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Supplement of

Improvement by public participation? The case of the German calculation basis for the dose assessment for final disposal of high-level waste (HLW)

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TRANSENS
TRANSDISCIPLINARY RESEARCH ON THE MANAGEMENT OF HIGH-LEVEL RADIOACTIVE WASTE IN GERMANY

Improvement by Public Participation? The Case of the German Calculation Basis for the Dose Assessment for Final Disposal of HLW (BeGru)

Volker Hormann, Anna Kogiomtzidis, Clemens Walther

1.) Critical Discussion of BeGru Model

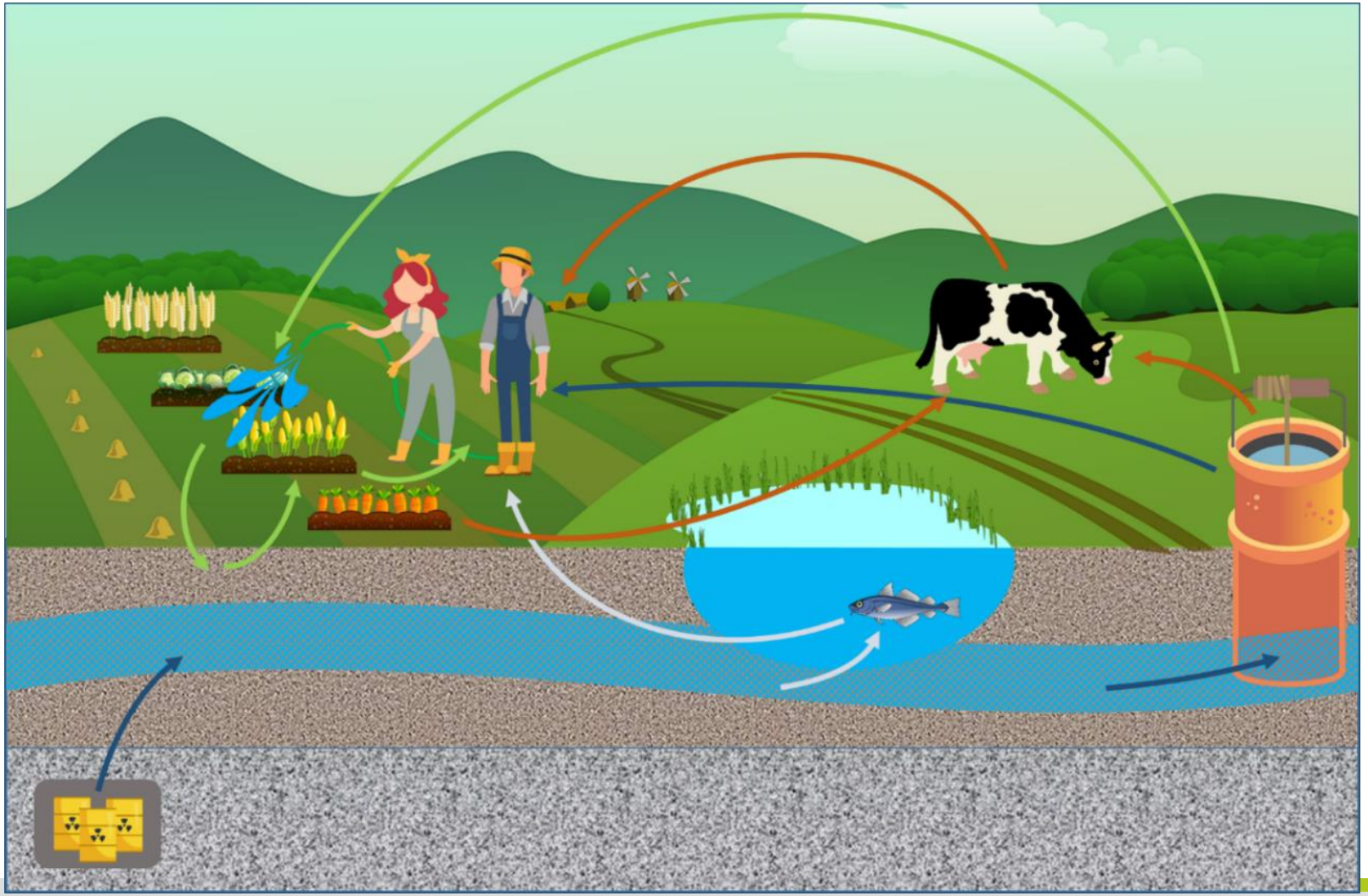
2.) Public participation by BMUV / BASE

Part 1: The Model

Radioecological modeling of radionuclide transport in the biosphere.

Goal:
Estimation of
the radiation exposure after release of radionuclides into the ecosphere

Dose as "**Indicator**"



Basic assumptions in the BeGru

- Concept of "representative persons" (based on ICRP 101):

"Hypothetical individuals (...) who are representative of higher-exposure populations in the relevant age group based on their lifestyle habits."

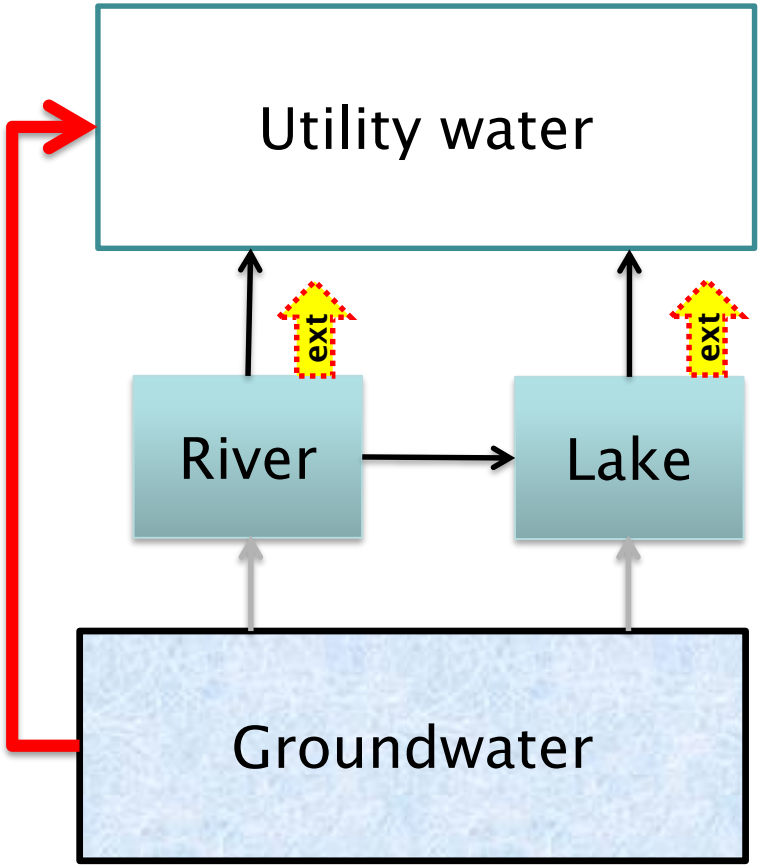
- Model scenario: a farm managed by 10 people
  → Self-sufficiency (drinking water 100 %, food 50 %)

- Production of food and residence of people at the "most unfavorable impact points".

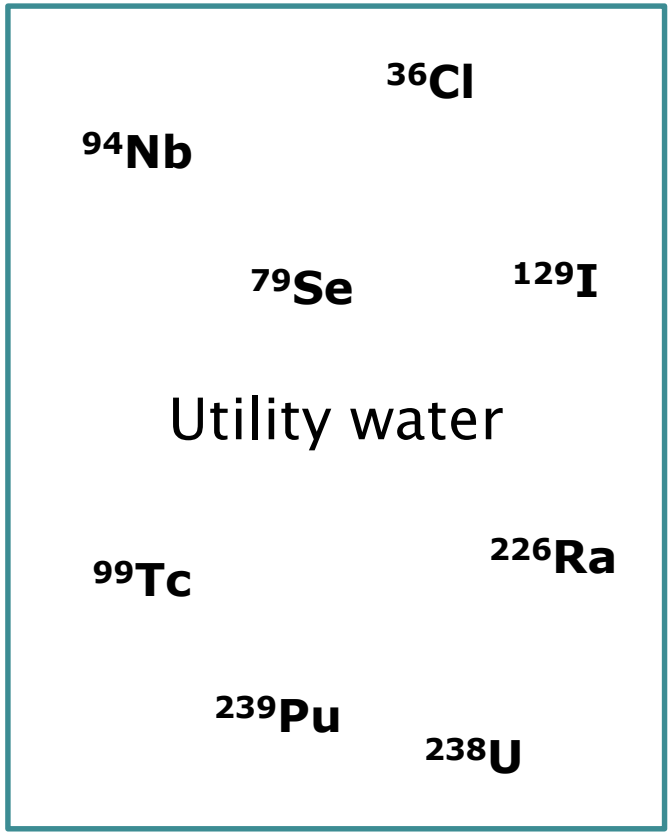
- initially cool temperate climate, then climatic developments

- different usage scenarios (well water, surface water)

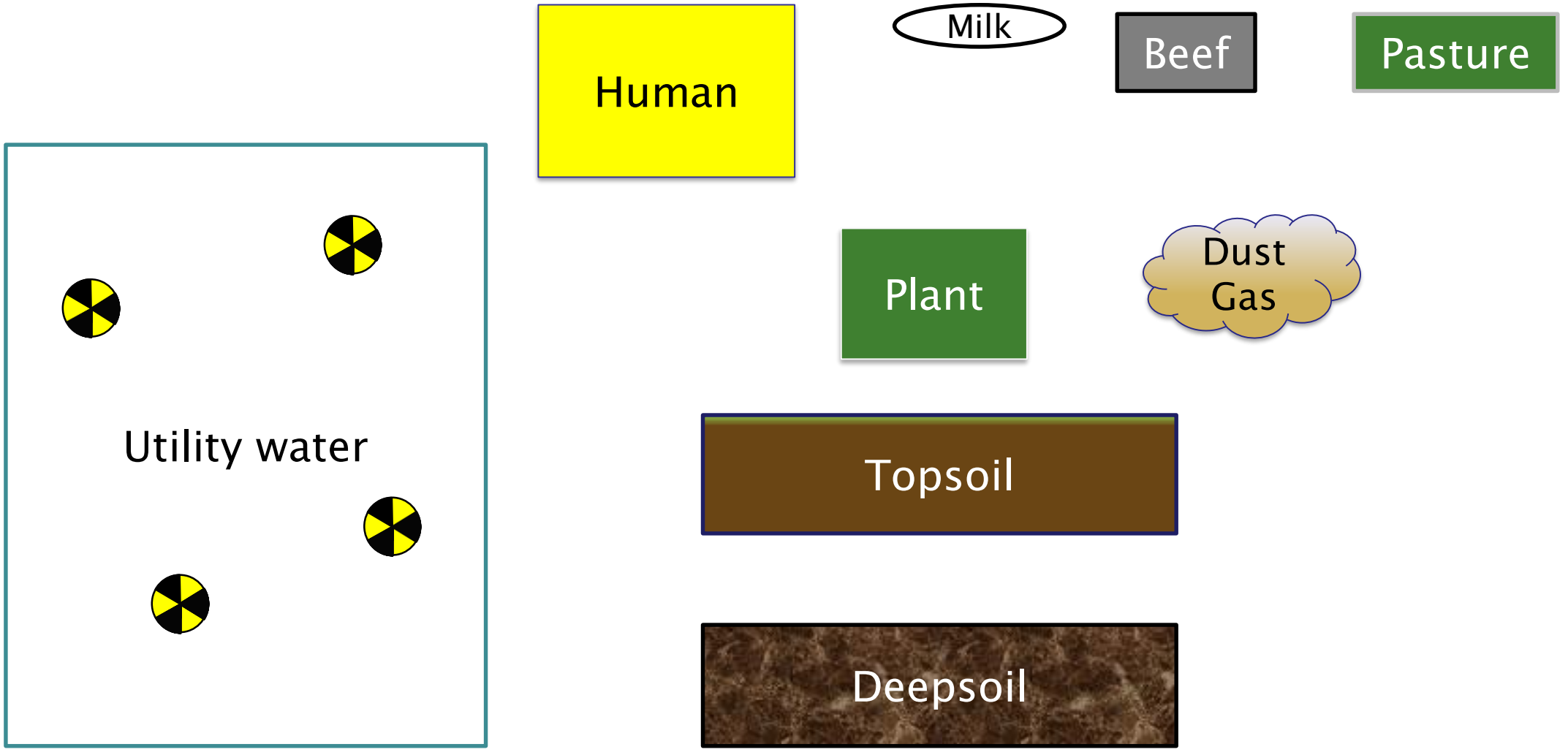
Paths in the BeGru model



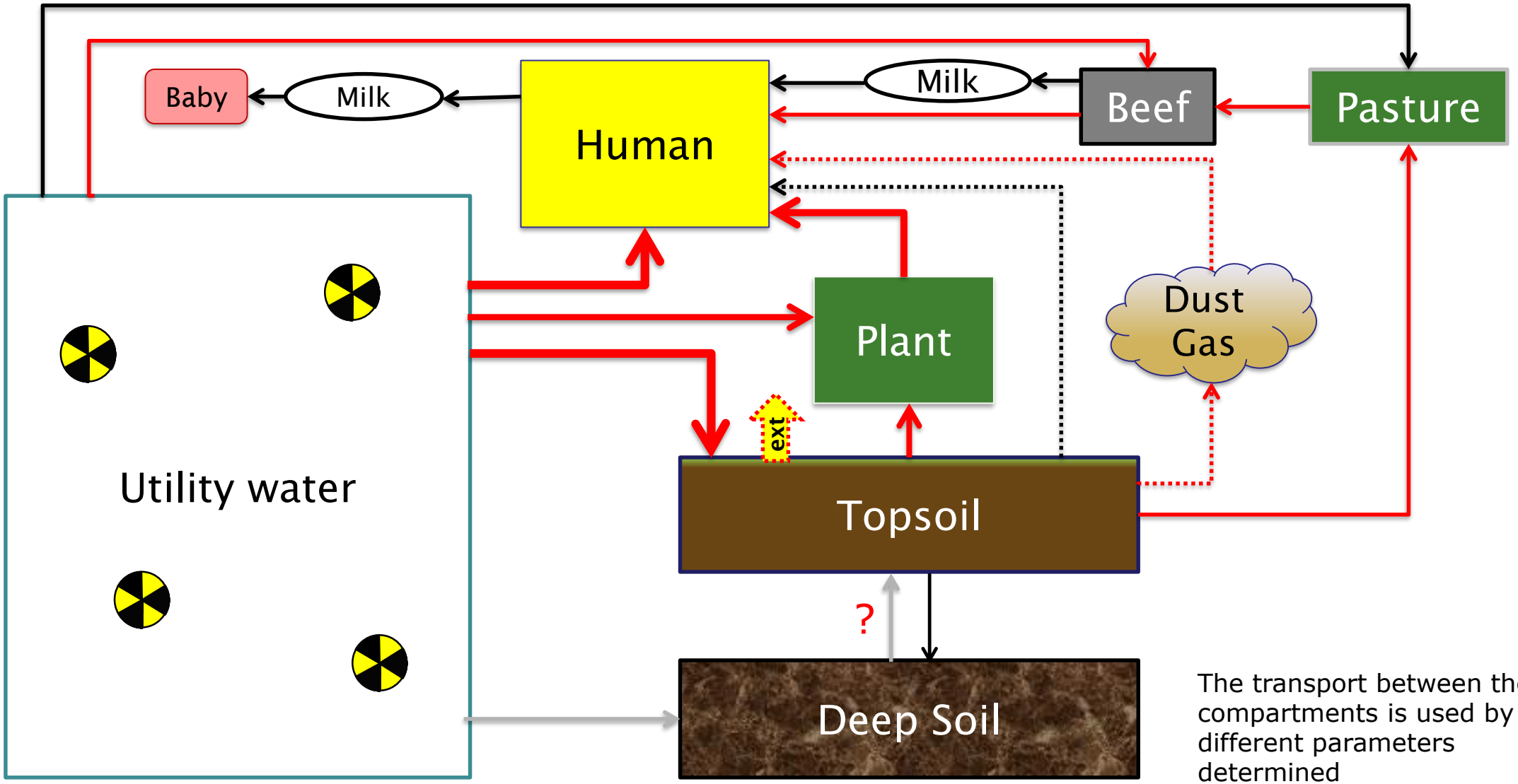
Paths in the BeGru model



Paths in the BeGru model



Paths in the BeGru model



The transport between the compartments is used by different parameters determined

Parameters in the BeGru model

- Mathematical description of radionuclide transport between compartments by (differential) equations.

- Simple example:

$$C_r^{Fish} = C_r^{Water} \cdot T_r^{Fish}$$

Concentration of the Radionuclide r in fish (Bq/kg)

Concentration in water (Bq/L)

Transfer factor water → fish (L/kg)

  - Subsequently, calculation of the dose contribution from this compartment:

$$E_r^{Fish} = U^{Fisch} \cdot C_r^{Fish} \cdot g_{g,r,eff}$$

annual effective dose from fish consumption (Sv)

Annual consumption of fish (kg)

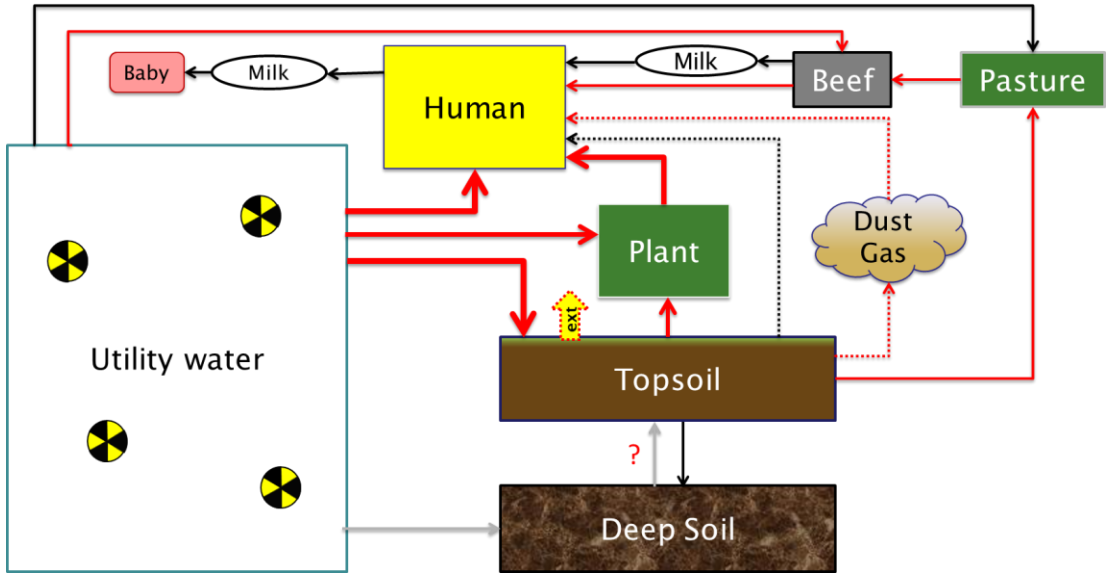
Concentration in fish (Bq/kg)

Dose coefficient for ingestion of radionuclide r (Sv/Bq)

Most important parameters

which parameters are most important?

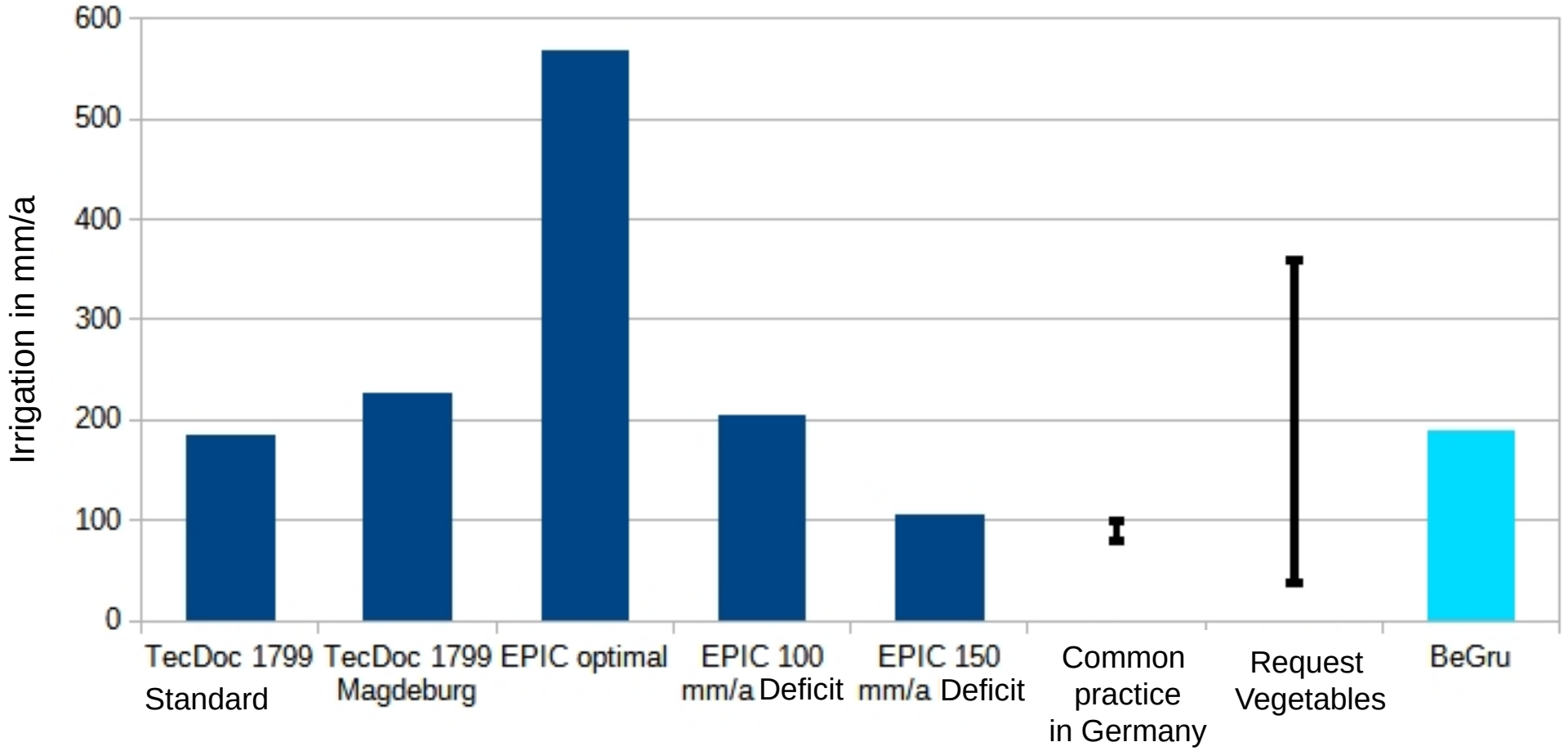
(1) Activity Concentration
(2) Irrigation / Drinking water quantity
(3) Consumption rates
(4) Soil-plant transfer factor
(5) Interception factor
(proportion that remains on the plant when irrigated)
(6) Retention time of the RN in the soil (BeGru: 3 categories).



model and nuclide dependent!

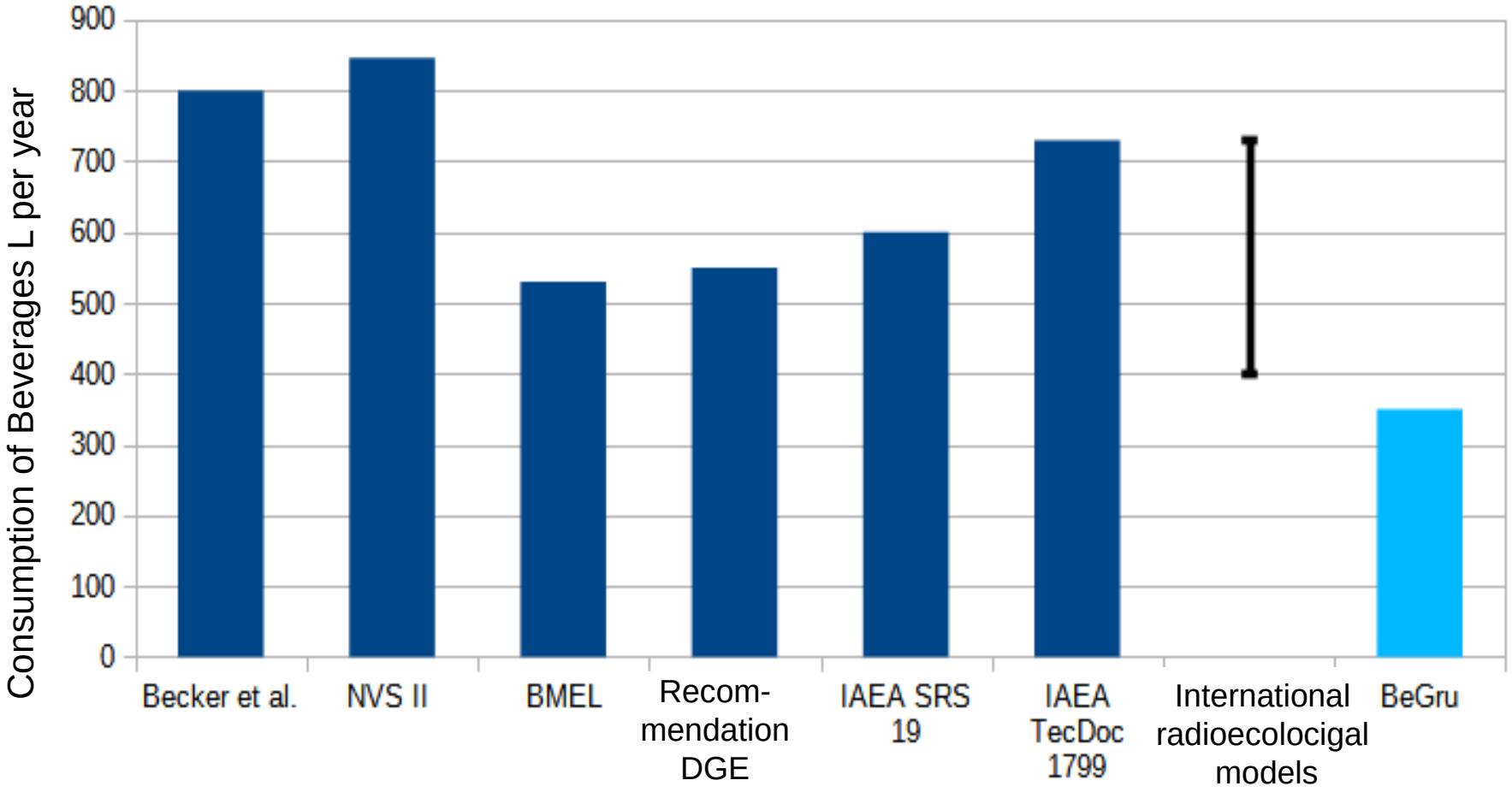
estimated uncertainties:
(1) Model dependent
(2) Factor 2
(3) Factor 2
(4) nuclide-, plant- and soil-dependent, exceeding a factor of 10
(5) plant-dependent, up to factor 10
(6) nuclide- and soil-dependent, exceeding a factor of 10

Example irrigation



IAEA TecDoc 1799: Reference Models from the EMRAS II Program

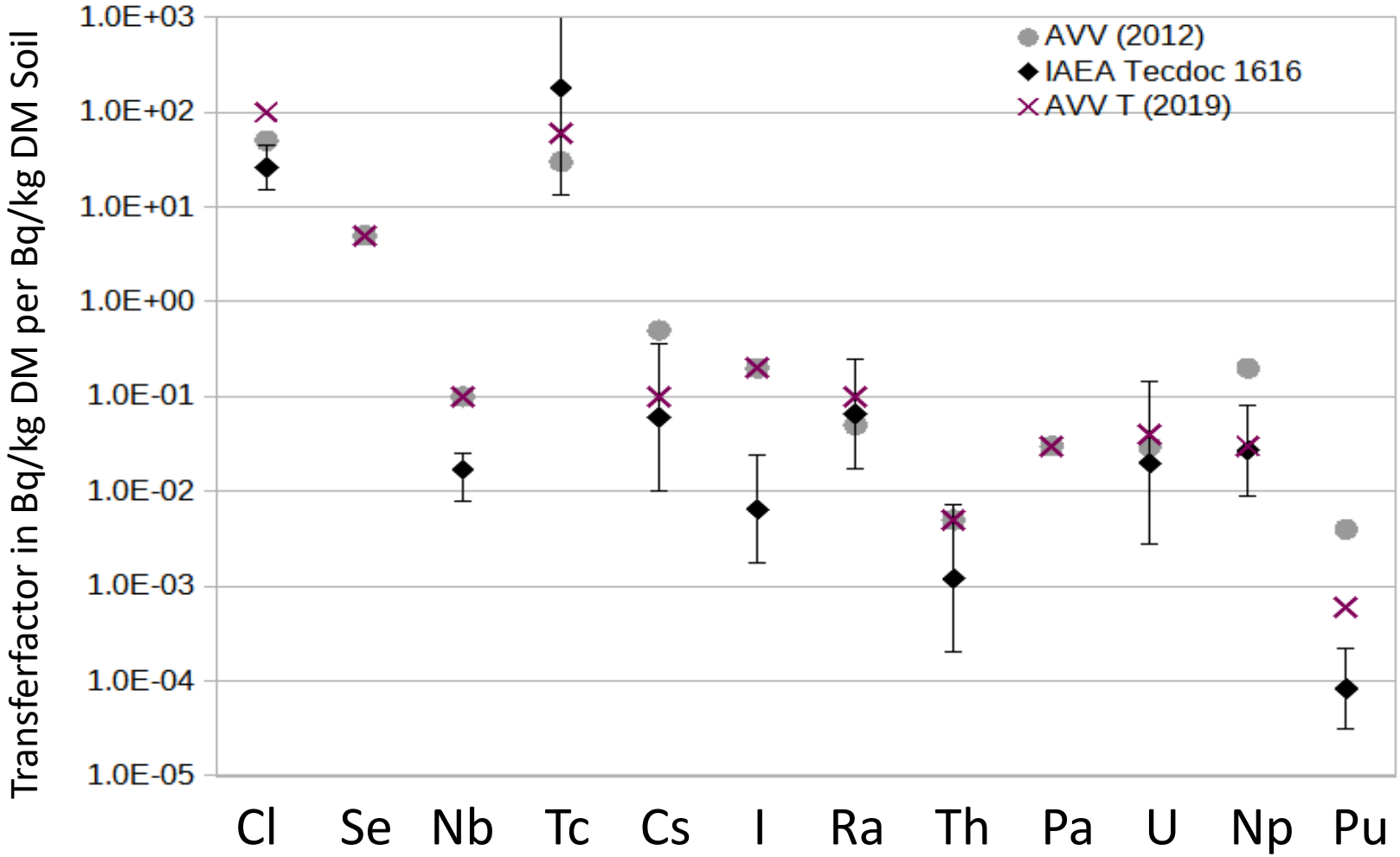
Example water consumption



for the other foodstuffs, the BeGru values are close to those from national and international studies

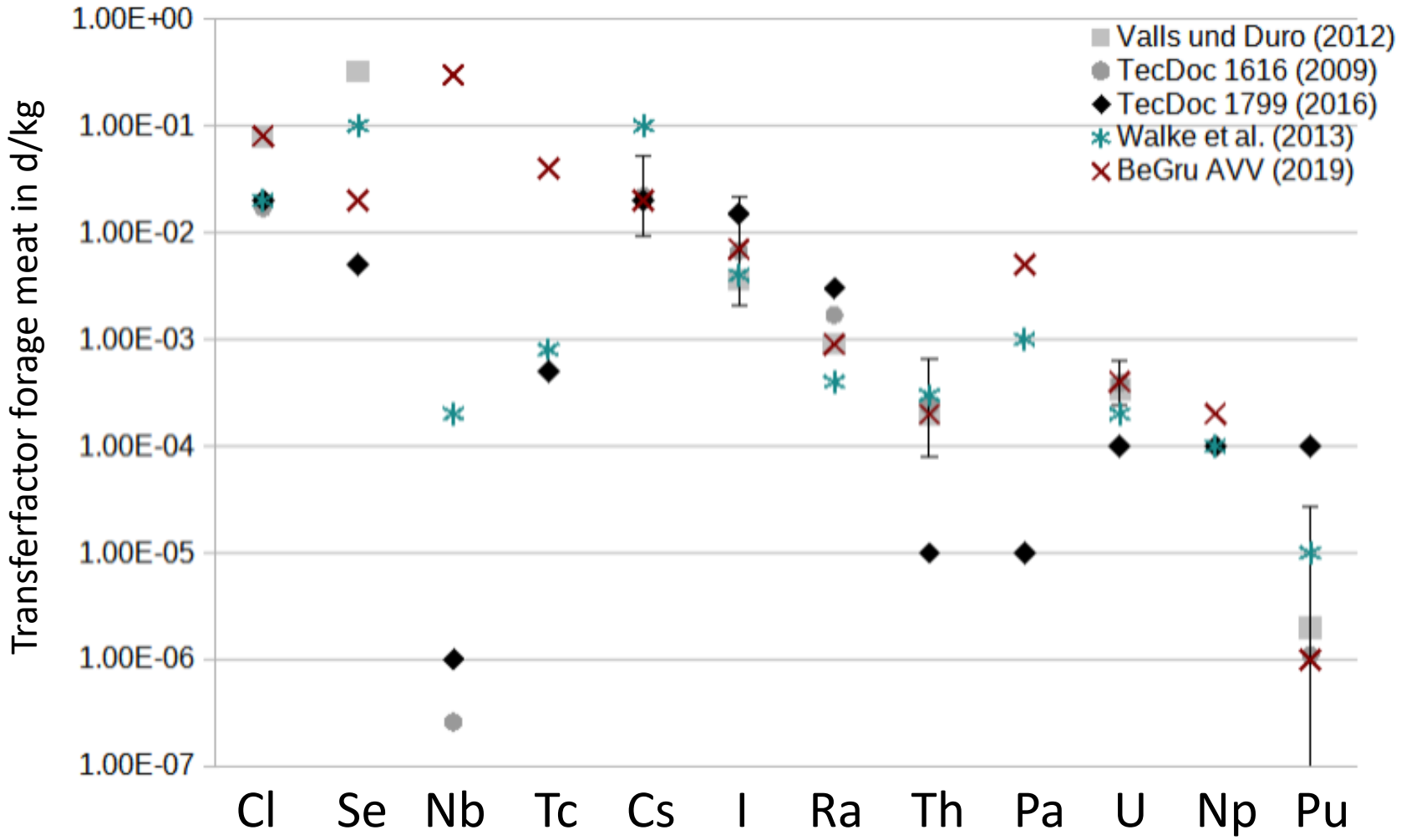
Example: transfer factors soil -plant

transfer factors for leafy vegetables in IAEA TecDoc 1616 (2009) and the German regulations (where leafy vegetables = other vegetables)



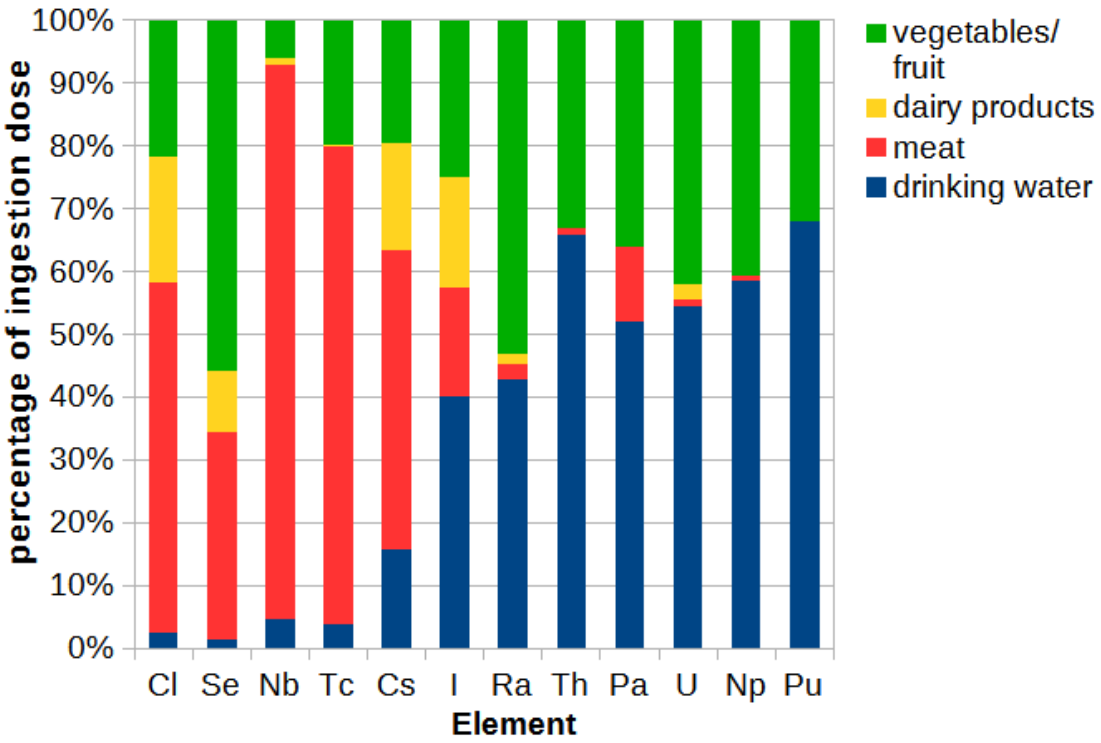
Transfer factor forage-meat

transfer factor forage-meat in the literature compared to BeGru/AVV

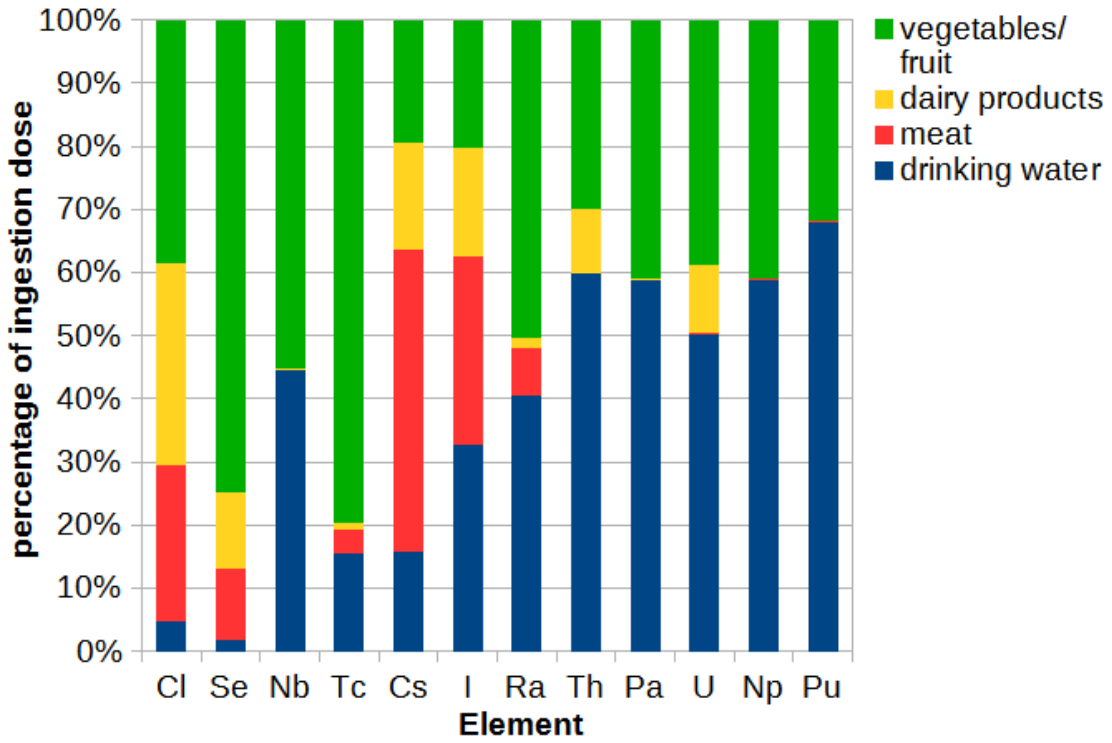


Effects on relative contribution of meat consumption to ingestion dose

using AVV/BeGru values



using values from IAEA TecDoc 1799



Uncertainties of the parameters

- Sources and uncertainties for parameter values are not given

  → Comparison of the values with those from the literature
  (e.g. IAEA tables, other radioecological studies).

- In order not to underestimate the indicator dose the BeGru model contains various conservative assumptions (higher exposed individuals/worst impact sites).

- Some further examples:

- Multiplication of the consumption quantity that provides the highest ingestion dose at medium consumption by a factor of 1.6 - 5 (depending on the food)
- if both surface water (SW) and ground water (GW) can be used, the less favorable one is always assumed
- No sedimentation, SW is not filtered (but sedimentation is assumed in the calculation of external exposure at the shore).

Conservatism in the BeGru model

- Danger: Accumulation of conservatisms
- possible result: unrealistically high total dose values

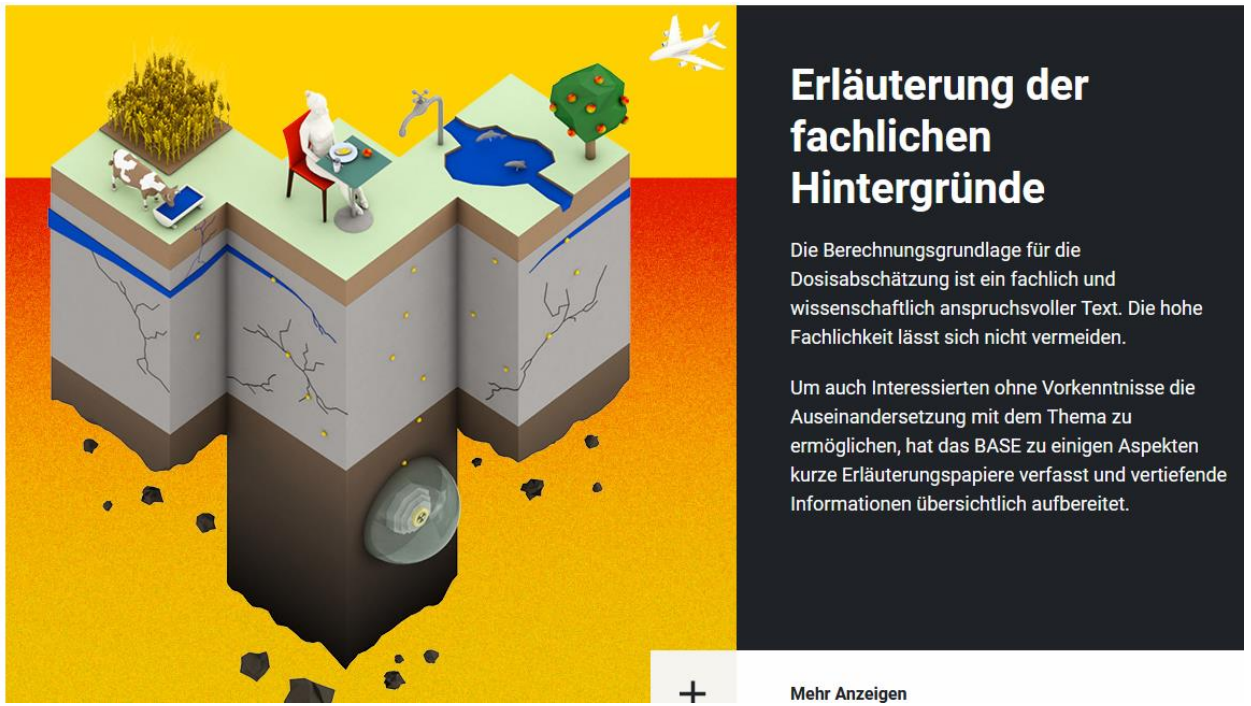
- In contrast, the requirement from the EndlSiAnfV § 7 that the estimated dose value (for expected developments) should be in the range of **10 µSv** per year is itself also conservative

Annual dose due to natural radioactivity in Germany:
1000 - 10000 µSv, mean value: **2100 µSv**

Part 2

Discussion of the calculation basis

- 2020: draft of the calculation basis for the estimation of radiation doses due to the storage of highly active nuclear waste (“BeGru”) was issued by BASE and BfS



- BASE provided supplementary explanation of the rather complicated basics on its website

https://www.endlagersuche-infoplattform.de

Discussion of the calculation basis

- April 2022 BASE invited the public to comment on the BeGru draft
- Until June 2022 ca 580 comments and suggestions submitted (ca. 60 by IRS especially concerning radioecological modelling)
- Published on website

https://www.endlagersuche-infoplattform.de

Expert workshop on 29.06.–01.07.22 at BASE

- hybrid event (presence/online)
- ~ 15 persons present, about 50% from BASE and BfS, 3 from BGE
- online: representatives from BfS, BMUV and SSK
- few members of the public
- initially focused on terms and definitions, discussion of radioecological topics and issues almost only on morning / noon 01.07.2022
- due to the large number of comments (577 in the table), **only a subset of issues could be discussed**

Outcome

- November 2022: A table with comments (“Kommentartabelle”) by the participants and responses by BASE/BfS was issued on the BASE website

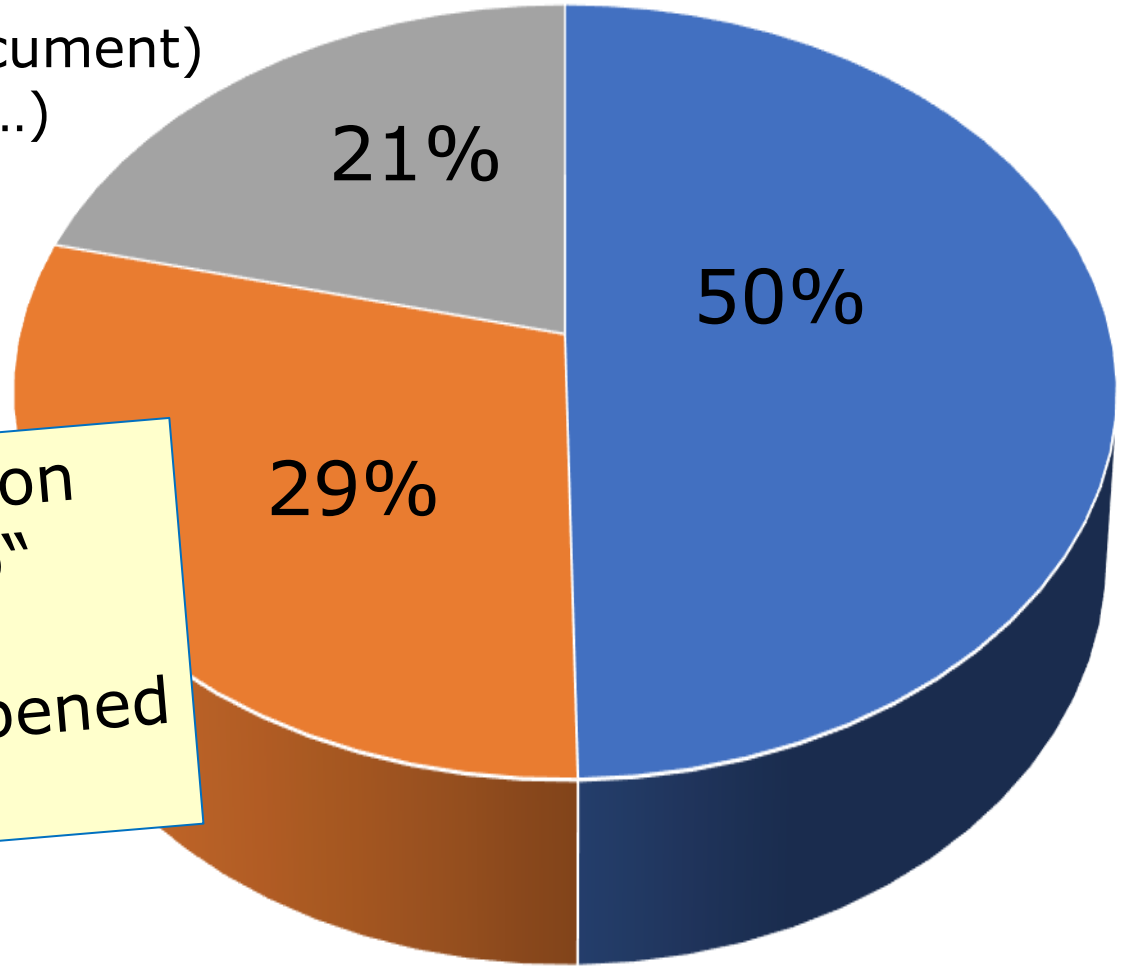
Lfd. Nr.	Kap. Nr., Absatz Nr.	Anmer-kung *	Anmerkung/Kommentar/Einwendung	Vorgeschlagene Änderung	Auswertung Work-shop
E-19	4.2 (20)	tec	Unklar bleibt jedoch, was in Zusammenhang mit der Dosisabschätzung genau unter gleich-wertigen Methoden zu verstehen ist (Original-text "mindestens gleichwertiger Lösungsan-satz")	Eine nähere Erläuterung der Formulierung „gleichwertige Methoden“ oder eine Benen-nung von Kriterien, nach welchen verwen-dete Methoden zur Dosisabschätzung als gleichwertig anzusehen sind, wären daher hier wünschenswert.	
G-23	4.2 (20)	tec	Dies ist kein Grundsatz	verschieben in Kapitel 2	

Einfügen nach 1. Satz: „Lorem ipsum dolor sit amet, consectetur adipisici elit …“

Keine Zustimmung der Teilnehmer:innen, da …

Outcome: 577 comments

Will be treated in „Fachlicher Begründungstext“
(technical explanatory document)
scheduled for May 2023 (…)



52 decisions (~10%) based on discussion in „Fachworkshop“

only 4 times additional deepened discussion with authors

Some comments

- The request is understandable. However, implementation is refrained from
  *(*Der Wunsch ist verständlich. Von einer Umsetzung wird jedoch abgesehen)

- After discussion with authors the approach was deleted
  Nach Diskussion mit Autoren wurde der Anstrich (sic!) gestrichen

- The request was not met because it was probably based on a misunderstanding.
  Dem Anliegen wurde nicht entsprochen, da es vermutlich auf einem Missverständnis beruht.

- The request was rejected. Both the choice of words and the wording are unambiguous.
  Das Anliegen wurde abgelehnt. Sowohl die Wortwahl als auch die Formulierung sind unmissverständlich.

Effect of the comments by IRS

- The following processes will now be taken into account:
  - the (long-term) transport of radionuclides from groundwater through the subsoil into the root zone
  - siltation and shifting of river streams

- not accepted:
  - revision of model parameters, e.g. usage of current IAEA transfer factors
  - taking into account attenuation of gamma radiation in irrigated soils
  - usage of reference soils and the K_d concept
  - some overconservativities e.g. ignoring sedimentation in surface water while taking it into account in the calculation of external exposure at river banks

- some comments are planned to be part of the technical explanatory document that has not been issued yet

Conclusion

- Good approach
- Time line OK
- Most smaller comments regarding the phrasing of some text passages have been accepted

- Time for discussion in workshop not sufficient.
- No transparent process, why some comments / suggestions were accepted and some were not
- Chance to get in closer contact with authors was not used in all cases

Thank You !

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