Environmental footprints: assessing anthropogenic effects on the planet's environment

Fang, K.

Publications in this thesis

Chapter	Reference
2	Fang, K., Heijungs, R., De Snoo, R. G., 2014. Theoretical exploration for the combination of the ecological, energy, carbon, and water footprints: Overview of a footprint family. *Ecological Indicators* 36, 508–518. DOI: 10.1016/j.ecolind.2013.08.017.
3	Fang, K., Heijungs, R., 2015. Investigating the inventory and characterization schemes in footprinting: lessons for the classification and integration of footprints. *Journal of Cleaner Production* 108, 1028–1036. DOI: 10.1016/j.jclepro.2015.06.086.
4	Fang, K., Heijungs, R., 2015. The role of impact characterization in carbon footprinting. *Frontiers in Ecology and the Environment* 13, 130–131. DOI: 10.1890/15.WB.005.
	Fang, K., Heijungs, R., 2014. Moving from the material footprint to a resource depletion footprint. *Integrated Environmental Assessment and Management* 10, 596–598. DOI: 10.1002/ieam.1564.
	Fang, K., Heijungs, R., 2014. There is still room for a footprint family without a life cycle approach: Comment on "towards an integrated family of footprint indicators". *Journal of Industrial Ecology* 18, 71–72. DOI: 10.1111/jiec.12067.
	Fang, K., Heijungs, R., 2015. Rethinking the relationship between footprints and LCA. *Environmental Science & Technology*, 49, 10–11. DOI: 10.1021/es5057775.
5	Fang, K., Heijungs, R., De Snoo, R. G., 2015. Understanding the complementary linkages between environmental footprints and planetary boundaries in a footprint–boundary environmental sustainability assessment framework. *Ecological Economics* 114, 218–226. DOI: 10.1016/j.ecolecon.2015.04.008.
6	Fang, K., Heijungs, R., Duan, Z., De Snoo, R. G. The environmental sustainability of nations: Benchmarking the water, carbon and land footprints with allocated planetary boundaries. *Sustainability* 7, 11285–11305. DOI: 10.3390/su70811285.

Acknowledgment

I would like to thank all the people who supported me in the last four years of my PhD research in The Netherlands. Special thanks go to my daily supervisor Dr. Reinout Heijungs and promoter Prof. Geert R de Snoo, who inspired me in many ways and helped this work to come true. I thank my colleagues, Coen van der Giesen, Edi Wiloso, Hao Qiu, Jeroen Admiraal, Jiali Rui, Jory Sjardijn, José Brittijn, Lan Song, Laura Bertola, Mingming Hu, Patrik Henriksson, Sanne de Groot, Stefano Cucurachi, Susan van den Oever, Wenjie Liao, Yang Liu, Yinlong Xiao, and many others at the Institute of Environmental Sciences (CML), for the scientific exchanges and practical supports. I am also grateful to Profs. Arnold Tukker, Helias Udo de Haes, Jan Boersema and Peter van Bodegom for their valuable comments on the whole or part of the thesis.

For the past four years, I had quite some opportunities to communicate with colleagues outside CML. I would like to acknowledge Profs. Arjen Y Hoekstra at the University of Twente, Bo Pedersen Weidema at Aalborg University, Caizhi Sun at Liaoning Normal University, Gaodi Xie at the Chinese Academy of Sciences, Lizhong Zhu at Zhejiang University, Manfred Lenzen at the University of Sydney, Mark A J Huijbregts at Radboud University Nijmegen, Xianjin Huang at Nanjing University, and Yong Geng at Shanghai Jiao Tong University, as well as Drs. Guoping Zhang at the Water Footprint Network, Jian Peng at Peking University, Ming Cao at the University of Groningen, Thomas Wiedmann at the University of New South Wales, and Zheng Duan at Technische Universität München, for their feedback and suggestions.

Finacial support from the China Scholarship Council–Leiden University Joint Program (No. 2011617078) is gratefully acknowledged.

My deepest gratefulness is always due to my family members, particularly to my parents, my wife, and my lovely son who was born just a few months ago. With their immeasurable love and endless support they got me here.

Thanks again for all your help.

Curriculum Vitae

General

Name	Kai Fang
Date of birth	10 October, 1986
Place of birth	Dalian, China

Education

2011-2015 (expected)	Ph.D., Environmental Science, Leiden University
2009-2011	M.Sc., Environmental Science, Jilin University
2005-2009	B.Sc., Environmental Science, Zhejiang University

Publications in peer-reviewed journals (in English)

1. Fang, K., Heijungs, R., 2015. Investigating the inventory and characterization schemes in footprinting: lessons for the classification and integration of footprints. *Journal of Cleaner Production* 108. DOI: 10.1016/j.jclepro.2015.06.086.
2. Fang, K., Heijungs, R., De Snoo, R. G., 2015. Understanding the complementary linkages between environmental footprints and planetary boundaries in a footprint–boundary environmental sustainability assessment framework. *Ecological Economics* 114. DOI: 10.1016/j.ecolecon.2015.04.008.
3. Fang, K., Heijungs, R., Duan, Z., De Snoo, R. G., 2015. The environmental sustainability of nations: Benchmarking the water, carbon and land footprints with allocated planetary boundaries. *Sustainability* 7. DOI: 10.3390/su70811285.
4. Fang, K., Heijungs, R., 2015. Rethinking the relationship between footprints and LCA. *Environmental Science & Technology* 49. DOI: 10.1021/es5057775.
5. Fang, K., Heijungs, R., 2015. The role of impact characterization in carbon footprinting. *Frontiers in Ecology and the Environment* 13. DOI: 10.1890/15.WB.005.
6. Fang, K., Heijungs, R., De Snoo, R. G., 2014. Theoretical exploration for the combination of the ecological, energy, carbon, and water footprints: Overview of a footprint family. *Ecological Indicators* 36. DOI: 10.1016/j.ecolind.2013.08.017.
7. Fang, K., Heijungs, R., 2014. There is still room for a footprint family without a life cycle approach: Comment on "towards an integrated family of footprint indicators". *Journal of Industrial Ecology* 18. DOI: 10.1111/jiec.12067.
8. Fang, K., Heijungs, R., 2014. Moving from the material footprint to a resource depletion footprint. *Integrated Environmental Assessment and Management* 10. DOI: 10.1002/ieam.1564.
9. Fang, K., Heijungs, R., De Snoo, G., 2013. The footprint family: Comparison and interaction of the ecological, energy, carbon and water footprints. *Revue De*

Metallurgie, 110. DOI: 10.1051/metal/2013051.

10. Wiloso, E. I., Heijungs, R., Huppes, G., Fang, K. Effect of biogenic carbon inventory on the life cycle assessment of bioenergy: challenges to the neutrality assumption. *Journal of Cleaner Production*, submitted.

Publications in peer-reviewed journals (in Chinese)

11. Fang, K., 2015. Footprint family: current practices, challenges, and future prospects. *Acta Ecologica Sinica*, accepted. DOI: 10.5846/stxb201407031373.
12. Fang, K., Duan, Z., 2015. An integrated assessment of national environmental sustainability by synthesizing carbon, water and land footprints and boundaries. *Journal of Natural Resources* 30. DOI: 10.11849/zrzyxb.2015.04.001.
13. Fang, K., 2015. Assessing the natural capital use of eleven nations: an application of a revised three-dimensional model of ecological footprint. *Acta Ecologica Sinica* 35. DOI: 10.5846/stxb201305211128.
14. Fang, K., 2015. Paradigms for the categorization and integration of environmental footprints. *Ecological Economy* 31. DOI: 10.3969/j.issn.1671-4407.2015.07.005.
15. Fang, K., 2015. Footprint family: Concept, classification, theoretical framework and integrated pattern. *Acta Ecologica Sinica* 35. DOI: 10.5846/stxb201305211128.
16. Fang, K., 2014. Multidimensional assessment of national environmental sustainability based on footprint family and planetary boundaries. *Ecology and Environment Sciences* 23. DOI: 10.3969/j.issn.1674-5906.2014.11.022.
17. Fang, K., 2014. Changes in the spatial distribution of natural capital use among G20 countries from 1999 to 2008. *Resources Science* 36. DOI: zykx201404016
18. Fang, K., Gao, K., Li, H., 2013. International comparison of natural capital use: A three-dimensional model optimization of ecological footprint. *Geographical Research* 32. DOI: 10.11821/dlyj201309008.
19. Fang, K., 2013. Ecological footprint depth and size: New indicators for a 3D model. *Acta Ecologica Sinica* 33. DOI: 10.5846/stxb201111051670.
20. Fang, K., Shen, W., Dong, D., 2013. Impacts of economic growth and technological progress on energy eco-footprint in Jilin Province. *Arid Land Geography* 34. DOI: 10.13826/j.cnki.cn65-1103/x.2013.01.013.
21. Fang, K., Heijungs, R., 2012. A review on three-dimensional ecological footprint model for natural capital accounting. *Progress in Geography* 31. DOI: 10.11820/dlkxjz.2012.12.016.
22. Fang, K., Li, H., 2012. Provincial pattern of China's natural capital use: A modification and application of ecological footprint depth and size. *Journal of Natural Resources* 27. DOI: 10.11849/zrzyxb.2012.12.001.
23. Fang, K., Shen, W., Dong, D., Lin, Z., 2012. Calculation method of energy ecological footprint based on global net primary productivity. *Acta Ecologica Sinica* 32. DOI: 10.5846/stxb201103280399.
24. Fang, K., Shen, W., Dong, D., 2012. Effects of multiple factors on changes of

energy eco-footprint: An empirical study. *Journal of Ecology and Rural Environment* 28. DOI: 10.3969/j.issn.1673-4831.2012.02.004.

25. Fang, K., Dong, D., Shen, W., 2012. Carbon footprint of global electricity and its equivalent calculation. *Chinese Journal of Ecology* 31. DOI: 10.13292/j.1000-4890.2012.0408.
26. Wang, J., Fang, K., 2012. Estimation of China's carbon footprint of electric power based on sources diversity. *Journal of Electric Power* 27. DOI: 10.3969/j.issn.1005-6548.2012.02.018.
27. Fang, K., Shen, W., Dong, D., 2011. Modification and prediction of energy ecological footprint accounting: Case study of Jilin Province. *Geographical Research* 30. DOI: 10.11821/yj2011100010.
28. Fang, K., Shen, W., Zheng, Q., Gao, K., Liu, J., 2011. Study on ecological carrying capacity of fossil energy land based on ecological footprint theory. *Environmental Science & Technology* 34. DOI: 10.3969/j.issn.1003-6504.2011.12.043.
29. Fang, K., Dong, D., Shen, W., 2010. Discussion on shortcomings and improvement of ecological footprint theory in energy consumption assessment. *Journal of Natural Resources* 25. DOI: 10.11849/zrzyxb.2010.06.013.
30. Fang, K., Dong, D., Shen, W., 2010. A new energy ecological footprint model based on net primary productivity and its comparison with traditional model. *Ecology and Environmental Sciences* 19. DOI: 10.3969/j.issn.1674-5906.2010.09.005.
31. Fang, K., Dong, D., Shen, W., 2010. Modified energy ecological footprint method and its application to analysis and evaluation of regional energy utilization benefit. *Scientia Geographica Sinica* 30. DOI: 10.13249/j.cnki.sgs.2010.05.017.
32. Fang, K., Shen, W., Wang, L., 2010. Sustainability analysis in agricultural area based on modified energy ecological footprint model. *Geography and Geo-Information Science* 26. DOI: 10.3969/j.issn.1672-0504.2010.06.017.
33. Fang, K., Wang, L., Li, H., 2010. Impact assessment of land use planning on traditional agricultural area of Southern Yangtze River based on ecosystem services value. *Resources and Environment in the Yangtze Basin* 19. DOI: 10.11870/cjlyzyyhj2010z2017.
34. Fang, K., Shen, W., 2010. Construction and application of calculation model for CO_2 emission carrying capacity. *Ecological Science* 29. DOI: 10.3969/j.issn.1008-8873.2010.06.011.
35. Fang, K. A framework for quantification and integration of environmental footprints: A perspective of life cycle assessment. *Acta Ecologica Sinica*, submitted.

Presentations

16-18 Oct. 2015 A framework for quantification and integration of environmental footprints. The 2015 China Society of Natural Resources (CSNR) Annual Conference, Kunming, China.

2 Sep. 2015 Environmental footprints: Concept, accounting and integration.

	School of Geographic and Oceanographic Sciences, Nanjing University, Nanjing, China.
3-7 May 2015	Investigating the characterization and weighting schemes for footprinting. Society of Environmental Toxicology and Chemistry (SETAC) Europe 25th Annual Meeting, Barcelona, Spain.
23 Apr. 2015	Environmental footprints: Concept, classification, and the relevance to planetary boundaries. Water Footprint Network (WFN), University of Twente, Twente, The Netherlands.
23 Mar. 2015	The applications and implications of environmental footprints for environmental governance. School of Public Affairs, Zhejiang University, Hangzhou, China.
30-31 May 2012	The footprint family: A comparison and discussion of ecological, water and carbon footprints. The 6th Society & Materials (SAM) International Conference, University of Leuven, Leuven, Belgium.
20-24 May 2012	The footprint family: Differentiation, classification, and integration. The 6th SETA World Congress, Berlin, Germany.
12-16 Feb. 2011	Net primary productivity as the basis for assessing energy ecological footprint. Center for Energy and Environmental Sciences, University of Groningen, Groningen, The Netherlands.
22-23 Oct. 2010	Calculation method of energy ecological footprint based on global net primary productivity. The 2010 CSNR Annual Conference, Chongqing, China.