

Sediment transport in agricultural catchments- the need of methods for tracing sediment sources from agricultural areas .

Examples from the National Agricultural Environmental Monitoring Programme.

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ABSTRACT

In the Agricultural Environmental Monitoring Programme in Norway losses of sediments and nutrients have been measured since 1991 in ten agricultural catchments of sizes between 1-30 km².

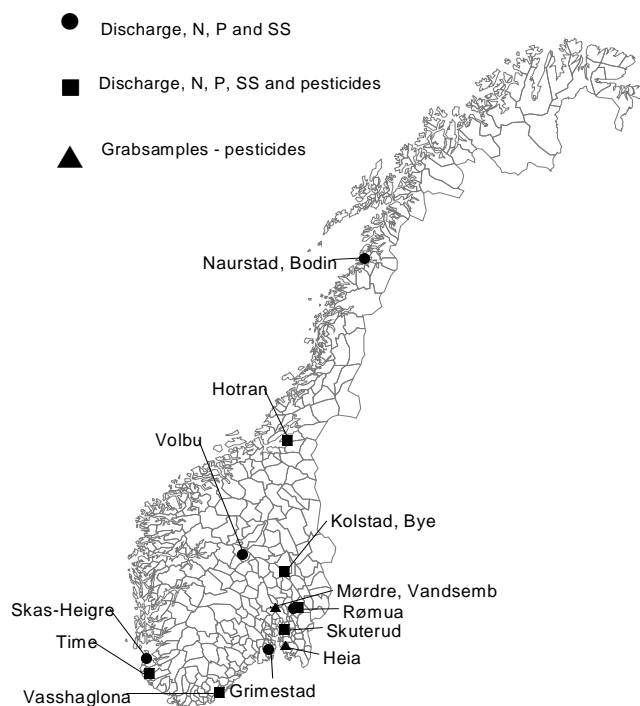


Figure 1. Catchments in the Norwegian Monitoring Programme

One of the major objectives of the Monitoring Programme is to document the effect of different agricultural production systems and site – specific characteristics on erosion and nutrient losses to surface waters and give advice to the policymakers about agricultural production systems and their environmental effects.

Annual variations in weather conditions have a significant influence on the losses while also political decisions concerning subsidies etc. may also influence on cropping systems and thereby influence erosion. During the last ten years new subsidies, with the objective to

change tillage systems from autumn tillage to spring tillage in addition to subsidies for catch crops, buffer zones and sedimentation ponds have lead to changes in agricultural practices. Within the Agricultural Environmental Monitoring Programme, information concerning agricultural practices is collected yearly for individual fields in the catchments and any changes in practices are thereby recorded.

Although there has been a reduction in the areas being autumn ploughed (Fig.2), there has not been documented a high reduction in the measured annual soil losses. This is partly due to large variations in weather conditions and runoff between the years. But it might also be that other sources than agriculture contribute to the soil losses.

The focus in this paper is on two small agricultural catchments Skuterud and Mørdre which are situated in the south east of Norway. Site characteristics are given in Table 1. Discharges are measured continually using a Crump weir while runoff water is sampled on a volume proportional basis. A composite sample is collected bi-weekly and among others analysed for suspended solids in addition to total nitrogen and phosphorus. On the basis of the total runoff volume and the analysis results the total loss is calculated.

Table 1 Site characteristics of the catchments Skuterud and Mørdre included in the Agricultural Environmental Monitoring Programme in Norway. Temperature and precipitation expressed as 30 year annual means (DNMI, 1993).

Catchments	Total area (ha)	Farm-land (%)	Arable land (% of farmland)	Manure animal units (mau/ha)	Temp (°C)	Prec. (mm)	Soil type	Major crops	Study start
Skuterud	449	61	93	0.2	5.5	785	Silty loam	Cereals	1993
Mørdre	680	65	95	0.2	4.3	665	Silt and clay	Cereals	1991

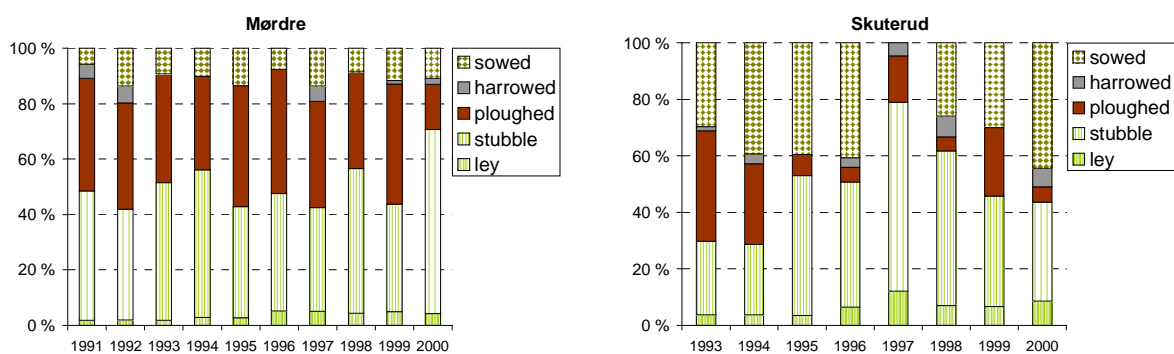


Fig.2 Land management in the autumn for the Mørdre and Skuterud catchment.

Soil losses have varied from around 100 kg ha^{-1} to nearly 3000 kg ha^{-1} (Fig. 3). Highest erosion is measured in catchments with a large area ploughed during the autumn. Detailed erosion pattern on each field in the catchments are registered after major runoff events and after snowmelt periods during the winter season. Erosion patterns are dependent on agricultural practices, runoff condition and the winter conditions with frozen or unfrozen soils.

These field investigations have also documented that in some years there is an active bank erosion in the catchment. Also erosion around hydrotechnical equipment like inlets for surface water, outlets from drainage pipes into the river bank etc. has been observed. This leads to concentrated erosion and particle transport from the agricultural landscape. Field investigations (event studies) have documented particle transport through drainage pipes. It is assumed that the process with transport through macropores and cracks, preferential flow is more important than earlier assumed for these catchments. In the autumn of 2000 the south-eastern part of Norway received 2-3 times higher precipitation than normal. Runoff in the Skuterud and Mørdre catchments was respectively 5 and 3 times higher than average for the whole monitoring period. Compared to earlier autumn periods the soil losses in Skuterud and Mørdre catchments were 6 times higher even though less area than normal had been autumn ploughed. This autumn there was also an increase in area with catch crops. Field investigations did not document especially much visible erosion, and not rills and gullies which are more usual after winter runoff events. It is assumed that erosion was dominated by sheet erosion and especially by preferential flow through soil profile. In the following spring 2001 significant landslips were registered along the streambanks and over drainage pipes in these catchments. This might be due to oversaturation and instability caused by the unusual wet previous autumn period.

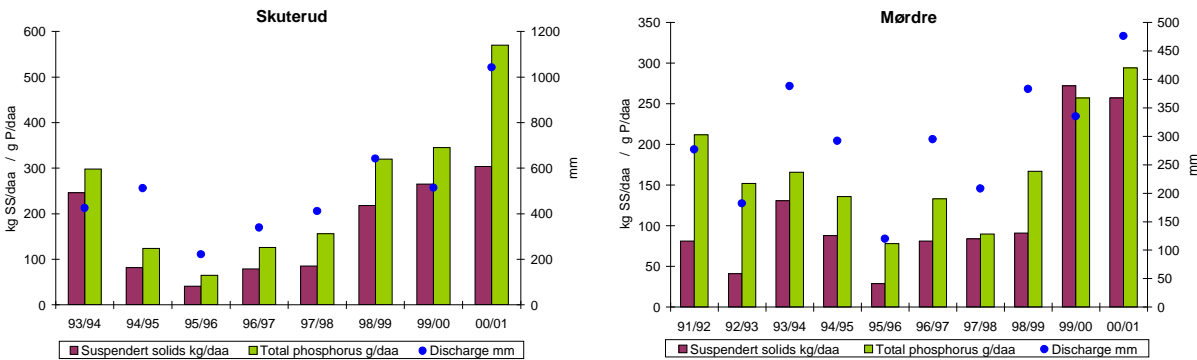
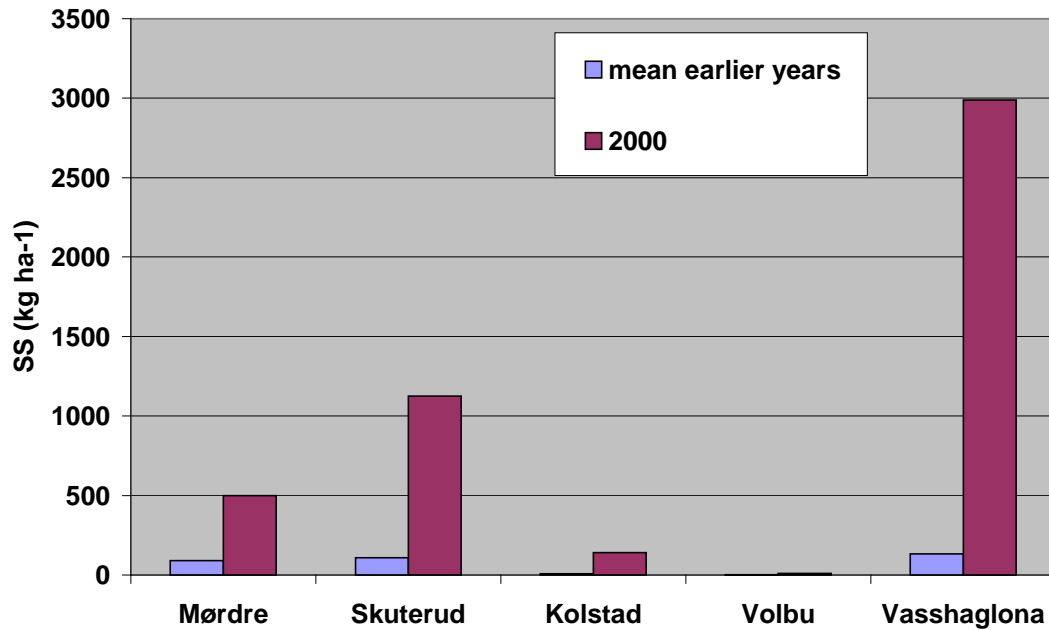


Fig.3 Losses of suspended solids (kg/daa), total phosphorus (g/daa) and discharge (mm) for agrohydrological year (May 1. – May 1.) for the Mørdre and Skuterud catchment.

For planning further measures to reducing erosion from agricultural areas it is important to have methods that document whether the particles are coming from bank erosion or from the agricultural areas. Such studies are now planned to take place in selected catchments in the Agricultural Environmental Monitoring programme. There is a need for methods for tracing the sediment sources from agricultural areas.

Loss of Suspended solids from catchments
October 6th to December 15th



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