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Sustainability in Soil Protection – Land Use and Conservation of Natural Resources

Phosphorus Fertilization and Soil Biodiversity as a Legal Problem

Summary

This article broaches the legal treatment of the declining, non-renewable, non-substitutable resource phosphorus which is indispensable for life. We address a highly important resource problem that has hitherto received little attention in the legal discourse. Furthermore, excessive and dissipative phosphorus entry into the environment, soils, and water bodies has significant harmful effects on ecosystems, and is represented by subtle, long-term accumulations in the aquatic ecosystem as well as soil contaminations. In this article, we present this problem field and demonstrate that currently neither European nor German fertilizer legislation and soil conservation legislation provide for adequate regulatory approaches. In this respect, a precautionary concept on the European level is basically non-existent. Insufficient regulations in the above mentioned fields lack concreteness, real enforcement, prevention of relocating problems and a safeguard for absolute quantity reductions in phosphorus usage. If these factors are not taken into account, it will remain impossible to effectively address ecological and resource problems because phosphorus politics will otherwise be constrained to constant consideration on an individual basis, where every individual case might be deemed to entail ”few negative consequences“. Yet it is the sum of multiple minor actions of farmers etc. that can lead to ecologically and resource-related fatale consequences. It is not sufficient to increase efficiency in phosphorus uptake per individual plant, because if crop cultivation is expanded to previously unused areas at the same time, for instance via greater animal feed crop production (due to globally rising meat consumption) or via bioenergy plant production, it will be impossible to achieve the necessary absolute phosphorus application reductions by higher efficiency per plant. We conclude that this will eventually lead to an important new strategy in environmental policy: “Technical solutions”, “efficiency” and “command and control” alone will not solve resource problems or quantity problems if at the same time (global) production increases or remains at a constant high level.

I. Problem statement: phosphorus and sustainability – environmental and resource aspects

Point of origin for modern soil protection – and this holds true for current environmental

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policy in general – is the sustainability principle. Sustainability, as the terminological fusion of the claim for more intergenerational justice and global justice, has experienced a remarkable career over the last 15 years.[1] However, western societies are currently pursuing a lifestyle that is neither maintainable in the long term nor globally. At the same time, a major proportion of the world population lives in stark poverty. Key elements of sustainability are the increased usage of renewable resources according to natural renewal rates as well as conservative usage of non-renewable resources. The key nutrient phosphorus, indispensable for plant, human and animal life, is just such a non-renewable resource. To date, it has not received adequate public attention either as a resource or environmental issue; discussions have been limited to its role as an environmental pollutant. However, phosphorus is first and foremost a non-renewable, non-substitutable resource, whose currently uncertain and disputed long-term availability represents a basic threat to global food security.[2] This article is therefore dedicated to analyzing sustainability in soil protection by focusing on the macronutrient phosphorus. In doing so, it also takes on the problem of resource conservation, which represents the second most important global issue after climate change.[3] Our goal was to excerpt and highlight problems in phosphorus usage from a legal and policy perspective, taking into account the feasibility of long-term and global (hence sustainable) practice in handling.[4] Within this discourse, we briefly include, in a comparative manner, yet another neglected soil issue: soil biodiversity. Overall, an aggregated perspective will be constructed on how sustainability in soil protection can be moved forward.

Soil represents, together with water and air, an elemental prerequisite for life. Soil is part of the natural livelihood of humankind, serves as the nutritional basis for plants and animals and is production basis for foodstuff and animal feed.[5] As a non-renewable resource, its utilization must be aligned with the precept of sustainable management. Sustainable soil utilization calls for usage that is adjusted in manner and scope to the needs of the current generation; yet such global utilization requirements also call for soil functions to remain intact or to be improved

[1] For detailed information on the sustainability principle and against the widely occurring suppression of the decisive space-time-dimension as well as its replacement by the three-pillar-formula, see Ekardt, Theorie der Nachhaltigkeit: Rechtliche, ethische und politische Zugänge [Theory of sustainability: legal, ethical and political perspectives], 2010; Ekardt, Zeitschrift für Umweltpolitik und Umweltrecht 2009, p. 223 et seq. These works stress sustainability not as a meaningless term representing everything good and desirable in the world but rather as a concept which transmits the following relatively concrete content: Justice (the requirement for „fair“ regulations and organization structures for cohabitation) ought to incorporate time-space remote interests and concerns in a more potent way. This does not exclude other relevant interests such as ”economic growth here and now“ since weighing all relevant interests is crucial in finding justice. Yet concrete sustainability calls for a lasting and globally maintainable lifestyle. For a similar argumentational direction (albeit in part less clear) is taken in World Commission on Environment and Development (ed.), Our common future, 1987, p. 43; Lee, Nachhaltiger Bodenschutz – international, europäisch und national, 2006, p. 1.; Ott/ Döring, Theorie und Praxis starker Nachhaltigkeit [Theory and practice of strong sustainability], 2004; see also for critics on the current sustainability discourse Siemer, in: Ekardt (ed.), Generationengerechtigkeit und Zukunftsfähigkeit [Intergenerational justice and sustainability capability], 2006, p. 129 et seq.

[2] See Cordell et al., Global Environmental Change, 2009, 292 (305) for global food security and declining phosphorus reserves.

[3] The resource issue has many links to climate change, for example does the excessive use of finite fossil fuels as well as problematic forms of land use (e.g. deforestation, livestock farming, among others) present the climate problem in its very core.

[4] The text therefore presents a governance analysis; for details on its methodological combination of empirical investigations (however not in this case) as well as observations, secondary evaluation of empirical data by other researchers, thoughts on plausibility, theoretical conclusions, among others, see Ekardt/ Heitmann/ Hennig, Soziale Gerechtigkeit in der Klimapolitik [Social justice in climate policies], 2010, chapter II.

[5] For these and additional soil functions see Sparwasser/ Engel/ Voßkuhle, Umweltrecht: Grundzüge des öffentlichen Umweltschutzrechts, 5th edition 2003, § 9 No. 2 et seq.

on a long-term basis in order to secure their potentials and to enable future generations to fulfill their needs and choose their lifestyle freely. Maintaining or restoring soil functions in the long-term is also a declared goal of the national legislation, e.g. in Germany of the federal soil protection legislation (Bundes-Bodenschutzgesetz/ BBodSchG).[6] However, soil protection is in many ways still deficient and poorly sustainable. Unchangingly ongoing and hardly reversible, soil degradation continues at an alarming rate.[7]

For years, one of the most significant soil problems has been intensive and locally not well adapted soil management and cultivation practices, primarily carried out by conventional agriculture, especially in regard to large farms with intensive animal husbandry. For instance in Germany, 52 % of all land is used for agricultural purposes. Next to the deposition of airborne pollutants and the application of waste, relevant diffuse input of contaminants and nutrients occurs in the form of pesticide and fertilizer application in agriculture.[8] It is estimated that globally more than half of agricultural land can no longer be deemed fit for unrestricted use because of soil degradation.[9]

Agricultural crops require a pool of different mineral nutrients in different quantities for growth.[10] While these nutrients are present in most soils, only some fractions are directly available to plants. Moreover, with every harvest the soil is being further depleted further off its nutrients. Without their replacement, soils would become nutrient depleted and could no longer provide their natural functions.[11] Nutrients such as phosphorus, which are either unavailable in certain soils or consumed, need to be replaced by fertilizer application. For this purpose, different types of fertilizer are available, and can generally be classified as industrial fertilizer, farm fertilizer and secondary fertilizer.[12] Industrial fertilizers are those that do not originate from farms. Rather, they are being produced commercially as soil additives for the purpose of fertilization and need to be bought by farmers. Most industrial fertilizer is mineral fertilizer mainly for nutrient supply, providing high, precise concentrations of the main nutrients. These are nitrogen, phosphorus, potassium, calcium, magnesium and sulfur. In contrast to industrial fertilizer, the term farm fertilizer comprises on-farm-accumulating and applicable residues such as animal excrement, manure, slurry and similar by-products. These residues, predominantly of animal origin, are suited for fertilization due to their nitrogen, phosphorus and potassium content. The third category of fertilizers, secondary fertilizers, comprises human excreta, sewages sludge, struvite, and similar materials from municipal waste and other sources.

Modern agriculture (on the one hand crop farming, and on the other, hand animal husbandry with its considerable requirements for feed) often applies substantial amounts of phosphorus

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[6] Legislation on the protection against harmful soil modifications and clean up of contaminated sites (Bundes-Bodenschutzgesetz), dating from 17.03.1998, BGBl. I 1998, p. 502 et seq.
[7] SRU, Umweltgutachten 2008, No. 533.
[8] SRU, Umweltgutachten 2008, No. 485, 492.
[9] Compare Giger/ Humi/ Portner/ Scheidegger, GAIA 2008, p. 280 (281); also see Bongert/ Albrecht, GAIA 2008, p. 287 (288).
[10] For this section, the contribution by Schnug/ Ekardt/ Haneklaus/ Schick, Ökologie & Cultivation 3/ 2008, p. 52 et seq. plays an important role as the original natural science input.
[11] For details see Sattelmacher/ Stoy, in: Blume (ed.), Handbuch des Bodenschutzes: Bodenökologie und -belastung. Vorbeugende und abwehrende Schutzmaßnahmen, 3rd edition 2004, p. 265 et seq.
[12] Cf. for the different forms of fertilizer Kloepfer, Umweltrecht, 3rd edition 2004, § 19 No. 228; Härtel, Düngung im Agrar- und Umweltrecht: EG-Recht, deutsches, niederländisches und flämisches Recht, 2002, p. 48 et seq.; Finck, Dünger und Düngung: Grundlagen und Anleitung zur Düngung der Kulturpflanzen, 1979, p. 15 et seq.; SRU, special report [Sondergutachten] 1985, No. 406 et seq.

fertilizer that is being manufactured from rock phosphorus. However, phosphorus resources are limited, geographically highly concentrated and declining both in terms of quantity and quality.[13] Although the assured reserve base (which should not be confused with current reserves) amounts to 47 billion tonnes, its mining is currently considered to be economically and technically feasible only on a very rudimentary level.[14] Approximately 80 % of all mined rock phosphate in the world is being synthesized to mineral fertilizer for agricultural application; in 2009, this amounted to 158[15] million tonnes.[16] This makes modern agriculture highly dependent on phosphorus fertilizer and at the same time also highly vulnerable to shifts in supply. Germany for example does not have any deposits and therefore must import its necessary supply for industry and agriculture. In 2005, this corresponded to a total of 87 000 tonnes of unground phosphate rock, 79,9 % of which originated from Israel and 17,3 % from Russia.[17] Developed countries import great quantities of phosphorus from developing or emerging countries via inexpensive animal feed to cover the immense demand from intensive animal husbandry.

Ecological problems from intensive phosphorus application also arise in respect to the energy and climate balance. Phosphorus mining, processing and marketing from the extraction site to the farm require a great deal of energy and cause considerable emissions. Moreover, various adverse effects result for soils and water bodies. On the one hand, these are ascribed to heavy metals and radioactive substances often contained in fertilizers. In this respect, is important to note primarily uranium, which represents a direct (toxic and cancerous) peril for soil quality as well as for ground and drinking water.[18] On the other hand, fertilizer application often leads to additional nutrient accumulation in soils because nutrient uptake of plants is limited. On average, substantially higher amounts of phosphorus and nitrogen are being applied for yield growth than what plants actually require. Over the years, such practices have resulted in considerable phosphorus accumulation in German soils.[19] High natural levels of phosphorus in soils are already being steadily increased by consistently higher than required fertilizer supplies of phosphorus.[20] The main reason for these soil loadings are excessive farm balances generated by the application of inexpensive mineral fertilizer application, especially in intensive farming operations, and the increasing industrialization of animal husbandry and its re-

[13] For details see Harben/ Kurzvart, Industrial Minerals, 1996. Naturally occurring phosphorus is limited in the environment. Its main appearance is in magmatic apatite or sedimentary phosphorite. Guano, or bird excrements, does no longer plays an important role in supply since its deposits have largely been depleted during the last century. Due to these geological prerequisites, phosphorus mining is concentrated in only a few countries. The most important deposits are found in China, Morocco/ Western Sahara, South Africa and the U.S. Currently known, minable reserves are estimated at 16 billion tonnes, of which more than two thirds are allotted to the above mentioned countries; cf. Jasinski, U.S. Geological Survey, Phosphate Rock, 2010.

[14] For further barriers to future phosphorus rock mining, see Ulrich/ Malley/ Voora, Peak Phosphorus, 2009, p. 5 (17).

[15] Cf. Jasinski, U.S. Geological Survey, Phosphate Rock, 2010.

[16] Cf. IFA, Database, 2008.

[17] Röhling, in: BAD (ed.), Rohstoffverfügbarkeit, 2007, p. 23.

[18] For environmental impairments of contaminants in fertilizers see SRU, Umweltgutachten 2008, No. 494, 497, 913 et seq.; SRU, Umweltgutachten 2004, No. 300 et seq.; for the uranium problem see Schnug/ de Kok (ed.), Loads and fate of fertilizer derived uranium, 2008; Ekardt/ Seidel, Natur und Recht 2006, 420 et seq.; for technical feasibility, applied extraction of uranium and its cost efficiency see Haneklaus/ Schnug, in: Schnug/ de Kok, Loads, p. 111 (126); Hu u.a., in: Schnug/ de Kok, Loads, p. 127 (133).

[19] Currently, the overall application of fertilizers in Germany is slightly declining compared to an increase up until the late 1990s. Yet it still remains at early 1990s levels; compare SRU, Umweltgutachten 2008, No. 1004.

[20] SRU, Umweltgutachten 2008, No. 494; SRU, Umweltgutachten 2004, No. 291; SRU, Umweltgutachten 2000, No. 474; Härtel, Düngung, p. 51.

lated necessary waste disposal of enormous amounts of produced slurry.[21] In soils, overapplication of fertilizers adds to soil acidification, which in return results in reduced capacities of soils to filter and buffer nutrients and contaminants. Moreover, it impairs soil fertility. Exceeding site-specific absorption capacities generally leads to long-term, sometimes even irreversible impairments. Further, it derogates ground water, surface water, climate and the natural environment.[22] Fertilizer application enhances the growth of particular plants only, but leads to the loss of other less-responsive plants and dependant animals. This is also one reason why intensive agricultural practices are blamed for the loss of biodiversity.[23] If phosphorus input exceeds the adsorption capacity of soils, then phosphorus is being transported within the soil matrix into the ground water.[24] Even more than groundwater, surface water is being affected by diffuse phosphate entry. Half of this load originates from diffuse sources, of which approximately 90 % emanates from agricultural lands.[25] One consequence of this increased, anthropogenic phosphorus entry is the massive bloom of toxic blue-green algae in surface waters and oceans, or generally speaking, eutrophication, which also substantially harms biodiversity.[26] This can be observed for example in the Baltic Sea.[27]

When it comes to phosphorus, we not only need to deal with the ecological problems mentioned but also with the massive, already briefly outlined resources challenge. In comparison with other resources such as oil and gold, global phosphorus reserves that can be considered economically viable for mining are alarmingly limited; moreover, new deposits or mines often have a lower degree of quality and higher fractions of the radioactive or toxic heavy metals uranium and cadmium. Predictions as to how long global resources will last depend among other variables on the profitability of mining, and henceforth on the market price and its fluctuations. Further, they vary according to the underlying calculation methodology. Yet most scientific literature on the subject suggests 50 to 100 years.[28] We have already pointed out that besides undesirable accumulations in soil, there are massive phosphorus losses into

[21] SRU, Umweltgutachten 2008, No. 1004; SRU, Umweltgutachten 2004, No. 298.
[22] SRU, Umweltgutachten 2008, No. 494; Härtel, Düngung, p. 52.
[23] Sparwasser/ Engel/ Voßkuhle, Umweltrecht, § 6 No. 14; Giger/ Humi/ Portner/ Scheidegger, GAIA 2008, p. 280 (281); Weins, Zeitschrift für Umweltrecht 2001, p. 247 (248); Schink, Umwelt- und Planungsrecht 1999, p. 8 (9).
[24] SRU, Umweltgutachten 2004, No. 317. This problem is especially relevant in sandy soils because they naturally have reduced adhesion capacity; compare Härtel, Düngung, p. 52 and 354.
[25] Schink, Umwelt- und Planungsrecht 1999, p. 8 (9); for older data cf. Hoffmann, Phosphorus and nitrogen input from agriculture into the Baltic Sea, especially by suspended particles of water bodies, 1979, p. 58 et seq. Phosphorus enters water bodies mainly by water and wind erosion. Problems of soil erosion have become worse over the last years. One contributary factor was the vast transition of grasslands to arable land in many parts of Germany as well as the resulting removal of hedges and wind breaks against wind erosion during the last decades. Current agricultural practices accelerate soil erosion since crop cultivation often does not allow for year-round vegetation cover. The existing risk is even increased by inappropriate cultivation practices; cf. Sattelmacher/ Stoy, in: Blume, Handbuch, p. 280.
[26] World Resources Institute, World hypoxic and eutrophic coastal areas, 2009; Schink, Umwelt- und Planungsrecht 2004, p. 8 (10); for exceeding thresholds in ecosystems Scheffer/ Carpenter/ Trends in Ecology & Evolution 2003, p. 648 (656).
[27] One of the largest *dead zones* worldwide is located in the Baltic Sea. Dead zones are areas characterized by oxygen content too low to sustain aquatic life due to eutrophication. Since their first appearance in the 1970s, the number of dead zones has increased to over 400 in 2008; cf. NASA, Science Focus, 2009 or Pelley, Environmental Science & Technology 2004. Together with other nutrients, 36.000 tonnes of phosphorus from agriculture enter the Baltic Sea each year; cf. Paulsen/ Volkgenannt/ Schnug, Landbauforschung 2002, p. 211 (218).
[28] The point in time when demand will exceed industrial mineral fertilizer production has been termed “peak phosphorus”, similar to “peak oil” for oil`s peak production prognosis, cf. Gilbert, Nature 2009, p. 716 (718): 125 years (with an annual predicted increase of 2,5-3 %); Vaccari, Scientific American, 2009, p. 54 (59): 90 years; Cordell/ Drangert/ White, Global Environmental Change 2009, p. 292 (305) predict the peak already for 2034.

aquatic ecosystems. This all leads to implications for ensuring universal peace (which is often addressed within the odd phrase of “geopolitical aspects”) as well as for social distributive justice, on the national and on the global level. We will come back to the latter aspect in the final section.

From environmental and resources perspectives, closed-loop phosphorus cycles, such as those in agriculture, as well as phosphorus recycling will have play a fundamental role in the future. Compared to conventional agriculture, organic farming generates enhanced nutrient cycles (it also tends to have a better profile in respect to uranium contamination). Moreover, animal density is lower, animal feed is possibly produced on-site, and neither very little nor no industrial or synthesized fertilizer are applied. Obviously, the uranium problematic is nonetheless existent, insofar as that current EU regulation permits the application of (non plant-available) rock phosphate[29] in organic farming; however, the ratio is smaller because fertilization is carried out to maintain soil fertility rather than to correspond to expected plant needs. In contrast, it is difficult to recycle phosphorus back into the system without causing harmful effects, such as is the case when sewage sludge is applied to agricultural land in order to preserve mineral phosphorus fertilizer. Despite these barriers, improved technological methods are increasingly in place.[30] For the following it is important to keep all these aspects in mind when we analyze the challenges and limits of legislative regulations. We will further consider possible additional positive effects on soil, water, nature conservation and health resulting from a change in agriculture that goes beyond conventional practices.

II. Administrative regulation in phosphorus fertilization

How does legislation respond to this issue? Unlike nitrogen, phosphorus from agricultural sources is not subjected to a European regulatory approach. Also on the national level, where there are only isolated environmental regulations; conservation of natural resources is even less considered. This will be demonstrated this in the following section. Further, we will illustrate how overall limitations of possible administrative regulations (command and control/ Ordnungsrecht) in respect to the issue (and later alternatives thereof) can be interpreted.[31]

1. Applicability of diverse regulations in soil conservation, water, waste and fertilizer legislation

Regulations on phosphorus usage are set up at the interface of soil protection, water, fertilizer and waste legislation. Technically speaking, these domains work with regulatory requirements, hence with orders and prohibitions (“command and control”). EU regulations are thus still missing inasmuch as that no soil framework directive has been enacted so far (but has been planned several times).[32] For this reason our focus shifts to the national level, exemplified in German legisation. In respect to the ecological damage and resources perspective, one

[29] This is certainly a regulation which needs to be reconsidered when taking sustainability aspects into account. We thank Silvia Haneklaus for this information.

[30] Cf. Schnug/ Ekardt/ Haneklaus/ Schick, Ökologie & Landbau 3/2008, p. 52 et seq.

[31] Where appropriate, we will refer to a number of other publications (mainly in respect to climate protection) where the question of “quantitative control or administrative criteria regulation” as well as questions on the theory of sustainability, justice and governance are further elaborated.

[32] For further details on this discussion see Valentin/ Beste, Der kritische Agrarbericht [The critical agrarian report] 2010, p. 178 (179 et seq.).

might well expect the phosphorus issue to be placed within soil protection legislation because the function of the BBodSchG stated in § 1 is the sustainable safeguarding or rehabilitation of soil functions. To achieve these goals, § 1 S. 2 BBodSchG demands that „harmful soil alterations need to be held off“; moreover, „provisions need to be taken against adverse soil impacts“ (precautionary principle). In principle, this law is just applicable for adverse soil changes and brownfields according to § 3 para. 1 BBodSchG. While the scope of application is positively described, numerous soil-related activities are directly excluded. This concerns the regulations stated in numbers 1 to 11 of the exclusion catalogue, insofar as they regulate soil impacts. If such a behavior is subject to these special regulations, that may have direct or indirect consequences for soil functions in respect to § 2 para. 2 BBodSchG, then they obtain primary application. This is also the case if the overriding regulation lags behind the standard of the BBodSchG.[33]

Focusing on agricultural fertilization, two normative complexes become relevant to which the BBodSchG is subsidiary if impacts on soil are regulated. According to § 3 para. 1 no. 1 BBodSchG, this is on the one hand regulations concerning the effect of recycling management and waste legislation on the application of waste to utilize as secondary fertilizer or as farm fertilizer and laws enacted on the basis of the recycling management and waste legislation as well as the sewage sludge regulation. The second relevant normative complex, on the other hand, is § 3 para. 1 no. 4 BBodSchG, “regulations of the fertilizer and plant protection legislation”.

Requirements for recycling management in agricultural fertilization are covered in § 8 KrW-/AbfG[34]. § 8 Abs. 1 KrW-/AbfG contains the power to enact a non-parliamentary regulation (Verordnung) on the part of the German federal government . Accordingly, by statutory order, the federal government can determine “requirements to secure the correct and unharmful application in accordance with para. 2”. In individual cases it is possible, pursuant to § 8 para. 2 KrW-/AbfG for the application of secondary fertilizers or farm fertilizers on agricultural, silvicultural or horticultural soils, to mandate “prohibitions or limitations according to characteristics such as constitution and composition of soils, area and timing of application, and natural habitat” as well as “analysis of waste or farm fertilizer or soils, methods to pretreat these materials or other appropriate methods.” By using the term “unharmful application“, it is referred to § 5 para. 3 sentence 3 KrW-/AbfG. Accordingly, an application is deemed to be carried out without harm “when waste composition, level of pollution and method of disposal are not likely to impair the public interest” (Gemeinwohl).

A definition of “public interest” – without which the term would be meaningless[35] - is given within the principles of waste disposal compatible with common welfare, stated in § 10 para. 4 sentence 1 KrW-/AbfG. An impairment of the public interest is particularly given when the „soil is affected in a destructive manner.“ This also holds true for waste disposal.[36] Therefore, § 8 KrW-/AbfG regulates impacts on soil. With the creation of the BioAbfV[37], which states

[33] Cf. Sondermann/ Hejma, in: Versteyl/ Sondermann, BBodSchG, 2nd edition 2005, § 3 No. 15.

[34] Legislation on the advancement of the recycling economy and securing environmental friendly waste disposal [Kreislaufwirtschafts- und Abfallgesetz], September 27, 1994, BGBl. I 1994, p. 2705 et seq.

[35] On the criticism of the term “public interest” as well as on legal perspectives without this term, see Ekardt, Wird die Demokratie ungerecht?, 2007, chapter IV E.

[36] In respect to the dispute on direct, analogous or application aligned to environmental interests, see Frenz, KrW-/AbfG, 3rd edition 2002, § 5 No. 80 et seq.

[37] Regulation on the reclamation of bio waste of agricultural, sivicultural or horticultural soils [Bioabfallverordnung] of 21.09.1998, BGBl. I 1998, p. 2955 et seq.

the requirements for application of bio waste and compost on soils, this has recently[38] led to a priority handling proceeding soil protection legislation.

The same holds true for AbfKlärV[39] on the grounds of § 15 Abs. 2 AbfG a.F. The topic of regulation subject is the usage of sewage sludge[40] according to § 1 Abs. 1 no. 2 AbfKlärV. Prerequisite for its legitimate application is according to § 3 para 1 section 1 AbfKlärV "not to impair the public interest and that application methods, timing and quantity are aligned to the plant nutrient requirement under consideration of soil nutrient content and organic substances as well as of location and cultivation conditions". Accordingly, soil protection[41] against phosphorus-induced ecological damage is addressed by both BioAbfV and AbfKlärV.

Besides regulations of the waste legislation relevant to slurry and sewage sludge, regulations of fertilizer legislation and hence regulations on mineral fertilizer also precede the BBodSchG insofar as that they regulate impacts on soils. Among these are DüngG[42], which has replaced DüngMG[43] without substantially altering its content, as well as those regulations which were enacted on its basis. DüngMG contains regulations in respect to the marketing and application of fertilizers. Fertilizers are legally defined in § 2 no. 1 DüngG as substances which are intended to be applied directly or indirectly to crops in order to enhance and improve their growth, yield or quality. According to § 5 Abs. 1 DüngG, they are only allowed to be marketed commercially if they comply with the stated requirements, conform to the specifications of European law, and most importantly do not compromise the natural environment. The requirements for fertilizer approval are concretized in DüMV[44]. Accordingly, fertilizers must be harmless in respect to causing damage to plants, plant products or soils. The same is true for the application of approved fertilizers. Pursuant to § 3 para. 2 DüngG, they are only allowed to be applied according to the code of good practice (gute fachliche Praxis). This implies that "fertilization method, quantity, and timing must be aligned to plant and soil needs in consideration of existing plant-available nutrients and organic substances in soils as well as location and cultivation preconditions". In respect to applying fertilizers, there are also regulations being developed concerning soil impact; this implies that fertilizer directives override the BBodSchG.

Regulations on secondary, farm and mineral fertilizer within BioAbfV, AbfKlärV, DüngG, and DüMV have precedence over the BBodSchG insofar as they are complied with.[45] According to this legislative concept, it is only possible to fall back to the BBodSchG when it is already too late for the protection of soils, that is to say when harmful soil alterations have already taken place.[46] This is further highlighted in § 17 BBodSchG, which, in respect to agri-

[38] Cf. Hipp/ Rech/ Turian, BBodSchG, 2000, § 3 No. 87; a different opinion is held by Frenz, BBodSchG, 2000, § 3 No. 10, who does not deem necessary the remittal of a concrete regulation necessary.

[39] Sewage sludge regulation [Klärschlammverordnung] of April 15, 1992, BGBl. 1992, p. 912 et seq.

[40] Sewage sludge is defined in § 2 Abs. 2 Satz 1 AbfKlärV as "sludge produced during the treatement of waste water in waste water treatment plants including appendant complexes dealing with further waste water treatment, also dehydrated, dried or in other manner treated."

[41] Frenz, BBodSchG, § 3 No. 19; Brinkmann, § 3 BBodSchG – Geltung, Subsidiarität und Ausschluss, 2008, p. 92; Meinert, Zur Subsidiarität des Bundes-Bodenschutzgesetzes, 2005, p. 82.

[42] Fertiliser legislation (Düngegesetz/ DüngG) of January 9, 2009, BGBl. I 2009, p. 54 et seq.

[43] Fertilizer law of November 15, 1977, BGBl. I 1977, p. 2134 et seq.

[44] Regulation on the marketing of fertilizers, soil additives, cultural substrates and plant additives (Fertilizer Ordinance) [Düngemittelverordnung] of December 16, 2008, BGBl. 2008, p. 2524 et seq.

[45] Landel/ Vogg/ Wüterich, BBodSchG, 2000, § 3 No. 10; cf. also Ekardt/ Seidel, Natur und Recht 2006, p. 420 (423).

[46] Härtel, Düngung, passim; Ekardt/ Seidel, Natur und Recht 2006, p. 420 (423); Ekardt/ Heym/ Seidel, Zeitschrift für Umweltrecht 2008, p. 169 (174).

culture, again only points to the code of good practice as a requirement. This basically means that it disclaims any precautionary requirements – which are the subject of this norm – from the outset (incidentally based on the authorization for official assertion of such requirements).[47]

Neither European nor German water legislation[48] (regulated particularly in the European WFWD[49] and in the German WHG[50]) introdue much change: In respect to ecological hazard, water legislation is not explicitly subsidiary to fertilizer or waste legislation. Nonetheless, it does not include concrete regulations for agriculture and fertilization according to its current interpretation. Those passages on drinking water quality and various thresholds refer to obligations toward compliance with certain standards by the drinking water supplier, which have to clean (only) the drinking water, yet not by the farmer. Further, the general regulations on the quality of surface waters and ground water would only be applied against phosphorus fertilization if fertilization was considered as water usage – which is contrary to common legal belief. A priori, neither water nor soil protection legislation take the *resource* aspect of the phosphorus problem into account.[51]

2. Concrete legal requirements for fertilizer application – regulation deficits and its reasons[52]

The question on resource and environment-related phosphorus regulations is hence directed towards waste and fertilizer legislation. Pursuant to § 3 para. 2 DüngG, fertilizers are only allowed to be applied in accordance to the "code of good practice". The intended purpose of fertilization according to this principle is to ensure necessary nutrient supply to the plant as well as to maintain and enhance soil fertility. According to § 3 para. 2 DüngG, fertilization alignment must correspond with type, quantity and timing of plant and soil needs in consideration of existing plant-available nutrients and organic substances in soils as well as location and cultivation preconditions, whereas high quality and low cost products should be produced. This is concretized in the DüngV[53] which was enacted on the basis of § 3 para. 3 DüngG. There it is specified that the appropriate fertilization needs to be determined before every fertilization application (§ 3 Abs. 1 DüngV) and that application timing and application quantity should be chosen in such a manner that plants obtain nutrients in a timely and quantitative manner which corresponds to the identified need (§ 3 Abs. 4 DüngV). Moreover, there is an obligation to carry out soil analysis to determine the soil-inherent available nutrient

[47] For more information, see Ekardt/ Heym/ Seidel, Zeitschrift für Umweltrecht 2008, p. 169 (174 et seq.); also on pesticide legislation.

[48] On this and the following aspect in respect to agriculture, see Ekardt/ Heym/ Seidel, Zeitschrift für Umweltrecht 2008, p. 169 (176 et seq.); Ekardt/ Weyland/ Schenderlein, Natur und Recht 2009, p. 388 (392 et seq.), respectively with additional references.

[49] Directive 2000/60/EG of the European Parliament and Council of October 23, 2000 for the creation of a legal framework for measures of the union in water policy (Wasserrahmenrichtlinie), ABl. L No. 327, p. 1.

[50] Legislation on the regulation of the water budget (Wasserhaushaltsgesetz); July 31, 2009, BGBl. I 2009, p. 2585 et seq.

[51] Provisions on the European Cross Compliance do not change anything in our current findings; see Ekardt/ von Bredow, in: Leal (ed.), The Economic, Social and Political Aspects of Climate Change, 2010 (forthcoming).

[52] On governance or regulation deficits as generic term for regulation and enforcement deficits, see Ekardt, Steuerungsdefizite im Umweltrecht: Ursachen unter besonderer Berücksichtigung des Naturschutzrechts und der Grundrechte – zugleich zur Relevanz religiösen Säkularisats im öffentlichen Recht, 2001, p. 38 et seq.

[53] Regulation on the application of fertilizers, soil additives, cultural substances, and plant additives according to the principles of the code of good practice in fertilization (Fertilizer Ordinance) [Düngemittelverordnung] of February 27, 2007, BGBl. I 2007, p. 221 et seq.

quantity (§ 3 Abs. 3 DüngV), a ban on applying fertilizers with high nitrogen or phosphate content during winter months (§ 4 Abs. 5 DüngV) as well as on water-saturated, flooded, snowcovered or frozen soils (§ 3 Abs. 5 DüngV). In order to prevent nutrient run-off, a minimum-distance from surface waters must be maintained (§ 3 Abs. 6 DüngV).

In order to prevent overfertilization especially with phosphorus, the following regulations are additionally provided: According to § 3 Abs. 3 no. 2 DüngV, available phosphorus contents in soils must be identified by the farm at least every six years. In addition, the farmer must prepare an operational nutrient comparison on an annual basis, amongst others, for phosphorus. This can be done either in the form of a balance sheet or as an aggregated "Schlagbilanz". Both must be provided to the appropriate agricultural authority upon request, as is stated in §§ 5 Abs. 1 and 6 para. 1 DüngV. As long as this nutrient comparison does not exceed, on average, an operational nutrient surplus of 20 kg per hectar during the last six fertilization years, it is being assumed according to § 6 para. 2 no. 2 DüngV that the application quantity corresponded with plant requirements and, as a result, was carried out in accordance with the code of good practice.

With respect to the application of the overriding fertilization legislation it is encouraging that the amendment of the DüngV has led to the tightening of current legislation in several points. At this time, for example, more stringent regulations are in place in respect to obligations for more appropriate fertilization, periods when fertilizers cannot be applied, and the minimum safety distance to water bodies has been extended. Admittedly, many regulations of the DüngV are too general and too poorly defined [54] to fulfill the code of good practice. Simply speaking, they do not go far enough. We want to illustrate this with the example of nutrient balance implementation, where nutrient input and output are compared to a certain reference value and time period. The resulting total is an important indicator for the environmental impact by nutrients. It is regulated by § 5 para. 1 DüngV to establish a nutrient balance sheet for a certain area. Such a balance sheet compares the nutrient input in the form of industrial or farm fertilizer on a given area to the output in the form of crops. Since this approach does not require a livestock balance sheet (Stallbilanz), and since for its calculation guide values can be used, it is only of limited value for animal husbandry (which is the major environmental problem with regard to phosphorus) and difficult to check.[55]

Furthermore, current administrative law has not taken account of any resources regulation in respect to phosphorus. Using farm and secondary fertilizers such as sewage sludge, which is regulated in the BioAbfV and AbfKlärV, can help to conserve scarce phosphorus resources and add to a stable nutrient balance. However, their application threatens to trigger nutrient excess and accumulation of harmful substances in soils because fertilizers are often loaded with heavy metals. Moreover, the acceptable discharge is aligned to how many contaminants are contained in dry matter and how much of dry matter is deployed per hectare. This allows for loads which can be significantly higher than what is being extracted. There is no real regulation for the problem of increasingly excessive levels for ecosystems – not for excessive resource deprivations resulting from high user rates in feed and strongly expanded livestock farming; ecological regulations do exist, however they are inadequate, as will be further illus-

[54] SRU, Umweltgutachten 2008, No. 971.

[55] SRU, Umweltgutachten 2008, No. 1005. Apart from this, not all operations are obliged to establish a balance. The exemptions in § 5 Abs. 4 DüngV note that due to the area size, on average, 47 % of the operations and at least 5 % of agricultural area are exempted from complying with the obligation to establish a nutrient balance, SRU, Umweltgutachten 2004, No. 309.

trated in the following.

We can therefore summarize here that in order to stress the gap-closing functions[56] of the BBodSchG, § 3 BBodSchG with its eleven amendments was created. As a consequence of their priority handling, vital areas of both quantitative and qualitative soil conservation are exempted from the scope of application of the legislation[57] - as is the case with fertilizer use. Likewise, water legislation relies upon regulations of the waste and fertilizer legislation. As has been shown, fertilizer legislation hardly aims at environmental protection and sustainable resource use.[58] The level of fertilization is mainly measured by economic criteria.[59] Regulations take soil conservation and phosphorus application rudimentary into account in only a rudimentary way, if at all, since they are seen as only "maintaining and enhancing soil fertility", and hence exclusively the soil function of being a basis for food production. Other soil functions are not mentioned. Generally speaking, large nutrient surpluses are still accepted for the element phosphorus. As a resources problem, it has essentially not even been broached in the law fields analyzed for this paper. Yet also from the contamination perspective, most uses are only weakly or, rather, not at all regulated: Uranium as a contaminant is currently largely unregulated.[60] The same holds true in waste management, which does not provide sufficient concrete regulations for phosphorus as an environmental or resource problem. The resource problem is tackled with the usage of sewage sludge, but in a very limited manner and with considerable ecological and potentially health-threatening side effects. This could be said to an even greater extent for the production and the subsequent use of animal secondary resources resulting from intensive animal husbandry. Neither does it do anything to come to terms with the analyzed long-term risks, nor does it prevent a continued deterioration of soil quality.[61]

A further point of criticism is the still inadequate implementation of the - already weakly ambitious - legal prerequisites. These implementational shortcomings exist on the one hand toward of the normative addressee, i.e. the individual farmer. The farmer is in the middle of a trade-off between economic and ecological interests. This conflict of aims might well be even more pronounced than in other areas of economic activity due to the income situation in agricultural soil cultivation. Since long-term quality conservation of soils represents the necessary basis for securing lasting yields, one would generally assume a farmer's motivation to maintain good soil conditions. Instead, his behavior is often oriented towards short-term profit expectations.[62] Moreover, the European agricultural subsidy system still rewards a short-term perspective by primarily emphasizing primarily quantity in agricultural production, and hence

[56] Print Document of the German Federal Parliament BT-Drs. 13/ 6701, p. 20; last general comments also Schrader, Umwelt- und Planungsrecht 2008, p. 415 et seq.
[57] On the criticism of the bill compare Peine, Umwelt- und Planungsrecht 1997, 53 (56 et seq.); Peine, Deutsches Verwaltungsblatt 1998, p. 157 (161). After its implementation, SRU, Umweltgutachten 2008, No. 516; SRU, Umweltgutachten 2000, No. 444 et seq.; Peine, Umwelt- und Planungsrecht 2003, p. 406 et seq.; Ekardt/ Seidel, Natur und Recht 2006, p. 420 et seq.; Ekardt/ Lazar, Altlasten-Spektrum 2003, p. 237 et seq.
[58] SRU, Umweltgutachten 2008, No. 516; Ekardt/ Seidel, Natur und Recht 2006, p. 420 (425); Peine, Umwelt- und Planungsrecht 2003, p. 406 (408); Kloepfer, Umweltrecht, 3rd edition 2004, § 19 No. 226.
[59] Cf. Sattelmacher/ Stoy, in: Blume, Handbuch, p. 265 et seq.
[60] Cf. Ekardt/ Schnug, in: Schnug/ de Kok, Loads, p. 209 (216); Ekardt/ Seidel, Natur und Recht 2006, p. 420 et seq. An exemtion are thresholds for uranium in drinking water, which however do not affect any change in the distribution of uranium.
[61] SRU, Umweltgutachten 2008, No. 516; Peine, Deutsches Verwaltungsblatt 1998, p. 157 (161); Ekardt/ Heym/ Seidel, Zeitschrift für Umweltrecht 2008, p. 169 (175).
[62] It would otherwise be hard to explain why farmers have not taken preventive action towards the diagnosed ecological and resources-political phosphorus problem on their own accord.

encourages animal husbandry, which is problematic from an ecological and resource policy perspective. Shortcomings in implementation continue on the applied normative level. If monitoring takes place at all[63], then such action resulting from implied responsibilities of the DüngV is assigned to the agricultural administration, whose primary task is to represent the interests of agricultural operations. Since administrations give priority to realizing sectoral interests when it comes to implementation of legislation, one can hardly expect increased commitment on their part in respect to resources or environmental policy goals; existing loopholes are mostly used in favor of other interests, and enforcement of the incredibly modest legal requirements is neglected.[64] Sadly but unsurprisingly, consumers are often quite pleased with the alleged (short-term) low price of food.

The reasons for short-sightedness and the subordination of ecological and resource-political questions go deeper than the explanation of economic and administrative self-interests might indicate. Ultimately, it is a multi-layered vicious circle involving farmers, consumers, politicians, law applicants, fertilizer producers and others that mutually strengthens certain basic attitudes contributing to this context, since all participants are jointly dependant on each other.[65] This is why agriculture in its current orientation towards increasing short-term profit next to economic self-interests is also aligned to traditional values (such as "production increase", illustrating the underlying concept of the omnipresent growth paradigm). Further, anthropogenic constants such as the "narrow" space-time focus of human emotionality on the here and now as well as habits, suppressions, and convenience will presumably make it rather difficult for most of those involved to face a long-term and currently "not visible" phosphorus problem in a resolute manner. Moreover, there is a problem with public goods: All those involved know that possibly the ecological problem dimension and definitely the resource-problem dimension in respect to phosphorus cannot be resolved by single individuals, which makes action often less appealing. These are generally the same problems that prevail within every societal transition towards increased sustainability.

3. Reformation options and limitations of the administrative law approach in soil conservation

Hoping for a free play of actors and markets without government control (or the self-regulation of farmers[66]) in respect to the phosphorus question has proven unsuccessful, and our root cause analysis strives to explain why. One way of dealing with this problem could be to demand stricter, more ambitious, and more concrete command and control legislation, which in

[63] The federal government and the German Länder have agreed, upon pressure from the EU Commission, that the implementation of parts of the DüngV will be controlled within 5 % of those operations which are funded by the EU, compare Weins, Zeitschrift für Umweltrecht 2001, p. 247 (247). Substantial findings of fertilizers in the environment are however a clear indication that control and monitoring of good practice is so far obviously only insufficiently taking place in Germany; this can only be limitedly resolved by checks of the (weaker) Cross Compliance which are required by EU subvention regulation; see SRU, Umweltgutachten 2008, No. 971.

[64] For existing enforcement problems, compare SRU, Umweltgutachten 2008, No. 484, 533; SRU, Umweltgutachten 2004, No. 306; on general enforcement shortcomings in environmental law see Ekardt, Steuerungsdefizite § 6. Ramsauer, in: Koch (ed.), Umweltrecht, 2nd edition 2007, p. 96, takes it further and talks about enforcement deficits which reach as far as to a complete lack of enforcement.

[65] On the double vicious circle and generally on reasons for non-sustainability Ekardt, Cool Down: 50 Irrtümer über unsere Klima-Zukunft – Klimaschutz neu denken, 2009, chapter II.

[66] On basic opportunities and limitations of self-regulation and free markets see Ekardt/ Meyer-Mews/ Schmeichel/ Steffenhagen/ Welthandelsrecht und Sozialstaatlichkeit – Globalisierung und soziale Ungleichheit, Böckler-Arbeitspapier No. 170, 2009, chapter 3.

fact appears to make sense on first sight from a transparency, motivation and ecology perspective. Preferentially, the EU-level would appear to be appropriate since phosphorus does not solely represent a national issue, either from a resource-political or from an environmental policy perspective. Although phosphorus contributes essentially to eutrophication, the EU nitrate directive[67] only regulates nitrate application in agriculture. Perhaps regulations on the application of phosphorus could be implemented in the nitrate directive, or a separate phosphorus directive also taking on the resource aspect could be established.[68] All of this and hence a European precautionary concept for soil and resource protection is so far lacking. Similar steps could be required on the national level, for instance a redefinition of the term "code of good practice", since the boundary between fertilization and overfertilization has so far been drawn where further yield and quality increase is no longer possible by simply applying more fertilizer. The required amount of fertilization from an ecological and resources-policy point of view then is already exceeded since that limit stands below the agriculturally-defined optimal fertilization intensity.[69] From a resources and environmental policy perspective, this could be normatized accordingly. From a consumption perspective, decreased yields are quite justifiable in the face of the wasteful food handling in western societies (disposal rate, high meat consumption).[70] Moreover, instead of using the surface balance in order to measure the nutrient balance, the more comprehensive and implementation-friendly enterprise balance should be applied, since the latter includes all nutrients going into and leaving the pool, such as seeds, fertilizer, feed, animal, crop yield and farm fertilizer.[71] Last but not least, slurry as a by-product of factory farming as well as phosphorus use in feed ought to be reduced structurally. As an alternative, lower limits in applying farm fertilizer as well as refraining from using additional mineral fertilizer could be discussed in order to encourage faster closed-loop cycles such as those in organic agriculture.[72] In addition to the above it would be necessary to improve enforcement of the respective regulations. This could be achieved by concrete norms, stricter monitoring and a legal basis not subject to governmental discretion.[73]

Although such (and perhaps also other) reform options in respect to phosphorus fertilization would be quite welcome, and have been discussed in part for a long time (of course without implementing them), there are a number of reasons for assuming that the administrative regulatory approaches described in this paper will not in the end succeed in solving the resource and environmental problem of phosphorus:

- First, the enforcement problem in agriculture can hardly be solved with a command and control regulatory approach, since an endless multitude of minimal processes would need to be monitored. The vision of a "policeman on every tractor" is hardly realistic.[74]

[67] Directive No. 91/676/EWG on the protection of waters against pollution by nitrate from agricultural sources, December 31, 1991, ABl. L No. 375, p. 1 et seq.
[68] Similar to this also Härtel, Düngung, p. 387.
[69] Kloepfer, Umweltrecht, § 19 No. 232; Sattelmacher/ Stoy, in: Blume, Handbuch, p. 265; Salzwedel, Natur und Recht 1983, p. 41 (42). The complex agricultural debate on defining „optimal" fertilization timing cannot be traced here due to space limitations and the specific focus of the paper.
[70] New studies show that approximately 40 % of global food production is not consumed. For the uneconomical handling of foodstuff in western societies compare Stuart, Waste, 2009; FOE, Checking out the environment, 2005; Henningsson et al., Journal of Cleaner Production 2004, p. 505 (512). This number might be estimated quite conservatively, since reports state that alone one third of food in households is thrown away.
[71] SRU, Umweltgutachten 2008, No. 1005; Frossard et al., Phosphor, p. 107 et seq.
[72] It is important to mention that agriculturally applied phosphorus is 100 % plant available, which must be considered accordingly when determining the supply rate.
[73] SRU, Umweltgutachten 2008, No. 971, Ekardt, Steuerungsdefizite, § 21.
[74] In 1998, the evaluation of European environmental-agrarian actions showed that despite annual administrative

Also, as has been shown, one cannot count solely on self-regulation in agriculture and elsewhere.

- Administrative approaches (command and control) often have the disadvantage that they unexpectedly shift environmental problems to other areas.[75] If the EU were to decrease phosphorus use, this might trigger intensified cultivation outside of the EU – or a massive increase in the likewise not unproblematic use of green genetic engineering.[76]
- There is one problem inherent to all similar legislative solutions: administrative legal systems are often prone to individual case-based exceptions, discretion or weighing. These expectations can often thwart the spirit of the legal norm through frequent application.
- Further, it is difficult to translate aspects such as "long-term preservation of food security" into administrative legal criteria (command and control) since they do not directly correspond to individual fertilizer application.[77]
- This leads to our central point: The essential problem of the ecological impact and even more so for the resources problem is demonstrated not so much with single fertilization. Rather, it is the cumulation of many, and when taken separately, insignificant fertilizer applications and the resulting excess fertilization, as well as mass production. This also holds true for the significant contribution of agriculture to climate change by energy-intensive fertilization, methane-releasing livestock farming and other environment-affecting issues. Regarded individually, the single adverse effects on the natural and aquatic environment often seem not to be sufficiently relevant, yet in total, they add up to substantial relevant adverse effects.

It is therefore necessary to find a regulatory approach that captures the required holistic perspective. Only a real decrease in the total quantity of all phosphorus used (ultimately on a global scale) and at the same time much more enhanced phosphorus recycling can actually achieve the necessary resource conservation while at the same time alleviating ecological impacts. Absolutely central to this thinking is the realization that creating regulations solely focusing on efficient phosphorus application will not be sufficient. Indeed, any reduced phosphorus application "per plant" in the current food crop system represents prima facie a gain. However, if at the same time the area of currently unused land is increasingly used for e.g. feed crop cultivation (triggered by globally rising meat consumption) or for bioenergy plants,

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expenses of 700 Mio Euro, no effective controls were possible and that some responsibilities in the practical field were just not controllable; compare Möckel, Zeitschrift für Umweltrecht 2007, p. 176 (177); on general legal regulations in agriculture and enforcement deficits in Germany, SRU, Umweltgutachten 2008, No. 971; SRU, Umweltgutachten 2004, No. 306, 322; Ekardt/ Heym/ Seidel, Zeitschrift für Umweltrecht 2008, p. 169 et seq.

[75] On the disadvantages of criteria or administrative legislative approaches („command and control") in respect to environmental policy-related quantity problems (and the often found superiority of economic tools) Ekardt/ von Bredow, in: Leal, Aspects; Ekardt/ Hennig, Zeitschrift für Umweltrecht 2009, p. 543 et seq.

[76] Perhaps green genetic engineering can contribute to a more efficient phosphorus usage in the field of animal feed by producing transgenic corn types. Nonetheless, using genetic engineering often proves to be at best a „second-best" solution. The use of genetic engineering collides on a principle level with the sustainability aspect of not triggering any irreversible processes. Yet the usage of genetic engineering mainly distracts from important concerns about a healthier, less meat-based diet and less pesticide as well as less fertilizer-dependant, less industrialized agriculture practices. Irrespective of the finiteness of phosphorus as fertilizer, the application of genetically modified products (such as seeds) is limited in developing countries due to high pricing. On some problems of the legal treatment of genetic engineering compare Ekardt/ Hennig/ Wilke, JbUTR 2009, p. 157 et seq.; Ekardt/ Hennig, Natur und Recht 2010 (forthcoming).

[77] Examplified in food security and bioenergy Ekardt/ Hennig, Zeitschrift für Umweltrecht 2009, p. 543 et seq.

the required absolute reduction in phosphorus use cannot be met. This problem of impending rebound effects is currently being realized in the climate change discourse - and even here not often enough - yet it also exists within the resource problematic.[78] It should further be pointed out that the resource problem can ultimately only be solved on a global scale. A reduction of phosphorus in the EU would certainly help the ecological problem of waterways and soils, yet the resource problem would remain – increasingly declining global phosphorus supplies would likely be used elsewhere.

Our global food security would not be put at risk, because any genuine quantity regulation that included manure measurement would make the production of food of animal origin unattractive (one calorie of food from animal origin requires four to twelve plant-based calories), and so food security would probably be stabilized (also because of the gained phosphorus savings). This is likely to result in the promotion of ecologically advantageous, cycle-oriented forms of land use such as organic farming. Apart from natural circulation systems on farms, the agenda could be set for consistent efforts to recycle phosphorus from residues, such as from the sewage sector or the waste industry, back into agriculture. From an ecological and health perspective, this implies to clearly counter-acting the impending overload of soils with heavy metals and organic pollutants through new, recycling and treatment concepts[79], a task which has not been sufficiently integrated in the past.

The fact that thoughts on small-scale regulatory improvements almost exclusively dominate the debate despite the obvious frictions presented might seem more remarkable than it actually is. The previously described individual types of motivation of the public, entrepreneurs, legal practitioners and politicians do indeed promote approaches which may demand no substantial behavioral changes of those involved. Rather, they seemingly provide "technical problem solving".[80] Apparently, most people involved fear nothing more than some sort of debate on "abdication", in which the durability and global realization of our occidental resource use (for example our high meat consumption) would need to be discussed in depth and not only in the language of euphemistic speeches. If at this point (predictably) many administrators, lawyers, and others might possibly try to avoid the debate by pointing out that such a new approach might not be "politically enforceable", and thus cannot be further discussed, then the existing majority options in western countries are, of course, correctly described. Admittedly, this would then (1) not be an objective practical constraint, but an (explainable, see above) behavior of concrete people in politics, administration, the public and farming community, for which all these would need to take responsibility, especially in respect to resulting consequences. Further, one should then (2) plainly admit that a real solution to the phosphorus problematic thus probably cannot be attained, with all the highly negative long-term consequences of such a "business as usual" policy.[81]

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[78] For biogenergy, its ambivalences and the impending rebound, compare Ekardt/ von Bredow, in: Leal, Aspects; on a general perspective of climate-related rebound effects see Ekardt, Cool Down, chapter II-III.

[79] Cf. indications in Schnug/ Ekardt/ Haneklaus/ Schick, Oekologie & Landbau 3/ 2008; 52 et seq. Relevant examples for such concepts are the EU-project SUSAN which is devoted to the nutrient recovery from sewage sludge, www.susan.bam.de, phosphorus recycling from municipal sewage sludge at Berliner Wasserbetriebe, www.bwb.de, and respectively the Ostara project, www.ostara.com.

[80] This is also being criticized by Valentin/ Beste, Der kritische Agrarbericht 2010, p. 178 (180).

[81] It is also possible to additionally ask why this is so little discussed in the legal, political and environmental discourse. Just as in practical politics, one can often observe that fundamental problems are not being picked out as central themes on the one hand. But then in contrast the "practical" *real* implementation of e.g. certain existing regulations receives rather little attention, too. The discussion therefore often remains on a "middle level" as concrete new thresholds, without systemically asking to which extent a given set of problems can be solved with

III. Soil protection through economic instruments such as subsidy reform, charges, and certificate markets? Also on social justice

A global approach to quantity control is simpler to enforce, prevents shifts in location, – because one cannot avoid quantity control anyway -, removes the rebound problem and ideally tackles a given problem (also in the case of phosphorus) at its roots. Global quantity control can therefore be, where necessary, less bureaucratic and democracy-friendly since the legislative body and not the administration with their multifaceted actions for concretization make the real decisions. Further, quantity control potentially provides more freedom since within a given quantity frame it leaves the freedom of decision to the citizen.[82] However, what is not implied is that such a quantity regulatory approach should generally take over in soil protection; even in those areas where it would be appropriate to have such an approach (such as in the context given), it might become necessary to develop additional administrative law regulations, as for instance for the use of sewage sludge, which on the one hand should be increasingly used, yet this is only possible under certain ecological and technical premises.

An obvious tool for phosphorus quantity regulation[83] could be a clear rearrangement of EU subsidies for the agrarian sector towards subsidies of environmental services, away from mass production and livestock farming. This stands to reason also from a fiscal perspective and for world trade legislative reasons. An alternative or even better cumulative effect would be the introduction of a fee on mineral fertilizer. Such a possibility has been discussed for some time already for the nutrient nitrate[84], but it is also plausible for phosphorus.[85] Instead, one could practice friendly enforcement with respect to fertilizer producers.[86] If in the case of phosphorus resources implications should be covered apart from ecological ones, taking also generally into account the global agrarian market and the extremely important animal feed market, then certainly a European or even global fee would be appropriate. Due to the time lag of effects it is important to start as soon as possible with these suggested measures. First results, particularly in respect to eutrophication, are likely to be visible only in several years or decades; and also the resource problem demands quick action.

An approach focusing on raising taxes would simultaneously tackle many other problems beyond the phosphorus issue (see IV below). The same affect as that provided by a tax could perhaps be achieved with a certificate-approach similar to the global greenhouse gas emission trading system, by creating entitlements to phosphorus and by gradually reducing phosphorus certificates on the global scale. A further alternative might be provided by a general certificate approach on land use, which could be linked to a completely newly designed European and global greenhouse gas emission trading system. The latter approach would establish different,

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such an approach and what enforcement will finally look like.

[82] Generally on these aspects of economic respectively quantity regulation tools, see Ekardt, Demokratie, chapter VI E.

[83] We are using the term quantity regulation here for tools which specifically influence the quantity of a resource (here: phosphorus). In contrast to many environmental economists, the term is also used for describing approaches which do not specifically assess the quantity but convey this indirectly via pricing (e.g. fees, taxes or eliminating subsidies).

[84] Compare SRU, Umweltgutachten 2004, No. 324 and following; SRU, Umweltgutachten 2008, No. 1006 et seq., whereas the requirement of a nitrate fee has given way to a nitrate surplus fee; also compare Ekardt/ Weyland/ Schenderlein, Natur und Recht 2009, p. 388 et seq.

[85] This is being approved by Möckel, Zeitschrift für Umweltrecht 2007, p. 176 (177).

[86] SRU, Umweltgutachten 2004, No. 324; Möckel, Zeitschrift für Umweltrecht 2007, p. 176 (177).

typified land use type certificates depending on the degree of their ecological relevance and would then again gradually reduce them on the global scale. From a climate-policy perspective, including land use is in any case on the agenda, however, severe enforcement difficulties are expected (also on the operative level due to determining the ecological value of certain areas and land use types) – however, they will be even more apparent in administrative legislative global solutions.[87] The easiest approach might well be to establish a parallel global certificate market for phosphorus and for greenhouse gas emissions. A subsequently resulting price and cost pressure and the resulting changes in land use would certainly also be indirectly beneficial to other land use problems (this is further elaborated in the following section).

In European law, article 9 WFWD on the imperative of rendering tasks economical, suggests an economic solution for the phosphorus issue especially in respect to waterways anyway. According to current prevalent belief, fertilization is considered only as a form of water usage, not as a water service since it does not comply with the definition given in article 2 no. 38 WFWD. Article 9 section 1 sub-section 1 WFWD demands that also those which are not water services must take on an appropriate share for the cost recovery of providing such water services if they are to some degree responsible for these costs. Accordingly, sectors such as for example agriculture in fact need to bear the (additional) costs that result from overapplication of fertilizers in wastewater treatment for the provision of drinking water (this also includes extracting e.g. uranium). Finally, water quality impairments linked to fertilizer production could also be taken into account.

Phosphorus use and, in general, any administrative law or quantity control approach eventually leads to implications for social distributive justice. This not only refers to conflicts between economic freedom and the protection of physical preconditions of freedom (in parts also guaranteed by fundamental/ human rights), which are always present in environmental protection.[88] Rather, it refers to secondary effects that arise from the resulting compromises between these different rights in environmental policy. In other words, harm and benefit arising from phosphorus application do not always align. This problem has a national and global dimension.[89] Declining phosphorus reserves are likely to result in higher prices and quality degradation due to higher heavy metal loads. While industrialized countries are still able to pay prices for higher quality and fertilizer in general, developing countries are likely to face severe availability and accessibility problems. Moreover, soils in the southern hemisphere are currently exposed to substances such as uranium for a production that is mostly consumed in industrialized countries. However, especially these questions on distribution speak for quantitative regulation rather than administrative law regulation since in the former case it is not problematic to side with social adjustment payments, such as paying higher prices for foodstuffs and other commodities.[90] Such compensation payments could for instance distribute the revenues arising from a charge or from a certificate system auctioning per capita to the citizens of every state. Another option would be to partially or completely frame them as a North-South transfer.

[87] For further development options of the European and global greenhouse gase emission trading system see Ekardt, Cool Down, chapter III; Ekardt/ Exner/ Albrecht, Carbon & Climate Law Review 2009, p. 261 et seq.
[88] More in Ekardt, Die Verwaltung 2010, Beiheft 1 (forthcoming).
[89] More detailed information may be found in Ekardt/ Heitmann/ Hennig, Gerechtigkeit, chapter III-VI; Ekardt, Cool Down, chapter III-V.
[90] For corresponding models view fn. 89.

IV. Final comparison: Soil biodiversity as an additional problem in sustainability

As has been stated before, a consistent quantity control in phosphorus management or land use would tackle different problems simultaneously: mass production, deforestation, land consumption, the climate problem, among other issues. Accordingly, we want to briefly outline an additional soil protection domain in a comparative manner. We want to highlight the interaction between soil (protection) and biodiversity. One of the main global problem fields is the loss of biodiversity connected with the deterioration of soils. The interconnection between these two domains is slowly being acknowledged in scientific discourse. Yet in reality, there is no cooperation and exchange between the responsible key actors in policy making.[91] The last time that key inventories in agriculture were conducted and published on international institutions was in 2008 with the World Development Report[92] and the report of the International Council on Agricultural Knowledge.[93] The current status quo analysis found in these reports confirms a manifold increase in land productivity as well as work productivity in European agriculture over the last century. The main reason for this productivity increase is reported to be, next to the mechanization of agriculture, the massive application of fertilizers and pesticides as well as the cultivation of high-yield crops. One of the globally most important causes of loss of biodiversity relates to agriculturally induced changes of natural ecosystems to areas for crop production.[94] In respect to genetic variety, agricultural breeding practices and research which are exclusively devoted to marketable species have resulted in 90 % of the world's crop production depending on only ten plants. Subsidy mechanisms, industrialization of cultivation and processing, as well as only a few globally active food production companies dominating the market are the main reasons for this development. Over the last fifty years, availability and subsidy of pesticides and fertilizers have essentially led to an irrecoverable loss of about 70 % of genetic variety in agricultural crops.[95]

The European Union[96] and (for instance) the German government have programmatically committed to contain and, respectively, stop the loss of biodiversity by 2010. On the national level, the populations of the majority of species which are typically found in our cultural landscape are supposed to be secured by 2015. Moreover, biodiversity in agro-ecosystems will be significantly increased by 2020.[97] Still, knowledge gaps in biodiversity remain and scientific bindings can still be considered insufficient in some areas. Therefore, the European Commission[98] as well as above-cited studies foresee an increased need for research in these areas in order to establish a better founded basis for political action.[99] In Germany, these measures should for example comprise a more stringent integration of relevant measures in respect to soil biodiversity into agronomic legislation. Further, the principle of the code of good practice must be reassessed or substantiated as a minimum requirement, insofar as that all areas make a contribution to the conservation of biodiversity; compile, by 2010, integrative strategies for increasing agro-biodiversity; and establish adequate consulting, funding and monitoring in-

[91] See Seidl/ Fry/ Joshi, GAIA 2003, p. 187 et seq.
[92] The World Bank (ed.), World Development Report 2008: Agriculture for Development, 2008.
[93] International Assessement of Agricultural Knowledge, Science and Technology for Development (IAASTD)
[94] Compare Giger/ Humi/ Portner/ Scheidegger, GAIA 2008, p. 280 (281).
[95] Compare with other references Bongert/ Albrecht, GAIA 2008, p. 287 (288 et seq.).
[96] Containing the loss of ecological varietey until 2010 and beyond – Conservation of ecosystem services for the good of humankind, KOM (2006), 216.
[97] National Strategy for Biodiversity, resolved November 7, 2007, p. 47.
[98] Thematical strategies for soil protection, KOM (2006), 231.
[99] For this purpose, the EU, on July 19, 2008, put out a tender for a research contract on the „evaluation of tools within the scope of policies for protecting biodiversity within the 27 EU member states".

struments by 2015.[100]

Despite all these proposed concepts, biodiversity as such is not necessarily approached as a subject of protection in itself. Rather, biodiversity has far-reaching economic implications, as well as additional service functions for humanity.[101] In any case, the combination of waiting, self-regulation and pointing to the code of good practice should also prove to be just as unsuccessful in the case of biodiversity as in that of the phosphorus problem complex. Here, too, the different problems need to be ultimately tackled at their roots. One could argue that biodiversity, and also soil biodiversity - in contrast to phosphorus - are ultimately “renewable” resources. However, even renewable resources can be overused and hence be finite in their own way.

[100] National Strategy for Biological Diversity, p. 48.

[101] Issues such as resource use and biodiversity do not primarily compromise freedom. Rather, they are of real value for mankind in various ways (according to current knowledge). This certainly does not mean that the overall relevance of biodiversity for humankind, its freedom and its freedom prerequisites can be expressed in monetary values. Such a view would probably be claimed by most economists. Certainly, it would be easier to communicate the eligibility of biodiversity protection if an exact economic value can be attached (for instance in respect to productivity or climate relevance of soils). However, to attach an artifical monetary value to biodiversity *as a whole* (!) would distract from the idea that securing the basis of life ultimately (or in the long term) relates to the life and health of people. The latter ones might be subject to weighing/ balancing, but they certainly do not have a tangible monetary value. Even economic value calculations on a „hypothetical willingness of people to pay for biodiversity“ will not change this perspective since such calculations deserve harsh criticism for many reasons: Any hypothetical willingness to pay is fictive and hence not significant; moreover, it is also limited by the ability to pay (Bill Gates’ vote hence would count a million times more than that of an unemployed person). Often, conclusions are made on measured willingness to pay, e.g. for real estate, which is not compellable – for instance the preference for having real estate in a green environment does not declare any preference for biodiversity. On these issues and on further principle frictions of the economic theory on preferences as decision tools, cf. Ekardt, The Limits to Climate Economics, 2010 (forthcoming).