Piloting Phytoremediation of a Site With the Use of Sludge in Circular Economy Context

The 5th workshop of the IWAMA project will focus on **nutrients reduction and recovery in the wastewater treatment sector**.

13–15 June 2018 in Kalmar, Sweden.

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Latvia University of Life Sciences and Technologies
Scientific Laboratory of Forest and Water Resources

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- Who we are and what we do
- The phytoremediation concept
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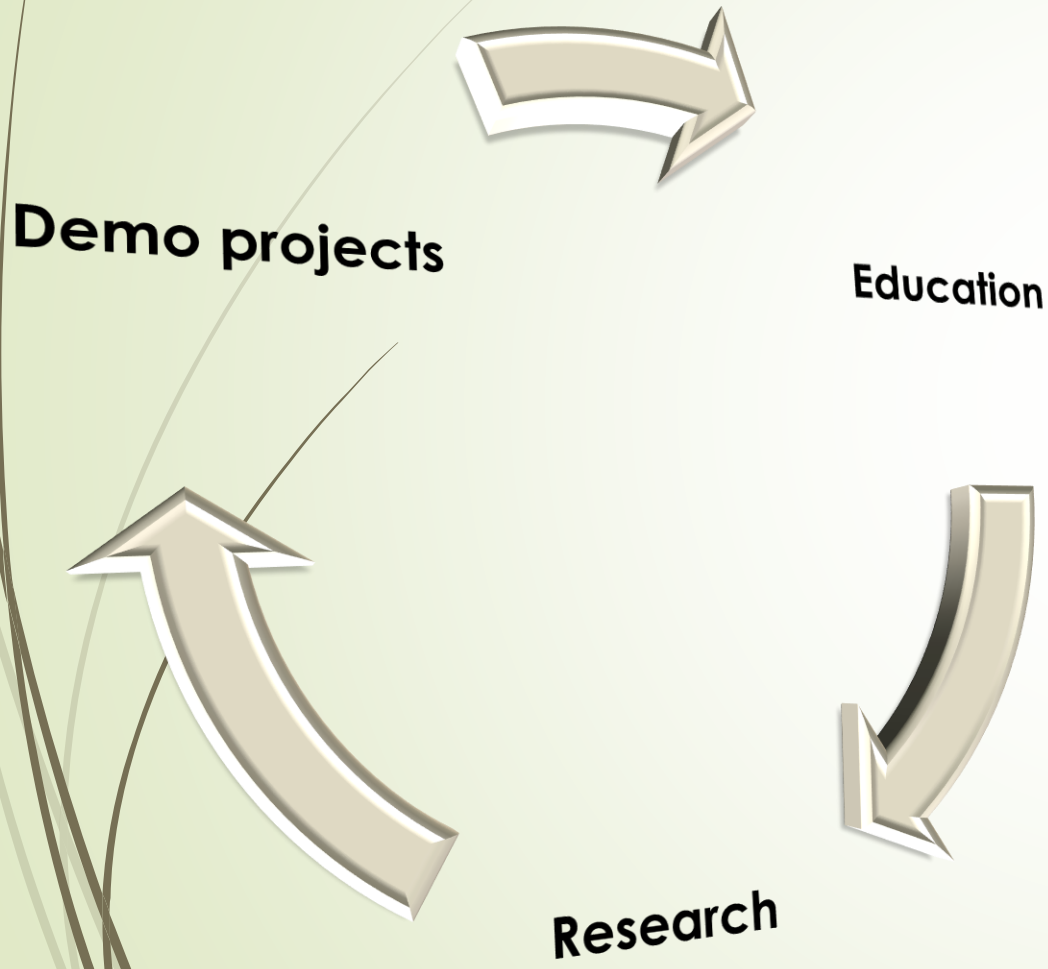
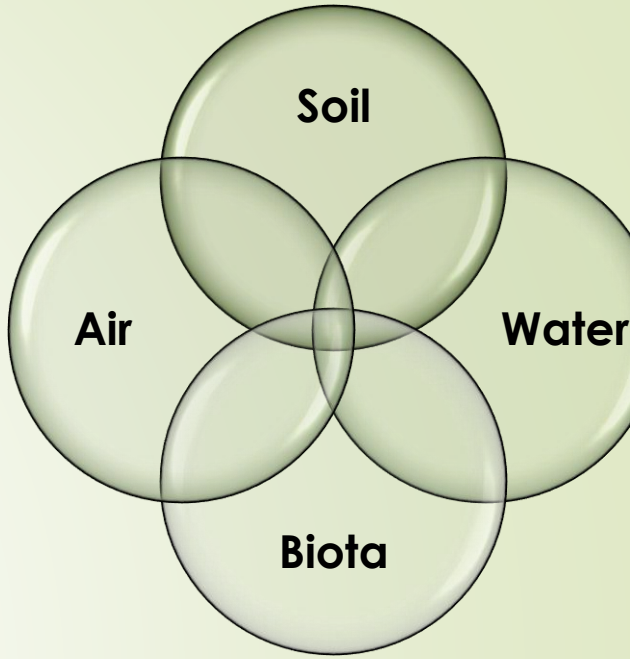
- The ideas of future development

Scientific Laboratory of Forest and Water Resources

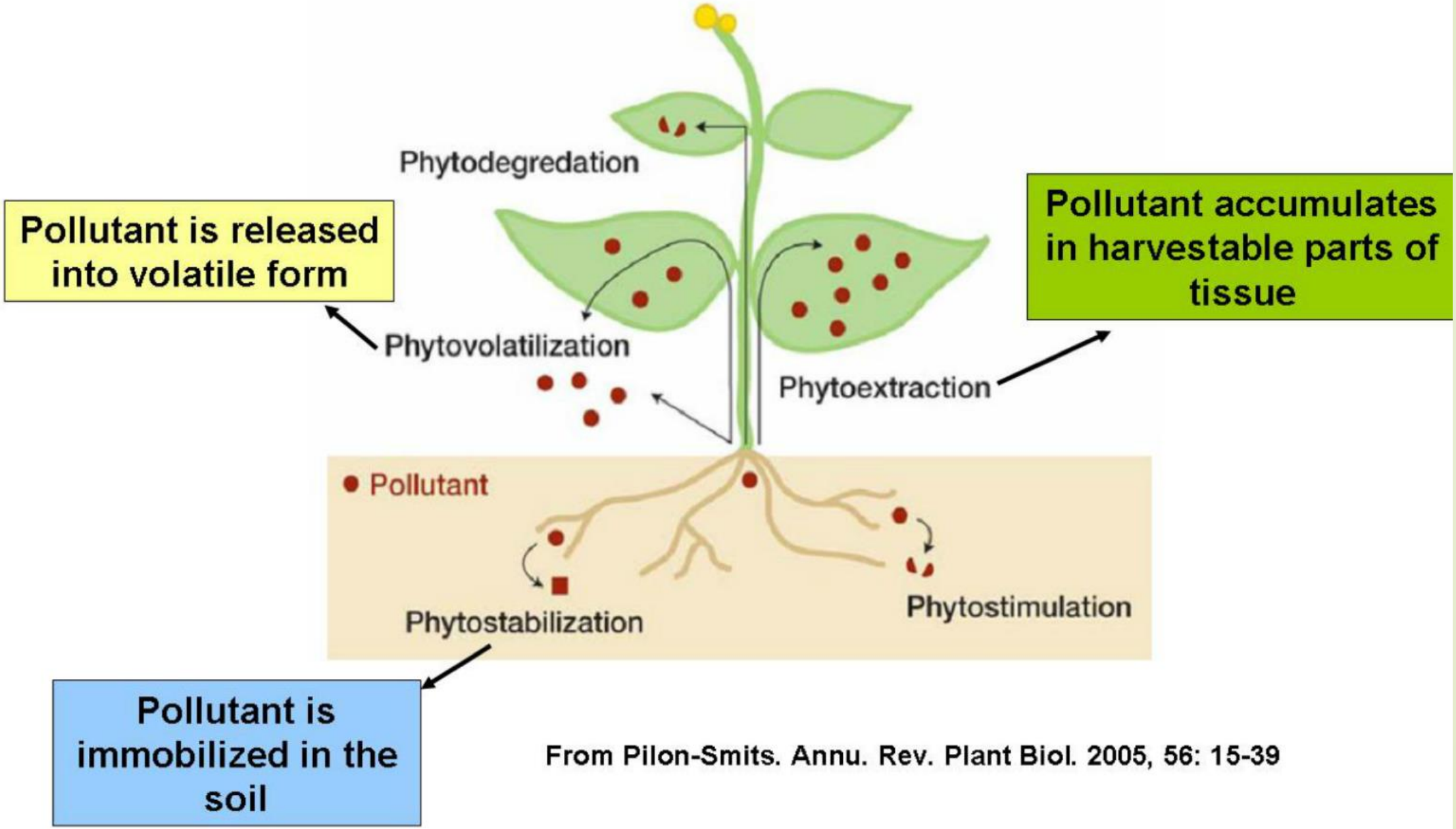




- Research fields
  - Phytoremediation
  - Urban air and snow water quality
  - GHG emission from agricultural sector
  - Nitrogen budget
  - Hydrological ➔Ecosystem models

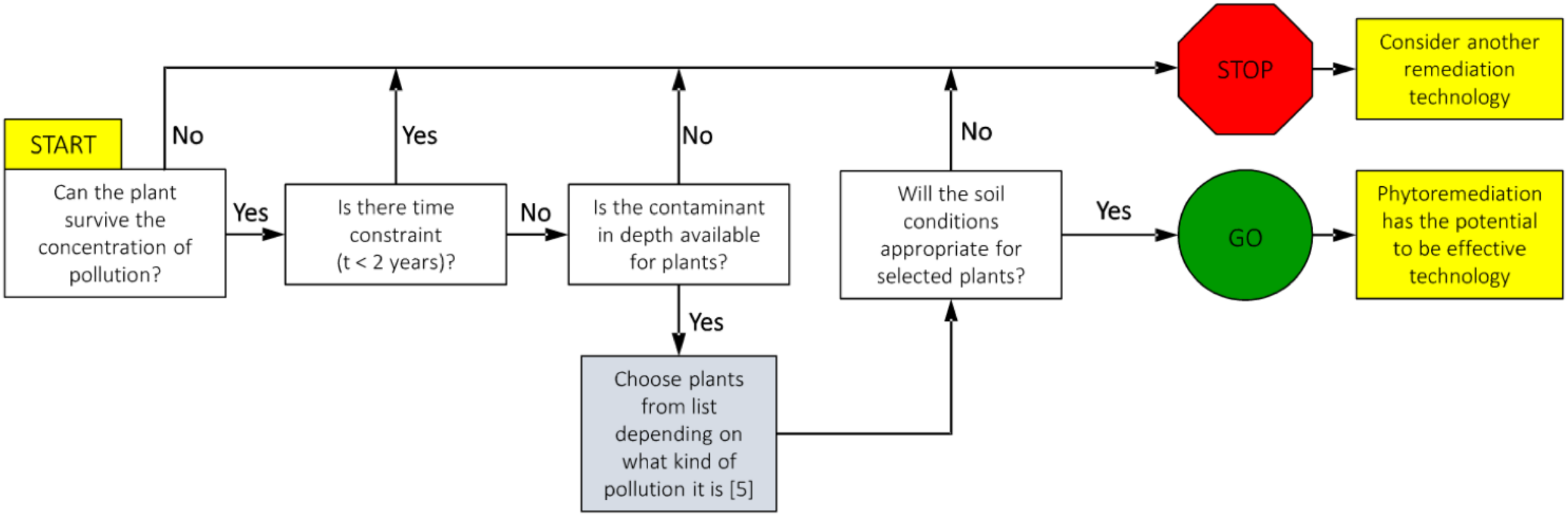
The phytoremediation concept

- Phytoremediation - "Phytoremediation is the **direct use of green plants** and their **associated microorganisms** to **stabilize or reduce contamination** in soils, sludges, sediments, surface water, or ground water ... Sites with **low** concentrations of contaminants over **large** cleanup areas and at **shallow depths** present especially favorable conditions for phytoremediation." - U.S. Environmental Protection Agency, 2011

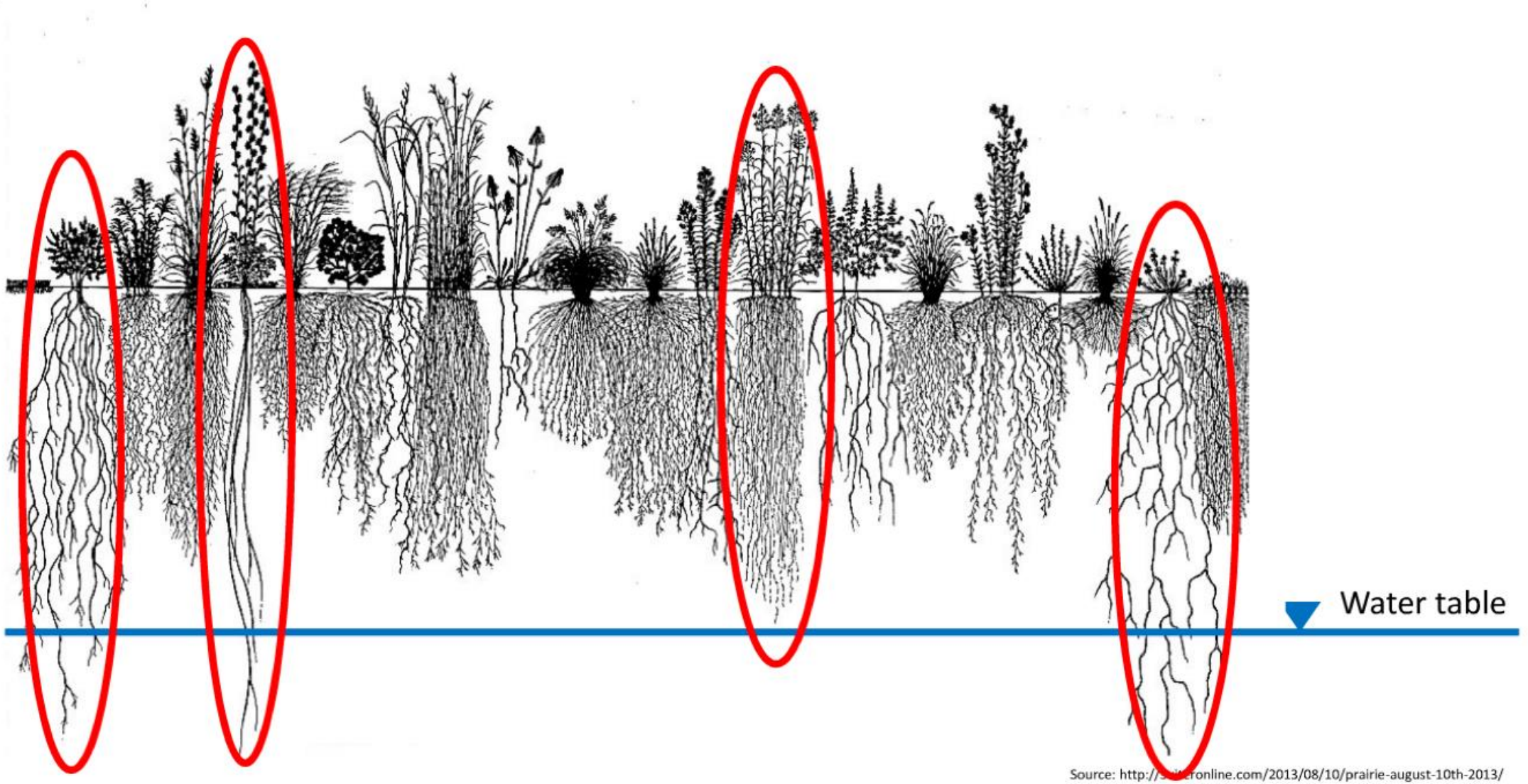


From Pilon-Smits. Annu. Rev. Plant Biol. 2005, 56: 15-39

Decision tree

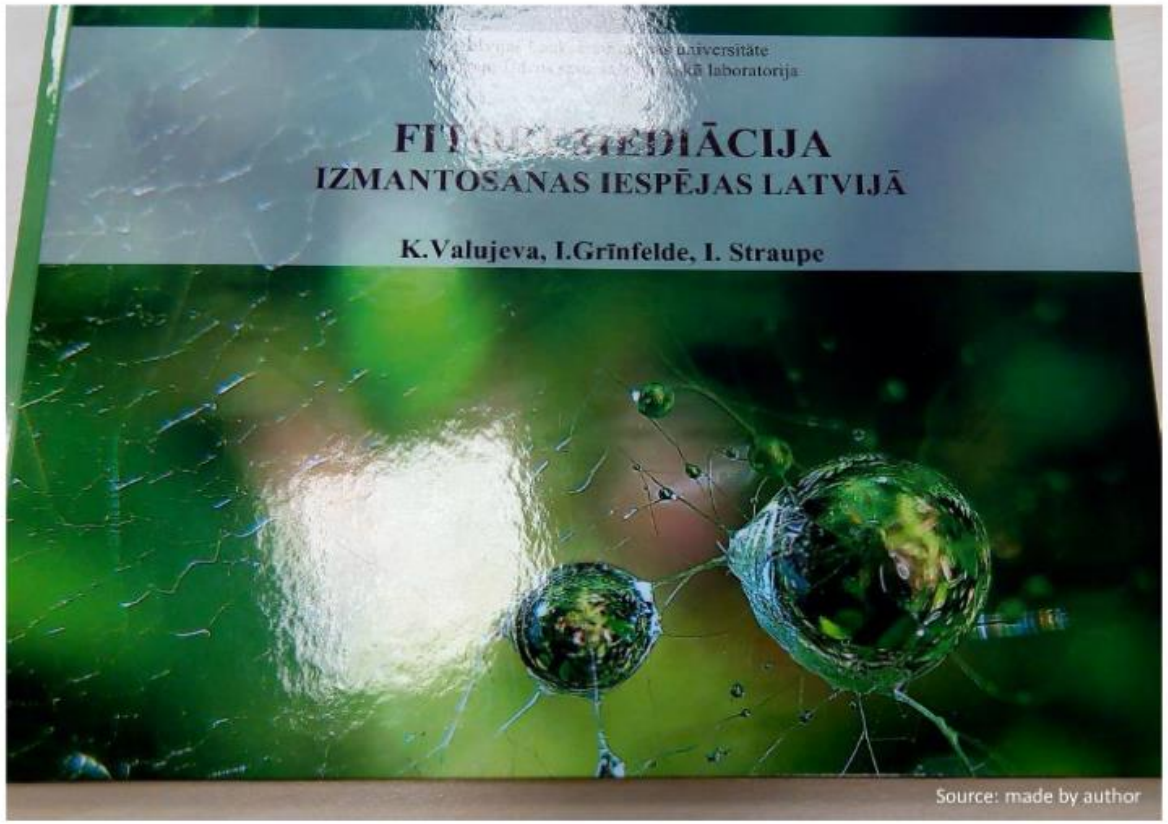


Is the contaminant in depth available for plants?



Source: http://[illegible]ronline.com/2013/08/10/prairie-august-10th-2013/

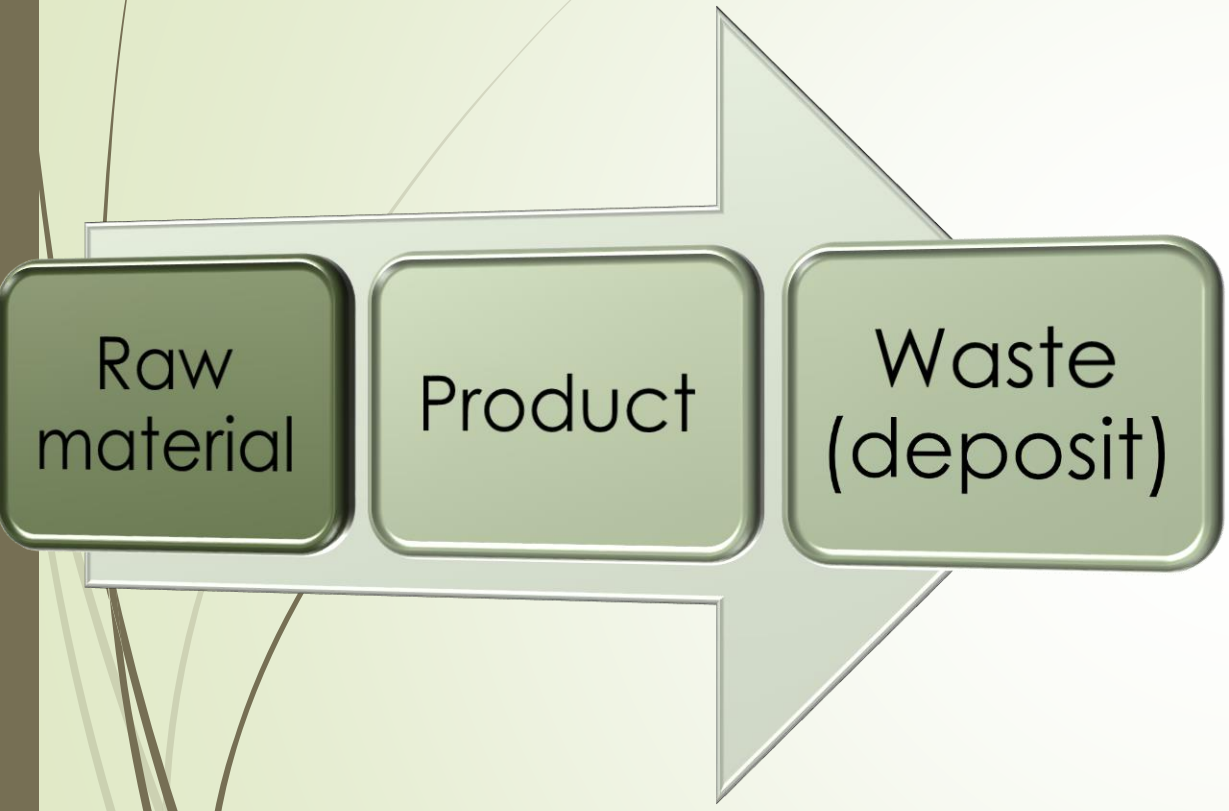
Choose plants from list depending on what kind of pollution it is

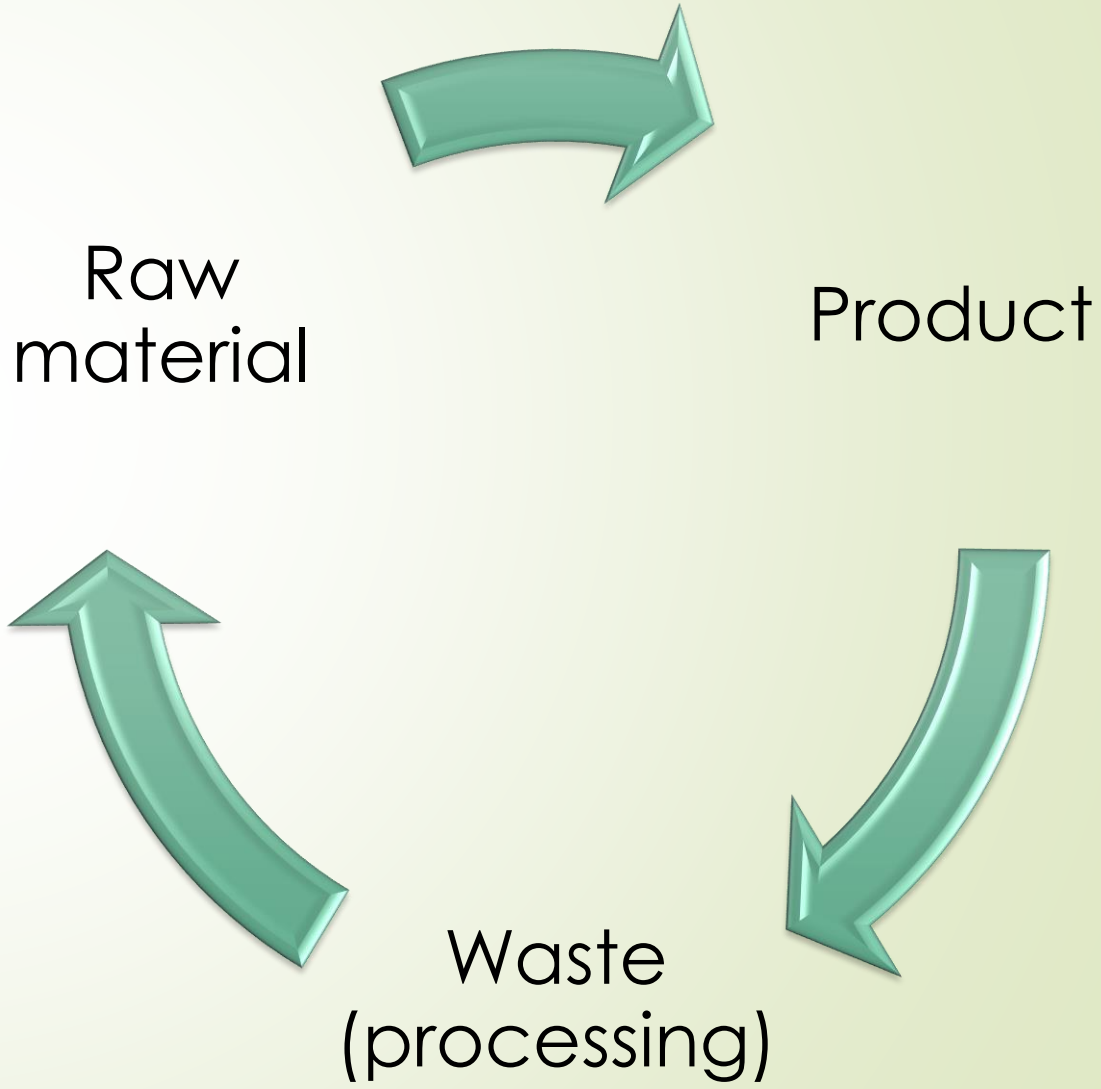


Source: made by author

Baltais jeb ložņu āboliņš *Trifolium repens* L.
Daudzgadīgā airene *Lolium perenne* L.
Hibrīdapse *Populus deltoides x Wettstein*
Hibrīdpapele *Populus hybrids*
Hibrīdvītols *Salix schwerinii x viminalis*
Izplestais jeb plašais donis *Juncus effusus* L.
Kamolu donis *Juncus conglomeratus* L.
Krupju donis *Juncus bufonius* L.
Lauka vībotne *Artemisia campestris* L.
Ložņu vārpata *Elytrigia repens* (L.) Nevski
Niedru auzene *Festuca arundinacea* Schreb.
Parastā māllēpe *Tussilago farfara* L.
Parastā priede *Pinus sylvestris* L.
Parastais biškrēsliņš *Tanacetum vulgare* L.
Plakanā skarene *Poa compressa* L.
Pļavas skarene *Poa pratensis* L.
Pūkainais grīslis *Carex hirta* L.
Sarkanā auzene *Festuca rubra* L.
Slotiņu jeb smiltāja ciesa *Calamagrostis epigeios* (L.) Roth
Smiltāja kāpukviesis *Leymus arenarius* (L.) Hochst.
Smilts grīslis *Carex arenaria* L.
Spožaugļu donis *Juncus articulatus* L.
Tievais donis *Juncus filiformis* L.
Tīruma kosa *Equisetum arvense* L.
Tīruma tītenis *Convolvulus arvensis* L.
Tīruma usne *Cirsium arvense* (L.) Scop.

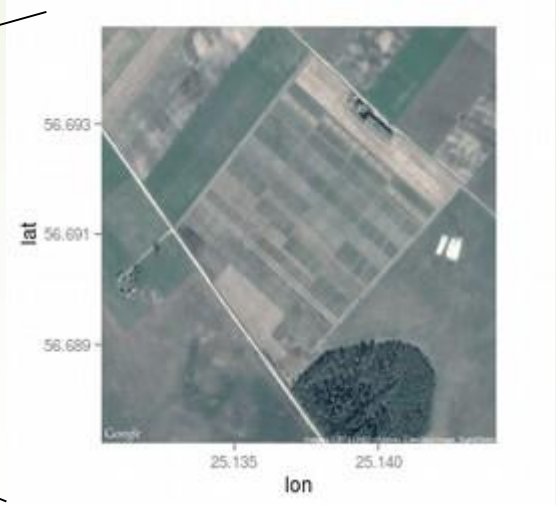
The phytoremediation application in circular economy context





Agroforestry Research

- Doses of spreaded fertilisers:
  - I class (according to regulations of the Cabinet of Ministers No. 362) **sewage sludge** (10 t DM ha-1) from "Aizkraukles ūdens";
  - Stabilized **wood ash** from the boiler house in Sigulda (6 t DM ha-1);
  - **Digestate** (30 t ha-1) from the methane reactor in Vecauce district.

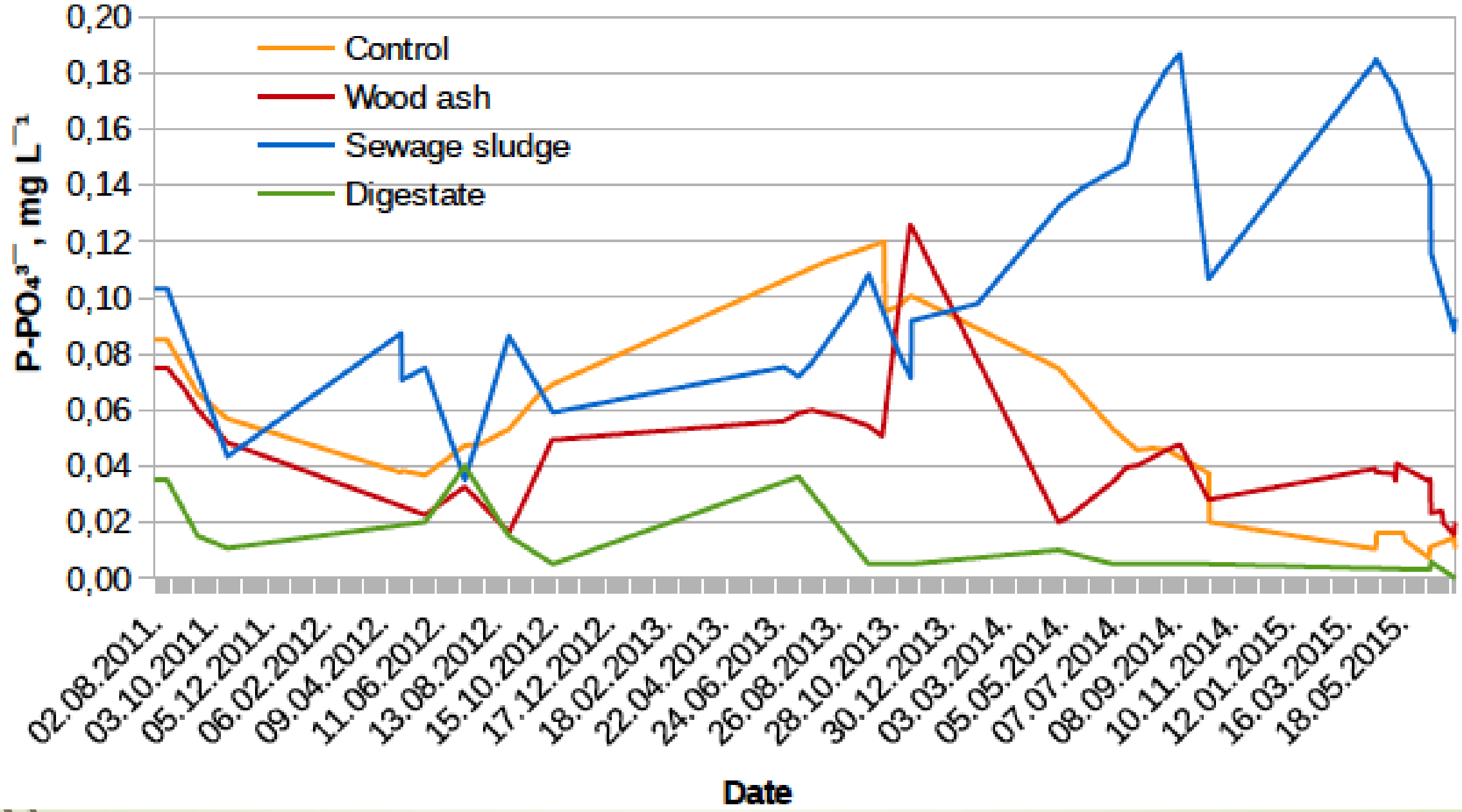


Spring 2011

Summer 2012

Summer 2015

(Bartule et al 2015)



(Bartule et al 2015)

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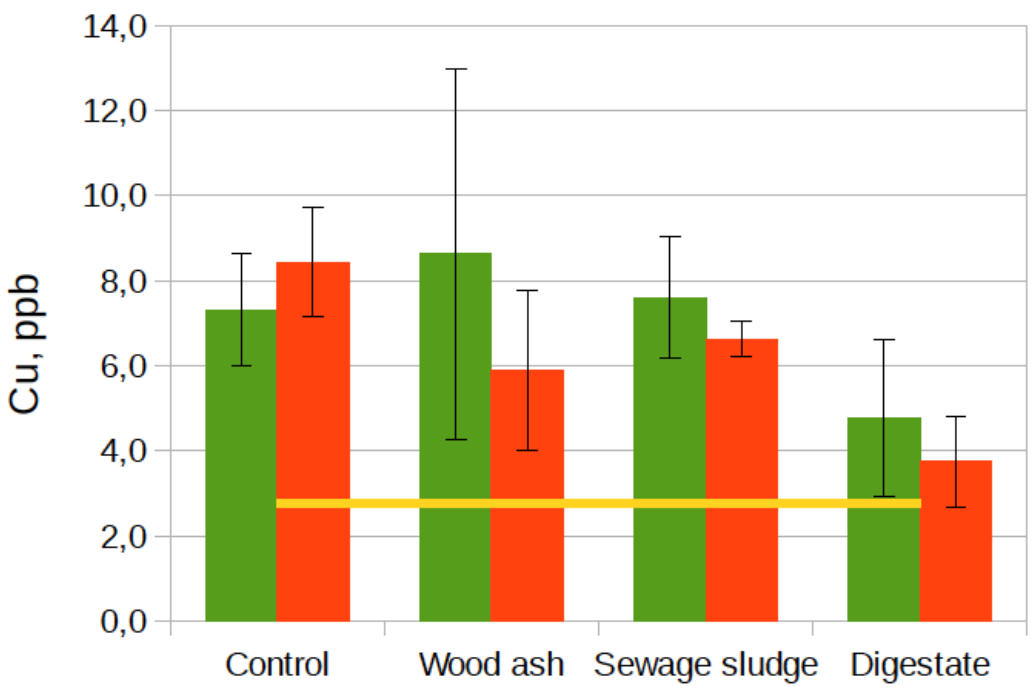
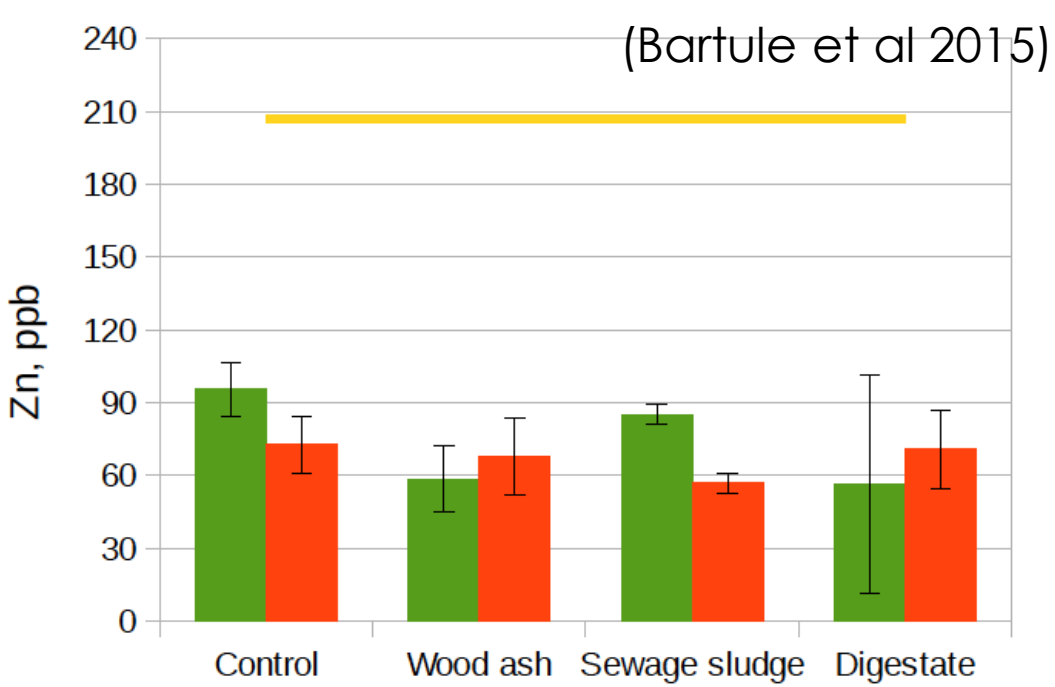
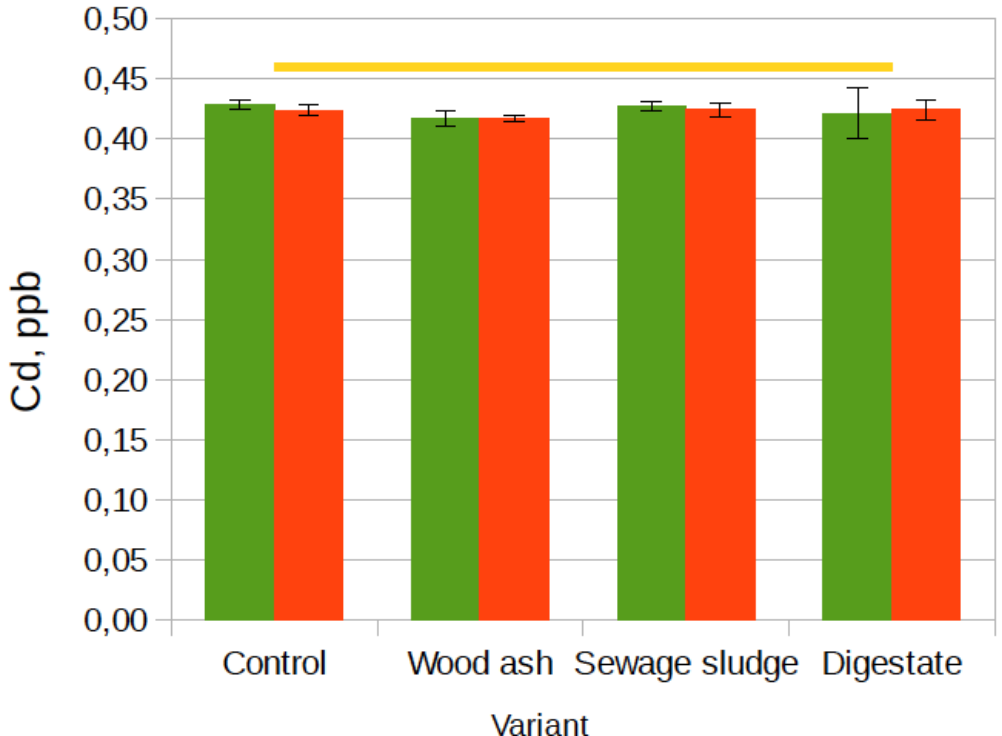
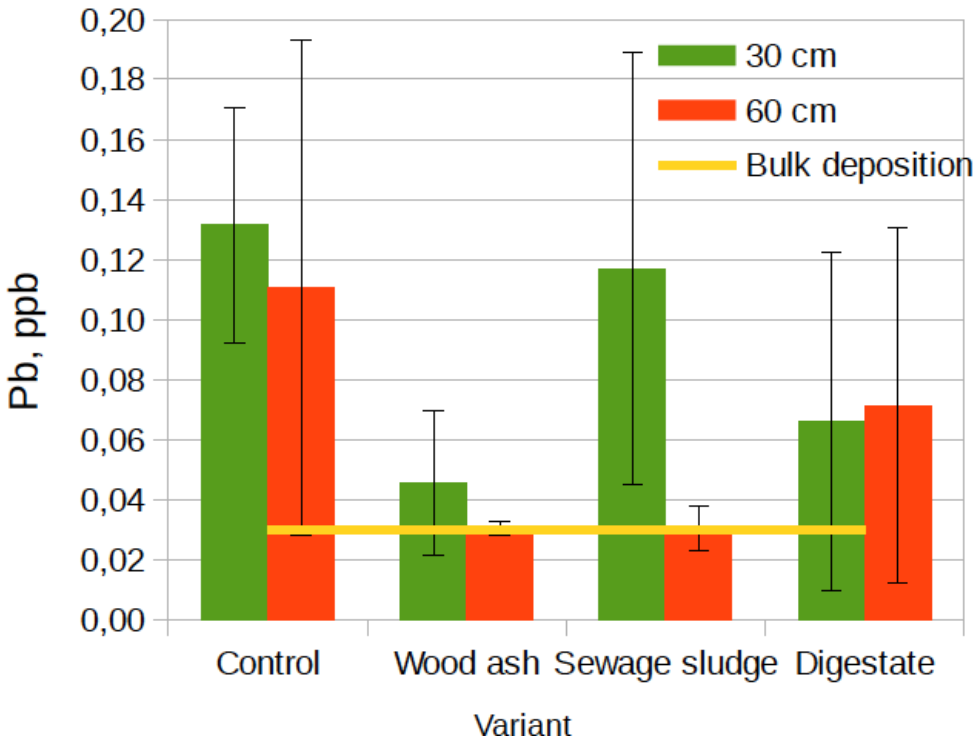








Agricultural Run-Off

Research object – surface and subsurface flow constructed wetlands at farm „Mežacīruļi”

Farm „Mežacīruļi” is located at Zalenieki county, Jelgava region, in the middle of Latvia

The study site is located in the **nitrate vulnerable zone** made in accordance with the criteria set out in the EU Nitrates Directive (1991), since intensity of agricultural production throughout the Zemgale region is high.

(Grinberga, 2017)

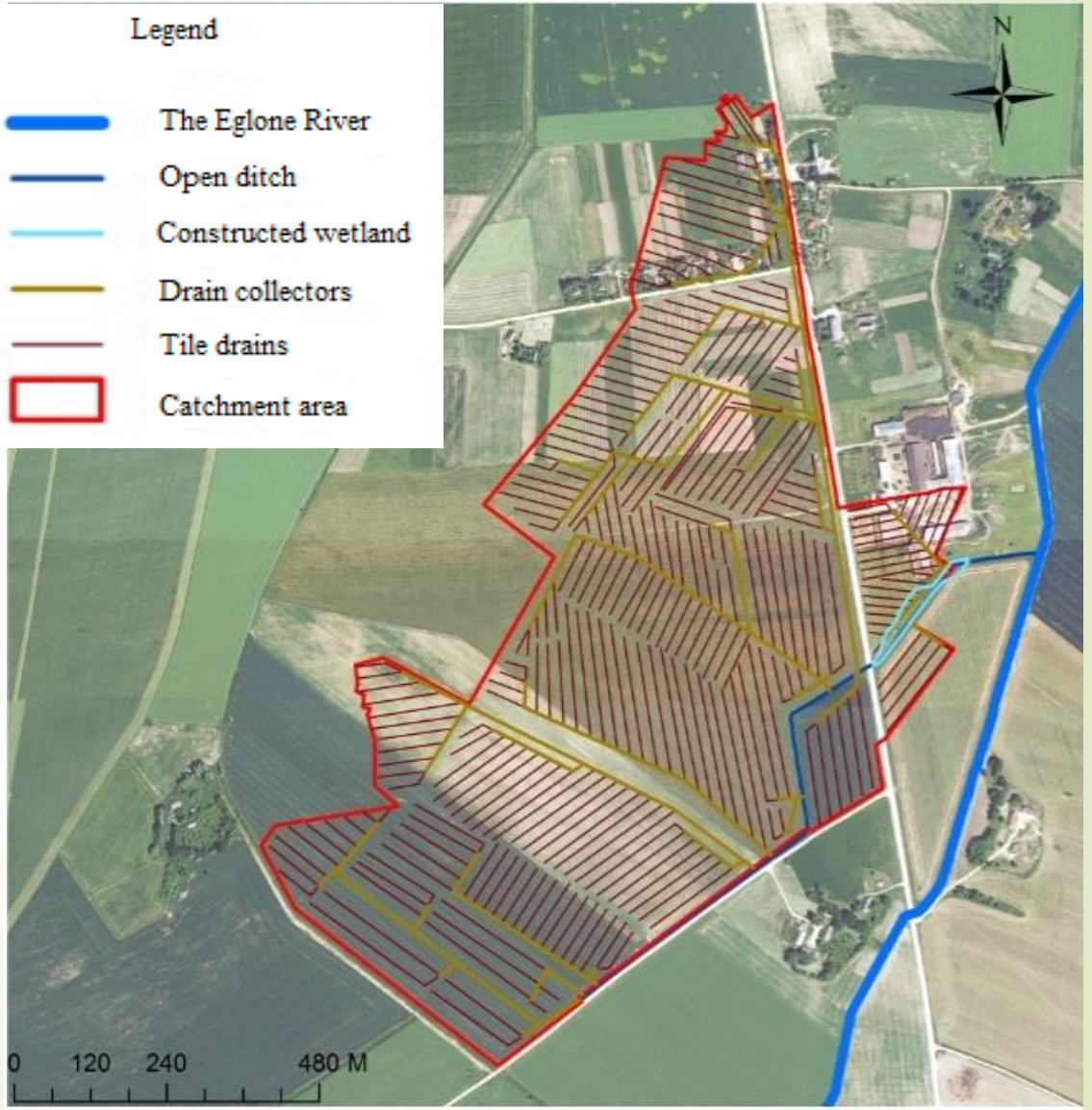


Table 2. Area parameters of the constructed wetlands.

Wetland construction	Catchment area, ha *	Surface area, ha	Surface/catchment area ratio, %
Surface flow	74.7	0.37	0.5
Subsurface flow	0.8	0.016	2

* Estimated based on the digital database of drainage network prepared by the State Limited Liability Company "Ministry of Agriculture Real Estate"

(Grinberga, 2017)

Site	NH_4-N	NO_3-N	TN	PO_4-P	TP	TSS
Surface flow CW	-24	-20	-19	-32	-31	-46
Subsurface flow CW	-68	-24	-44	-85	-85	-55

Nutrient retention (%) in two constructed wetlands.

(Grinberga, 2017)

Orrefors Park

- **Water**
- **Soil**
- **Air**
- **Biota**

- **Heritage of glass industry**

THE CHEMISTRY OF COLOURED GLASS

Glass is coloured in 3 main ways. It can have transition or rare earth metal ions added; it can be due to colloidal particles formed in the glass; or it can be due to particles which are coloured themselves. This graphic shows some of the typical chemical elements that are used to colour glass.

SODA-LIME GLASS

COMPOSITION

SiO_2 **70-74%**
SILICON DIOXIDE

CaO **10-14%**
CALCIUM OXIDE

Na_2O **13-16%**
SODIUM OXIDE

Soda-lime glass is the most common glass type, making up an estimated 90% of all manufactured glass. Its uses include containers, windows, bottles, and drinking glasses. The above percentages are a general composition only; other compounds are also present in smaller amounts.

These are typical colours, and can be affected by the type of glass as well as the concentration of the colourant. Combination with other elements and compounds can also have an effect on the final colouration of the glass.

Orreforsh park

Brainstorming

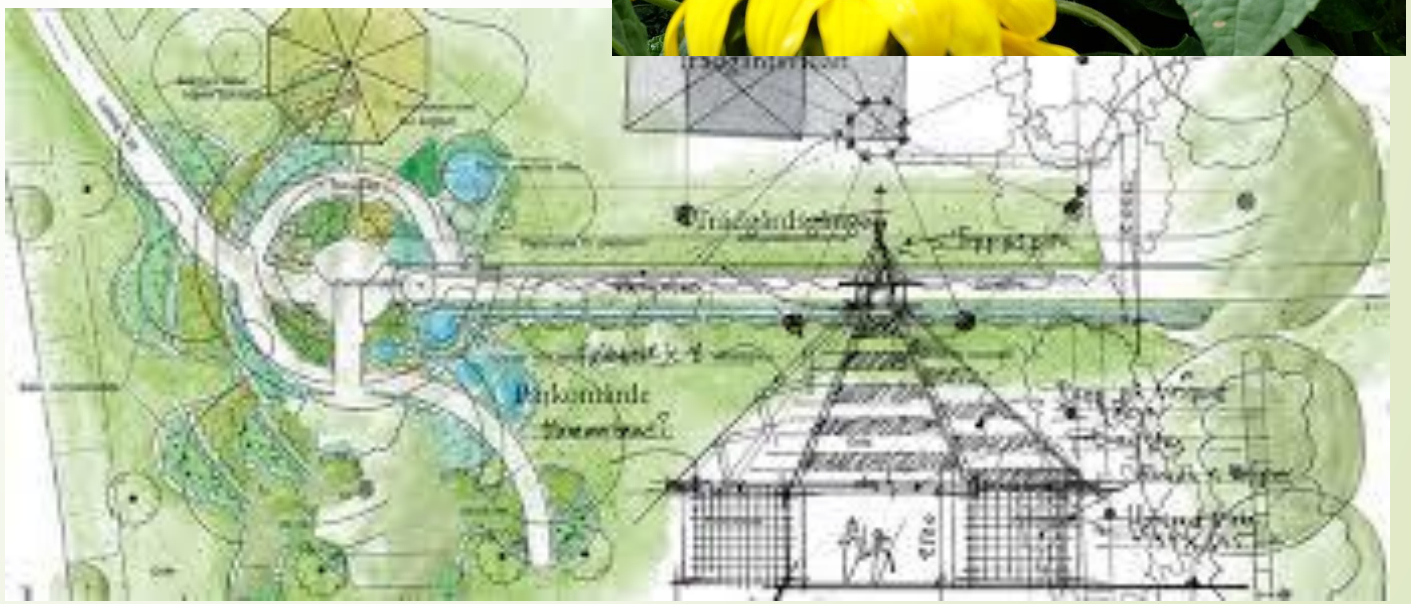
Synergy


Can the plant survive the concentration of pollution?
Pinus sylvestris L.
Salix viminalis L.
Medicago sativa L.
Diesel fuel
Oil products
Salt
Lnu.se
Glassmining & phytoremediation
in collaboration with
Svenska Institutet
Latvian University of Agriculture
Estonian University of Life Science
Ormanlı Bruk

Phytopark

- Ecotourism
- Family tourism
- Orreforsh brand

- Plants for phytopark

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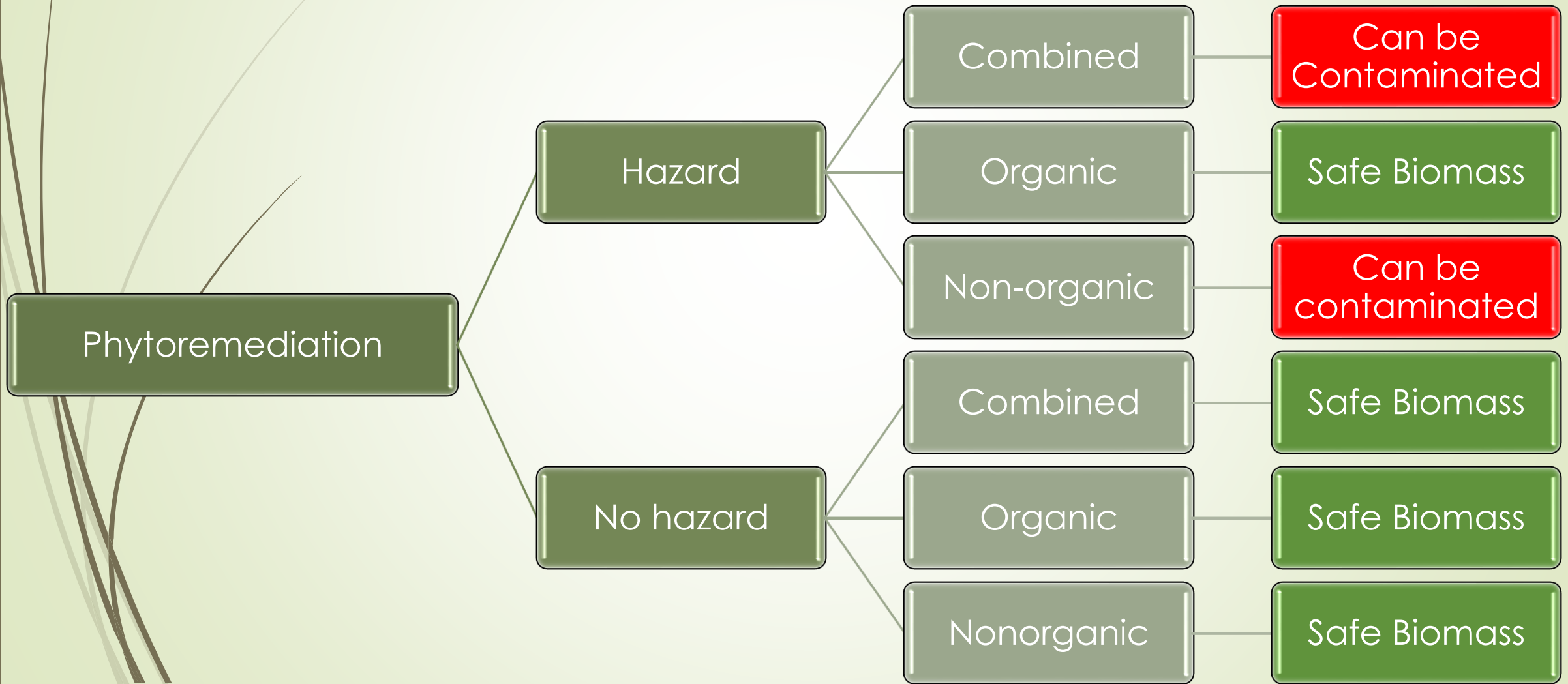
Phytoremediation in Circular Economy Context



Thank You!

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