Pesticide Risk Reduction Programme – Ethiopia

Surface water: Scenario selection procedure

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joint collaborative programme on pesticide registration and post-registration

MoA

ALTERRA

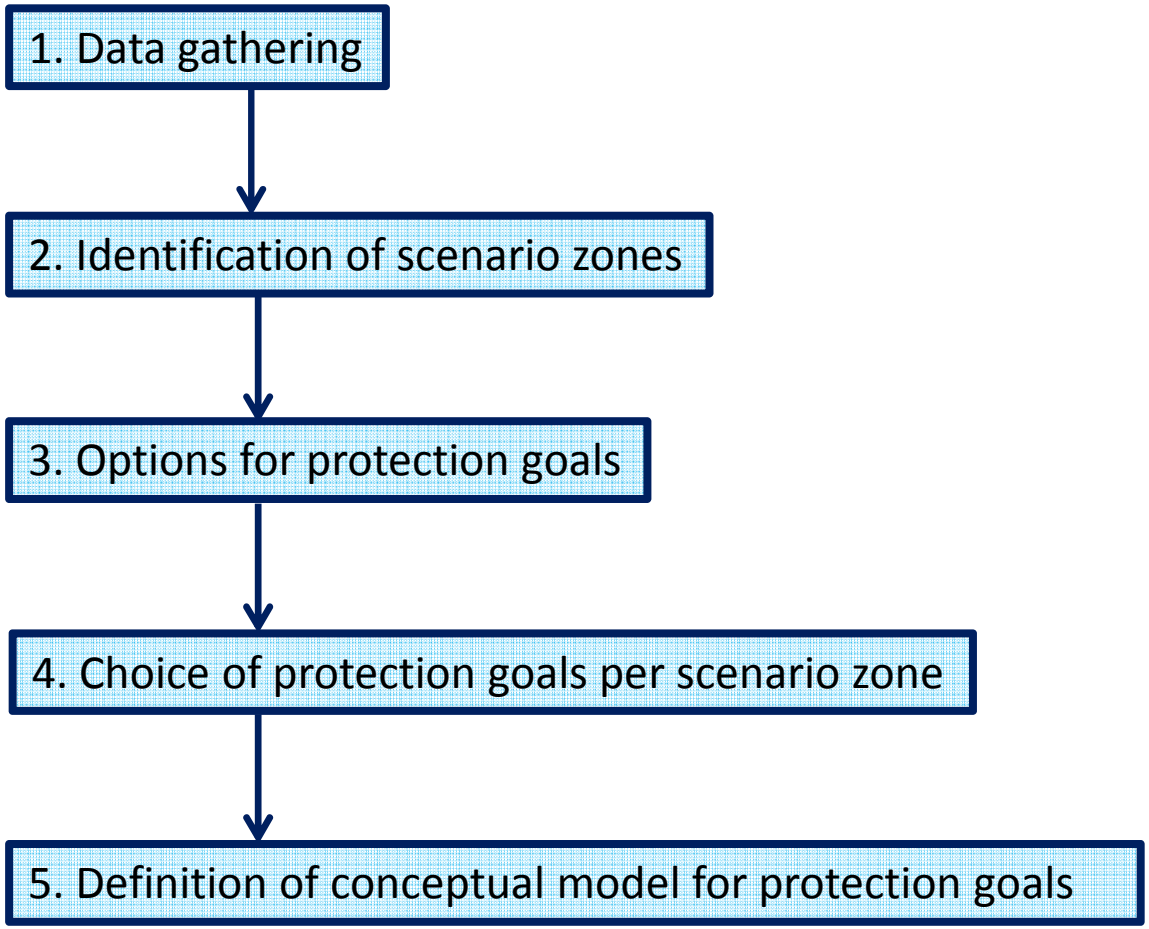
Towards a sustainable use of pesticides in Africa

Definition of protection goals

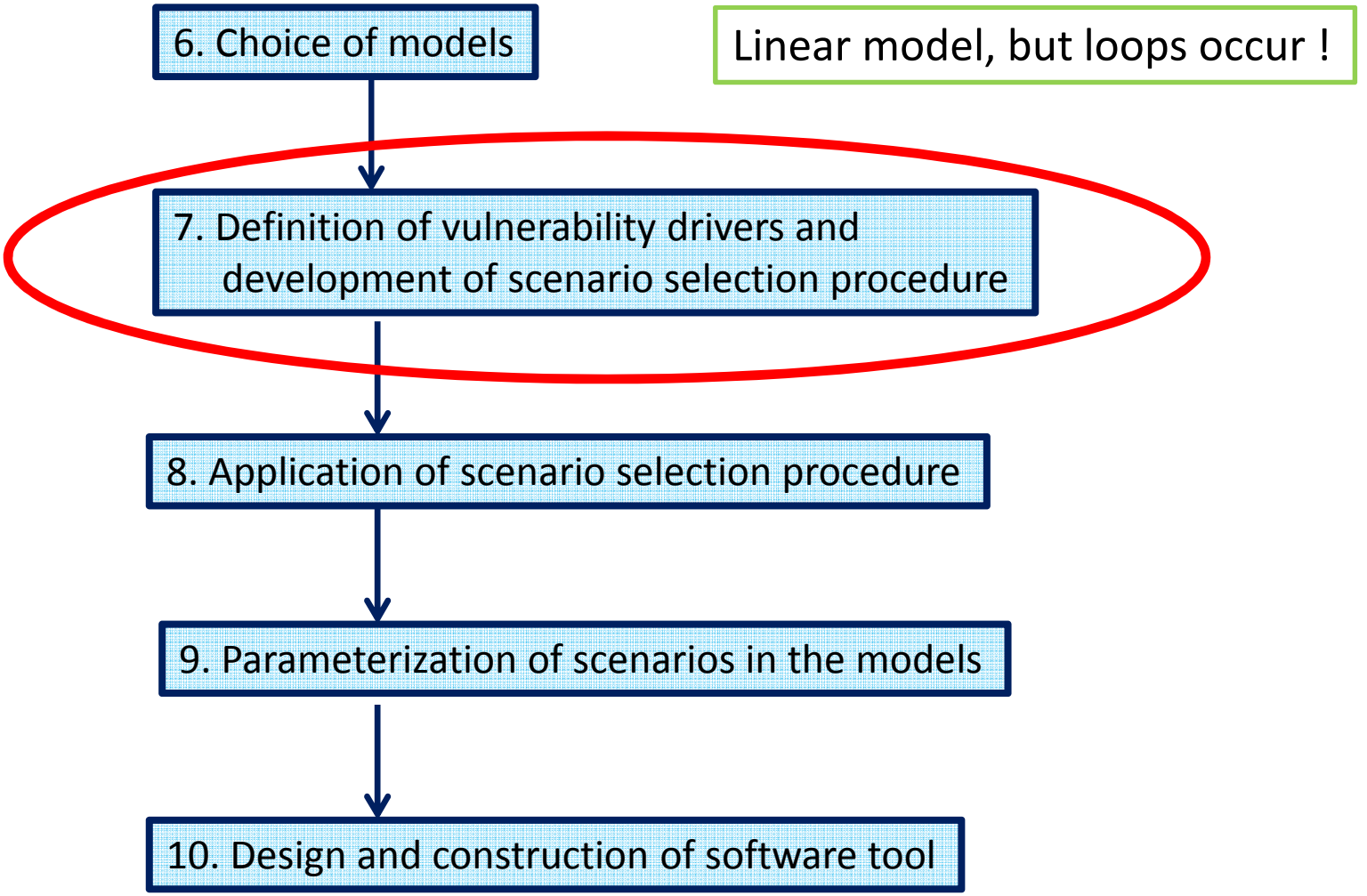
Outline

- Vulnerability drivers and scenario selection procedure

Definition of protection goals



Scenario selection and parameterization

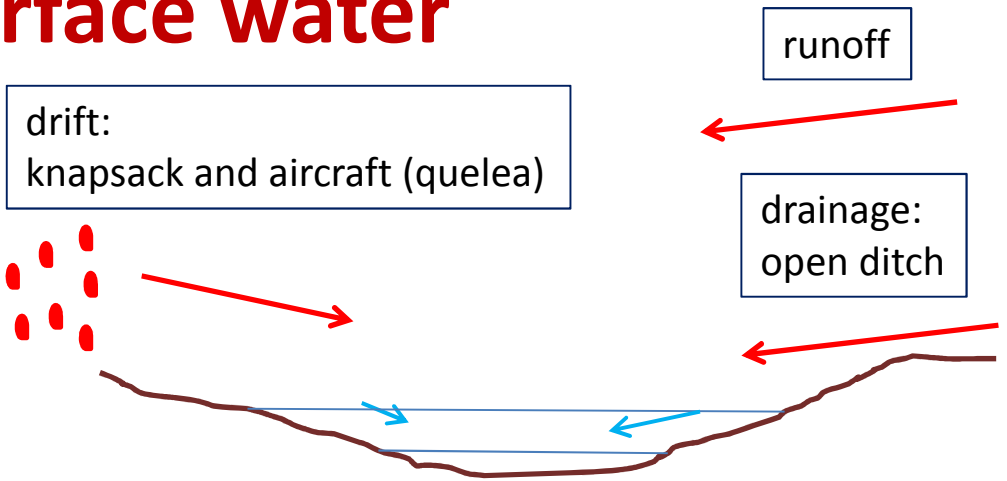


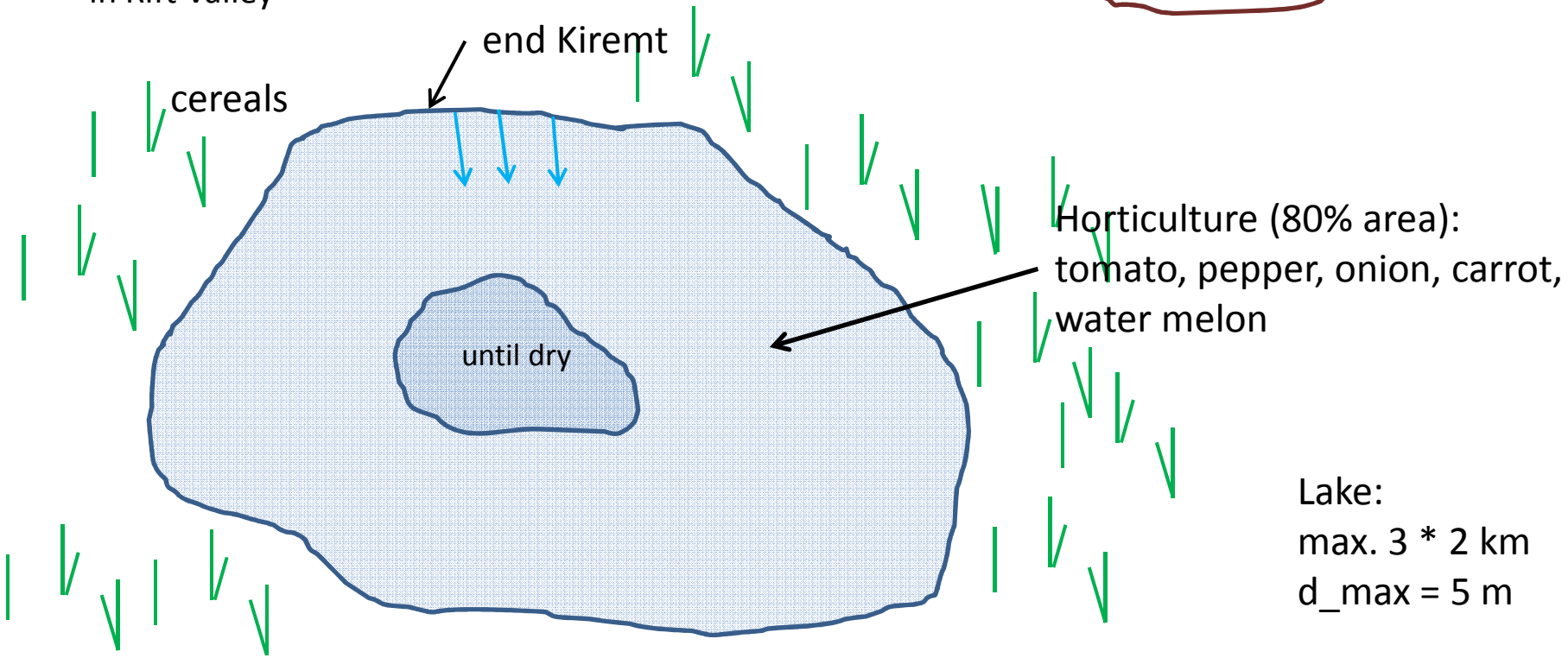
Protection goals: surface water

2. Temporary lakes

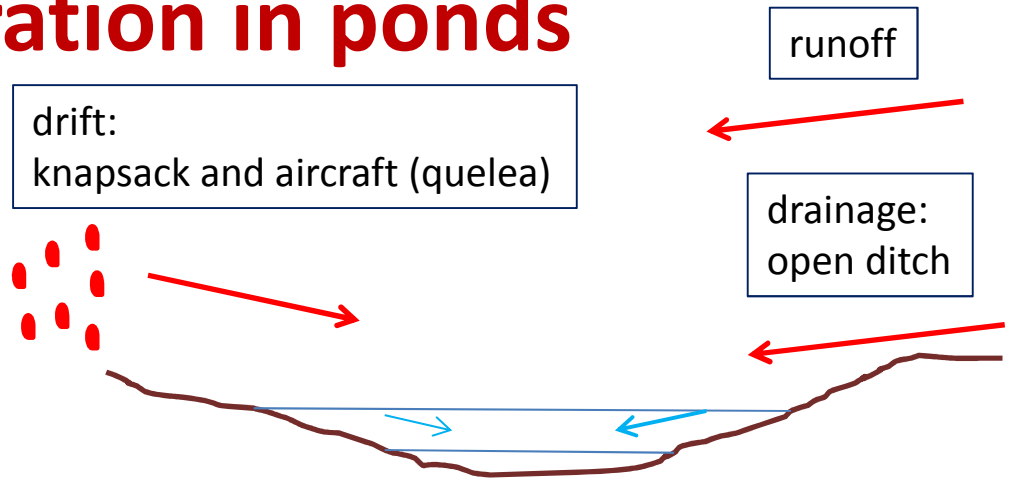
- Drinking water for cattle (until dry)
- Horticulture (irrigation with pumps)

- Start after Kiremt rains until dried up
- E.g. Koka area (swamp),
  in Rift Valley





Drivers for concentration in ponds



Relevant entry routes:

- Spray drift deposition
- Runoff (include furrows draining runoff water)
- ~~Drainage channels~~ (draining excess groundwater)

Surface water: (spray drift)

Temporary pond, back-of-envelope calculation:

Assume application equals 1 kg/ha:
20*20 m wide, 1 m deep;

5% spray drift over strip of 10 m (10-0%), i.e.
0.05*100 mg/m^2 in 1 m depth corresponds to 5 ug/L
diluted by factor 2, so pond concentration is 2.5 ug/L

100*100 m, 1 m deep;

5% spray drift over strip of 100 m, i.e.
5 ug/L diluted by factor 5, so pond concentration is 1 ug/L

(# what if overspray ?

100 mg/m^2 in 1 m depth corresponds to 0.1 mg/L,
so 100 ug/L)

Surface water: (runoff)

Temporary pond, back-of-envelope calculation:

Assume application equals 1 kg/ha and 10 ha treated around:
20*20 m wide, 1 m deep;

4 mm runoff (20 mm rain) with 500 ug/L (**tracer,** R4 FOCUS scen)
pond becomes 20 * 40 m (1 m deep) and concentration in runoff is diluted by factor 2, so pond concentration is 250 ug/L

100*100 m, 1 m deep;

4 mm runoff (20 mm rain) with 500 ug/L (tracer)
pond becomes 100 * 104 m) and
concentration in pond becomes ~20 ug/L

100*100 m, 1 m deep, 100 ha treated around;

4 mm runoff (20 mm rain) with 500 ug/L (tracer)
pond becomes 100 * 140 m and
concentration in pond becomes ~150 ug/L

so, runoff entries may be more important than spray drift entries (not overspray) !

Runoff estimation

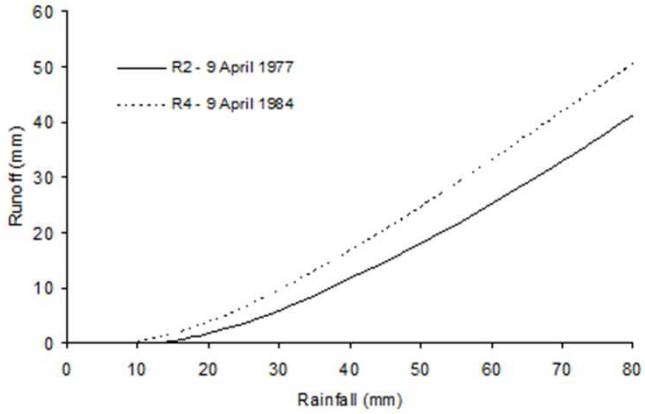
Estimation of runoff entries (Adr. et al, in prep):

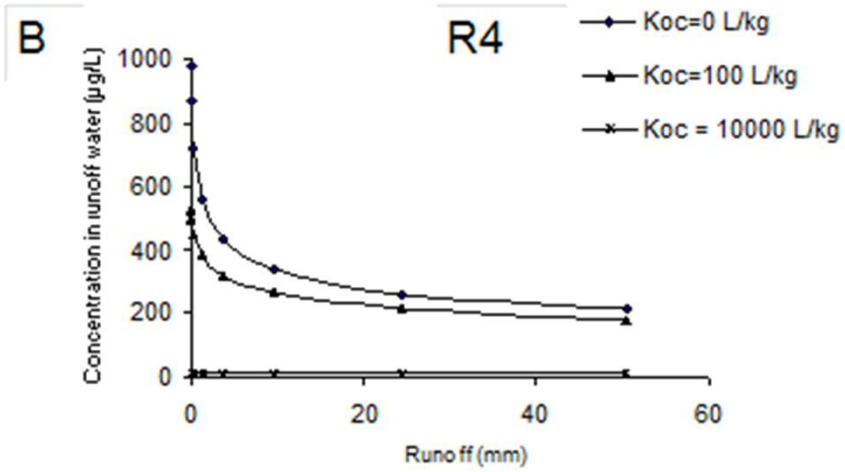
Use FOCUS R4 stream scenario:

highest potential for runoff of 4 EU runoff scenarios
(Roujan, France, soil group C, low oc (0.6%), high RCN (maize, fallow, 91))

simulations for runoff=f(daily rain), 3 compounds, 1 kg/ha

20 mm rain -> 5 mm runoff with 500 ug/L (tracer)
50 mm rain -> 30 mm runoff with 200 ug/L (tracer)

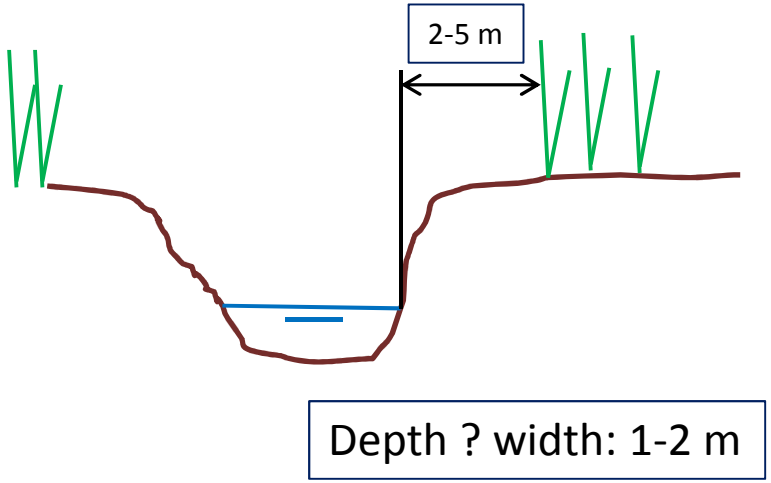


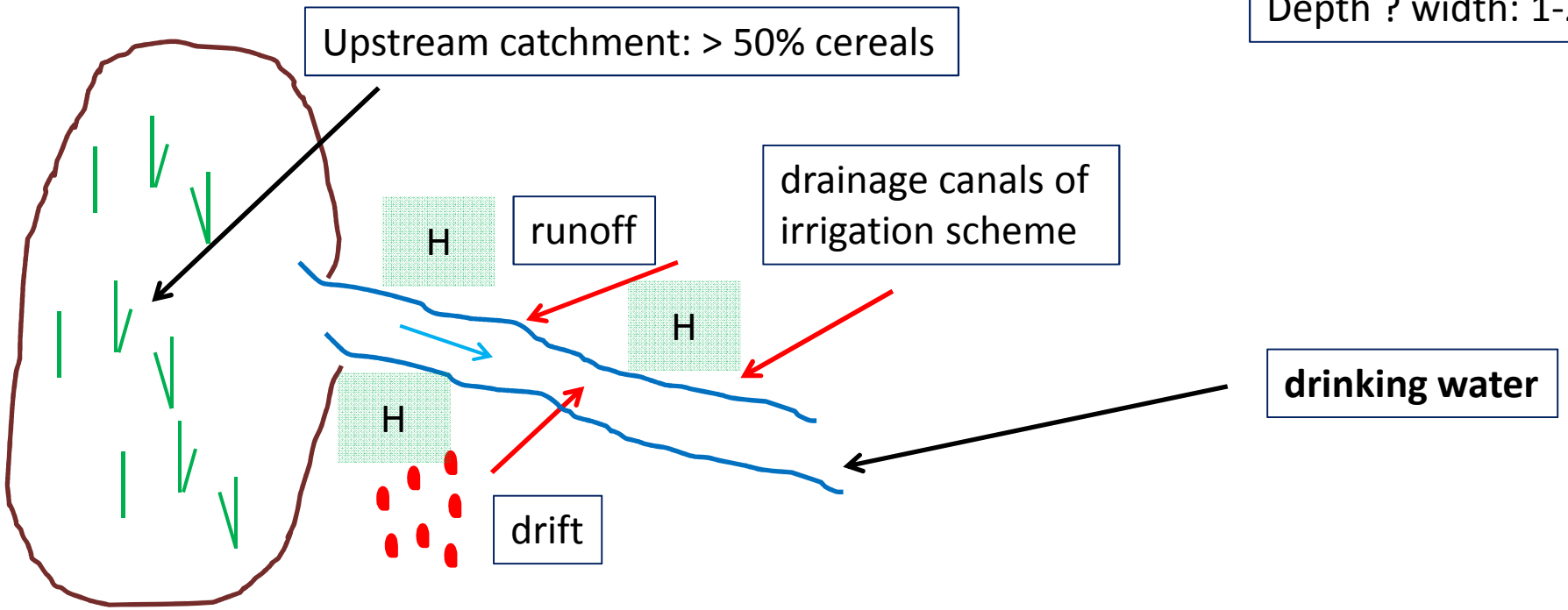


Protection goals: surface water

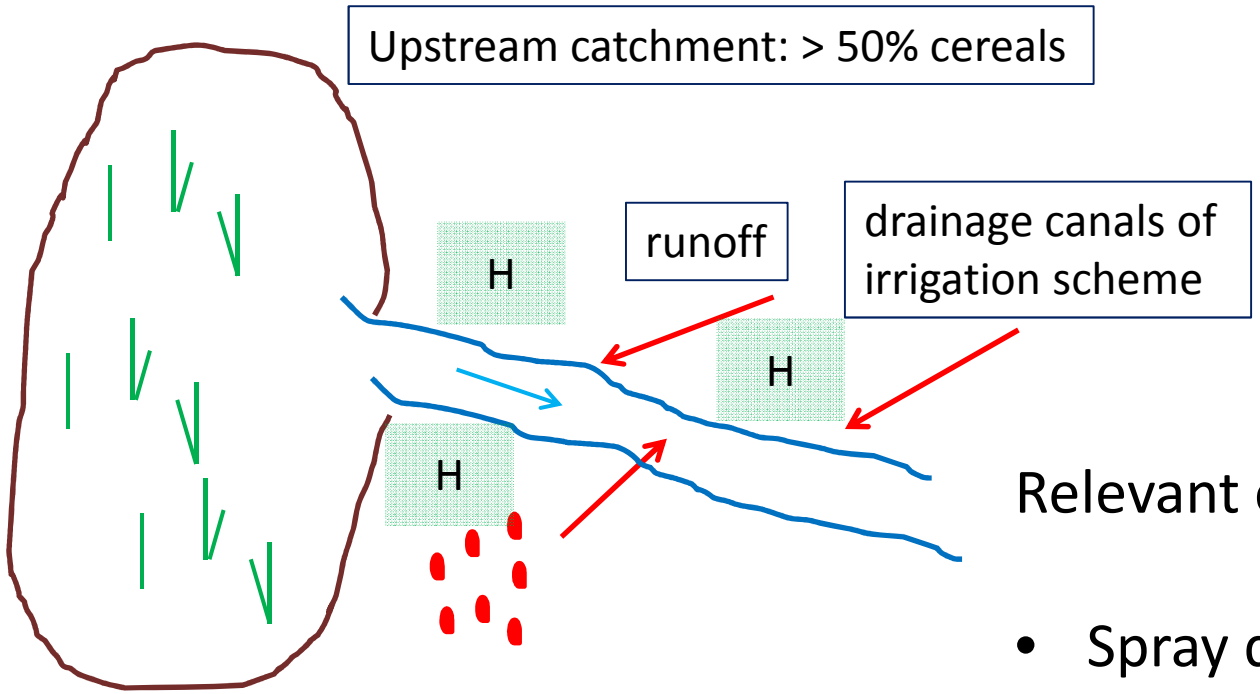
3. Stream/small rivers

- Drinking water (villages) until depleted (just before Kiremt, horticulture still done)
- Drinking water for cattle
- Irrigation of horticulture (H)





Drivers for concentration in streams



Relevant entry routes:

- Spray drift deposition
- Runoff (include furrows draining runoff water)
- ~~Drainage channels (draining excess groundwater)~~

Surface water: (spray drift)

Stream/small river, back-of-envelope calculation:

Assume application equals 1 kg/ha :
2 m wide, 0.50 m deep;

5% spray drift, i.e. 0.05*100 mg/m^2 in 0.5 m water depth corresponds to 10 ug/L

(# what if overspray ?

100 mg/m^2 in 0.5 m depth corresponds to 0.2 mg/L, so 200 ug/L)

Surface water: (runoff)

Stream/small river, back-of-envelope calculation:

Assume all stream water replaced by runoff :

4 mm runoff (20 mm rain) with 500 ug/L (**tracer,** R4 FOCUS scen)

30 mm runoff (50 mm rain) with 200 ug/L (**tracer**)

N.B. contributing area is 100% treated !

so, also in stream: runoff entries may be more important than spray drift entries (not overspray) !

Surface water: conclusion on drivers

- These calculations show that for
  both temporary pond and stream/small river
  runoff is a more important entry route than spray drift

- So, in designing the exposure scenario
  we should focus more
  on the runoff entry route

N.B. PRZM calculates
sheet runoff flow,
not via gullies !

Interludum: Vulnerability

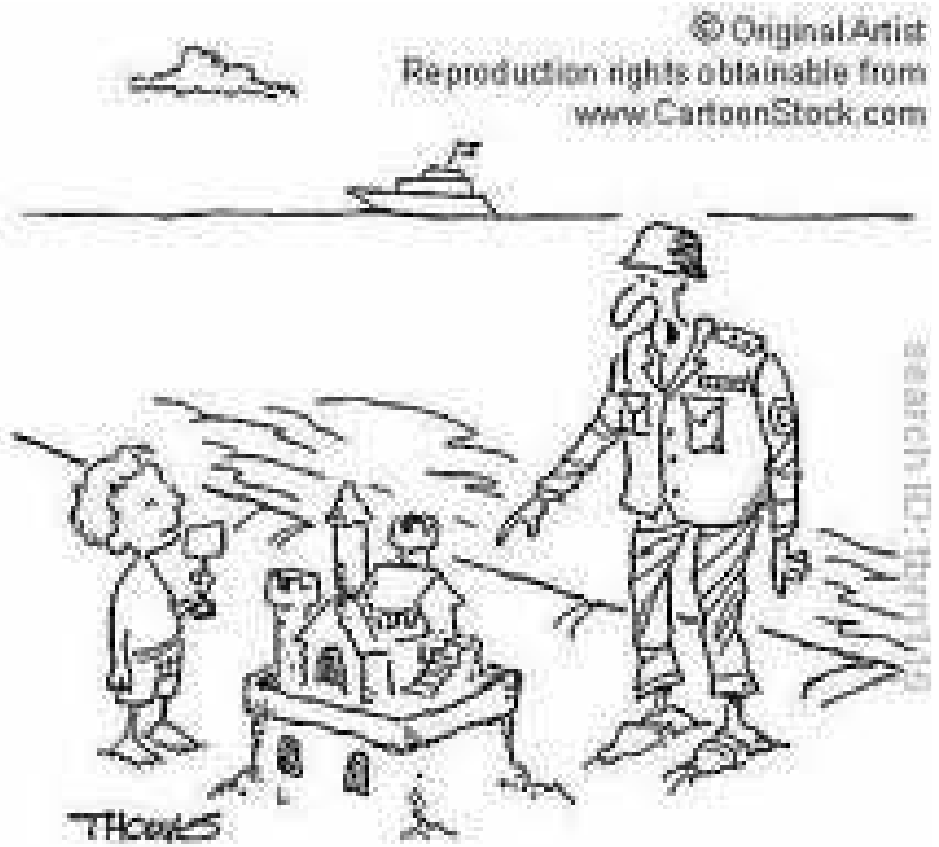
7. Definition of vulnerability drivers and development of scenario selection procedure

Vulnerability:

The predisposition of a protection goal to be at risk for exposure to pesticides.

Scenarios should be protective

→ therefore **vulnerability concept**



"Not bad kid, but you'd be vulnerable to attacks here and here."

Interludum: Vulnerability

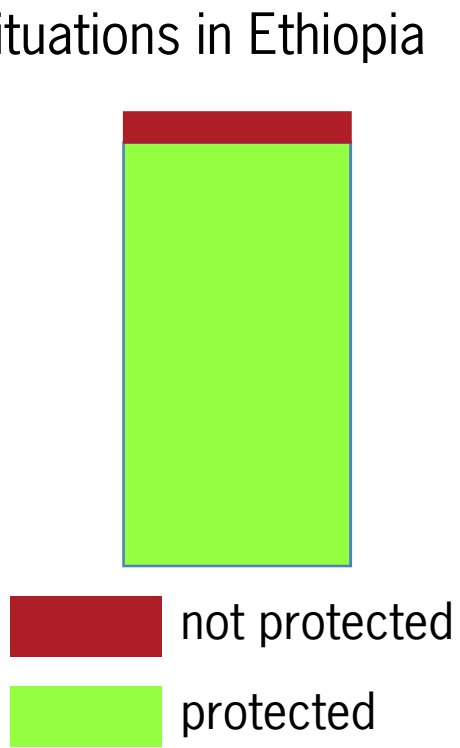
7. Definition of vulnerability drivers and development of scenario selection procedure

Scenarios should be protective

x % of in reality existing situations (in time and space) in Ethiopia are protected

50% means half of all situations in Ethiopia are protected = general situation

90% means that 90% all situations in Ethiopia are protected = EU translation of “realistic worst case situation”



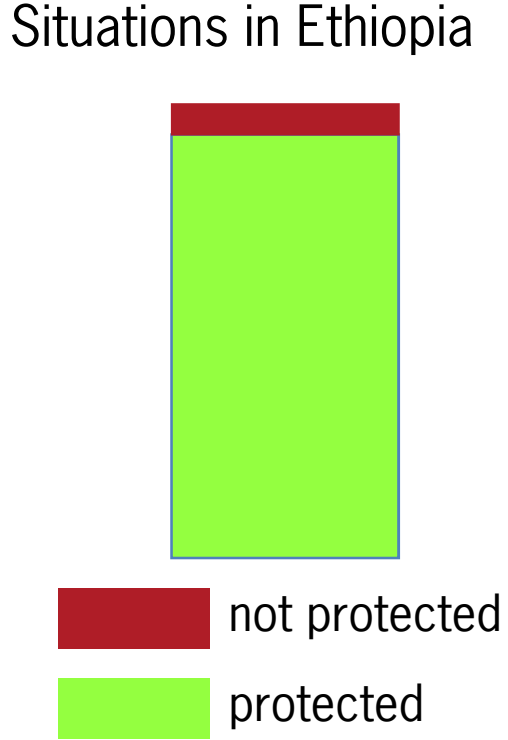
Interludum: Vulnerability

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

Scenarios should be protective,
"realistic worst case"

Proposal: 99th%-ile occurrence in time and space is protected, so 1% is not protected

More strict than in EU because human-toxicological standard is used in Ethiopia (exceedance means casualties)



Drivers for temporary ponds / streams

One conclusion:

99^{th}-ile worst-casedness operationalised by

number of d with runoff, i.e. with P_{day}>20 mm (Blenkinson et al,) to be distributed between time and space

Drivers for small streams (> 1500 m)

Procedure selection 99th ile # days with runoff, i.e. P_{day}>20 mm, 33 years available

1. Distribute grids between > 1500 m and < 1500 m
2. Follow procedure below for scenario zone > 1500 m:
3. Rank first in time, then in space
4. For each grid and each year: determine # days with P_{day}>20 mm
5. Next rank 33 values and select 99^{th}%-ile (nr 33)
6. Repeat for all grids, result: 100 grids in scen zone > 1500 m: 100 values

Drivers for small streams (> 1500 m)

Procedure selection 99th ile # days with runoff, i.e. P_{day}>20 mm, 33 years available

7. Now spatial %-ile:
8. Rank all 100 99%ile values select 3 grids around 99%ile
9. Now 99th %ile obtained for the selected scenario zone
10. Plot these 3 grids on map, indicate elevation and #d with P_{day}>20mm, check that they cover arable land (no forest, desert etc)
11. Discuss with Ethiopians to select most defensible location (2,3) for scenario, to be combined with protection goal “small rivers” and crops
12. Run PRZM 33 years, for scenario+crop+pesticide+appln pattern: 33 peak c_{runoff}
13. Rank 33 values and select 99th ile (=crop+pesticide+appln pattern specific temporal %-ile, i.e. step 4-6 repeated)

Drivers for temporary ponds (>1500 m)

Procedure selection 99th ile # days with runoff, i.e. P_{day}>20 mm, 33 years available

1. Distribute grids between > 1500 m and < 1500 m
2. Follow procedure below for scenario zone > 1500 m, but below 2000 m:
3. Rank first in time, then in space
4. For each grid and each year: determine # days with P_{day}>20 mm
5. Next rank 33 values and select 99th%-ile (nr 33)
6. Repeat for all grids, result: 40 grids in scen zone (> 1500 m but < 2000 m: 40 values

Drivers for temporary ponds (> 1500 m)

Procedure selection 99th ile # days with runoff, i.e. P_{day}>20 mm, 33 years available

7. Now spatial %-ile:

8. Rank all 40 99%ile values select 3 grids around 99%ile

9. Now 99th %ile obtained for the selected scenario zone

10. Plot these 3 grids on map, indicate elevation and #d with P_{day}>20mm, check that they cover arable land (no forest, desert etc)

11. Discuss with Ethiopians to select most defensible location (2,3) for scenario, to be combined with protection goal “temporary ponds” and crops in highlands
12. Run PRZM 33 years, for scenario+crop+pesticide+appln pattern: 33 peak c_{runoff}

13. Rank 33 values and select 99th ile (=crop+pesticide+appln pattern specific temporal %-ile, i.e. step 4-6 repeated)

Drivers for temporary ponds (<1500 m)

Procedure selection 99th ile # days with runoff, i.e. P_{day}>20 mm, 33 years available

1. Distribute grids between > 1500 m and < 1500 m
2. Follow procedure below for scenario zone < 1500 m, but with more than 500 mm rain (long term annual average):
3. Rank first in time, then in space
4. For each grid and each year: determine # days with P_{day}>20 mm
5. Next rank 33 values and select 99^{th}%-ile (nr 33)
6. Repeat for all grids, result: 80 grids in scen zone (< 1500 m but >500 mm rain: 80 values

Drivers for temporary ponds (<1500 m)

Procedure selection 99th ile # days with runoff, i.e. P_{day}>20 mm, 33 years available

7. Now spatial %-ile:

8. Rank all 80 99%ile values select 3 grids around 99%ile

9. Now 99th %ile obtained for the selected scenario zone

10. Plot these 3 grids on map, indicate elevation, and #d with P_{day}>20mm, check that they cover arable land (no forest, desert etc)

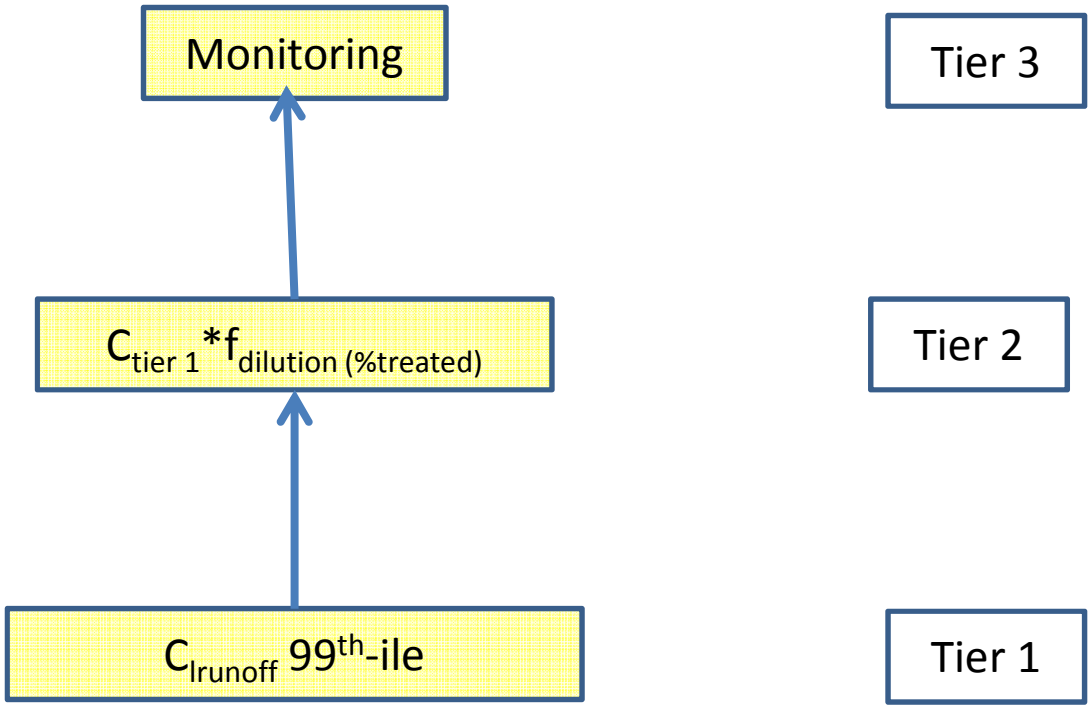
11. Discuss with Ethiopians to select most defensible location (2,3) for scenario, to be combined with protection goal “temporary ponds” and crops in lowlands

12. Run PRZM 33 years, for scenario+crop+pesticide+appln pattern: 33 peak c_{runoff}

13. Rank 33 values and select 99th ile (=crop+pesticide+appln pattern specific temporal %-ile, i.e. step 4-6 repeated)

Interludum: tiered approach

2nd tier: % treated with compound considered (may be different crops, but with same pest, e.g. aphids)



Scenario selection procedure

Scenario selection procedure

For Mechteld (gw procedure)

Plot these 3 grids on map, indicate elevation, oc and $P_{ave,year}$, check that they cover arable land (no forest, desert etc)