Sources and measures to reduce pollution of pesticides

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GRUE kommune

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Study area

The landscape of alluvial deposits (fig.1) along river Glomma, the largest river in Norway, provides good conditions for potato production and represents a main area for potato production in Norway.

Figure 1. Large amount of fluvial deposits suitable for potato production (Photo J. Kværner).

In most of the area soils consist of a 40-100 cm thick layer of silt loam above sand (table 1).

Table 1. Soil layering in the study area (Kværner et al. 2014)

Soil type	Dominating grain size	Soil classificatian (WRB 1998)	Area (%)
Gl5	70-100 cm sandy silt above silty fine sand	Fluvic Cambisol	56.7
Lr5	70-100 cm sandy silt above silty fine sand	Endostagni-Fluvic Cambisol	21.7
Lt5	70-100 cm sandy silt above silty fine sand	Stagnic Umbrisol (Fluvic)	4.7
Ls5	50-70 cm silt / sandy silt above medium / coarse sand	Fluvic Cambisol	3.2
Ki5	70-100 cm sandy silt above silty fine sand	Stagni-Fluvic Cambisol	1.7
Tm5	25-30 cm sandy silt above finsand	Arenic Fluvisol	1.7

Because of the high groundwater level influenced by the river, the aquifer can be easily used as local water supplies of households.

Pesticide monitoring

Groundwater samples from ten sites were analysed for pesticides in 1999/2000 (n=3).The same locations were reinvestigated in 2015/2016 (n=4).

The following pesticides were detected from the periode in 1999/2000: BAM, bentazone, metribuzin, metalaxyl, MCPA, 2.4-D and ETU. From the last periode 2015/2016: BAM, cyazofamid, glyphosate, imidacloprid, metribuzin, IN70942 and IN70942 (degradation products from rimsulfuron).

Sources of pesticide pollution

Based on frequency of occurence and monitoring of the pesticides, modelling of pesticide leaching, registrations of washing sites for pesticide spraying equipment and groundwater flow patterns, assumption of the different sources of pollution was estimated

- **Point sources**

Relatively high concentrations of pesticides might be due to point sources caused by seed treament, filling operations or cleaning of sprayers and boxes for storing potatoes. These pesticides were: BAM, glyphosate, ETU, metribuzin, metalaxyl and imidacloprid.

- **Diffuse sources**

Occurence of pesticides or degradation products distributed on large areas might be due diffuse sources. Escpecially degradation products from rimsulfuron occure in all sites the last periode 2015/2016.

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Measures

To prevent pollution, different mitigations were tested by the stakeholders. A biofilter was installed, risk tables, maps and web-based calculators was demonstrated.

- **Biofilter**

At one farm as a pilot project for demonstration and monitoring a biofilter was installed to protect groundwater and avoid point sources. An impermeable bunded sprayer fill area with required fall was drained to a silt trap and liquid collector/chamber (fig.2).

Figure 2. Construction of the sprayer fill area with drainage to the silt trap and liquid container (Photo K. Sveen).

From this container a pump transfered the liquid from the platform to the highest container. This is a classical biofilter with three containers mounted one above the other connected to each other to allow drainage and recirculation from a liquid collection at the bottom supplying the highest container (fig.3). The containers were filled with biomix which is compost, soil and straw (1:1:2).

Figure 3. Containers filled with biomix and stacked to allow gravity flow and recirculation (Photo E. Fløistad).

- **Risk tables**

Risk tables (table 2) were demonstrated and tested among involved farmers. These tables contained information of concentration of the pesticides in ground water simulated with MACRO-DB (Eklo et al., 2009). Soil maps was combined with risk tables necessary to make the farmers able to make their choices of pesticides.

Table 2. Risk tables of pesticides used in spring cereals and table of soil types (Eklo at al., 2009).

Grue - Spring cereals

		Soil types									
Trade name	Active ingredient	ATm4	AFs5	FOs5	TLt5	KMk5	KGl5	KLr5	TKi5	THg5	Dosage (NAD)
Actril 3-D	Ioxynil	1	1	1	1	1	1	1	1	1	3 l/ha
	Dichlorprop - P	4	4	4	4	4	4	4	4	4	
	MCPA	1	1	1	3	2	1	1	1	1	
Ally 50 ST	Metsulfuron - methyl	4	3	3	3	3	4	3	3	3	0.012 kg/ha
Ally Class 50 WG	Metsulfuron - methyl	4	3	3	3	3	4	3	3	3	0.05 kg/ha
	Carfentrazone - ethyl	4	3	3	3	3	4	3	4	3	
Ariane S	Fluroxypyr 1-methylheptylester	4	3	3	3	3	4	3	4	3	2.5 l/ha
	Clopyralid	4	4	4	4	4	4	4	4	4	
	MCPA	1	1	2	3	3	1	1	1	1	
Roundup ECO	Glyphosate	1	1	1	1	1	1	1	1	1	4 l/ha
Express	Tribenuron - methyl	4	3	3	3	3	4	3	3	3	1 tabl./0.5 ha
Harmony Plus 50 T	Thifensulfuron - methyl	1	1	1	1	1	1	1	1	1	0.015 kg/ha
	Tribenuron - methyl	4	3	2	2	3	4	3	3	2	
Hussar	Mefenpyr - diethyl										0.2 kg/ha
	Iodosulfuron - methyl	3	2	2	2	2	3	2	2	1	
MCPA 750	MCPA	4	1	3	4	4	4	1	4	3	4 l/ha
Optica Mekoprop - P	Mecoprop - P	4	2	3	3	3	4	3	3	2	3 l/ha
Primus	Florasulam	1	1	1	1	1	1	1	1	1	0.1 l/ha
Puma Extra	Fenoxaprop - P - ethyl	1	1	1	1	1	1	1	1	1	1.2 l/ha
	Mefenpyr - diethyl										
Starane	Fluroxypyr 1-methylheptylester	4	4	4	4	4	4	4	4	4	2 l/ha
Acanto Prima	Cyprodinil	1	1	1	1	1	1	1	1	1	150 g/daa
	Pikoksystrobin										
Amistar	Azoksystrobin	1	1	1	3	2	1	1	1	1	100 ml/daa
Amistar Duo	Azoksystrobin	3	1	2	3	3	3	1	1	1	100 ml/daa
	Propikonazol	2	1	2	3	3	2	1	1	1	

1 = no risk
2 = low risk
3 = moderate risk
4 = high risk

Soil types	ATm4	AFs5	FOs5	TLt5	KMk5	KGl5	KLr5	TKi5	THg5
WRB-enhet	Haplic Arenosol	Endogleyic Arenosol	Gleyic Fluvisol	Umbric Fluvic Cambisol	Endostagnic Fluvic Cambisol	Fluvic Cambisol	Endostagnic Fluvic Cambisol	Fluvic Stagnosol	Fluvic Stagnosol
Org C (%)	1-2	2-3	3-5	>5	2-3	1-2	2-3	2-3	2-3

- **Risk maps**

GIS based risk maps based on simulations with MACRO-DB combined with soil maps (fig 4.) is an other way to present risk tools to support users.

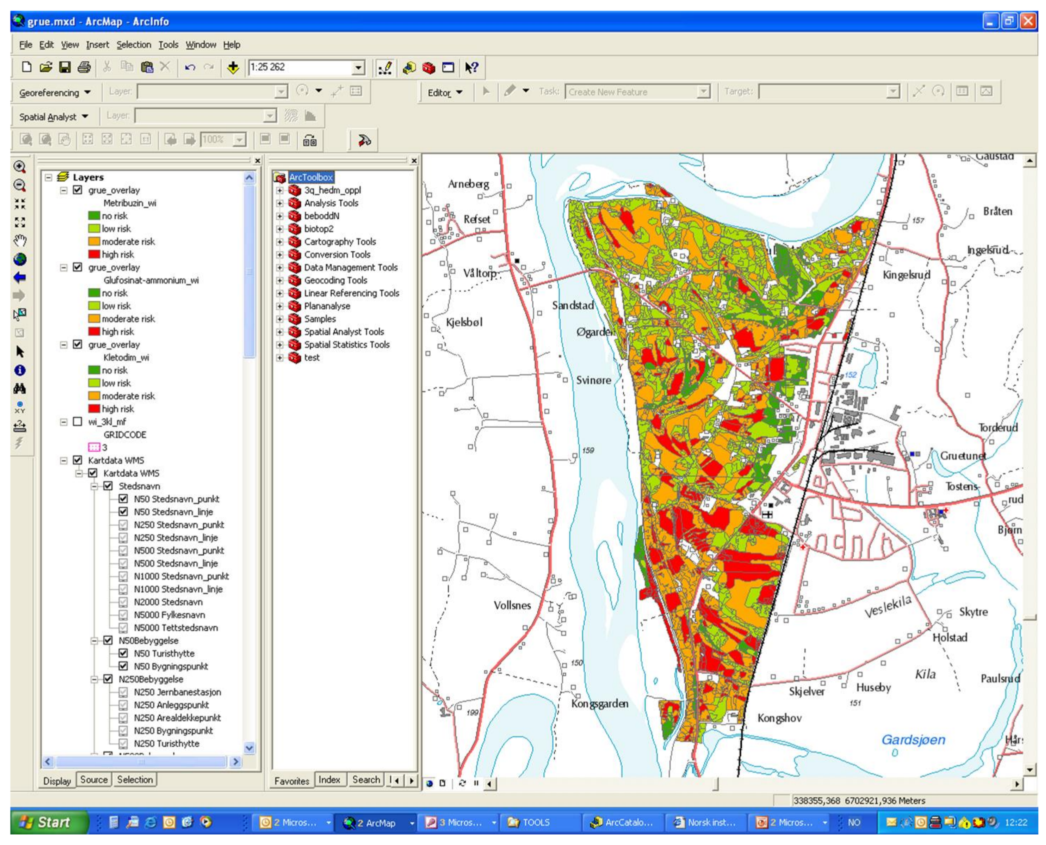

Figure 4. GIS map estimating risk of groundwater pollution of pesticides on different soil types. (Eklo et al., 2009).

- **Web-based risk calculator**

A step further is a new internet-based tool SYNOPS-WEB (Dominic et al. 2017) which calculate exposure toxicity ratio (ETR) for different field scenarios. (fig. 5)

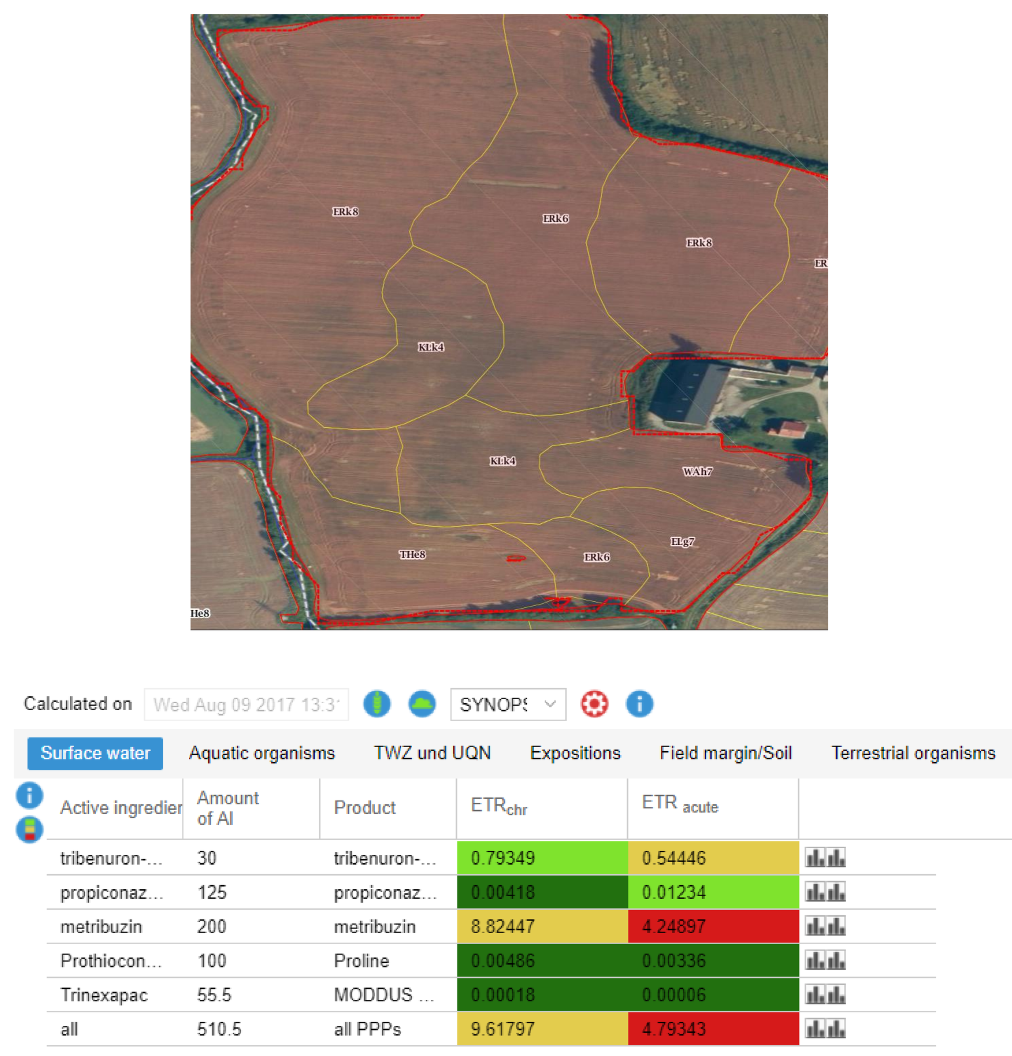

Figure 5. SYNOPS-WEB, an internet based tool for calculating the exposure toxicity ratio (ETR) for different field application scenarios of pesticide (Dominic et al. 2017).

References:
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SUMMARY
Monitoring of pesticides in groundwater have documented point sources and diffuse pollution from agriculture. Biofilters to avoid point sources has been installed and tools to select pesticides have been tested to reduce diffuse pollution. Site specific information and knowledge about soil and climate combined with pesticide properties are still a challenge to prevent environmental pollution and experience with stakeholders has demonstrated still needs of available knowledge about pesticide risk of pollution. Validation of models and development of userfriendly tools are still needed.

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