

# Expanding the Nitrogen Footprint Pathway

James N. Galloway<sup>1</sup>, Allison M. Leach<sup>2</sup>, Elizabeth A. Castner<sup>3</sup>, Elizabeth S. M. Dukes<sup>1</sup>

<sup>1</sup> Environmental Sciences Department, University of Virginia, Charlottesville VA, USA

<sup>2</sup> The Sustainability Institute, University of New Hampshire, Durham NH, USA

<sup>3</sup> Geography Department, University of California at Davis, Davis CA, USA

E-mail: jng@virginia.edu

## Abstract

N-Print was established in 2010 by researchers from the United States and the Netherlands to develop country-specific N footprint calculators. Since then it has developed into a multiple-country project and expanded to include N footprint tools for watersheds, institutions and communities. Recently, in cooperation with others, it developed SIMAP, an integrated N-C footprint tool. In the immediate future, it will develop a N-C-P-Water footprint tool. This presentation provides a brief history, states current projects and lays out future plans for the use of footprint tools to minimize the impacts of resource use by people, communities and institutions.

Keywords: footprint, national, institutions

## 1. Introduction

Footprint tools are effective in educating people and the countries, communities and institutions in which they reside and work on how resources use results in environmental pollution and what people can do to moderate that pollution.

## 2. The Beginning to the Present

The first two footprint tools developed were the country specific per-capita tool (Leach et al., 2012) and the institutional tool (Leach et al., 2013) which was expanded to a network of 20+ institutions (Castner et al., 2017). This was followed by a watershed N footprint tool in 2016 and a community tool (Dukes et al., 2018) (Figure 1).

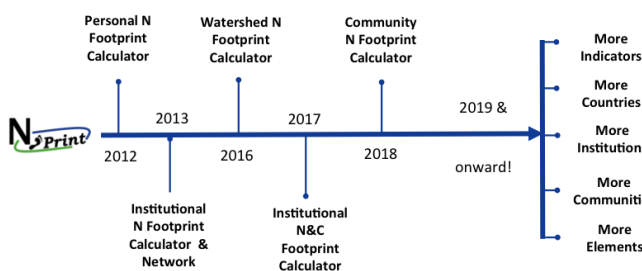


Fig. 1: The N Footprint Timeline

In 2016, Leach et al. published an integrated food label toolkit that included N, C, and water. In 2017, as noted in Figure 1, an integrated N&C footprint tool (SIMAP) was launched (Leach et al., 2017); currently there are over 500 institutions using the tool.

## 3. Focus on the Future

The plans for the future include:

- personal N calculators for Brazil, Portugal, Canada, Ukraine and Denmark.
- Integrated N, C, P and water tools for institutions and the people who populate them.
- Release of a community footprint tool model that can be applied to any place in the US and in other countries where geospatial databases are available.

## 4. Summary

This paper will focus on the plans for the future on how the developed tools will contribute to nitrogen management.

## Acknowledgements

We acknowledge support from the USEPA, INMS, University of Virginia and University of New Hampshire.

## References

Castner E A, Leach A M, Leary N, Baron J S, Compton J E, Hastings M G, Kimiecik J, Lantz-Trissel J, de la Reguera E, Ryals R, Galloway J N. 2017. The Nitrogen Footprint Network: A multi-institution program to limit nitrogen pollution. *Sustainability: the Journal of Record* 10, 79-88

Dukes E S, Galloway J N, Band L E, Groffman P, Leach A M, Castner E A. 2019. A community nitrogen footprint analysis of Baltimore City, Maryland. *ERL*, in review.

Leach A M, Galloway J N, Bleeker A, Erisman J W, Kohn R, Kitzes J 2012 A nitrogen footprint model to help consumers understand their role in nitrogen losses to the environment. *Environmental Development* 1, 40-66

Leach A M, Majidi A N, Galloway J N, Greene A J 2013 Towards institutional sustainability: A nitrogen footprint model for a university. *Sustainability: The Journal of Record*, 6, 211 – 219. DOI:10.1089/sus.2013.9852.

Leach A M, Emery K A, Gephart J, Davis K, Erisman J W, Leip A, Pace M L, D’Odorico P, Carr J, Cattell Noll L, Castner E, Galloway J N. 2016. Environmental impact food labels combining carbon, nitrogen, and water footprints. *Food Policy*. 61: 213-223

Leach A M, Galloway J N, Castner E A, J Andrews J. 2017. An integrated tool for calculating and reducing institution carbon and nitrogen footprints. *Sustainability: the Journal of Record* 10, 140-14