New Zealand – China Water Research Centre
新西兰－中国水研究中心

2019 PhD Proposal – China Scholarships Council and New Zealand – China Water Research Centre Joint PhD Programme Application

Information to be published on NZ – China Water Centre website if proposal is selected	
Project title	Impact of subsoil compaction on water and nitrogen processes in arable soils
Supervisors titles and names	Dr. Henry Chau (Lecturer); Dr. Wei Hu (Senior Scientist); Dr. Mike Beare (Science Team Leader, Principle Scientist, Adjunct Professor)
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Project outline Please outline the PhD project in 300 words (approx)	With greater use of heavy machinery and forage crop grazing, intensification of cropping presents an increased risk to subsoil compaction. State-of-Environment data in New Zealand indicate that 80% of New Zealand agricultural land had penetration resistance >2.5 MPa (at soil water content of 20% $g\ g^{-1}$) at 15-30 cm in arable soils. Compared with surface soil compaction, subsoil compaction may cause persistent and potentially irreversible damage to soil health and ecosystem functions. Subsoil compaction can result in a loss of structure that impedes root penetration and create a "hydraulic barrier" to drainage or water uptake. This can increase the risk of water pollution by increasing lateral seepage of excess water or runoff as well as reducing the capacity of the soil to buffer/filter pollutants. It may also increase GHG production and nitrogen losses through denitrification under wetter conditions. However, subsoil compaction may vary spatially because of differences in inherent soil susceptibility, climate, crop systems and land management practices. The extent of subsoil compaction in New Zealand's arable soils and its effects on soil hydraulic processes and associated nitrogen dynamics is poorly known. This PhD project proposal is based on the hypothesis: subsoil compaction and its effect on water use and nitrogen processes vary depending on soil, climate, cropping systems and management practices. The main objectives include: (1)

	characterizing the spatial variability of subsoil compaction and its controlling factors in Canterbury arable soils; (2) developing a pedotransfer function with readily available data for predicting the risk of subsoil compaction; and (3) quantifying and predicting the effects of subsoil compaction on soil hydraulic properties, soil water (e.g., evapotranspiration and drainage) and nitrogen processes (e.g., NO_3^- leaching and N_2O emissions) using experimental and modelling approaches with the aim to minimizing its detrimental impact. We welcome applicants who have experience and knowledge in soil physics, water management, nitrogen cycle and its process, water and solute transfer, pedotranfer functions, and biophysical modelling.
References for further reading (optional)	Batey T. 2009. Soil compaction and soil management - a review. Soil Use Manage. 25: 335-345. Drewry J J, Cameron K C, Buchan G D. 2008. Pasture yield and soil physical property responses to soil compaction from treading and grazing - a review. Aust J Soil Res. 46: 237-256. D'Or D, Destain M F. 2014. Toward a tool aimed to quantify soil compaction risks at a regional scale: Application to Wallonia (Belgium). Soil Till Res. 144: 53-71. Hatfield J L, Sauer T J, Prueger J H. 2001. Managing soils to achieve greater water use efficiency: A review. Agron J. 93: 271-280. Hu, W., Tabley, F., Beare, M., Tregurtha, C., Gillespie, R., Qiu, W.W., Gosden, P., 2018. Short term dynamics of soil physical properties as affected by compaction and tillage in a silt loam soil. Vadose Zone Journal, doi: 10.2136/vzj2018.06.0115. Probert M E, Keating B A, Thompson J P, Parton W J. 1995. Modelling water, nitrogen, and crop yield for a long-term fallow management experiment. Aust J Exp Agr. 35: 941-950. Schjønning P, Larnande M. 2018. Models for prediction of soil precompression stress from readily available soil properties. Geoderma. 320: 115-125. Tafteh A, Sepaskhah A R. 2012. Application of hydrus-1d model for simulating water and nitrate leaching from continuous and alternate furrow irrigated rapeseed and maize fields. Agr Water Manage. 113: 19-29.
Please indicate if research operational funding is available to support the project, and if so, the sources of funding.	Operational funding to support this PhD is available through existing programmes of research (MBIE, SSIF) subject to confirmation of funding from the New Zealand – China Water Research Centre and identification of a suitable student. We will also seek additional support from industry groups, depending on the specific focus of PhD research.

References

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