Role of risks in a sustainability management of a food ecosystem

Elintarvike-ekosysteemin kestävä hallinnointi

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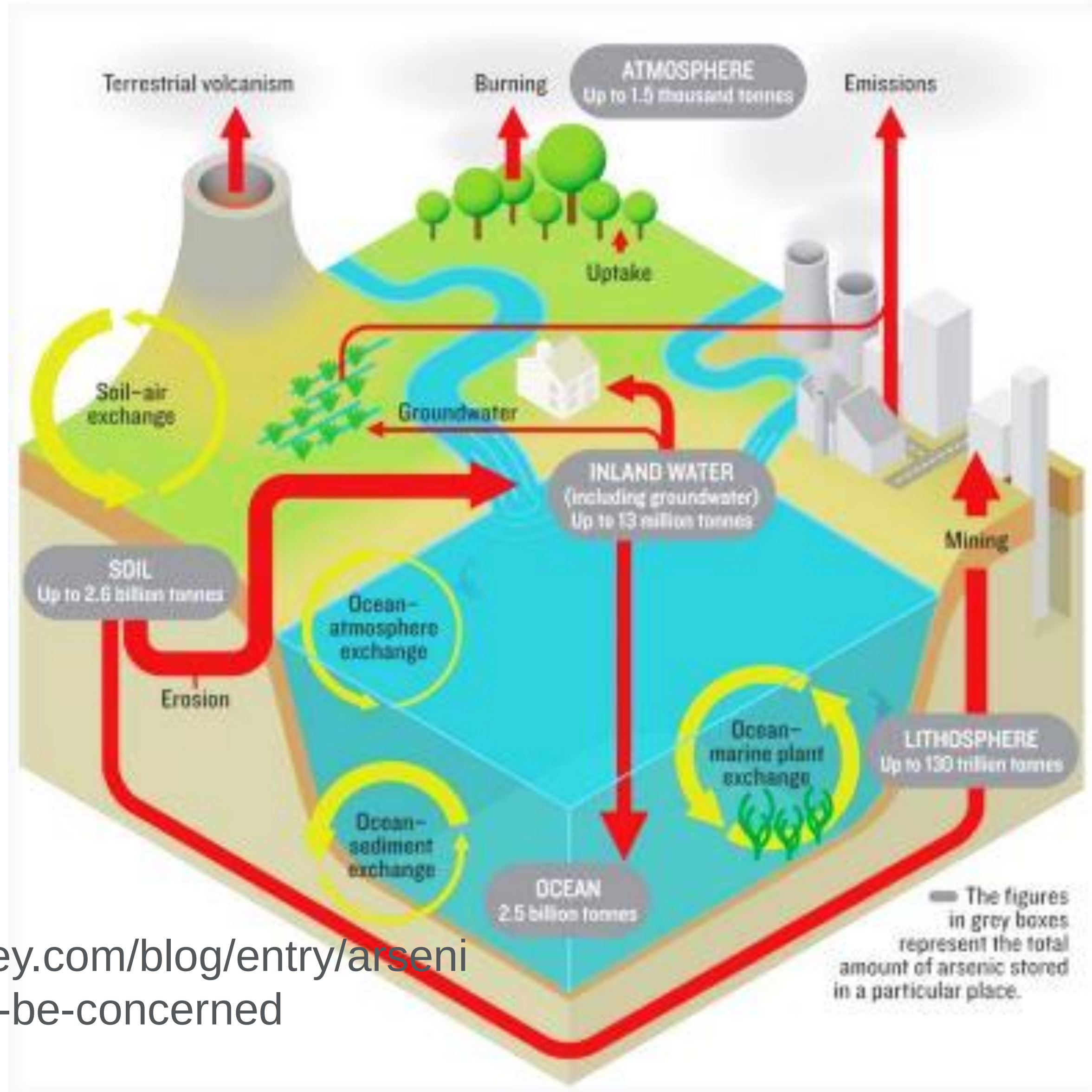

https://www.drcarney.com/blog/entry/arsenic-in-rice-should-we-be-concerned

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Risk routes for food ecosystem

- Land use for cultivation
- Secondary land use (residential area, playground)
- Cultivation techniques
- Soil amendments
- Fertilizers
- Dust
- Irrigation water for cultivation
- Precipitation
- Water for process
- Water for consumption
- Plant and animal based products for consumption
- Use of side flows and circulation

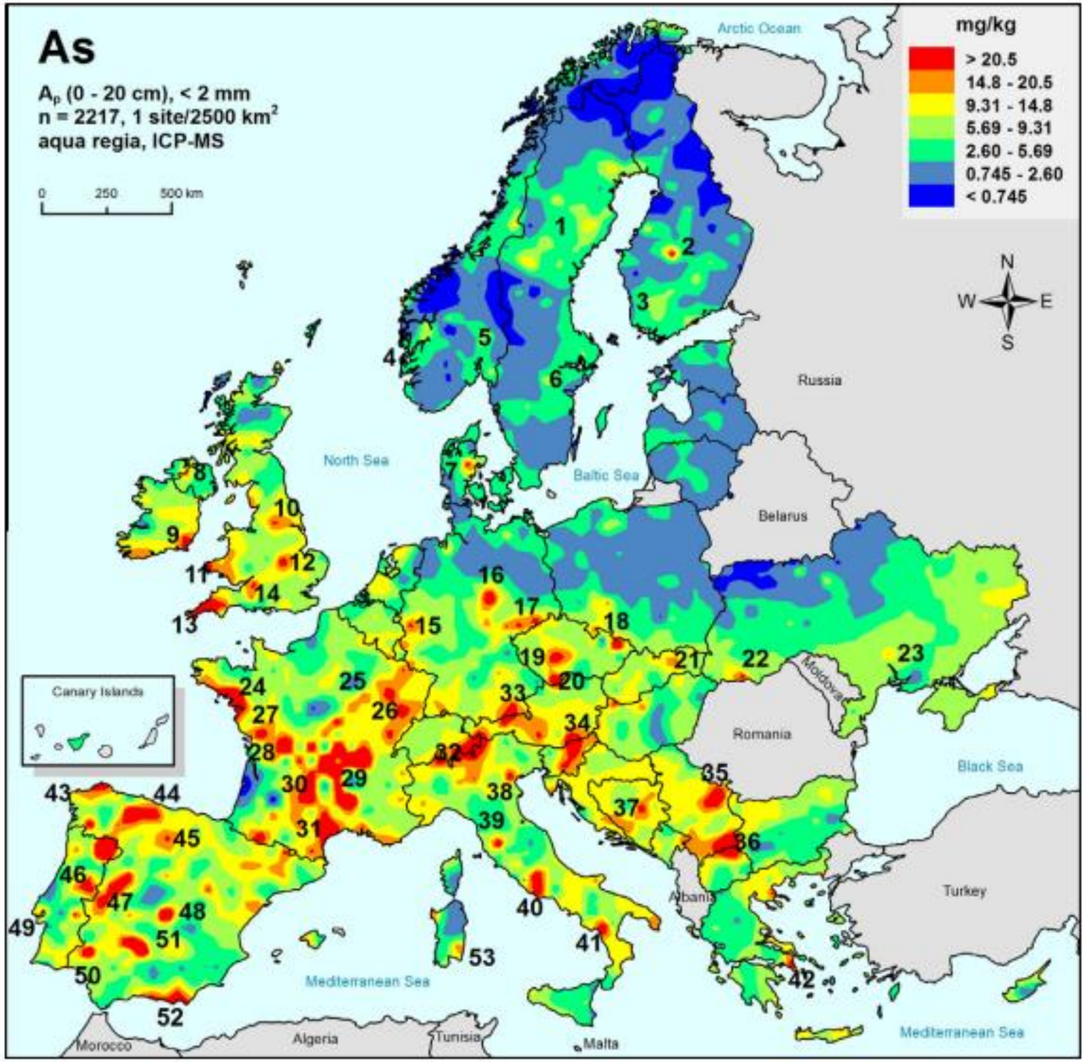
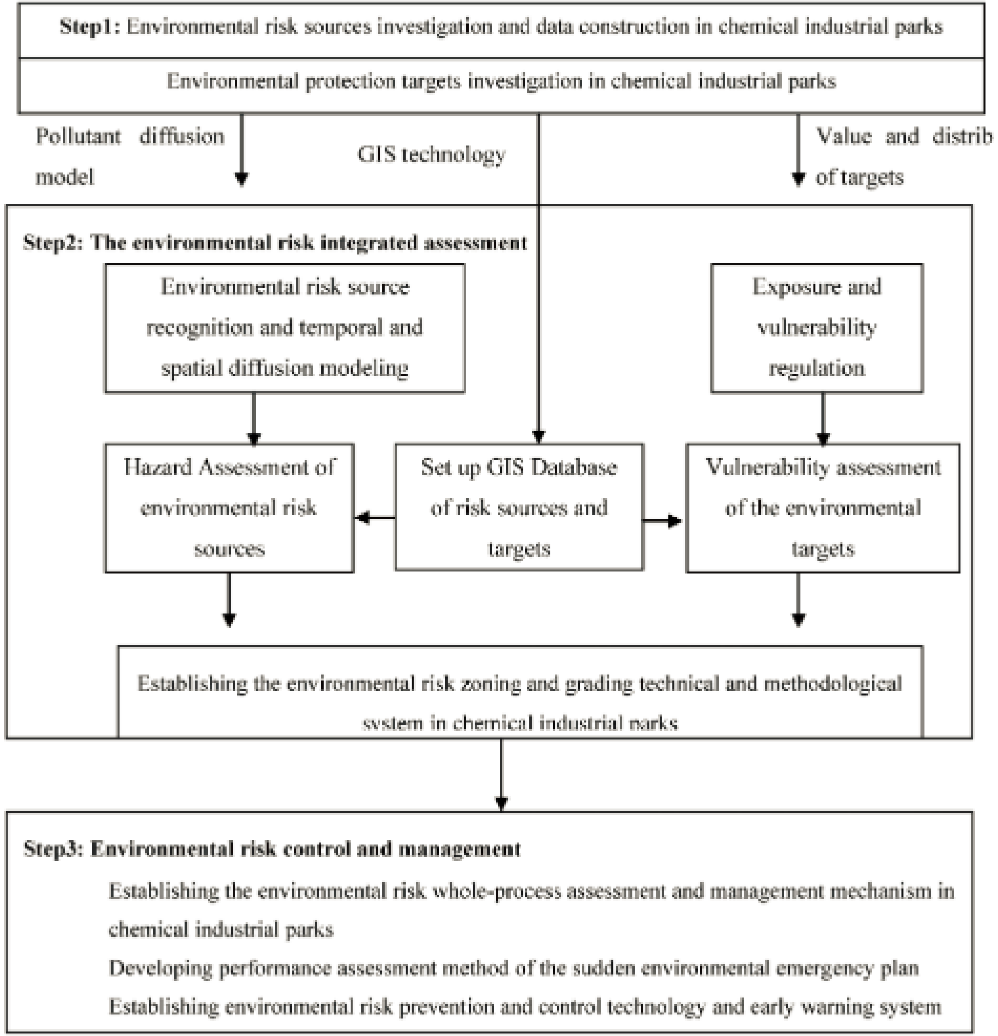


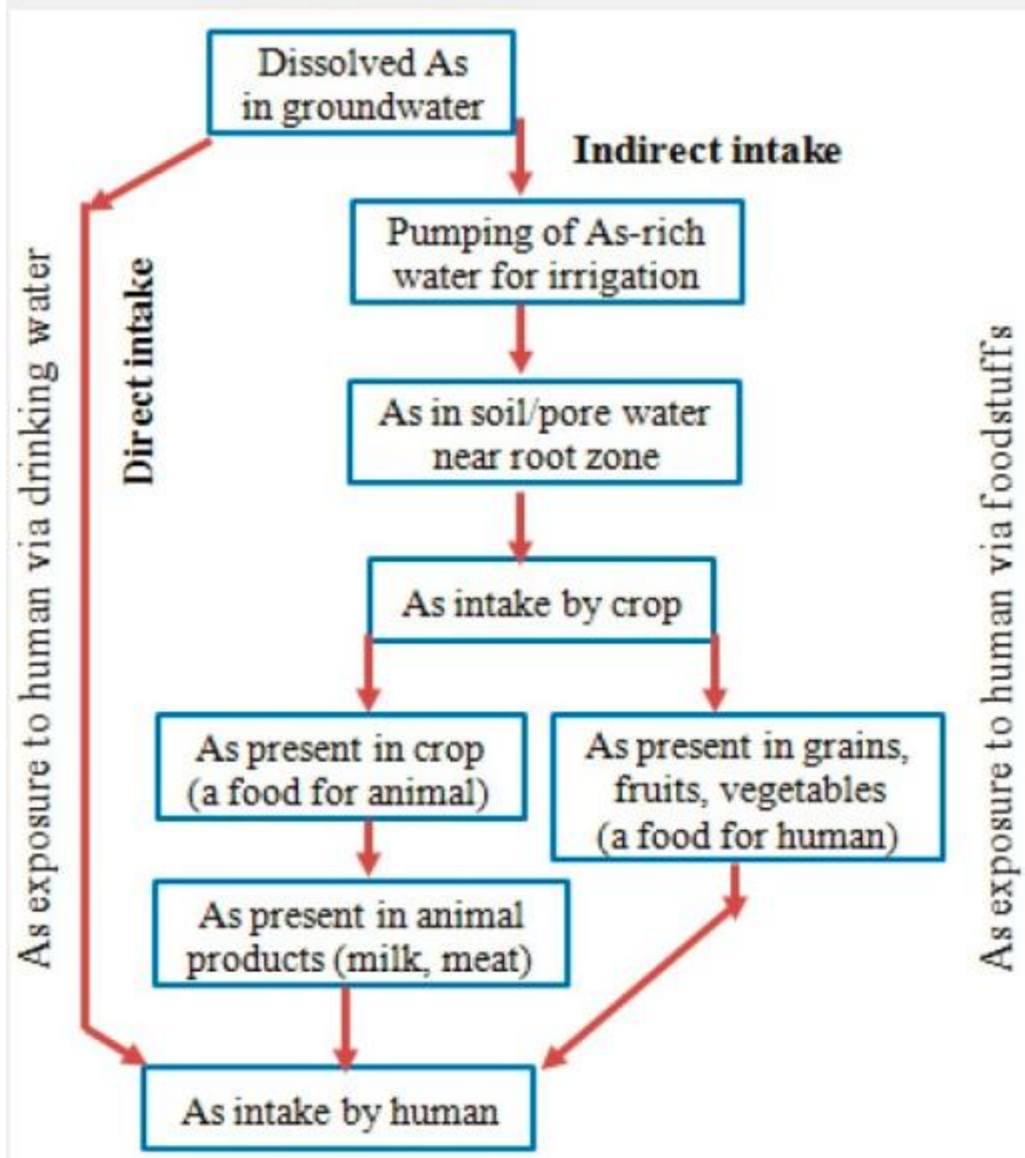
Fig. 3. Distribution of As in European agricultural topsoils. Aqua regia extraction of the <2 mm size fraction.

Timo Tarvainen, Stefano Albanese, Manfred Birke, Michal Ponˇavic, Clemens Reimann (The GEMAS Project Team) Arsenic in agricultural and grazing land soils of Europe. Applied Geochemistry 28 (2013) 2–10


Vulnerability
Hazard
RISK
Exposure


Step1: Environmental risk sources investigation and data construction in chemical industrial parks
Environmental protection targets investigation in chemical industrial parks
Pollutant diffusion model
GIS technology
Value and distrib of targets
Step2: The environmental risk integrated assessment
Environmental risk source recognition and temporal and spatial diffusion modeling
Exposure and vulnerability regulation
Hazard Assessment of environmental risk sources
Set up GIS Database of risk sources and targets
Vulnerability assessment of the environmental targets
Establishing the environmental risk zoning and grading technical and methodological system in chemical industrial parks
Step3: Environmental risk control and management
Establishing the environmental risk whole-process assessment and management mechanism in chemical industrial parks
Developing performance assessment method of the sudden environmental emergency plan
Establishing environmental risk prevention and control technology and early warning system

Arsenic contaminated groundwater and its treatment options in Bangladesh.
Jiang JQ, Ashekuzzaman SM, Jiang A, Sharifuzzaman SM, Chowdhury SR - Int J Environ Res Public Health (2012)



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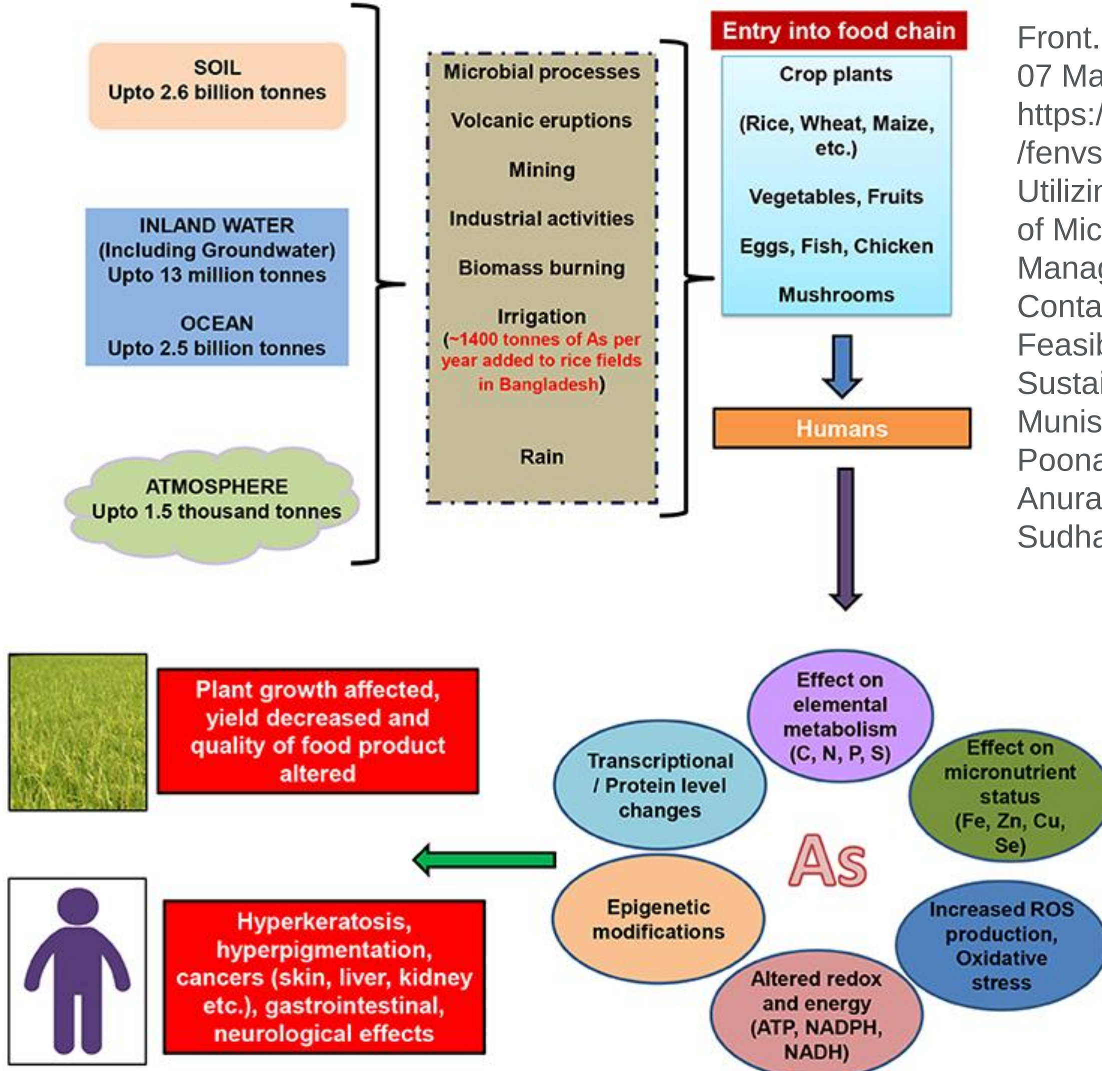
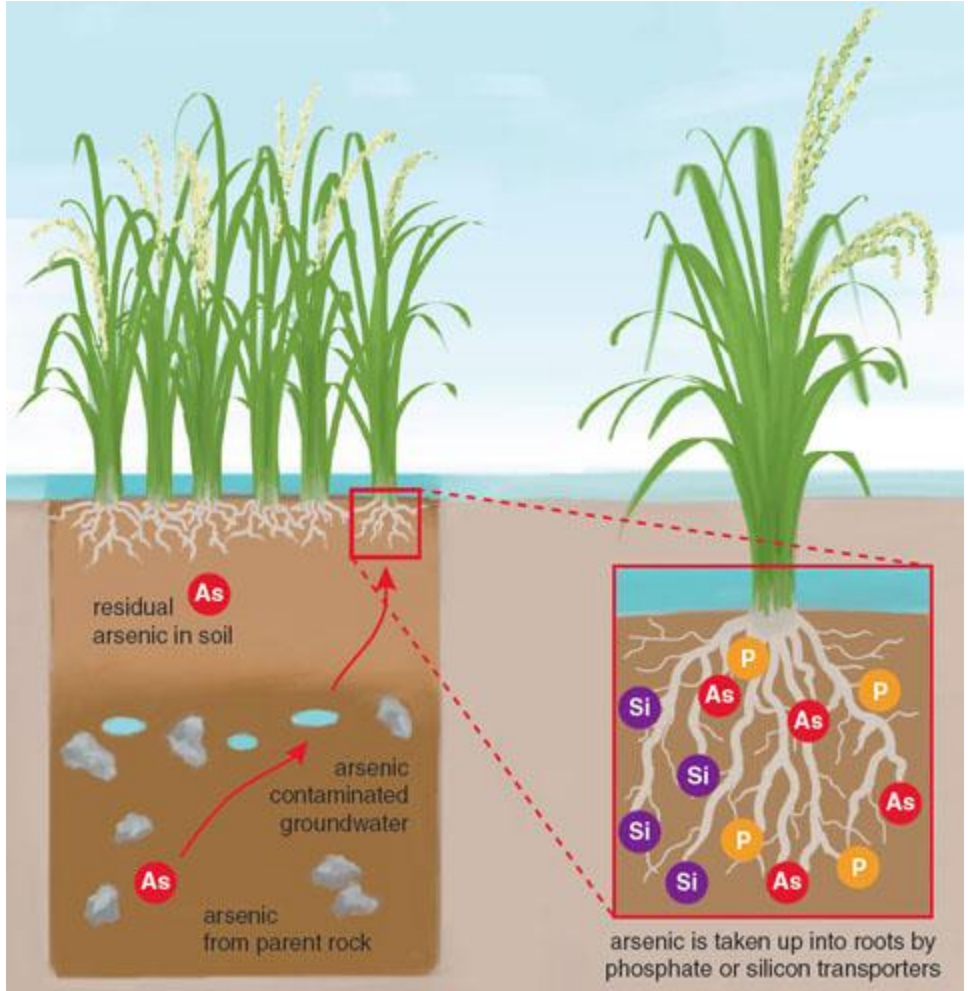
The figure represents the presence of As in soil, water, and air and the entry routes of As to plants, animals and humans via irrigation, volcanic eruptions, mining and industrial activities, microbial processes and rain. Once inside plants and humans, the toxicity mechanisms include elemental interactions, reactive oxygen species (ROS) production, oxidative stress induction, redox and energy imbalance, and epigenetic, transcriptional and proteomic changes. Prolonged exposure to As leads to diminished growth, and yield in plants and to various medical problems, including cancers in humans. (As values for soil, inland water, ocean, and atmosphere and irrigation water taken from Neumann et al. (2011) and Sohn (2014).



Front. Environ. Sci., 07 May 2018 | https://doi.org/10.3389/fenvs.2018.00024
Utilizing the Potential of Microorganisms for Managing Arsenic Contamination: A Feasible and Sustainable Approach
Munish K. Upadhyay, Poonam Yadav, Anurakti Shukla and Sudhakar Srivastava*



residual arsenic in soil
As
arsenic contaminated groundwater
As
arsenic from parent rock
Si
As
P
arsenic is taken up into roots by phosphate or silicon transporters

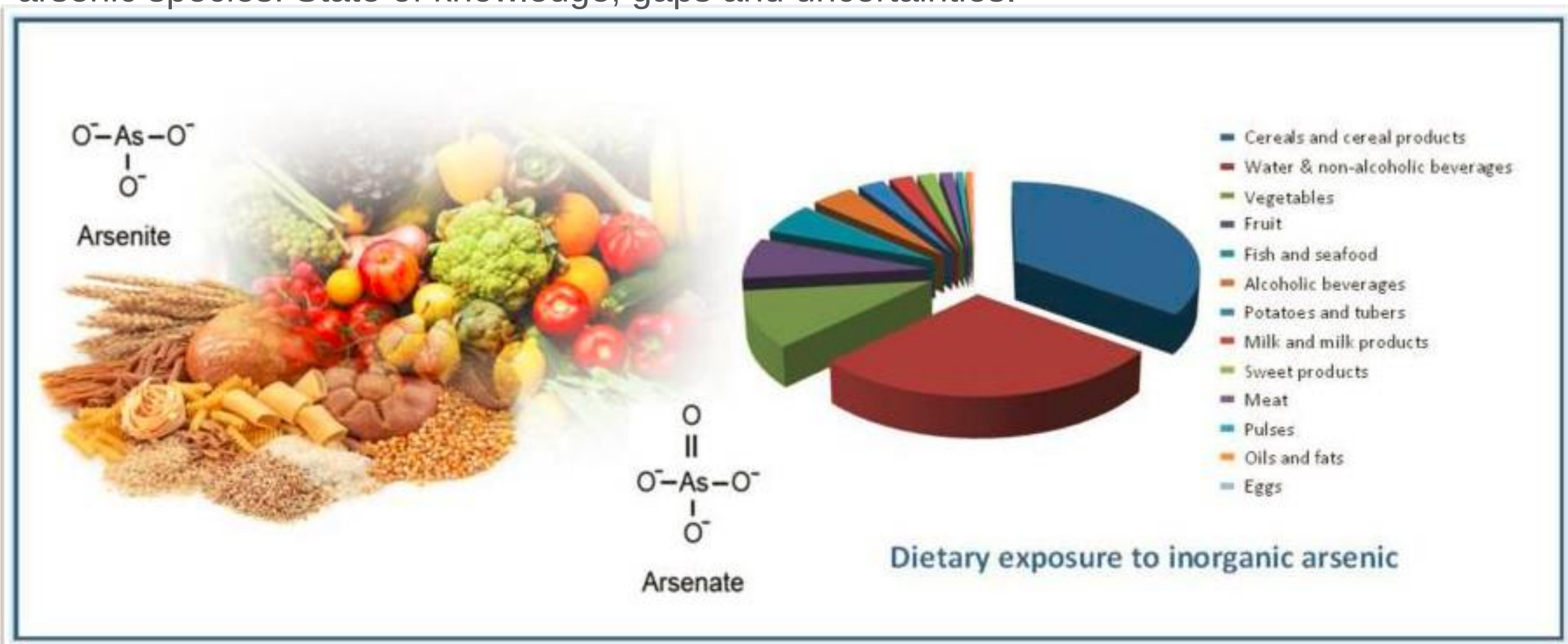
What are the limits on inorganic arsenic in food?

In 2015 EU maximum limits were introduced on inorganic arsenic in rice – including rice that is used in the production of food for infants and young children – as well as rice products.

For non-parboiled milled rice (polished or white rice) the limit is 0.2 milligrams per kilogram, while the limit is 0.25 mg/kg for parboiled rice and husked rice. The limit for rice waffles, rice wafers, rice crackers and rice cakes is 0.3 mg/kg. For rice used in the production of food destined for infants and young children the limit is 0.1 mg/kg.

An EU recommendation was issued the same year to all member states to perform increased monitoring of inorganic arsenic in foods in order to improve the dataset on which risk assessments of the intake are based.

Sci Total Environ. 2017 Feb 1; 579: 1228–1239. Published online 2016 Nov 30. doi: 10.1016/j.scitotenv.2016.11.108
Francesco Cubadda, Brian P. Jackson, Kathryn L. Cottingham, Yoshira Ornelas Van Horne and Margaret Kurzius-Spencerd. Human exposure to dietary inorganic arsenic and other arsenic species: State of knowledge, gaps and uncertainties.



Human exposure assessment through different dietary approaches including duplicate diet studies, market basket surveys, and total diet studies

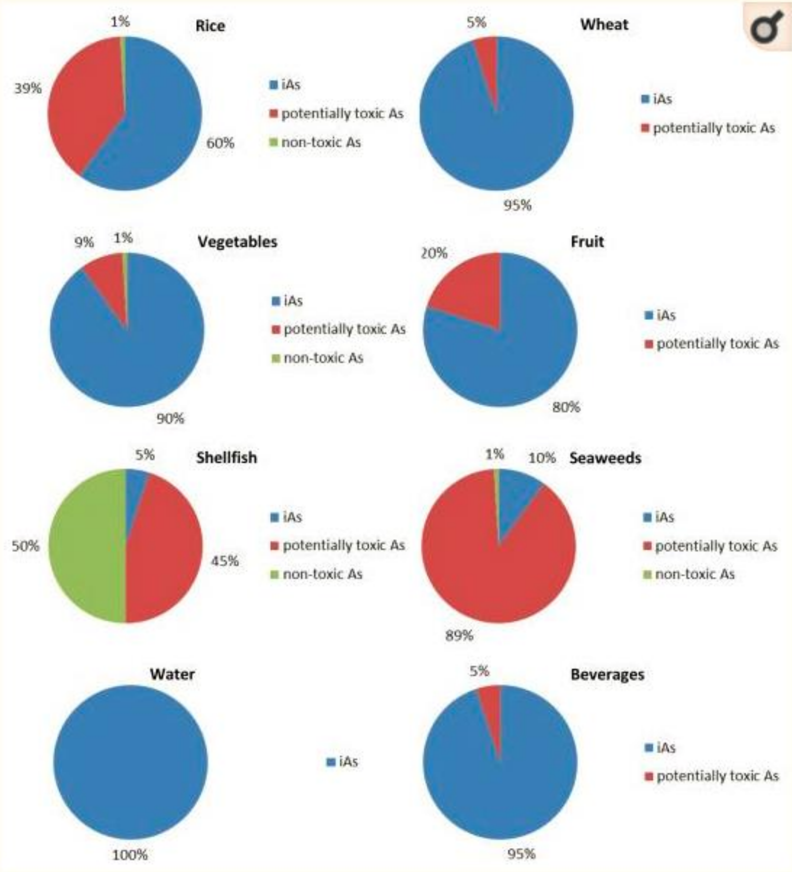


Figure 1

Estimated proportions of iAs and other arsenic species belonging to the 'potentially toxic fraction' and the 'non-toxic fraction' (arsenobetaine) in important contributors to iAs dietary exposure (for references see Table S1, Supplementary Material).

Total Diet Study

Elements Results Summary Statistics

Market Baskets 2006 through 2013

Element	TDS Food No.	TDS Food Name	N of Analyses	N of Non-detects	N of Trace	Mean (mg/kg)	Std Dev (mg/kg)	Median (mg/kg)	Min (mg/kg)	Max (mg/kg)	LOD (mg/kg)	LOQ (mg/kg)
ARSENIC	34	Fish sticks or patty, frozen, oven-cooked	32	0	0	0.504	0.176	0.549	0.055	0.780	0.020	0.040
ARSENIC	75	Crisped rice cereal	32	1	0	0.159	0.080	0.156	0	0.505	0.010	0.040
ARSENIC	276	Fish sandwich on bun, fast-food	32	3	0	0.424	0.212	0.484	0	0.745	0.020	0.040
ARSENIC	340	Tuna, canned in water, drained	32	0	0	0.999	0.420	0.9	0.349	1.900	0.012	0.040
ARSENIC	317	BF, teething biscuits	31	15	15	0.010	0.013	0.011	0	0.054	0.010	0.040

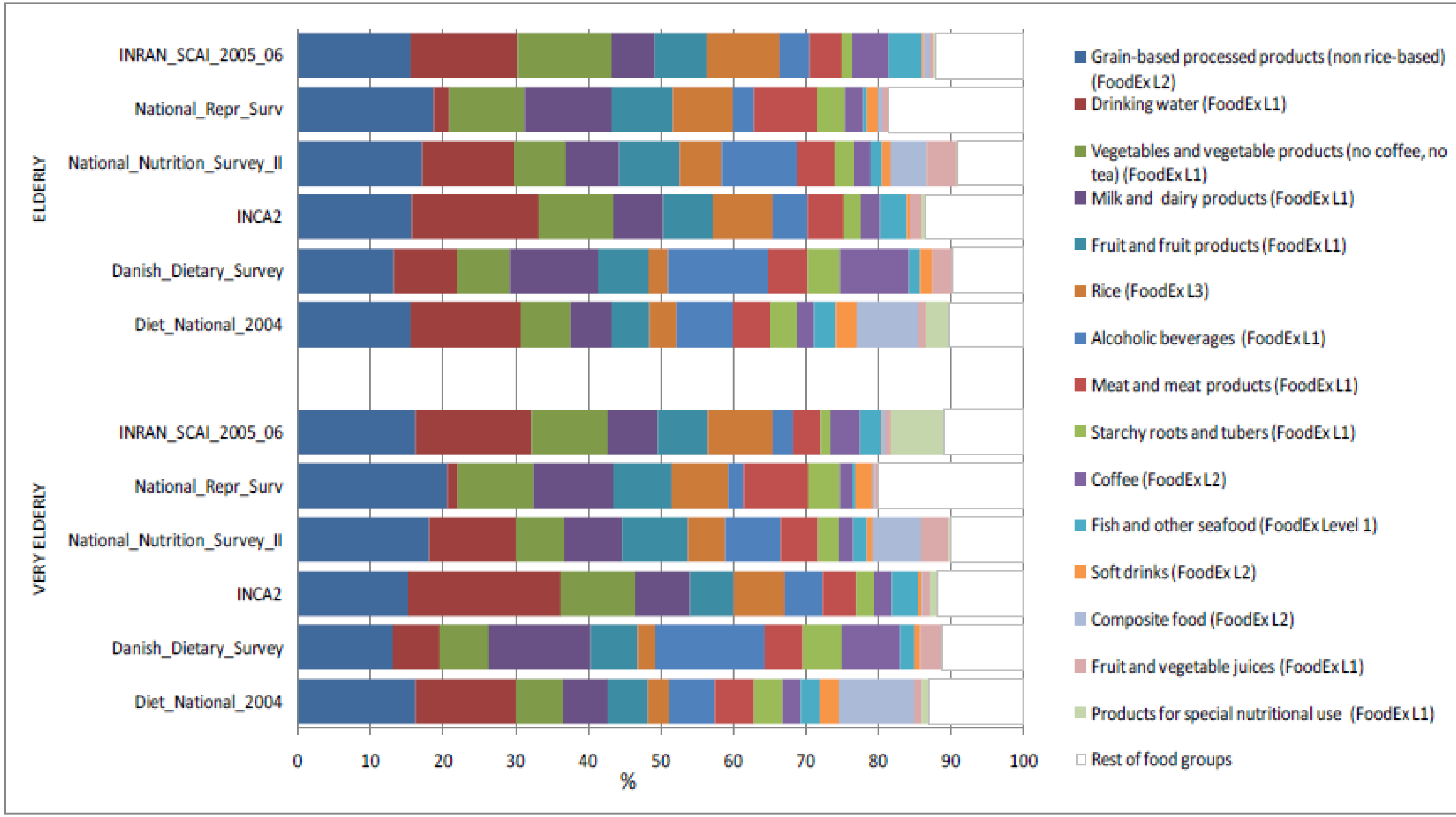
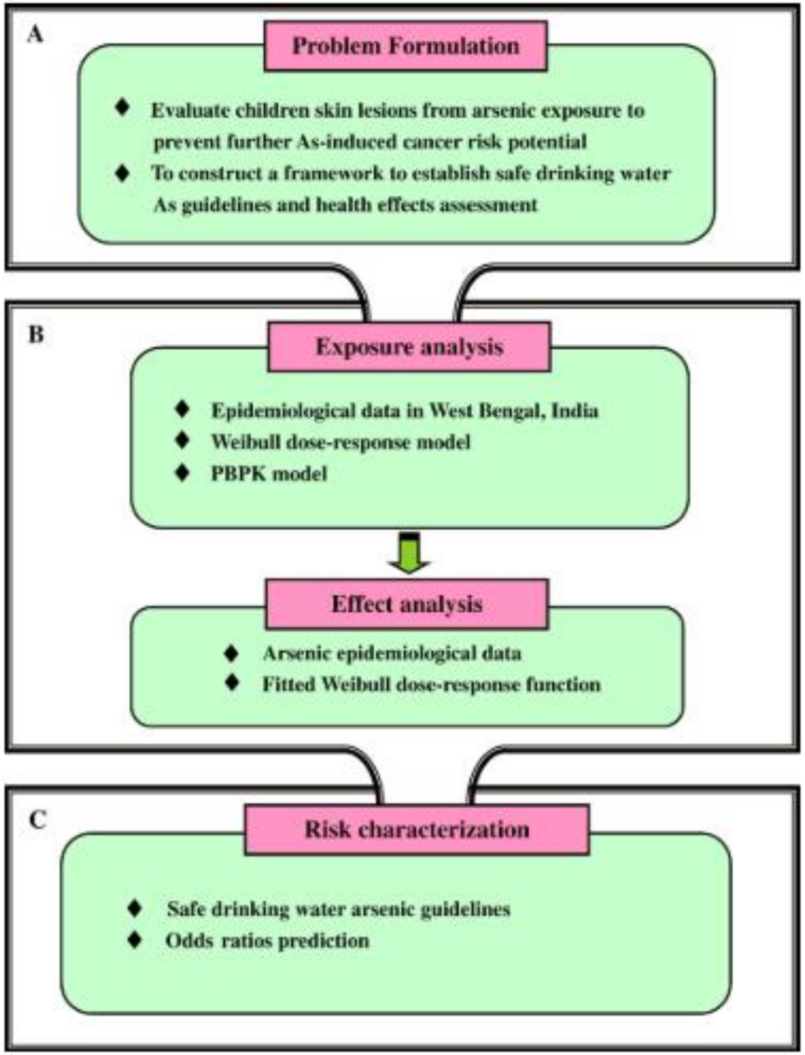
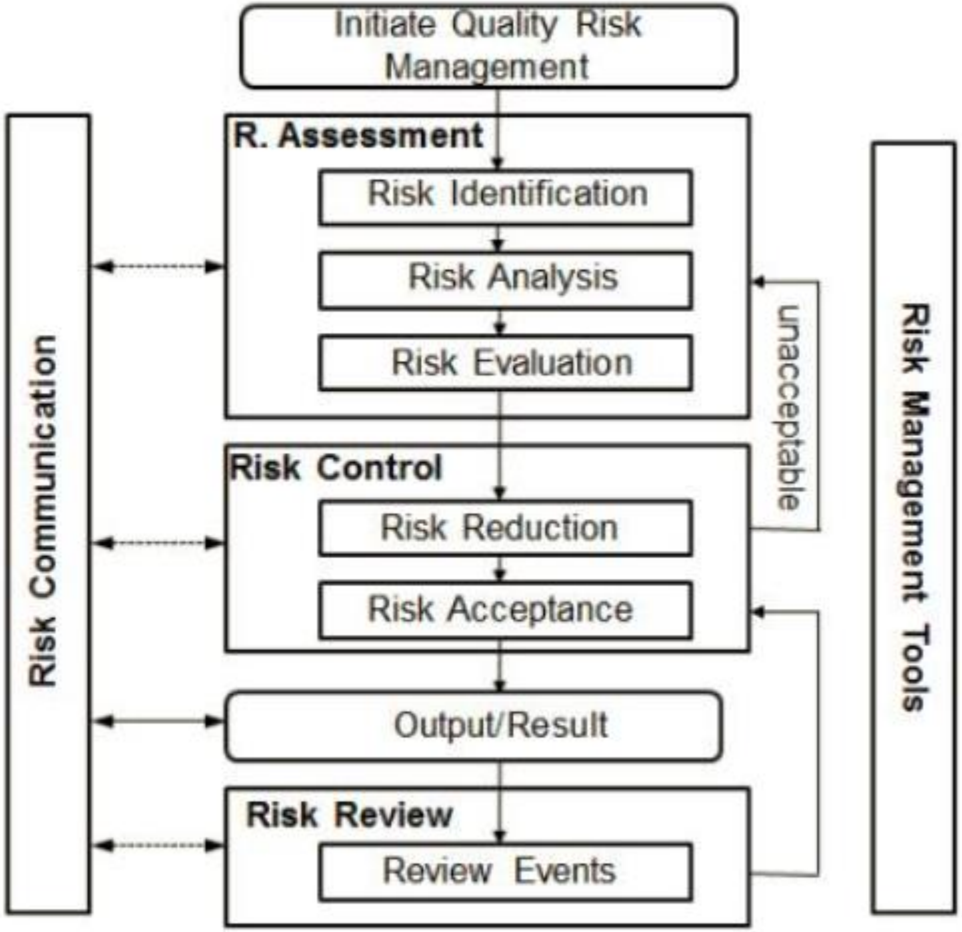


Figure 9: Main food groups contributing (%) to the mean chronic dietary exposure to iAs for the age classes 'Elderly' and 'Very elderly'. Data are presented by individual dietary surveys across Europe using MB estimations. Names on the left refer to the names of the different surveys (see Appendix A-5).

SCIENTIFIC REPORT OF EFSA Dietary exposure to inorganic arsenic in the European population European Food Safety Authority (EFSA), Parma, Italy

Limit of Detection (LoD), and Limit of Quantitation (LoQ)





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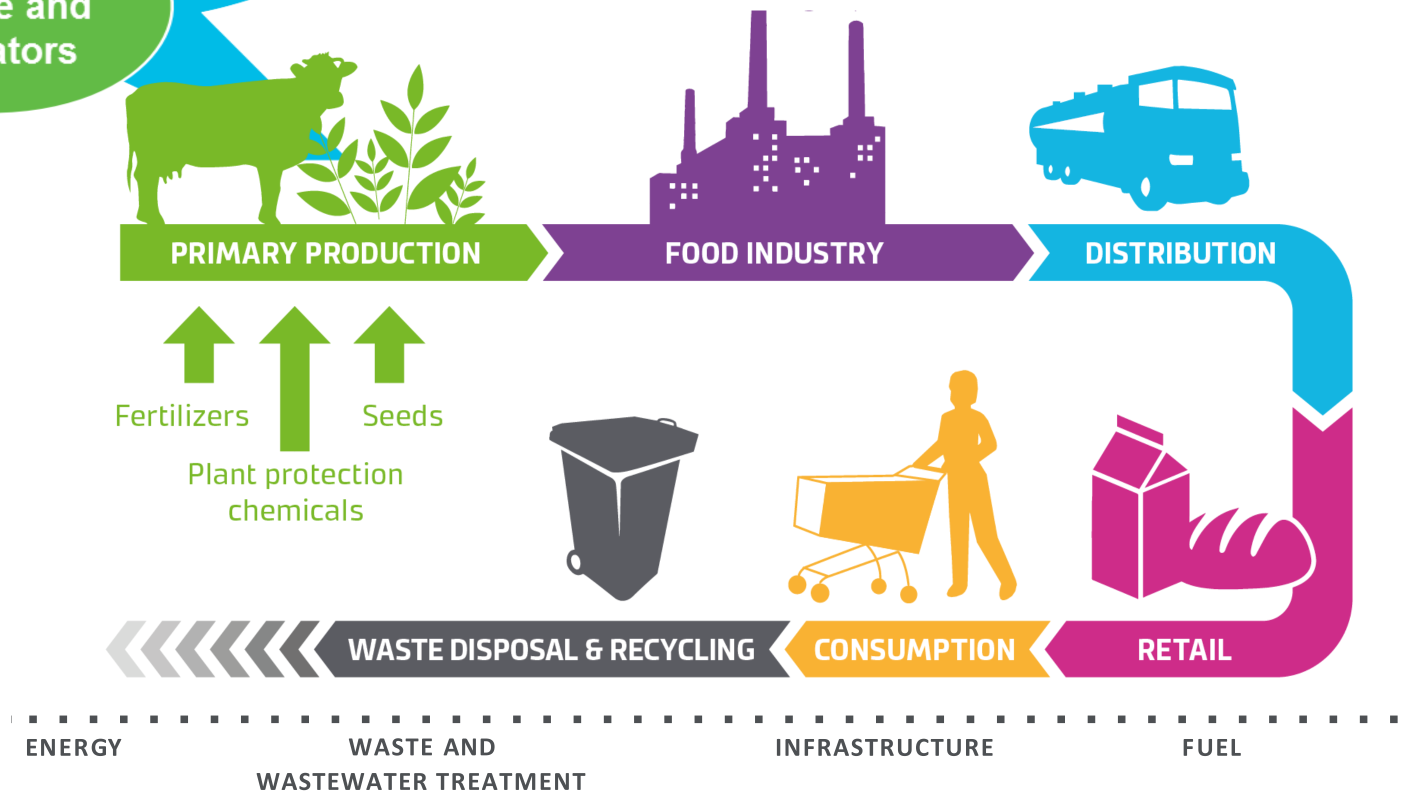
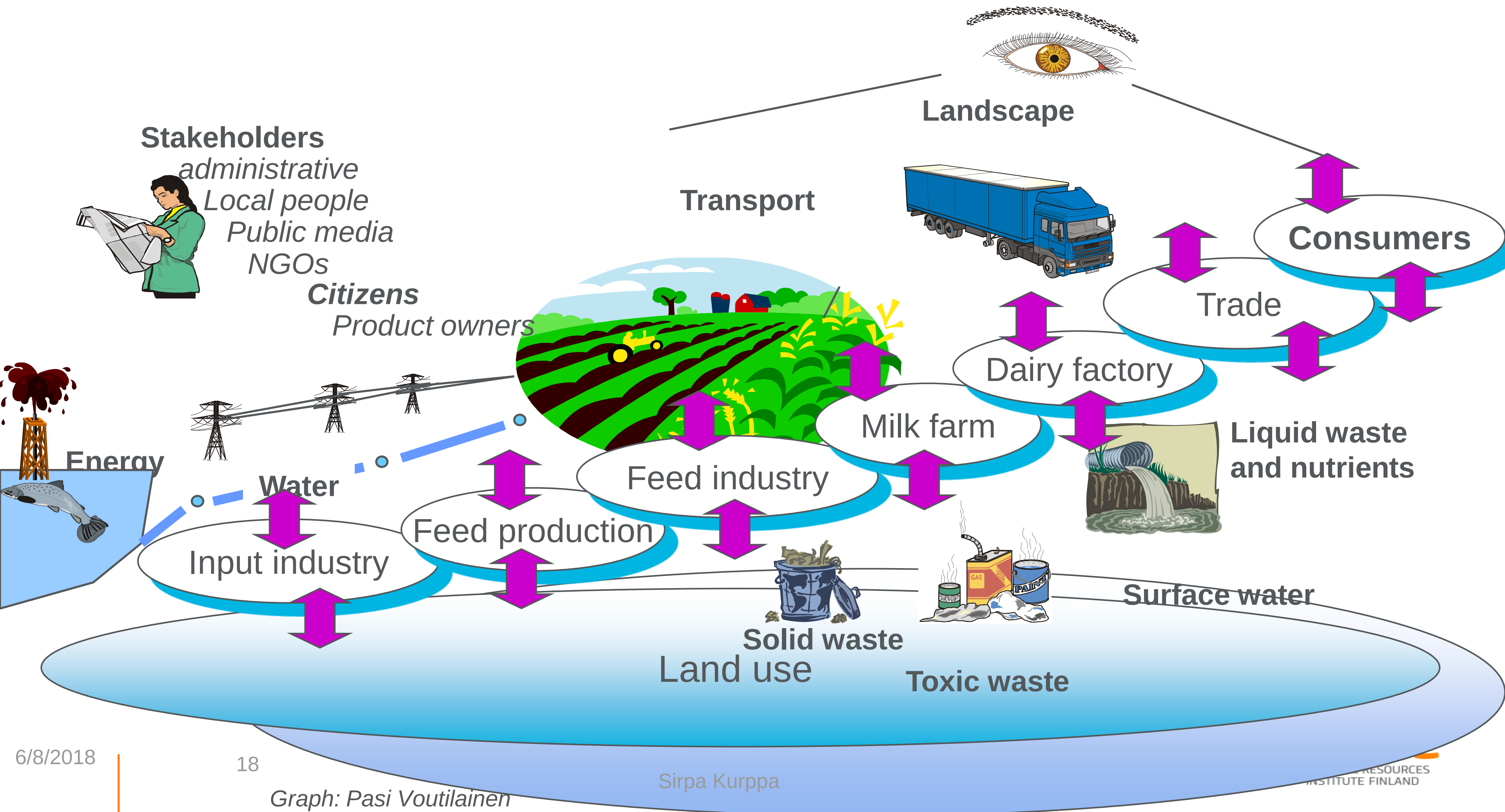
LIFECYCLE SUSTANABILITY

ECOMODULES - NEW PRODUCT PORTFOLIO COMING



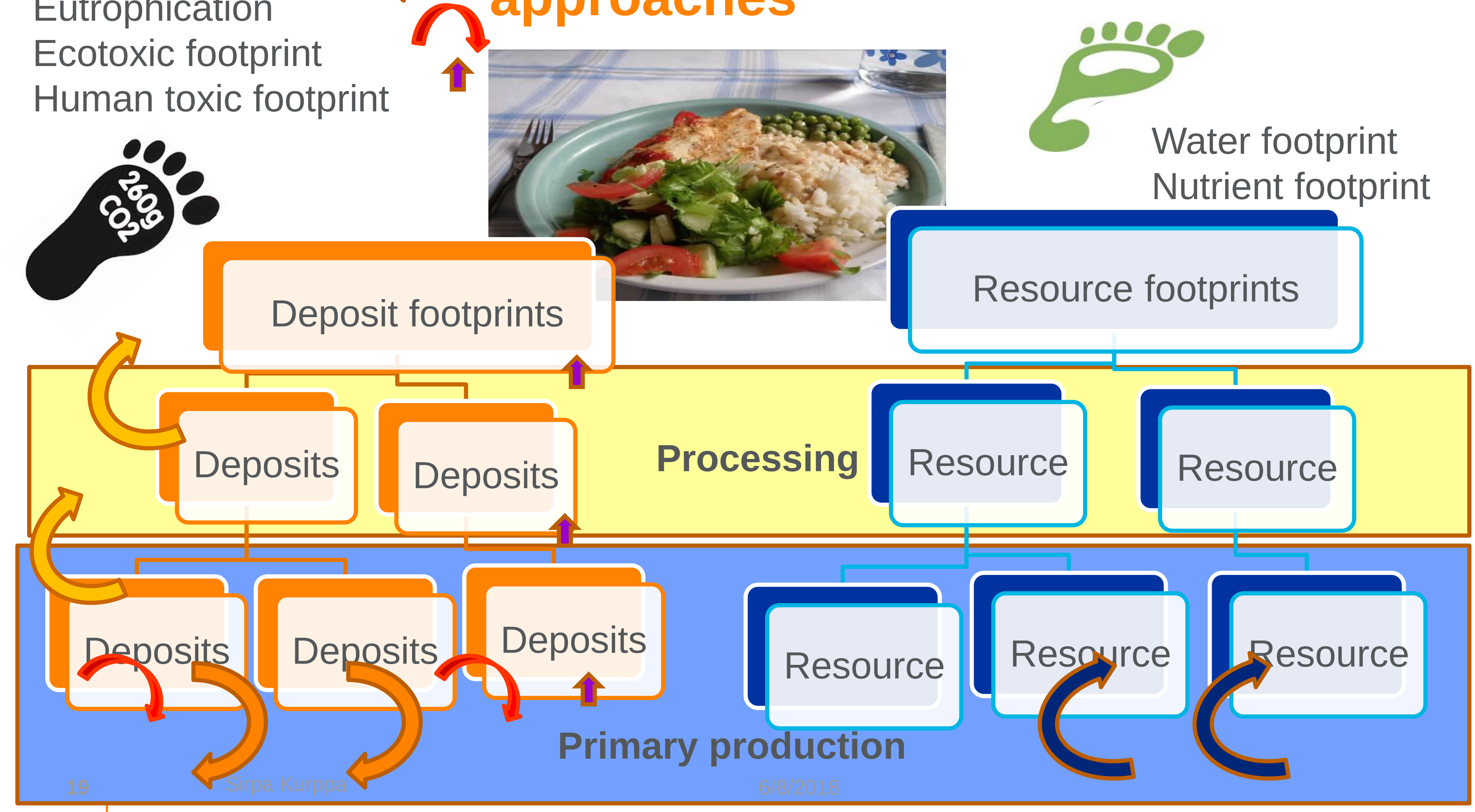
How ecological footprint is being formed.



Graph: Pasi Voutilainen

Environmental assessments – two approaches

Carbon footprint
Eutrophication
Ecotoxic footprint
Human toxic footprint



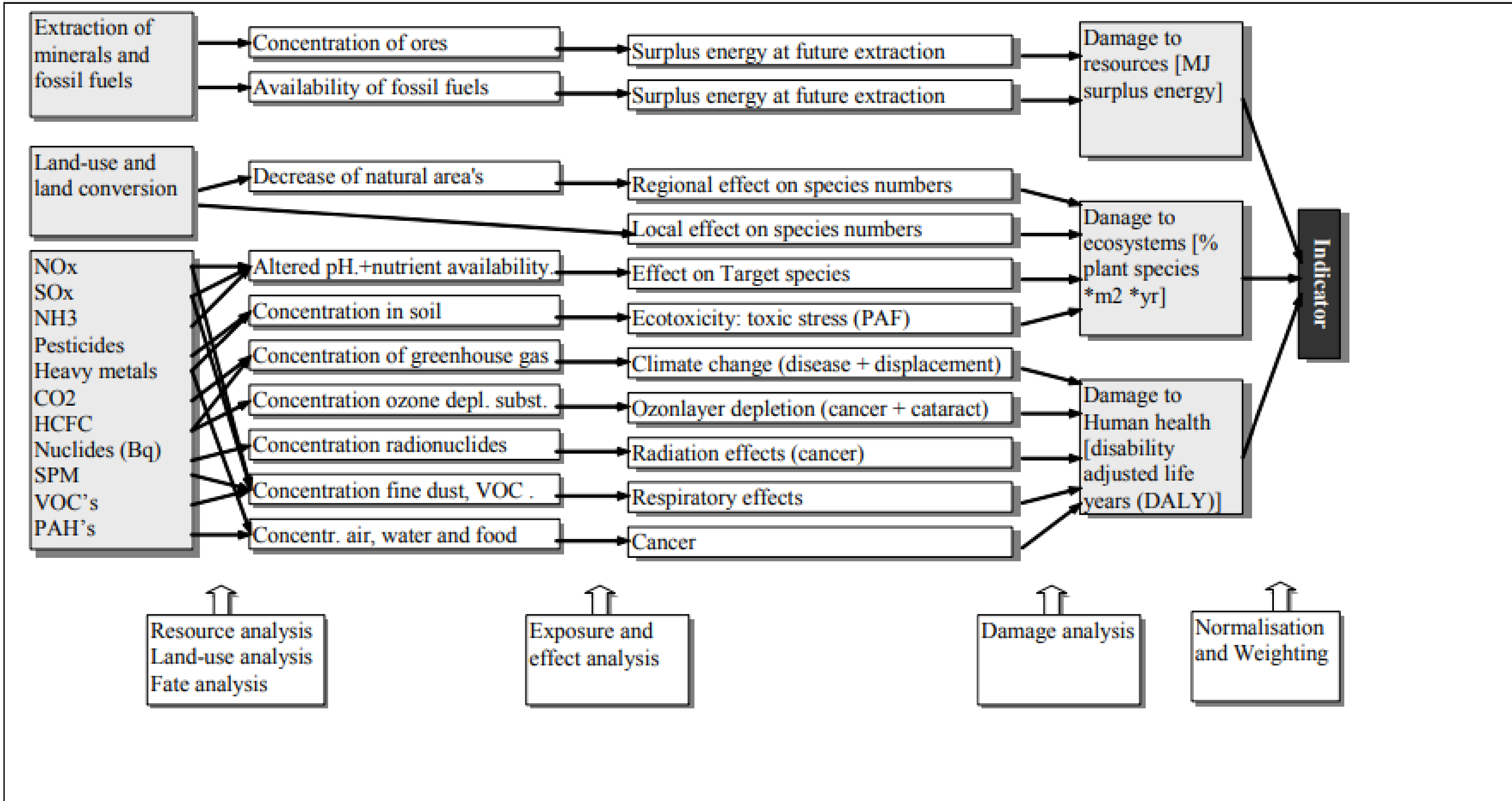
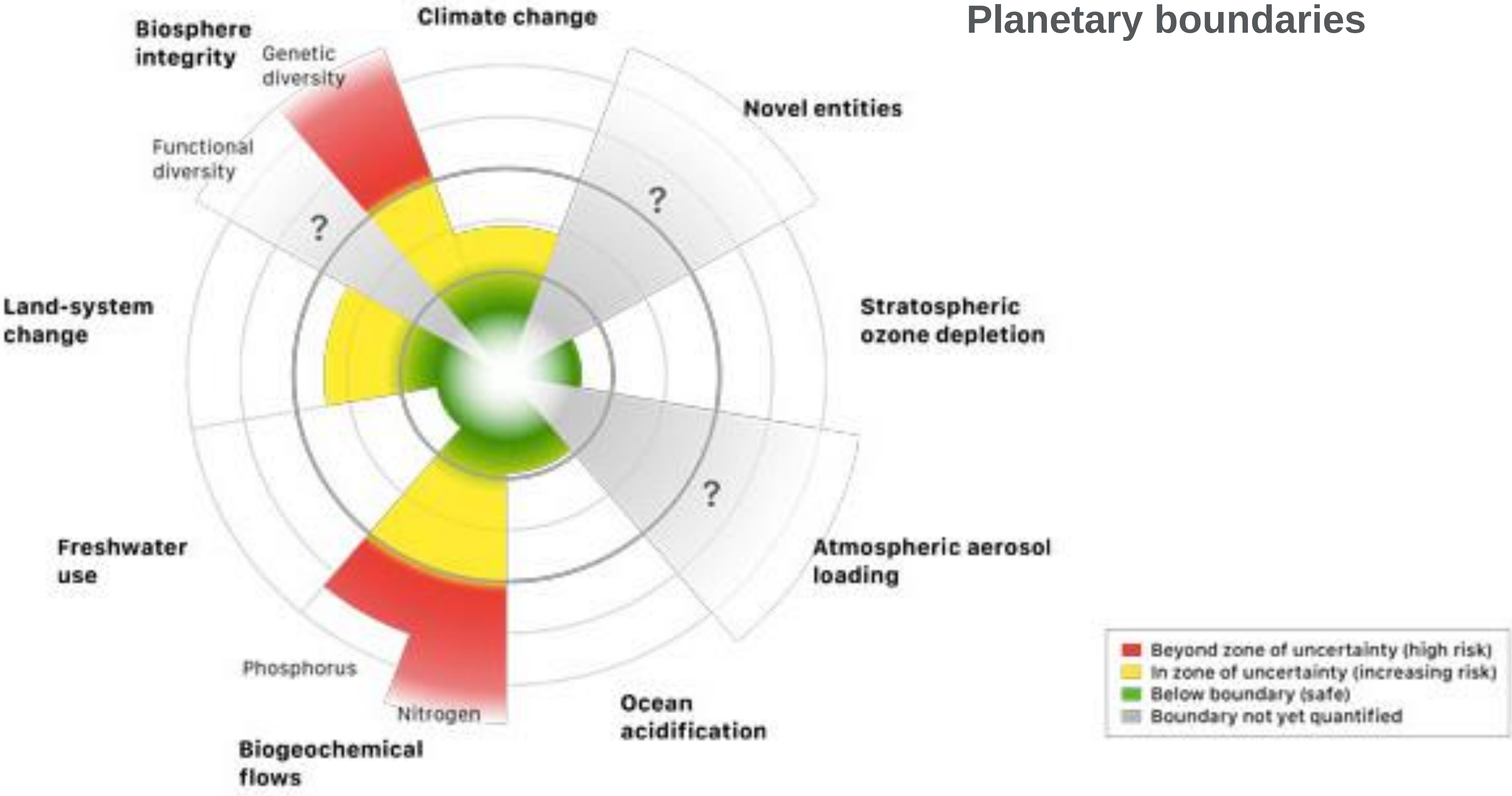


Figure 2 Impact categories and pathways covered by the Eco-indicator 99 methodology

Planetary boundaries



Ecosystem services based orientation Millennium Ecosystem Assessment (2005).

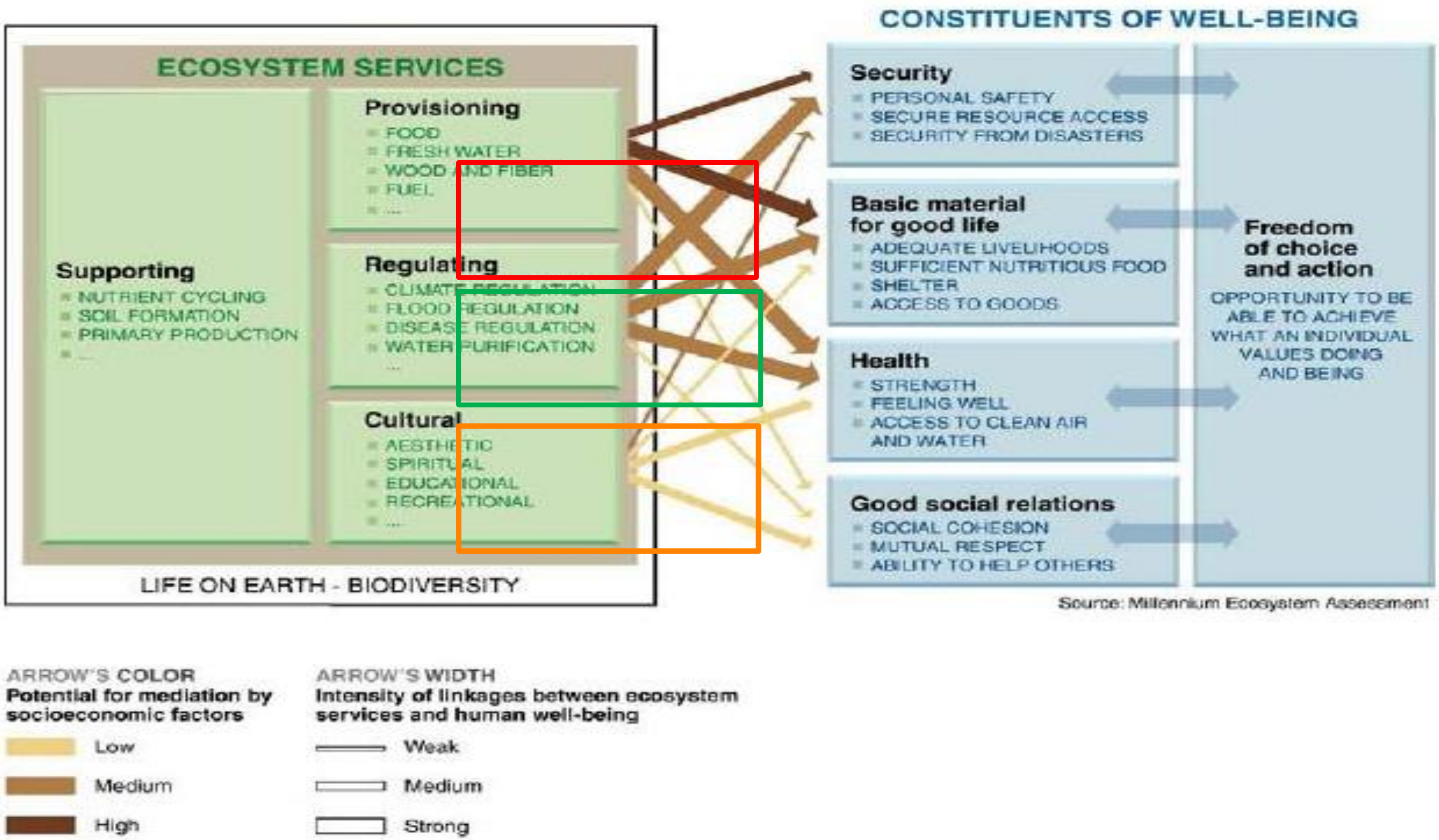


Figure SDM - A - The MA framework

In the Millennium report, adaptive mosaic was selected as the most promising alternative to enhance protection of ecosystem services – valuable genetic resources form pricipal basis for adaptive mosaic.

- **Global Orchestration:** Globally connected society that focuses on global trade and
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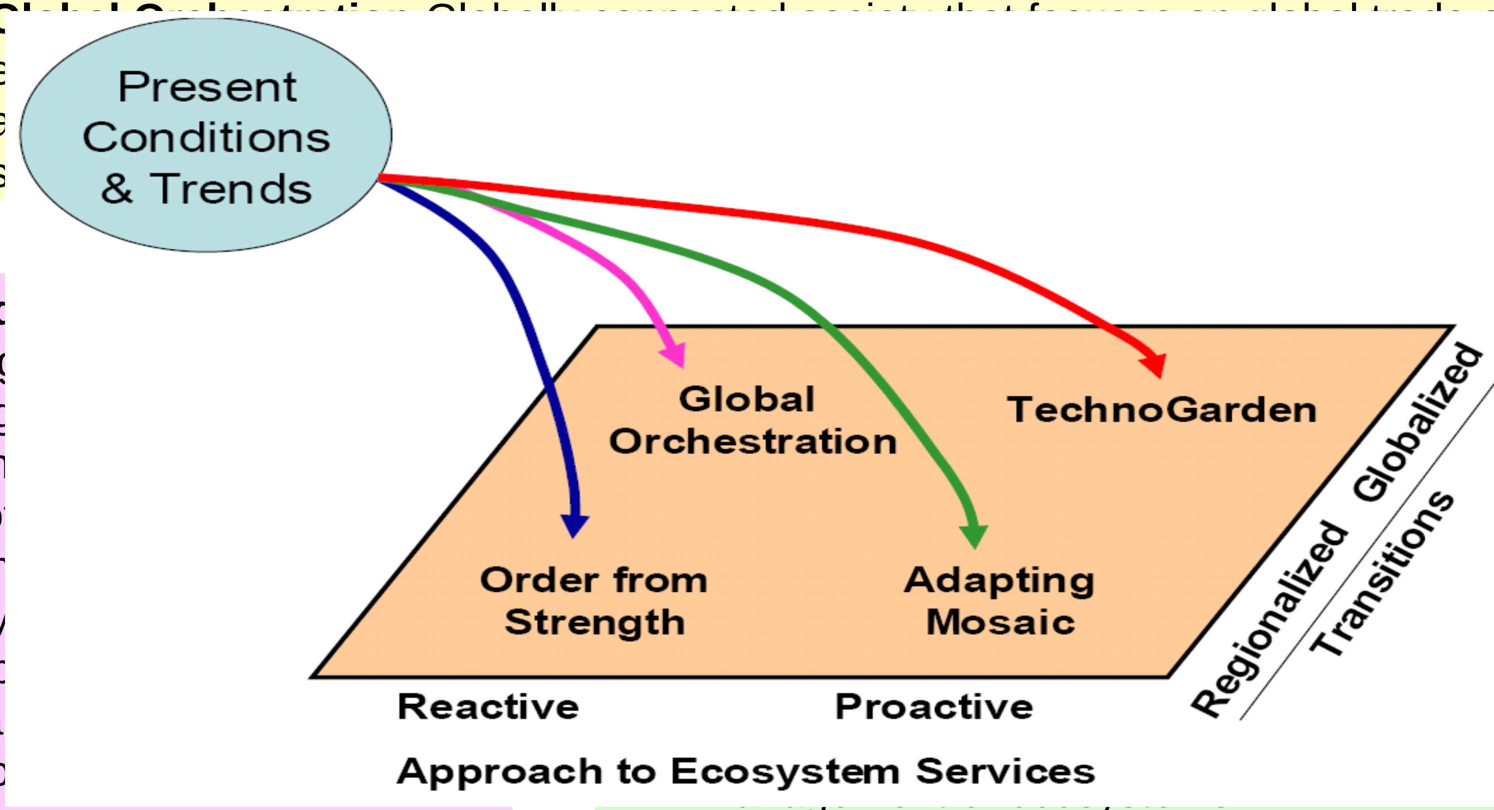

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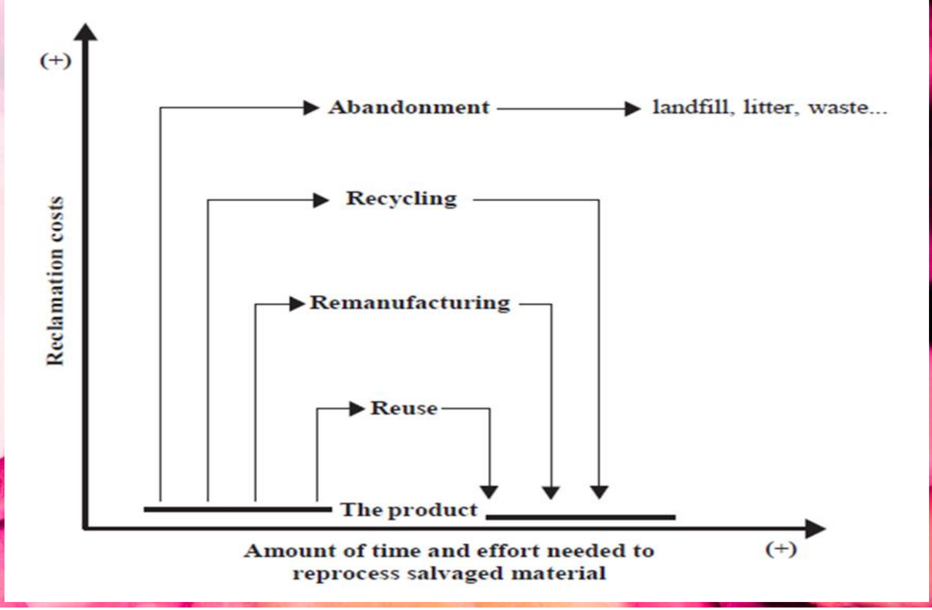
Circular Economy in the food system

- Nutrient recycling in agriculture
- Food waste minimization in the food chain and resource efficient concepts
- Sustainability assessment of the food system



Circular economy reduce, reuse, revive – where arsenic might have a role in terms of security

- Feed efficiency
- Food efficiency
- Supplements
- Additives
- Synthesis of new compounds

- Naturalness
- Robust animals
- Nature based functional impacts
- Nature derived bioprocessing

All combinations between these

SCALING – smart management of Arsenic

Smart farming

- Precision Livestock Farming: automatic animal monitoring using sensors to optimize animal feeding, breeding, health and welfare
- Precision farming: environmental, profitable and efficient biomass production
- Optimal control and production environments using sensor
- Robots, drones, Industrial Internet and other enabling technologies

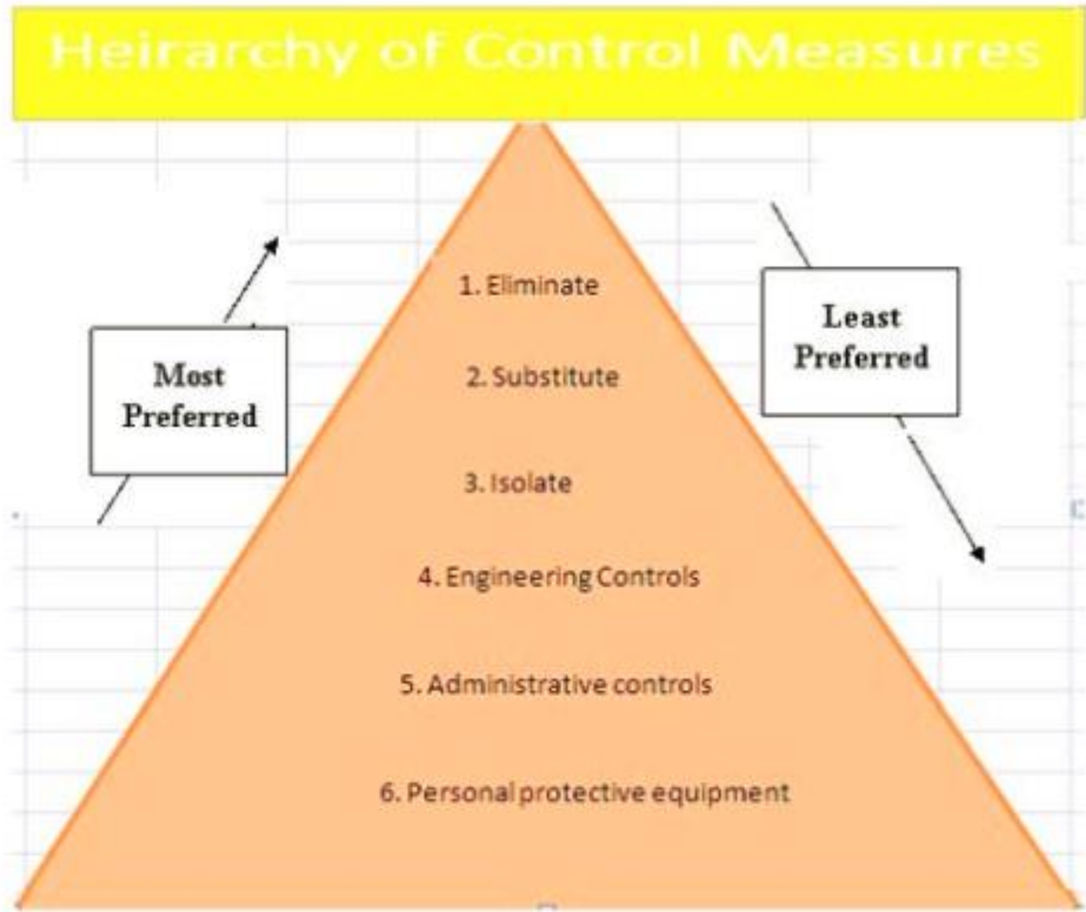
Smart food chain

- Intelligent, networked products, IoT, Traceability
- Integration and interaction between systems and actors

BigData and data mining applications in agriculture

- Use of genome info in different contexts
- Utilization of data previously unavailable
- Big data as management and benchmarking tool

The options are always context specific.



Thank you!

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