

# Gedaref watershed soil sampling

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## Purpose

The soil sampling draft briefly describes Gedaref watershed (terrain), the suggested sample locations, soil sampling depths, and the according sampling techniques (disturbed and undisturbed). Lab analysis will be discussed/suggested separately after clarifying lab analysis options.

## Definitions

*Disturbed sample:* mixed soil sample, taken with a shovel or auger e.g. representing one sample location and depths layer. Sample amount ca. 2kg each sample, excluding large stones (to provide enough material for different physical and chemical analyses). Samples shall be stored in a bag (plastic or paper) open for air drying.

*Undisturbed sample:* in this context, undisturbed samples are core cylinder samples (vertically taken). Undisturbed samples, as long as enough core cylinders are available, shall be taken in three replications each sampling point (location and depths). If not enough core cylinders available reduce accordingly (two or no replications). Core cylinders shall be stored without upper cap (drying, not molding).

## Watershed and sampling locations

Gedaref watershed is small with clear topographic pattern (Figure 1 - sketch). Therefore, obtaining defined samples from representative locations based on site visit (saving GPS locations by sampling) might be better than pre-defined grid sampling over the site. The watershed has large agricultural plain with deep clay soil (Figure 1 and 2; 'Sesame Plain') and a hill/mountain in the east as top of the watershed. From investigation in spring 2016 the watershed might be separated into (see Figure 1):

- 1) Agricultural Plain (Sesame Plain; Figure 1 and 2) – largest and most crucial component
- 2) Mountain
  - a. 1<sup>st</sup> Step (foot of the mountain; Figure 3); very stony.
  - b. Plateau (small gentle sloped area in the middle of the hill; Figure 4); stony but also soil.
  - c. 2<sup>nd</sup> Step and Mountain Top (Figure 5); stony.

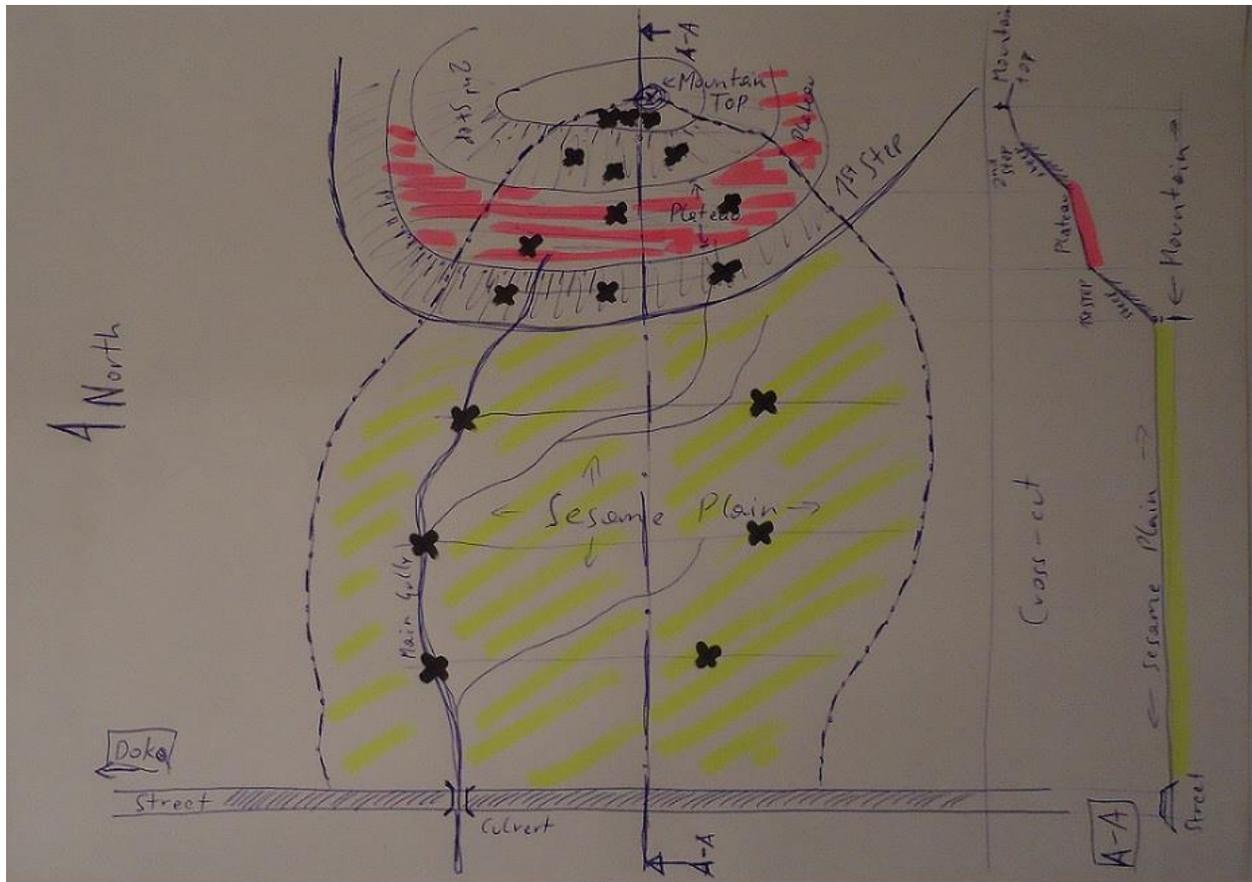


Figure 1: Sketch of Gedaref watershed (Agricultural Plain, 'Sesame Plain' (yellow) and Mountain); and a Cross Cut (A-A) on the right side of the sketch. Black 'X' mark potential (suggested) sampling locations.



Figure 2: Agricultural Plain (Sesame Plain) in front; Mountain area in the background



Figure 3: Mountain 1<sup>st</sup> Step (shallow soil and stones).



Figure 4: Mountain Plateau (red hatched area) from top view; gently sloped, stony, but also certain soil depth expected.



Figure 5: Mountain Top.

Even though (1) Agricultural Plain is most crucial, also (2b) Plateau might have potential for forest, fruit trees, apiculture, applying soil conservation bunds e.g. Soil sampling might be performed by means of two approaches i) Agricultural Plain (deep clay soils) using deep soil sampling pits, and ii) Mountain (expected shallow soils) by surface sampling (shovel, auger) only.

#### Soil sampling technique

##### ***i) Soil sampling pits (deep clay soils 'Sesame Plain')***

Suggested are three pits along the main gully (Figure 1; black 'X' marks), which might be established by new and clean cuts (shovel) at the main gully side bank (Figure 6 and 7). In addition up to three pits to the south (in field), which shall be not at a gully bank but prepared as pits to compare soil changes (if soil is different/deeper at gully zones; Figure 8). If three field pits are too labor intensive one or two pits (aside from three gully pits) might be feasible too. Both pit approaches (gully and field pits) shall be appr. 1m wide and clean cut with a shovel (Figure 7 and 8). Prepare gully pits as deep as the gully, and the field pits up to 1.2m depths from surface. After a clean cut, take pictures (with a scale beside) count stone content, macro pores and root depths. Describe soil layers/horizons and depths (Example for counting stone content: put 1m rope or tape along certain soil horizon and count and accumulate all stone diameters which are touched by the rope (for example 3 x 2cm stones on one meter rope come to 6% vol. stone content, which is appr. 3% gravimetric stone content, e.g.)). Then take disturbed and undisturbed samples as described in below.

#### Pit front samples

*Undisturbed* (core cylinders) to take in vertical direction! (k-value in infiltration direction):

0-10cm (core cylinder, there replications, core cylinder center at appr. 5cm from soil surface)

10-50cm (core cylinder, three replications, center at 30 cm)

50-100cm (core cylinder, three replications, center at 75 cm)

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*Disturbed* samples (shovel); take around 2kg mixed sample for each depth layer:

0.5-3.0cm (Remove top 0.5cm soil (residues))

0-10cm

10-50cm

50-100cm

In addition and in deep gully pits only! (if gully is deep enough!)

100-200cm

200-300cm

#### Pit bottom samples

Disturbed samples (auger at bottom; Figure 7 and 8); from gully or pit bottom. Push the soil auger as deep as possible, and take representative soil samples (mixed samples over whole 0.5m depth increments). This is also important to document soil depth – please note depth when the auger comes to hard layer/stone, otherwise as deep as the soil auger gets (appr. 0.5-1.0m).



Figure 6: Main gully bank – possible location for gully pit (clean cut).

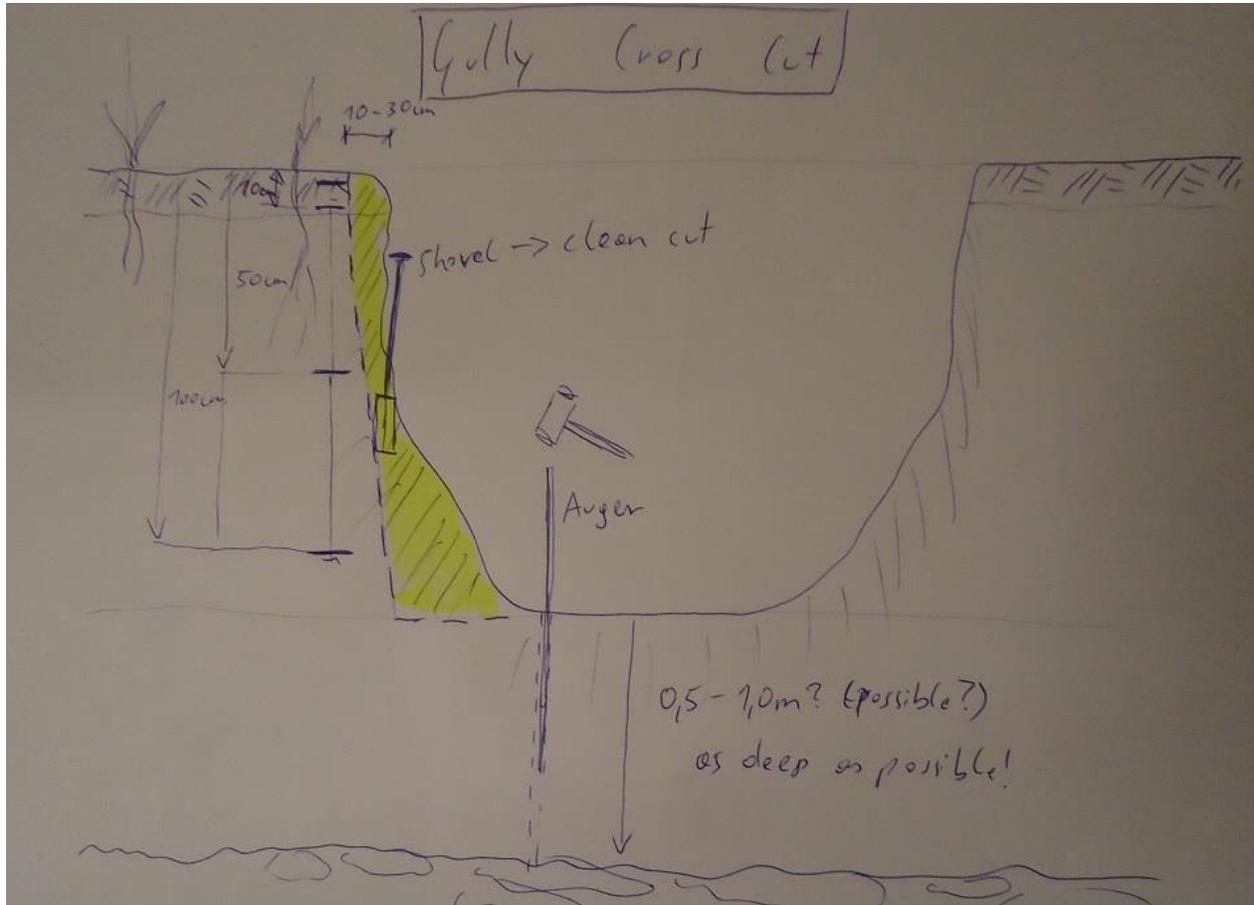


Figure 7: Sketch of gully pit; clean and new cut into gully bank (appr. 1m wide) and bottom auger sampling

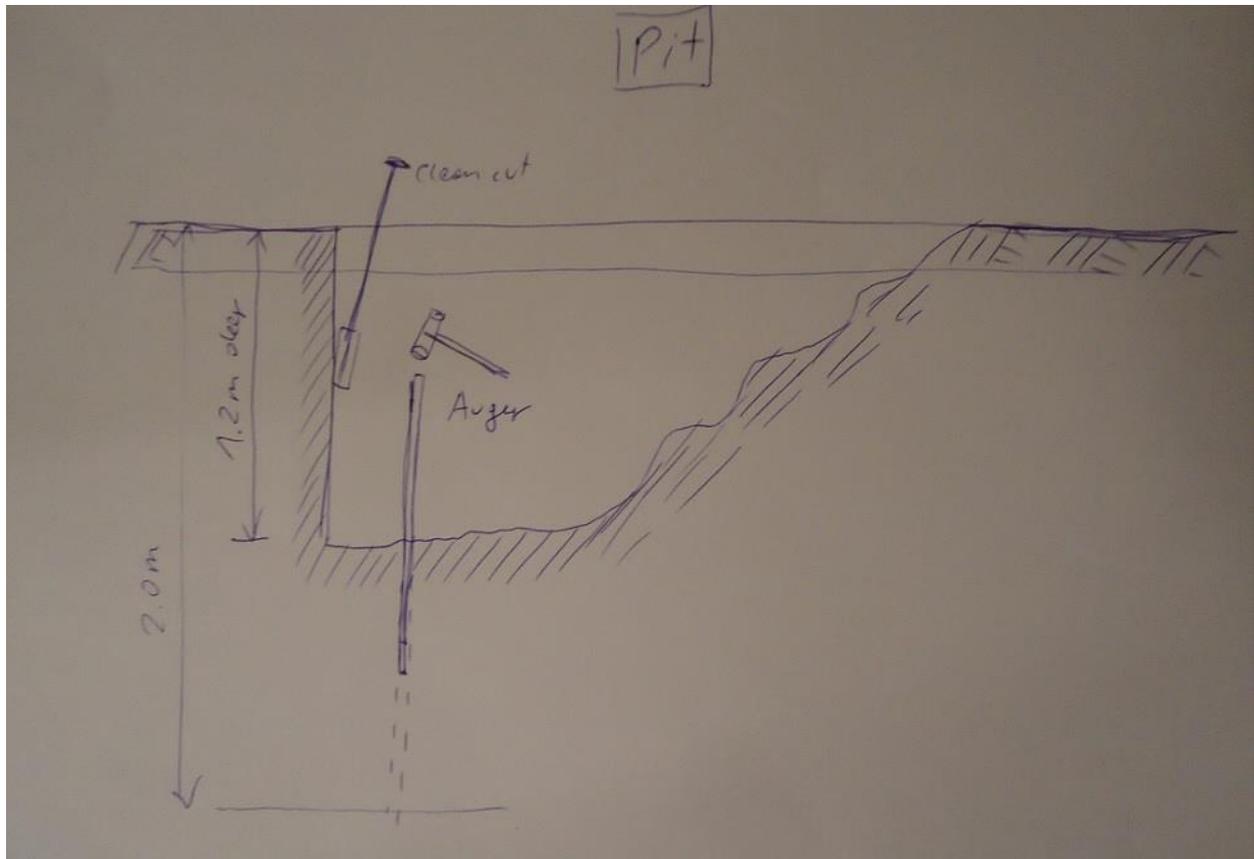


Figure 8: Sketch of agricultural plain field pit; ca. 1.2m deep pit (appr. 1m wide) and bottom auger sampling.

**ii) Mountain (shallow soil)**

Suggested are up to 0.5m deep soil pits from top by shovel or auger. Three replications (pits) shall be done for each of the defined mountain zones (1<sup>st</sup> Step, Plateau, 2<sup>nd</sup> Step and Mountain Top (Figure 1)). Stop digging and note pit depth once hard stone layer is reached before 0.5m depth. Here, because large stone content is expected, no core cylinders shall be used (only disturbed samples). Please make a picture of the soil surface before digging the pit with a measurement tape on the picture (to estimate surface stone content from image analysis). Please take appr. 2kg soil, excluding large stones (appr. >2cm diameter) from following sampling:

*Disturbed* samples (shovel); take around 2kg mixed sample for each depth layer:

0.5-3.0cm (Remove top 0.5cm soil (residues))

0-10cm

10-50cm

### Total sampling amount

Gully and field pits (Agricultural Plain): Following the above suggested sampling, per pit, 9 core cylinders shall be taken as well as 4 undisturbed (2kg) samples from the pit front plus 1 or 2 auger samples from the bottom (depending on auger depth). In cases the gully is deeper > 2m, additional front samples can be taken (1-2m and 2-3m). Entirely, 6 pits (3 gully + 3 field) are suggested, but can be reduced to maybe 4, if field pits are too labor intensive to establish. In total, from Agricultural Plain, there might be 12 up to 54 core cylinders and 20 up to 60 disturbed samples.

Mountain pits: Only three disturbed samples (appr. 2kg) per pit. It is suggested to sample three pits per Mountain region (1<sup>st</sup> Step, Plateau, 2<sup>nd</sup> Step and Mountain Top), which comes to 9 pits and therefore in total 27 samples from the mountain.

*Note:* Please store taken samples ready for air drying (open) avoiding molding. Bulk density and/or rest soil moisture analysis can be done after physical analysis (core cylinder) or drying parallel sample (disturbed sample). Lab analysis will be defined (together) after checking lab analyses possibilities