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IMPACT ASSESSMENT

Limits for cadmium in phosphate fertilisers

Accompanying the document

Proposal for a Regulation of the European Parliament and of the Council

laying down rules on the making available on the market of CE marked fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009

{COM(2016) 157 final}
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1. INTRODUCTION

Concerns regarding the risks posed by cadmium to human health and the environment were addressed by the Council already in its Resolution of 25 January 1988[1] which emphasized the importance of reducing inputs of cadmium into soils from all sources including diffuse sources (e.g. atmospheric deposition, phosphate fertilisers, sewage sludge…) by among others *"appropriate control measures for the cadmium content of phosphate fertilisers based on suitable technology not entailing excessive costs and taking into account environmental conditions in the different regions of the Community"*. Among the possible actions (reduced atmospheric emissions, limit values for sewage sludge), cadmium in phosphate fertilisers remains the main point not having been dealt with so far at EU level.

The EU fertiliser market is only partly harmonised. Regulation (EC) No 2003/2003 of the European Parliament and of the Council of 13 October 2003 relating to fertilisers[2] (hereinafter referred to as "the Fertilisers Regulation") aims to ensure the free circulation on the internal market of "EC fertilisers" i.e. those fertilisers that meet certain requirements for their nutrient content, their safety, and their lack of adverse effect on the environment. The Fertilisers Regulation does not affect the so-called "national fertilisers" placed on the market of the Member States in accordance with national legislation. Producers can choose to market fertiliser as "EC fertiliser" or as "national fertiliser". Depending on agricultural practices in the Member States, "EC fertilisers" have, on average, market shares from 60 to 70 %[3].

Twenty Member States have already introduced or intend to introduce diverging limits for cadmium in national fertilisers. On the other hand, there is currently no limit value for cadmium in the Fertilisers Regulation. However, Recital 15 of the Fertilisers Regulation specifies that "*Fertilisers can be contaminated by substances that can potentially pose a risk to human and animal health and the environment. Further to the opinion of the Scientific Committee on Toxicity, Ecotoxicity and the Environment (SCTEE), the Commission intends to address the issue of unintentional cadmium content in mineral fertilisers and will, where appropriate, draw up a proposal for a Regulation, which it intends to present to the European Parliament and the Council*".

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1 OJ C 30, 4.02.1988, p. 1.
2 OJ L 304, 21.11.2003, p. 1.
3 Evaluation of Regulation (EC) No 2003/2003 to fertilisers. Centre for Strategy and Evaluation Services. Final Report. November 2010. HTTP://EC.EUROPA.EU/ENTERPRISE/SECTORS/CHEMICALS/FILES/FERTILIZERS/FINAL_REPORT_2010_EN.PDF

Commission Regulation (EC) No 889/2008[4] on organic products sets an upper limit of 90 mg/kg P_2O_5[5] for cadmium in two phosphate fertiliser types (soft ground rock phosphates, aluminium-calcium phosphate) that may be used in organic production. Those fertiliser types also fall under the scope of the Fertilisers Regulation.

2. CONSULTATION OF INTERESTED PARTIES AND EXPERTISE

The various consultations conducted as part of this impact assessment report have been carried out in compliance with the Commission's minimum standards on consultation[6].

2.1. Consultation of other Commission services

An impact assessment steering group (IASG) was established in May 2008 to which the following Directorates-General were invited: Enterprise and Industry, Environment, Health and Consumer Protection, Agriculture, Trade, External Relations, Research, Development, Economic and Financial Affairs, Internal Market, Secretariat General and Legal Service. The members of the steering group were also invited to participate in meetings with experts in decadmiation, stakeholders and Member States representatives.

The IASG met six times between June 2008 and May 2010 in order to accompany the preparation of the impact assessment. Directorates-General Enterprise and Industry, Environment, Health and Consumer Protection, Agriculture and Trade were the most active participants.

2.2. Consultation of the Member States and EU fertiliser industry in the frame of the Fertiliser Working Group

During the Fertilisers Working Group meeting of 5 November 2007, most Member States supported setting upper limits for cadmium for all phosphate fertilisers (EC and national fertilisers). Several Member States having set already national limits that so far affect only national fertilisers insisted on being allowed to continue to apply them to address their specific environmental concerns. Annex I contains an overview of the limit values for national fertilisers that Member States have already introduced or intend to introduce in legislation.

In October 2009, representatives of the Member States, producing countries of phosphate rocks and fertilisers, EU fertiliser manufacturers, environmental NGOs, trade unions, farmers and consumers organisations[7] were consulted at a specific workshop on potential policy options for implementing cadmium limit(s). The advantages and drawbacks of the options

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4 Commission Regulation (EC) No 889/2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control. OJ L 250, 18.09.2008, p. 1.

5 See Glossary of terms and abbreviations.

6 Available at: HTTP://WWW.CC.CEC/HOME/DGSERV/SG/STAKEHOLDER/INDEX.CFM?LANG=EN&PAGE=GUIDANCE

7 BEUC (European Consumers Organisation), COPA COGECA, CEN (European Committee for Standardisation), European Environmental Bureau (EEB), IMPHOS (World Phosphate Institute), OCP (Office Chérifien des Phosphates), EFMA (European Fertilisers Association), EFBA (European Fertilisers Blenders Association), EFIA (European Fertilisers Imports Association), IFA (International Fertilizers Association), ETUC (European Trade Union Confederation), EMCEF (European mine, chemical and energy workers' federation).

developed in this impact assessment (except Option 2)[8] were presented in detail and stakeholders were requested to provide their views on the options. The preferences expressed during that meeting are provided in Annex II.

In summary, a majority of stakeholders supported the following approach:

– Introduction of an upper limit of 60 mg cadmium/kg P_2O_5 decreasing progressively to more stringent limits because of sufficient scientific evidence establishing a conclusive link between soil cadmium concentration, transfer to plants, dietary intake and possible human health risks. Some Member States advocated starting with a limit value of 75 mg cadmium/kg P_2O_5 and decreasing to 60 mg cadmium/kg P_2O_5 after 3 years.

– However, the adoption of limits lower than 60 mg cadmium/kg P_2O_5 would be conditional on the successful implementation of a decadmiation technology at industrial scale which is so far unproven as low cadmium phosphate sources will not be sufficient to cover all needs of EU farmers.

– The setting of low limits needs to be mindful of the problem that not all the current fertiliser types placed on the market can be decadmiated, in particular decadmiation would not be possible for the phosphate fertilisers currently authorised in organic farming.

– The timing of a progressive decrease in cadmium limits will therefore mainly depend on progress in decadmiation technology and/or on the availability of phosphate fertiliser alternatives containing less cadmium (e.g. from manure, sewage sludge, bio-waste, industrial by-products…).

In addition to this consultation, an earlier public consultation via internet had been conducted in 2003 regarding the possible introduction of Community limits on cadmium in fertilisers below 60 mg cadmium/kg P_2O_5. The distribution of the 65 replies received by the Commission, which may be broadly classified as for, against and neutral, was as follows:

- 7 broadly approved the Commission's proposal;
- 54 expressed strong concerns in particular concerning the introduction of uniform limits below 60 mg cadmium/kg P_2O_5;
- 4 replies did not directly express an opinion on the proposal, but sent studies relating to the subject of cadmium in fertilisers.

Further details are contained in Annex III. A renewed public consultation via internet was not considered necessary, as based on the available knowledge through direct contacts the positions of those who participated in the earlier consultation have not changed. All key stakeholders were represented at the workshop in October 2009 referred to above.

2.3. SMEs consultation

In the framework of the implementation of the Small Business Act, requests for input on the various options (except option 2) developed in the impact assessment were also submitted to Small and Medium Size Enterprises (SMEs) on the basis of a specific questionnaire supported by a background note clarifying the technical and economical aspects of the proposal. 40 companies in 14 Member States participated in the consultation. This might represent around 5% of the SMEs active in the production and trade of mineral fertilisers across

[8] Option 2 (market-based incentives) was not part of the earlier consultations because it was included in the analysis only after the first review of the draft impact assessment report by the Commission's Impact Assessment Board.

Europe. In general, SMEs producing only mineral fertilisers or producing mineral fertilisers plus organic fertilisers and soil improvers commented mostly on possible negative impacts on the competitiveness of the sector from measures restricting the supply in phosphate fertilisers. Further information on the SMEs replies is incorporated in the analyses in section 6 and is available in Annex IV.

2.4. Scrutiny by the Commission impact assessment board

The impact assessment board (IAB) [9] of the European Commission assessed a draft version of the impact assessment and issued its first opinion on 2 July 2010. The impact assessment board made several comments and, in the light of those suggestions, the revised impact assessment report:

– **provides a broader description of the problem** by presenting in more detail the current supply conditions and related economic issues such as incentives for developing decadmiation technologies;

– **explains in the description of the problem why long term risks for the population** and for the environment cannot be assessed more quantitatively and why it is impossible to directly correlate soil cadmium inputs from mineral phosphate fertilisers and their effects on public health and the environment;

– **clarifies the objectives** pursued with the legislative proposal accompanied by this impact assessment;

– **indicates more clearly the trade-offs between the different objectives** and specifies why choices are limited by political constraints such as trade obligations and external relations;

– **introduces and analyses a new option on market-based incentives including fiscal incentives (hereinafter option 2)** to increase the use of fertilisers with low cadmium content and a new annex explaining the calculations carried out;

– **analyses for each option** the incentives to trigger the development and implementation of decadmiation technologies;

– **provides additional explanations why the most ambitious option** of an immediate EU limit of 20 mg cadmium/ kg P_2O_5 has been discarded at an early stage and clarifies that this option is implicitly contained in one of the options that has been fully analysed.

The Impact Assessment Board issued its final position on a revised draft impact assessment report on 26 July 2011 and, based on those comments, the final impact assessment report:

– **Better present the time dimension of the problem** in terms of long term health impacts and technological developments

– **Clarifies how the trade-offs between the objectives** have been taken into account in the formulation of objectives and why a complete harmonisation of the cadmium limit value is not envisageable

– **Provides clearer arguments to disguard the option of immediately imposing a 20 mg limit**

[9] HTTP://EC.EUROPA.EU/GOVERNANCE/IMPACT/IAB_EN.HTM.

3. PROBLEM DEFINITION

3.1. Why is the presence of cadmium in phosphate fertilisers an issue?

Cadmium is a non-essential element that has a high transfer rate from soil to plants compared to other non-essential elements. Certain plants (e.g. sunflowers, colza, triticale, tobacco...) tend to accumulate larger amounts of cadmium. Cadmium is naturally present in phosphate rocks which are mined for the manufacture of phosphate fertilisers.

The additional annual cadmium accumulation rate from various anthropogenic sources such as atmospheric deposition, mineral fertilisers, manure and sewage sludge is generally small but quantitative estimates vary. In 2002, the Scientific Committee on Toxicity, Ecotoxicity and the Environment (SCTEE-2002[10]) considered that annual net accumulation from all sources is typically in the order of about 1 % of the amount already present in agricultural soils[11], whilst several Member States having conducted specific risk assessments concluded that annual net accumulation would be in the order of 0.4-1.25 % from phosphate fertilisers alone if their cadmium content is at 60 mg/kg P_2O_5[12].

Once present in soil, cadmium cannot be removed and might accumulate and migrate to pore solution where plant roots take up their nutrients. Quantification of the net contribution of phosphate fertilisers to transfer to plants is extremely complex and depends on soil and climatic conditions. Cadmium solubilisation and bioavailability are affected by soil pH – acidic soils favour the solubility of cadmium – and are also largely controlled by the presence of organic matter, sand, clay or micro-nutrients such as zinc, iron and manganese. Other factors such as crop variety, rainfall and farming practices may also affect cadmium bioavailability. However, soil pH and soil cadmium accumulation are considered as the main factors controlling the availability of cadmium for uptake by plants.

The presence of cadmium in plants and cadmium intake from foodstuffs could eventually lead to adverse effects on human health in the longer term. In addition to human health impacts, further cadmium accumulation in soils could have negative effects on soil biodiversity and therefore on soil functions (e.g. decay of organic matter) and on groundwater quality via leaching in soils.

In 2002, the Scientific Committee on Toxicity, Ecotoxicity and the Environment (SCTEE - 2002)) was asked by the Commission for its opinion[11] on the likelihood for accumulation of cadmium in soils through the use of phosphate fertilisers. Based on risk assessment studies carried out by 8 Member States (+ Norway) and additional analysis, the SCTEE-2002 estimated that phosphate fertilisers containing 60 mg cadmium/kg P_2O_5 or more are expected to lead to cadmium accumulation in most EU soils whereas phosphate fertilisers containing 20 mg cadmium/kg P_2O_5 or less are not expected to cause long-term soil accumulation over 100 years, if other cadmium inputs are not considered. A similar trend is expected for cadmium uptake in crops although the actual increase would be much smaller. The SCTEE-2002 was also of the opinion that the derivation of a limit exclusively based on soil accumulation does not take into account the level of risk for human health and the environment associated with the current situation and considered that such a limit should be derived on a more solid risk assessment basis using a probabilistic approach and taking all cadmium sources into consideration.

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10 Now renamed SCHER.

11 HTTP://EC.EUROPA.EU/HEALTH/PH_RISK/COMMITTEES/SCT/DOCUMENTS/OUT162_EN.PDFI.

12 HTTP://EC.EUROPA.EU/ENTERPRISE/SECTORS/CHEMICALS/DOCUMENTS/SPECIFIC-CHEMICALS/FERTILISERS/CADMIUM/RISK-ASSESSMENT_EN.HTM

In 2015, the Commission mandated the Scientific Committee on Health and Environmental Risks (SCHER-2015) to evaluate a new mass-balance analysis[13] (hereinafter the "new analysis") based on new information about atmospheric deposition of cadmium, use of inorganic phosphate fertilisers and new and more accurate models to estimate the cadmium leaching from the soil. The main objective was to compare the results of the new analysis with the SCTEE-2002 opinion in order to assess whether new trends in soil cadmium accumulation can be observed based on the most up-to-date data.

The SCHER released its final opinion on 27.11.2015[14] and concluded that, on average, cadmium accumulation is not likely to occur in EU 27 + Norway arable soils when using inorganic phosphate fertiliser containing less than 80 mg Cd/kg P_2O_5. According to SCHER, the new conclusion is justified by the significant decrease in the level of cadmium actually present in the environment since the last assessment of 2002 which was based on data from the nineties.

The SCHER-2015 highlighted however that an average scenario does not reflect the various soil and climatic conditions in the EU. In extreme conditions (high fertiliser consumption, critical soil conditions), SCHER showed that cadmium soil accumulation could still happen at a concentration of 20 mg Cd/kg P_2O_5.

As the new conclusion from SCHER-2015 came during the interservice consultation on a draft Commission proposal for a revision of the Fertilisers Regulation, the assessment of the impacts have been construed based on the conclusions of SCTEE-2002. However, the opinion of SCHER-2015 should be considered as a new important scientific element and therefore its impact on the choice of the preferred option is discussed in Section 8 of this impact assessment.

The most important conclusions of recent risk assessments concerning cadmium are presented in the following section. Summaries of previous mass-balance calculations and risk assessments are available in Annex V.

3.1.1. Toxicity of cadmium for human health via the diet

In the framework of Council Regulation (EEC) No 793/93 of 23 March 1993 on the evaluation and control of the risks of existing substances[15], cadmium and cadmium oxide were identified as priority substances for evaluation in accordance with Commission Regulations (EC) No 1179/94[16], (EC) No 2268/95[17] and (EC) No 143/97[18], respectively. Belgium was designated as Rapporteur Member State and completed a risk evaluation for cadmium and cadmium oxide to the environment and human health in accordance with Commission Regulation (EC) No 1488/94 of 28 June 1994 laying down the principles for the assessment of risks to man and the environment of existing substances[19]. The EU Risk

13 HTTP://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S0048969714004495

14 HTTP://EC.EUROPA.EU/HEALTH/SCIENTIFIC_COMMITTEES/ENVIRONMENTAL_RISKS/OPINIONS/INDEX_EN.HTM

15 OJ L 84, 5.04.1993, p. 1.

16 Commission Regulation (EC) No 1179/94 of 25 May 1994 concerning the first list of priority substances as foreseen under Council Regulation (EEC) No 793/93.OJ L 131, 16.05.1994, p. 3.

17 Commission Regulation (EC) No 2268/95 of 27 September 1995 concerning the second list of priority substances as foreseen under Council Regulation (EEC) No 793/93.OJ L 231, 28.09.1995, p. 18.

18 Commission Regulation (EC) No 143/97 of 27 January 1997concerning the third list of priority substances as foreseen under Council Regulation (EEC) No 793/93.OJ L 25, 28.01.1997, p. 13.

19 OJ L 161, 29.06.1994, p. 3.

Assessment Report[20] (hereafter EU RAR) on cadmium and cadmium oxide was issued in December 2007.

The EU RAR on cadmium found that the most sensitive toxicological/ecotoxicological endpoint is kidney toxicity through repeated oral exposure (intake via the diet). Cadmium in food is the second factor after smoking that contributes to cadmium human body burden. For the general non-smoking population, food is actually the main source of cadmium intake. Although cadmium absorption through the gastrointestinal tract is relatively low (3-6 %), cadmium is efficiently retained in kidneys and liver. Once absorbed, cadmium is not easily excreted (biological half life between 10 and 30 years) and tends to accumulate in humans and may eventually cause renal dysfunction.

The food groups that contribute most to adult dietary cadmium intake are, in decreasing order of importance: cereals and cereal products; vegetables; meat, meat products and offal (inner organs); as well as fish and seafood. Vegetables and wheat are the crop categories with the highest inputs of phosphate fertilisers (market shares of 17.8 % and 16.4 %, respectively).

The EU RAR found that the contribution of dietary cadmium constitutes about half the tolerable intake and concluded that there is a need for limiting the risks to human health from cadmium via the environment from all sources of cadmium combined because, at current level of exposure, health risks cannot be excluded for adult smokers and people with depleted iron body stores and/or living near industrial sources.

Based on the conclusions of the EU RAR, the Risk Reduction Strategy for cadmium and cadmium oxide recommended concrete measures to reduce cadmium content in foodstuffs, tobacco blends and for phosphate fertilisers taking into account the variety of conditions throughout the Community[21].

In 2007, the Commission asked the European Food Safety Authority (EFSA) to assess the risks to human health related to the presence of cadmium in foodstuffs[22]. The Panel on Contaminants in the Food Chain of EFSA (CONTAM Panel) issued its scientific opinion[23] in January 2009. Based on updated exposure assessments from foodstuffs and on statistical review of available information, the CONTAM Panel concluded that a value of 1 µg cadmium/g creatinine for urinary cadmium (Cd-U) would be an appropriate biomarker value to protect 95 % of the general population by the age of 50. The dietary exposure that corresponds to the value of 1 µg cadmium/g creatinine after 50 years corresponds to a tolerable weekly dietary intake of 2.5 µg cadmium/kg body weight (TWI).

The current average weekly dietary exposure across Europe – 2.3 µg cadmium/kg body weight – is very close to the TWI proposed by the CONTAM Panel and may be exceeded about 2-fold for certain sub-groups of the population such as vegetarians, children, smokers and people living in contaminated areas. Quantitative data on the size of these high risk groups, the distribution of risks within these groups, their risk increase in relation to the

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20 HTTP://ECB.JRC.EC.EUROPA.EU/DOCUMENTS/EXISTING-CHEMICALS/RISK_ASSESSMENT/REPORT/CDOXIDEREPORT302.PDF and HTTP://ECB.JRC.EC.EUROPA.EU/DOCUMENTS/EXISTING-CHEMICALS/RISK_ASSESSMENT/REPORT/CDMETALREPORT303.PDF.

21 OJ C 149, 14.06.2008, p. 6.

22 For exposure assessments, dietary intake included only cadmium in food but not in drinking water.

23 Scientific Opinion of the panel on contaminants in the Food Chain on a request from the European Commission on cadmium in food. The EFSA Journal (2009) 980, p. 1-139. HTTP://WWW.EFSA.EUROPA.EU/EN/SCDOCS/DOC/980.PDF

general population and the potential impact on public health costs were not assessed by EFSA as such data is not available and the calculation of public health costs is outside the remit of EFSA. Furthermore, a more detailed estimate of risk to establish relations between certain risk levels and the percentages of the population exposed to given risk levels would require a probabilistic risk assessment, for which not enough information is available.

Although the risk for adverse effects on kidney function at an individual level and at dietary exposures across Europe is very low, EFSA concluded that the current exposure to cadmium at population level should be reduced. EFSA evaluated qualitatively the impact of the uncertainties associated with their risk assessment according to EFSA and international guidelines. The outcome of this evaluation was that "*the impact of the uncertainties on the risk assessment of exposure to cadmium is limited*" and "*that its assessment of the risks is likely to be conservative- i.e. more likely to overestimate than to underestimate the risk*". This approach is in line with the precautionary principle. In fact, although early signs of kidney dysfunction may be reversible, it is difficult for people to decrease their exposure as most of the exposure to cadmium for the general population is via the food chain. These early signs mostly appear at the age of 50 when kidneys are supposed to function still for several decades.

Furthermore, according to the SCHER, the vulnerability of diabetics and patients with kidney disease needs to be ascertained with regard to cadmium effects on kidney function.

In June 2010 the Joint FAO/WHO expert Committee on food additives (JECFA)[24] evaluated the toxicology of dietary cadmium and revised its earlier provisional tolerable intake downwards from 7 µg cadmium/kg body weight **per week** to the slightly lower value of **25 µg cadmium/kg body weight per month**. JECFA considered that the current cadmium ingestion through the diet for all age groups, including consumers with high exposure and subgroups with special dietary habits (e.g. vegetarians) does not lead to increased health risks. The limit value set by JECFA is rather close to that of the EU-RAR which is **21 µg cadmium/kg body weight on a monthly basis**, whereas the corresponding EFSA value is significantly different at **10 µg cadmium/kg body weight per month**.

In July 2010, EFSA was asked by the European Commission to confirm whether the current TWI of 2.5 µg cadmium/kg body weight is still considered appropriate or whether any modification are needed in view of the opinion of JECFA. In February 2011, the CONTAM Panel confirmed its TWI limit[25]. The assessments of the CONTAM Panel and the JECFA were based on the same indicator of cadmium induced kidney damage (i.e. the beta 2-microglobulin B2M) and the same epidemiological studies. However, the statistical approaches to quantify the variations between those studies were different and lead to different values of permitted tolerable weekly intake.

Annex VI provides further information on the differences in the calculations made in the various assessments[26].

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24 HTTP://WWW.WHO.INT/FOODSAFETY/PUBLICATIONS/CHEM/SUMMARY73.PDF. Summary report of the 73rd meeting of JEFCA. JECFA is the Joint FAO/WHO Expert Committee on Food Additives. FAO is the Food and Agriculture Organization of the United Nations. WHO is the World Health Organisation.

25 EFSA Panel on Contaminants in the Food Chain (CONTAM); Statement on tolerable weekly intake for cadmium. EFSA Journal 2011;9(2):1975. [19 pp.]. doi:10.2903/j.efsa.2011.1975. Available online at: http://www.efsa.europa.eu/en/efsajournal/pub/1975.htm#

26 In 2001 the US State of California proposed a maximum limit for dietary intake of cadmium of 0.7 µg/kg/day, which would correspond to 0.49 µg/kg/week – hence even considerably lower than EFSA. The value has been derived under California's Proposition 65, which applies to chemicals that

In January 2011, the German Federal Institute for Risk Assessment (BfR) has released a report[27] on the current levels of cadmium, lead, mercury, dioxins and polychlorinated biphenyls (PCBs) intakes by the general population through the food chain. The report concludes that, on average, the current cadmium ingestion via the diet for all age groups is below the Tolerable Weekly Intake recommended by EFSA. However some specific groups with specific dietary habits (e.g. teenagers and vegetarians) might occasionally exceed the EFSA limit.

In conclusion, for the general population the main exposure to cadmium is through food ingestion and the most critical endpoint is kidney toxicity. Two reports (EU RAR 2007 and JECFA 2010) indicate that intake via food constitutes about half the tolerable intake for 95 % of the population, and a third report (EFSA 2009) that food constitutes the whole tolerable intake for the average adult. The EU-RAR concludes that exposure via the environment to cadmium from all sources combined constitutes a risk, and that there is a need for specific measure to limit the risk. EFSA is also of the opinion that exposure to cadmium at the population level should be reduced. The negative impacts of cadmium on human health are only gradual and could appear after 50 years of exposure.

Due to the very complex relation between cadmium content in soil and cadmium content in plants, which is influenced by a range of parameters (as described above), it is not possible to derive a specific limit value for cadmium in fertilisers that would ensure that the cadmium content in food stays below a desired value. However, the general relation that increasing amounts of cadmium in soil will lead to increasing cadmium content in plants – and conversely decreasing cadmium content in soil will eventually lead to decreasing cadmium content in plants – is valid. In order to protect human health from adverse effects of cadmium via dietary intake, it is, therefore, important to decrease cadmium input into soils.

3.1.2. Environmental concerns about the presence of cadmium in soils

The EU RAR concluded that there is a need for specific measures to limit the risks to terrestrial ecosystems in the vicinity of cadmium production and plating sites and in one region in the UK based on the 90th percentiles of measured cadmium concentrations of European soils.

The EU RAR did not conclude that there is a need to limit the risks from cadmium in the environment in general. However, the SCTEE-2002[28] criticised the choice of the Predicted environmental concentration (PEC) and the Predicted no-effect concentrations (PNEC) mentioned in the EU-RAR and suggested creating PEC/PNEC probabilistic distributions to improve insights and information for potential risk management decisions. This probabilistic element was eventually not included in the final version of the EU-RAR. Furthermore, more recent scientific evidence shows that accumulation of cadmium in European soils threatens the long term sustainability of water and soil functions such as storing, filtering and

are carcinogenic or toxic to reproduction. The legislation requires dividing the No-Observed Effect level (NOEL) for reproductive toxicity by 1.000 to establish the maximum allowable dose level and does not account for other toxic effects, such as renal toxicity. This explains why the limit derived in California is significantly low than even the limit established by EFSA, even though kidney toxicity is actually more sensitive than reproductive toxicity.

27 HTTP://WWW.BFR.BUND.DE/CM/238/AUFNAHME_VON_UMWELTKONTAMINANTEN_UEBER_LEBENSMITTEL.PDF

28 HTTP://EC.EUROPA.EU/HEALTH/PH_RISK/COMMITTEES/SCT/DOCUMENTS/OUT228_EN.PDF

transforming nutrients and water, biodiversity and carbon pools[29]. The influence of heavy metals, including cadmium, and their bioaccumulation by earthworms has been the subject of many studies in the past[30]. Heavy metals (including cadmium) have been shown to cause mortality and reduce fertility, cocoon production, cocoon viability and growth of earthworms. Negative effects on the aquatic ecosystem in Spain have been reported in a recent study[31].

Cadmium inputs from anthropogenic sources, e.g. emissions from industry and intensive agriculture, affect the natural background concentration of cadmium and the residence time of cadmium could be several decades. The relative annual contributions from various sources to soil cadmium inputs are described in Annex VII for 11 Member States and Norway (phosphate fertiliser contribution ranges from just 3 % in certain regions up to 86 % in others).

The current cadmium concentration in the plough layer of Member States is shown in Figure 1. The cadmium concentration in soil solution (the cadmium fraction that could be assimilated by plants) is not reflected on this map.

All mathematical models[32] predict a net accumulation of cadmium over the long term (60 to 100 years) with current cadmium inputs. However, the historical increase of the last century – which results in important cadmium reservoirs as illustrated in Figure 1 – is unlikely to continue at the same rate because of the decrease in air emissions from different anthropogenic sources and the reduction in the overall consumption of mineral phosphate fertilisers in Europe (See example for France in Figure 7).

EU legislation already restricts atmospheric deposition through emission limits for cadmium from major anthropogenic sources such as coal-fired power stations, waste incinerators and metal refineries. Other EU legislation is also in place to limit the content of cadmium in several products and waste, as well as to reduce and prevent the emissions of cadmium to the environment. Annex VIII contains a list of relevant legislation.

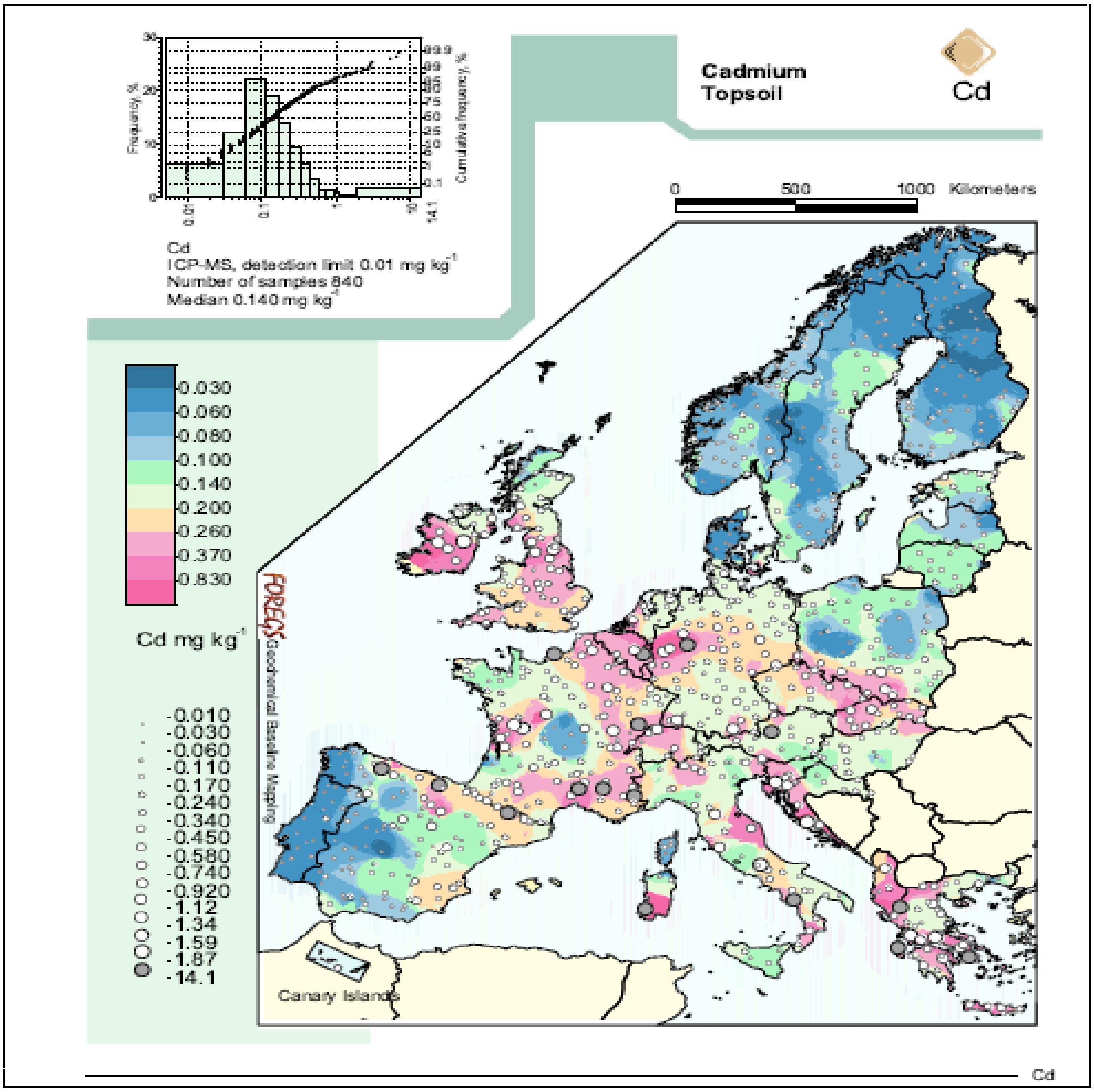
Figure 1: *Current cadmium concentration (mg/kg) in European topsoil including natural background and human sources (Source: Geochemical Atlas of Europe – Soil data and information system – FOREGS and JRC Ispra)*

29 *'Soil biodiversity, functions; threats and tools for policy makers'*, available at: HTTP://EC.EUROPA.EU/ENVIRONMENT/SOIL/BIODIVERSITY.HTM

30 For example: Bouche 1994, Morgan and Morgan 1999, Kennette et al. 2002.

31 E. Dopico, A.R. Linde and E. Garcia-Vasquez (2009). Traditional and modern practices of soil fertilisation: effects on cadmium pollution of river ecosystems in Spain. Human Ecology, 37(2), 235-240.

32 Algorithm of Anderson and Christensen (1988), algorithm of Christensen (1989), algorithm of Mac Bride (1997), algorithm of Römkens (2000), algorithm of Smolders (2007).



As regards surface water[33], an EU Environmental Quality Standard for cadmium has been recently adopted under the Water Framework Directive together with an obligation for Member States to cease or phase-out emissions, discharges and losses, as well as maximum concentration limits in rivers and lakes depending on the local water hardness level.

As regards groundwater[34], quality standards have been adopted taking into account local or regional conditions together with measures to prevent or limit the input of cadmium into groundwater. Based on recent surveys, the competent authorities responsible for the groundwater Directive have reported the following data in 2009:

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33 Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/178/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 200/60/EC of the European Parliament and of the Council. (OJ L 348, 24.12.2008, p. 84-97).

34 Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration. (OJ L 372, 27.12.2006, p. 19-31).

– 11 Member States indicated that they have groundwater bodies at risk of not complying with their environmental objectives because of cadmium,

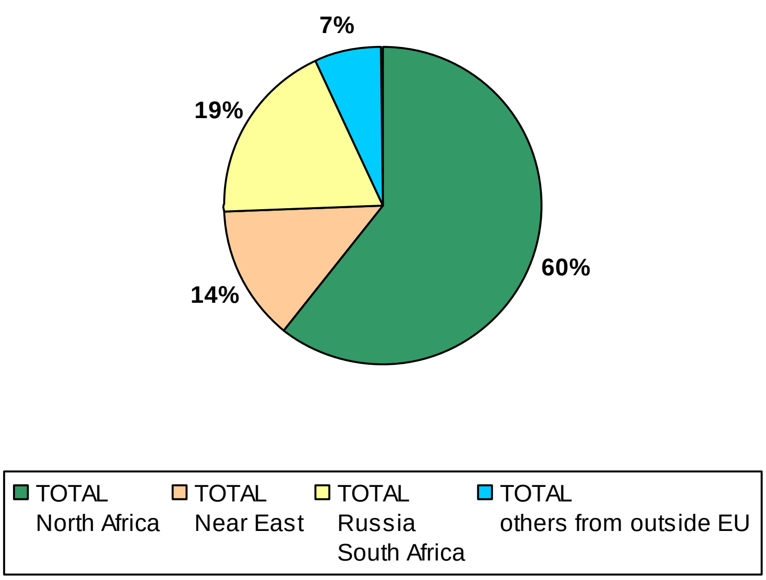
– 6 Member States already declared at this stage that they have groundwater bodies that fail the cadmium standards.

3.2. Current EU supply in mineral phosphate fertilisers

Mineral phosphorous is a non-renewable resource. According to the statistics of Fertilisers Europe, EU farmers applied on their land on average around 2.7 million tonnes of phosphate fertilisers (expressed as P_2O_5) over the last three years which correspond to approximately 38 kg P_2O_5/year for each hectare of arable land.

The main suppliers of phosphate rock, phosphoric acid or phosphate fertilisers to the EU are Morocco, Tunisia, Syria, Egypt, Israel, Jordan, South Africa and Russia. Morocco is one of the world's main suppliers and holds the most important phosphate rock reserves in the world. Figure 2 presents a breakdown by origin of imports.

Figure 2: *Phosphate rock imports to EU-27 in 2007, share of different producer countries (source: IFA – International Fertiliser Industry Association)*



The EU market takes up about 25 % of the Moroccan phosphate production and phosphate exports represent about 20 % of the total Moroccan exports (ERM 2001). The only commercially viable source of phosphate rock in the EU is located in Finland.

The cadmium content of phosphate rock varies considerably from one source to another (an overview for the main producing countries is contained in Annex IX). The phosphate rocks which are mined in Finland, Russia and South Africa are igneous rocks i.e. they were formed deep within the earth, and have very low cadmium contents (sometimes below 10 mg cadmium/kg P_2O_5). In contrast, those found in North and West Africa and the Middle East are sedimentary rocks i.e. they formed on the seabed by the decay of organic matter, and generally have much higher cadmium levels. In North and West Africa (Tunisia, Togo, Senegal), the levels are frequently above 60 mg cadmium/kg P_2O_5 while Morocco, the most important EU supplier, does have deposits which lead to cadmium content in fertilisers above or lower the 60 mg cadmium/kg P_2O_5 (see Annex IX for further details). In the Middle East

(Jordan, Syria, Egypt), the rocks are also sedimentary but the cadmium content is lower at about 20-40 mg cadmium/kg P_2O_5.

Global demand for phosphate fertilisers is forecast to grow at an annual rate of 3 % although demand in Europe is expected to continue to be weak (see Figure 7). Over the next five years, close to 40 new units producing various phosphate fertilisers (MAP, DAP and TSP) are expected to be constructed in ten countries, half of them in China alone. New facilities are planned in Africa (Algeria, Morocco and Tunisia), Middle East (Saudi Arabia), Asia (Bangladesh, China, Indonesia and Viet Nam), and Latin America (Brazil and Venezuela). For the period 2010 to 2014, it is estimated that all new supply additions will be absorbed by global growing demand for food, feed, fibres and bioenergy and that prices of phosphate fertilisers will experience upward pressure.

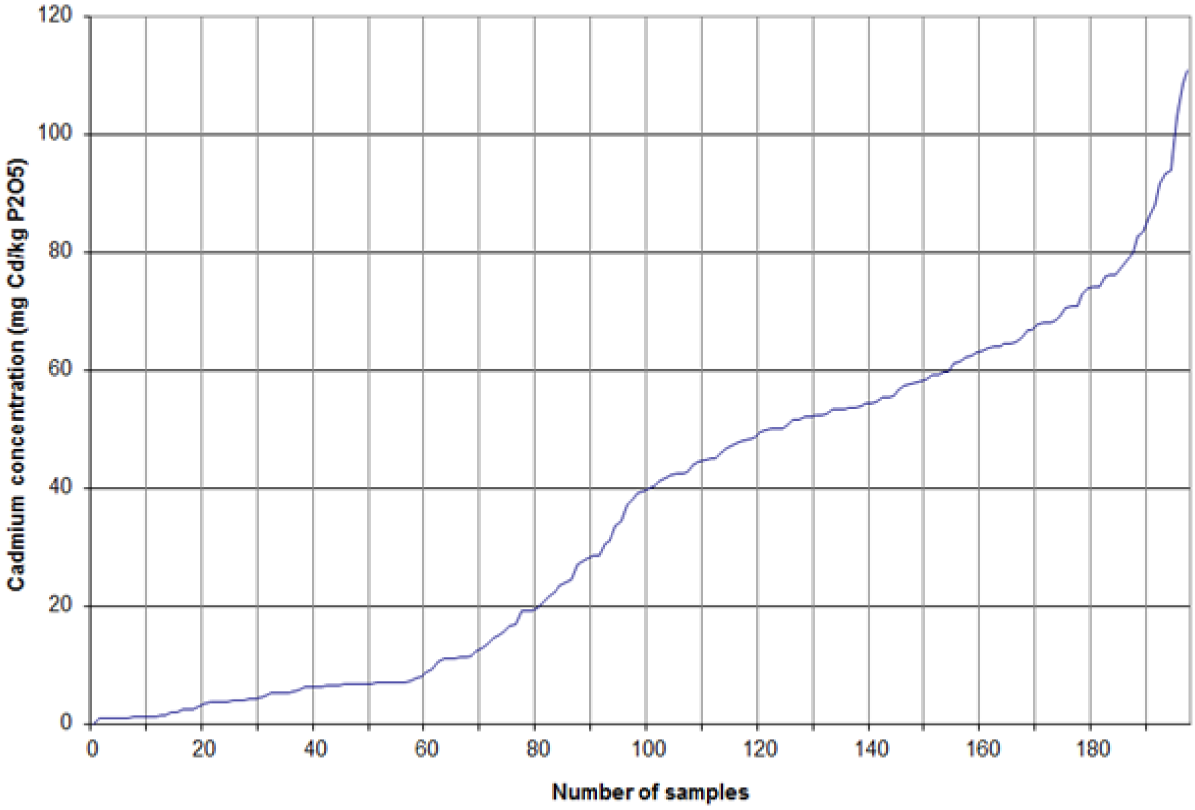
Very few data are available on the actual cadmium content of mineral phosphate fertilisers placed on the market in the EU as this parameter is not routinely monitored by either manufacturers or importers. Annex X gives information about the content of cadmium in phosphate mineral fertilisers from various sources. In 2007, Nziguheba and Smolders[35] measured the cadmium content of 197 phosphate fertiliser samples provided by 12 Member States (see Figure 3).

About 21 % of those samples contained more than 60 mg cadmium/kg P_2O_5. Samples have not been weighted for the size of the local market compared to the size of the EU market (e.g. 18 samples from France and 16 from Belgium) nor is it specified which overall volume of fertiliser each sample represents. If the data from the study were used to calculate the cumulative cadmium content contained in phosphate fertilisers as a function of the concentration contained in the samples analysed, the curve in Figure 3 would emerge.

However, it has to be underlined that the figure is given mainly for illustration purposes, as information provided in the study does not allow concluding that the data used are representative for the entire EU phosphate fertiliser market. Despite this limitation, the figure will be used in the analysis of the policy options to provide an indication of which reduction in cadmium input could potentially be achieved through the implementation of the options.

[35] Nziguheba G., Smolders E. Inputs of trace elements in agricultural soils via phosphate fertilizers in European countries, Sci Total Environ (2007).

Figure 3*: cadmium distribution 197 samples of phosphate fertilisers (From the data of Nziguheba and Smolders (2007) – communicated directly by the authors. The data are not necessarily representative of the EU phosphate fertiliser market situation)*



3.3. Possible alternatives to mineral phosphate fertilisers with high cadmium content and their availability

Mineral phosphates containing high levels of cadmium (> 60 mg/kg P_2O_5) could be replaced by the following alternatives:

– phosphates from igneous or sedimentary sources with (very) low cadmium content,

– decadmiation of phosphate rocks during the production process of fertilisers,

– phosphates from organic fertilisers.

The different possibilities and their limitations are reviewed in the following sections.

3.3.1. Use of igneous rocks or sedimentary rocks of low cadmium content

Some 85 % of the world phosphate production is derived from sedimentary phosphate deposits and reserves of igneous rocks, in the neighbourhood of the EU, are limited to Russia. Instead of exporting igneous rocks as such, Russia prefers to export transformed products like DAP and MAP. There are also doubts whether Russia will be able to increase its capacity from existing deposits. The current operations are not particularly efficient and would require huge investments to maintain or even increase production.

Although notable investments in new capacity are coming on-stream in Brazil and South Africa, a sufficient supply in phosphates from igneous rock in these countries is not expected at affordable prices due to high costs of transport. Moreover, the main investments have been developed to support national farming in these countries.

In addition, the characteristics of igneous-based SSP and TSP (higher free acidity, higher moisture) would require the EU fertiliser producers to bear significant technological adjustment costs for using different raw materials.

In 2007, 18 % of overall EU-27 imports (9 000 ktons) of phosphate rocks for all purposes (fertilisers, food industry, etc) came from sedimentary rocks of low cadmium content mined in the Middle East[36]. Imports of phosphate fertilisers from this region represented only 3.2 % of the total EU consumption. Given their overall shares in world phosphate reserves and fertiliser production (see Annex XI), it is unlikely that exports of sedimentary phosphate rocks of low cadmium content could increase to such quantities as to replace the current imports of sedimentary phosphates from sources with high cadmium content that are used in the production of phosphate fertilisers.

In conclusion, it is not feasible to supply the EU market with phosphate fertiliser solely from igneous origins or from sedimentary phosphates with low cadmium content.

3.3.2. Decadmiation of phosphate rocks

Without a specific decadmiation treatment, the final fertiliser retains most of the original cadmium content of the phosphate rocks. So far, two decadmiation technologies have been developed at laboratory scale, which can be applied in production processes where phosphoric acid is an intermediate. Further details concerning the processes are contained in Annex XII.

Figure 4 contains a schematic representation of phosphate fertiliser production pathways. All currently known decadmiation processes can only be used for fertilisers being produced via the phosphoric acid route. Consequently, several EU manufacturers (BASF, Belgium; YARA, Norway; AMI, Austria; Azomures, Romania; Lovochemie, Czech Republic), who in order to address growing environmental concerns about the generation of gypsum wastes produced in the conventional phosphoric acid route have opted for the production of NP and NPK[37] fertilisers via the nitrophosphate route, are not in a position to use the known decadmiation technologies. Single superphosphate, double superphosphate, partially solubilised rock phosphate production which do not follow the phosphoric acid route can also not be decadmiated.

Based on overall cost structure (price of phosphoric acid, ammonia, sulphur and phosphate rock) and estimated decadmiation running costs between EUR 12-32/t P_2O_5[38] as suggested for one of the decadmiation processes, experts of the International Fertilisers Association (IFA) have estimated a possible price increase for phosphate fertilisers derived from sedimentary rock phosphate with high cadmium content in the range of 2 to 7 %. However, these economic figures must be considered with caution as the costs for decadmiation and their impact on fertiliser prices have not been confirmed at industrial scale. During the stakeholder consultation of October 2009, experts in decadmiation commented that the minimum increase in fertiliser prices would be most likely in the range of 5 to 15 %. The current state of development of the various technologies does not allow any certain prediction as to the future decadmiation costs (including the costs for a sound disposal of cadmium containing waste,

36 Egypt (200 kt), Syria (1 100 kt) and Jordan (300 kt). Source EFMA.

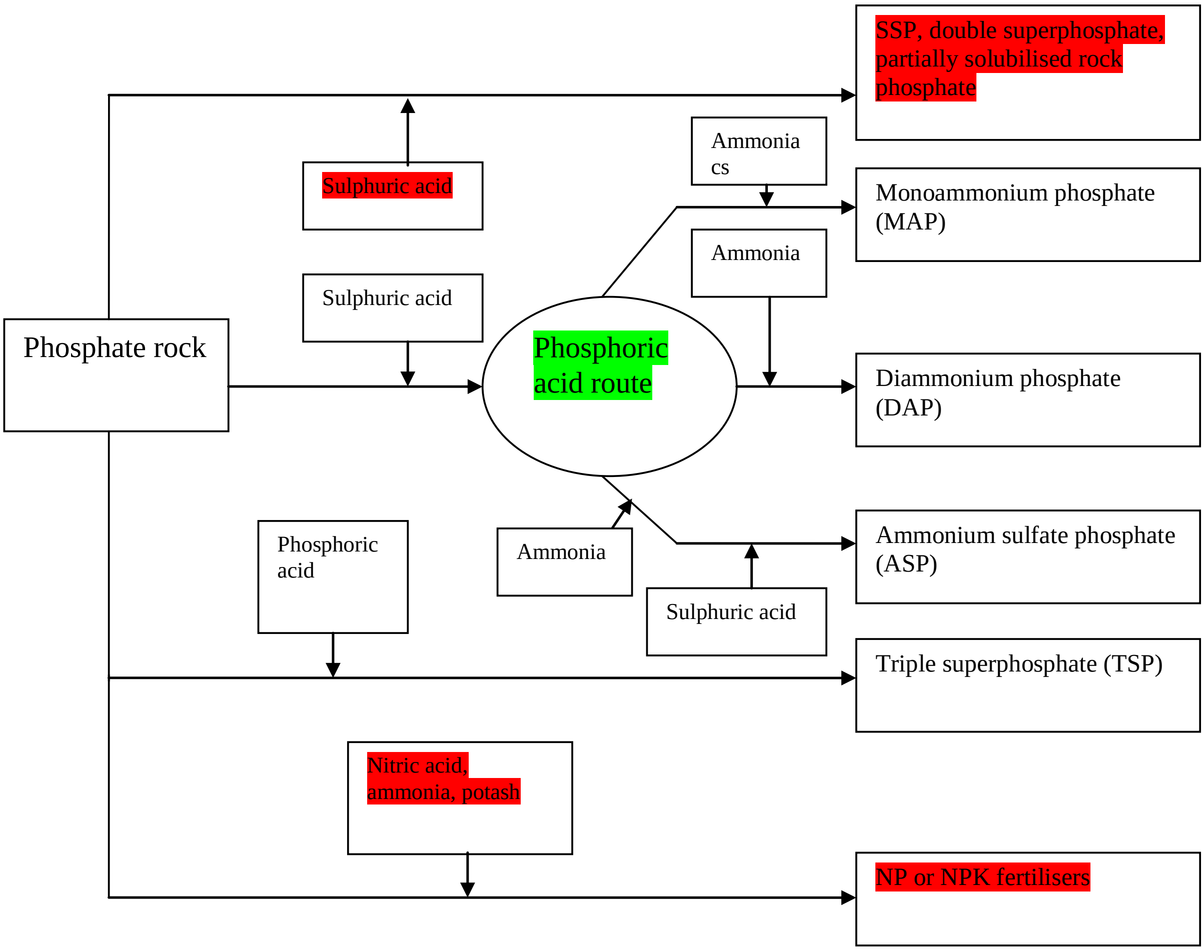
37 30% of the volume of NP and NPK fertilisers marketed in the EU follow the nitrophosphate route.

38 Exchange rate: EUR 1 = USD 1.25.

which would be generated as by-products) and the possible income from the marketing of added-value by-products (such as certain other heavy metals).

In any case, costs due to decadmiation would become a structural disadvantage for phosphate producers mining deposits with high cadmium content. Producers from Russia or Syria, Jordan and Egypt would have no decadmiation costs to bear since the cadmium content of their ores is (very) low. This would be different for producers based in Northwest Africa, which today produce the bulk of phosphates imported in the EU.

Figure 4: *schematic representation of phosphate fertiliser production pathways*



Decadmiation technology for high-quality phosphates for human and animal consumption, which are sold at much higher prices than phosphate fertilisers, is already in operation in two phosphate production plants in Tunisia[39] to reduce the level of cadmium impurities below very strict regulatory limits in food and feedstuffs. The development and installation of the technology came in response to this regulatory drive, in combination with the economic consideration that the additional cost due to decadmiation would still be preferable than a restriction of phosphate sources or export possibilities.

39 *The precipitation process SIAPE is used by the Groupe Chimique Tunisien in Gabès and Skhira. Annual phosphoric acid production capacity: Gabès: 470 000 tons P_2O_5; Skhira: 375 000 tons P_2O_5. In October 2012, the Tunisian producer stated that the existing decadmiation process could be applied to the production of fertilisers at reasonable costs. This statement was unfortunately not confirmed later on.*

In conclusion, in the present circumstances, there is no reason why decadmiation for phosphate fertilisers would be developed on industrial scale: producers have not been required to do so, e.g. through the setting of limit values in important phosphates markets, neither is there a financial incentive as phosphate fertiliser prices are not correlated with cadmium content. Several attempts started earlier – probably in response to the long-standing debates in the EU for setting a limit in phosphate fertilisers – have not gone beyond laboratory scale. For example, in 1993, the EU signed a contract of ECU 1 million with CERPHOS for the development of a decadmiation process at laboratory scale. The results were positive, but CERPHOS was unwilling to develop a pre-industrial pilot plant without additional funding of ECU 7.5 million by the EU.

Further details concerning the state of development of the various processes and their future perspectives are contained in Annex XII.

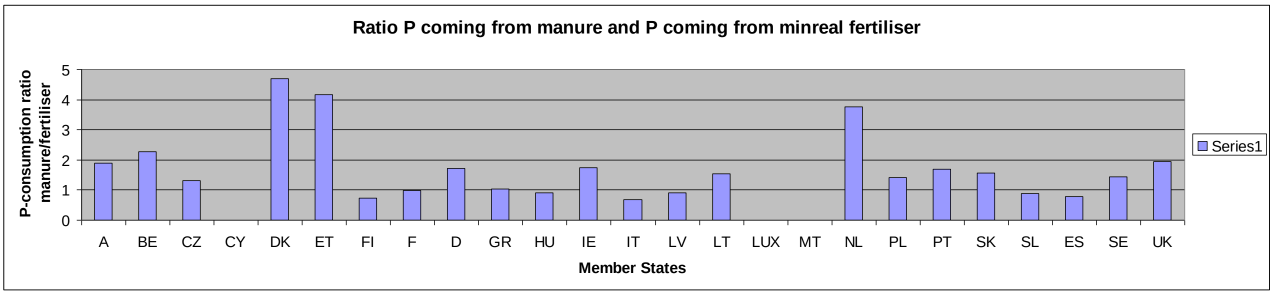
3.3.3. Organic fertilisers

Most experts estimate reserves of mineral phosphorous to last little more than one hundred years. The highest quality reserves will be depleted more rapidly and current use of phosphates is not in line with the principles of sustainable development (only 20 % of the phosphorous mined end up in crops).

Mineral phosphates are not the only possible source of this indispensable nutrient for plant growth. Manure and to a lesser extent sewage sludge and biowaste are potential sources of phosphorous. In fact, animal manure is the main source of phosphorous in the EU and 4.7 million tonnes of manure are applied as fertilisers annually in the EU[40].

Figure 5 illustrates that for 15 Member States out of 22 (no data available for Cyprus, Luxembourg, Bulgaria, Romania and Malta), the main source of phosphorous in agricultural land is manure. In Denmark, Netherlands and Estonia the amount of phosphorous coming from manure is more than three times that coming from mineral fertilisers – but those Member States have a surplus of manure due to the high density of animal farms – whereas in Finland, France, Greece, Hungary, Italy, Latvia, Slovenia and Spain, mineral phosphate fertilisers are the main source of phosphorous.

Figure 5: *ratio of the use of manure and mineral fertiliser in EU-25 (Source: Study addressing phosphorous related problems in farm practice. Soil Service of Belgium – 2005)*



Furthermore, among the 22 Member States, only the Czech Republic, Slovakia and Hungary have a negative balance in phosphorous as illustrated in Figure 6. The others have a phosphorous surplus which means that the input of phosphorous to soil is higher than the output.

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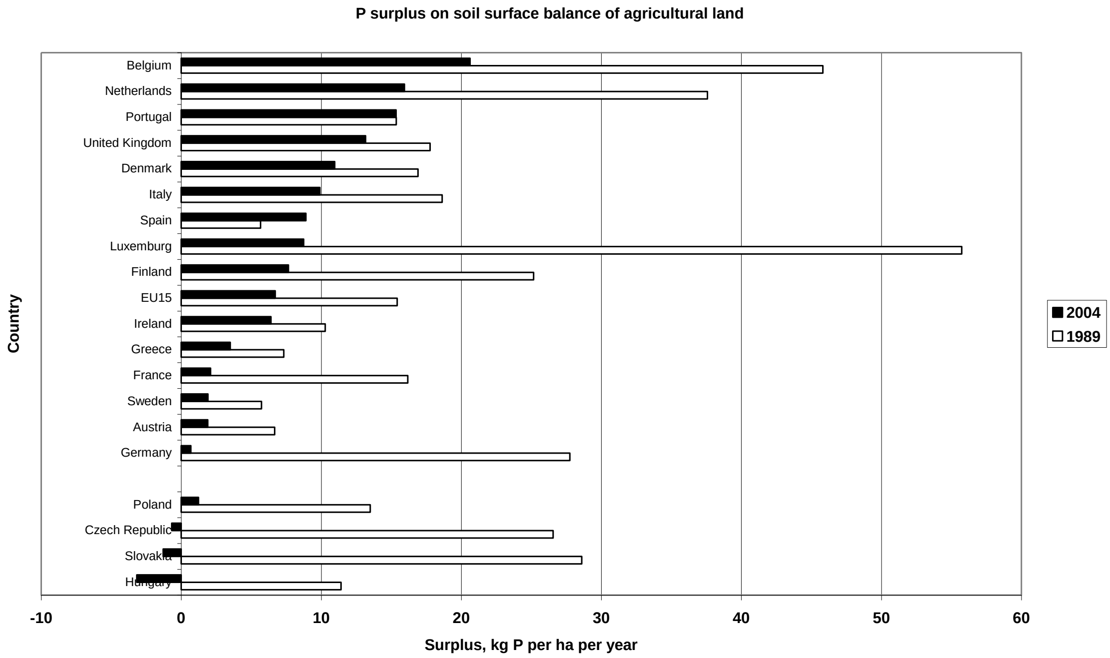
40 *Richards, J.R. & D.J. Dawson (2008). Phosphorous imports, exports, fluxes and sinks in Europe. Proceedings 638, International Fertilizer Society. York, UK: 1-28.*

Figure 6: phosphorous surplus in 1989 and 2004 (kg P per ha UAA (Utilised Agricultural Area) (Source OECD))



In comparison to mineral phosphate fertilisers, a complete recovery of phosphate from organic fertilisers (e.g. manure, sewage sludge, and bio-waste) would also have the advantage of not increasing the overall cadmium mass present in the European ecosystem. Cadmium impurities in manure, bio-waste and, to a lesser extent, sewage sludge mainly come from food and feedstuffs produced in Europe which in turn contain cadmium absorbed from European soils.

EU environmental legislation has been the main driver for the development of phosphorous recovery technologies. Alternatives to mineral phosphate fertilisers in agriculture are promoted by several EU environmental instruments:

- Generation of energy from renewable sources[41] and use of remaining solid fractions as fertiliser. The characteristics of the end product are a function of the relative ratio between the different sources of organic wastes.
- The Sewage Sludge Directive has established the conditions to ensure a safe use of sludge on agricultural lands although the maximum limit values for cadmium therein are rather high. 16 Member States have adopted more stringent standards than those given in the Directive. Therefore the amount of sewage sludge applied on land is currently limited and represents only 40 % of the volume of sludge produced in EU-15 Member States.
- The Landfill Directive[42] requires Member States to progressively reduce landfilling of municipal biodegradable waste by 35 % in 2016 compared to 1995 which will instead be used for biogas production or compost. The Directive has led to a very significant increase in the recycling of bio-waste to produce biogas and nutrients for soil improving and agriculture.

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[41] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources. OJ L 140, 5.06.2009, p. 16-62.

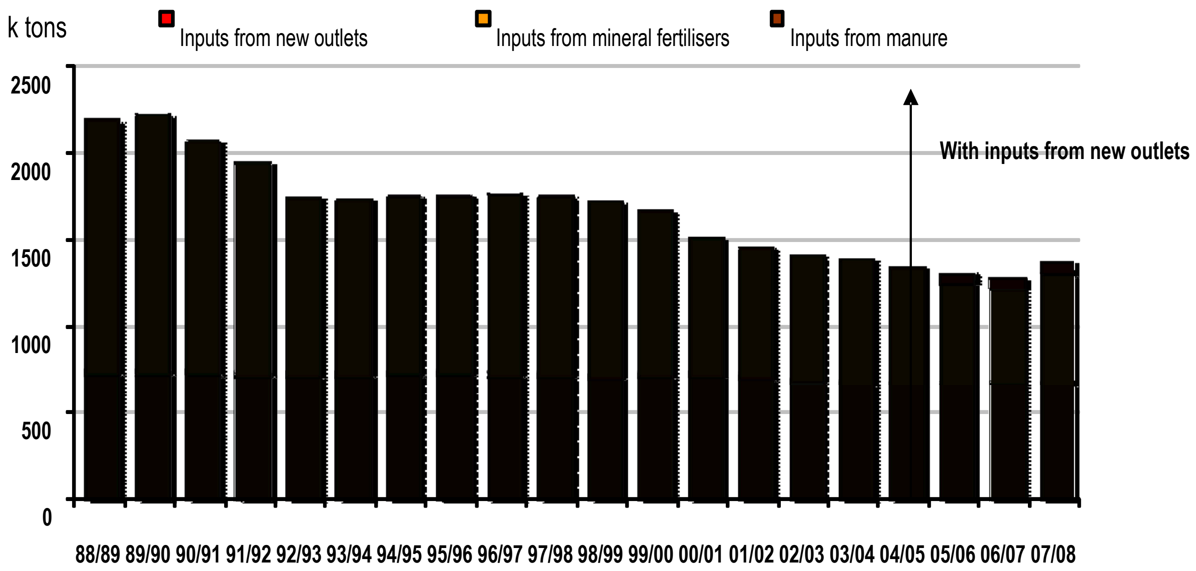
[42] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste. OJ L 182, 6.07.1999.

- The Water Framework Directive which requires Member States to reduce discharge, emissions and losses of phosphorous in the environment.

Although many industrial phosphorous recovering technologies are already on-stream, there is no common strategy to promote the use of such renewable sources by farmers. The price of recycled fertilisers is commonly much higher than mineral phosphate fertiliser prices. Annex XIII contains further details on the various sources of phosphorous available in the EU and their relative efficiency in relation to mineral fertilisers, the cadmium content of those sources and a description of the EU fertiliser industry.

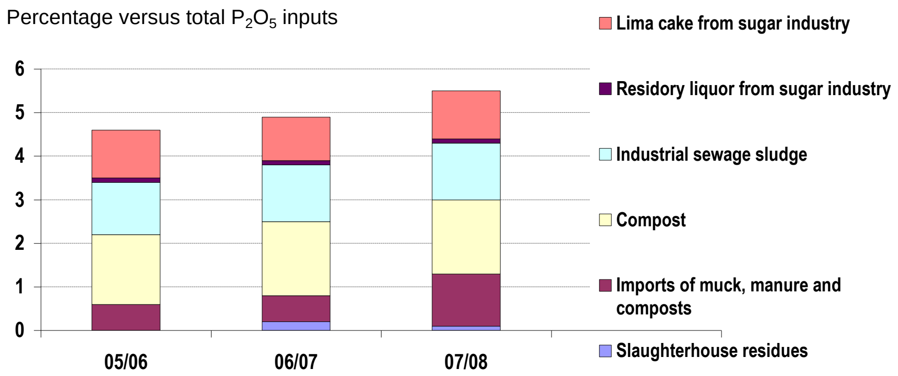
Possibilities to stimulate further substitution of mineral phosphates by alternatives have been examined by in the Commission Communication on future steps in bio-waste management in the EU[43]. Priority actions include rigorous enforcement of the targets on diverting bio-waste away from landfills (the Landfill Directive requires MS to progressively reduce landfilling of municipal biodegradable waste by 35 % in 2016 compared to 1995), proper application of the waste hierarchy and other provisions of the Waste Framework Directive to introduce separate collection systems as a matter of priority. Compost collection and treatment could substitute 10 % of phosphate fertilisers, 9 % potassium fertilisers and 8% of lime fertilisers. Supporting initiatives at EU level – such as developing standards for compost – will be crucial to accelerate progress.

Figure 7: *Total phosphorous inputs in France for the last 20 years (Source: UNIFA)*



[43] COM (2010) 235

Figure 8: *Inputs from new phosphate sources (versus total phosphorus inputs for the three last growing seasons – Source UNIFA)*



Still, whilst the need for mineral phosphates fertilisers is presently slightly decreasing, the complete recycling of phosphorous from organic fertilisers will not be able to replace them completely in the foreseeable future. In France, where fertilising patterns have been recorded for more than 20 years, the amounts of phosphorous coming from the recovery of manure and other organic inputs covered about 55 % of the French farmers' needs in 2008 as illustrated in Figures 7 and 8.

According to an Austrian Company active in the recovery and treatment of manure, sludge and slaughterhouse residues, more than 50 % of the current phosphate fertilisers imports could theoretically be replaced by recycled phosphates, if all available phosphate resources were managed sustainably (e.g. increase of biomass-to-energy technologies for manure) as a pathway to a more efficient use of phosphorous in the EU and a lesser reliance on mineral phosphate fertilisers imports. Today, this volume ends up in landfills, cement, ashes of power plants and waste incinerators.

The Commission has contracted work to a consultant to assess the sustainable use of phosphorus[44]. The result of this study will contribute to possible development and promotion of other alternatives to the current phosphate products provided that environmental and economical benefits emerge i.e. that the general characteristics (phosphorus and cadmium content) and prices of organic wastes fertilisers and mineral phosphate fertilisers are comparable.

In summary, whilst recycling of phosphates from organic waste will increase, it is not certain, that within the foreseeable future the available quantities will be sufficient to replace imports of mineral phosphates with high cadmium content.

3.4. Trade obligations and external relations

As explained in section 3.2, the majority of current EU imports of mineral phosphates originate in Northern Africa. Countries such as Morocco and Tunisia are covered by the European Neighbourhood Policy (ENP) which was developed in 2004 with the objective of establishing a deeper political relationship and economic integration between the EU and its

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[44] HTTP://EC.EUROPA.EU/ENVIRONMENT/FUNDING/PDF/CALLS2009/SPECIFICATIONS_EN09025.PDF

immediate neighbours by land or sea. Measures taken in the EU with regard to phosphates, could potentially lead to strong reductions of phosphates exports to the EU, which are today significant sources of revenues (e.g. 20 % of the total Moroccan exports). This would be contrary to the ENP objectives.

Furthermore, the EU is a member of the World Trade Organisation (WTO) and bound by its rules. Consequently, any measures adopted to protect human health or the environment, must be the least trade-restrictive in order to achieve the intended objectives. All possible options therefore have to be assessed with regard to their compatibility with WTO obligations. The proposal accompanied by this impact assessment report will also be notified to the WTO under the TBT agreement, which will allow 3rd countries to comment.

3.5. Fragmentation of the internal market and administrative burden

Every Member State is concerned to a greater or lesser extent by the threat that accumulation of cadmium poses to the long-term sustainability of crop production. Twenty Member States have already introduced or intend to introduce rules limiting the cadmium content in national fertilisers under their obligations to reduce emissions of cadmium in the environment and thereby the cadmium exposure to humans. Depending on the Member State, between 30 to 40 % of total mineral fertilisers are marketed as national fertilisers.

Based on the former Article 95(4) of the EC Treaty (now Article 114 TFEU), the Commission has granted derogation to the free circulation of “EC fertilisers” to Austria, Finland, and Sweden[45] to apply national limits for cadmium also to “EC fertilisers”. Such requests need to be accompanied by appropriate justification and the Commission has to take a decision within 6 months. This process constitutes significant administrative burdens for both Member States and the Commission. For example, efforts by the Czech Republic to provide appropriate justification for their intention to set a limit value also for EC Fertilisers at 50 mg cadmium/kg P_2O_5 have been ongoing for several years. When a first request was submitted in 2006, several Commission services have been involved in the examination in order to deal with it within the prescribed time period (including consultation of SCHER). Following the withdrawal of the request in the light of SCHER's negative opinion on the quality of the submitted justification, the Czech Republic has worked for more than a year with several experts on a re-submission, which has ultimately not happened, as an EU proposal is now expected instead.

The diversity of rules concerning the cadmium content of phosphate fertilisers marketed in the EU has a negative effect on the internal market of phosphate fertilisers which is more and more fragmented and fertiliser manufacturers have to be aware of and comply with an increasing number of diverging limit values, e.g. by sourcing appropriate raw materials and conducting the necessary quality analyses.

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45 Commission Decision 2006/349/EC of 3 January 2006 on the national provisions notified by the request of the Republic of Austria under Article 95(4) of the EC Treaty concerning the maximum admissible content of cadmium in fertilisers. Cadmium limit: 75 mg cadmium/kg P_2O_5.
Commission Decision 2006/348/EC of 3 January 2006 on the national provisions notified by the request of the Republic of Finland under Article 95(4) of the EC Treaty concerning the maximum admissible content of cadmium in fertilisers. Cadmium limit: 22 mg cadmium/kg P_2O_5.
Commission Decision 2006/347/EC of 3 January 2006 on the national provisions notified by the request of the Kingdom of Sweden under Article 95(4) of the EC Treaty concerning the maximum admissible content of cadmium in fertilisers. Cadmium limit: 44 mg cadmium/kg P_2O_5.

Furthermore, in accordance with Regulation (EC) No 764/2008 on mutual recognition[46], Member States are obliged to accept fertilisers lawfully placed on the market of another Member State unless they can demonstrate that there are specific reasons to the contrary. The cadmium content of mineral fertilisers can be used as an argument by competent authorities to refuse the marketing of products within their territories if their specific soil conditions require action. However, Member States authorities have limited resources for market surveillance and if they fail to notify their decision within the period foreseen in Regulation (EC) No 764/2008, products are considered as lawfully placed on the market, even though the Member States might have legitimate reasons to be more restrictive.

3.6. Regulatory failures

As a direct consequence of the EFSA report and the recommendations in the Risk Reduction Strategy, the Commission is envisaging revising the maximum levels for cadmium in food as set in Regulation (EC) No 1881/2006[47]. However, the setting of more stringent limits in food could become impossible as the cadmium content of foodstuff is dependent on soil cadmium concentration, which confirms the need for an overall action to reduce cadmium inputs to soils through the use of phosphate fertilisers.

Furthermore, limit values for national fertilisers can actually be circumvented by industry through marketing phosphate fertilisers as 'EC fertilisers', which benefit from the free movement clause in the current EU Regulation on fertilisers, except for the three Member States that have obtained derogation in accordance with Article 114 TFEU. The current EU legislation could thus be used to undermine the efforts of Member States who have set limits for national fertilisers to achieve a high level of protection of human health and the environment.

3.7. Who is affected, how and to what extent by the current situation?

In the current situation, fertilisers with high cadmium content can be used and the following stakeholders are affected:

– The general population for which current exposure is very close to the current safety limit recommended by EFSA. For some parts of the population current exposure might already exceed this safety limit twofold, and they are, therefore, at risk of unacceptable cadmium exposure via food with possible adverse effects in the longer term.

– The European fertilisers industry which, without a harmonised market for phosphate fertiliser, has to comply with different values for cadmium in the Member States and thereby faces extra compliance costs.

– Phosphate producing companies in third countries and the European fertiliser industry have no incentives to develop and implement decadmiation technologies at industrial scale, nor are there incentives to promote the recycling of phosphates as an alternative to mineral fertilisers.

[46] Regulation (EC) No 764/2008 of the European Parliament and of the Council of 9 July 2008 laying down procedures relating to the application of certain national technical rules to products lawfully marketed in another Member States and repealing Decision No 3052/95/EC. OJ L 218, 13.08.2008, p. 21.

[47] Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs. OJ L 364, 20.12.2006, p. 5-24.

- EU farmers have no information[48] on the cadmium content of EC phosphate fertilisers and are currently not able to take action to control cadmium inputs to agricultural soils.
- Food safety authorities have difficulties to implement safe maximum levels of cadmium concentration in foodstuffs without unduly restricting the supply of food commodities that are beneficial and essential for human health (fruit and vegetables, cereals…). The limits are set taking into account the recommended daily intake but also considering pragmatically the current load of contaminants in the environment.
- National public administrations in Member States having established limit values for cadmium in phosphate fertilisers to avoid soil contamination by cadmium have difficulties to enforce their limit values under their obligations on mutual recognition of 'national fertilisers' from other Member States and due to the possibility for the industry to circumvent the national rules by marketing fertilisers as 'EC fertilisers'.

3.8. How would the situation evolve if no action is taken?

In the longer term, cadmium levels in EU agricultural soils from phosphate fertiliser inputs would probably increase. The production of food complying with safe limit values for cadmium that would guarantee that the TWI recommended by EFSA would be respected in the EU could therefore become impossible, and certain sub-groups of the population would continue to be at risk.

Most soils would see an increase in cadmium concentrations, thus threatening soil functions and the aquatic environment. The objectives of the Water Framework Directive with regard to the chemical status of groundwater might also not be achieved.

EU farmers would not get any means to limit the cadmium input into their soils from mineral fertilisers.

The internal market for phosphate fertilisers would continue to be fragmented, with increasing tendency, as more and more Member States might take legislative action at national level and convergence towards lower limit values would not be a realistic outcome of the current situation. The European fertilisers industry would continue to face extra compliance costs. There would be no incentive for industry or phosphate producing countries to invest in decadmiation technologies or the technical recycling of phosphates from manure, sewage sludge and bio-waste.

Additional Member States wishing to set limit values for cadmium in EC fertilisers would have to request derogations based on Article 114(6) TFEU. This will create administrative burdens for the Member States – examples from the past have shown that gathering the necessary data requires significant resources – and for the Commission to evaluate and decide on the requests. National public administrations in Member States having established limit values for cadmium in phosphate fertilisers to avoid soil contamination by cadmium will have increasing difficulties to enforce their limit values under their obligations on mutual recognition of 'national fertilisers' from other Member States and due to the possibility for industry to market fertilisers as 'EC fertilisers' rather than national fertilisers.

[48] Only the Czech Republic authorities have introduced a mandatory labelling of the cadmium content of national mineral phosphate fertilisers.

3.9. The EU right to act

3.9.1. Legal basis

The legal basis of the proposal accompanied by this impact assessment is Article 114 of the Treaty on the Functioning of the European Union (TFEU). Article 114 has the objective to establish an internal market while ensuring a high level of protection of human health and the environment.

3.9.2. Subsidiarity and proportionality

Legislation relating to fertilisers is already partly harmonised by the Fertilisers Regulation: "EC fertilisers" complying with the requirements of that Regulation can circulate freely in the internal market and Member States cannot hamper their free movement based on their composition. If a Member State wants to impose limits to the content of cadmium in "EC fertilisers" used in their territory it has to request derogation based on Article 114(6) TFEU. So far, such derogations have been granted by the Commission to three Member States.

Many Member States have also introduced national rules limiting the cadmium content in national phosphate fertilisers, setting limit values that are widely diverging. However, in accordance with the recent legislation on mutual recognition, Member States would be obliged to accept fertilisers lawfully placed on the market of another Member State unless they can demonstrate that the fertilisers in question present a serious risk to the environment or human health.

Moreover, the Council in its Resolution of 25 January 1988[49] has explicitly called on the Commission to reduce inputs of cadmium into soils from all sources including diffuse sources such as phosphate fertilisers.

Consequently, Member States cannot achieve a functioning internal market for phosphate fertilisers by themselves. As a result of the stakeholder consultation, Member States support broadly the setting of a harmonised EU limit with the possibility by individual Member States to impose stricter limits or to gradually impose stricter EU limits under the condition that decadmiation technologies become available. Action at EU level to set an overall limit can, therefore, be considered proportionate.

4. OBJECTIVES

4.1. General objective

The general objective is to ensure a high level of protection of human health and the environment from the potential adverse effects of cadmium in phosphate fertilisers while ensuring a well functioning internal market for such fertilisers.

4.2. Specific objectives

- Reduction of cadmium inputs to European agricultural and pastoral soils, contributing to the overall reduction of cadmium inputs to the environment to supplement existing environmental legislation affecting several other industrial sectors.
- Reduction of the exposure of humans to cadmium through food ingestion.
- Reduction of the exposure of soil organisms and maintaining soil biodiversity which provide essential ecological services and are important elements of soil fertility.

[49] OJ C 30, 4.02.1988, p. 1.

– A secure and adequate supply of the EU from diverse sources of phosphate fertilisers at reasonable costs and minimisation of negative economic impacts on third countries and on EU farmers.

– Improvement of the functioning of the internal market for phosphate fertilisers through a reduction of the divergence of existing limit values for cadmium in such fertilisers. Harmonisation of cadmium limit(s)[50] is seen by most of the Member States as the only way to reduce the environmental problems caused by the mutual recognition of national fertilisers.

– Reduction of the burden for public administrations for developing and justifying national measures in the absence of harmonised measures at the level of the European Union.

The proposed objectives highlight that choices to reduce the exposure to cadmium are limited by constraints as regards trade obligations and external relations.

5. POLICY OPTIONS

5.1. Possible options which have been discarded at an early stage

5.1.1. Voluntary commitment by the fertiliser industry

Fertiliser manufacturers and importers could agree to establish voluntarily a limit value for cadmium in phosphate fertilisers and would then make only such fertiliser available on the EU market. Additionally, they could agree to work with farmers (or farmer associations) to reduce cadmium input to agricultural soils by implementing good agricultural practices.

In 2000, in an effort to avoid legislation, EFMA (today called "Fertilisers Europe") members tried to adopt an overall upper limit of 60 mg cadmium/kg P_2O_5. In 2007, a survey on the cadmium content of phosphate fertilisers[51] showed that 21 % of phosphate fertilisers placed in the EU market are still exceeding the 60 mg cadmium/kg P_2O_5 limit (see also Figure 3).

Members of Fertilisers Europe cover only 60 % of the EU phosphate fertilisers market and full harmonisation by voluntary commitment is unlikely to be achieved for the whole sector.

Furthermore, those Member States that have already set legally binding limit values for national fertilisers (see Annex I) and in some cases also for EC fertilisers would most likely not modify these limit values when faced with a voluntary commitment by industry.

5.1.2. Setting directly an EU limit of 20 mg cadmium/kg P_2O_5 without intermediate steps

In the absence of a reliable and cost efficient decadmiation process at industrial scale, the immediate introduction of a limit of 20 mg cadmium/kg P_2O_5 would have disastrous economical consequences for almost all producing countries in Northern Africa and the Middle East (see section 3.2) who would be shut out of the European market, as their phosphate deposits contain significantly higher amounts of cadmium. It would thus be utterly incompatible with the ENP objectives. As these countries are the main suppliers of the European phosphates fertilisers market, sufficient supply of EU farmers at reasonable prices would be endangered. Whilst such a low limit value would be a very strong incentive to invest in decadmiation, the construction and operation of plants at industrial scale is yet unproven

[50] A complete harmonisation would not take into account the diverging soil and climatic conditions among the Member States.

[51] Nziguheba G., Smolders E. Inputs of trace elements in agricultural soils via phosphate fertilizers in European countries, Sci Total Environ (2007).

and will not be feasible in the short term. As a consequence, practically the entire EU supply would depend on one single phosphates exporting country, in the current circumstances Russia, which mines igneous rocks with low cadmium content. However, igneous rock, which is much harder, requires different machinery for transformation than softer sedimentary rocks. Most EU producers would have to invest heavily to modify their equipment and it is uncertain whether Russia will be able to increase its production to levels necessary to make up for the no longer available sedimentary rocks.

On the other hand, this option would be fully in line with the opinion of the SCTEE-2002 according to which a limit of 20 mg cadmium/kg P_2O_5 or less is not expected to result in long-term soil accumulation over 100 years. The ultimate goal of achieving a cadmium limit of 20 mg/kg P_2O_5 is, therefore, not discarded, but is part of option 4 (albeit with a longer timer horizon), which will be examined in full. Although there is still no firm and clear commitment from Third countries to invest in decadmaition, technical solutions are currently being investigated in Morocco. The Commission signed in 2012 a political agreement with Tunisia on raw materials. The developemnt of a decadmiation technology for the production of phosphate fertilisers was part of the deal.

5.2. Description of the examined options

5.2.1. Option 1: No action

The status quo would continue: no maximum limit for cadmium in phosphate fertilisers would be adopted at EU level (with the exception of the already existing limits for phosphate fertilisers authorised in organic farming). Member States having established limit values for national or EC phosphate fertilisers will maintain them, whilst others might do so in the future.

5.2.2. Option 2: Market incentives

Options based on market incentives include taxation of fertilisers on the basis of cadmium content, subsidies for low-cadmium containing fertilisers, quotas on imports and/or the use of fertilisers containing cadmium, or combinations of these elements. Adopting either of these options would in turn make decadmiation more attractive and send a market signal to that effect.

5.2.3. Option 3: A new Regulation setting an upper limit of 60 mg cadmium/kg P_2O_5 in phosphate fertilisers while allowing Member States to impose a limit value of 40 or 20 mg cadmium/kg P_2O_5 for the placing on the market and use depending on the conditions prevailing in their territories

The new Regulation would define a maximum level of 60 mg cadmium/kg P_2O_5 for the entire EU to enter into force after an appropriate transition period (e.g. 2 to 3 years) and Member States would be allowed to establish a lower limit by choosing from two possible values when there are reasons in the light of soil and climatic conditions. Fertilisers would be labelled with the information of whether they comply with the limit of 60 mg cadmium/kg P_2O_5 or 40 mg/kg, or 20 mg/kg, respectively.

Concerning the level of justifications to derogate from the 60 mg limit value, a formal notification under the procedures of Article 114(6) TFEU would no longer be necessary. A notification under Directive 98/34/EC on the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations[52] would be sufficient to inform the Commission and the other Member States.

5.2.4. *Option 4: A new Regulation setting a Community limit value for cadmium content in phosphate fertilisers at 60 mg cadmium/kg P_2O_5 decreasing over time to 40 and eventually 20 mg cadmium/kg P_2O_5, if decadmiation becomes available on industrial scale*

The new Regulation would set a Community upper limit for cadmium in phosphate fertilisers at 60 mg cadmium/kg P_2O_5 after an appropriate (e.g. 2 to 3 years) transition period.

Five years after the end of the transition period, the Commission would reassess the technical and economic feasibility of decadmiation, taking into consideration the socio-economic aspects but also the need to protect the EU citizens against cadmium inputs in the environment. If considered feasible and proportionate, the upper limit value would be decreased to 40 mg cadmium/kg P_2O_5 and, after a further review at a later point in time, would be decreased to 20 mg cadmium/kg P_2O_5.

The three Member States who have been granted derogations to apply national limits for the cadmium content of phosphate fertilisers would continue to benefit from them until an equivalent level is reached by EU action. Other Member States wishing to reduce the cadmium inputs to agricultural land will have to request derogation under Article 114(6) of the TFEU as long as the EU level stays higher as what they consider necessary for their territories.

5.2.5. *Option 5: A new Regulation setting an upper limit of 40 mg cadmium/kg P_2O_5 in phosphate fertilisers while allowing Member States to set a limit value of 60 or 20 mg cadmium/kg P_2O_5 for the placing on the market and use depending on the conditions prevailing on their territories*

This option would be similar to Option 3 except that the normal upper limit for cadmium in phosphate fertilisers would be set at 40 mg cadmium/kg P_2O_5 after an appropriate transition period (e.g. 2 to 3 years). By way of derogation, Member States would be allowed to opt for setting a higher limit of 60 mg cadmium/kg P_2O_5 or a lower limit of 20 mg cadmium/kg P_2O_5 throughout their territories where acceptable or necessary in the light of prevailing soil and climatic conditions. Fertilisers would be labelled with the information of whether they comply with the limit of 40 mg cadmium/kg P_2O_5 or 60 mg, or 20 mg, respectively, as foreseen for Option 3.

As explained in Option 3, Member States wishing to derogate from the 40 mg limit value would have to inform the Commission and the other Member States of their decision by using Directive 98/34/EC on the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations.

6. IMPACT ANALYSIS

Effects of the various policy options on food prices will not be analysed in the assessment, as for end-consumers, the estimated costs increase due to higher costs for low cadmium content fertilisers would be negligible because cultivated products are mostly commodities, i.e. easily

[52] OJ L 204, 21.07.1998, p. 37-48.

tradable and therefore prices are defined by the overall market situation rather than on an “additional cost” basis[53].

6.1. Option 1: No action

Risks to human health and the environment from cadmium in fertilisers depend very much on soil properties, agricultural practices and dietary habits, which vary significantly between the Member States. They are therefore well placed to determine which limit values would be the most appropriate for them. As mentioned before, 20 Member States have already set or intend to set limit values for national fertilisers placed on their markets. Three Member States (Sweden, Finland and Austria) have obtained authorisation under Article 114 TFEU (the former Article 95 of the Treaty) to set limit values also for EC fertilisers at 44, 22, and 75 mg/kg P_2O_5, respectively.

In the absence of an EU limit of cadmium content in phosphate fertilisers and if not all Member States take action to set appropriate limit values, there is a risk that in the longer term, cadmium levels in EU agricultural soils from phosphate fertilisers inputs would increase. Furthermore, national limits apply only to national fertilisers, which on average make up between 30 and 40 % of total consumption in the Member States. In the absence of an EU limit, there would be a risk that phosphate fertilisers with high cadmium content will be sold primarily in those Member States not setting limit values, leading to faster cadmium accumulation in their agricultural soils with possible adverse consequences on the cadmium content in food, groundwater and surface water. Sub-groups of the population would continue to be at risk. The long term preservation of soil functions and the protection of soil biodiversity would be in jeopardy. The objectives of the Water Framework Directive with regard to the chemical status of groundwater might also not be achieved.

According to a recent report from the Commission on the implementation of the Nitrates Directive[54], the consumption of mineral phosphorous fertilisers has gone down by 9 % in the EU-15 in the reporting period 2004 to 2007 and by only 1 % for the EU-27 as compared with the last reporting period (2000-2003). According to earlier forecasts by Fertilisers Europe, the EU-27 consumption of mineral phosphate fertilisers could fall by 4.3 % over the next ten years which in turn will lead to reduced cadmium input regardless of the introduction of regulatory cadmium limit values (by either Member States or the EU). However, in the light of the available information, it is not possible to conclude that this decrease in overall consumption of phosphate fertilisers would be sufficient to stop or reverse cadmium accumulation from mineral fertilisers. Conversely, growing food production needs and decrease in available production areas from urban sprawl or competition with bio-fuel production may cause a reverse trend in mineral phosphate consumption. In fact, in its latest forecasts in the 2009 Annual Report, Fertiliser Europe notes that for the first time in several decades an increase of 3.9 % in the consumption of mineral phosphates fertilisers is expected for the next ten years, with significant growth in Sweden, Spain and the UK.

Impacts on industry, producing countries – and hence the secure and adequate supply of phosphates – as well as farmers would be limited in the short-term and there would be no

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53 For example, high food prices during 2007/2008 were mainly caused by a drastic reduction of worldwide cereals stocks and not necessarily by higher fertiliser prices, which had raised in line with energy and raw material costs.

54 Report on the implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources based no member States reports for the period 2004-2007 (HTTP://EC.EUROPA.EU/ENVIRONMENT/WATER/WATER-NITRATES/PDF/COM_2010_47.PDF).

particular incentive to invest in decadmiation. However, impacts could increase if more and more Member States introduced different limit values – in particular if those limit values cannot be met by the main producing countries without decadmiation. Fragmentation of the internal market would increase and EU industry would have to adapt to a multitude of different limit values applicable in various Member States which would create additional compliance costs, e.g. for sourcing appropriate raw materials, supply chain management, and conducting the necessary quality analyses.

Member States wishing to introduce more stringent limit values for cadmium in EC fertilisers would have to ask for authorisation by the Commission in accordance with Article 114 (5) of the Treaty on the Functioning of the European Union (TFEU), which would create significant administrative burdens as described in section 3.5. Likewise, correct implementation of Regulation (EC) No 764/2008 on mutual recognition might be a problem for Member States wishing to enforce existing low national cadmium limits, as they will have to justify refusal of placing on the market of national fertilisers with higher cadmium content that are lawfully placed on the market in Member States having established higher limits or no limits at all. In addition, limit values for national fertilisers could be circumvented by industry through marketing phosphate fertilisers as 'EC fertilisers', as described in section 3.6.

Conclusions:

This option would not achieve most of the intended objectives, as neither the input of cadmium into soils through mineral fertilisers, nor the uptake of cadmium by crops and human exposure to cadmium through the diet would be significantly reduced, unless all Member States adopted appropriate national limits. However, not all Member States have taken action to reduce cadmium inputs from the use of national fertilisers and only three Member States have obtained derogation for EC fertilisers.

Conversely, if more and more Member States introduced specific cadmium limits, the internal market would be more and more fragmented and the EU fertilisers industry will have to meet a multitude of cadmium limits leading to additional compliance costs.

There would be no immediate impacts on the security of supply. No action at EU level would lead to significant administrative burdens for Member States authorities in relation with their obligations concerning Regulation (EC) No 764/2008 on mutual recognition, or for requesting derogation under Article 114 TFEU and for the Commission to decide on such requests.

6.2. Option 2: Market incentives

Currently, prices of phosphate fertilisers do not reflect their cadmium content. Consequently, there are no price signals giving incentives to manufacturers or farmers to increase the share of phosphates with low cadmium content. Moreover, the supply of phosphates with a low cadmium content is limited (see section 3.3.1), whilst decadmiation during the production process is associated with certain costs and is currently unavailable at industrial scale (see section 3.3.2 for details).

There are different sub-options to provide market incentives for increasing the use of low-cadmium containing phosphate fertilisers, and their impacts will be analysed separately. Adopting either of these options would in turn make decadmiation more attractive and send a market signal to that effect. Numerical examples will illustrate how high a tax (or conversely a subsidy) would need to be to compensate for the additional costs of decadmiation.

6.2.1. Sub-option A: Fiscal incentives for stimulating substitution of current mineral phosphate fertilisers with suitable alternative sources or for creating a separate market for low-cadmium mineral phosphate fertilisers

This option has been studied by Oosterhuis et al.[55] who examined charges of EUR 1.00 per gram of cadmium per ton of fertilisers applied across the board, or charges of EUR 0.25 per gram of cadmium per ton of fertiliser applied to fertilisers with more than 60 mg cadmium per kg P_2O_5 in combination with lowering the latter threshold to 40 mg/kg after two years and to 20 mg/kg after four years. Member States would in all cases be able to impose higher charges nationally to reflect different soil characteristics and other national circumstances. The purpose of a tax would be to incentivise users of high-cadmium fertilisers to switch to organic or low-cadmium mineral fertilisers. The purpose would not be to raise revenue.

In terms of benefits, the perceived tax revenues could theoretically be redistributed to the farming and fertiliser industries (in the form of support for developing decadmiation technologies, training and awareness raising for farmers, etc.), although based on the experience in other areas, it is more likely that the revenues will become part of the general Member States budgets. The sub-option is potentially easy to implement and run, as a tax system would impose limited additional administrative burden on users, producers and importers.

Provided the tax level would be set at the appropriate level so that decadmiation becomes advantageous above a certain cadmium content (see section 6.2.5 and Annex XIV), the overall reduction of cadmium content in phosphate fertilisers (and hence the input into agricultural soils) would be comparable to that achieved by setting a regulatory limit value. These are further examined in sections 6.3, 6.4, and 6.5.

Two critical parameters for the success of this sub-option are the price and substitution elasticities of phosphate fertilisers. Estimates in existing literature suggest that the demand for phosphate fertilisers has low price elasticity, around 0.1 in absolute terms[56]. Therefore even doubling the price by imposing a tax of 100 % would only reduce demand by about 10 %. Substitution elasticities appear to be slightly higher in absolute terms, meaning that the purpose of making users shift to organic or low-cadmium mineral fertilisers would be achieved to a greater extent by the introduction of a tax than the purpose of reducing the overall use of fertilisers.

On the other hand, taxation of phosphates containing high levels of cadmium would push up demand for low-cadmium mineral phosphate fertilisers, the demand for which may exceed maximum production capacity in the absence of viable decadmiation technology at industrial scale. If technical, economical or social constraints would not allow an increase in the use of untapped sources of organic phosphorous (e.g. from biowaste or sewage sludge), overall prices would thus go up and constitute a burden on EU farmers. Taxation of phosphates with high cadmium content would sour relations between the EU and (mainly African) exporting countries. There could be stockpiling of high-cadmium fertilisers in anticipation of the tax and

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55 A possible EU wide charge on cadmium in phosphate fertilisers: economic and environmental impacts". Final report to the European Commission, April 2000 (Report no E-00/02).

56 Low price elasticity is confirmed by recent data for the growing seasons 2007/2008 and 2008/2009: Despite a very strong price increase in the season 2007/2008 (prices for some fertiliser types almost tripled – see Annex X), consumption of phosphate fertilisers showed only a small decrease in line with long-term trends. However, in the season 2008/2009, prices went down strongly but consumption in EU-27 actually dropped by 40 % (according to the 2009 Annual Report of Fertilisers Europe) due to difficulties for farmers to have access to finance.

there would be a risk of illegal imports to avoid the tax. EU-wide taxes would not reflect the true externalities of cadmium in fertilisers, which can vary regionally or even locally depending on different soil characteristics. Last but not least, unanimity in the Council would be needed for the adoption of any legal act on EU cadmium taxes.

The existing fragmentation of the internal market would not be reduced. Member States wishing to maintain or introduce more stringent limit values for cadmium in EC fertilisers would have to ask for authorisation by the Commission in accordance with Article 114(4) or (5) of the Treaty on the Functioning of the European Union (TFEU), which would create significant administrative burdens as described in section 3.5. Likewise, correct implementation of Regulation (EC) No 764/2008 on mutual recognition might be a problem for Member States wishing to enforce existing low national cadmium limits, and limit values for national fertilisers could be circumvented by industry through marketing phosphate fertilisers as 'EC fertilisers', as described in section 3.6.

6.2.2. Sub-option B: Subsidies for the use (or production) of suitable alternatives to high-cadmium mineral phosphate fertilisers

This sub-option would involve rewarding users (or producers) financially when purchasing (producing) any fertilisers (including those with organic phosphorous) defined as preferable to mineral phosphate fertilisers with high cadmium content. The purpose would be to use the price mechanism to steer consumption (production) away from fertilisers with high cadmium content, but not to reduce overall use of fertilisers.

As virtually all phosphates producers are located outside the EU (apart from a modest production in Finland), giving financial support to producers would mean channelling public funds from the EU into the fertiliser industry in non-EU countries, which is probably politically difficult. Financial support to users can be given either at the point of purchase (the user would pay only part of the price, the remainder being covered by the subsidy) or *ex-post*, for instance annually in the form of tax credits. In the latter case the user would pay the full price at the point of purchase and be compensated later.

There would be a shift from non-subsidised fertilisers with high cadmium content to subsidised fertilisers, within the limits of availability of fertilisers with low cadmium content. This sub-option is likely to appeal more to users than taxation. If combined with a tax on fertilisers with high cadmium content, the revenues from the tax could be returned to the user community in the form of subsidies.

On the other hand, it is also possible that due to the limited availability of low cadmium-containing phosphates, producers would increase their profit margins on subsidised fertilisers in order to get a share of the subsidy. Provided the subsidy would be set at the appropriate level so that decadmiation becomes advantageous above a certain cadmium content (see section 6.2.5 and Annex XIV), the overall reduction of cadmium content in phosphate fertilisers (and hence the input into agricultural soils) would be comparable to that achieved by setting a regulatory limit value. These are further examined in sections 6.3, 6.4, and 6.5.

As for sub-option A, the fragmentation of the internal market and the administrative burden related to maintaining or setting limit values in the Member States and those related to mutual recognition would persist. The entire system would be difficult to administrate and run, and there would be a high risk of fraud. The actual amounts of the subsidies are difficult to calibrate to different soil characteristics.

6.2.3. *Sub-option C: Quotas on imports of mineral phosphate fertilisers with high cadmium content*

Import quotas on fertilisers with high cadmium content would limit their availability in the EU, thereby pushing up prices to the point where the demand of the users with the highest willingness to pay for such fertilisers would match the limited supply. Users with insufficient willingness to pay would be excluded from the market for fertilisers with high-cadmium content and would need to turn to organic or mineral fertilisers with low cadmium content, the prices of which would also go up as a result.

As a consequence, the overall amount of phosphates with high cadmium content imported and used in the EU would go down. Provided the quotas could be set at the appropriate levels so that decadmiation becomes advantageous above a certain cadmium content (see section 6.2.5 and Annex XIV), the overall reduction of cadmium content in phosphate fertilisers (and hence the input into agricultural soils) would be comparable to that achieved by setting a regulatory limit value. These are further examined in sections 6.3, 6.4, and 6.5.

However, import quotas would probably fall foul of WTO rules and would be detrimental to relations between the EU and (mainly African) exporting countries. It would be extremely difficult to calculate appropriate quotas – balancing the overall needs of EU agriculture, the different soil characteristics that vary on regional and even local scale, and the availability of low cadmium-containing phosphates. All users and some producers would suffer welfare losses. There is a risk of stockpiling of fertilisers with high cadmium content in anticipation of the quotas and of illegal imports to circumvent them.

As for sub-option A, the fragmentation of the internal market and the administrative burden related to maintaining or setting limit values in the Member States and those related to mutual recognition would persist.

6.2.4. *Sub-option D: Quotas on the use of mineral phosphate fertilisers containing cadmium*

In analogy to the European emissions trading scheme for greenhouse gas emissions, "cadmium permits" could be distributed to users of fertilisers in relation to the size of the productive farming area and taking into account its soil characteristics. Users could choose to use several permits at once to buy fertilisers with high cadmium content, fewer permits to buy fertilisers with low cadmium, or no permits at all to buy organic fertilisers or ‘recycled phosphates’ with low cadmium content. Users running out of permits would need to either buy additional permits or refrain from buying mineral phosphate fertilisers. Users with more permits than needed would be able to sell them on a special exchange. Member States would be able to control the total number of permits and the use of cadmium, by buying or selling on the exchange and by limiting the validity of permits so that they expire after a number of years and then issue new permits, possibly in smaller numbers.

The scheme would guarantee a genuine market equilibrium in which the users with the highest marginal benefit of high-cadmium fertilisers end up using the permits. Assuming that the number of available permits is such that all permits will be used, Member States would be able to calculate with accuracy the actual total use of cadmium and fine-tune it by making available fewer (or more) permits. In calculating the amount of permits, it would be possible to take account of different soil qualities.

However, the development and administration of such a permit system would potentially be very burdensome and expensive. It would impose a heavy administrative burden on participants. In fact, the latest draft internal proposal discussed in the Commission in 2005 foresaw the labelling of phosphate fertilisers as being in one of three classes (up to 20, 40, 60 mg/kg, respectively) and the possibility that Member States designate 'vulnerable zones' according to certain criteria and that in these zones only fertilisers with low cadmium content could be used. However, this was rejected by many other Directorates-General as too bureaucratic, complicated, and unenforceable. Furthermore, due to inelastic demand the market for permits may not work. There is a risk of stockpiling of fertilisers with high cadmium content in anticipation of the trading scheme, illegal imports to circumvent it, and a high risk of fraud.

In line with the total amounts of permits, the overall cadmium input into agricultural soils will decrease, but it is not possible to forecast, whether this will lead to reduced exposure of humans and the environment, as farmers, who should use low-cadmium containing fertilisers in the light of the soil characteristics on their farms and/or the plants they wish to grow, would still be able to buy permits and high-cadmium containing phosphates. As for sub-option A, the fragmentation of the internal market and the administrative burden related to maintaining or setting limit values in the Member States and those related to mutual recognition would persist.

6.2.5. Incentives for investing in decadmiation

Decadmiation is expensive to invest in, which is one reason why no full-scale industrial decadmiation plants have been built so far for the production of fertilisers. Moreover, the two existing technologies that could be cost-effective have not yet been proven feasible at industrial scale. However, given the right incentives, using one of the four sub-options outlined above, producers may decide it makes business sense to make the investment. Changing circumstances such as a breakthrough in decadmiation technology would have the same effect.

In the case of an incentive for decadmiation in the form of a tax on fertilisers with high cadmium content, Oosterhuis et al. showed that under a set of simplifying assumptions[57], investing in decadmiation can be profitable. Building on that approach, an analysis is made in Annex XIV, in which a simple tax is introduced that needs to be paid on every gram of cadmium per ton of phosphate fertiliser brought on the EU market. Every producer of phosphate fertilisers then has to decide whether it is cheaper to pay the tax or to decadmiate the phosphates in the fertiliser production process, which costs money but also leads to tax savings.

In this model, for a given cost of the decadmiation technology, it is possible to calculate the tax rate that induces producers to decadmiate phosphate fertilisers above a certain desired threshold (in terms of cadmium content), while for phosphate fertilisers below the threshold it is cheaper to pay the tax. In summary, the lower the desired threshold is, the higher the tax rate needs to be.

Data for the two most-promising decadmiation technologies (CERPHOS and ELICAD) have been used in order to estimate which tax rates would be required per gram of cadmium in order to provide the appropriate incentives for decadmiation. For a full description of the model, the data used, the results and some sensitivity analysis, please refer to Annex XIV.

[57] Note that the model may be over-simplified and that the results therefore need to be interpreted with care.

Figure 9 compares the most promising decadmiation technologies in terms of tax effect to stimulate decadmiation for the cadmium content in the phosphate fertilisers (using the data with regard to cadmium content from Figure 3). Figure 10 illustrates the effect of a tax on the average cadmium content of phosphate fertilisers (using the data with regard to cadmium content from Figure 3). For the ELICAD process, tax effects have been calculated on the basis of estimated low and high operative costs.

The main conclusions are that:

1. The necessary tax rate depends on several essential parameters that characterise a decadmiation technology (notably costs, process effectiveness and production capacity). The two technologies examined produce different results (see figure 9): a tax rate of EUR 0.5 has a break-even for Cerphos at around 57 mg cadmium whereas the same tax rate would provide a break-even between 37 to 44 mg cadmium for Elicad depending on its final operative costs.

2. The sensitivity analysis (see Annex XIV) shows that the effectiveness of the decadmiation process (how much cadmium can be removed by it) is the most important factor, while various other parameters do not significantly change the results for a given technology. The choice of the discount rate is also important.

Figure 9: Comparison Elicad/Cerphos. Break-even between tax and cost of decadmiation

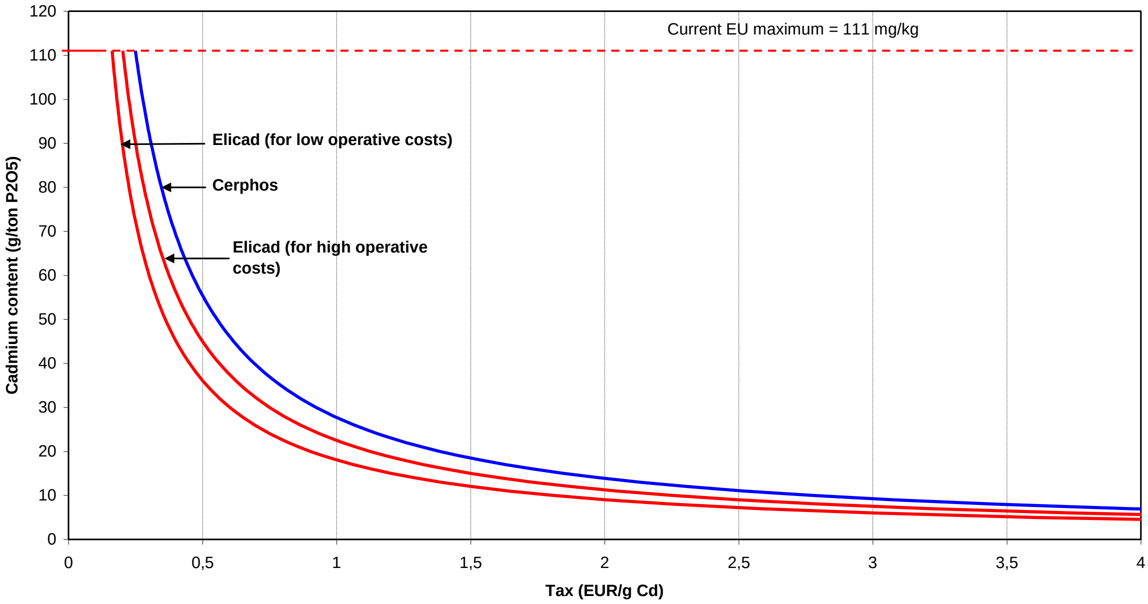
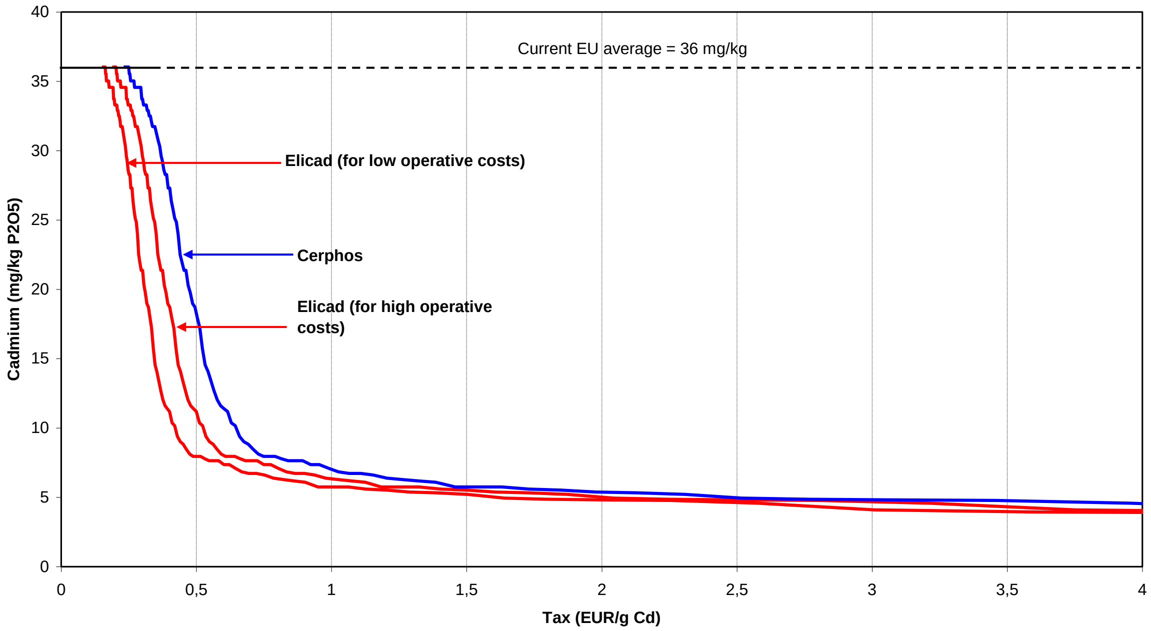


Figure 10: Comparison Elicad/Cerphos. Effect of tax on average Cd content



Based on the figures presented in Figure 9, an estimation of the level of the tax needed to stimulate decadmiation for a given desired limit can be made as well as its influence on the increase of fertilisers costs.

Results for the ELICAD process:

Desired maximum cadmium content per ton of fertiliser [g/ton]	Tax per gram of cadmium [EUR/g] for lower cost estimate	Tax per gram of cadmium [EUR/g] for higher cost estimate
60	0.3	0.37
40	0.45	0.56
20	0.90	1.12

Irrespective of the threshold chosen, this would increase the price of a ton of fertiliser close to or slightly above the desired threshold by approximately EUR 18 to 22.5 (sum of decadmiation costs and tax to be paid on remaining Cd content), which at a price of USD 250 per ton – a price observed during much of 2007 – and an exchange rate of USD 1.25 per EUR would correspond to an increase of 9 to 11 %. If the initial Cd content is higher, the price increase would also be higher – for example for an initial content of 100 g Cd/ton phosphate, the increase would be 10-16 % (See Annex XIV for details).

Results for the CERPHOS process:

Desired maximum Cadmium content per ton of fertiliser [g/ton]	Tax per gram of cadmium [EUR/g]
60	0.5
40	0.7
20	1.4

Irrespective of the threshold chosen, this would increase the price of a ton of fertiliser close to or slightly above the desired threshold by approximately EUR 28 (sum of decadmiation costs and tax to be paid on residual Cd content), which at a price of USD 250 per ton – a price observed during much of 2007 – would correspond to an increase of 14 %. If the initial Cd content is higher, the price increase would also be higher – for example for an initial content of 100 g Cd/ton phosphate, the increase would be 15-20 % (See Annex XIV for details).

The same results can be used to determine the required subsidies – as an alternative to a tax. The available information does not allow to model the system of quotas and/or permits, which would make decadmiation financially attractive.

Conclusions:

At least two of the sub-options (taxation or subsidies) have the potential to stimulate investment in decadmiation and provided the taxes/subsidies could be set at the appropriate levels, the overall reduction of cadmium content in phosphate fertilisers (and hence the input into agricultural soils) would be comparable to that achieved by setting a regulatory limit value.

However, politically it will be rather impossible to get unanimity in the Council for the adoption of a tax or subsidies at EU level. All sub-options will have significant impacts on farmers – in fact decadmiation (triggered by taxation) and paying the tax on the remaining cadmium content will lead to significant price increases – for phosphates containing originally 100 mg cadmium/kg P_2O_5 from about 10 to 20 % for the ELICAD or CERPHOS processes which would be passed on as additional costs to farmers – see Annex XIV for details. If the raw material contains more cadmium, or if the efficiency of the decadmiation process is lower than assumed, price increases would even be higher, while they would be lower for raw material containing less cadmium or for more efficient decadmiation processes.

There would also be potentially negative effects on phosphates producing countries (in particular if their deposits contain high cadmium levels) and security of supply. None will lead to a reduction of the fragmentation of the internal market, nor to a reduction of administrative burdens linked to Article 114 requests for derogation or mutual recognition, as Member States will keep their legislation setting limit values (or introduce new one). Quite on the contrary, there will be additional administrative burdens to introduce and administer the sub-options, which will be particularly high for a system of import quotas or tradable permits.

6.3. Option 3: A new Regulation setting an upper limit of 60 mg cadmium/kg P_2O_5 in phosphate fertilisers while allowing Member States to impose a limit value of 40 or 20 mg cadmium/kg P_2O_5 for the placing on the market and use depending on the conditions prevailing in their territories

An EU limit of 60 mg cadmium/kg P_2O_5 combined with the possibility for Member States to set a lower limit at either 40 or 20 mg cadmium/kg P_2O_5 will lead to some reduction of new cadmium input into soils. However, it is uncertain whether this will result in a significant decrease in soil cadmium accumulation and hence lower cadmium levels in food since the SCTEE-2002 considered that in most European soils, cadmium accumulation will likely continue if a 60 mg cadmium/kg P_2O_5 limit was implemented. On the other hand, the flexibility foreseen in this option as an element of subsidiarity will allow Member States to opt for limit values at either 40 or 20 mg cadmium/kg P_2O_5 in the light of prevailing conditions and it would therefore not be totally inconsistent with the SCTEE-2002 opinion.

As already set out in section 3.2, the actual cadmium content of the fertilisers placed on the market in the EU is not well studied, and it is therefore difficult to quantify the reduction in new cadmium input into agricultural soils that this option would entail. Phosphate fertilisers with cadmium concentrations higher than 60 mg cadmium/kg P_2O_5 could no longer be marketed in the EU and would be replaced by others with lower cadmium content. It is not possible to know precisely the cadmium content of the phosphate fertilisers that would replace the prohibited quantities with cadmium content above 60 mg/kg P_2O_5, but this will have a strong influence on the reduction that can be achieved. On the basis of the data contained in Figure 3, which are, however, not necessarily representative for the EU, the introduction of an upper limit at 60 mg cadmium/kg P_2O_5 could reduce the annual input of cadmium on EU agricultural soils by around 30 % if all fertilisers with cadmium content above the limit were to be replaced by fertilisers with a cadmium content of 25 mg cadmium/kg P_2O_5 (which is the average of those currently on the market below 60 mg cadmium/kg P_2O_5). However, if all replacement quantities had a cadmium content of exactly 60 mg cadmium/kg P_2O_5, the overall cadmium reduction would only be at around 10 %, whereas replacement with phosphates at 0 mg cadmium/kg P_2O_5 would lead to an overall reduction of 45 %. Further details of the analysis are contained in Annex XV.

In terms of impacts on third countries, the main supplier of phosphates to the EU, Morocco, has a number of different mines, each with different average cadmium content, and the fertilisers produced from these mines also have different cadmium contents (see Annexes IX and X). The deposits within each mine are several meters thick and are layered rather uniformly. Some of these layers have higher cadmium content than others. By selective use of certain mines (e.g. Khourbiga) and/or of certain layers within a deposit, an upper limit of 60 mg cadmium/kg P_2O_5 appears to be feasible for Moroccan phosphate producers on the scale needed to supply the EU market for the foreseeable future without the need for decadmiation. In fact, selective mining for quality purposes in relation to P_2O_5 content is already in place in a majority of mines. Further sedimentary phosphates with low cadmium content are available in Syria, Jordan and Egypt. Thus, sufficient production capacity of sedimentary rock with cadmium content at or below 60 mg cadmium/kg P_2O_5 from existing sources seems to be available, and a significant increase of rock price is unlikely. Some smaller phosphate producing countries in Africa, such as Togo and Senegal, where cadmium content in phosphates is higher than 60 mg kg P_2O_5, would face difficulties – however, for more than 10 years there have not been any exports to the EU from these countries.

Consequently, the European fertiliser industry could meet an upper limit of 60 mg cadmium/kg P_2O_5 using their current supply chains without decadmiation through the selective mining and blending of sedimentary phosphate rock deposits with appropriate cadmium content. The European Standard EN 14888[58] has been developed to determine the cadmium content of fertilisers. The related analytical costs are around EUR 60 per sample.

16 out of 26 European SMEs consulted on the potential impacts of the different policy options developed in this impact assessment (except Option 2) reported that the economical impacts would be smallest if a cadmium limit of 60 mg cadmium/kg P_2O_5 was to be adopted. A more stringent limit would inevitably make the supply of adequate sources of phosphate fertilisers and the management of the different stocks of raw material more problematic. Annex IV provides details of the SMEs consultation.

58 Determination of cadmium content by flame atomic spectroscopy (AAS) and by inductively coupled plasma-optical emission spectroscopy (ICP-OES) after extraction in nitric acid.

Labelling fertilisers with the cadmium content could be a measure to facilitate enforcement of limit values and would increase awareness of farmers about the cadmium content of fertilisers. So far, only one Member State having introduced legislation to limit the cadmium content of phosphate fertilisers requires such labelling, but one company does this voluntarily. Consultation with industry revealed that the determination of cadmium content and labelling fertilisers with the exact content (i.e. per individual batch of production) would lead to high costs, whereas the sole indication on the label that fertilisers respect the limit value of either 60, 40 or 20 mg cadmium/kg P_2O_5 would not entail significant costs.

Given that the main suppliers of phosphates could meet an EU limit of 60 mg cadmium/kg P_2O_5 without decadmiation, this option will not provide a direct incentive to invest in developing such technologies. However, if over time more and more Member States would choose to allow only marketing and use of fertilisers with a cadmium content of 40 or 20 mg cadmium/kg P_2O_5, Morocco and other producing countries of phosphate rock with high cadmium content would have to invest into decadmiation or the EU fertiliser industry would have to increase its supply from phosphate sources with low cadmium content, which could lead to an increase in costs for mineral phosphate fertilisers. As the majority of Member States seem to be satisfied by the upper limit of 60 mg cadmium/kg P_2O_5 as evidenced by the outcome of the consultations described in section 2, such a development is not expected in the near future.

Impacts on conventional farmers are expected to be limited as the main producing countries can supply the EU market at the 60 mg cadmium/kg P_2O_5 limit without additional costs except costs for analysis and raw material stock management. No phosphate fertiliser type will be shut out of the market.

Organic farming represents approximately 4 to 5 % of the cultivated land in the EU; organic crop production is therefore currently limited. In organic farming, phosphorous generally comes from organic sources e.g. composted farmyard manure, but use of mineral phosphate fertilisers (soft ground rock phosphate, aluminium-calcium phosphate) as described in Regulation (EC) No 889/2008 occurs. Soft ground phosphate rocks cannot be decadmiated, but sources of low cadmium phosphate rocks are available in Jordan and Syria, which could comply with a limit value of 60 mg cadmium/kg P_2O_5. Some Member States have adopted action plans to increase organic farming. In particular Germany, Austria, Slovenia, UK (Wales) have committed to increase this area up to 20 %[59]. It is therefore likely that organic production will increase in the future and all phosphorous sources need to be available in particular for areas where organic sources are less available. As this could lead to increasing demand for soft ground phosphate rock with low cadmium content, it might be necessary in the future to consider appropriate measures for organic agriculture, including further recycling of organic materials.

An upper limit of 60 mg cadmium/kg P_2O_5 would satisfy the needs of a majority of Member States (see Annex I). Allowing Member States to restrict placing on the market and use to 40 or 20 mg cadmium/kg P_2O_5, would satisfy those Member States wishing to reduce further the cadmium emissions in their environment due to specific prevailing conditions. This would be fully in line with the subsidiarity principle and the fact that there are divergent conditions among the Member States. There would be no administrative burden linked to mutual recognition or the need for Member States wishing to set one of the two lower limit values to request derogation under Article 114 TFEU. In fact, an upper limit of 60 mg cadmium/kg

[59] Source FP6. ORGAP (The Consortium partners of the European Research Project) – 2008.

P_2O_5 would make the existing derogation for Austria (with a limit value of 75 mg cadmium/kg P_2O_5) redundant, whereas the current derogations for Sweden and Finland could be fully accommodated by imposing the possible lower limits of 40 or 20 mg /kg P_2O_5 – the existence of the former derogations would be a sufficient justification. Industry could no longer circumvent national limit values by marketing fertilisers as 'EC fertilisers'. Overall, fragmentation of the internal market would be reduced compared to the situation today, as instead of complying with a multitude of different limits, there would be only 3 different values and companies could choose themselves whether they want to produce only fertilisers respecting the EU limit of 60 mg cadmium/kg P_2O_5 and hence forego marketing in those Member States having set lower limits, or whether they want to produce also fertilisers complying with the lower limit values.

Conclusions:

Setting an upper limit of 60 mg cadmium/kg P_2O_5 would lead to some reduction of new cadmium input into agricultural soils from phosphate fertilisers throughout the EU. This effect would be more pronounced in Member States opting for one of the lower limits of either 40 or 20 mg cadmium/kg P_2O_5. Due to the limited availability of data, quantification of the reduction of new cadmium input to soils is difficult – using the available but not necessarily representative data shown in Figure 3, the reduction could be in the order of 30 % (possible range 10-45 %).

However, in the light of the SCTEE-2002 opinion, cadmium accumulation will likely continue in most soils with the implementation of the 60 mg cadmium/kg P_2O_5 limit. A possible decrease of soil cadmium accumulation and, hence transfer from soil to foodstuffs, will therefore depend on the number of Member States using the flexibility of this option to set lower limits at either 40 or 20 mg cadmium/kg P_2O_5.

An EU limit of 60 mg cadmium/kg P_2O_5 could be met without a major disturbance of the EU supply in phosphate fertilisers as the main supplying country, Morocco, could provide sufficient quantities by selective mining and blending, but would not be a sufficient incentive for producing countries to develop and invest in a reliable decadmiation technology, unless a growing number of Member States chose to set one of the two lower limits. Given that supply would not be strongly affected, the transition period for introducing the limit value could be relatively short, between 2 and 3 years after entry into force of the legislation.

It would improve the functioning of the internal market for phosphate fertilisers, by reducing the already existing fragmentation with a multitude of different limit values and would also avoid further fragmentation in the future. No Member State would be required to request authorisation for derogation under Article 114 TFEU and there would be no future administrative burden related to such requests for either the Member States or the Commission.

6.4. Option 4: A new Regulation setting a Community limit value for cadmium content in phosphate fertilisers at 60 mg cadmium/kg P_2O_5 decreasing over time to 40 and eventually 20 mg cadmium/kg P_2O_5 if decadmiation becomes available on industrial scale

When fully implemented, i.e. when decadmiation is available at industrial scale, this option would be fully in line with the opinion of the SCTEE-2002 concluding that, in most European soils, a limit of 60 mg cadmium/kg P_2O_5 in mineral phosphate fertilisers would not be sufficient to avoid accumulation of cadmium, whilst a limit of 20 mg cadmium/kg P_2O_5 would be appropriate to achieve that goal. Consequently, this option would lead to a decrease of cadmium concentrations in soil in the long term and hence a clear reduction of risks to the environment and to human health via the diet provided that it is fully implemented, i.e. that further reductions to 40 mg and 20 mg cadmium/kg P_2O_5 become effective.

As already set out in section 3.2, the actual cadmium content of the fertilisers placed on the market in the EU is not well studied, and it is therefore difficult to quantify the reduction in new cadmium input into agricultural soils that this option would entail. On the basis of the data contained in Figure 3, which are, however, not necessarily representative for the EU, and with the same calculations as set out for Option 3 (see Annex XV for details), setting the limit value at 60 mg cadmium/kg P_2O_5 could lead to a reduction of cadmium inputs in the order of 30 % (possible range 10-45 %) compared to today, whilst a further decrease to 40 mg cadmium/kg P_2O_5 could lead to a reduction of cadmium input by 69 % (possible range 30-84 %), and a decrease to 20 mg cadmium/kg P_2O_5 could bring a reduction of about 81 % (possible range 60-92 %).

As explained in the analysis of Option 3, an initial limit value of 60 mg cadmium/kg P_2O_5 could probably be met by phosphates exporting countries (except for some smaller African producers, which do, however, not export to the EU) and the EU fertiliser industry without excessive costs and disturbance of supply, by using raw material from selective mining of sedimentary phosphate rock from mines with sufficiently low cadmium content. As for option 3, an appropriate transition period to set this limit could be of the order of 2 to 3 years after entry into force of the legislation.

As the entry into force of stricter cadmium limits would be conditional on the existence of a suitable decadmiation technology, producers would still not have any immediate reason for developing such technology (see also section 3.3.2). Conversely, the impacts of a reduction of the EU limit to 40 or 20 mg will strongly depend on the availability of alternatives to phosphates as described in section 3.3. Given that the availability of natural deposits of phosphates with low cadmium content and the potential for increased recycling of phosphates from waste streams is limited, the feasibility of decadmiation at industrial scale will be decisive.

In the absence of decadmiation at industrial scale and at reasonable costs, the consequences of a reduction of the EU limit will be very negative for a broad range of phosphates producing countries in Northern Africa, who effectively will not be able to export to the EU anymore – including also the main producer Morocco. Consequently, there will be a disruption of the supply of the EU fertiliser industry and farmers, who will also face strongly increased prices due to very high demand for the limited amounts of alternative phosphates with low cadmium content. At the same time, countries such as Morocco and Tunisia are covered by the European Neighbourhood Policy (ENP) which was developed in 2004 with the objective of establishing a deeper political relationship and economic integration between the EU and its immediate neighbours by land or sea. Without proven feasibility of decadmiation, both could see their exports of phosphates to the EU being severely limited, which are today significant sources of revenues. This would be contrary to the ENP objectives.

As a further consequence, producers in Northwest Africa would probably seek to export phosphates with high cadmium content that could no longer be sold to the EU to other third countries, in particular to developing countries, as several other developed countries have already introduced restrictions on cadmium content in fertilisers[60].

[60] Several third countries have introduced restrictions on cadmium content in fertilisers: Switzerland (21 mg Cd/kg P_2O_5), Norway (43 mg Cd/kg P_2O_5), Japan (146 mg Cd/kg P_2O_5).

Many of the soils in developing countries are naturally acidic with little opportunity of being limed to raise their pH and thereby cadmium applied to these acidic soils will be likely to enter the food chain. The EU imports in turn agricultural produce from developing countries, the cadmium content of which could then possibly increase. In that context, the Kenyan authorities notified in mid October 2010 to the World Trade Organisation their intention to impose limits on heavy metals, including cadmium[61], in rock phosphate for use in manufacture of fertilisers and common phosphate fertiliser types. The main objective of the Kenyan authorities is to ensure a safe use of fertilisers for consumers and environment protection. No member of the WTO objected or submitted comments on the Kenyan notification.

On the other hand, implementation of stringent limits for cadmium in phosphate fertilisers would constitute a clear signal from the EU to phosphates producing countries to invest in decadmiation technologies in order to ensure continued access to the EU market in the long term future. For example, construction of the existing installation with decadmiation for food-grade phosphates in Tunisia was probably motivated by the EU's setting of stringent limits for cadmium in food and feedstuffs. Further research and development could bring down the costs of such processes, and would allow these countries to remain competitive also on other third country markets where limit values for cadmium are already in place or might be established in the future.

In June 2010 and in January 2011, the European Investment Bank has received applications to finance two projects in Tunisia (EIB 21 276 2010) and Morocco (EIB 21 05 2011) concerning the modernisation or construction of new phosphate fertiliser plants. In its comments, the Commission has recommended that the investors also consider developing and installing an industrial decadmiation process in the light of possible future limits for cadmium in phosphate fertilisers.

Still, whilst successful decadmiation would restore a sufficient supply base for the European fertiliser industry and farmers, third countries mining phosphates with high cadmium content would face some structural disadvantage due to the costs associated with decadmiation – as set out in the analysis of Option 2, price increases due to decadmiation could be in the order of 10 to 20 % – and for certain fertiliser types that are not produced involving phosphoric acid as an intermediate, decadmiation technologies are not yet available, even at laboratory scale.

As long as no decadmiation at industrial scale is available, the fragmentation of the internal market will persist, as 60 mg cadmium/kg P_2O_5 will remain the *de facto* EU limit. Member States wishing to maintain or introduce more stringent limit values for cadmium in EC fertilisers would have to ask for authorisation by the Commission in accordance with Article 114 TFEU, which would create significant administrative burdens as described in section 3.5. However, once decadmiation is available and the EU limit can be decreased, fragmentation will be reduced and eventually the Internal Market will be fully harmonised.

Conclusions:

Full implementation of this option would strongly reduce the cadmium content in phosphate fertilisers throughout the EU, which would reduce the input of cadmium to agricultural soils and hence transfer into food and ultimately also intake by humans through the diet. It would eventually be fully in line with the opinion of the SCTEE-2002 indicating that, at a limit value of 20 mg cadmium/kg P_2O_5, no further cadmium accumulation from phosphate fertilisers is

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[61] Maximum cadmium content in rock phosphate: 30 ppm cadmium on dry matter i.e. around 90 mg Cd/kg P_2O_5 for phosphate content of 32 % (wt % P_2O_5).

likely to occur in most European soils. Due to the limited availability of data, quantification of the reduction of new cadmium input to soils is difficult – using the available but not necessarily representative data shown in Figure 3, the reduction could be in the order of 30 % (possible range 10-45 %) for the initial limit of 60 mg cadmium/kg P_2O_5, whilst a further decrease to 40 mg cadmium/kg P_2O_5 could lead to a reduction of cadmium input by 69 % (possible range 30-84 %), and a decrease to 20 mg cadmium/kg P_2O_5 could bring a reduction of about 81 % (possible range 60-92 %).

Feasibility of the full implementation of this option will largely depend on the availability of a decadmiation process at industrial scale. If stringent cadmium limits were to be adopted even though no industrial decadmiation process is available, there would likely be a rush to either sedimentary low-cadmium phosphate rock or to a lesser extent to igneous rocks leading to severe effects on producing countries, EU fertiliser industry and farmers. In the mid term at least, the recovery of nutrients from organic wastes such as manure, sewage sludge and bio-waste will not cover the phosphate needs of EU farmers. On the other hand, drivers such as this option could stimulate decadmiation and phosphorous recycling technologies and if a workable timetable for implementation of the lower limits were foreseen, these adverse effects on supply could be mitigated.

With a single EU limit value for cadmium in phosphate fertilisers – decreasing over time – fragmentation of the internal market would eventually disappear and enforcement by national authorities would be easier. However, as long as the EU limit would stay at 60 mg cadmium/kg P_2O_5 several Member States wishing to maintain lower national limits would have to submit requests for derogation under Article 114 TFEU with the related administrative burdens and fragmentation of the internal market would persist.

6.5. Option 5: A new Regulation setting an upper limit of 40 mg cadmium/kg P_2O_5 in phosphate fertilisers while allowing Member States to impose a limit value of 60 or 20 mg cadmium/kg P_2O_5 for the placing on the market and use depending on the conditions prevailing on their territories

This option might be considered as a variant of Option 3. An upper limit of 40 mg cadmium/kg P_2O_5 after an appropriate transition period would better address the concerns about cadmium accumulation in European soils by limiting the input of cadmium from the application of phosphate fertilisers and would be more in line with the opinion of the SCTEE-2002. However, it is not certain that this will result in a significant decrease in soil cadmium accumulation and hence lower cadmium levels in food since the SCTEE-2002 considered that in most European soils, cadmium accumulation will be avoided only if a 20 mg cadmium/kg P_2O_5 limit was implemented.

As already set out in section 3.2, the actual cadmium content of the fertilisers placed on the market in the EU is not well studied, and it is therefore difficult to quantify the reduction in new cadmium input that this option could entail. On the basis of the data contained in Figure 3 which are, however, not necessarily representative for the EU, and using similar calculations as for the previous options (for details see Annex XV), setting the limit value at 40 mg cadmium/kg P_2O_5 could lead to a reduction of new cadmium inputs by 69 % (possible range 30-84 %).

Compared to Option 3, this option would have significant economic impacts on the fertiliser industry and producing countries, unless a majority of Member States would opt to deviate from the default value of 40 mg/kg P_2O_5. This is not guaranteed because many Member States – although actually satisfied with a limit value of 60 mg/kg P_2O_5 (see Annex I) – would have to act to allow the marketing and use of phosphate fertilisers containing 60 mg cadmium/kg P_2O_5 if an EU limit value was set at 40 mg/kg P_2O_5. With regard to labelling, the same considerations as for Option 3 apply.

As explained in the analysis of Option 4, there will be a strong negative impact on producing countries mining sedimentary rocks containing a high amount of cadmium. In particular Morocco, as the main supplier of phosphate to the EU, will also be immediately affected. Indeed, as Morocco, Tunisia and Israel will not be able to supply the European market with phosphate fertilisers with an upper limit of 40 mg cadmium/kg P_2O_5 without decadmiation technology, there will be a rush to low cadmium phosphates sources which will most likely lead to strong price increases for such phosphates. The same supply constraints as discussed for Option 4 apply.

No Member State would be required to request authorisation for derogation under Article 114 TFEU and there would be less administrative burden, in comparison with option 1, related to such requests for either the Member States or the Commission. In fact, an upper limit of 40 mg cadmium/kg P_2O_5 would make the derogation for Austria (with a limit value of 75 mg cadmium/kg P_2O_5) and Sweden (with a limit value of 44 mg cadmium/kg P_2O_5) redundant, whereas the derogation for Finland (with a limit value of 22 mg cadmium/kg P_2O_5) could be fully accommodated.

However, according to the results of the stakeholder meeting of 28 October 2009 (see Annex II for details) the number of Member States that might adopt the 60 mg cadmium/kg P_2O_5 limit instead of the EU limit of 40 mg cadmium/kg P_2O_5 would be significantly higher than those opting for lower limits in Option 3. This would create administrative burdens for a higher number of Member States.

Conclusions:

Compared to Option 3, this option would reduce the cadmium content in phosphate fertilisers throughout the EU, which would further reduce the input of cadmium into agricultural soils and hence transfer into food. Due to the limited availability of data, quantification of the reduction of new cadmium input to soils is difficult – using the available but not necessarily representative data shown in Figure 3, the reduction could be in the order of 69 % (possible range 30-84 %).

However, in the light of the SCTEE-2002 opinion, cadmium accumulation might still continue in some soils with the implementation of the 40 mg cadmium/kg P_2O_5 limit and more so, if Member States opt to increase the limit to 60 mg cadmium/kg P_2O_5. A possible decrease of soil cadmium accumulation and, hence transfer from soil to foodstuffs, will therefore depend on the number of Member States using the flexibility of this option to set either a higher limit at 60 mg cadmium/kg P_2O_5 or a lower limit at 20 mg cadmium/kg P_2O_5. In the absence of a technically and economically feasible decadmiation technology at industrial scale, there would be very high economic impacts on producing countries that currently supply the bulk of phosphate fertilisers imported into the EU. On the other hand this option would provide a clear signal to invest in the development of decadmiation or phosphates recycling.

The option would improve the functioning of the internal market for phosphate fertilisers, by reducing the already existing fragmentation of the internal market with a multitude of different limit values and would also avoid further fragmentation in the future but the number of Member States deviating from the EU limit would be higher than in Option 3.

Lastly, the Legal Service of the Commission considers that, according to Article 114 TFEU, economic reasons are not recognised as possible grounds to justify deviation from harmonised measures, in particular when less strict measures are adopted, which seems to preclude Member States from opting for a limit value of 60 mg cadmium/kg P_2O_5. This effectively rules out an implementation of this option in practice.

7. COMPARING THE OPTIONS

The comparison of the various policy options has been conducted taking into account the criteria of:

– **effectiveness** of the option in achieving the objectives (reduction of cadmium inputs into agricultural soils, reduction of exposure of humans via food and reduction of the exposure of soil organisms, secure supply and minimisation of negative impacts on third countries producing phosphates, reduction of internal market fragmentation, reduction of administrative burden). Overall effectiveness has been calculated as an average across achievement of the individual objectives, assigning, however, double weight to the objectives linked to human health and the environment;

– **efficiency** of the option in achieving the objectives. Efficiency aims at comparing the costs of the implementation of a particular policy option to its effectiveness in reaching the objectives. In the absence of reliable quantitative estimates, the costs of implementation are interpreted as adverse economic impacts on producing countries, fertiliser manufacturers or farmers[62];

– **coherence** of the option with other EU objectives (e.g. European Neighbourhood Policy) and trade obligations including WTO rules .

While the following tables represent a qualitative analysis of the arguments developed in section 6, the quotation presented is a necessary simplification to facilitate comparison and identify trade-offs and should be therefore treated as purely indicative.

The options have been assessed as being "strongly negative (---)", "negative (--)", "slightly negative (-)", "neutral (=)", "slightly positive (+)", "positive (++)" or "strongly positive (+++)" compared to the no EU action option (baseline scenario). The selected options have been assessed according to two scenarios:

Scenario 1: technologically and economically feasible decadmiation for large scale processing is not available;

Scenario 2: technologically and economically feasible decadmiation for large scale processing is available.

[62] ***Nota bene:*** for the purpose of this indicative comparison and in the absence of reliable quantitative estimates, the costs of the development and investment in the decadmiation technology are not taken into account.

Scenario 1: technologically and economically feasible decadmiation for large scale processing is not available:

Criteria	Option 1	Option 2	Option 3	Option 4	Option 5
Reduction of cadmium input into soils	=	=/+	+	+	++
Reduction of human exposure to cadmium	=	=/+	=/+	=/+	+
Reduction of exposure of soil organisms / Maintaining soil biodiversity	=	=/+	=/+	=/+	+
Security of supply and minimisation of negative impacts on 3rd countries	=	=	=	=	---
Reduction of Internal market fragmentation	=	=	++	=	++
Reduction of burden for public administration	=	--	+++	=	++
Overall effectiveness	=	=	+	=/+	+
Costs of implementation	=	--	-	-	---
Efficiency	=	-	=	- /=	--
Coherence	=	-	++	++	---
Explanatory comments	=	If no decadmiation is available, incentives will not change very much which fertilisers will be available or bought. A tax would cause adverse economic impacts on producing countries, industry and/or farmers through price increases. Fragmentation of internal market and related administrative burdens will remain unchanged – still need for Art. 114 TFEU requests for Member States wishing to set limits. In addition administrative burdens for developing and implementing any of the sub-options. Incoherent with neigh-bourhood and trade policies.	Some reduction of new cadmium inputs into agricultural soils. Uncertain whether this will result in decrease of total soil cadmium and hence reduced exposure of humans via food or reduced exposure of soil organisms. Reduced fragmentation of internal market as only 3 limit values will be possible. No need for Art. 114 TFEU requests Some negative economic impacts. Coherent with neighbourhood and trade policies.	Some reduction of new cadmium inputs into agricultural soils - the 60 mg limit would remain the de facto limit value. Uncertain whether this reduction will result in decrease of total soil cadmium and hence reduced exposure to humans via food or reduced exposure of soil organisms. Some Member States will wish to maintain or introduce lower limits, which necessitates Art. 114 TFEU requests as today. No reduction of fragmentation of internal market. Some negative economic impacts. Coherent with neighbourhood and trade policies as long as limit stays at 60 mg Cd/kg P_2O_5.	Significant reduction of new cadmium inputs into soils and some reduction of soil cadmium accumulation. Consequently, some reduction of the exposure of humans via food and some reduction of exposure of soil organisms. Reduced fragmentation of internal marked as only 3 limit values possible. No need for Art. 114 TFEU requests, but more Member States would wish to opt for 60 compared to those opting for 40 or 20 in option 2. Strong negative economic impacts. Incoherent with several EU policies (neighbourhood and trade policies, intentions of Art. 114 TFEU).

Scenario 2: technologically and economically feasible decadmiation for large scale processing is available

Criteria	Option 1	Option 2	Option 3	Option 4	Option 5
Reduction of cadmium input and reduction of risks to human health	=	+++	+	+++	++
Reduction of human exposure to cadmium	=	+++	+/=	+++	+
Reduction of exposure of soil organisms and maintaining soil biodiversity	=	+++	+/=	+++	+
Security of supply and minimisation of negative impacts on 3rd countries	=	=	=	=	=
Reduction of Internal market fragmentation	=	=	++	+++	++
Reduction of burden for public administration	=	--	+++	+++	++
Overall effectiveness	=	++	+	+++	++
Costs of implementation	=	--	-	--	-
Efficiency	=	=	=	+	+
Coherence	=	-/=	++	-/=	--
Explanatory comments	=	If incentives are set at appropriate level, reduction of cadmium input and hence risk to human health and the environment will be similar to regulatory limits. Some adverse economic impacts on producing countries, industry and/or farmers. Fragmentation of internal market and related administrative burdens unchanged – still need for Art. 114 TFEU requests for Member States wishing to set limits. Administrative burdens for developing and implement-ting all sub-options. Disadvantages for countries with phosphates of high cadmium content, otherwise coherent with neighbourhood and trade policies	Some reduction of new cadmium inputs into agricultural soils. Uncertain whether this will result in decrease of total soil cadmium and hence reduced exposure of humans via food or reduced exposure of soil organisms. Reduced fragmentation of internal market as only 3 limit values will be possible. No need for Art. 114 TFEU requests. Some negative economic impacts. Coherent with neighbourhood and trade policies.	Strong reduction of new cadmium input into soils and of soil cadmium accumulation. Reduction of exposure to humans via food of soil organisms. Eventually full harmonisation and no need for Article 114 TFEU requests. Some adverse economic impacts – in particular on producers not using the phosphoric acid route. Some structural disadvantages for third countries mining phosphates with high cadmium content, otherwise coherent with neighbourhood and trade policies.	Reduction of new cadmium inputs into soils and some reduction of soil cadmium accumulation. Consequently, some reduction of the exposure of humans via food and some reduction of exposure of soil organisms. Reduced fragmentation of Internal Marked as only 3 limit values possible. No need for Art. 114 TFEU requests, but more Member States would wish to opt for 60 compared to those opting for 40 mg or 20 mg in option 2. Some negative economic impacts. Incoherent with Art. 114 TFEU.

8. PREFERRED POLICY OPTION

From the comparison of the different options, it emerges that in the current situation where technically and economically viable decadmiation at industrial scale is not available, overall effectiveness and efficiency are better for option 3 compared to option 4 and even more so compared to option 5. This is due in particular to the reduced fragmentation of the internal market and lower administrative burdens for option 3, and not to better achievements of the objectives to reduce cadmium exposure for humans and the environment. In the absence of a decadmiation technology, both options 3 and 4 have only limited effects in achieving those objectives as, in the light of the SCTEE-2002 opinion, cadmium accumulation could actually still continue in most European agricultural soils unless lower limits are adopted. However, under the condition that a technically and economically viable decadmiation process becomes available at industrial scale, option 4 will be clearly preferable, as it would be the most effective in achieving all objectives.

It is not possible to estimate with confidence the effectiveness of option 2 in achieving the objectives because of the limitation of the economic model used to derive the level of the tax and the uncertainties of the parameters introduced in the model. However, this option would not result in a reduction of the fragmentation of the internal market and would increase significantly administrative burdens. Whilst it will provide an incentive to invest in decadmiation technologies it would also increase phosphate fertiliser prices.

It is therefore crucial in view of achieving all the intended objectives that the proposed new Regulation gives an incentive to invest in further developments of decadmiation technologies. This would be in line with the opinion of the SCTEE-2002 with regard to potential cadmium accumulation in soil and would respond to the desire of many stakeholders to achieve a further decrease of the cadmium content of phosphate fertilisers.

A new Regulation should therefore be adopted that would establish an EU limit value of 60 mg cadmium/kg P_2O_5 as a starting point. This limit would take effect after an appropriate transition period of e.g. 2 to 3 years. Flexibility should be given to allow Member States to set limit values at either 40 or 20 mg cadmium/kg P_2O_5 in the light of specific conditions in their territories. Fertilisers would be labelled to provide an indication which limit value for cadmium they comply with.

In order to provide incentives for further developments in decadmiation technologies and their implementation at industrial scale, different alternatives could be chosen:

– to include in the legislative proposal a clause triggering a review of the situation 5 to 10 years after the date of application of the 60 mg cadmium/kg P_2O_5 limit based on biannual reporting by manufacturers and importers of phosphates fertilisers on the efforts undertaken to develop a decadmiation process and on statistical data about the cadmium content of mineral phosphate fertilisers. The review should also address further developments in the supply situation for phosphates with low cadmium content and the availability of recycled phosphates;

or

– to set, in the legislative proposal, a timetable for implementation of lower limit values, e.g. 40 mg cadmium/kg P_2O_5 5 to 10 years after the date of application of the 60 mg/kg limit, and 20 mg cadmium/kg P_2O_5 after 15 to 20 years. The Commission would, nevertheless, need to monitor the actual development at industrial scale of a decadmiation process, the evolution of phosphate imports into the EU, and the availability of alternative phosphate sources through recycling to avoid shortages of supply of phosphates in the EU and/or disproportionate effects on phosphates exporting countries.

The selection of the incentive to be included in the final legislative text will be a political choice.

As mentioned in section 3.1, the SCHER-2015 opinion estimated that the current actual cadmium level in the environment justifies the revision of the CSTEE-2002 opinion and concluded that the accumulation of cadmium in soils is not expected to occur on average in most EU-27 + Norway soils if the concentration of cadmium in inorganic phosphate fertilisers does not exceed 80 mg/kg P_2O_5. In the SCTEE-2002 opinion, the same effect was achieved with a limit value of 20 mg cadmium/kg P_2O_5.

Despite the new assessment of future trends in soil cadmium accumulation, the conclusions of experts assessing the toxicology of cadmium through the food chain (See Section 3.1.1) remain valid i.e. that in order to protect human health from adverse effects of cadmium via dietary intake[63], it is important to decrease cadmium input into soils. Such reduction seems in light of the SCHER-2015 opinion more rapidly achievable than expected in 2002.

The overall approach would:

- achieve a reduction of new cadmium inputs to soils thereby reducing, in the long term, the presence of cadmium in the environment and in crops harvested in Europe and therefore the cadmium exposure of humans via food, depending on the actual development of technically and economically feasible decadmiation at industrial scale;
- achieve initially a rather harmonised internal market with an upper EU limit while allowing Member States to set with low administrative burdens one of two possible lower limits to reduce the cadmium content of phosphate fertilisers marketed in their territories proportionate to their specific conditions. Full harmonisation will be achieved when a technically and economically feasible decadmiation at industrial scale will be available;
- have limited and gradual economic impacts on phosphate producing countries, fertiliser manufacturers and farmers and on the economy as a whole;
- reduce the administrative burden for the Commission and the Member States as requests for derogation in accordance with Article 114 TFEU will not be necessary any longer.

9. MONITORING AND EVALUATION

The proposal, once adopted, is going to be implemented in close cooperation with all stakeholders concerned. To this end, the Committee and the Working Group on Fertilisers have provided for a valuable forum for the past and will be used in the future.

As long as a decadmiation technology is not available at industrial scale, Member States wishing to impose limits of 40 or 20 mg/kg P_2O_5, respectively, within their territories will notify those measures to the Commission accompanied by justification in terms of particular conditions. The Commission will make the information received from Member States publicly available, to increase awareness of operators and facilitate enforcement.

[63] As mentioned in section 3.7, food safety authorities are not able to implement today safe maximum levels of cadmium concentration in staple food as these limits take also into account the actual cadmium concentration currently present in the environment.

Under their obligations of market surveillance set in Regulation (EC) No 765/2008, Member States will have to collect data on cadmium limit values in phosphate fertilisers after implementation of this legislation through the determination of the cadmium content of phosphate fertilisers that are representative of their national markets. This information will be available from manufacturers and importers of phosphate fertilisers, who will have to determine the cadmium content of the fertilisers placed on the market in order to label them with the correct limit value that they comply with.

As one important objective of the proposal is to reduce exposure to cadmium through the food chain, the Commission should continue to request EFSA to periodically review new toxicological studies and/or the occurrence of cadmium in foodstuffs. However, as the residence time of cadmium into the soil is very long, effects of the adopted measure are not likely to emerge in the short term.

The Commission also intends to review the situation of the European market supply (recycling of organic waste and their cadmium content, better availability of low cadmium sedimentary rocks sources, better availability of phosphorous to plant roots leading to reduced application of phosphorous) and other parameters that affect the proposal (development of decadmiation technology).

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11. GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

- **AP** means ammonium phosphate (or triammonium phosphate). A substance which is used used as ingredient in some fertilisers as source of nitrogen and phosphorous.

- **Bioavailability** is the proportion of a substance capable of being absorbed by plants and available for use or storage.
- **B2M** stands for beta-2-microglobulin a low molecular weight protein recognised as useful bio-marker in relation with cadmium body burden.
- **Cadmium** is a heavy metal that is found as an environmental contaminant both from natural occurrence and from industrial sources. Food is the major source of exposure to cadmium for the non-smoking general population.
- **Cd-U** is the quantity of cadmium excreted in urine. It is often expressed in relation with a molecule totally excreted by the kidneys (creatinine).
- **COPA COGECA:** European farmers and agri-cooperatives association.
- **Decadmiation:** an industrial process by which cadmium could be removed from phosphoric acid. The two main processes that could be suitable for the fertiliser industry are described in Annex XII.
- **EC fertilisers:** fertilisers complying with the provisions of Regulation (EC) No 2003/2003.
- **EFBA:** European Fertilisers Blenders Association.
- **EFMA:** European Fertilisers Manufacturers Association. Recalled Fertilizers Europe as of 1 January 2010.
- **EU RAR:** EU Risk Assessment Report.
- **Eutrophication:** an increase in available nutrients or nutrient enrichment of a water body.
- **HEA:** Health and Environmental Alliance.
- **IFA:** International Fertiliser Industry Association.
- **IMPHOS:** the World Phosphate Institute represents six phosphate producing countries: Algeria, Jordan, Morocco, Senegal, Togo and Tunisia.
- **MAP and DAP:** monoammonium phosphate and diammonium phosphate respectively. Ammonium salts of phosphoric acid are those days the most largely used phosphate fertilisers.
- **mg cadmium/kg P_2O_5** is the way the cadmium content in phosphate fertilisers is expressed. 1 kg P is equivalent to 2.29 kg P_2O_5.
- **National fertilisers:** fertilisers complying with national rules.
- **NP, PK and NPK** are fertilisers having a declarable content of at least two of the primary nutrients (Nitrogen, Phosphorous and/or Potash). Whenever figures are mentioned, they indicate the content of each nutrient.
- **OCP:** Office Chérifien des Phosphate. A leading Moroccan company for the production of phosphate rocks and derivatives.
- **P_2O_5:** phosphorous oxide. A way to express the content of phosphorous in fertilisers.
- **Phosphate fertilisers:** fertilisers containing mineral phosphate fertilisers in amounts greater than 5 % P_2O_5 equivalent.

- **PEC:** Predicted Environmental concentration. This is the estimated concentration of a chemical in an environmental compartment calculated from available information on its properties, its use and discharge patterns and the quantities involved.
- **PNEC:** Predicted Non-Effect Concentration. It can be defined as the concentration below which a specified percentage of species in an ecosystem are expected to be protected or the content below the level of which soil function are not impaired by the effect of hazardous substance.
- **Reserve:** that part of the reserve base which could be economically extracted or produced at the time of determination.
- **Reserve base:** that part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness, and depth. The reserve base is the in-place demonstrated (measured plus indicated) resource from which reserves are estimated. It may encompass those parts of the resources that have a reasonable potential for becoming economically available within planning horizons beyond those that assume proven technology and current economics. The reserve base includes those resources that are currently economic (reserves), marginally economic (marginal reserves), and some of those that are currently subeconomic (subeconomic resources).
- **SCTEE:** Scientific Committee on Toxicity, Ecotoxicity and the Environment. One of the scientific committees managed by DG SANCO.
- **SCHER:** Scientific Committee on Health and Environmental Risks. The former SCTEE
- **Solubilisation:** to make or become a substance soluble or more soluble in water.
- **SSP and TSP:** single super phosphate and triple superphosphate respectively. The advantage of those fertilisers is their high phosphorous content.
- **Technical Guidance Document (TGD):** is the document issued in 1996 by the Institute for Health and Consumer Protection in support of Commission Directive 93/67/EEC on Risk Assessment for New Notified Substances and Commission Regulation (EC) No 1488/94 on Risk Assessment for Existing Substances.
- **Topsoil** is the upper, outermost layer of **SOIL**, usually the top 5 cm to 20 cm. It has the highest concentration of **ORGANIC MATTER** and **MICROORGANISMS** and is where most of the **EARTH**'s **BIOLOGICAL** soil activity occurs. **PLANTS** generally concentrate their **ROOTS** in and obtain most of their **NUTRIENTS** from this layer.
- **UNIFA, Assofertilizzanti and IVA** are respectively the French, Italian and German fertiliser producers associations.
- **Welfare loss:** A situation where marginal social benefit is not equal to marginal social cost and society does not achieve maximum utility.

ANNEX I: OUTCOME OF A MEMBER STATES AND INDUSTRY CONSULTATION ON LIMITS FOR CADMIUM IN NATIONAL PHOSPHATE FERTILISERS

Member State represented	*Maximum limits for cadmium in national fertilisers containing more than 5 % P_2O_5* *mg cadmium/kg P_2O_5*
Austria	75
Belgium	90
Czech Republic	50
Denmark	48
Finland	22
France	60
Germany	60
Poland	50
Hungary	20
Italy	50
Cyprus	60
Lithuania	60
Spain	60
Romania	60
Slovenia	60
Slovakia	20
Bulgaria	50
Greece	60
Sweden	44
Latvia	60

ANNEX II: SUMMARY OF MEMBER STATES AND INDUSTRY CONSULTATION ON THE OPTIONS PRESENTED AT THE WORKSHOP IN OCTOBER 2009[64]

Option 1	Option 3	Option 4a*	Option 4b*	Option 4c*	Option 5
OCP	*UK*	*IE*	*FR*	*SE*	
IMPHOS	*BG*	*FI*	*BE*	*HEA*[65]	
	RO	*LT*	*IT*		
	PT	*SI*	*SP*		
	PL[66]	*DK*[67]	*UNIFA*		
	CZ	*HU*	*Assofertillizzanti*		
	LV	*GR*			
	EE	*LU*			
		AT			
		DE			
		IVA			
		Copa Cogeca			

* **Option 4a:** Option 4 as proposed by the Commission in this Impact Assessment.

** **Option 4b:** Option 4 with a cadmium limit starting from 75 mg and decreasing to 60 mg after 3 years of entry into force of the proposal. Further reduction would be then dependent on the availability of a reliable and cost-effective decadmiation technology that would be suitable for fertiliser production.

*** **Option 4c:** Option 4 with a lower starting limit (40 mg).

64 *Nota bene*: Option 2 had not been discussed during the stakeholder consultation, as it was only included into the analysis after the first review of the draft impact assessment report by the Commission's Impact Assessment Board.

65 HEA suggested starting from 40 mg and decreasing rapidly to 20 mg. This proposal was supported by other NGOs like Greenpeace, the European Environmental Bureau and WWF.

66 Subject that the starting limit would be 75 ppm.

67 Subject to the condition that DK can maintain a lower national limit of 48 ppm.

ANNEX III: SUMMARY OF AN EARLIER INTERNET CONSULTATION ON LIMITS FOR CADMIUM IN PHOSPHATE FERTILISERS

In 2003, DG Enterprise and industry ran an Internet consultation on a first draft proposal relating to cadmium in fertilisers. This proposal introduced a phasing out approach with an initial limit for the cadmium content in phosphate fertilisers starting from 60 mg cadmium/kg P_2O_5 and decreasing stepwise to 40 and 20 mg cadmium/kg P_2O_5 over a period of 15 years during which decadmiation technology would have been introduced to supply the whole EU market with low cadmium-content phosphate fertilisers (*Nota bene*: this is very similar to option 4 examined in this impact assessment).

Stakeholders were invited to comment on the text of a Draft Proposal and on an accompanying impact assessment which were available on-line[68].

The EU fertiliser manufacturing industry replied that 60 mg would be the lowest limit that could be applied. A maximum limit of 90 mg was proposed by some stakeholders to be consistent with the provisions of Commission Regulation (EC) No 889/2008 of 5 September 2008[69] laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control.

Some replies suggested waiting for the completion of the European risk assessment report on cadmium oxide and cadmium metal. The final report of the EU RAR on cadmium was published in December 2007[70].

Many replies stated also that the proposal was not based on an adequate risk assessment and questioned the assumptions on which the proposal was based concerning cadmium input into agricultural soils. In particular questions were raised relating to the following issues:

- many experiments have shown that most phosphate fertilisers used for long periods did not increase crop cadmium concentration as these fertiliser treatments have not increased the bioavailability of cadmium;
- the validity and type of algorithm or model for soil accumulation used;
- the overall phosphate fertiliser consumption in the EU (the proposal mentioned 3.5 million tons per year, which was considered too high).

All replies concerning decadmiation possibilities pointed out that no decadmiation technology was yet implemented at industrial scale and that the related additional costs would therefore be uncertain but that they were probably considerably underestimated in the impact assessment of the proposal. Some of these replies also stressed that decadmiation could pose a risk to the environment due to the waste generated and the problem of its disposal.

All but two companies (KEMIRA in Finland and PHOSAGRO in Russia) argued that the impact on the EU industry and farmers as well as some high cadmium content sedimentary phosphate rock producing countries could be severe due to the creation of a quasi

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68 See: HTTP://EC.EUROPA.EU/ENTERPRISE/NEWSROOM/CF/DOCUMENT.CFM?ACTION=DISPLAY&DOC_ID=2968&USERSERVICE_ID=1&REQUEST.ID=0.

69 OJ L 250, 18.09.2008, p. 1.

70 European Union Risk Assessment Report on cadmium and cadmium oxide. Vol. 72 and 74. JRC Ispra (2007). HTTP://ECB.JRC.EC.EUROPA.EU/DOCUMENTS/EXISTING-CHEMICALS/RISK_ASSESSMENT/REPORT/CDOXIDEREPORT302.PDF

monopolistic position of the Russian producer of low cadmium igneous rock. Moreover, the nature of the Russian phosphate rock is not suitable for the production of simple and triple super-phosphates according to Amsterdam Fertiliser and OCP[71]. Several replies, and in particular those of two agricultural cooperatives, indicated that the farmers would not be able to bear the additional costs resulting from decadmiation.

[71] Office Chérifien des Phosphates.

ANNEX IV: SUMMARY OF THE SMEs CONSULTATION ON LIMITS FOR CADMIUM IN PHOSPHATE FERTILISERS

The Commission ran a SMEs consultation from 24 October 2009 to 11 January 2010 by using the European Enterprise Network. The purpose of the consultation was to receive information from industry on their estimated compliance costs from a potential Commission proposal setting limit values for cadmium in mineral phosphate fertilisers.

In addition to technical and scientific arguments regarding the contribution of phosphate fertilisers to cadmium exposure through the environment, the Commission intended to investigate the socio-economic consequences on EU SMEs from possible limits on cadmium content in phosphate fertilisers in order to identify the most proportionate and adequate course of action.

The questionnaire was divided into three sections asking SMEs to provide information on the company (section 1), their local market situation (section 2) and the possible impacts on business from possible harmonised limits on cadmium for phosphate fertilisers (section 3).

75 % of the participating companies declared less than 49 workers. 14 companies registered as mineral fertiliser retailers, 11 as mineral fertiliser producers, 4 as importers and 12 as being also active in the production of organic fertilisers and liming material. A majority of enterprises were present on their national markets and in neighbouring countries.

Price, value for money and the quality of service are currently the three main sales arguments. Human health and environmental concerns are regarded as less important.

In section 3 (economical impacts of cadmium limits on business), one of the questions put forward was about whether limit values of 60, 40 or 20 would have detrimental, neutral or beneficial consequences on business.

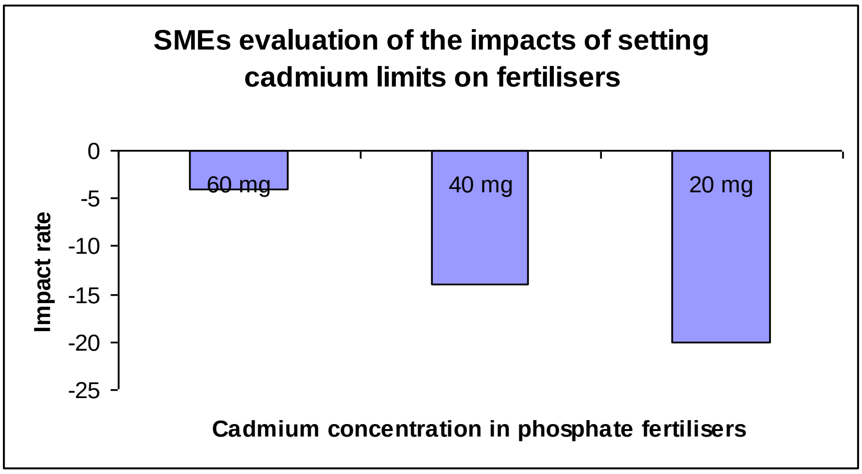
Companies located in countries already applying cadmium limits below 60 mg/kg P_2O_5 (Norway, Denmark) would have less difficulties to implement stricter limits. EU-10 companies worried more than EU-15 companies about the possible implementation of cadmium limits in phosphate fertilisers.

52 % of the respondents declared that they already suffered from a disruption in the supply of mineral fertilisers in the past. However, companies having less than 10 workers did not claim to have more difficulties than larger enterprises to be correctly supplied in phosphate fertilisers.

In general, SMEs producing only mineral fertilisers or having a wider portfolio (organic fertilisers, liming material) were most concerned about the possible negative impacts on the competitiveness of the sector from measures restricting the supply in phosphate fertilisers. Importers and retailers expressed less concerns about the possible economical impacts of the policy options.

Relatively few companies provided quantitative estimates of price increases if the limit value was set below 60 mg cadmium/kg P_2O_5 and these ranged from 0-220%. However, as no real justification was provided for these estimates, it has not been possible to make quantitative estimates for the entire sector.

The following figure provides the results of a semi-quantitative analysis determining an 'impact rate'[72] and shows that stringent limits are seen as potentially detrimental for the competitiveness of the sector.



<u>Summary of the SMEs Test</u>

(1) Consultation with SMEs representatives	See sections 2.3, as well as Annex IV.
(2) Preliminary assessment of businesses likely to be affected	See sections 2.3., as well as Annex IV.
(3) Measurement of the impact on SMEs	See sections 6.2, 6.3, 6.4, and 6.5 as well as Annex IV.
(4) Assess alternative options and mitigating measures	See sections 6.2, 6.3, 6.4, and 6.5.

72 The impact rate is the score achieved by rating the replies according to the following table and summing up the result:
Strongly beneficial: +2
Slightly beneficial: +1
No effect: 0
Slightly detrimental: -1
Strongly detrimental: -2
The maximum achievable impact rate for a total of 40 companies would therefore be ± 80.

ANNEX V: SUMMARY OF PREVIOUS RISK ASSESSMENTS ON CADMIUM

Environmental concerns caused by cadmium in fertilisers were raised at Community level during the negotiations for the accession of Austria, Finland and Sweden in 1995. The three Member States were granted temporary derogation from Community legislation on fertilisers pending a careful Community evaluation of the risks from cadmium in fertilisers.

In this context, the Commission first gathered all available data and information on the exposure situation. As not enough data was available in all Member States, the Commission mandated two studies to elaborate a methodology and procedures[73] with a view to assessing the risks to the environment from cadmium in fertilisers. Member States were subsequently invited to carry out nation-wide risk assessments by making use of the above methodology and procedures.

In 2000, eight Member States (plus Norway) submitted reports[74] in line with the agreed methodology. In each case, these assessments showed that soils and climatic conditions strongly affect the rate of soil cadmium accumulation. Those nine countries did not represent the whole EU – Mediterranean countries were not among them – nor did they address the actual risk to human health or the environment, focusing instead only on cadmium accumulation in soil.

In 2002, the Scientific Committee on Toxicity, Ecotoxicity and the Environment (SCTEE) was asked for its opinion[75] on the results of the reports submitted by those eight Member States (+ Norway) and in particular on the likelihood for slow build-up of cadmium in soils through the use of phosphate fertilisers. The SCTEE criticized the mass balance approach chosen by the consultant and used by the nine countries. The main uncertainty associated with this methodology was the estimation of leaching output which has never been confirmed in a real-world environment. This led to some significant variability in the prediction of the long-term soil accumulation sometimes leading to opposing trends. Nevertheless, the SCTEE estimated that despite the differences in values for input and output variables, the various assessments suggested some consistent trends: phosphate fertilisers containing 60 mg cadmium/kg P_2O_5 or above are expected to lead to cadmium accumulation in most European soils and application of 20 mg cadmium/kg P_2O_5 or less would lead to slow increase and even decrease of cadmium accumulation. A similar trend is expected for cadmium accumulation in crops although the actual increase is much smaller.

Moreover, the SCTEE was of the opinion that the derivation of a limit exclusively based on soil accumulation does not take into account the level of risk for human health and the environment associated with the current situation and considered that such a limit should be derived on a more solid risk assessment basis using a probabilistic approach and taking all cadmium sources into consideration.

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73 Environmental Resources Management (ERM), March 1999, contract No **ETD/98/501711** and (ERM), February 2000, contract No **ETD/99/502247**. HTTP://EC.EUROPA.EU/ENTERPRISE/SECTORS/CHEMICALS/DOCUMENTS/SPECIFIC-CHEMICALS/FERTILISERS/CADMIUM/RISK-ASSESSMENT_EN.HTM.

74 Available at: HTTP://EC.EUROPA.EU/ENTERPRISE/SECTORS/CHEMICALS/DOCUMENTS/SPECIFIC-CHEMICALS/FERTILISERS/CADMIUM/RISK-ASSESSMENT_EN.HTM#H2-%0A-RISK-ASSESSMENTS-FROM-THE-MEMBER-STATES%0A--------

75 Scientific Committee on toxicity, ecotoxicity and the environment (SCTEE) – Brussels, 24 September 2002. HTTP://EC.EUROPA.EU/HEALTH/PH_RISK/COMMITTEES/SCT/DOCUMENTS/OUT162_EN.PDF.

In 2004, the opinion of the SCTEE[76] was requested on the results of a first draft EU Risk Assessment Report on cadmium and cadmium oxide (EU RAR). In general, the SCTEE considered that the EU RAR contained satisfactory scientific information to assess the environmental benefit of potential risk management decisions but indicated that probabilistic assessment techniques would enhance the risk characterization and would provide improved insights and information for the risk management. This point was subsequently partly addressed in the revised EU RAR which based its approach on the use of 90th percentiles to introduce a probabilistic element in its assessment.

The lowest dose with observed adverse effects (LOAEL[77]) proposed in the EU RAR for urinary cadmium concentration (Cd-U) is 2 µg cadmium/g creatinine because it has been demonstrated in several studies that this limit is predictive of the age related decline of the kidney filtration rate. However, the SCTEE[78] considered that the proposed LOAEL (Cd-U) of 2 µg Cd/g creatinine is uncertain and not sufficiently conservative.

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76 Scientific Committee on toxicity, ecotoxicity and the environment (SCTEE) – Brussels, 28 May 2004. HTTP://EC.EUROPA.EU/HEALTH/PH_RISK/COMMITTEES/SCT/DOCUMENTS/OUT228_EN.PDF.

77 Lowest Observed Adverse Effect Limit.

78 Scientific Committee on toxicity, ecotoxicity and the environment (SCTEE) – Brussels, 8 January and 28 May 2004. (HTTP://EC.EUROPA.EU/HEALTH/PH_RISK/COMMITTEES/SCT/DOCUMENTS/OUT228_EN.PDF, HTTP://EC.EUROPA.EU/HEALTH/PH_RISK/COMMITTEES/SCT/DOCUMENTS/OUT220_EN.PDF.

ANNEX VI: COMPARISON OF CADMIUM TOLERABLE INTAKES MADE BY EFSA, JECFA AND EU-RAR

Parameter	**EFSA (Issued in 2009)**	**JECFA (Issued in 2010)**	**EU- RAR (Issued in 2007)**	**Comment**
Criterion for the threshold of toxicological concern (effects assessment)	5 % incidence of elevated Beta-2-microglobulin in the sub-population aged >50 years compared with whole population	Any increase in the mean Beta-2-microglobulin level for individuals who were 50 years or older	Elevated levels of low MW proteins in urine	The studies do not give the 'normal' value of the biomarker. It is not known if EFSA and JEFCA take the same value for B2M
Urinary Cd concentration corresponding to the threshold of concern	4 µg Cd/g creatinine	5.24 µg Cd/g creatinine	2 µg Cd/g creatinine	
Adjustment factors applied to above value	3.9 (for inter-individual variations in creatinine/B2M correlation)	None – confidence interval 4.94-5.57	NOAEL=LOAEL/3	
Max safe Cd level in urine	1 µg Cd/g creatinine	5.24 µg Cd/g creatinine	0.66 µg Cd/g creatinine	
Criterion for calculating dietary intake needed for max safe urine level	Safeguard 95th percentile of the non-smoking population after 50 years exposure	Safeguard 95th percentile of the whole population	Safeguard 95th percentile of the non-smoking population after 53 years exposure	JEFCA do not mention the smoker/non-smoker issue
Tolerable intake	2.5 µg Cd/kg body weight/**week**	25 µg Cd/kg body weight/**month**	0.67 µg Cd/kg body weight/**day**	
Tolerable monthly intake (TMI)	**10µg** Cd/kg body weight	**25 µg** Cd/kg body weight	**21 µg** Cd/kg body weight	
Monthly dietary exposure	≥ 10 µg Cd/kg body weight. Mean value for adults, subgroups may be twice as high	No JEFCA assessment, but JEFCA claims that no exposure estimate exceeds 25 µg Cd/kg body weight, even for sensitive groups	4.6-8.5 µg Cd/kg body weight (Norway) 9.3-12 µg Cd/kg body weight (Belgium) 8.9-11.2µg Cd/kg body weight (Italy). Mean values for adults	Additional study from Germany (published in 2010): mean values for adults: 6.0-7.2 µg Cd/kg body weight high consumption groups (teenagers and vegetarians): 12.5-15.0 µg Cd/kg body weight

ANNEX VII: RELATIVE CONTRIBUTION OF VARIOUS SOURCES TO TOTAL CADMIUM INPUT IN SOIL FOR VARIOUS MEMBER STATES

(Source: Environmental and Human Health Risk Reduction Strategy-Cd metal and Cd oxide. Addendum to report of March 2006.04/09307/KDV-April 2007)

		Total Cd input *g Cd/ha/yr*	*Relative contribution of various sources to total cadmium input in soil*					
			Atmospheric deposition	*Phosphate fertiliser*	*Manure*	*Sewage sludge*	*Lime*	*Other organic wastes*
Austria	Arable land	3,43	61,22 %	22,94 %	13,50 %	1,17 %		1,17 %
	Grassland	3,353	62,63 %	10,44 %	24,55 %	1,19 %		1,19 %
Belgium	Region 1	3,89	38,56 %	27,25 %	33,93 %	0,26 %		
	Region 2	6,04	60,43 %	17,55 %	21,85 %	0,17 %		
	Region 3	38,89	93,85 %	2,73 %	3,39 %	0,03 %		
Czech Republic		1,66	78,31 %	15,66 %	6,02 %			
Denmark	Cereals	4,144	9,89 %	33,59 %	11,78 %	34,99 %	9,65 %	0,10 %
	Root crop	3,552	11,54 %	22,52 %	13,74 %	40,82 %	11,26 %	0,11 %
	Grassland	3,448	11,89 %	20,19 %	14,15 %	42,05 %	11,60 %	0,12 %
Finland		0,605	33,06 %	4,13 %	53,22 %		5,79 %	3,80 %
France		5,35	31,78 %	68,22 %				
Germany		7,94	21,41 %	70,53 %	8,06 %			
Greece	Kopaida	0,971	3,19 %	82,39 %	4,12 %		10,30 %	
	Koropi	0,955	4,71 %	73,30 %	9,42 %		12,57 %	
	Thessaloniki	0,981	4,18 %	71,36 %	14,27 %		10,19 %	
	Lorissa	0,771	4,02 %	64,85 %	18,16 %		12,97 %	
	Biotia	1,324	3,32 %	86,10 %	3,02 %		7,55 %	
	Chalkidiki	0,59	6,78 %	74,58 %	1,69 %		16,95 %	
	Biotia-Kopaida	0,721	4,30 %	83,22 %	5,55 %		6,93 %	
Ireland		4,0747	36,81 %	40,98 %	22,09 %	0,12 %		
Sweden	Min	0,96	67,71 %	27,08 %	5,21 %			
	Max	1,47	44,22 %	52,38 %	3,40 %			
UK		3,98	45,23 %	54,77 %				
Norway	Min	0,88	56,82 %	13,64 %	4,55 %	22,73 %	2,27 %	
	Max	0,97	51,55 %	21,65 %	4,12 %	20,62 %	2,06 %	

ANNEX VIII: LIST OF EU LEGISLATION DEALING WITH CADMIUM

Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs	OJ L 364, 20.12.2006, p. 5-24
Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment	OJ L 37, 13.02.2003, p. 19-23
Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of-life vehicles	OJ L 269, 21.10.2000
Council Directive 86/278/EEC of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture	OJ L 181, 4.07.1986, p. 6
Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy	OJ L 348, 24.12.2008, p. 84-97
Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy	OJ L 327, 22.12.2000
Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators	OJ L 266, 26.09.2006, p. 1-14
European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste	OJ L 365, 31.12.1994, p. 10-23
Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption	OJ L 330, 5.12.1998, p. 32-54
Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration	OJ L 372, 27.12.2006, p. 19-31
Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste	OJ L 332, 28.12.2000, p. 91-111
Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control	OJ L 24, 29.01.2008, p. 8-29
Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). Annex XVII	OJ L 396, 30.12.2006, p. 1-849
Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe	OJ L 152, 11.06.2008, p. 1-44

ANNEX IX: CADMIUM CONTENT IN PHOSPHATE ROCK (MG CD/KG P_2O_5)

Origin	Davister, 1996	Oosterhuis et al, 2000
Igneous rock		
Russia (Kola)	< 13	0,25
Russia (Pharlaborwa)	< 13	0,38
Sedimentary rock		
USA (Florida)	23	24
Jordan	> 30	18
Morocco (Khouribga)	46	55
Syria	52	22
Algeria	60	
Egypt	74	
Morocco (Boucraa)	100	97
Israel	100	61
Morocco (Youssoufia)	121	120
Tunisia (Gafsa)	137	173
Togo	162	147
USA (North Carolina)	166	120
Senegal (Taiba)	203	221

ANNEX X: CADMIUM CONTENT IN CERTAIN FERTILISER TYPES

Trace elements concentration in Triple Superphosphate (TSP). The cadmium concentration is expressed as mg per kg P_2O_5 whereas the concentration of the other elements is expressed in relation to the dry mass of fertilisers. (Source IMPHOS)

			Elements (in mg cadmium/ kg P_2O_5)					
Country	**Deposit**	**P205(%wt)**	**As**	**Cd**	**Cr**	Hg	Ni	Pb
Sediment deposits								
Algeria	Djebel Onk Djebel Onk	28,8 27,9	7,4	53,2 29,3	285,7	0,3		2,3
Australia		28,8	23,0	9,9	57,5	0,1		7,7
Burkina Fasso		25,4	11,2	5,4	54,0	0,2		1,7
China	?	31,1	39,5	5,5	50,2	7,6		1,4
	Kaiyang	35,9	11,9	3,8	23,7	0,3		3,7
Colombia	Media Luna Sardinalia	30,1 36,2		20,3 29,1				
Egypt	Abu Tartur	29,9	55,4	13,0	39,5	0,1		14,1
	Hamrawen	22,2	55,4	46,0	370,6	0,2		1,0
	West Makamid	26,5	10,7	15,4	133,8	0,2		12,5
India	Mussoorie Rajasthan	25,0 36,7	149,4	21,8 1,9	105,9	3,2		22,2
Israel	Arad	32,4	8,0	30,0	189,7	0,2	58,4	1,4
	Zin	**31,1**	15,2	67,4		0,3		3,6
	Oron	33,6	11,3	10,1	150,6	0,2		0,7
	?	32,8		50,2	327,3			3,4
Jordan	El Hasa Ruseife	32,4 30,8	11,7 16,9	11,3	134,3 353,1	0,1	24,8	1,4
	Shidyia	30,5	14,0	13,4	76,0	0,1		1,5
Mali		28,8	18,1	18,9	37,8	0,0		15,4
Morocco	Boucraa	35,1		72,7			25,6	
	Khourbiga	32,6	19,4	31,5	290,1	1,2	46,4	6,8
	Youssoufia	32,1	13,6	61,9	374,2	0,2		9,7
	?	32,4	17,8	54,6	407,2	0,1		
Nauru		37,5	3,8	154,6				
Niger		34,3	5,5	7,9	67,6	0,1		5,2
Peru		30,1	20,9	56,5	201,1	0,2		8,8
Senegal		35,9	22,9	164,3	184,4	0,4	69,8	3,7
Syria		31,9	5,9	6,4	155,6	0,0	37,1	2,1
Tanzania		28,6	13,2	2,4	26,5	0,1		1,6
Togo		36,7	12,9	108,3	130,1	0,5	45,1	4,8
Tunisia		29,3	7,3	139,3	232,4	0,2	25,8	3,0
USA	Central Florida	31,9	16,8	19,4	88,9	0,3	59,3	11,8
	North Florida	31,2	10,6	13,3	98,5		33,3	8,5
	North Carolina	29,9	17,7	86,9	249,9	0,4		5,9
	Idaho	31,7	35,4	198,1	950,2	0,4	126,8	8,4
Venezuela		27,9	6,8	9,8	55,9	0,1		1,6
Mean		**31,2**	**20,0**	**45,4**	**195,5**	**0,6**	**53,0**	**5,7**
Igneous deposits								
South Africa		38,2	16,1	2,3	1,2		43,3	6,4
Brazil	Araxa	37,0	22,4	4,6	38,3	0,1		13,2
	Catalão	37,4	19,0	3,6	45,5	0,1		17,2
Burundi		40,4	2,3	3,4	36,3	0,0		5,5
Finland		39,5	3,6	3,4	16,8	0,0		2,2
Uganda		38,6	4,9	1,8	13,5	0,0		20,7
Russia	Kola	35,9	13,2	2,3			2,6	20,4
Sri Lanka		36,4	34,7	4,1	129,9	0,3		7,3
Sweden	Grangesburg	37,8	469,1	1,8	25,0	0,1		11,7
	Kjiruna	37,2	945,7	0,0		0,2		6,0
Zimbabwe		33,1	8,6	2,1	14,3	0,1		4,0
Mean		**37,4**	**153,0**	**2,7**	**34,1**	**0,1**		**8,9**

Trace elements in Mono Ammoniumphosphate (MAP). The cadmium concentration is expressed as mg per kg P_2O_5 whereas the concentration of the other elements is expressed in relation to the dry mass of fertilisers. (Source IMPHOS)

			Elements (in mg cadmium/ kg P_2O_5)					
Country	**Deposit**	**P205(%wt)**	**As**	**Cd**	**Cr**	**Hg**	**Ni**	**Pb**
Sediment deposits								
Algeria	Djebel Onk Djebel Onk	28,8 27,9	8,6	51,6 28,4	334,3	0,4		1,5
Australia		28,8	26,9	9,6	67,2	0,2		5,1
Burkina Fasso		25,4	13,1	5,2	63,2	0,2		1,1
China	?	31,1	46,3	5,3	58,7	8,9		0,9
	Kaiyang	35,9	13,9	3,7	27,7	0,3		2,4
Colombia	Media Luna Sardinalia	30,1 36,2		19,8 28,3				
Egypt	Abu Tartur	29,9	64,8	12,6	46,3	0,1		9,3
	Hamrawen	22,2	64,8	44,6	433,7	0,2		0,7
	West Makamid	26,5	12,5	15,0	156,6	0,2		8,2
India	Mussoorie Rajasthan	25,0 36,7	174,8	21,1 1,8	123,9	3,7		14,6
Israel	Arad	32,4	9,4	29,2	222,0	0,2	68,3	0,9
	Zin	31,1	17,8	65,4		0,4		2,3
	Oron	33,6	13,2	9,8	176,2	0,2		0,4
	?	32,8		48,8	382,9			2,2
Jordan	El Hasa Ruseifa	32,4 30,8	13,7 19,8	11,0	157,1 413,2	0,1	29,0	0,9
	Shidyia	30,5	16,3	13,0	88,9	0,1		1,0
Mali		28,8	21,1	18,4	44,2	0,1		10,1
Morocco	Boucraa	35,1		70,6			29,9	
	Khourbiga	32,6	22,7	30,6	339,4	1,5	54,3	4,5
	Youssoufîa	32,1	15,9	60,1	437,8	0,2		6,4
	?	32,4	20,8	53,0	476,4	0,1		
Nauru		37,5	4,4	150,1				
Niger		34,3	6,5	7,7	79,0	0,2		3,4
Peru		30,1	24,4	54,9	235,3	0,2		5,8
Senegal		35,9	26,8	159,6	215,8	0,4	81,7	2,4
Syria		31,9	6,9	6,2	182,1	0,1	43,4	1,4
Tanzania		28,6	15,5	2,3	31,0	0,1		1,0
Togo		36,7	15,1	105,1	152,3	0,5	52,8	3,2
Tunisia		29,3	8,5	135,3	271,9	0,2	30,2	2,0
USA	Central Florida	31,9	19,6	18,8	104,1	0,3	69,4	7,8
	North Florida	31,2	12,4	12,9	115,3		39,0	5,6
	North Carolina	29,9	20,7	84,4	292,4	0,4		3,9
	Idaho	31,7	41,4	192,4	1111,8	0,5	148,4	5,5
Venezuela		27,9	7,9	9,5	65,4	0,1		1,0
Mean		**31,2**	**23,4**	**44,1**	**228,8**	**0,7**	**62,1**	**3,7**
Igneous deposits								
South Africa		38,2	18,8	2,2	1,4		50,7	4,2
Brazil	Araxa	37,0	26,2	4,5	44,9	0,2		8,7
	Catalão	37,4	??,2	3,5	53,3	0,1		11,3
Burundi		40,4	2,7	3,3	42,5	0,0		3,6
Finland		39,5	4,2	3,3	19,6	0,1		1,5
Uganda		38,6	5,7	1,7	15,8	0,1		13,6
Russia	Kola	35,9	15,4	2,2			3,1	13,4
Sri Lanka		36,4	40,6	4,0	152,0	0,4		4,8
Sweden	Grangesburg	37,8	548,9	1,7	29,3	0,1		7,7
	Kjiruna	37,2	1106,6	0,0		0,2		3,9
Zimbabwe		33,1	10,0	2,0	16,7	0,1		2,6
Mean		**37,4**	**179,0**	**2,7**	**39,9**	**0,1**		**5,8**

Trace elements concentrations in Diammonium Phosphate (DAP). The cadmium concentration is expressed as mg per kg P_2O_5 whereas the concentration of the other elements is expressed in relation to the dry mass of fertilisers. (Source IMPHOS)

			Elements (in mg cadmium/ kg P_2O_5)					
Country	**Deposit**	**P205(%wt)**	**As**	**Cd**	**Cr**	**Hg**	**Ni**	**Pb**
Sediment deposits								
Algeria	Djebel Onk Djebel Onk	28,8 27,9	7,3	49,7 27,4	280,6	0,31		1,3
Australia		28,8	22,6	9,3	56,4	0,13		4,2
Burkina Fasso		25,4	11,0	5,0	53,0	0,16		1,0
China	?	31,1	38,8	5,1	49,3	7,45		0,8
	Kaiyang	35,9	11,6	3,5	23,3	0,27		2,0
Colombia	Media Luna Sardinalia	30,1 36,2		19,0 27,3				
Egypt	Abu Tartur	29,9	54,4	12,1	38,8	0,12		7,8
	Hamrawen	22,2	54,4	43,0	364,0	0,17		0,6
	West Makamid	26,5	10,5	14,4	131,4	0,16		6,9
India	Mussoorie Rajasthan	25,0 36,7	146,7	20,4 1,7	104,0	3,10		12,2
Israel	Arad	32,4	7,9	28,1	186,3	0,19	57,3	0,8
	2n	31,1	14,9	63,1		0,30		2,0
	Oron	33,6	11,1	9,5	147,9	0,18		0,4
	?	32,8		47,0	321,4			1,9
Jordan	El Hasa Ruseife	32,4 30,8	11,5 16,6	10,6	131,9 346,8	0,07	24,4	0,8
	Shidyia	30,5	13,7	12,5	74,6	0,08		0,8
Mali		28,8	17,7	17,7	37,1	0,05		8,5
Morocco	Boucraa	35,1		68,0			25,1	
	Khourbiga	32,6	19,1	29,5	284,9	1,22	45,6	3,7
	Youssoufia	32,1	13,3	57,9	367,4	0,17		5,3
	?	32,4	17,5	51,1	399,9	0,09		
Nauru		37,5	3,7	144,7				
Niger		34,3	5,4	7,4	66,3	0,14		2,9
Peru		30,1	20,5	52,9	197,5	0,19		4,9
Senegal		35,9	22,5	153,8	181,1	0,35	68,6	2,0
Syria		31,9	5,8	6,0	152,8	0,04	36,4	1,1
Tanzania		28,6	13,0	2,2	26,0	0,06		0,9
Togo		36,7	12,7	101,3	127,8	0,46	44,3	2,7
Tunisia		29,3	7,1	130,4	228,2	0,16	25,4	1,7
USA	Central Florida	31,9	16,4	18,2	87,3	0,29	58,2	6,5
	North Florida	31,2	10,4	12,4	96,7		32,7	4,7
	North Carolina	29,9	17,4	81,3	245,4	0,36		3,3
	Idaho	31,7	34,7	185,4	933,1	0,42	124,5	4,6
Venezuela		27,9	6,7	9,1	54,9	0,10		0,9
Mean		**31,2**	**19,6**	**42,4**	**192,0**	**0,57**	**52,1**	**3,1**
Igneous deposits								
South Africa		38,2	15,8	2,2	1,2		42,5	3,5
Brazil	Araxa	37,0	22,0	4,3	37,7	0,14		7,3
	Catalão	37,4	18,6	3,4	44,7	0,05		9,5
Burundi		40,4	2,3	3,2	35,6	0,02		3,0
Finland		39,5	3,5	3,2	16,5	0,05		1,2
Uganda		38,6	4,8	1,6	13,2	0,05		11,4
Russia	Kola	35,9	12,9	2,1			2,6	11,2
Sri Lanka		36,4	34,1	3,8	127,6	0,32		4,0
Sweden	Grangesburg	37,8	460,7	1,7	24,6	0,07		6,5
	Kjiruna	37,2	928,7	0,0		0,19		3,3
Zimbabwe		33,1	8,4	1,9	14,0	0,06		2,2
Mean		**37,4**	150,2	**2,6**	33,5	0,07		4,9

ANNEX XI: GLOBAL PHOSPHATES PRODUCTION AND RESERVES

World production of phosphate rock[79] in 2005 *(Source US Geological Survey)*

Country	Production (10^6 kg)	World share (%)
United States	36 300	24,69
China	30 400	20,68
Morocco	25 200	17,14
Russia	11 000	7,48
Tunisia	8 000	5,44
Jordan	6 230	4,24
Brasil	6 100	4,15
Syria	3 500	2,38
Israel	2 900	1,97
Egypt	2 730	1,86
South Africa	2 577	1,75
Australia	2 050	1,39
Senegal	1 520	1,03
Togo	1 215	0,83
India	1 200	0,82
Canada	1 000	0,68
Algeria	878	0,60
Finland	825	0,56
Others	3 396	2,31
Total	147 021	100

79 The P_2O_5 content varies with the origin of the rock.

World phosphate rock reserves and reserves base *(Source: US Geological Survey 2007 and 2008)*

	Mean grade (wt % P_2O_5)	**Mine production 2005 (1 000 tons)**	**Mine production 2006 (1 000 tons)**	**Reserves[80] (1 000 tons)**	**Reserve base[81] (1 000 tons)**
United States of America	31,2	36 300	30 100	1 200 000	3 400 000
Australia	31,2	2 050	2 300	77 000	1 200 000
Brazil	35 to 38	6 100	5 800	260 000	370 000
Canada	37,5	1 000	550	25 000	200 000
China	35,9	30 400	30 700	6 600 000	13 000 000
Israel	32,5	2 900	2 200	180 000	800 000
Syria	31,9	3 500	3 850	100 00	800 000
Jordan	31,2	6 230	5 870	900 000	1 700 000
Egypt	26,2	2 730	2 200	100 000	760 000
Morocco	32,2	25 200	27 000	5 700 000	21 000 000
Senegal	35,9	1 520	600	50 000	160 000
South Africa	36 to 40	2 580	2 600	1 500 000	2 500 000
Togo	36,7	1 220	1 000	30 000	60 000
Tunisia	30	8 000	8 000	100 000	600 000
Russian Federation	39 to 40	11 000	11 000	200 000	1 000 000
Other countries		6 500	7 740	890 000	2 200 000
World total		147 000	142 000	18 000 000	50 000 000

80 Assuming a production cost of USD 36/ton.
81 Assuming a production cost of USD 90/ton.

ANNEX XII: DECADMIATION PROCESSES

The CERPHOS (Centre d'Etudes et de Recherches des Phosphates Minéraux) and a Dutch start-up[82] have developed on laboratory scale two decadmiation processes that could be suitable and economically viable for the fertilisers industry. The feasibility of both processes has not yet been demonstrated at industrial scale and the environmental and economic aspects will have to be carefully investigated when they will be available.

- The CERPHOS process[83] (co-crystallisation):

This co-crystallisation process is based on the addition of sulphate ions in the form of gypsum to the diluted phosphoric acid before a concentration step. The following crystallisation is influenced by many impurities and must be adjusted to the phosphate rock processed. The removal of cadmium requires a temperature between 80 °C to 100 °C and takes place at a phosphoric acid concentration above 56.6 % P_2O_5. A purity level of 87 % could be achieved (corresponding to a reduction from 75 to 10 mg Cd/kg P_2O_5) but requires investment costs of around USD 4.56 million. In 2007, CERPHOS estimated that the increase in DAP fertiliser prices is expected at around USD 30/ton P_2O_5 if this process is introduced. The process generates also an important amount of cadmium salts that must be disposed of and the post-treatment of those salts should have an important impact on the final costs. The figures will have to be refined by CERPHOS when data from a pilot plant – the construction of which remains uncertain – will be available.

- The ELICAD process:

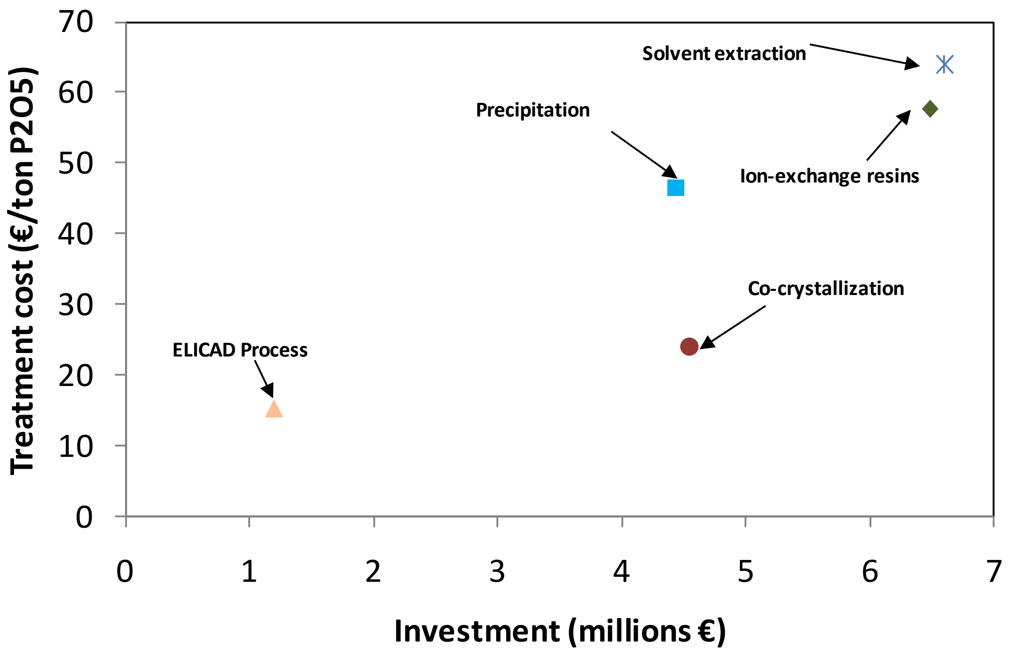
This process would eliminate cadmium from a continuous flow of phosphoric acid by a selective adsorption of cadmium on an active material. When this material is saturated, it can be regenerated five times by a physico-chemical treatment. The process allows also the removal of other heavy metals like arsenic, mercury, nickel, copper, zinc, vanadium, chromium and lead and most probably uranium. The investment costs should be below EUR 1.2 million for an installation treating 1200 tons of phosphoric acid per day. Fertiliser price increase from the use of this technology would be around EUR 12 to 32/ton P_2O_5 (figures from 2009) for a 90 % effectiveness. The figures need to be refined when data from a pilot plant will be available. This was expected by mid 2010, however no project for constructing a pilot plant found the necessary funding and it is uncertain when this will happen. The objective of the Dutch start-up is to make the process eventually available to fertilisers and mining companies.

Compared to other decadmiation processes, the ELICAD process would be more cost effective as illustrated in the following figure.

[82] INOS: Innovative Engineering System.

[83] Promoting the development and semi-industrial application of a potentially high performing process for removing cadmium from phosphoric acid. CERPHOS issue paper to OECD Cd Workshop – Stockholm 1995.

Costs estimations of different decadmiation processes (Source INOS).



Based on the potential cost increases from the use of the ELICAD process, the increase in mineral phosphate fertilisers prices has been estimated by IFA as presented in the following table. Further calculations conducted by the Commission are contained in Annex XIV.

Potential increase in price for several phosphate fertiliser types from Morocco related to the implementation of a decadmiation process (Source: IFA)

Fertiliser name	**Decadmiation costs of phosphoric acid** **EUR/t P_2O_5**	**Fertiliser prices in September 2009** **EUR/t fertiliser**	**Average price increase if the ELICAD process is introduced** **EUR/t fertiliser**	**Average percentage increase in fertiliser price if the ELICAD process is introduced** ***%***
DAP	0	**305**	-	*0,0*
Diammonium phosphate	12 (= USD 15)	311,5	6,5	*2,2*
	32 (= USD 40)	324,5	19,5	*6,4*
MAP	0	**283**	-	*0,0*
Monoammonium phosphate	12 (= USD 15)	289,7	6,7	*2,4*
	32 (= USD 40)	303	20	*7,1*
TSP	0	**242**	-	*0,0*
Triple superphosphate	12 (= USD 15)	247,1	5,1	*2,1*
	32 (= USD 40)	257	15	*6,2*

As worldwide demand for cadmium metal is decreasing due to growing restrictions on its use, it will most likely not be possible to sell the recycled cadmium metal in order to reduce costs. Therefore, there is little incentive to recover cadmium at all and the initial residues will have to be disposed of which will create risks of inappropriate disposal and contamination of the environment in producing countries. However, the capture and possible recovery of several other heavy metals in the ELICAD process would allow a reduction of the costs for the treatment of the saturated product and its final destruction.

Currently, 130 million tons of phosphogypsum are produced each year worldwide as by-product of the production of phosphoric acid. The costs for treatment and management of phosphogypsum reach up to EUR 5/ton. The introduction of a decadmiation technology could partly reduce this volume and make phosphogypsum more available as raw material product for construction. The management of the cadmium-rich waste generated by the decadmiation process would need to be properly addressed to avoid environmental pollution.

ANNEX XIII: CURRENT SUPPLY OF THE EU IN PHOSPHATE FERTILISERS

In the EU, phosphorous is supplied to agricultural land either by mineral fertilisers (natural rock phosphate, superphosphates and NPK mixtures) or by organic fertilisers (mostly animal manure and slurry as well as to a lesser extent, sludge and bio-waste).

The rationale for phosphorous application is to maintain soil phosphorous concentration in readily available soil reserves sufficiently high to ensure a correct crop yield. This is achieved by replacing the quantity of phosphorous that is removed from soil in the harvested crops (maintenance and replacement application). At farm level, an analysis of soil samples is conducted every 4 or 5 years to determine the needs in fertilisers for a particular crop.

In European agriculture, environmental concerns related to the use of phosphate fertilisers (eutrophication in surface and marine waters as a consequence of run-off of phosphates from agricultural land) and a better understanding of the plant nutrition mechanisms have allowed a substantial decrease in the consumption of phosphate fertiliser in recent years.

For example, the French fertiliser manufacturers association has reported on average a strong decrease in the consumption of chemically processed phosphate fertilisers since 1972 from 72 kg P_2O_5/ha/year to approximately 23 kg P_2O_5/ha/year for the growing season 2007-2008.

1. Mineral fertilisers

The worldwide primary market for phosphate rock derivatives is agriculture (79 %) followed by animal feeds (11 %), detergents (7 %) and specific applications (3 %). Mined phosphate rock is not commonly used directly as fertiliser because the solubility of the phosphate in the rock is rather low. In order to increase the bioavailability of rock phosphate on neutral and alkaline soils, phosphate fertilisers are manufactured from the rock by dissolution in acid and subsequent precipitation. In the past, phosphate rock was imported into the EU for conversion to fertilisers but producing countries now generally prefer to export either the phosphoric acid intermediate product or even the finished fertiliser (mainly in the form of ammonium phosphate) which offers significant technical and economic advantages. This trend is likely to continue for all producing countries.

Currently, only one European fertiliser producer can be supplied with igneous rocks from Finland and Russia at affordable price as Russia prefer to export to the high added value feed supplements market. All others rely mainly on the sedimentary rocks, the phosphoric acid or the final products coming from North Africa to produce phosphate fertiliser. The current cadmium content of the most largely used phosphate fertilisers are described in Annex X in relation to their origin.

Morocco and China hold the most important phosphate reserves in the world (See Annex XI).

Jordan, Syria and Egypt have substantial reserves of sedimentary phosphate rock of low cadmium content (1.7 Gt, 0.8 Gt and 0.75 Gt respectively – US Geological Survey Minerals Yearbook 2000) but their phosphate fertiliser production capacity is limited and can not cover all the EU farmers needs in the short term. EU organic farmers needs could however be covered, but the Jordan and Syrian ores are very dusty and some European ports have already banned their unloading in bulk shipments.

Current world reserves of phosphate rocks are estimated to last 100 years (at current consumption and production costs) but this could be extended to more than 300 years if proven phosphate deposits become economically viable in the future. (See Annex XI). Large phosphate resources have been identified on the continental shelves and on seamounts in the

Atlantic Ocean and the Pacific Ocean, but cannot be recycled economically with current technology.

2. Other sources of nutrient phosphorous

Organic fertilisers are another source of phosphorous supply. However, whilst mineral fertilisers (with the exception of natural ground phosphate) are readily available for plants, only a fraction of the phosphates in organic materials can be assimilated by crops (See table). The organically bound phosphorous mineralises slowly through the activity of soil microorganisms and becomes thereby available for plants.

Indicative phosphate levels and the relative distribution of mineral phosphorous and organically bound phosphorous in different organic wastes in relation to the mineral fertiliser TSP (triple superphosphate). (Source Alterra report 991, 2004)

Manure Type	Total phosphate content (kg P_2O_5 ton^{-1})	Mineral Phosphorous. Readily available for plants (% on mass)	Organic Phosphorous. Slowly available for plants (% on mass)
Solid cattle manure	3,3	60	40
Cattle slurry	1,5	90	10
Chicken slurry	6,7	80	20
Fixed pig slurry	11,8	85	15
Pig slurry	2,6	95	5
Compost	4,4	70	30
Urban sludge[84]	1,8	50	50
Garden turf	0,6	20	80
Triple superphosphate (TSP)	460	100	0

The amount of phosphorous mineralised (and hence bioavailable) show great variability and depend not only on climatic conditions, storage, handling but also on the farming system and the nature of the soil.

3. Cadmium content in various organic waste

The next table shows the average cadmium content in different organic wastes in 13 Member States.

Cadmium content in different organic wastes (mg cadmium/kg P_2O_5) (Source: Annex to the Report from the Commission to the Council and the European Parliament on the implementation of community waste legislation – Directive 75/442/EEC on waste, Directive 91/689/EEC on hazardous waste, Directive 75/439/EEC on waste oils, Directive 86/278/EEC

[84] According to data provided by UNIFA.

on sewage sludge and Directive 94/62/EC on packaging and packaging waste, Directive 1999/31/EC on the landfill of waste – for the period 2001-2003 {COM(2006) 406 final) SEC(2006)972)

Compost	25
Cattle manure	11
Pig manure	10
Sewage sludge	23

Despite its low cadmium concentration, urban sludge is often applied in such quantities that the annual cadmium input to the soil might exceed the cadmium input from the use of mineral phosphate fertilisers as illustrated in the following example from Belgium. In 2006, farmers in the Walloon Region have applied on average 4 tons of urban sludge per hectare containing on average 1.5 mg cadmium/kg dry matter. This means an average annual input of 6 g cadmium per hectare. In comparison the average annual input from the application of phosphate fertiliser containing 60 mg cadmium/kg P_2O_5 and applied at an annual rate of 40 kg per hectare is of 2.5 g cadmium per hectare. Urban sludge is prohibited for use as fertiliser in Flanders.

Consequently, when setting limit values for cadmium in mineral phosphate fertilisers other sources of cadmium, such as urban sludge, also need to be addressed. A revision of the sewage sludge Directive is under preparation and more stringent Community values for heavy metals content in sludge might emerge.

4. Organic or inorganic: which nutrient source is better for plants?

Mineral fertiliser contains precise, guaranteed levels of nutrients, in forms that are readily available for plant uptake and use. Their application can be timed to meet crop requirements, assuring efficient nutrient use and minimizing any potential impact on the environment if used correctly. Because of their high nutrient content, mineral fertilisers are easy and economical to ship to great distance from their point of production. However the reserves of mineral phosphate are finite and located in a limited number of countries. They also contain certain amounts of hazardous substances such as heavy metals (including cadmium).

Organic fertilisers such as manure, urban sludge and bio-waste contain varying amounts of plant nutrients and provide organic carbon. They improve the biological, chemical and physical properties of the soil. There are, however, concerns associated with their use:

– They are low in nutrient content making impractical the transport of organic sources over long distances.

– It is also virtually impossible to time the release of the nutrients they contain so as to match the needs of the growing crop and minimize residual amounts that can impact the environment. For example, the nitrogen content of manure and human waste (sewage sludge) is often the factor determining the rate of application. Their relative fixed nutrient ratios can result in excessive phosphorous loading in heavily manured soils because crops require much less phosphorous compared to nitrogen contained in the manure. This can pose a threat of excessive phosphorous moving into surface waters though runoff.

– Nutrient content of livestock manures and other organic material varies considerably. The phosphorous content in manure and urban sludge might decrease somewhat in the future following the continuous decrease of phosphorous in animal feedstuffs and detergents. The quantity of animal husbandry is now stabilised in EU 27 after a significant decrease for the period 2003-2007.

– Indiscriminate use of animal manures and urban sludge can create human health hazards through the accumulation of heavy metals (including cadmium), pathogens and organic compounds.

Therefore, the quality of municipal sewage sludge, manure and meat and bone meal as regards their heavy metals and nutrient content should be improved and projects under the Sixth EU Research Framework Programme have aimed at increasing their use in agriculture and thereby at reducing the EU dependence on mineral phosphate fertilisers.

According to an Austrian engineering company which has developed a process for treating urban sludge and slaughterhouse residues, 15 EU plants could be equipped with such technology to produce around 650 000 tons of phosphorous (as P_2O_5) annually within a period of 5 to 7 years.

This company has recently put on the German and Austrian markets two compound fertilisers (NPK and PK) to assess the reaction of farmers. Both products were accepted as valuable alternatives to traditional mineral fertilisers. However, recycled phosphate fertilisers are currently sold at EUR 0.85-0.90/kg P_2O_5 when triple superphosphate is sold at EUR 0.55-0.60/kg P_2O_5. This disadvantage is currently overcome by selling specialities.

5. Accessibility of mineral phosphate fertilisers for EU farmers during the last three years

During the season 2007/2008, prices for all kind of fertilisers have surged worldwide (see next table). Phosphate rock prices have multiplied by 9 in 12 months from around EUR 32/ton to EUR 272/ton. The reasons for this price increase are the global demographic pressure, high energy prices and the demand for renewable fuels, thereby pushing the demand for fertilisers which cannot be immediately balanced by a production increase of the phosphate rock producers. Prices decreased again in 2009 as a consequence of the global economic crisis.

In 2009, access to finance remained a key problem in the current economical situation and certain categories of farmers were unable to take out loans to buy fertilisers because banks refused to provide credits in the light of the financial and economic crisis.

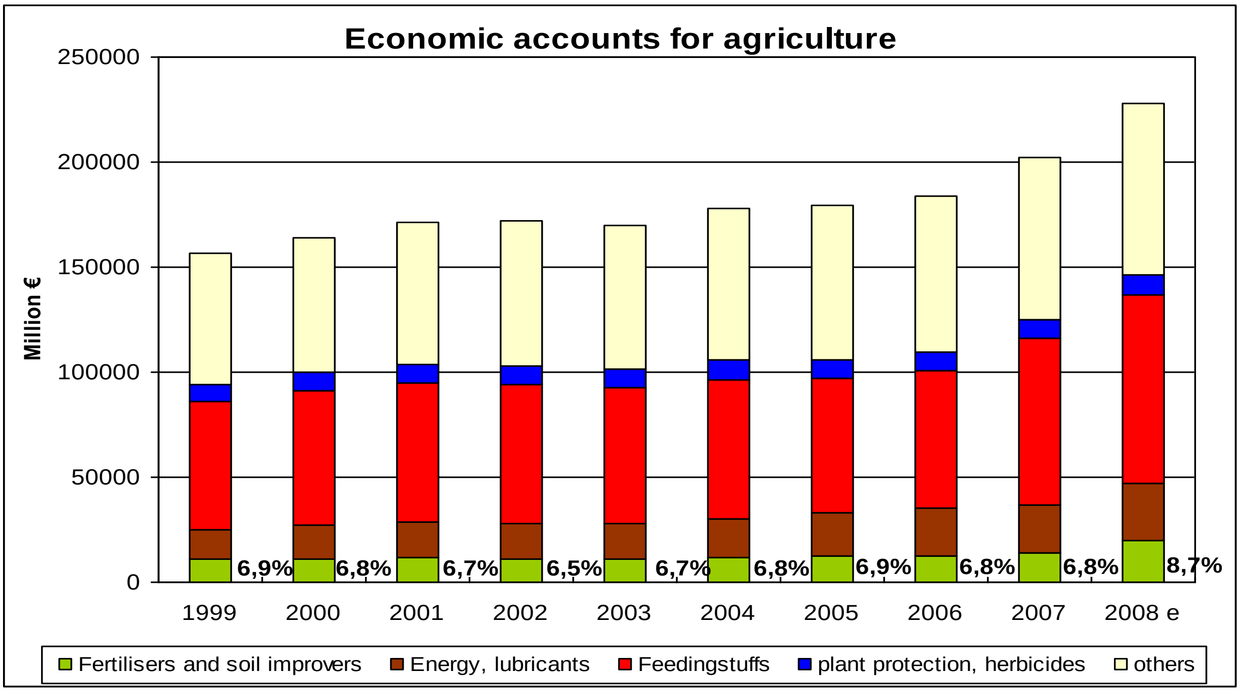
Fluctuations in prices for DAP (Diammonium Phosphate), TSP (Triple Superphosphate) and NPK (compound fertiliser) during the last two years in EUR/ton. (Source World Bank and EFMA)

Fertiliser name	January-December 2007	January-December 2008	January-October 2009
DAP (bulk, fob US Gulf)	290	315	215
TSP (bulk, fob US Gulf)	225	590	175

NPK 16-16-16 (fob Baltic)	250	600	280

By the end of 2009, prices of agricultural produce were at historical low level – cereals prices largely depend on cereals worldwide stocks. This had an impact on the purchase of fertilisers by EU farmers who already reduced their fertiliser purchase in spring and autumn and intend to adopt a very cautious approach for 2010. This negative environment had consequences on the production and turnover of some SMEs producing mineral fertilisers.
The current share of costs for fertilisers and soil improvers in cereal farmers' input costs was around 8.1 % in 2008, slightly higher than the long term average of 6.8 % (see figure below for further details).

EU Farmers input costs for the last ten years (Source EFMA)



6. Description of the EU fertiliser industry

EU fertiliser producers are organised in two different categories:

– large companies transforming the basic elements (nitrogen from air, phosphorous and potassium from mines) into a small range of fertilisers that are used for cereals, colza and maize crops,

– Small and Medium Size Enterprises which blend fertilisers produced by the majors for specific needs of their local market (vineyards, fruits, vegetables…).

Fertiliser manufacturing plants are distributed throughout the EU. Major producing Member States are France, The Netherlands, Germany, Poland and Spain, being close to the market because transport costs constitute a significant part of the cost of the finished product. Together with energy costs, the other main factor affecting the competitive position of fertiliser manufacturers and importers will be the price and the availability of the phosphate-based raw materials and intermediate products. Since cadmium has not yet become a determining factor for the price of phosphate rock and fertilisers, the price of igneous or sedimentary rocks are roughly the same.

ANNEX XIV: MODELLING THE INCENTIVES FOR DECADMIATION BY TAXATION / SUBSIDIES

Incentives to invest in decadmiation can be steered by imposing a tax on the cadmium content of phosphate fertiliser. The same results can be used to determine an appropriate subsidy, as essentially, a subsidy is a negative tax. Therefore, only taxation will be analysed here, the discussion of subsidies would be analogous.

The basic model[85] consists of a simple tax per gram of cadmium per ton of phosphate expressed in P_2O_5 put on the market. The tax rate is denoted by t [in EUR/g] and needs to be paid by the manufacturer[86].

The model assumes that fixed costs are required to build a decadmiation plant and that constant variable costs are incurred for the decadmiation of a ton of phosphate. The fixed costs are denoted by C^f and the variable cost by c. Both are measured in EUR.

Furthermore, the cadmium content of the non-decadmiated fertiliser is denoted by x and measured in [g/ton].

Finally, the model assumes that decadmiation cannot remove all cadmium from the phosphates but that a fraction remains. That fraction is denoted by β. Note that in the model, the tax is still to be paid on the remaining cadmium content after decadmiation[87]. It further assumes that the variable cost is independent of the original cadmium content of the input phosphate.

In this model, producers of fertilisers are only interested in profit maximisation. Therefore, they will invest in decadmiation and decadmiate phosphates if (and only if) this is cheaper than paying the tax for the entire cadmium content of the non-decadmiated phosphate fertiliser. It is clear that a necessary (but not sufficient) condition that needs to be met if decadmiation is to be stimulated is that the variable cost of decadmiating a ton of fertiliser are lower than the tax savings that can be realised by it.

Mathematically, this can be described as follows:

(1) if $c + x \cdot \beta \cdot t > x \cdot t$, then it is cheaper to pay the tax than to pay c per ton of fertiliser in order to save $(1 - \beta) \cdot x \cdot t$. Therefore the following condition needs to be met to make decadmiation interesting for given cadmium content of phosphate:

(2) $c + x \cdot \beta \cdot t \leq x \cdot t$. This can be rewritten as follows:

(3) $$c/t + x \cdot \beta \leq x \Leftrightarrow c/t \leq x \cdot (1 - \beta) \Leftrightarrow \frac{c}{t \cdot (1 - \beta)} \leq x$$

85 This model is based on several assumptions that need not necessarily be met in reality. Most importantly, it uses cost estimates for decadmiation that are based on laboratory scale processes or at best pre-commercial pilot plants. None of these technologies is currently used at industrial level. Therefore the cost estimates may not reflect what can be realised in practice.

86 This is the simplest way of collecting the tax. Other ways are possible and should not lead to radically different conclusions.

87 There are other ways how the tax system could be designed. One could for instance think of a tax that is only payable for fertiliser with a cadmium content above a certain threshold, while for fertiliser below it, no tax needs to be paid at all. This would limit price increases for decadmiated fertiliser to the same level as a regulatory limit. However, such a tax system would be so similar to introducing a regulatory limit that the additional administrative cost of setting up and enforcing a tax system does not appear justifiable.

Furthermore, this condition is not sufficient to induce decadmiation *ex-ante*, since it is also necessary to recover the investment costs over the lifetime of a decadmiation plant (C^f and the cost of capital).

Therefore, the model is extended by the following:

A decadmiation plant has initial investment costs of C^f [in EUR] and an expected lifetime of L years. Furthermore, it has a daily capacity of decadmiating R tons of phosphate and operates on d days per year. Finally, cost of capital is described by i.

In order to operate profitably, a plant must generate sufficient margins to recover the cost of capital over time. The (constant) margin per ton required is denoted by π. This condition is met if the margin allows realising a positive net present value (NPV, see also Annex 11.6 of the Commission IA guidelines).

This can be written as

(4) $$-C^f + \sum_{n=1}^{L} \frac{\pi \cdot R \cdot d}{(1+i)^n} > 0 \Leftrightarrow R \cdot d \cdot \sum_{n=1}^{L} \frac{\pi}{(1+i)^n} > C^f$$

We will calculate the minimum margin required to just generate a zero net present value in a first step, using parameters for two known decadmiation technologies. In a second step, we can then calculate the tax rate that is necessary to induce decadmiation for all fertiliser exceeding a desired threshold in terms of cadmium content per ton of fertiliser.

ELICAD process:

For the so-called ELICAD process, the following values are known:

C^f = EUR 1 200 000 R = 1 200 tons P_2O_5/day L = 20 years

c = EUR 16 to 20 per ton P_2O_5

The number of operating days (d) is assumed to be 300 per year. The required return on investment is assumed to be 4 % (i). Finally, β is assumed to be 0.1 (90 % of cadmium can be removed).

In order to achieve a positive NPV, the annual operating profit must be greater than EUR 88 300, which translates into a margin of π = EUR 0.25 per ton.

In a second step, the tax rate (t) can be calculated, which incentivises decadmiation for a given level of maximum cadmium content desired in fertilisers (Cd^{max}), while still allowing generating the required margin per ton of fertiliser that is decadmiated.

From equation (3) it can be seen that the following must hold:

(5) $t \geq \frac{c}{x \cdot (1-\beta)}$ but this equation needs to be amended to also incorporate the margin per ton required to make the initial investment worthwhile.

This can be done by simply replacing the term c by the term c + π, such that

(6) $$t \geq \frac{c+\pi}{x \cdot (1-\beta)}$$

For the maximum levels discussed in the options in this impact assessment, the required tax rates for the ELICAD technology would be:

Cd^{max}	t [EUR/g] for low c	t [EUR/g] for high c	tax per ton [EUR] for low c	tax per ton [EUR] for high c
60	0.3	0.37	18	22.5
40	0.45	0.56	18	22.5
20	0.90	1.12	18	22.5

At a price level of USD 250/ton phosphate fertiliser – as observed for example during 2007 (see Annex XIII) – and an exchange rate of USD 1.25 per EUR, this would mean a price increase of 9-11 % for a ton of phosphate with a cadmium content close to the desired maximum level. If the initial cadmium content is higher, the price increases would also be higher – see illustrative example below.

CERPHOS process:

For the so-called CERPHOS process, the following values are known:

C^f = EUR 4 560 000 R = 1 200 tons P_2O_5/day L = 20 years

c = EUR 24 per ton P_2O_5

The number of operating days (d) is assumed to be 300 per year. The required return on investment is assumed to be 4 % (i). Finally, β is assumed to be 0.1 (90 % of cadmium can be removed).

In order to achieve a positive NPV, the annual operating profit must be greater than EUR 335 600, which translates into a margin of π = EUR 0.93 per ton.

For the maximum levels discussed in the options in this impact assessment, the required tax rates for the CERPHOS technology would be:

Cd^{max}	t [EUR/g]	tax per ton [EUR]
60	0.5	28
40	0.7	28
20	1.4	28

At a price level of USD 250/ton phosphate fertiliser – as observed for example during 2007 (see Annex XIII) – this would mean a decadmiation cost of 14 % for a ton of phosphate with a cadmium content close to the desired maximum level. If the initial cadmium content is higher, the price increases would also be higher – see illustrative example below.

Illustrative example

In order to illustrate how the model works, we choose the case of a producer who sells phosphate with a cadmium content of 100 g/ton (which corresponds to 100 mg cadmium/kg P_2O_5). If a tax on cadmium is introduced, the producer would have to pay a tax of $T = t \cdot$ EUR 100 per ton if he decides not to use decadmiation. On the other hand, if the producer decides to decadmiate, he incurs the decadmiation costs and he would need to pay a tax on the remaining cadmium content after decadmiation. This would amount to $c + \pi + \beta \cdot t$.

The following table reports the additional financial burden on the manufacturer for the scenarios described above, once for simply paying the tax and once for decadmiating and paying a tax on the remaining cadmium content (for β we use the 10 % as above).

ELICAD process:

Cd^{max}	t [EUR/g] for low c	t [EUR/g] for high c	Cost for simply paying the tax (low c)	Cost for simply paying the tax (high c)	Cost for decadmiating and paying tax on remaining Cd (low c)	Cost for decadmiating and paying tax on remaining Cd (high c)
60	0.3	0.37	30	37	19.25	23.95
40	0.4	0.56	40	56	20.25	25.85
20	0.9	1.12	90	112	25.25	31.45

At a price level of USD 250/ton phosphate fertiliser – as observed for example during 2007 (see Annex XIII) – and an exchange rate of USD 1.25 per EUR this would mean a price increase of 10-16 % for decadmiation and payment of tax on remaining cadmium content, and 15-56 % for simply paying the tax.

CERPHOS process:

Cd^{max}	t [EUR/g]	Costs for simply paying the tax	Costs for decadmiating and paying tax on remaining cd
60	0.5	50	30
40	0.7	70	32
20	1.4	140	39

At a price level of USD 250/ton phosphate fertiliser – as observed for example during 2007 (see Annex XIII) – this would mean a price increase of 15 to 20 % for decadmiation and payment of tax on remaining cadmium content, and 25-70 % for simply paying the tax.

What can be seen from this example is that for this producer it is under all scenarios cheaper to decadmiate than to simply pay the tax over the total cadmium content. It can also be seen that for the different maximum cadmium levels desired, the choice of the corresponding tax rate has a large impact if the producer decides to simply pay the tax but that it has a relatively small impact if he decides to decadmiate. This is due to the fact that with higher tax rates, the tax is due on the entire cadmium content in the one case but only on 10 % of the original cadmium content in the case of decadmiation.

Conclusion

It can be concluded that the results depend on the decadmiation technology that is used. For ELICAD, lower tax rates would induce fertiliser producers to decadmiate compared to the CERPHOS process.

It has to be noted also that decadmiation (triggered by taxation) and paying the tax on the remaining cadmium content will lead to price increases – for phosphates containing originally 100 mg cadmium/kg P_2O_5 from about 10 to 16 % for the ELICAD process and 15 to 20 % for CERPHOS, which would be passed on as additional costs to farmers. If the raw material contains more cadmium, price increases would even be higher, while they would be lower for raw material containing less cadmium.

Sensitivity analysis:

In order to check the robustness of the results, several rounds of calculations have been carried out with varying parameters.

a) capacity utilisation

One assumption that is implicit and the model above is that the decadmiation plant can be run at 100 % capacity utilisation. This is probably overly optimistic and the calculations have been re-run with a different value for R (which is the same as taking the original capacity and assuming an utilisation rate of less than 100 %).

For ELICAD 80 % utilisation results in:

Cd^{max}	t [EUR/g] for low c	t [EUR/g] for high c	tax per ton [EUR] for low c	tax per ton [EUR] for high c
60	0.30	0.38	18.12	22.56
40	0.45	0.56	18.12	22.56
20	0.91	1.13	18.12	22.56

and for CERPHOS 80 % utilisation would result in:

Cd^{max}	t [USD/g]	tax per ton [USD]
60	0.47	28
40	0.70	28
20	1.40	28

It can be seen that the required tax rate is not significantly higher for ELICAD and CERPHOS.

b) number of operating days

The number of operating days per year used in the basic model might be overly optimistic, and the model has been re-run with only 250 operating days per year (50 weeks with 5 working days a week).

For ELICAD the results are:

Cd^{max}	t [EUR/g] for low c	t [EUR/g] for high c	tax per ton [EUR] for low c	tax per ton [EUR] for high c

60	0.30	0.38	18.1	22.55
40	0.45	0.56	18.1	22.55
20	0.91	1.13	18.1	22.55

And for CERPHOS:

Cd^{max}	t [USD/g]	tax per ton [USD]
60	0.47	28
40	0.70	28
20	1.40	28

Consequently, the number of operating days per year does not change the results significantly for ELICAD and CERPHOS.

c) Cost of capital

The basic model uses an internal discount rate of 4 % (to note: the model assumes constant prices and does not capture inflation). To test for robustness, a higher rate of 8 % has been used.

For ELICAD and CERPHOS, an increase of 4 % in the discount rate will require an increase of 40 % of the annual operating profit to ensure a positive NPV. This might lead to a significant fertiliser price increase.

d) effectiveness of decadmiation process

Finally, calculations have been re-run with a higher value for $\beta = 20$ % (the cadmium portion that cannot be removed by decadmiation) to see how this would influence the results.

For ELICAD, it results in:

Cd^{max}	t [EUR/g] for low c	t [EUR/g] for high c	tax per ton [EUR] for low c	tax per ton [EUR] for high c
60	0.34	0.42	20.3	25.3
40	0.51	0.63	20.3	25.3
20	1.02	1.27	20.3	25.3

And for CERPHOS in:

Cd^{max}	t [USD/g]	tax per ton [USD]
60	0.52	31.2
40	0.78	31.2
20	1.56	31.2

A less effective decadmiation process means that the tax rate needs to be higher (as expected). It also means that total price increases (i.e. cost for decadmiation + tax on remaining cadmium) would be somewhat higher.

Conclusion:

The underlying assumptions do not change the results dramatically. For all processes, the choice of the discount rate and the effectiveness of the decadmiation process are important factors. The results for ELICAD and CERPHOS are close to each other.

ANNEX XV: POTENTIAL REDUCTION OF TOTAL QUANTITY OF CADMIUM INPUT INTO AGRICULTURAL SOILS FOR THE VARIOUS POLICY OPTIONS

As set out in section 3.2, the actual cadmium content of the fertilisers placed on the market in the EU is not well studied, and it is therefore difficult to quantify the reduction in new cadmium input into agricultural soils that the various policy options would entail.

Phosphate fertilisers with cadmium concentrations higher than the overall limit set in the policy options could no longer be marketed in the EU and would be replaced by others with lower cadmium content. It is not possible to know precisely the cadmium content of the phosphate fertilisers replacing the prohibited quantities.

On the basis of the data contained in Figure 3, the following table summarises the results of calculations for the overall cadmium input reduction, if the quantities of phosphate fertilisers that could no longer be marketed, were to be replaced in their entirety with other phosphate fertilisers of a given cadmium concentration. The shaded fields correspond to the situation where the fertilisers replacing the prohibited quantities contained the average concentration of the fertilisers currently on the market below the limit value.

Limit 60 mg Cd/kg P_2O_5 (43 out of 197 fertiliser samples above the limit)		Limit 40 mg Cd/kg P_2O_5 (96 out of 197 fertiliser samples above limit)		Limit 20 mg Cd/kg P_2O_5 (117 of 197 fertiliser samples above limit)	
Replacement Cd content	Net Cd reduction, %	Replacement Cd content	Net Cd reduction, %	Replacement Cd content	Net Cd reduction, %
0	45,20	0	83,89	0	92,32
10	39,43	10	70,36	6,8	81,21
20	33,65	11,3	68,61	10	75,98
25,2	30,65	20	56,84	20	59,64
30	27,88	30	43,32		
40	22,10	40	29,80		
50	16,32				
60	10,55				