

Pesticide Risk Reduction Programme – Ethiopia

Introduction- groundwater protection

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joint collaborative programme on pesticide registration and post-registration



MoA



ALTERRA



Towards a sustainable use of pesticides in Africa

Definition of gw protection goals

Outline

- Why groundwater ?
- Introduction to protection goals
- Proposed criteria for risk classification
- Stepped approach for selection and operationalising the groundwater protection goal: explanation and our program for today



Groundwater protection

Why do we work on protection of groundwater ?

Summary of 3 groups Nov2011 Workshop on Environment in Debre Zeit:

Protect

Underground water

(how deep differs from place to place and ranges from 10mt up to 60mt).

Where? All over the country

Groundwater protection

PG	1st	2nd	3rd	4th	5th
Ground water	-	2		3	1
Surface water	10	-	-	-	-
Aquatic ecosystem	-	2	2	-	1
Soil ecosystem	-	6	2	1	-
Terrestrial ecosystem	-	-	6	2	

Why work on groundwater ?

Summary of 3 groups Nov2011 Workshop on Environment in Debre Zeit:

Ranking:

groundwater not high, but

risk = combination of exposure concentrations and ecotoxicological effects

especially for gw EU exposure is not suitable for Ethiopia, so it is necessary to design a way to estimate local concentrations in groundwater

via drinking water contaminated groundwater poses risks to humans, (higher importance than aquatic, soil and terrestrial ecosystems)

Can you agree ?

Definition of protection goals

How to define protection goals into detail ?

Answer questions:

- What do you want to protect ?
- Where ?
- When and how strict ?

Definition of protection goals

Why is definition of protection goals important?

If protection goals have been defined into detail

we know which exposure concentrations we need to assess, so

we can design scenarios,

Definition of scenario: representative combination of crop, soil, climate and agronomic parameters used in modelling; representative means in this context that selected scenarios should represent physical sites known to exist, i.e. the combination of crop, soil, climate and agronomic conditions should be realistic.

Example:

Protection goal for aquatic ecosystem:

no immediate effects are accepted in field ditches

Required exposure scenario:

peak concentration of dissolved pesticide in water of field ditches

Definition of protection goals

Why is definition of protection goals important?

Examples:

Protection goal for groundwater:

no human toxicological effects in all groundwater in Ethiopia

Required exposure scenario:

all groundwater used now or in the future for drinking water production

Protection goal for groundwater:

no human toxicological effects in all groundwater used for drinking water production

Required exposure scenario:

all groundwater used now for drinking water production in Ethiopia

Definition of protection goals

What is role political level / risk managers ?:

They have to strike the balance between environment and socio-economic-cultural considerations

Example: no effects acceptable for aquatic ecosystem in small streams

Implication: 50% of pesticides currently used in Ethiopia cannot be registered

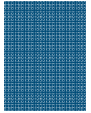
- minister of environment in Ethiopia 😊
- minister of agriculture in Ethiopia 😞
- farmers 😞
- pesticide industry 😞

So, specification of a protection goal is a political choice !
We make proposals here, but approval is needed
(Pesticide Advisory Board, others ?)

Definition of protection goals

- Protection goal: what, where, when and how strict
- Now on what and where, so the spatial component
- When: always, i.e. groundwater is always fulfilling the standard (and not only in e.g. Kremt)
- How strict: Already done, human toxicological standards (workshop criteria in June 2012 by Peter van Vliet)

Groundwater as source of drinking water



Proposal

- Where? At 10 m depth (= EU, i.e. everywhere at 10 m depth)
- How strict? Based on human toxicity values (ADI-approach)
- Exposure: PEC_{sw} at drinking water abstract points (PEC_{gw-dw}): see groundwater models Alterra
- Toxicity: Drinking Water Standard (DWS): based on ADI (Acceptable Daily Intake)

$$DWS = \frac{ADI * bw * P}{ConsWater}$$

ADI = Acceptable Daily Intake (mg/kg * d)
(safety factor of 100 included)

bw = body weight (60 kg for adults)

P = fraction of the ADI allocated to drinking water (DF = 0.1)

ConsWater = daily drinking water consumption (DF = 2 L for adults,
L/d)



ctgb

Groundwater as source of drinking water

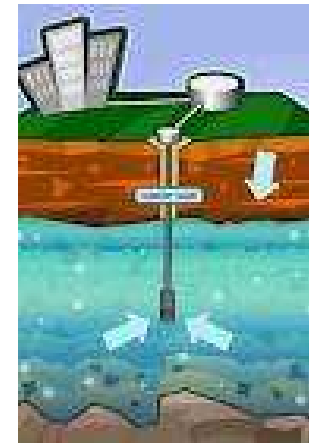
Risk assessment:

$$ETR_{gw-dw} = \frac{PEC_{gw-dw}}{DWS \times 1000}$$

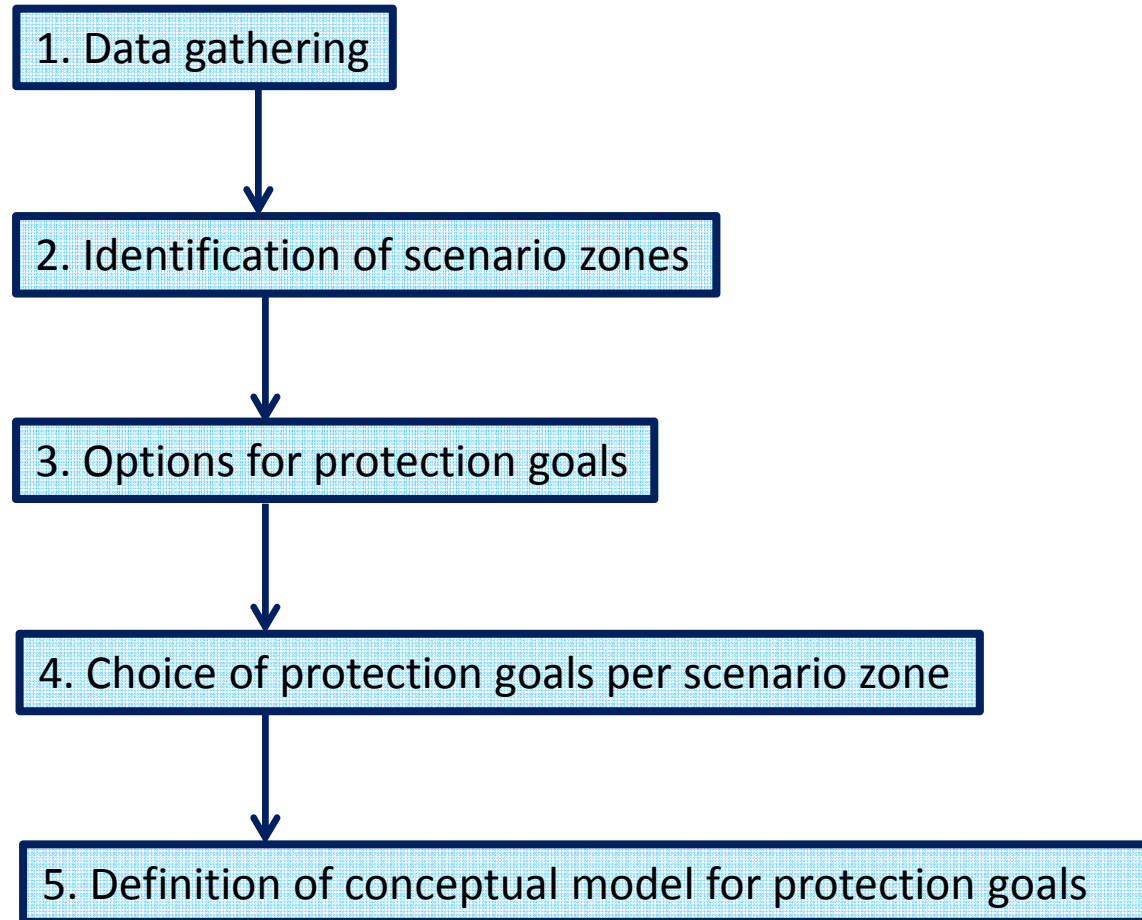
(1000 = factor to correct from ug/L to mg/L)

$ETR_{gw-dw} < 1$	→ low risk
$1 \leq ETR_{gw-dw} \leq 10$	→ possible risk
$ETR_{gw-dw} > 10$	→ high risk

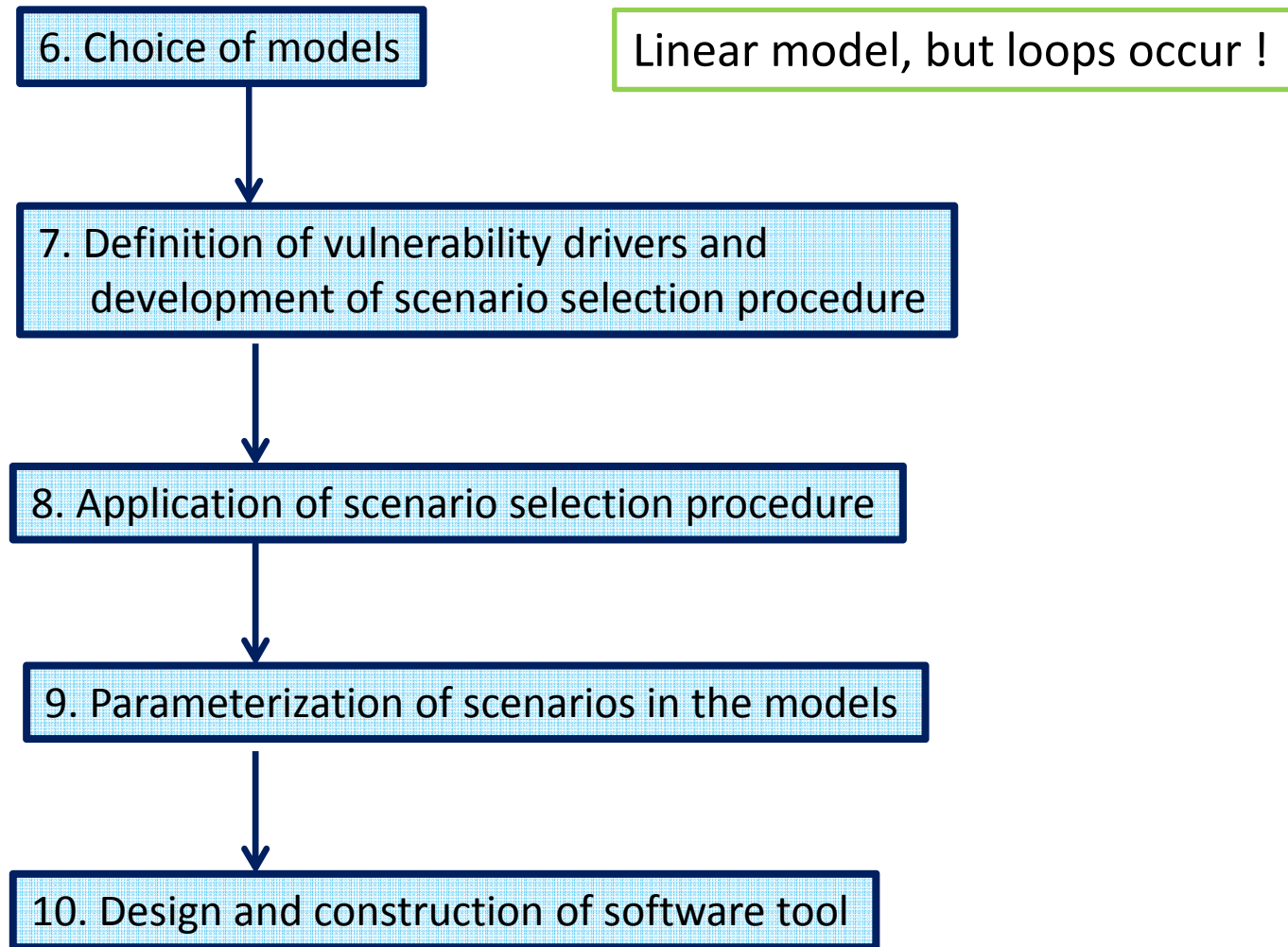
- Because a high safety factor is used to derive the ADI (factor 100) an exceedance factor of 10 is still considered relatively safe)



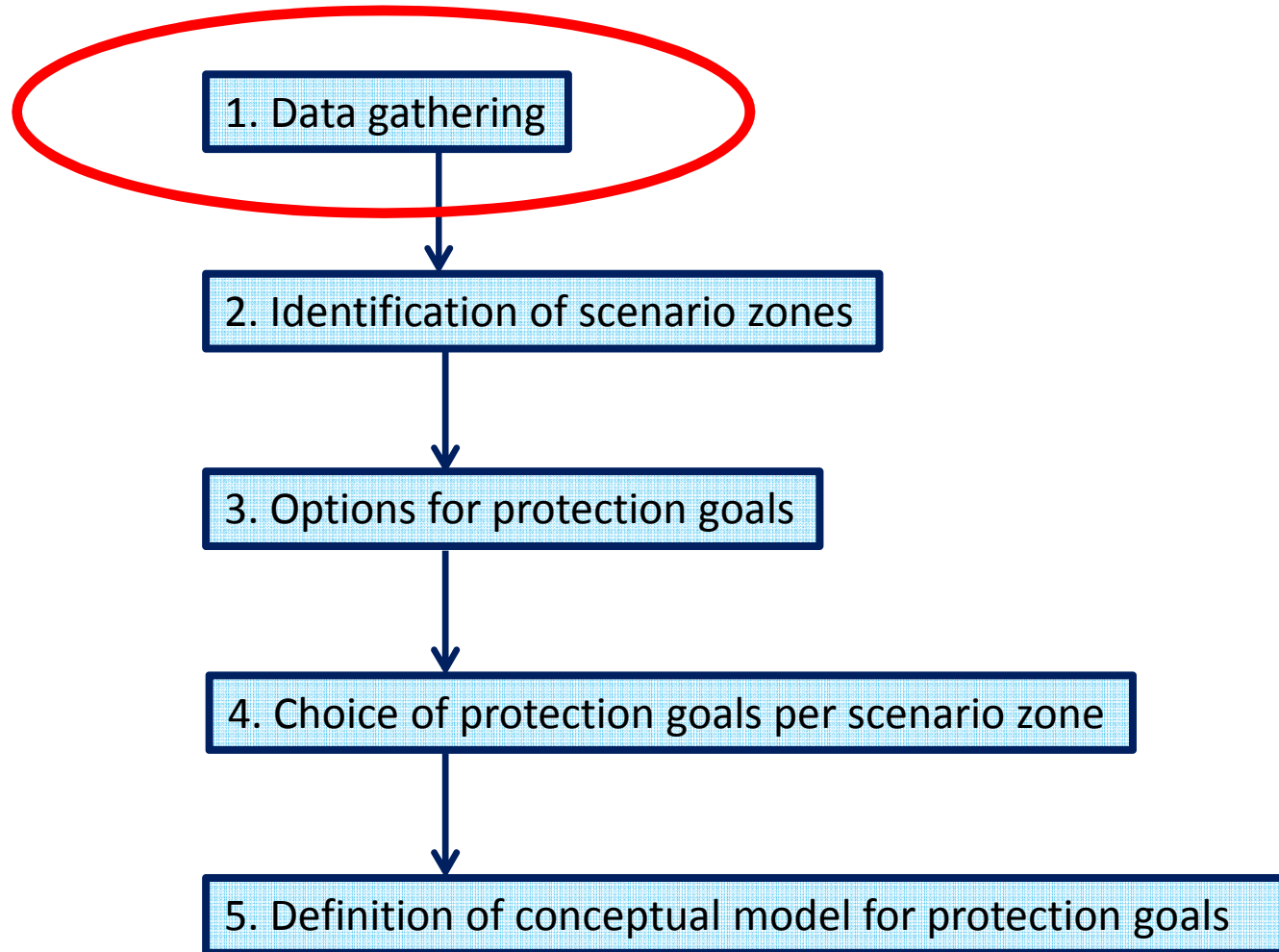
Definition of groundwater protection goal



Operationalising the groundwater protection goal



Definition of groundwater protection goal



Groundwater protection goal: steps in detail

1. Data gathering

- For groundwater systems:
 - Climate
 - Land use
 - Crops
 - Agricultural practices
 - Depth groundwater, catchment size
 - Pesticide use and application techniques

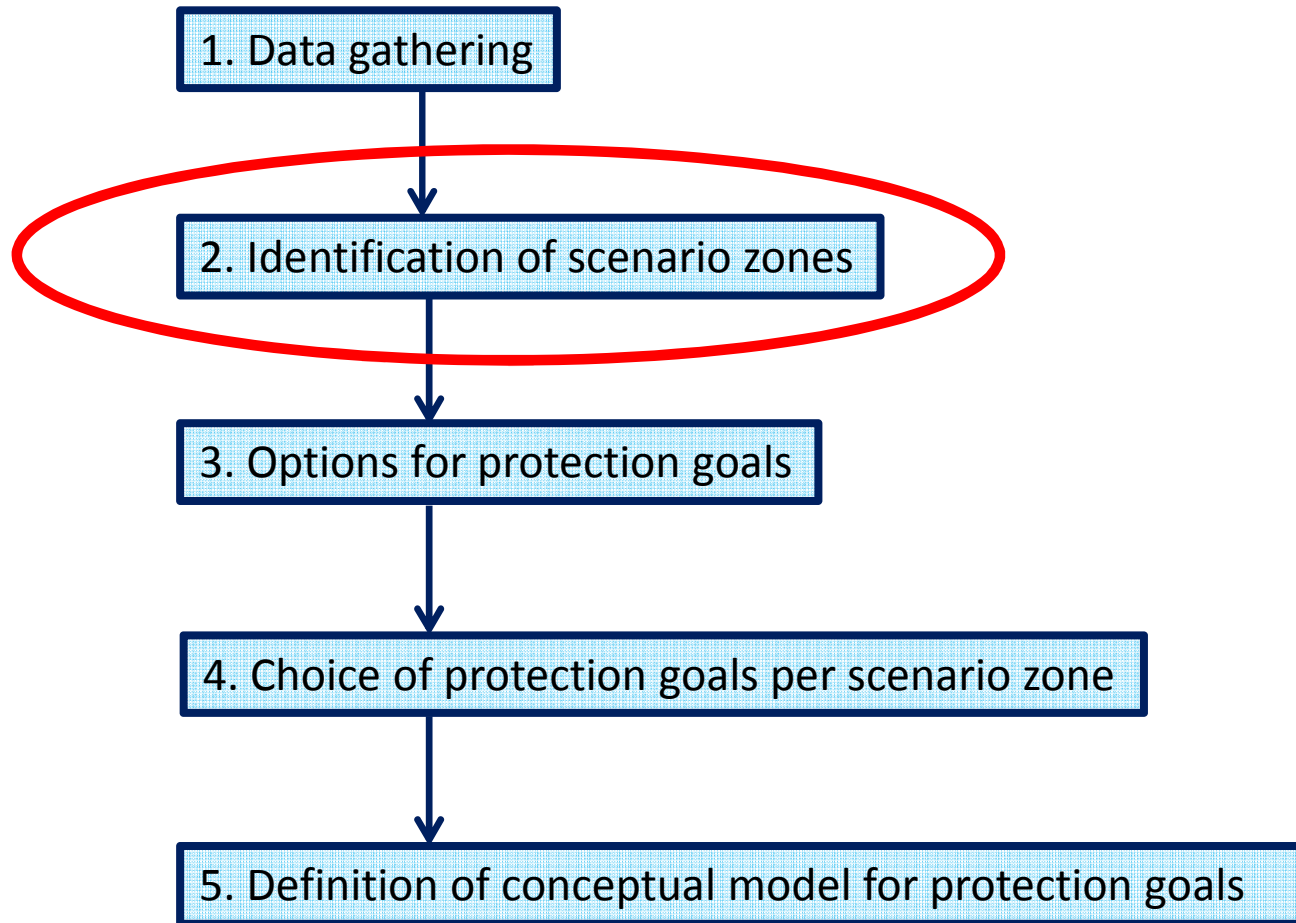
Groundwater protection goal: steps in detail

1. Data gathering

Today

- Expertise Engida on groundwater features and vulnerability for pesticides in Ethiopia

Definition of groundwater protection goal

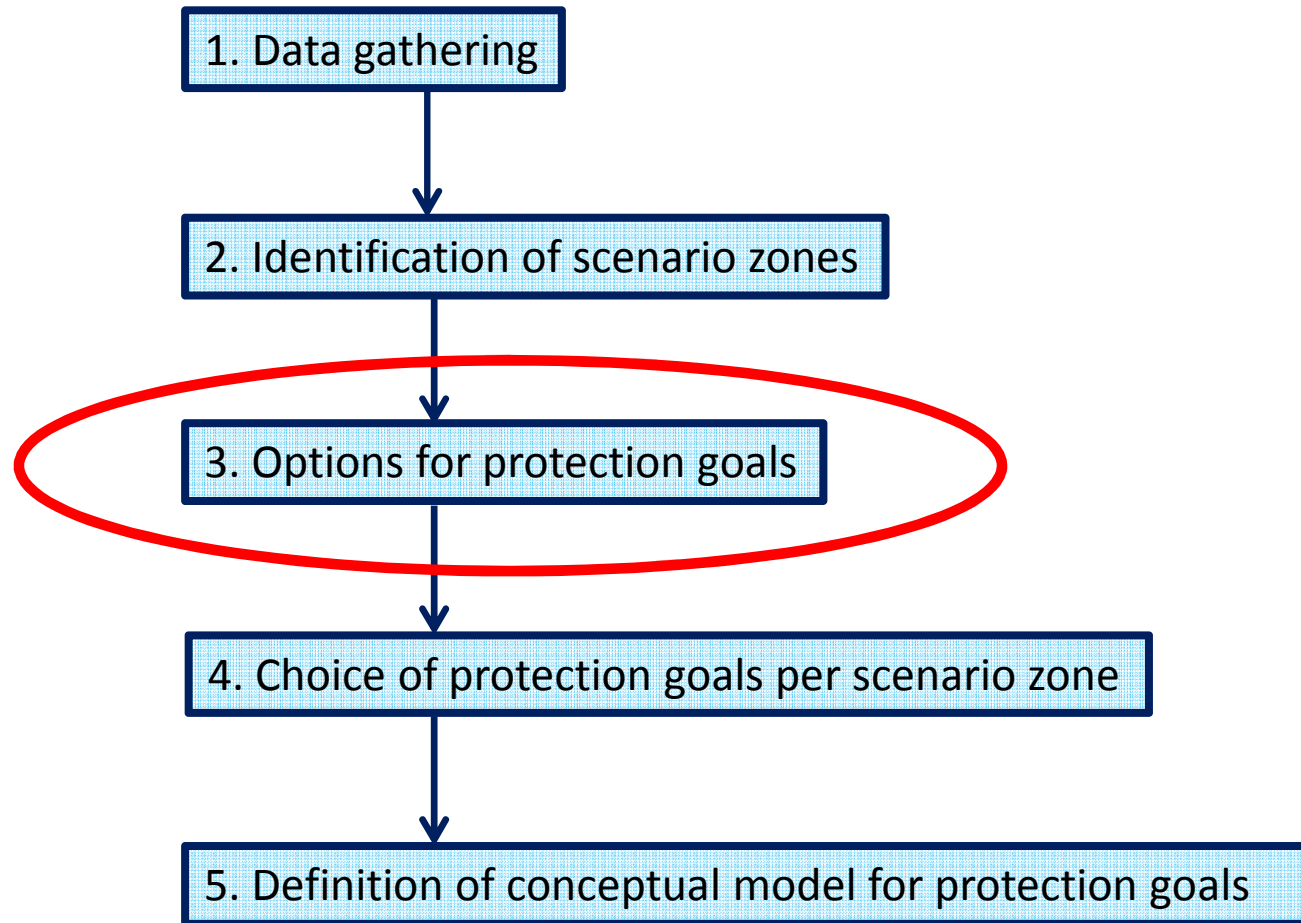


Groundwater protection goal

2. Identification of scenario zones

- Already done for surface water scenarios
- Same scenario zones for groundwater to keep Ethiopian registration procedure as simple as possible
- Any complications to do so ? Discuss when coupling protection goal to scenario zones

Definition of groundwater protection goal



Groundwater protection goal: steps in detail

3. Options for protection goals

- Definitions of options for protection goals, now drinking water from groundwater, .. (role for scientists)
- Today, after presentation of Engida, by Paulien
- What should be protected, where and how strict ?
Emphasis now on **what** and **where**, so the spatial component

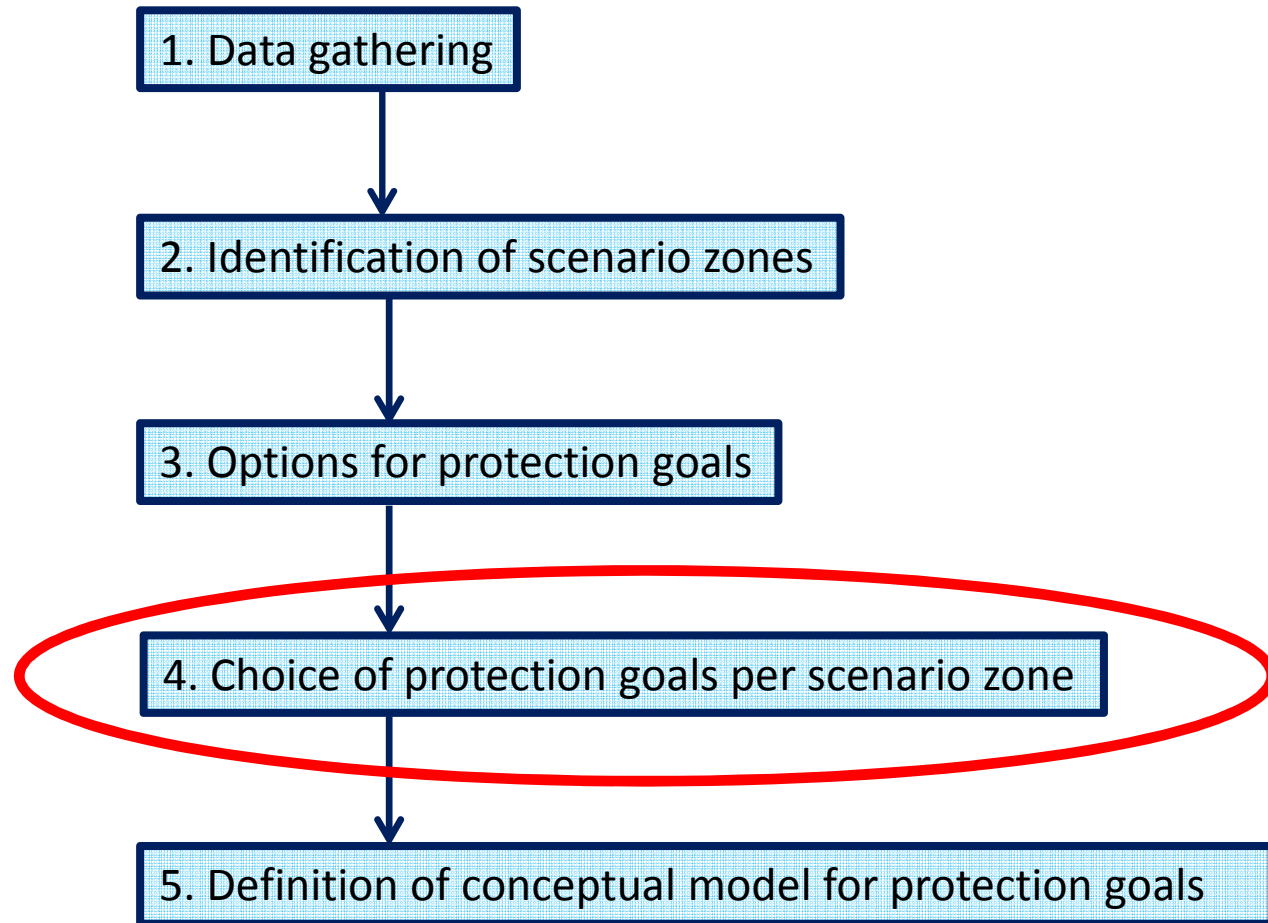
Groundwater protection goal: steps in detail

3. Options for protection goals

- For each protection goal: specify **what** and **where**
- E.g. groundwater for drinking water:
 - In each village, at shallow depth, location wells, across the entire country ? (so protection needed for few 100 m² around well)
 - In villages in Afar and Somali regional states: deep water wells, so protection needed for areas of several km²
 - In horticultural areas deep water wells of 50-100 m deep



Definition of groundwater protection goal



Groundwater protection goal: steps in detail

4. Choice of protection goals per scenario zone

- We make here options for protection goals, to be selected by pesticide Advisory Board and ...?
- Today we determine which protection goals valid for which scenario zones
- If necessary: we propose priorities in operationalizing the protection goals, to be confirmed by policy makers

Groundwater protection goal: steps in detail

4. Choice of protection goals per scenario zone

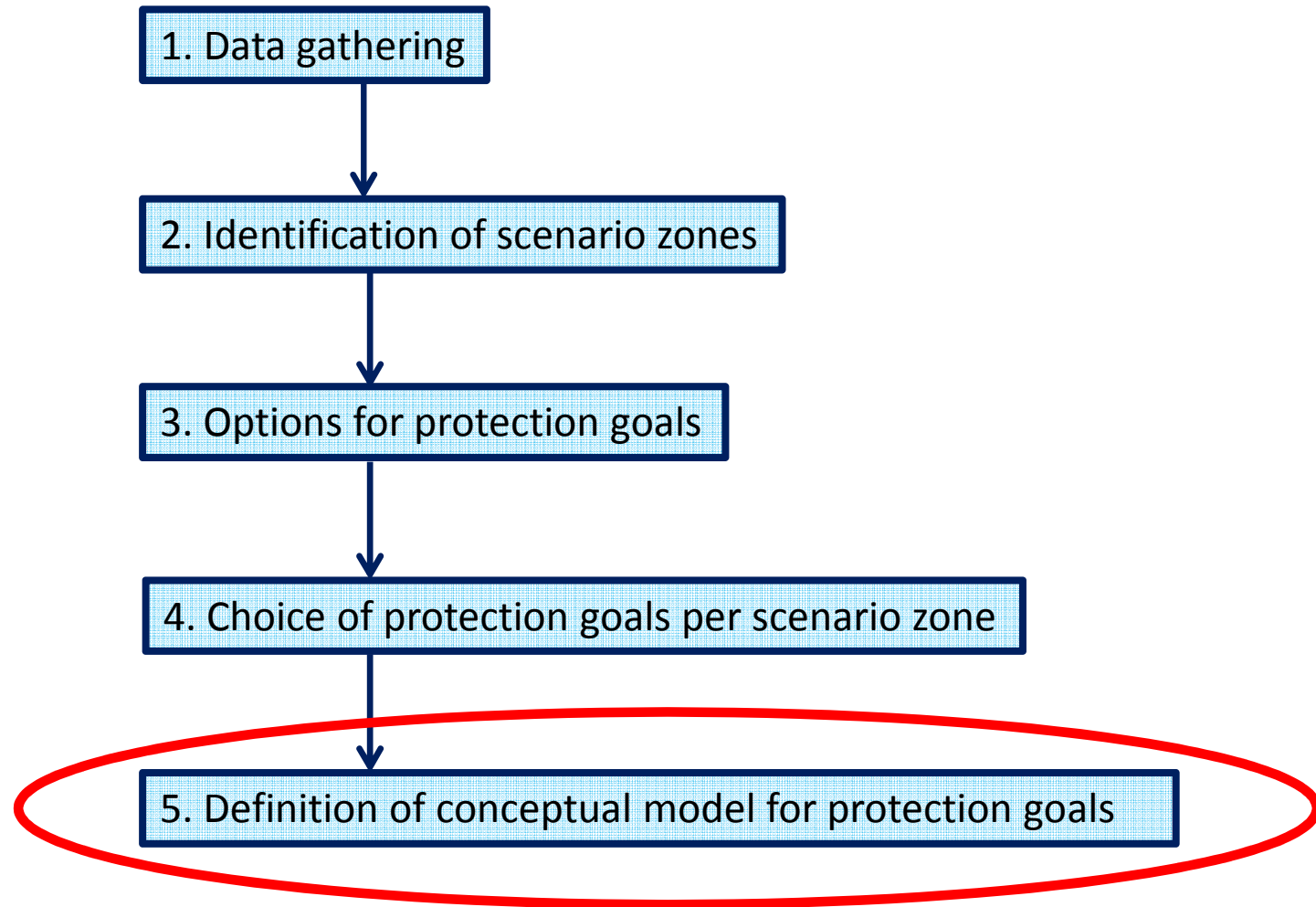
- Which protection goals valid for which scenario zones ?
 - e.g. if gw in scenario zone is not used for drinking water, do not consider this zone in your scenario selection procedure for the gw protection goal (otherwise not defensible/understandable for political level)
 - Definition of protection goal per scenario zone should focus on the overlap of areas where protection goal is relevant and where agriculture uses pesticides
 - If protection goal focuses on human health (indirectly), then focus on areas with use of most toxic compounds (i.e. insecticides instead of herbicides/fungicides) may be intelligent, pragmatic choice (see PPT John)
 - So, step 2 identification of scenario zones is further detailed in this step 4

Groundwater protection goal: steps in detail

4. Choice of protection goals per scenario zone

- This results in an overview of protection goals, coupled to scenario zone(s)
- If necessary: we propose priorities in operationalizing the protection goals, to be confirmed by policy makers
 - In principle each protection goal needs its own assessment method
 - E.g. pragmatic choice for considering only areas with current pesticide use, not future areas
 - Weighting e.g. economy vs environment is national policy

Definition of groundwater protection goal



Groundwater protection goal: steps in detail

5. Definition of conceptual model for protection goals

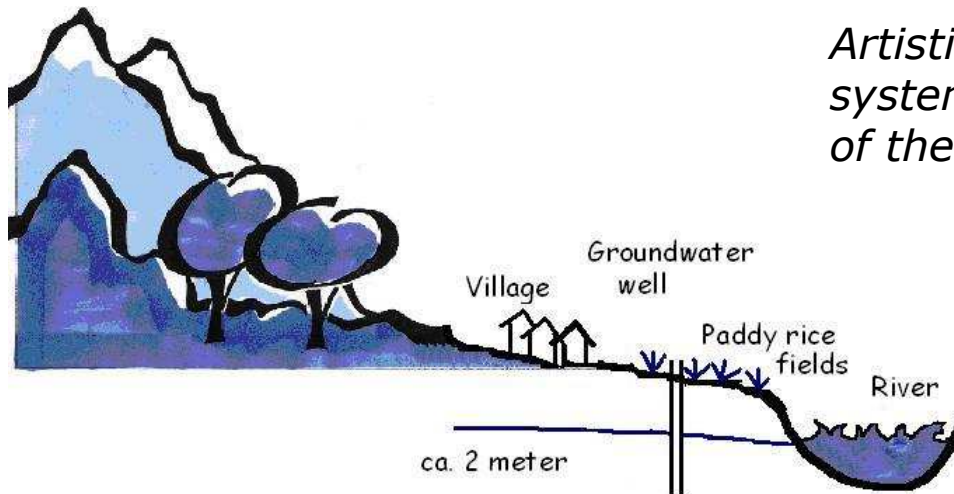
- Define conceptual model for each protection goal
- Start with conceptual models for 2-4 highest priority goals

- Conceptual model should contain all information relevant for determining the concentration
- Consists of a picture/drawing plus description

Groundwater protection goal: steps in detail

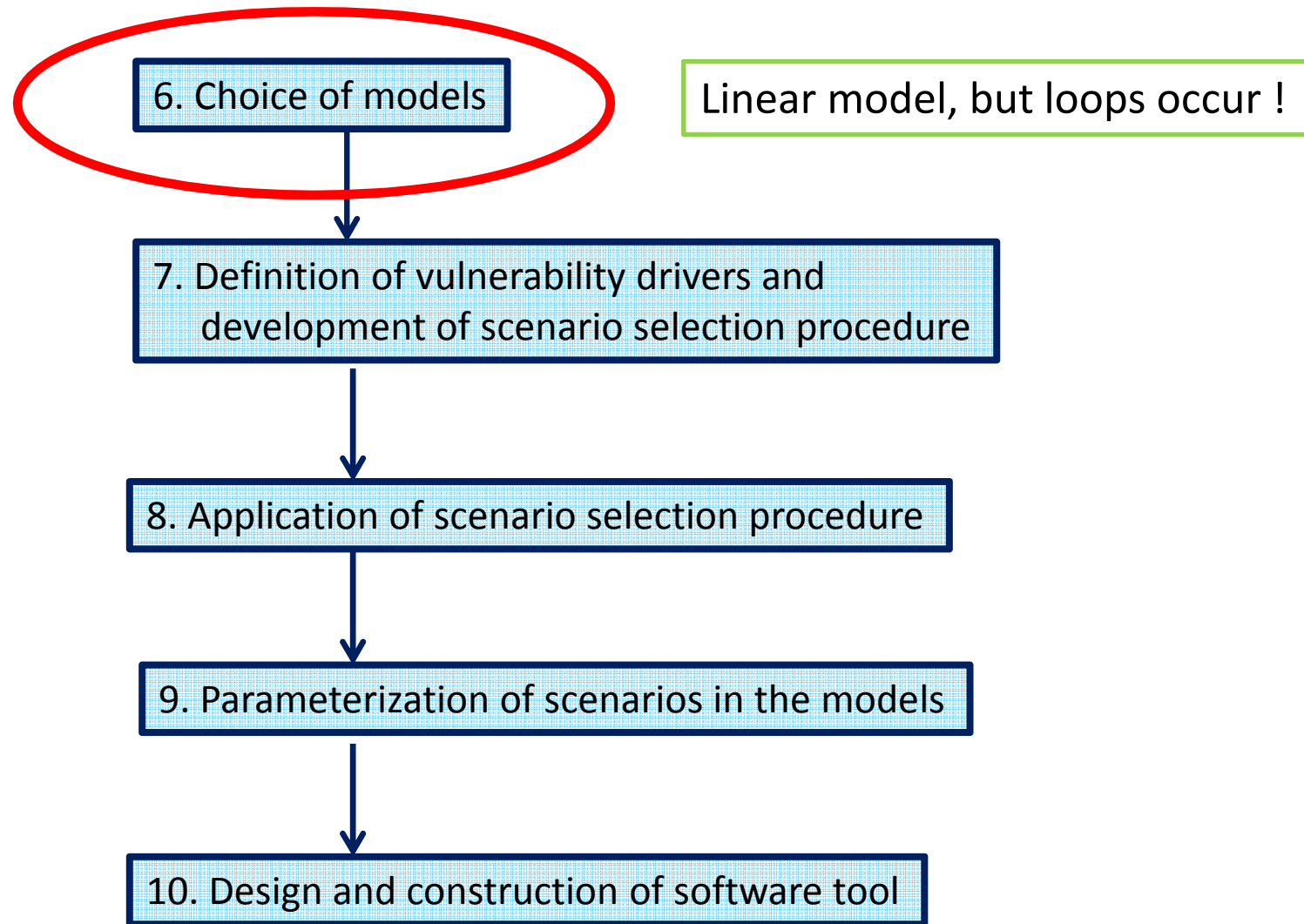
5. Definition of conceptual model for protection goals

- Example: groundwater for drinking water, China
 - Lay out + entry route+ location treated crops



Artistic impression of the groundwater system used as drinking water south of the Yangtze River in China

Operationalising the groundwater protection goal



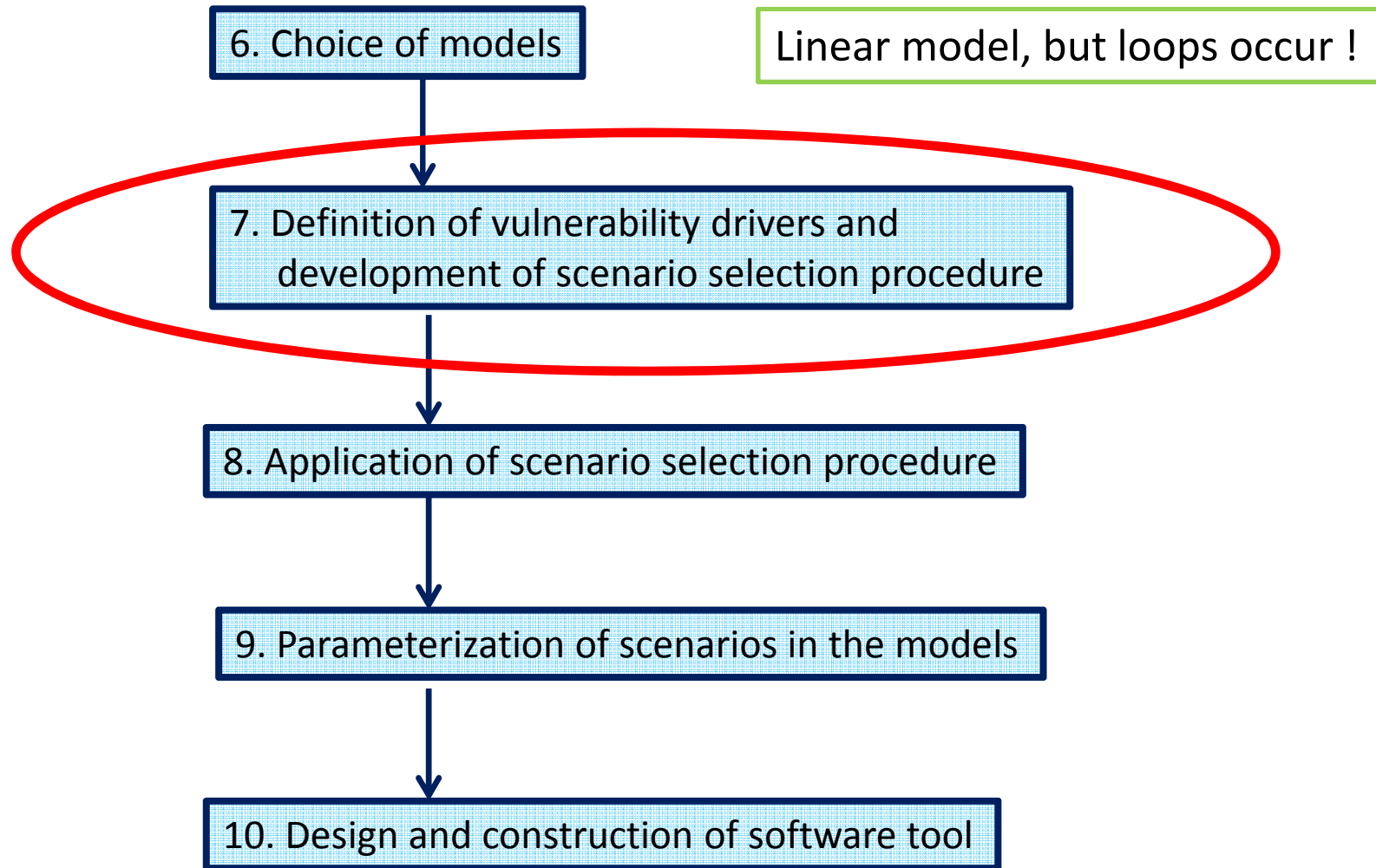
Groundwater protection goal

6. Choice of models

- metamodel EuroPEARL selected,
- developed for EU
- Relatively simple model, requiring limited input parameters

Calculations for ranking pesticides presented by John.

Operationalising the groundwater protection goal



Groundwater protection goal

7. Definition of vulnerability drivers and development of scenario selection procedure

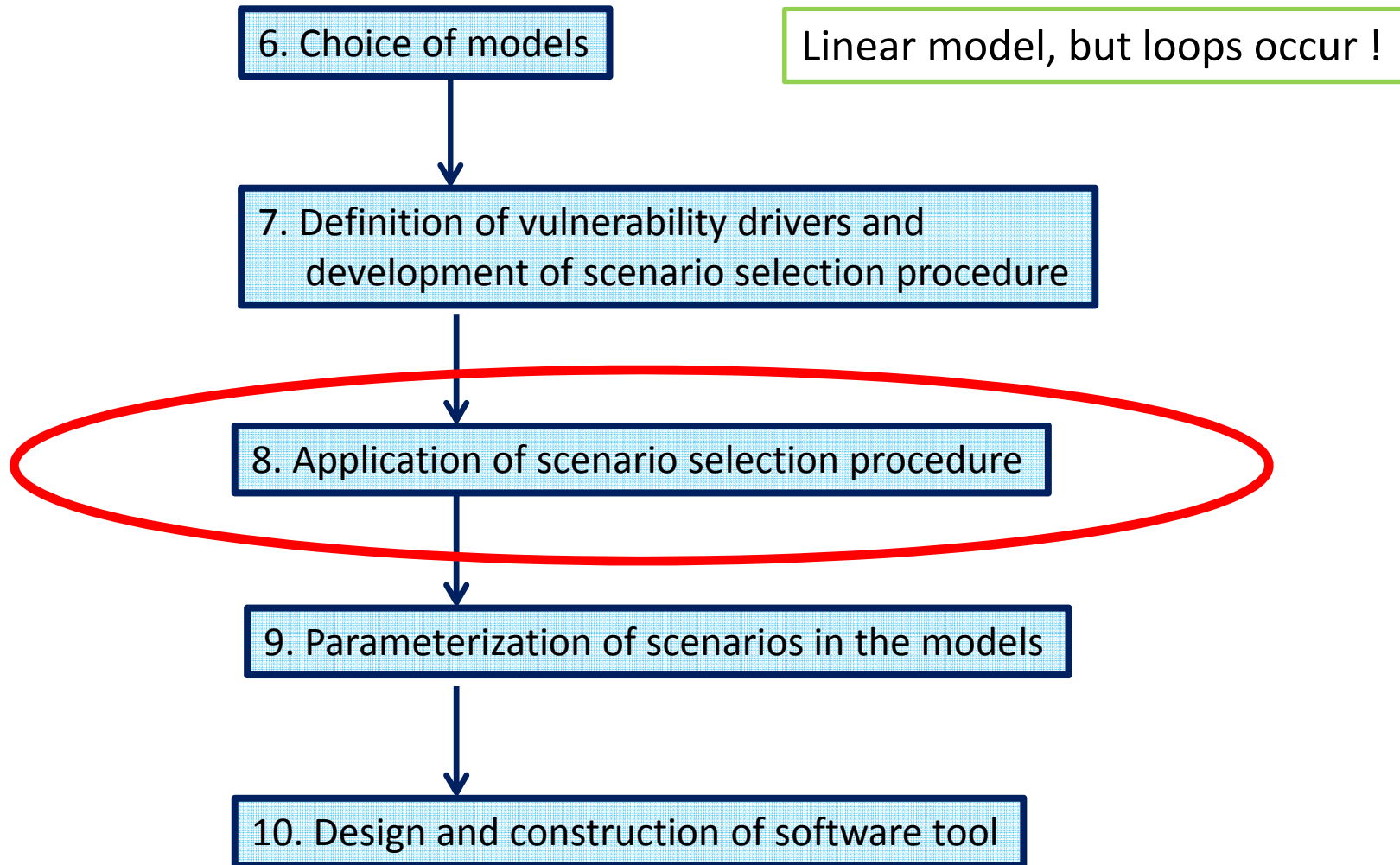
- Scenarios aim to represent 90th percentile of occurrence in time and space in each scenario zone of Ethiopia
(N.B. 90th –ile = EU translation of “realistic worst case situation”)
- Vulnerability drivers are main factors determining this 90th percentile, i.e. for groundwater 90th percentile of leaching concentration
- Combination of model parameters (determined by e.g. sensitivity analysis) and expert judgement of other factors (e.g. land use at intake area of groundwater wells)

Groundwater protection goal

7. Definition of vulnerability drivers and development of scenario selection procedure

- Scenario selection procedure combines vulnerability drivers in such a way that overall 90th percentile for leaching concentration is obtained
- Treated later today (Mechteld), after having finalised steps 1-6

Operationalising the groundwater protection goal

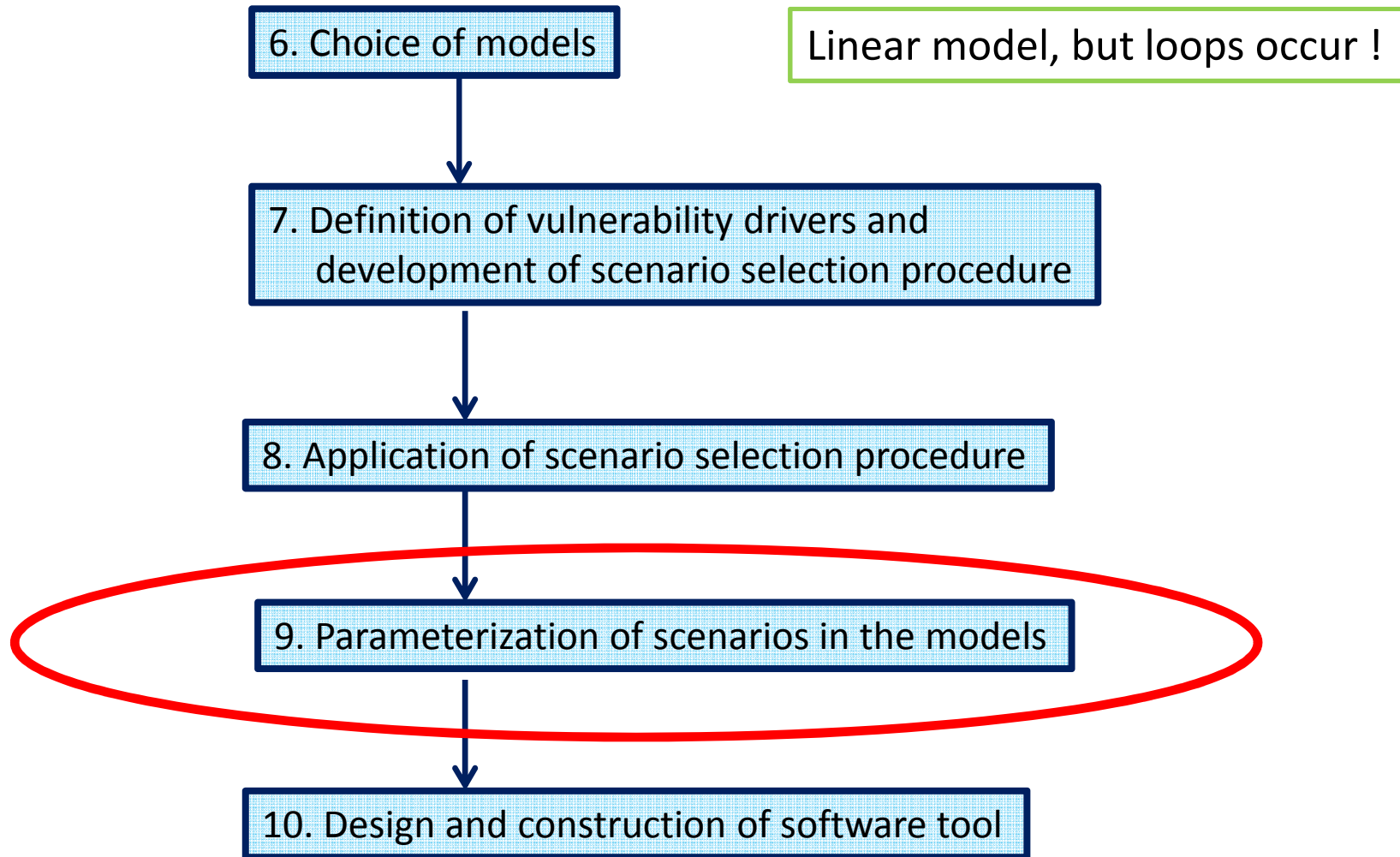


Groundwater protection goal

8. Application of scenario selection procedure

- Once procedure entirely defined, we will apply it
- Vulnerability drivers probably: organic matter upper soil layer, yearly precipitation surplus
- Geographical information available, so spatial percentiles can easily obtained by simply ranking
- Defined procedure to be applied by Mechteld Thursday

Operationalising the groundwater protection goal

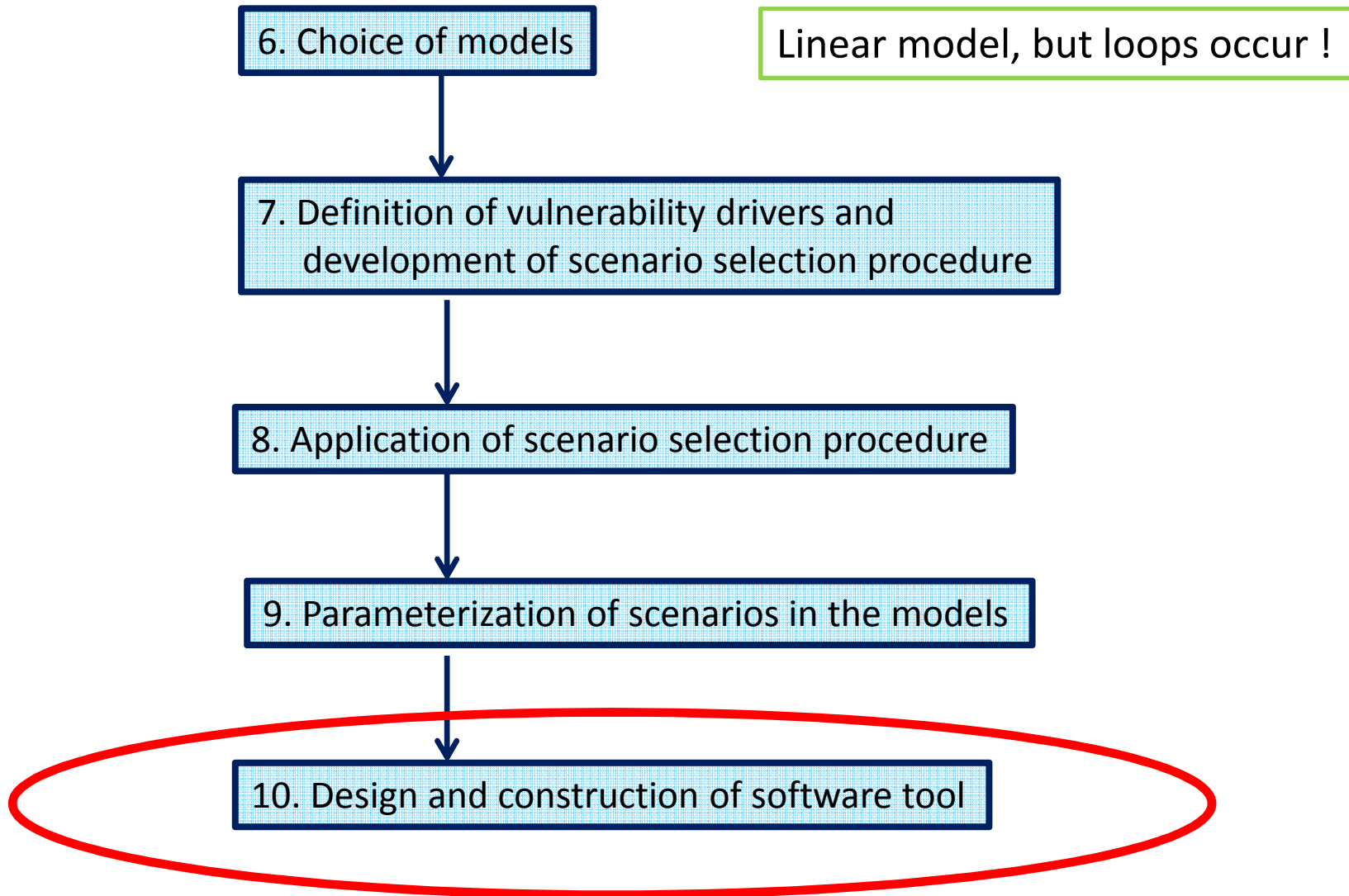


Groundwater protection goal

9. Parameterization of scenarios in the models

- Once scenarios and models to be used have been identified, we can make an inventory of data needed to parameterise the scenarios
- Will be done on Friday

Operationalising the groundwater protection goal



Groundwater protection goal

10. Design and construction of software tool

- To be done after this workshop by Alterra
- Aim is new version of PRIMET tool, specifically designed for Ethiopia

Definition of groundwater protection goal

