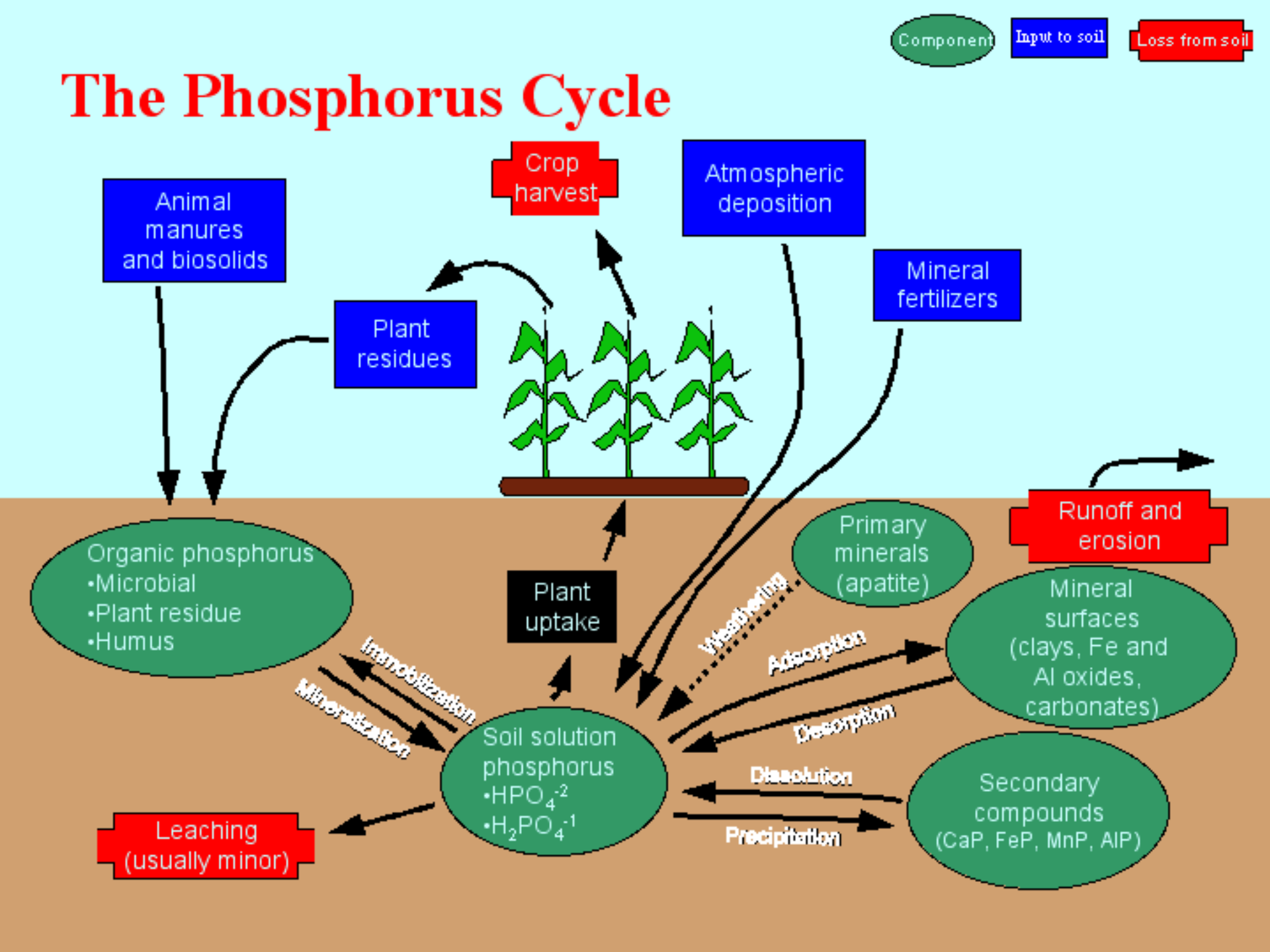
Fosfór og kadmíum

Fræðslufundur 8. febrúar 2012

Landbúnaðarháskóli Íslands

Plöntunæringarefni í uppskeru (kg/ha)

- Í “góðri” uppskeru af túni 50 hkg/ha þurrefnis) eru hub (kg/ha).
  - Ekki borið á
    - Súrefni 2.500
    - Kolefni 1800
    - Vetni 380
  - Áburðarefni
    - Köfnunarefni 120 Svipað og áborið
    - Kalí 100 Svipað og áborið
    - Fosfór 15 Oft borið meira á
    - Brennisteinn 12


Component
Input to soil
Loss from soil
The Phosphorus Cycle
Crop harvest
Atmospheric deposition
Animal manures and biosolids
Mineral fertilizers
Plant residues
Runoff and erosion
Organic phosphorus
•Microbial
•Plant residue
•Humus
Primary minerals (apatite)
Plant uptake
Weathering
Adsorption
Mineral surfaces (clays, Fe and Al oxides, carbonates)
Immobilization
Mineralization
Desorption
Soil solution phosphorus
•HPO_4^{-2}
•$H_2PO_4^{-1}$
Dissolution
Precipitation
Secondary compounds
(CaP, FeP, MnP, AlP)
Leaching
(usually minor)

Fosfór P- P_2O_5

- Upprunnin úr fosfórgrýti
- Primary rock (apatit)
- Secondary rock (setlög).
- Hreinsaður mulningur meðhöndlaður með brennisteins og/eða fosfórsýru
- Mjög oft tengt við ammoníum og selt sem mono- eða diammoniumfosfat

Economic and Potentially Economic Phosphate Deposits of the World

Er fosfórinn að klárast?

- Reserves = vinnanlegt með nútíma tækni og kostnaði
- Base reserves = Vinnanlegt með meiri kostnaði
- Recourses = það sem mögulega mætti vinna t.d. af sjávarbotni eða undir yfirborði

Fosfórforðinn

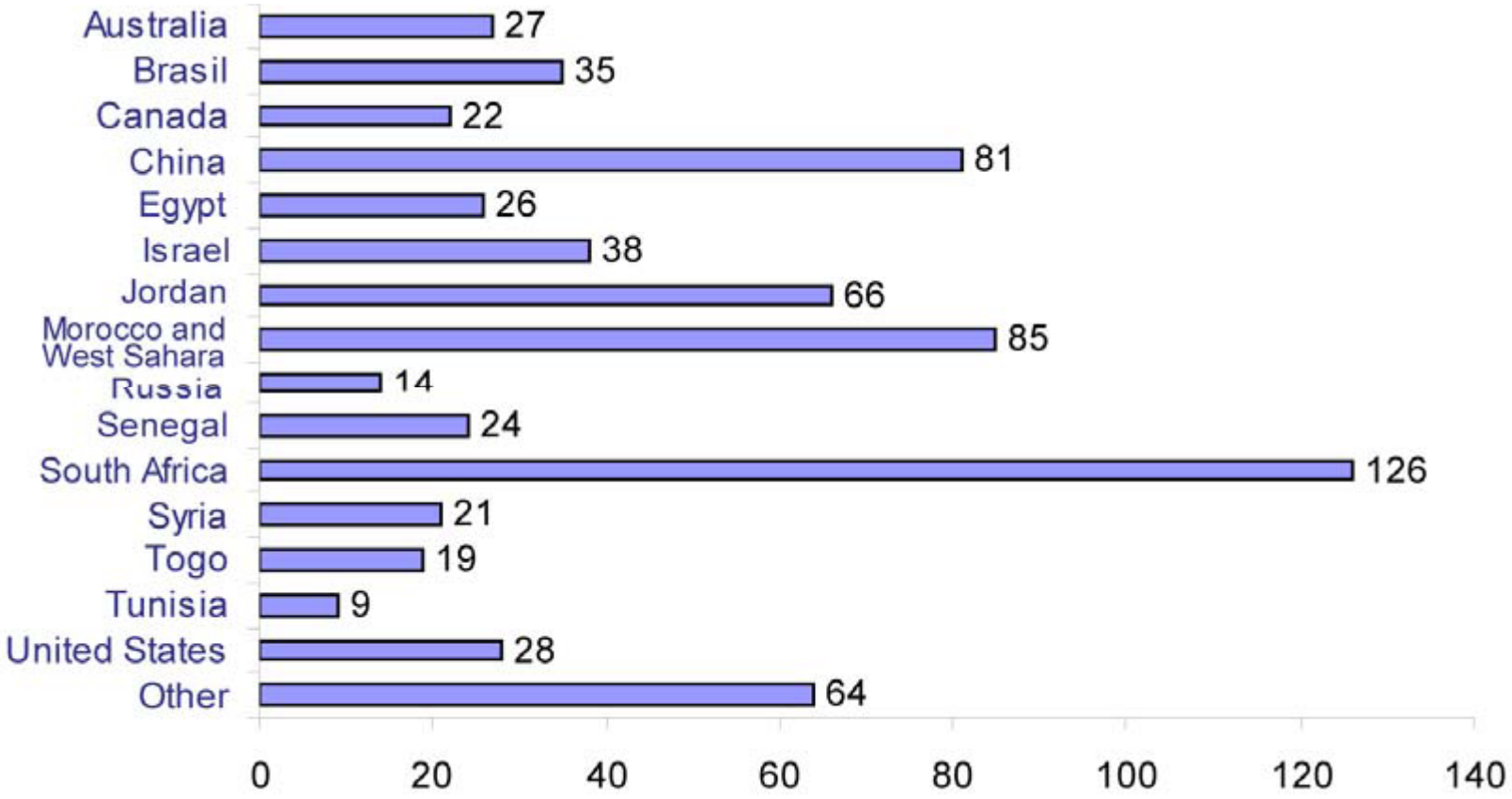


Figure 1: Phosphate rock – years of extraction remaining based on curren reserves from 2006 using a 2% yearly increase (Source: USGS)

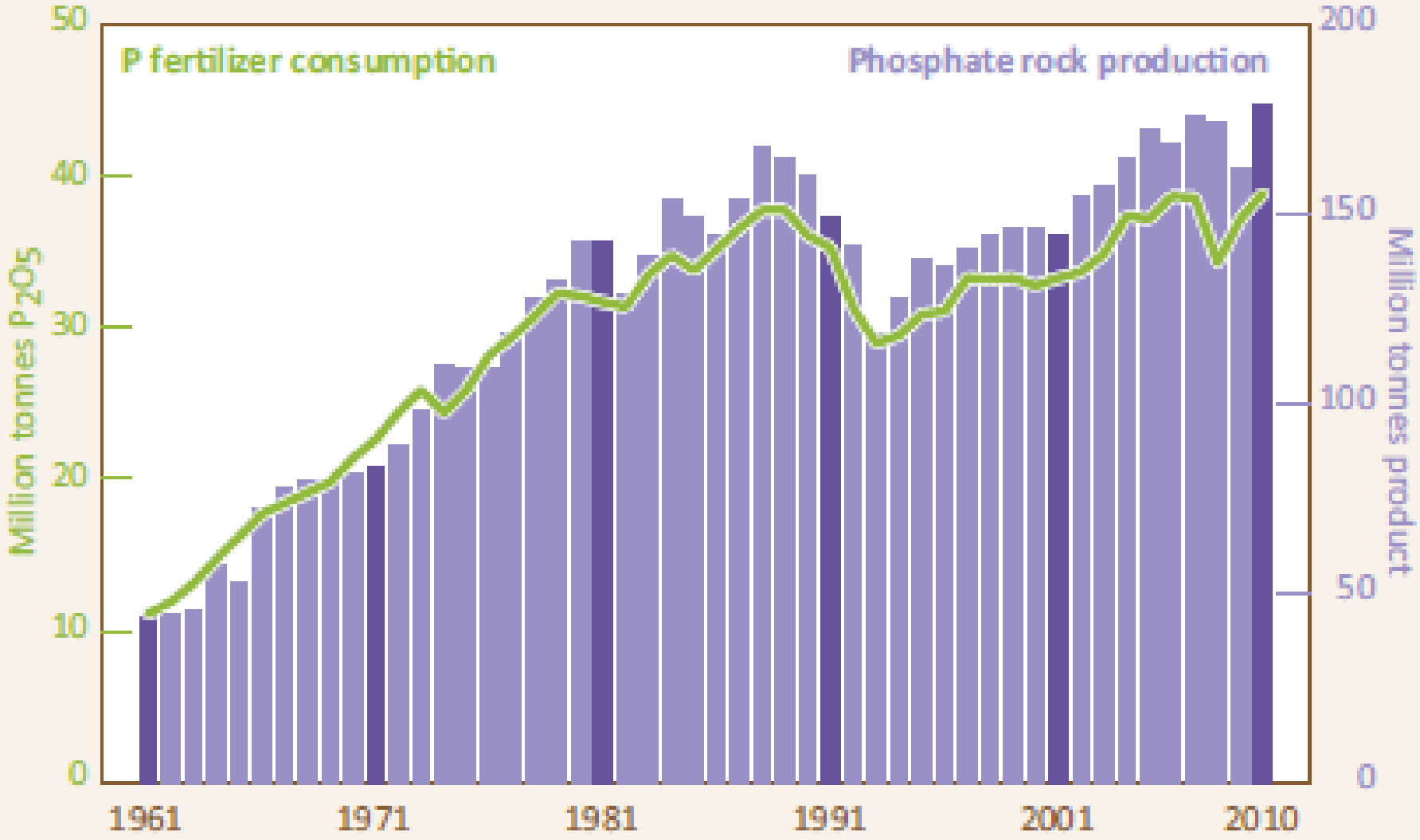
TABLE 1. World phosphate rock production, reserves, and reserve base.

Country	Average production, 1997-2001, thousand tons	Reserves[1], million tons	Reserve life[2], years	Reserve base, million tons	Reserve base life[2], years
United States	44,851	1,102	25	4,408	98
Brazil	4,875	364	75	408	84
China	24,134	1,102	46	11,020	457
Israel	4,487	198	44	882	196
Jordan	6,350	992	156	1,873	295
Morocco/ Western Sahara	25,346	6,281	248	23,142	913
Russia	11,020	220	20	1,102	100
Senegal	1,860	55	30	176	95
South Africa	3,152	1,653	524	2,755	874
Syria	1,955	110	56	882	451
Togo	1,917	33	17	66	34
Tunisia	8,697	110	13	661	76
Other countries	12,364	1,322	110	4,408	357
Total (rounded)	**151,000**	**13,224**	**88**	**51,794**	**343**

[1]Reserve and reserve base cost less than $36/ton and $90/ton, respectively. Cost includes capital, operating taxes, royalties (if applicable), miscellaneous costs, and a 15 percent rate of return on investment, FOB mine (1992 costs).
[2]Life based on 1997-2001 five-year average mine production.
Source: U.S. Geological Survey.

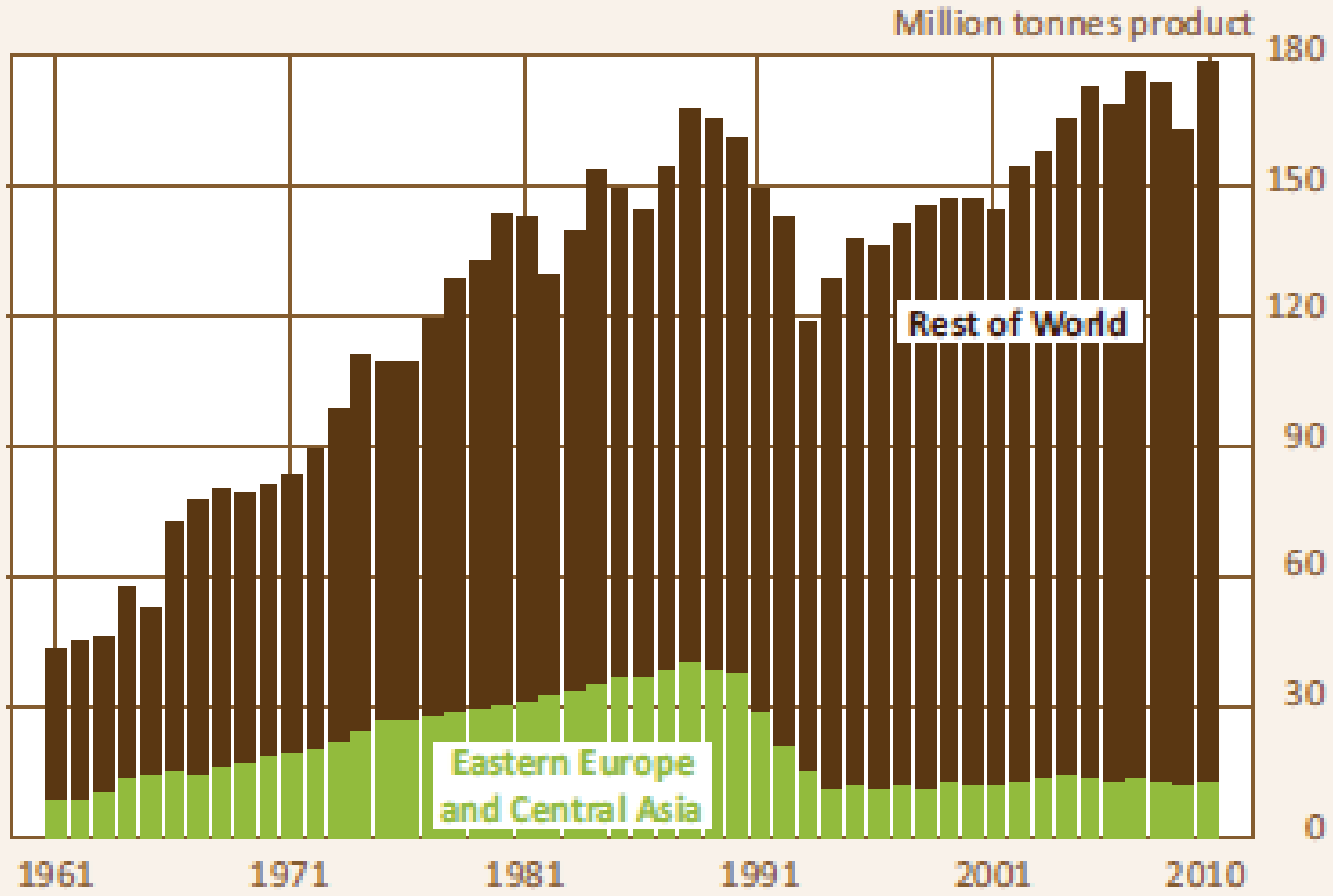
Landbúnað

World phosphate rock production and P fertilizer consumption



Source: International Fertilizer Industry Association, 2011

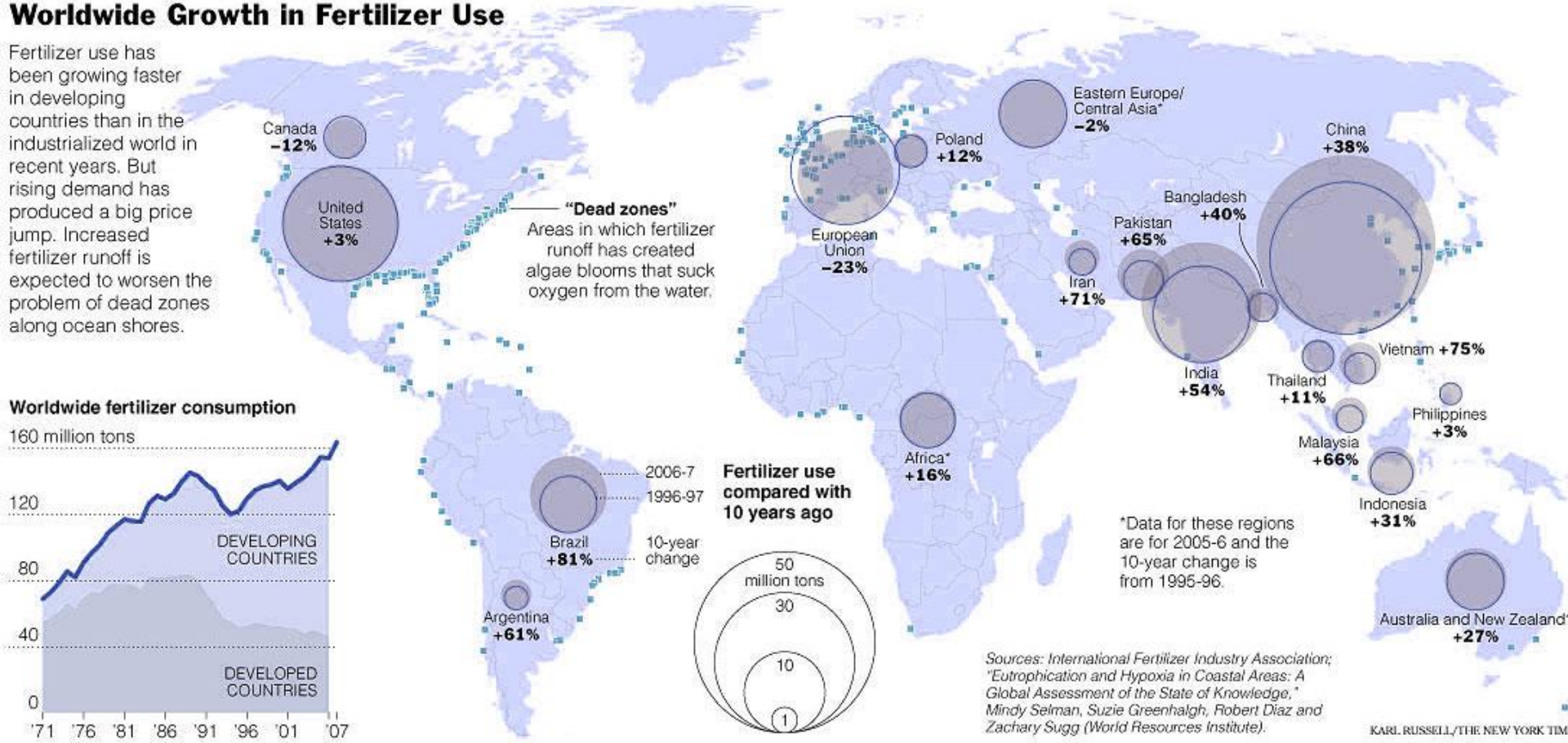
World and EECA phosphate rock production



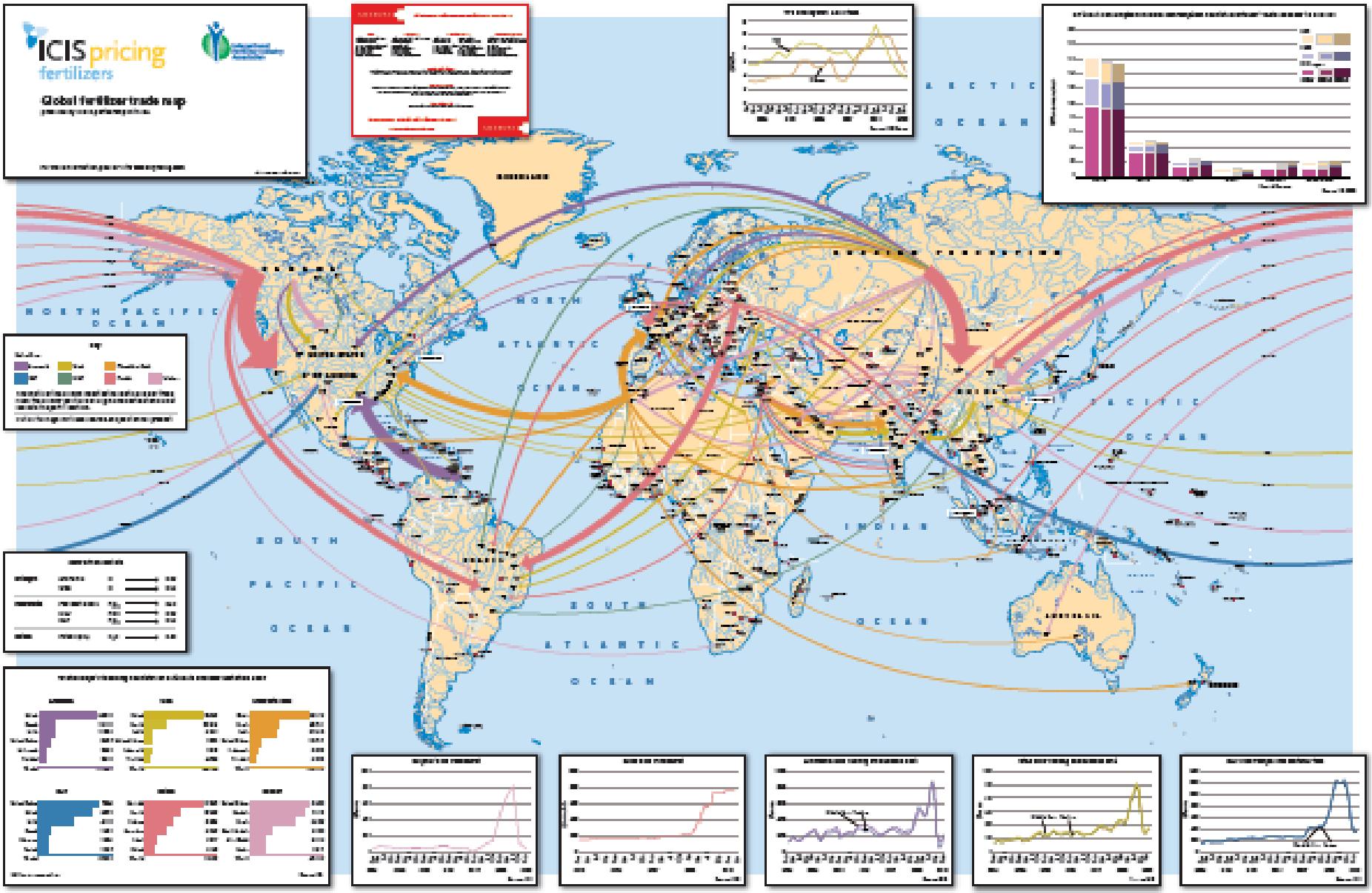
Source: International Fertilizer Industry Association, 2011

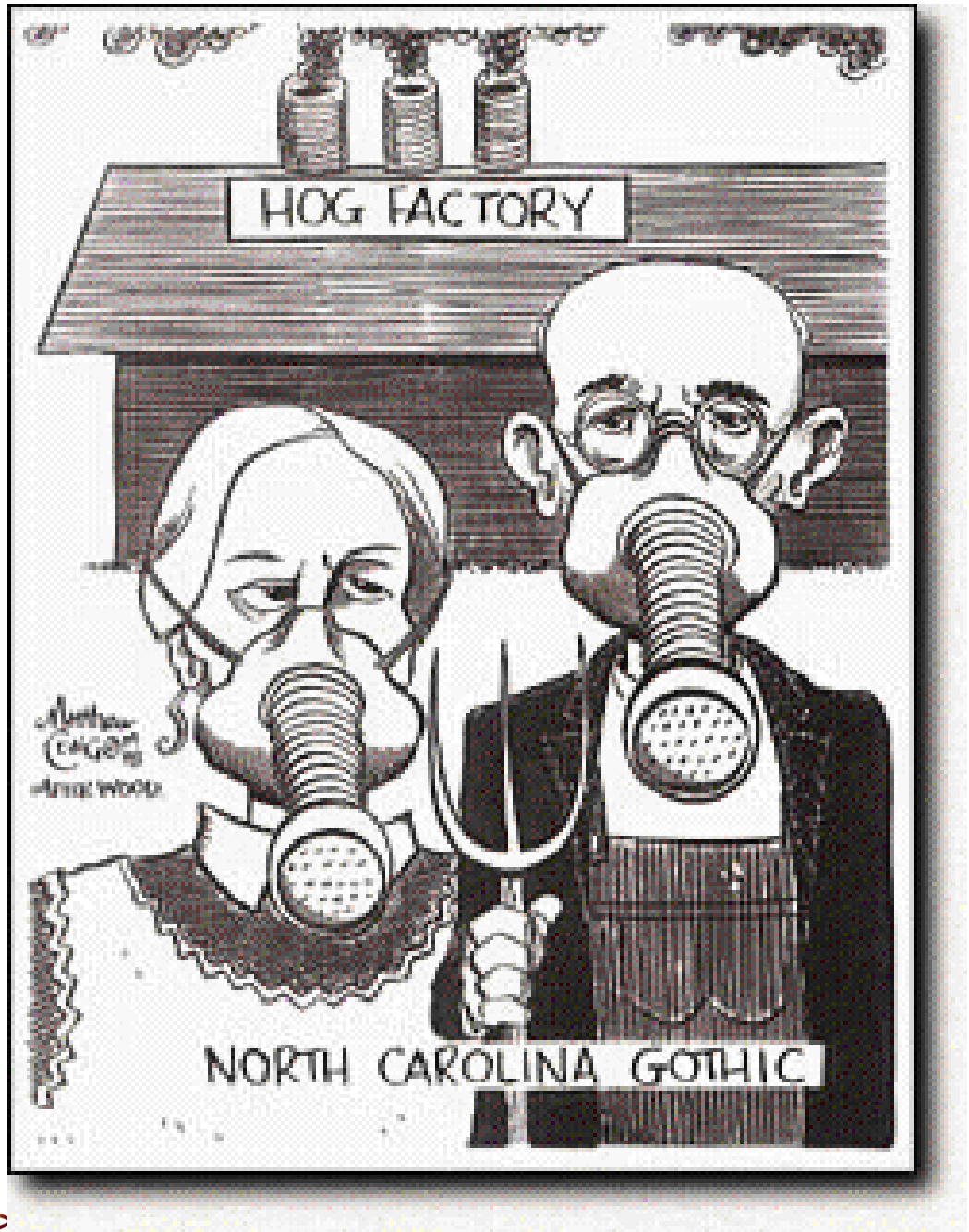
Worldwide Growth in Fertilizer Use

Fertilizer use has been growing faster in developing countries than in the industrialized world in recent years. But rising demand has produced a big price jump. Increased fertilizer runoff is expected to worsen the problem of dead zones along ocean shores.



Worldwide fertilizer consumption

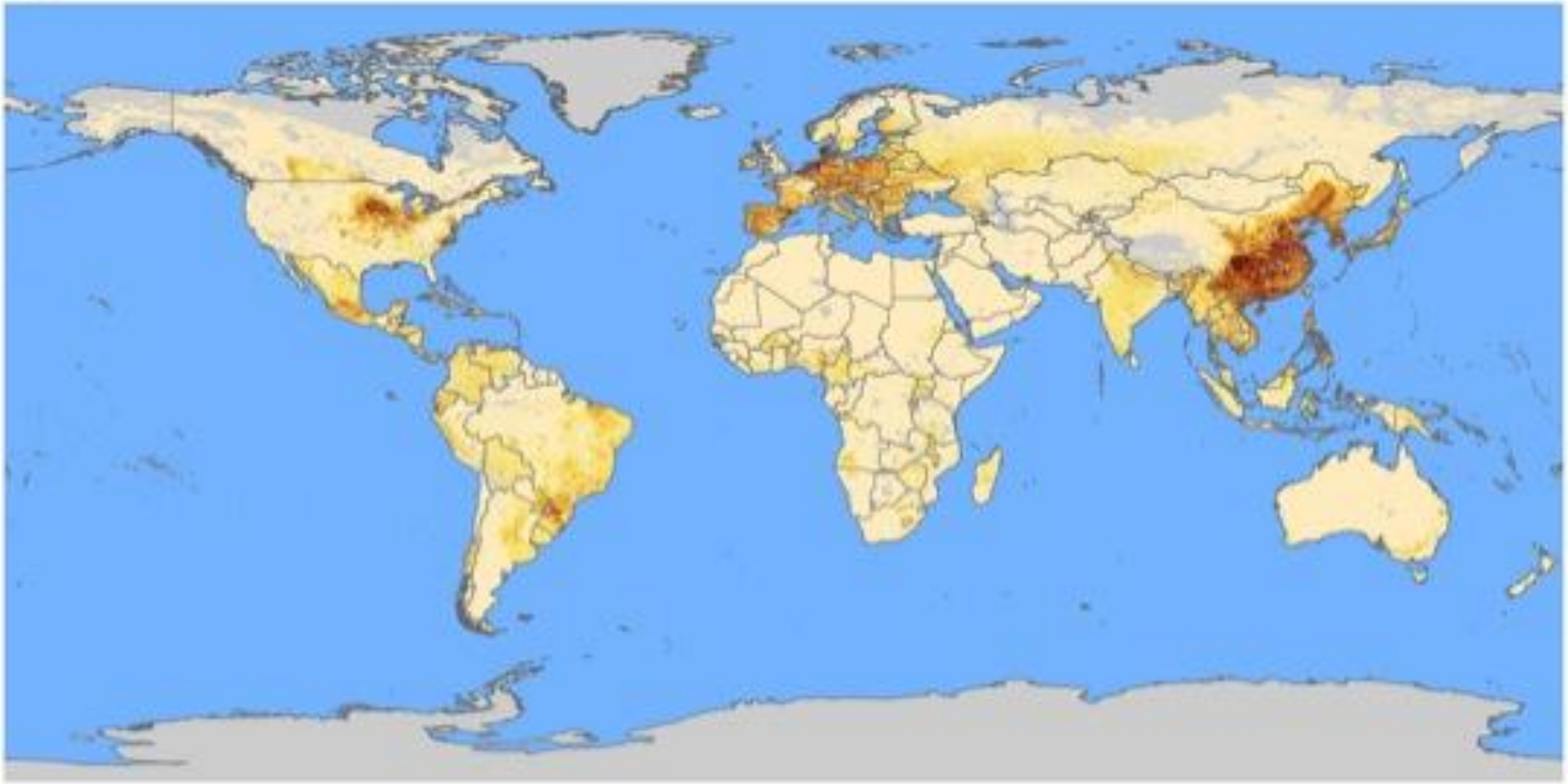

ICIS pricing
fertilizers
Global fertilizer trade map
NORTH PACIFIC OCEAN
NORTH ATLANTIC OCEAN
SOUTH PACIFIC OCEAN
SOUTH ATLANTIC OCEAN
INDIAN OCEAN
ARCTIC OCEAN



Óbein umhverfisáhrif áburðarnotkunar

Pigs density map matching FAOSTAT 2005 *(modelled)*

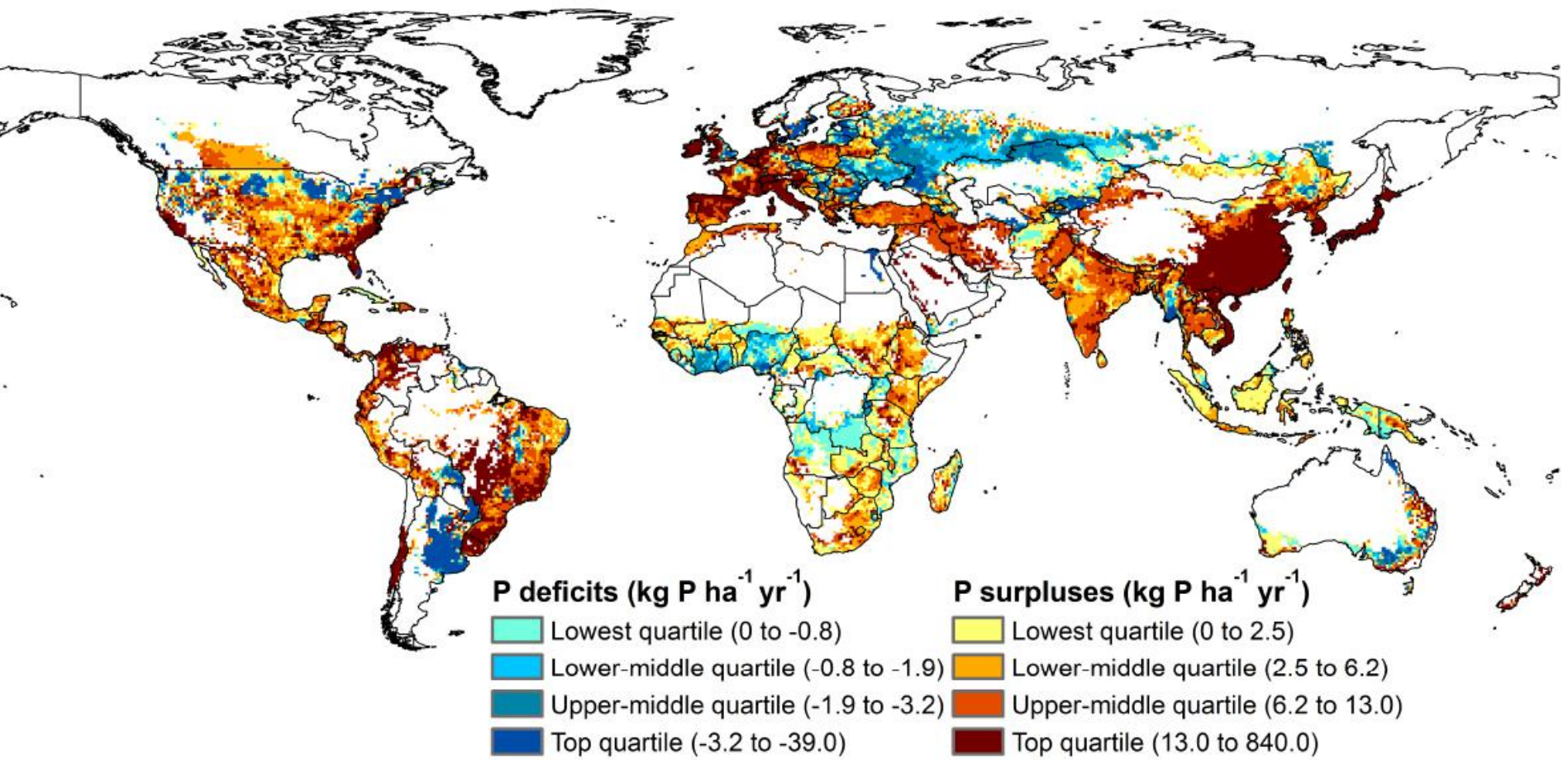
AGRICULTURE AND CONSUMER PROTECTION DEPARTMENT
Animal Production and Health Division

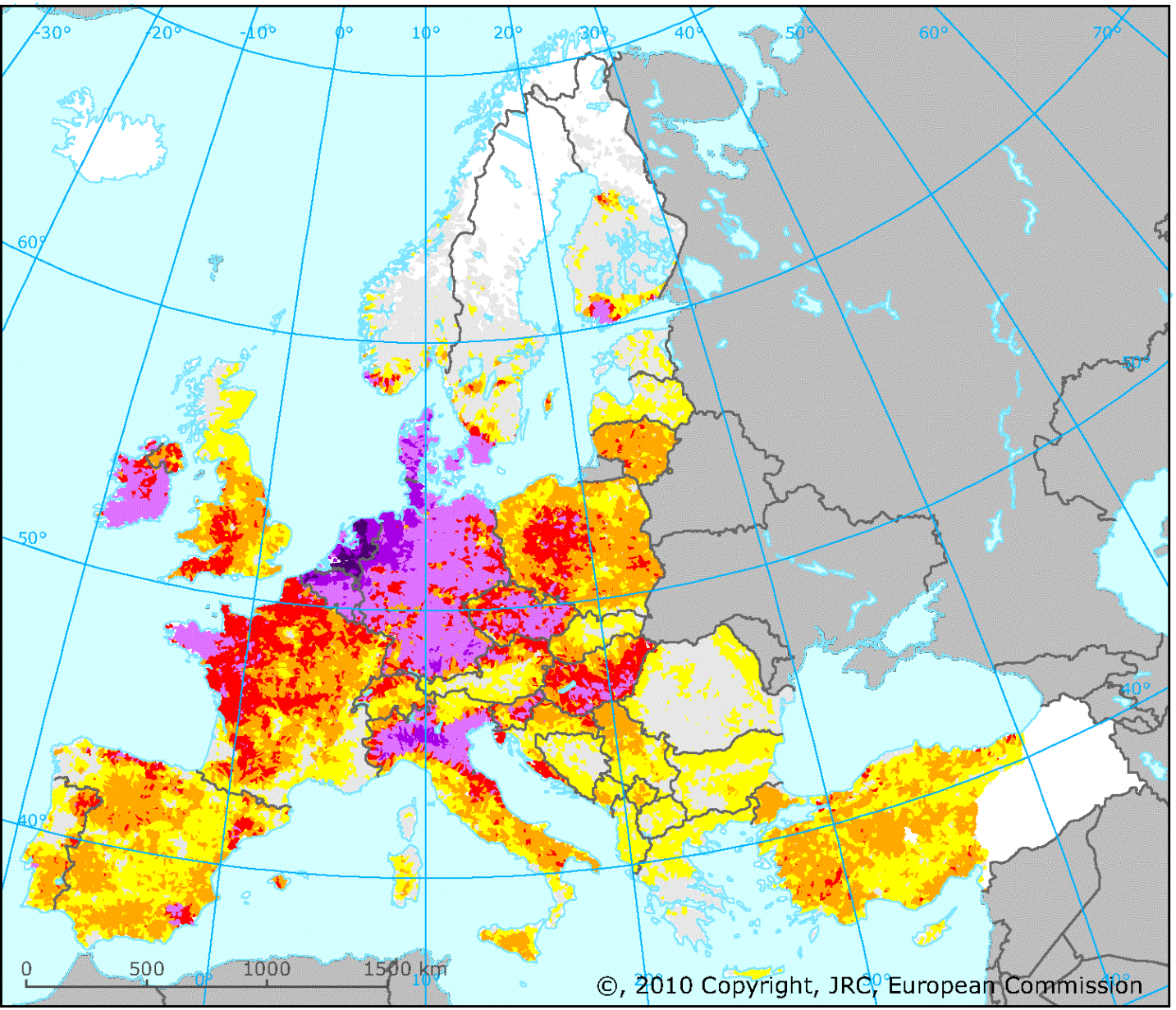


Number per square km

<1	5–10	20–50	100–250	Water
1–5	10–20	50–100	>250	Unsuitable for ruminat

Source: Gridded Livestock of the World


P deficits (kg P ha-1 yr-1)
Lowest quartile (0 to -0.8)
Lower-middle quartile (-0.8 to -1.9)
Upper-middle quartile (-1.9 to -3.2)
Top quartile (-3.2 to -39.0)
P surpluses (kg P ha-1 yr-1)
Lowest quartile (0 to 2.5)
Lower-middle quartile (2.5 to 6.2)
Upper-middle quartile (6.2 to 13.0)
Top quartile (13.0 to 840.0)



Nitrogen surplus, 2005

(kg/ha)

- < 10
- 10–20
- 20–30
- 30–40
- 40–80
- 80–150
- > 150
- No data
- Outside coverage

Landbúnaðarháskóli Íslands

Cd – fylgifiskur P

Table 1. Origin and concentrations of P and Cd in selected phosphate deposits (compiled from data presented in Syers *et al., 1986)*

Phosphate rock	Orgin	P g kg^{-1}	Cd mg kg^{-1}	Cd mg kg P^{-1}
Gafsa	Tunisia	134	38	283
North Florida	North Florida, USA	133	3	23
Jordanian	Jordan	134	4	30
North Carolina	North Carolina, USA	127	48	378
Sechura	Sechura Desert, Peru	131	11	84
Mexican	Mexico	140	8	57
Nauru Island	Nauru Island, South Pacific	156	100	641
Arad Negev	Desert, Israel	141	12	85
Makatea Island	Makatea Island, South Pacific	130	10	83
Chatham Rise	Chatham Rise, New Zealand	89	2	22

FINNISH ENVIRONMENT INSTITUTE

CADMIUM IN FERTILIZERS

RISKS TO HUMAN HEALTH AND THE ENVIRONMENT

Study report for the Finnish
Ministry of Agriculture and
Forestry
October, 2000

Landbúnaðarháskóli Íslands

Sviðsmyndir

Núverandi notkun P úr finnsku gosbergi, 2,5 mg Cd/kg P

Leyfilegt hámark í Finnlandi 50 mg Cd/kg P

Meðaltal áburðar í EU 138 mg Cd/kg P

Hveitiakur með 15 kg P/ári	0,04, 0,75 og 2,07 g Cd/ha
Kartöflur með 40 kg P/ári	0,10, 2,00 og 5,52 gCd/ha
Náttúruleg ákoma	0,3 g/ha

Látið ganga í 100 ár

Tekið tillit til þess sem fer með uppskeru og útskolun og foki

Table 13. Cadmium contents of soil, mg/kg d.m., at different times and at different Cd contents of P-fertilizers and changes (%) over 100 years.

Cd ACCUMULATION IN SOIL, mg/kg d.m.							
		Cd 2.5 mg/kg P		Cd 50 mg/kg P		Cd 138 mg/kg P	
Time elapsed, in years	0	100		100		100	
	mg/kg d.m.	mg/kg d.m.	%	mg/kg d.m.	%	mg/kg d.m.	%
Wheat field							
Anderson	0.21	0.215	2	0.250	19	0.314	50
Christensen	0.21	0.210	0	0.244	16	0.305	45
McBride	0.21	0.198	-6	0.232	10	0.278	32
Romkens	0.21	0.167	-20	0.198	-6	0.254	21
Potato field							
Anderson	0.21	0.212	1	0.307	46	0.481	129
Christensen	0.21	0.207	-1	0.301	43	0.473	125
McBride	0.21	0.195	-7	0.287	37	0.455	117
Romkens	0.21	0.163	-22	0.247	18	0.401	91

Table 20. Cadmium contents in crops, µg/kg d.m., at different times and at different Cd contents of P-fertilizers and changes (%) over 100 years.

ACCUMULATION MODULE							
CADMIUM ACCUMULATION IN CROPS, µg/kg d.m.							
		Cd 2.5 mg/kg P		Cd 50 mg/kg P		Cd 138 mg/kg P	
Time elapsed, in years	0	100		100		100	
	µg/kg d.m.	µg/kg d.m	%	µg/kg d.m	%	µg/kg d.m	%
Wheat							
Anderson	51.9	52.8	2	59.1	14	70.9	37
Christensen	**51.9**	**51.9**	0	**58.0**	**12**	**69.3**	34
McBride	51.9	49.8	-4	55.9	8	64.3	24
Romkens	51.9	44.0	-15	49.6	4	60.0	16
Potato							
Anderson	52.0	52.1	0,2	55.8	7	62.5	20
Christensen	**52.0**	**51.9**	**-0,2**	**55.5**	7	**62.2**	20
McBride	52.0	51.4	-1	55.0	6	61.5	18
Romkens	52.0	50.2	-3	53.4	3	59.4	14

Finnska rannsóknin

- Hvað gerist ef notaður áburður með 138 mg Cd /kg P í 100 ár? Meðal dagsneysla, μg Cd:

	2000	2100
Hveiti	4,3	5,9
Rúgur	0,7	0,9
Annað korn	0,4	0,6
Rótarávextir	1,2	1,5
Annað	2,4	2,8
Samtals	9,5	13,0

Höfum við sofið á verðinum?

- Aðskotaefni í matjurtum Sigurgeir Ólafsson Ráðunautafundur
- RALA Aðskotaefnin kadmín, kvikasilf... Ólafur Reykdal... Fjölrit RALA
- Berst kadmín í búfjárafurðir? Ólafur Reykdal Ráðunautafundur
- Efnagreiningar á kjöti 1984-19... Ólafur Reykdal... Fjölrit RALA
- Eftirlit með aðföngum í landbú... Ólafur Guðmundsson... Ráðunautafundur
- Eftirlit með efna- og sýklamen... Sigurður Örn Hansson Ráðunautafundur
- Fosfóráburður á mýrartún á Hva... Magnús Óskarsson... Búvísindi
- Gæðastýring í sauðfjárrækt Ólafur R. Dýrmundsson Ráðunautafundur
- Hlutverk fóðureftirlitsins gag... Lilja Grétarsdóttir Ráðunautafundur
- Hreinleiki mjólkurafurða Ólafur Reykdal... Ráðunautafundur
- Kadmín í jarðvegi á Íslandi [v... Bjarni Helgason Ráðunautafundur
- Kadmíum í íslensku umhverfi Þorsteinn Þorsteinsson... Íslenskar landbúnaðarrann... Landbúnaður og umhverfismál Guðni Þorvaldsson Freyr
- Landbúnaðurinn og umhverfi han... Guðni Þorvaldsson Ráðunautafundur
- Langtímatilraunir í jarðrækt, ... Þorsteinn Guðmundsson... Fræðaþing landbúnaðarins Lífrænn/hefðbundinn landbúnaðu... Ríkharð Brynjólfsson Ráðunautafundur
- Mengun jarðvegs og forvarnir Þorsteinn Guðmundsson Freyr
- Merkingar á áburði Lilja Grétarsdóttir Bændablaðið
- Söl - rannsóknir á nokkrum þát... Árni Snæbjörnsson... Freyr
- Umhverfisvæn jarðrækt Magnús Óskarsson Ráðunautafundur
- Umhverfisvöktun: Þungmálmar í ... Borgþór Magnússon... Ráðunautafundur
- Þungmálmar og önnur aðskotaefn... Brynjólfur Sandholt Ráðunautafundur

Rannsókn Þorsteins Þorsteinssonar og Friðriks Pálmasonar 1984

1. TAFLA. Kadmíum í tilbúnum áburði.
TABLE 1. Cadmium in fertilizers.

Tegund áburðar *Fertilizer*	Kadmíum mg/kg	P g/kg	mg Cd/gP
Þrífosfat	38	200	0.19
N-P 23—10	25	100	0.25
Garðáburður	16	80	0.20
Kalíáburður	0	0	

Tilraun á Akureyri með upphaf 1950

Áborinn fosfór Phosphate fertilizer	P kg/ha 0	13	26	39
Kadmíum Cd, ppm. D. M.	0.025	0.025	0.042	0.031

Tilraun á Sámstöðum með upphaf 1950

Áborinn fosfór Phosphate fertilizer	P kg/ha 0	13	22	31	39
Kadmíum Cd, ppm D. M. 1977	0.040	0.035	0.056	0.070	0.073

Rannsókn Bjarna Helgasonar 1991

1. tafla. Áhrif vaxandi fosfóráburðar (kg P/ha) á magn kadmíns (Cd) [og „nýtanlegs" fosfórs (P)] í framræstu mýrartúni að Sámsstöðum (nr. 9-50) og á Geitasandi (nr 3-59) í 0–10 cm jarðvegsdýpt, haustið 1999, mælt í mg/kg af loftþurrum jarðvegi.

	Fosfór áburður á hektara					
	0 kg	13,1 kg	21,9 kg	26,2 kg	30,6 kg	39,3 kg
Mýrartún						
Cd, mg/kg	0,30	0,37	0,43		0,48	0,62
Sandatún						
Cd, mg/kg	0,23	0,29		0,34		0,41

FAO Soils Bulletin 65

	Nor	Fin	Dan	Sví	Þýsk	Frakk	Bretl	Ísl
Cd, mg	0,1	0,21	0,25	0,26	0,52	0,74	1,0	0,29

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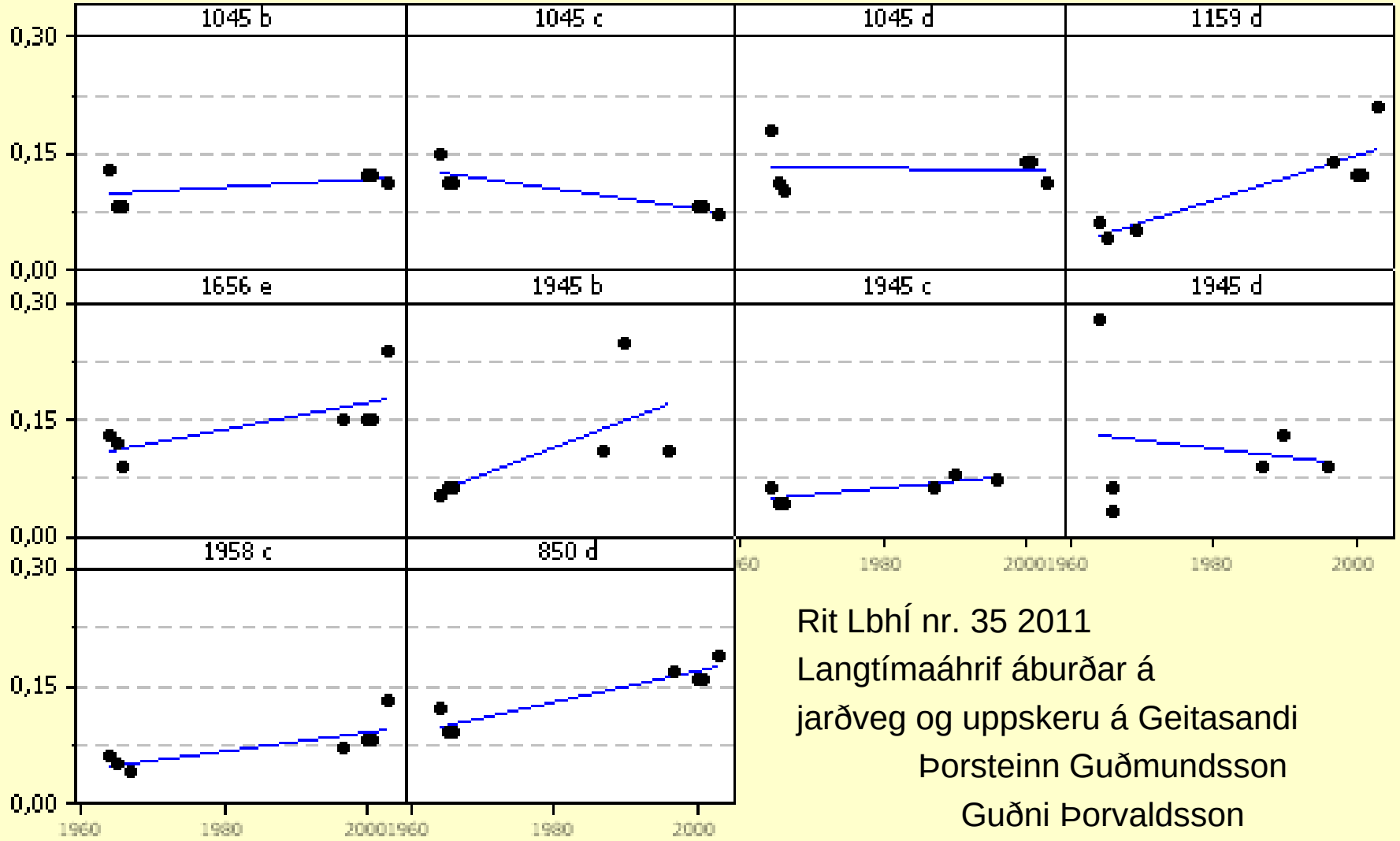
Landbúnaðarháskóli Íslands

Cadmín í langtímatilraunum, mg/kg þe



Rit LbhÍ nr. 35 2011

Langtímaáhrif áburðar á jarðveg og uppskeru á Geitasandi

Þorsteinn Guðmundsson
Guðni Þorvaldsson
Hólmgeir Björnsson

Pb í langtímatilraunum, mg/kg þe