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As an Earth Scientist with a focus on Landscape Ecology and Data Science, I am currently engaged at the Africa Soil Information Service (AfSIS Inc.). My work is dedicated to developing practical approaches and tools for natural resource management. In my role, I strive to balance the ever-growing demand for ecosystem services with data-driven insights that inform and enhance effective environmental stewardship.

With over 25 years of experience in applied ecosystem and landscape ecology, I am skilled in supervising and managing large research and operational teams. My experience extends to fundraising, grant management, and reporting on project outcomes. I have worked extensively on projects focusing on climate change adaptation, carbon sequestration, predictive soil mapping, and agroecological monitoring of agricultural systems across Africa and India.

My technical proficiency includes ecosystem, landscape, systems, and restoration ecology; digital measurement systems; open source/open access data management; research methods; remote sensing; NIR/MIR, XRF, and ICP spectrometry; data science; machine learning; geostatistics; statistical computing; and Bayesian inference and prediction.

In addition to my professional pursuits, my wife Barbara and I own and operate two small off-grid ranches, one near Arusha in Tanzania and another near Magdalena in New Mexico. I am fluent in English and German, and conversant in KiSwahili and French.

Work experience

- Landscape ecologist / Co-founder, AfSIS Inc., a non-profit company registered in New Mexico. (2020-present).
- Chief Scientist / Team Leader / Plant and Soil Lab Supervisor. Africa Soil Information Service (AfSIS). Selian Agricultural Research Institute, Arusha Tanzania (2009-2021).
- Senior research scientist / Landscape ecologist. Center for International Earth Science Information Network (CIESIN). The Earth Institute at Columbia University / Lamont-Doherty Earth Observatory, New York. (2017-2020).
- Senior research scientist / Landscape ecologist. Tropical Agriculture and Food Security Center. The Earth Institute at Columbia University / Lamont-Doherty Earth Observatory, New York. (2007–2017).
- Adjunct senior research scientist / Landscape ecologist. Tropical Soil Biology and Fertility Program (CIAT/TSBF), Nairobi, Kenya. (2009–2013).
- Honorary Lecturer. Department of Biology, Faculty of Science. Mbarara University, Mbarara, Uganda. (2009–2011).
- Senior research scientist / Team Leader, Western Kenya. World Agroforestry Center (ICRAF), Kisumu, Kenya. (2000–2007).

- Research scientist / GIS and remote sensing laboratory supervisor. World Agroforestry Center (ICRAF), Nairobi, Kenya. (1997–2000).
- Post-doctoral research scientist. Department of Rangeland Ecology and Management, Texas A&M University, College Station, Texas. (1995–1997).
- Graduate teaching assistant. Department of Rangeland Ecology and Management, Texas A&M University, College Station, Texas. (1991–1993).
- Rangeland management consultant. German Technical Development Agency (GIZ). (1989-1991).
- Field research station manager. German Research Foundation (DFG) / German Technical Aid (GIZ), Isiolo, Kenya. (1986–1989).
- Ranch hand. Ol Maisor Ranch, Laikipia, Kenya and Hillgrove Station, Charters Towers, Australia (1981–1982).

PI / Co-PI on major research for development grants

- Africa Soil Information Service Phase 2 (AfSIS). Funded by the Bill and Melinda Gates Foundation (14.3 M U$ 2015–2018)
- Africa Soil Information Service (AfSIS). Funded by the Bill & Melinda Gates Foundation (4.9 M U$, 2013–2014)
- Africa Soil Information Service (AfSIS). Funded by the Bill & Melinda Gates Foundation (18.2 M U$, 2008–2013).
- Western Kenya Integrated Ecosystem Management Project. Funded by World Bank / Global Environmental Facility (4.3 M U$, 2005–2009).
- West Africa Drylands Project. Funded by UNEP / Norwegian Development Agency (1.2 M U$, 2004– 2007).
- Improving Land Management in the Lake Victoria Basin. Funded by the Swedish Development Agency (2.9 M U$, 2001–2005).

Education

- PhD, Rangeland Ecology and Management, (1995, *summa cum laude*). Texas A&M University, College Station, Texas.
- BSc Animal Science, BSc Agricultural Mechanization, (1986). Iowa State University, Ames, Iowa.
- High school diploma, (1980). Rift Valley Academy, Kijabe, Kenya.

Recent FAIR data publications

Walsh, M.G., Modi, V. and Siddiqui, H. (2023). Quadracci Sustainable Engineering Lab (QSEL). https://doi.org/10.17605/OSF.IO/NJXQF

Walsh, M.G., Sila, A. M., Walsh, B., Chamberlin, J., Snapp, S., & Broadley, M.R. (2022). GeoNutrition. https://doi.org/10.17605/OSF.IO/47T3U.

Walsh, M.G., Vanlauwe, B., Walsh, B., & Manners, R.., et al. (2021). Rwanda soil information service. https://doi.org/10.17605/OSF.IO/Y9ZUT

Walsh, M.G., Meliyo, J., Wu, W., Simbila, et. al. (2020). Tanzania Soil Information Service (TanSIS). https://doi.org/10.17605/OSF.IO/4NGAU

Walsh, M.G. (2021). AfSIS spatial and spectral prediction workflows. https://doi.org/10.17605/OSF.IO/74AWG

Walsh, M.G.., Wu, W. (2020). GeoSurvey workflows. https://doi.org/10.17605/OSF.IO/VXC97

Recent open data science publications

Walsh, M.G., Modi, V. and Siddiqui, H. (2023). Spatial predictions of the distribution of irrigated crops in Uganda. Forthcoming at: https://doi.org/10.17605/OSF.IO/JZX72.

Walsh, M.G. (2023). Bayesian multilevel regression for small area estimation of building densities and cropland prevalence in Uganda. https://osf.io/mpcdy.

Walsh, M.G., Modi, V. and Siddiqui, H. (2023). Bayesian multilevel regression and survey poststratification on a discrete grid in Uganda. https://osf.io/szy6a.

Walsh, M.G. (2023). Spatially balanced sampling and small area predictions on a discreet grid. https://osf.io/9xq3z.

Walsh, M.G., Modi, V. and Siddiqui, H. (2023). Stacked spatial predictions of smallholder irrigation prevalence in Uganda. https://osf.io/kxsqm .

Walsh, M.G., Walsh, B.A., Chamberlin, J. and Snapp, S. (2023). GeoNutrition: Recommendations for assessing locally "hidden hunger risks" at food system scales. https://osf.io/r4upz.

Walsh, M.G. and Walsh, B.A. (2023). AfSIS SOPs for collecting soil and crop samples. https://osf.io/s9ch7).

Sila, A.M., Walsh, M.G., Kumssa, D.B., Mossa, A.W., Amede T., Nalivata P.C., Gashu D., Haefele S.M., Gameda S., Broadley M.R, Joy E.J.M., Bailey E.H., Lark R.M., Walsh B.A., Rodríguez Iglesias R., Chamberlin J. and Snapp S. (2022). Soil spectral predictions of cereal grain ionomes from Malawi. https://osf.io/cya8n.

Walsh, M.G., Sila, A.M., Kumssa, D.B., Mossa, A.W., Amede T., Nalivata P.C., Gashu D., Haefele S.M., Gameda S., Broadley M.R, Joy E.J.M., Bailey E.H., Lark R.M., Walsh B.A., Rodríguez Iglesias R., Chamberlin J. and Snapp S. (2022). Spatial predictions of cereal grain ionomes from Ethiopia and Malawi. https://osf.io/7xzqv.

Walsh M.G., Sila, A.M. and Walsh B.A. (2022). Land cover classification with multilabel GeoSurvey data from Malawi.

Walsh, M.G., Manners R., Meliyo, J., Rutebuka and Manners R. (2022). Workflows for predicting staple food systems with association rule mining and multilabel mapping. https://osf.io/w5ys8/.

Walsh, M.G. and Sila, A.M. (2022). Rating landscape soil aggregate stability from laser diffraction particle size data. https://github.com/mgwalsh/Soils/blob/master/LDPSA_aggregate_stability.Rmd

Walsh, M.G. (2021). Spectral workflows for diagnosing reserve soil acidity and soil-test-based lime requirements. https://osf.io/2v46w/.

Walsh, M.G., Nalivata P.C., Gashu D., Gameda S., Towett E.K., MacGrath S.P., Lark R.M. and Broadley M.R. (2021). Chemometric workflows for predicting zinc levels in maize grain https://osf.io/dp4vg/.

Walsh, M.G., Manners, R., Silva, J.V., Gameda, S., G. and Aston, S. (2021). Meta-analysis of agricultural lime application effects on crop yields from field trial data. https://osf.io/cngwx/.

Walsh, M.G., Rutebuka, J., and Manners, R. (2021). Crop distribution predictions from survey data and small area estimates in Rwanda https://osf.io/ub6ar/.

Walsh, M.G., Rodríguez Iglesias, R., Manners R., Nalivata, P.C. and Broadley M.R. (2021). Compositional data (CoDa) workflows for exploring mineral nutrient compositions of cereal grains. https://osf.io/5w8nd/.

Walsh, M.G., Rutebuka, J. and Manners, R. (2021). Machine learning workflows for predictive soil mapping. https://osf.io/3a5z6/.

Walsh, M.G. (2021). Workflows for predictive land cover mapping and small-area estimation https://osf.io/shkxp/

Walsh, M.G., Rutebuka, J. and Manners, R. (2021). RwaSIS cropland sampling frame. https://osf.io/a43y9/.

Walsh, M.G., Chamberlin, J., Silva, V. and Aston, S. (2021). Predicting spatial yield potentials from survey data. https://osf.io/a43y9/.

Print publications (also see at ResearchGate)

Aminu, O.R., Forde, T.L., Ekwem, D. *et al.* Participatory mapping identifies risk areas and environmental predictors of endemic anthrax in rural Africa. (2022). *Nature Scientific Reports*. https://doi.org/10.1038/s41598-022-14081-5.

Kumssa, D.B., Mossa, A.W., Amede, T., Ander, E.L., Bailey, E.H., Botoman, L., Chagumaira, C., Chimungu, J.G., Davis K., Gameda, S., Haefele, S.M., Hailu, K., Joy, E.J.M., Lark, R.M., Ligowe, I.S., McGrath, S.P., Milne, A.E., Muleya, P., Munthali, M., Towett, E., Walsh, M.G., Wilson, L., Young, S.D., Broadley, M.R., Gashu, D. and Nalivata, P.C. (2022). Cereal grain mineral micronutrient and soil chemistry data from GeoNutrition surveys in Ethiopia and Malawi. *Nature Scientific Data*. https://doi.org/10.1038/s41597-022-01500-5.

Botoman, L., Chagumaira, C., Mossa, A.W., Amede, T., Ander, E.L., Bailey, E.H., Chimungu, J.G., Gameda, S., Gashu, D., Haefele, S., Joy, E.J.M., Kumssa, D.B., Ligowe, I.S., McGrath, S.P., Milne, A.E., Munthali, M., Towett, E., Walsh, M.G., Wilson, L., Young, S.D., Broadley, M.R., Lark, R.M. and Nalivata, P.C. (2022). Geospatial variation in maize grain zinc concentration in Malawi: influence of soil and landscape factors. *Nature Scientific Reports*. https://doi.org/10.1038/s41598-022-12014-w.

Gashu D., Nalivata P. C., Amede T., Ander E.L., Bailey E.H., Botoman L., Chagumaira C., Gameda S., Haefele S.M., Hailu K., Joy E.J., Kalimbira A.A., Kumssa D.B., Lark R.M., Ligowe I.S., McGrath S.P., Milne A. E., Mossa A.W., Munthali M., Towett E.K., Walsh M.G., Wilson L., Young S.D. and Broadley M.R. (2021). The nutritional quality of cereals varies geospatially in Ethiopia and Malawi. *Nature*. https://www.nature.com/articles/s41586-021-03559-3.

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concentration of selenium (Se) in grain across part of Amhara Region, Ethiopia. *Science of the Total Environment*. https://doi.org/10.1016/j.scitotenv.2020.139231.

Kempen, B., Dalsgaard, S., Kaaya, A.K., Chamuya, N., Ruipérez-González, M., Pekkarinen, A. and Walsh, M.G. (2019). Mapping topsoil organic carbon concentrations and stocks for Tanzania. *Geoderma* 337: 164-180. https://doi.org/10.1016/j.geoderma.2018.09.01.

Hengl T, Walsh M.G., Sanderman J., Wheeler I., Harrison S.P., Prentice I.C. (2018). Global mapping of potential natural vegetation: an assessment of machine learning algorithms for estimating land potential. *PeerJ* 6:e5457. https://doi.org/10.7717/peerj.5457.

Hengl T., Leenaars J.G.B., Shepherd K.D., Walsh M.G., Heuvelink G.B.M., Mamo T., Tilahun, H., Berkhout E., Cooper M., Fegraus E., Wheeler I., and Kwabena N.A. (2017). Soil nutrient maps of Sub-Saharan Africa: assessment of soil nutrient content at 250 m spatial resolution using machine learning. *Nutrient Cycling in Agroecosystems* 109:77–102. https://doi.org/10.1007/s10705-017-9870-x.

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Shepherd, K.D., Shepherd G. and Walsh, M.G. (2015). Soil health surveillance and response: a framework for evidence-informed land management. *Agricultural Systems*. 132:93-106.

Hengl T., Mendes de Jesus, J., MacMillan, R.A., Batjes, N.H., Heuvelink, G.B., Ribeiro, E., Samuel-Rosa, A., Kempen, B., Leenaars, J.G.B., Walsh, M.G. and Gonzalez, M.R. (2014). SoilGrids1km - Global Soil Information Based on Automated Mapping. *PLOS-One*. https://DOI:10.1371/journal.pone.0105992.

UNEP. (2012). Land Health Surveillance: An Evidence-Based Approach to Land Ecosystem Management. Illustrated with a Case Study in the West Africa Sahel. United Nations Environment Programme, Nairobi. ISBN: 978-92-807-3299-3

Palm, C.A., Smukler, S.M., Sullivan, C.A. Mutuo, P.K., Nyadzi G., and Walsh, M.G. (2010). Identifying potential synergies and trade-offs for meeting food security and climate change objectives in sub-Saharan Africa. *PNAS*. https://www.pnas.org/cgi/doi/10.1073/pnas.0912248107.

Sanchez, P. A., Ahamed S., Carré F., Hartemink A.E., Hempel J., Huising J., Lagacherie P., McBratney A.B., McKenzie N.J., de Lourdes Mendonça-Santos M., Minasny B., Montanarella L., Okoth P., Palm C.A., Sachs J.D., Shepherd K.D., Vågen T.G., Vanlauwe B., Walsh M.G., Winowiecki L.A., and Zhang G.L. (2009). Digital soil map of the world. *Science* 325, 680-681.

Shepherd K.D., Vagen T.G., Gumbricht T. and Walsh M.G. (2008). Land Degradation Surveillance: Quantifying and Monitoring Land Degradation. In Sustainable Land Management Sourcebook. The World Bank, Washington DC, pp 141 – 147.

Awiti, A.O., Walsh M.G., Shepherd K.D. and Kinyamario J. (2008). Soil condition classification using infrared spectroscopy: A proposition for assessment of soil condition along a tropical forest-cropland chronosequence. Geoderma.

Awiti, A.O., Walsh M.G. and Kinyamario J. (2008). Dynamics of topsoil carbon and nitrogen along a tropical forest–cropland chronosequence: Evidence from stable isotope analysis and spectroscopy. Agriculture, Ecosystems and Environment.

Shepherd, K.D. and Walsh, M.G. (2007). Infrared spectroscopy - enabling an evidence-based diagnostic surveillance approach to agriculture and environmental management in

developing countries. Journal of Near Infrared Spectroscopy. https://doi.org/10.1255/jnirs.716

Vagen, T.G., Shepherd K.D. and Walsh, M.G. (2006). Stable carbon isotopes as evidence of past land use and soil organic carbon dynamics under land use conversions in Madagascar. Geoderma 135: 133-139.

Vagen, T.G., Walsh, M.G. and Shepherd, K.D. (2006). VNIR spectroscopy for characterization of landscape levels changes in soil quality following deforestation in the highlands of Madagascar. Geoderma 133: 281-294.

Brown, D., Shepherd, K.D. and Walsh, M.G. (2005). Global soil characterization using VNIR reflectance libraries and boosted regression trees. Geoderma, 132: 273-290.

Cohen, M.J., Shepherd, K.D. and Walsh, M.G. (2005). Empirical reformulation of the Universal Soil Loss Equation for erosion risk assessment in a tropical watershed. Geoderma, 124: 235-252.

Shepherd, K.D. and Walsh, M.G. (2003). Rapid soil analysis using diffuse reflectance spectrometry. In: R. Lal. Encyclopedia of Soil Science, 2nd edition.

Shepherd, K.D. and Walsh, M.G. (2002). Development of reflectance spectral libraries for characterization of soil properties. Soil Science Society of America Journal, 66(3): 988-998.

Schwartz, H.J. and Walsh, M.G. (1993-1994, 6 volumes including 36 maps). Range Unit Inventory. Range Management Handbook of Kenya, vol. II b, c, d, e, f, g. Min. of Agriculture, Range Management Division, Nairobi, Kenya.

Schwartz, H.J. and Walsh, M.G. (1993). The productive potential of the camel: In: H.J. Schwartz and M. Dioli M. (eds). The one-humped camel in Eastern Africa: A pictorial guide to diseases, health care, and management. Verlag Joseph Margraf, Weikersheim, Germany.