Evaluating different subsoil compaction depth estimation methods

R. Schierholz[1], T.L. van Orsouw[12], V.L. Mulder[1], J.M. Schoorl[1], G.B.H Heuvelink[13]

[1] Soil Geography & Landscape Group, Wageningen University & Research, The Netherlands

[2] Applied Research Group, Aeres University of Applied Sciences, The Netherlands

[3] ISRIC – World Soil Information, Wageningen, The Netherlands

Background

Actively involving students in relevant research is critical to their learning process. This mentality lies at the core of an ongoing Dutch project, where spatial data collection on the degree of subsoil compaction is partly done via student assignments. Relatively inexperienced students are required to make an estimation of the depth to subsoil compaction in order to take samples. The methods used are often qualitative and prone to human error, which begs the question: "how reliable are simple field methods commonly used by students to determine the depth to subsoil compaction?"

Objective

- Evaluation of the reliability of subsoil compaction depth estimations made by students.

Methods

A field-day was organised on which a group of students was asked to estimate the depths to the upper and lower limits of the compacted layer in two individual pits using:

1. Visual and tactile observations, finding highest resistance (knife-method).
2. Penetrometer measurements.

Reliability was assessed by comparison of observations made by the participants to a profile of soil dry bulk density from the two test pits. Figure 1 shows that both pits have peak density around 30-35 cm below the surface. One pit (pit 1) had heavy compaction, while the other (pit 2) displayed only light compaction.

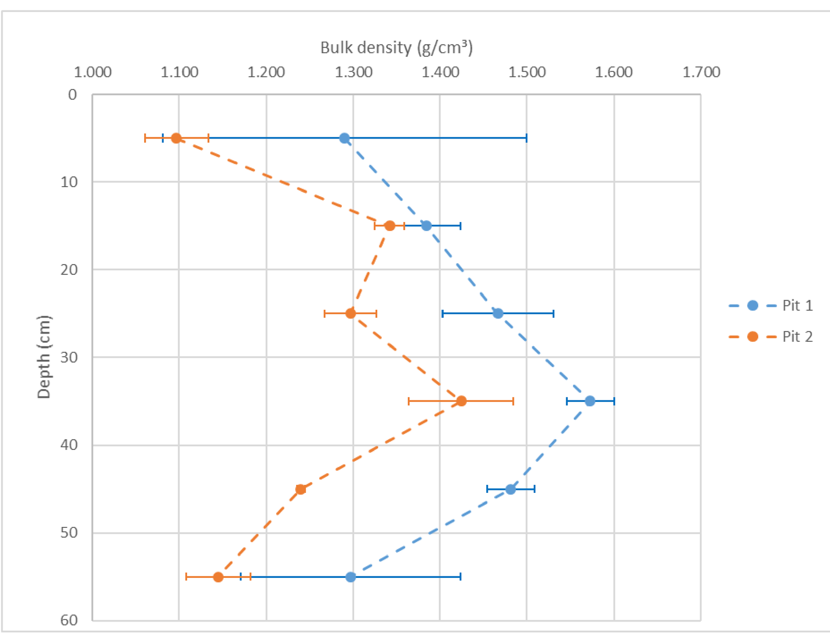

Figure 1. Bulk density profiles for both pits (heavy compaction in blue, light compaction in orange).

Figure 2. Representative soil profile for both pits, with a loamy topsoil and a transition to loamy fine sand at roughly 60 cm depth. The pit shown has only little compaction.

Results

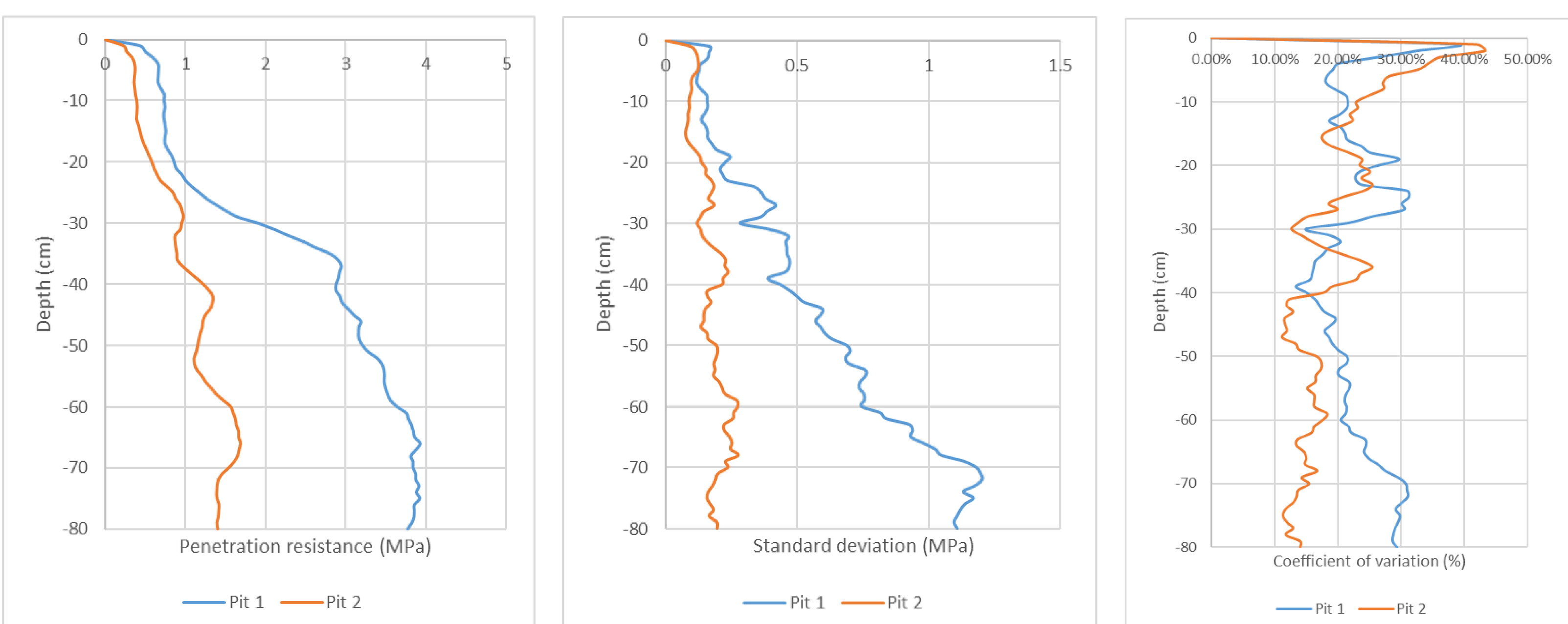

Figure 3. Mean of the penetration resistance (left), the standard deviation within the group of participants (centre) and the coefficient of variation (right).

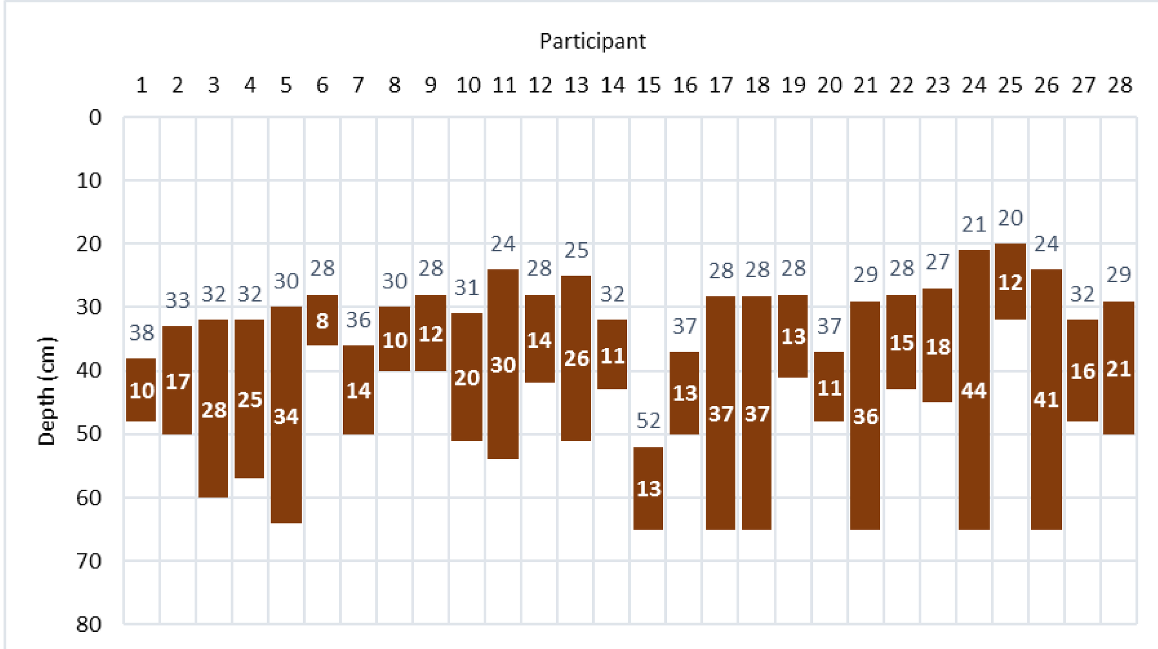

Figure 2. Visual and tactile (knife method) observations of the extent of subsoil compaction in a pit with **heavy** compaction.

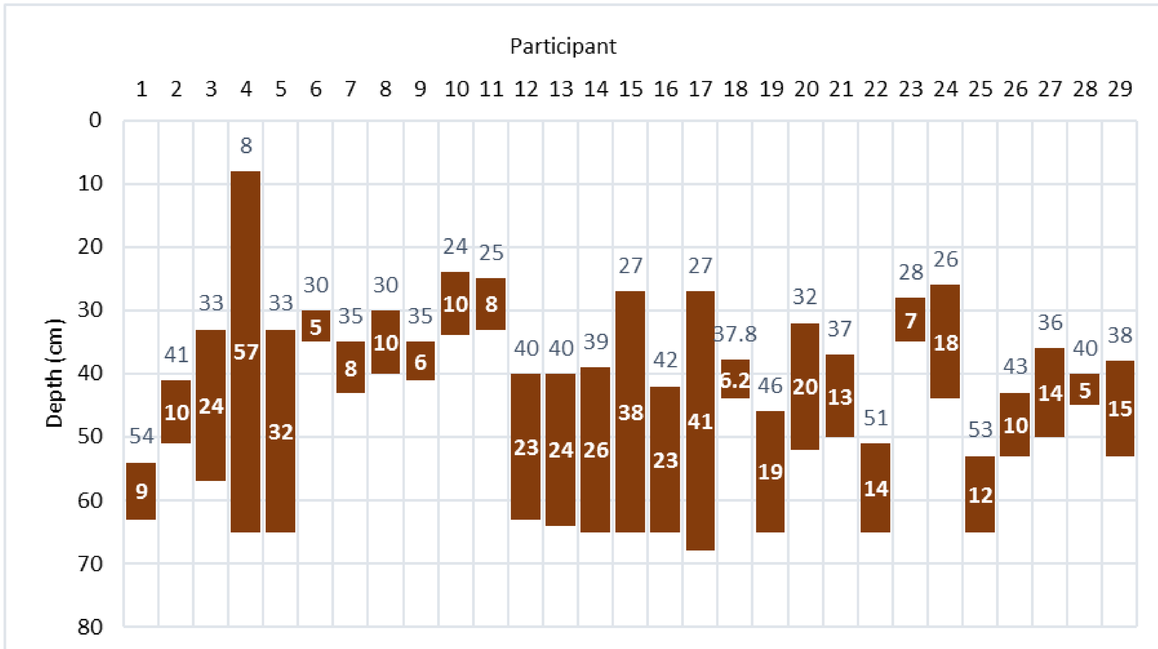

Figure 3. Visual and tactile (knife method) observations of the extent of subsoil compaction in a pit with **light** compaction.

Table 1. Summary statistics for the tested methods.

Method	Mean upper limit (cm)	Max. deviation from the mean	St. Dev.	Mean lower limit (cm)	Max. deviation from the mean	St.Dev
Heavy compaction pit						
Knife method	30	22	6.3	52	17	10.1
Penetro-meter (2MPa threshold)	31	6	2.5	-		-
Light compaction pit						
Knife method	36	28	9.5	53	19	11.4
Penetro-meter (2MPa threshold)	Never reached	-	-	-		-

Conclusions

- The mean **visual/tactile** estimations of the group correspond well to the upper limit of compaction.
- Students were less in agreement with each other, especially in the light compaction pit.
- Some outliers may be attributed to relative inexperience.
- The **penetrometer** was an excellent tool to find the depth to the upper limit of heavy compaction, using 2 MPa as a threshold value.
- Penetrometer measurements are difficult to interpret for pits with light compaction.

Acknowledgements

We would like to thank all the participators from both Aeres University of Applied Sciences and Wageningen University. This research was carried out as part of an MSc thesis.

Tijn van Orsouw
Soil Geography and Landscape Group
Contact: tijn.vanorsouw@wur.nl
M +31 (0)6 2875 4763
www.wur.nl/en/persons/Tijn-TL-van-Orsouw.htm

Wageningen University & Research
P.O. Box 123, 6700 AB Wageningen
T + 31 (0)317 480 100
www.wur.nl