-topsoil data, **arable land,** n = 935

Reference: P2O5-balance including biogas residue according to Gocht et al. (2014), Thuenen-Atlas (2016)

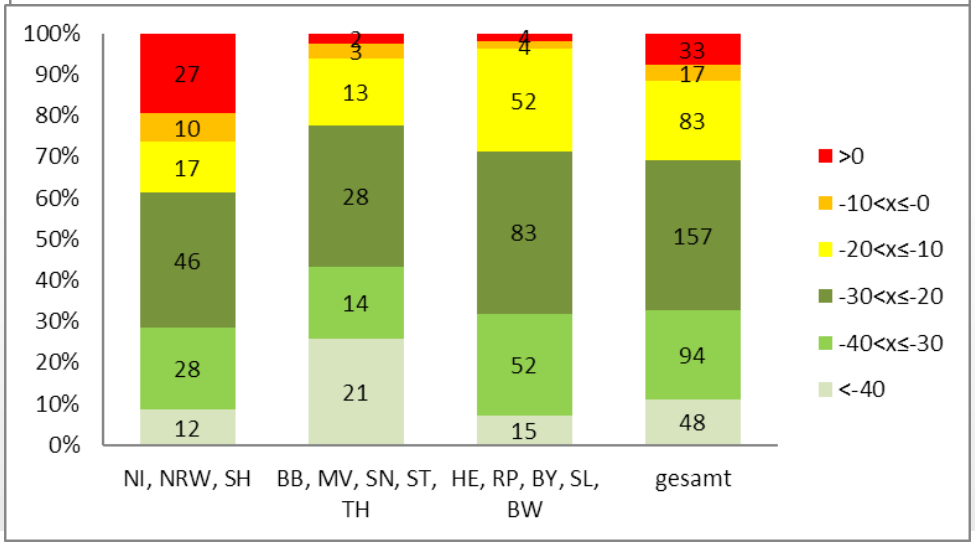

Figure 3a: Allocation of P-balances (without mineral fertilisers) determined per community to geo-referenced LUCAS-topsoil data, **grassland**, n = 432

Interims conclusion

- North-west of Germany: high P balances (charts do not include mineral fertiliser P) go along with high soil supply levels and intensive animal production
- East of Germany: low P balances correspond to low soil supply levels and very low animal production levels
- in general: P-fertilising intensity is lower on pasture than on arable land; this may signify a transfer of nutrients with animal manure from pasture to arable land; the effect seems to be especially pronounced in the middle and south of Germany

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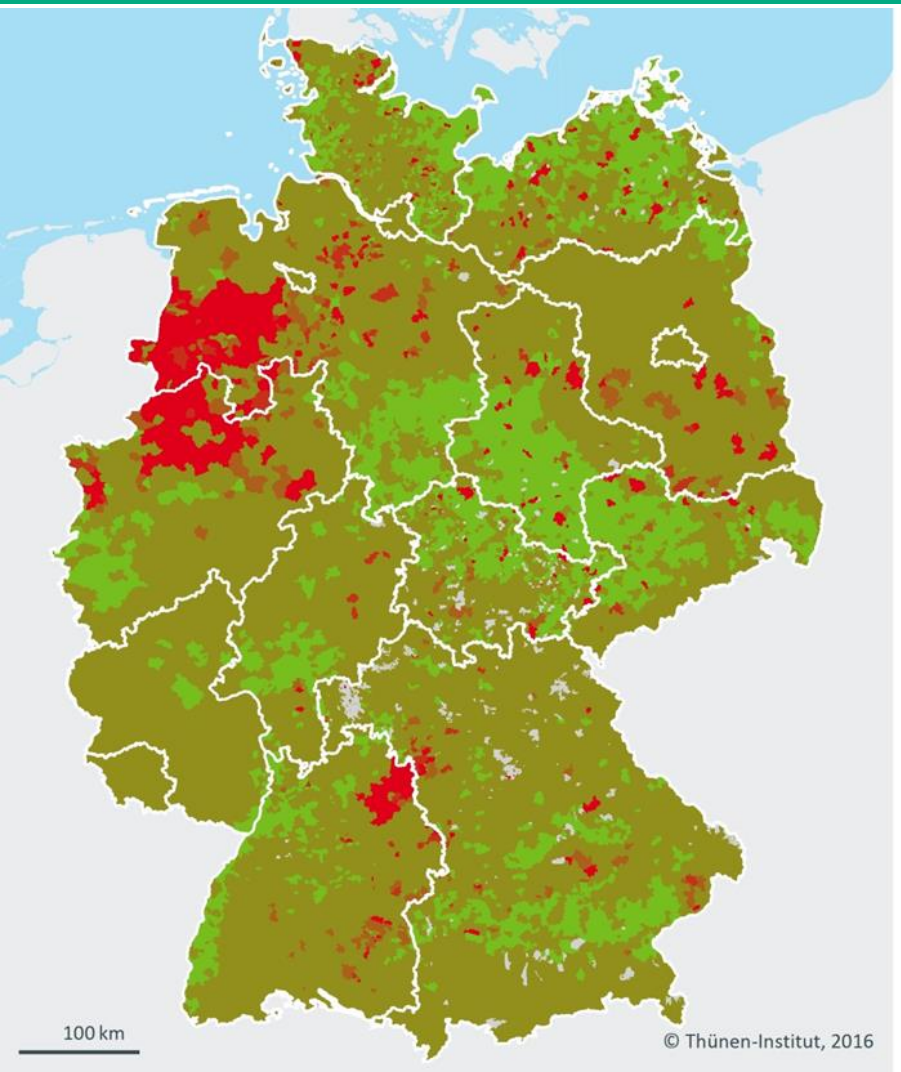
Partial phosphorus balance for Germany



map 1: partial phosphorus balance (animal excretion minus export by crops) in kg P_2O_5*ha^{-1} (without poultry manure)

Reference: Osterburg, Schüler und Klages (2016)

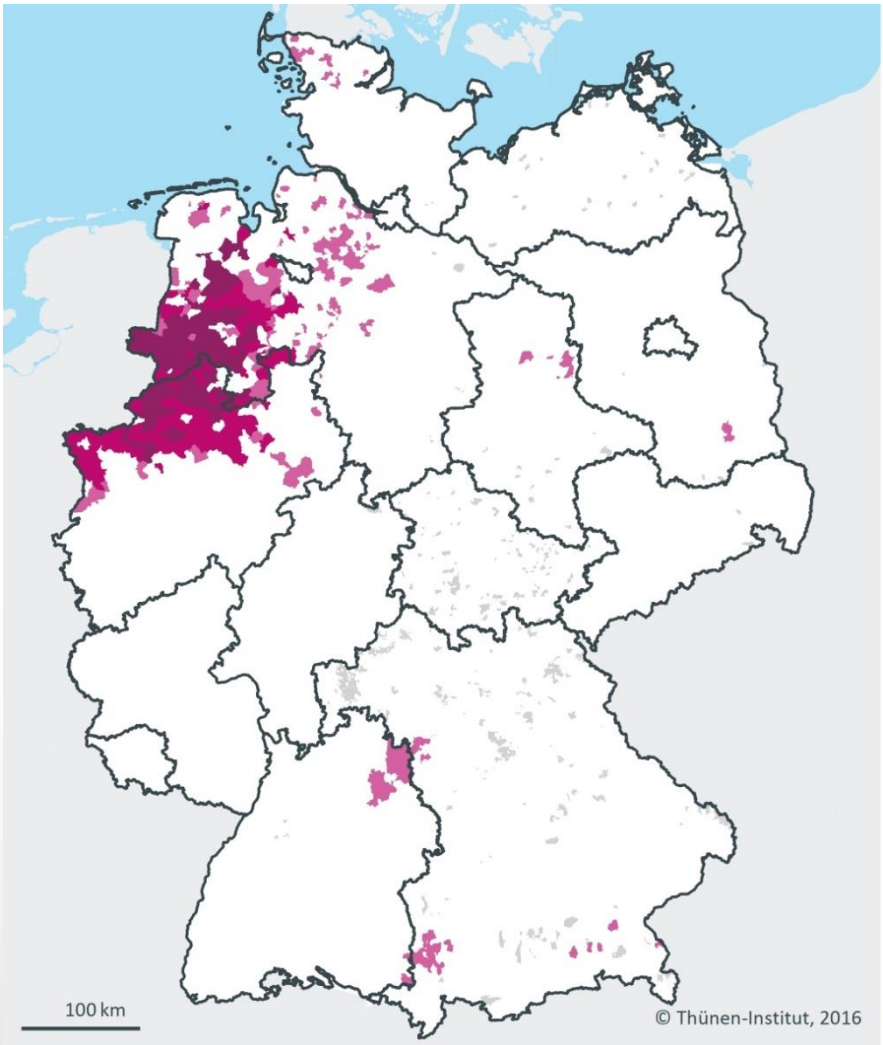
Need of transport for animal manure

Limitations for the application of phosphorus:

- Maximum excess fertilisation 10 kg P_2O_5*ha^{-1}*a^{-1}, norsurplus accepted in VDLUFA-supply class D and E
- No sufficient information concerning regional supply with phosphorus are available, therefore the following suggestions were made:

N-surplus in communities deriving from animal manure and biogas rests of plant origin	**P_2O_5-surplus *a^{-1}**
≥ 150	0
120 ≤ x < 150	≤ 2,5
80 ≤ x > 120	5
< 80	8

Need of transport for animal manure



map 1: average transport distance in km for manure and biogas digestate of plant origin, without poultry manure

Reference: Osterburg, Schüler und Klages (2016)

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Need for further action - I

Economic use of phosphorus

- Critical raw material according to EU-KOM
- Causes eutrophication (cf. comments of KOM on the draft of the fertiliser ordinance)

Better areal distribution of exceeding phosphorus

- better supply of soils in need of phosphorus, especially of grassland
- Stepwise reduction of legally permitted phosphorus balance surplus
- duty for P depletion of soils with a high P concentration (VDLUFA-supply level D, E and even higher), granting a long transition period
- Permission of new stables only under the condition of stricter limitations on phosphorus application on land

Need for further action - II

Optimisation

- Logistics and transport of surplus quantities of AM
- AM pre-treatment (as rich in dry matter as possible, enriched in phosphorus, harmless concerning other parameters)

Perspective

- No further intensificaton of animal breeding in hot spots
- Stepwise reduction of regional livestock concentration due to a regional stop for the constructions of new stables
- Treatment and long-distance transport of AM: only a interim solution?
- Vision: animal production unter controlled conditions, i.e. with zero emissions and extensive treatment of AM (substitution of mineral fertilisers)

Need for further action - III

Improvement of data situation

- Establishment of a nationwide soil cadastre with a grid as tight as possible, also taking into account deeper soil horizonts (up to 1 m), i.e. on basis of the German agricultural soil inventory
- Registry of transports of animal manure (location of production and application, quantities, composition)
- Further development of the Thünen-Atlas as political/strategic decision support tool

Need for further action - IV

Improvement of assessment instruments and criteria

- Different methods of phosphorus analysis and interpretation across Europe (Jordan-Meille et al., 2012): Harmonisation necessary!
- National level: analytical methods are comparable, but classification and fertilisation recommendations are different
- VDLUFA recommends a new evaluation supply levels, as well as a reduction of fertiliser recommendations
- Is a new EU-wide approach for analytical methods and evaluation for phosphorus in soils necessary (see: Jordan-Meille et al., 2012)?

Contact

Thank you for your attention!

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