

RESSALVA

Atendendo solicitação da autora,
o texto completo desta TESE será
disponibilizado somente a partir
de 31/01/2019.

UNIVERSIDADE ESTADUAL PAULISTA
“JÚLIO DE MESQUITA FILHO”
FACULDADE DE MEDICINA VETERINÁRIA
CÂMPUS DE ARAÇATUBA

AVALIAÇÃO DO CONSUMO DE ÁGUA E DA GERAÇÃO DE
EFLUENTES EM UMA INDÚSTRIA DE PROCESSAMENTO
DE TILÁPIAS

Karline Tikae Tani Murakami

Farmacêutica Bioquímica

ARAÇATUBA – SP

2018

UNIVERSIDADE ESTADUAL PAULISTA
“JÚLIO DE MESQUITA FILHO”
FACULDADE DE MEDICINA VETERINÁRIA
CÂMPUS DE ARAÇATUBA

**AVALIAÇÃO DO CONSUMO DE ÁGUA E DA GERAÇÃO DE
EFLUENTES EM UMA INDÚSTRIA DE PROCESSAMENTO
DE TILÁPIAS**

Karline Tikae Tani Murakami

Orientador: Prof. Adj. Dr. Marcos Franke Pinto

Tese apresentada à Faculdade de Medicina Veterinária – Unesp, Campus de Araçatuba, como parte das exigências para a obtenção do título de Doutor em Ciência Animal (Medicina Veterinária Preventiva e Produção Animal).

ARAÇATUBA – SP

2018



UNIVERSIDADE ESTADUAL PAULISTA

Câmpus de Araçatuba

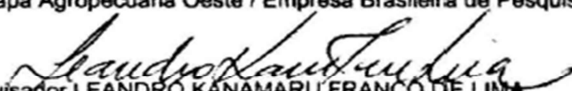
CERTIFICADO DE APROVAÇÃO

TÍTULO: AVALIAÇÃO DO CONSUMO DE ÁGUA E DA GERAÇÃO DE EFLUENTES EM UMA INDÚSTRIA
DE PROCESSAMENTO DE TILÁPIAS

AUTORA: KARLINE TIKAE TANI MURAKAMI
ORIENTADOR: MARCOS FRANKE PINTO
COORIENTADORA: DANIELLE DE BEM LUIZ
COORIENTADORA: ELISA HELENA GIGLIO PONSANO

Aprovada como parte das exigências para obtenção do Título de Doutora em CIÊNCIA ANIMAL, área: Medicina Veterinária Preventiva e Produção Animal pela Comissão Examinadora:

Analista DANIELLE DE BEM LUIZ
Embrapa Agropecuária Oeste / Empresa Brasileira de Pesquisa Agropecuária - EMBRAPA


Pesquisador LEANDRO KANAMARU FRANCO DE LIMA
Centro Nacional de Pesquisa em Pesca, Aquicultura e Sistemas Agrícolas / Empresa Brasileira de Pesquisa Agropecuária - EMBRAPA

Prof. Dr. MAURICIO AUGUSTO LEITE
Departamento de Fitossanidade, Engenharia Rural e Solos / Faculdade de Engenharia - Câmpus de Ilha Solteira/Unesp

Profa. Dra. ANDRÉA FONTES GARCIA
Cursos de Farmácia e Nutrição / Centro Católico Auxilium - UNISALESIANO/Araçatuba

Prof. Dr. MAX JOSÉ DE ARAUJO FARIA JUNIOR
Departamento de Apoio, Produção e Saúde Animal / Faculdade de Medicina Veterinária - Câmpus de Araçatuba/Unesp

Araçatuba, 31 de julho de 2018.

DADOS CURRICULARES DO AUTOR

KARLINE TIKAE TANI MURAKAMI - nascida em 03 de julho de 1979 no município de Guarulhos/SP. Em 2000, iniciou o curso de Farmácia e Bioquímica na Faculdade de Medicina do ABC – SP e formou-se em 2004. Iniciou em 2007 o curso de pós-graduação em Ciência Animal na Universidade Estadual Paulista “Júlio de Mesquita Filho” – FMVA/UNESP, na área de Medicina Veterinária Preventiva e Produção Animal. Nesse período, era responsável técnica em Farmácia onde atuou até o ano de 2011. Em 2014, iniciou o curso de doutorado do programa de pós-graduação em Ciência Animal na Faculdade de Medicina Veterinária de Araçatuba da Universidade Estadual Paulista “Júlio de Mesquita Filho”.

DEDICATÓRIA

Dedico

À minha família, pelos exemplos de determinação e amor.

Ao marido, Reinaldo, pelo amor, paciência e companheirismo.

Às minhas filhas Lelê e Milly, pelos momentos de carinho e alegria.

AGRADECIMENTOS

Agradeço ao meu marido Reinaldo Murakami pelo apoio e incentivo em todas as escolhas que faço na minha vida, à minha filha Letícia pelo carinho e compreensão pelos momentos que estive ausente no decorrer dessa jornada.

Agradeço à minha família por estarem sempre ao meu lado nos momentos de alegria e principalmente nos momentos de dificuldade.

À Embrapa Pesca e Aquicultura, Palmas/TO, em especial ao Pesquisador Dr. Leandro Kanamaru Franco de Lima pela parceria no desenvolvimento desse trabalho e à analista Dra. Danielle de Bem Luiz pelos ensinamentos, atenção e carinho.

Ao Entrepasto de pescado Geneseas Aquaculture por acreditar no nosso trabalho para a realização das atividades de campo e coleta de material.

Aos amigos: Leandro Kanamaru Franco de Lima, Jussara Yoshida Nakamura e Alex Akira Nakamura meus sinceros agradecimentos pela amizade e momentos de risadas.

Às amigas: Helenice Aparecida Pires, Ligia Mara Sandeski e Juliana Maziero Vacacari pelo companheirismo e pelo apoio durante a coleta das amostras e a realização das análises no Laboratório de Análises de Alimentos.

À Profa. Dra. Elisa Helena Giglio Ponsano, pela oportunidade de aprendizado e crescimento e pelo exemplo de superação.

Ao Prof. Marcos Franke Pinto pela oportunidade e disponibilidade para que eu pudesse concluir essa etapa de minha formação.

AVALIAÇÃO DO CONSUMO DE ÁGUA E DA GERAÇÃO DE EFLUENTE EM UMA INDÚSTRIA DE PROCESSAMENTO DE TILÁPIAS

RESUMO – O crescimento sustentável da indústria de processamento de tilápia está diretamente relacionado com o uso eficiente de água e com a gestão da qualidade da água devolvida ao meio ambiente. Foi avaliado o uso global de água em uma planta de produção de filé de tilápia, bem como o uso de água em diferentes etapas do processamento. Para isso, foram instalados hidrômetros em 13 pontos do estabelecimento. Em seguida, foram sugeridas ações de minimização visando diminuir o uso de água. O uso global de água foi de $432 \text{ m}^3 \cdot \text{dia}^{-1}$, sendo a etapa de depuração responsável por 40,7% desse volume, seguida das atividades relacionadas com a limpeza (32,3%). As ações de minimização implantadas reduziram 29% do uso de água referente à área limpa do processamento da empresa. Em seguida, foi realizada a caracterização físico-química e microbiológica dos efluentes gerados na indústria para a determinação das suas cargas de poluentes. A indústria, como um todo, gerou um efluente com alta carga de matéria orgânica, sendo as etapas onde há maior contato da água com o pescado e seus resíduos (cabeça, carcaça, carne, pele, sangue e vísceras) as maiores fontes poluidoras. Os parâmetros de DBO, DQO e óleos e graxas apresentaram os valores acima dos limites estabelecidos pela legislação para lançamento em sistemas de esgotamento sanitário ou em corpos hídricos receptores. Isso evidenciou a necessidade de um tratamento prévio do efluente antes do seu descarte. Além disso, foi avaliado o potencial do efluente gerado na etapa de depuração para reuso em sistemas de resfriamento e para fins urbanos. Este trabalho apresentou alternativas para minimização do uso de água e geração de efluente e também forneceu dados para orientar as indústrias de beneficiamento de tilápia na definição de ações e estratégias para segregação, tratamento e reuso de efluentes dentro dos princípios de gestão ambiental e sustentabilidade, considerando as restrições impostas pela legislação brasileira e as práticas higiênicas da indústria de alimentos.

Palavras-Chave: Peixes, Tecnologia Limpa, Conservação dos recursos naturais, Conservação dos recursos hídricos.

EVALUATION OF WATER CONSUMPTION AND EFFLUENT GENERATION IN A TILÁPIA PROCESSING INDUSTRY

ABSTRACT - The sustainable growing of the tilapia processing industry is directly related to the efficient use of water and to the management of the quality of water returned to the environment. The global use of water in a tilapia fillet processing plant and the use of water in different processing stages were evaluated. For this, hydrometers were installed at 13 points within the premisses. Additionally, minimization actions were suggested aiming at reducing the water use. It was used $432 \text{ m}^3 \cdot \text{d}^{-1}$ of water, being the depuration stage responsible for 40.7% of this volume, followed by the general cleaning process of the plant (32.3%). The applied minimization actions reduced in 29% the use of water in the clean area of the processing flow. After this, the physical-chemical and microbiological characterization of the effluents generated by the industry was performed in order to evaluate the pollutant load. The industry, as a whole, produced an effluent with high organic matter load, being the stages in which the water contacts the fish and the solid residues (head, carcass, meat trimmings, skin, blood and viscera) the main pollutant sources. The parameters BOD, COD, oils and greases presented values above the legal limits to dispose in the effluent treatment systems or in the hydric spring. This demonstrated the necessity of a previous treatment of the effluent before it is discarded. Besides that, the potential of the effluent from the depuration stage to be reused for urban purposes and in industrial cooling processes was evaluated. This study proposed alternatives to minimize water use and effluent generation and also provided data to orientate the tilapia processing industries in definition of effluent segregation, treatment and reuse actions and strategies, attending the principles of environmental management and sustainability, considering the restrictions settled by the Brazilian legislation and the food industries hygienic practices.

Keywords: Fisheries, Clean Technology, Natural Resource Conservation, Water Resource Conservation

CAPÍTULO 1 – CONSIDERAÇÕES GERAIS

1 Introdução

O crescimento do número de habitantes no mundo e do seu poder aquisitivo aliado à preocupação por uma alimentação mais saudável têm proporcionado um aumento significativo no consumo de peixe, revelando assim um potencial de oportunidade para o mercado da piscicultura no Brasil.

Em 2017, a piscicultura brasileira produziu 691.700 toneladas de peixes de cultivo que representa um aumento de 8% em relação ao ano anterior (MEDEIROS, 2018)

Contudo, o grande desafio é desenvolver uma aquicultura sustentável, já que a atividade demanda muito dos recursos naturais como água, energia e solo (KUBITZA, 2010). Por isso, é necessário que se faça a devida gestão e racionalização deles, ou seja, produzir de forma lucrativa, com conservação dos recursos naturais em toda a cadeia produtiva.

A indústria de processamento de pescado utiliza um volume alto de água potável que é utilizada em quase todas as etapas do processamento e para o processo de higienização da indústria. O volume de água utilizado está relacionado com: a espécie de pescado, o tipo de produto final obtido, o grau de processamento, a tecnologia adotada e principalmente com o grau de comprometimento da indústria com os conceitos de produção mais limpa, principalmente referente com as práticas de minimização do consumo de água (MURPHY, 2006)

A preocupação não é somente com a água que entra, mas também com aquela que sai do processo pois o volume de água utilizada pela indústria está diretamente ligado à quantidade de efluente produzido. O efluente gerado na indústria de processamento de pescado apresenta alta carga orgânica (CARAWAN, 1991), por isso o tratamento adequado é fundamental antes de ser lançado em corpos hídricos receptor.

Considerando a importância da água para as atividades aquícolas, programas de minimização do uso e iniciativas de reúso de água e de minimização de geração

ALFENAS, C. (Coord.). **Tilápias**. Manual prático de criação. Centro de produções técnicas. Disponível em: <
<http://cptstatic.s3.amazonaws.com/pdf/cpt/piscicultura/tilapias-cursos-cpt.pdf>>.
 Acesso em 07 Nov 2016.

BOSCOLO, W. R.; HAYASHI, C.; MEURER, F. Farinha de varredura de mandioca (*Manihot esculenta*) na alimentação de alevinos de Tilápia do Nilo (*Oreochromis niloticus* L.). **Revista Brasileira de Zootecnia**, v. 31, n. 2, p. 546 – 551, 2002.

BRASIL. Lei nº 9.433, de 08 de janeiro de 1997. Institui a Política Nacional de Recursos Hídricos, 1997a. Disponível em: <
<http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=370>>. Acesso em 06 de maio de 2017.

BRASIL. Ministério da Saúde. Portaria nº 326 de trinta de julho de 1997. Regulamento técnico sobre condições higiênico-sanitárias e de boas práticas de fabricação para estabelecimentos produtores/industrializadores de alimentos, 1997b. Disponível em: <
http://bvsms.saude.gov.br/bvs/saudelegis/svs1/1997/prt0326_30_07_1997.html>.
 Acessado em: 12 de fevereiro de 2017.

BRASIL. Ministério da Pesca e Aquicultura. **Boletim estatístico da pesca e aquicultura**: Brasil 2010. Brasília: Ministério da Pesca e Aquicultura, 2012. Disponível em:<
http://www.mpa.gov.br/images/Docs/Informacoes_e_Estatisticas/Boletim%20Estat%C3%ADstico%20MPA%202010.pdf>. Acesso em: 29 janeiro 2013.

BRASIL. Ministério da Saúde. Portaria MS nº 2914, de 12 de dezembro de 2011. Dispõe sobre os procedimentos de controle e de vigilância da qualidade da água para consumo humano e seu padrão de potabilidade, 2011a. Disponível em:<

http://bvsms.saude.gov.br/bvs/saudelegis/gm/2011/prt2914_12_12_2011.html>.

Acesso em: 19 de mar. 2018.

BRASIL. Ministério do Meio Ambiente. Conselho Nacional do Meio Ambiente – CONAMA. Resolução no 357, de 17 de março de 2005. Dispõe sobre a classificação dos corpos de água e diretrizes ambientais para o seu enquadramento, bem como estabelece as condições e padrões de lançamento de efluentes, e dá outras providências. **Diário oficial da União**, Brasília. Disponível em: <<http://www.mma.gov.br/port/conama/res/res05/res35705.pdf>>. Acesso em: 20 de dez de 2017.

BRASIL. Conselho Nacional do Meio Ambiente – CONAMA. Resolução nº 430, de 13 de maio de 2011. Dispõe sobre as condições e padrões de lançamento de efluentes, complementa e altera a Resolução nº 357, de 17 de março de 2005 do CONAMA, (2011 b). Disponível em: <www.mma.gov.br/port/conama/legiabre.cfm?codlegi=646>. Acesso em: 13 de agosto de 2017.

BRASIL. Ministério Agricultura, Pecuária e Abastecimento. Decreto nº 9.013 de 29 de março de 2017. Dispõe sobre o Regulamento da Inspeção Industrial e Sanitária de Produtos de Origem Animal – RIISPOA, 2017. Disponível em: <file:///C:/Users/Karline/Downloads/Decreto%20n%209013-2017_Alt%20Decreto%209069-2017_PT.pdf>. Acesso em: 12 de outubro de 2017.

CARAWAN, R.E. **Processing Plant Waste Management Guidelines - Aquatic Fishery Products**. Department of Food Science North Carolina State University, Seafood and the Environmental. Raleigh, N.C., 1991.

CARLSON, V. (Coord.). **1º Anuário Brasileiro da Pesca e Aquicultura**. ACEB, 2014. 132 p.

CASANI, Sandra; ROUHANY, Mahbod; KNØCHEL, Susanne. A discussion paper on challenges and limitations to water reuse and hygiene in the food industry. **Water Research**, v. 39, p. 1134-1146, 2005.

CHOWDHURY, P.; VIRARAGHAVAN, T.; SRINIVASAN, A. Biological treatment processes for fish processing wastewater – A review. **Bioresource Technology**, v. 101, p. 439-449, 2010

COSMANN, N. J.; GOMES, S. D.; ANDRADE, L.; KUMMER, A. C. B. Caracterização do efluente de processamento de pescado e desempenho da lagoa anaeróbia. In: SIMPÓSIO INTERNACIONAL SOBRE GERENCIAMENTO DE RESÍDUOS DE ANIMAIS, 1. Florianópolis, 2009. **Anais...** Concórdia: Embrapa Suínos e Aves. Disponível em: <
http://www.cnpsa.embrapa.br/sgc/sgc_publicacoes/publicacao_t2s72o5l.pdf >.
 Acesso em 09 Nov 2016.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. **The State of World Fisheries and Aquaculture**. Roma: FAO, 2016. 200 p.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. **Se o atual ritmo de consume continuar, em 2050 mundo precisará de 60% mais alimentos e 40% mais água**. Roma: FAO, 2015 a. Disponível em: <
<https://nacoesunidas.org/fao-se-o-atual-ritmo-de-consumo-continuar-em-2050-mundo-precisara-de-60-mais-alimentos-e-40-mais-agua/>>. Acesso em 21 de out 2017.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. 2050: A escassez de água em várias partes do mundo ameaça a segurança alimentar e os meios de subsistência, 2018. Disponível em:

<<http://www.fao.org/news/story/pt/item/283456/icode/>>. Acesso em: 13 de out de 2017.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. **Towards a water and food secure future. Critical perspectives for policy-makers.** Roma: FAO, 2015. 76 p.

FREIBAUER, A., MATHIJS, E., BRUNORI, G., DAMIANOVA, Z., FAROULT, E., GOMIS, J.G., TREYER, S., 2011. Sustainable Food Consumption and Production in a Resource-constrained World, **Retrieved from**. Disponível em: <http://ec.europa.eu/research/agriculture/scar/pdf/scar_feg3_final_report_01_02_2011.pdf> Acesso em: 24 de outubro de 2017.

HIEN, P.G.; OANH, L.T.K.; VIET, N.T.; LETTINGA, G.. Closed wastewater system in the tapioca industry in Vietnam. **Water Sci. Technol.**, v. 39, i. 5, p. 89-96, 1999.

JUSKAITÈ-NORBUTIENÈ, R.; MILIUTÈ, J.; CESNAITIS, R. Bio-degradable waste and by-products from food industry management systems in Lithuania: analysis, problems and improvement possibilities. **Environmental Research, Engineering and Management**, v. 4, n. 42, p. 60-69, 2007.

KUBITZA, F. **A Evolução da Tilapicultura no Brasil:** produção e mercado. Panorama da Aquicultura, v. 13, n. 76, p. 25 – 35, 2003. Disponível em: <<http://www.panoramadaaquicultura.com.br/paginas/revistas/76/tilapicultura.asp>> Acesso em 27 out 2016.

KUBITZA, F.; KUBITZA, L. M. M. **Tilápias:** qualidade da água, sistemas de cultivo, planejamento da produção, manejo nutricional e alimentar e sanidade. Parte1, 2016. Disponível em: <<http://www.panoramadaaquicultura.com.br/paginas/revistas/59/Tilapias59.asp>>. Acesso em 11 out 2016.

KUBITZA, F. **Os caminhos para uma piscicultura sustentável**. Panorama da Aquicultura, v. 20, n. 119, p. 1 – 9, 2010. Disponível em: <http://www.acquaimagem.com.br/docs/Pan119_Kubitza.pdf> Acesso em 21 out 2017.

KRUMMER, A. C. B.; ANDRADE, L.; GOMES, S. D.; FAZOLO, A.; HASAN, S. D. M.; MACHADO, F. Tratamento de efluente de abatedouro de tilápia com adição de manipueira na fase anóxica. **Engenharia Agrícola**, v. 31, n. 1, p. 150 – 157, 2011.

LEM, A.; BJORNDAL, T.; LAPPO, A. Economic analysis of supply and demand for food up to 2030 – special focus on fish and fishery products. **Fisheries and Aquaculture Circular** number 1089. Rome: Food and Agriculture Organization, 2014.

LUIZ, D. B. Gerenciamento Hídrico em Frigoríficos. 2007. 114f. Dissertação (Mestrado em Engenharia Química). Universidade Federal de Santa Catarina, Florianópolis

MALTA, C.; PRESTES, C. A commodity do século 21. **Amanhã**, São Paulo, p. 42-53, jan. 1997.

MASSOUD, M. A.; FAYARD, R.; EL-FADEL, M.; DRIVERS, R. K. Barriers and incentives to implementing environmental management systems in the food industry: A case of Lebanon. **Journal of Cleaner Production**, v. 18, n. 3, p. 200-209, 2010.

MEDEIROS, F (Coord.). Anuário Brasileiro da Piscicultura Peixe Br, 71p., 2018.

METCALF, L.; EDDY, H. P. Tratamento de efluentes e recuperação de recursos. McGraw Hill Brasil, 2015.

MURPHY, N. Meat Processing Environmental Impacts: Environmental Impacts from Meat and Fish Processing. *Waste Reduction Resource Center*, 2006. Disponível em: <http://e4r4.tetradyn.com/chem-bio-med-health-docmts/IDLH-toxic-chemicals/industry-emission-exposure/air-emissions-meta-fish-processing-industry.htm>. Acesso: 06 Jul 2011.

ONU (Organizações das Nações Unidas). Objetivos de Desenvolvimento Sustentável - Transformando nosso mundo: A agenda 2030 para o desenvolvimento sustentável. p. 49, 2015. Disponível em: <https://nacoesunidas.org/wp-content/uploads/2015/10/agenda2030-pt-br.pdf> Acesso em: 19 de jun de 2017.

OSTRENSKY, A.; BORGHETTI, J. R.; SOTO, D. Aquicultura no Brasil: o desafio é crescer. Brasília, 2008. 276 p.

PACHECO, J.W.; Guia técnico ambiental de frigoríficos industrialização de carnes (bovina e suína) – Série P+L. 85p. São Paulo: CETESB, 2006. Disponível em: <http://www.cetesb.sp.gov.br>. Acessado em: 02 de jan. 2017.

PRODUÇÃO e tecnologias limpas. Disponível em: <http://www.fiec.org.br/iel/bolsaderesiduos/Artigos/Produ%C3%A7%C3%A3o%20e%20Tecnologias%20Limpas.pdf>. Acesso em: 24 nov. 2009.

RAMJEAWON, T. Cleaner production in Mauritian cane-sugar factories. **Journal of Cleaner Production**, v. 8, n. 6, p. 503–510, 2000.

RODRIGUES, A. P. O.; LIMA, A. F.; ALVES, A. L.; ROSA, D. K.; TORATI, L. S.; SANTOS, V. R. V. (Eds.). **Piscicultura de água doce**: multiplicando conhecimentos. Brasília: Embrapa, 2013. 440 p.

SÁNCHEZ, I.M.R.; Ruiz, J.M.M.; López, J.L.C.; Pérez, J.A.S. Effect of environmental regulation on the profitability of sustainable water use in the agro-food industry. **Desalination**, v. 279, n. 1-3, p. 252-257, 2011.

SÃO PAULO. Decreto nº 50.667 de 30 de março de 2006. Regulamento dispositivos da lei nº 12.183 de 29 de dez de 2005. Disponível em< http://arquivos.ana.gov.br/institucional/sag/CobrancaUso/Agencias/Leis/DOU-31-mar_decreto-50667-06_SP.pdf> Acesso em: 23 de jan 2018.

SÃO PAULO. Lei nº 12.183 de 29 de dezembro de 2006. Dispõe sobre a cobrança pela utilização dos recursos hídricos do domínio do estado de São Paulo, os procedimentos para fixação dos seus limites, condicionantes e valores. Disponível em< <https://www.al.sp.gov.br/repositorio/legislacao/lei/2005/lei-12183-29.12.2005.html>> Acesso em: 01 set de 2017

SÃO PAULO. Decreto nº 8.468 de 8 de setembro de 1976. Dispõe sobre a prevenção e controle da poluição do meio ambiente. Disponível em< http://licenciamento.cetesb.sp.gov.br/Servicos/licenciamento/postos/legislacao/Decreto_Estadual_8468_76.pdf> Acesso em: 11 abril de 2017

SARTORI, A.G.O.; AMANCIO, R.D., Pescado: importância nutricional e consumo no Brasil. **Revista Segurança Alimentar e Nutricional**, v.2, p.83-93, 2012.

SAUTCHÜK, Carla Araújo; LANDI, Fernando Del Nero; MIERZWA, José Carlos; VIVACQUA, Maria Carolina Rivoir; SILVA, Maurício Costa Cabral da; LANDI, Paula Del Nero; SCHMIDT, William. **Conservação e Reúso de água: Manual de orientações para o setor industrial**. Federação e Centro das Indústrias do Estado de São Paulo – Fiesp/Ciesp, v. 1, 2005.

SCORVO FILHO, J. D.; FRASCÁ-SCORVO, C. M. D.; ALVES, J. M. C.; SOUZA, F. R. A. A tilapicultura e seus insumos, relações econômicas. **Revista Brasileira de Zootecnia**, v. 39, p. 112 -118, 2010.

SILVA, F.V.; ALMEIDA, N.L.S; VIEIRA, J.S.; TESSITORE, A.J.A.; OLIVEIRA, L.L.S.; SARAIVA, E.P. 2009. Características morfométricas, rendimentos de carcaça, filé, vísceras e resíduos em tilápias do nilo em diferentes faixas de peso. **Revista Brasileira de Zootecnia**, v. 38, n. 8, p. 1407-1412, 2009.

SIMÕES, M. R.; RIBEIRO, C. F. A.; RIBEIRO, S. C. A.; PARK, K. J.; MURR, F. E. X. Composição físico-química, microbiológica e rendimento do filé de tilápia tailandesa (*Oreochromis niloticus*). **Ciência Tecnologia de Alimentos**, v.27, n.3, p.608-613, 2007.

SOUZA, M. R.; SILVA, R. J. **A geração de resíduos industriais e sua destinação final**. Disponível em: <www.abepro.org.br/biblioteca/ENEGEP1997_T6501.PDF>. Acesso em: 04 Maio 2009.

THRANE, M., et al. Cleaner production in Danish fish processing – experiences, status and possible future strategies. *Journal of Cleaner Production*, v. 17, p. 380-390, 2009.

WWDR, Água para um mundo sustentável - Relatório Mundial das Nações Unidas sobre Desenvolvimento dos Recursos Hídricos, 2015.

UTTAMANGKABOVORN, M.; POONSUK, P.; ARAN, H. K. Water conservation in canned tuna (pet food) plant in Thailand. **Journal of Cleaner Production**, v.13, p. 547-555, 2005.

VISVANATHAN, C. & ASANO, T. The potential for industrial wastewater reuse. In: VIGNESWARAN, S. **Wastewater recycle, reuse and reclamation**. v. 1. Oxford: Eolss, 2009.

APÊNDICE B – NORMAS PARA ENVIO DO ARTIGO À REVISTA JOURNAL OF CLEANER PRODUCTION

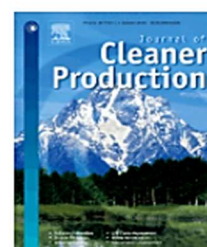


JOURNAL OF CLEANER PRODUCTION

AUTHOR INFORMATION PACK

TABLE OF CONTENTS

• Description	p.1
• Audience	p.1
• Impact Factor	p.1
• Abstracting and Indexing	p.2
• Editorial Board	p.2
• Guide for Authors	p.7



ISSN: 0959-6526

DESCRIPTION

The *Journal of Cleaner Production* is an international, transdisciplinary journal focusing on Cleaner Production, Environmental, and Sustainability research and practice. Through our published articles, we aim at helping societies become more sustainable.

'Cleaner Production' is a concept that aims at preventing the production of waste, while increasing efficiencies in the uses of energy, water, resources, and human capital.

The *Journal of Cleaner Production* serves as a platform for addressing and discussing theoretical and practical cleaner production, encompassing environmental, and sustainability issues in corporations, governments, education institutions, regions, and societies.

Subject areas include, but are not limited to: Cleaner production and technical processes Sustainable Development and Sustainability Sustainable Consumption Environmental and sustainability assessment Sustainable Products and Services Corporate sustainability and Corporate Social Responsibility Education for Sustainable Development Governance, legislation, and policy for sustainability

For a full list of topics, please have a look [here](#).

AUDIENCE

a. Managers, engineers, designers in all the process and service industries; b. Academic and research scientists specializing in cleaner production, regional sustainability, and education for sustainable development; c. Consultants, regulatory leaders, policy makers, planners and NGOs.

IMPACT FACTOR

2017: 5.651 © Clarivate Analytics Journal Citation Reports 2018

ABSTRACTING AND INDEXING

Geographical Abstracts
Engineering Village - GEOBASE
Fluid Abstracts
FLUIDEX
Scopus
Science Citation Index Expanded

EDITORIAL BOARD

Co-Editors-in-Chief

Jiří Jaromír Klemesš, Brno University of Technology (VUT Brno), Brno, Czech Republic

Cleaner Production and Technical Processes; Green/sustainable engineering; Green/sustainable supply chains; Biomass; Energy use and consumption; Waste minimisation; Pollution reduction; Renewable energy; Environmental assessment; Energy/exergy analyses; LCA of product and process - Footprints and other assessment types; Supply chains (modelling, mathematical, and engineering); Eco-industrial parks; Energy-water nexus

Cecilia Maria Villas Bôas de Almeida, Paulista University, São Paulo, Brazil

Cecilia is the first contact point for Review articles

Yutao Wang, Fudan University, Shanghai, China

Cleaner production; Circular economy; Climate change policy and adaptation; Bio-based industry; Extended producer responsibility; Industrial ecology; Life cycle assessment; Eco-efficiency; Sustainable products and services; Waste management; Ecological management and natural capital; Renewable resource; Environmental behavior; Urban metabolism; Environmental nexus; Energy policy; Sustainable consumption; Sustainable urbanization and Regional sustainability; Education for sustainability

Founder and Editor-in-Chief Emeritus

Don Huisingh, University of Tennessee, Knoxville, Tennessee, USA

Associate Editors

Kathleen Aviso, De La Salle University, Manila, Philippines

Giovanni Baiocchi, University of Maryland, College Park, Maryland, USA

Climate change mitigation; sustainable lifestyles; environmental accounting; environmental economics; sustainable agriculture; industrial ecology; input-output sustainability analyses; trade and environment; alternative consumption patterns; carbon footprints of cities

Enrico Benetto, Luxembourg Institute of Science and Technology (LIST), Esch-sur-Alzette, Luxembourg

Life cycle assessment, computational sustainability; uncertainty analysis; energy; network analysis; circular economy; smart city; green finance; eco-design; agent based modelling

Nicole D. Berge, University of South Carolina, Columbia, South Carolina, USA

Municipal solid waste; sustainable waste conversion; landfills; hydrothermal carbonization; nanomaterials; resource recovery; leachate; life cycle assessment; waste degradation; fate and transport

Giorgio Besagni, Ricerca sul Sistema Energetico - RSE S.p.A., Milan, Italy

Energy efficiency; Computational Fluid Dynamics, Energy Poverty; Multiphase flows; Energy system analysis; Ejector and refrigeration technology; Rational use of energy, Energy storage; Renewable energy; Energy use and consumption

Jun Bi, Nanjing University, Nanjing, China

environmental policy, environmental risk management, environmental health, environmental governance, environmental behavior, low carbon development, air pollution, watershed management, enterprise environmental management, EHS (environment, health & safety)

Sandra Caeiro, Universidade Aberta, Lisbon, Portugal

Coastal Zone Management; Marine protected areas; Coastal issues (i.e. beaches, dredging, natural disasters, hazards management, pollution, etc.)

Bin Chen, Beijing Normal University, Beijing, China

Environmental and ecological management; Environmental nexus; Energy economics; Thermoeconomics; Urban metabolism; Systems ecology

Charbel Jose Chiappetta Jabbour, Montpellier Business School, Montpellier, France

Change management for sustainability; environmental training and awareness; human aspects of cleaner production; green human resource management; sustainable human resource management; corporate social responsibility; corporate environmental management.

Kannan Govindan, University of Southern Denmark, Odense M, Denmark

Sustainable Supply Chain Management, Sustainable Operations Management, Green Supply Chain Management, Reverse Logistics, Closed Loop Supply Chain, Corporate Social Responsibility, Corporate Sustainability, Sustainable Consumption and Production, Extended Producer Responsibility, Optimizations Methods, Decision Analysis, Multi Attribute Decision Making methods (Multi Criteria Decision Making and Multi Objective Decision Making), Analytical Modelling, Fuzzy and Grey Set Theory

Baoshan Huang, University of Tennessee, Knoxville, Tennessee, USA

Sustainable Geo/Transportation Infrastructure – Multi-Scale Characterization and Modeling of Infrastructure Materials; Innovative Technologies Supporting Sustainable and Environmentally Friendly Subsurface Infrastructure Systems

Mingzhou Jin, University of Tennessee – Knoxville, Knoxville, Tennessee, USA

Advanced and Sustainable Manufacturing; Green Supply Chain; Sustainable Operations; Energy Efficiency; Optimization; Remanufacturing; Environmental Policy; Life Cycle Assessment

Jin-Kuk Kim, Hanyang University, Seoul, The Republic of Korea

Environmental process modeling and simulation; Process systems engineering; Energy system analysis; Techno-economic analysis; Process optimization; CO₂ capture and utilization; Water minimization; Natural gas processing; Industrial energy saving; Waste heat recovery

Chew Tin Lee, Universiti Teknologi Malaysia, Skudai, Johor, Malaysia

Organic waste management; Composting; LCA of products and processes; Waste treatment technology; Wastewater treatment; Environmental assessment; Waste to energy; Low-carbon emissions policy; Socio-economic impacts; Greenhouse gas mitigation

Zhen Leng, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

Sustainable infrastructure; Environment-friendly construction materials; Clean infrastructure construction technologies; Green pavement material and technologies; Life cycle assessment; Eco-efficiency analysis; Value-added waste recycling; Nondestructive evaluation of transportation infrastructure

Mattias Lindahl, Linköping Universitet, Linköping, Sweden

Ecodesign (Environmentally Conscious Design, Design for Environment (DfE)); Sustainable Business Models; Circular Economy; Sustainable Consumption; Product Development; Engineering Design Methods; Product-Service Systems (PSS); Integrated Product and Service Engineering (IPSE); Service Engineering

Zhifu Mi, University College London (UCL), London, England, UK

Climate change economics; energy policy; air pollution; green economy; carbon footprint; low carbon; econometrics; optimization model; input output analysis; integrated assessment model

Maria Theresa (Maite) Moreira Vilar, Universidade de Santiago de Compostela, Santiago de Compostela, Spain

Biochemical Engineering, Enzyme Reactors, Wastewater Treatment, Environmental Management, Life Cycle Assessment, Carbon Footprint, Eco-design, Eco-efficiency

Tomás Ramos, Universidade Nova de Lisboa (Lisbon), Caparica, Portugal

Sustainability Assessment and Indicators, Sustainability Reporting, Strategic Environmental Assessment and Planning, Environmental Impact Assessment, Stakeholder Engagement, Organisational Sustainability, Environmental Management, Green Jobs

Tomohiko Sakao, Linköping Universitet, Linköping, Sweden

Ecodesign (environmentally conscious design); Engineering design methods; Life Cycle Engineering; Life Cycle Management; Product-Service System (PSS); Circular Economy; Sustainable Consumption and Production; Computer support; Intelligent machines

Panos Seferlis, Aristotle University of Thessaloniki, Thessaloniki, Greece

Process design, Process optimization, Energy efficiency, Mathematical modeling, Automatic control, Sustainable process design, Energy conversion systems, Renewable energy systems, Emission reduction, Energy and water integration

Lei Shi, Tsinghua University, China

Industrial ecology, industrial complexity, complex network, complex systems, industrial ecosystem, industrial symbiosis, industrial metabolism, eco-innovation, circular economy, process systems engineering, cleaner production in developing countries

Vladimir Strezov, Macquarie University, New South Wales, Australia

sustainable energy, environmental engineering, chemical engineering, mineral processing, life cycle analysis, sustainability assessment, pollution control, waste management, environmental impact assessment, industrial ecology

Xin Tong, Peking University, Beijing, China

Extended Producer Responsibility; Sustainable consumption and production; Industrial ecology; Sustainable behaviour studies; Green supply chain; Spatial analysis; Global production network; Rural-urban transition; Technological transition; Urban and regional planning

Zheming Tong, Zhejiang University, Zhejiang, China

Air Pollution; Sustainable building; Built environment; Urban Physics; Urban vegetation; Traffic emission; Cabin environmental quality; Emission control; Computational Fluid Dynamics (CFD); Sustainable manufacturing

Krzysztof Urbaniec, Warsaw University of Technology, Plock, Poland

Innovation for sustainability; Energy efficiency; Hydrogen technology; Biotechnology

Sharifah Rafidah Wan Alwi, Universiti Teknologi Malaysia, Johor, Malaysia

process systems engineering, water, energy, Pinch Technology, Optimisation, Industrial applications

International Editorial Board

José Francisco Armendáriz López, Universidad Autónoma de Baja California, Mexicali, Mexico

Low energy in Buildings; Energy policies; Renewable energy systems; Photovoltaic systems; Solar thermal systems; Life cycle assessment; Natural ventilation; Climate change; Sustainability; Low carbon economy

Nicholas Ashford, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA

Lucie Bartoňová, VSB-Technical University of Ostrava, Ostrava, Czech Republic

Coal combustion; Unburned carbon; Yttrium; Arsenic; Desulphurization additives; Heavy metals; Emissions; Coal geochemistry; Sequential leaching; Adsorption

Rupert Baumgartner, Karl-Franzens-Universität Graz, Graz, Austria

Vincent Blok, Wageningen Universiteit, Wageningen, Netherlands

Syed Awais Ali Shah Bokhari, Universiti Teknologi PETRONAS, Perak, Malaysia

Biofuel production; Cleaner process development; Intensification technologies; Hydrodynamic cavitation; Ultrasonics; Biomass conversion; Energy; Sustainable Engineering; Non-edible oils; Biodiesel synthesis

Cassandra Bong Phun Chien, Universiti Teknologi Malaysia, Skudai, Johor, Malaysia

Organic waste management; Anaerobic digestion; Composting; Modelling & Kinetics; GHG; Biomass & Bioenergy; Low carbon; Environmental management; Wastewater; Solid waste

Frank Boons, University of Manchester, Manchester, England, UK

Ivan Bozhikin, University of National and World Economy (UNWE), Sofia, Bulgaria

Environmental Fiscal Policy; Sustainable Waste Management; CSR; Circular Economy; Social Entrepreneurship; Environmental Economics; Eco-efficiency; Tools for Corporate Sustainability; Governmental Policy; Economic and Environmental Policy; Sustainable Business Models

Mark Brown, University of Florida, Gainesville, Florida, USA

Laura Bulgariu, Technical University Gheorghe Asachi of Iași, Iași, Romania

Environmental pollution; Environmental bioremediation; Heavy metals pollutants; Biosorption/adsorption; Batch and continuous systems; Low-cost biosorbents/adsorbents; Wastewater treatment; Waste recycling; Valorization of exhausted biosorbents/adsorbents; Ecological fertilizers for soils

Chin Kui Cheng, Universiti Malaysia Pahang (UMP), Pahang, Malaysia

Renewable energy; Wastewater treatment; Sustainable development; Clean energy; Carbon footprint; Water footprint; Biofuel; Waste-to-wealth; Biofuel; Green chemistry

Anthony Chiu, De La Salle University, Manila, Philippines

Kim Christiansen, Dansk Standard, Charlottenlund, Denmark

Xiangzheng Deng, Chinese Academy of Sciences (CAS), Chaoyang District, China

Environmental and Natural Resource Economics; Land Change Science; Agricultural Policy and Sustainable Development; Water Management and Water Footprint; Ecosystem Services and Functions; Urbanization and Global Environment Change; Energy Economics and climate Policy; Sustainability-based Decision Making

Stephen DeVito, US Environmental Protection Agency, Washington, District of Columbia, USA

Pollution prevention; green chemistry; pollutant release and transfer registers; PRTRs; sustainable development

Sandra Duni Ekşioğlu, Clemson University, Clemson, South Carolina, USA

Kai Fang, Zhejiang University, Hangzhou, China

Environmental Footprint Analysis; Carbon Emission Accounting and Allocation; Environmental Sustainability Assessment; Industrial Ecology; Ecological Economics; Input-Output Analysis; Climate Change; Planetary Boundaries

Goran Finnveden, KTH Royal Institute of Technology, Stockholm, Sweden

Johannes Fresner, STENUM Environmental Consultancy and Research Company, Graz, Austria

Resource efficiency; Cleaner production; Cleaner technology; Energy efficiency; Environmental management; Energy management; Environmental sound technology; Chemical engineering; Process

- control; Sectors (metal processing, plastic processing, agroindustries, food, chemicals, wood processing, tourism); Product development; Eco innovation; Circular economy
Shabbir Gheewala, King Mongkut's University of Technology Thonburi, Bangkok, Thailand
 Life cycle assessment, sustainability assessment of energy systems, sustainability indicators, carbon footprint, water footprint, certification issues in biofuels and agro-industry
Biagio F. Giannetti, Paulista University, São Paulo, Brazil
Stefan Gold, Nottingham University Business School, Nottingham, England, UK
Ole Jorgen Hanssen, Stiftelsen Ostfoldforskning, Frederikstad, Norway
James Haselip, Danmarks Tekniske Universitet (DTU), Roskilde, Denmark
Reinout Heijungs, Vrije Universiteit Amsterdam, Amsterdam, Netherlands
Gavin Hilson, University of Surrey, Guildford, Surrey, England, UK
Hesam Kamyab, Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia
 Algal biotechnology; Wastewater treatment; Biomass; Agro waste water; Industrial wastewater treatment; Biofuels; Energy; Environmental Biotechnology; Compost; Self-Healing Concrete
David Kukulka, The State University of New York at Buffalo, Buffalo, New York, USA
Feng Li, Chinese Academy of Sciences (CAS), Beijing, China
 urban ecology, ecosystem services, urban land-use change, ecological infrastructure, ecological planning and management
Jeng Shiun Lim, Universiti Teknologi Malaysia, Johor Bahru, Malaysia
 Process systems engineering for resource conservation; Renewable energy; Carbon planning
Gang Liu, University of Southern Denmark, Odense, Denmark
 Material, substance, and energy flow analysis; Life cycle sustainability assessment; Urban metabolism; Industrial Ecology; Circular economy; Sustainable resource and waste management; Built environment stocks; Prospective modelling; Climate change mitigation; Linkages of sustainability
Yang Liu, University of Vaasa, Vaasa, Finland
Zhi-Yong Liu, Hebei University of Technology, Tianjin, China
 Wastewater minimization, debottlenecking of distillation columns, energy saving, applied thermodynamics, and simulation and optimization of chemical processes
Conrad Luttrupp, KTH Royal Institute of Technology, Stockholm, Sweden
Thokozani Majozi, University of the Witwatersrand, WITS, South Africa
 Optimization; Batch processes; Water minimization; Energy optimization; Scheduling, Synthesis and Design of batch plants
Jing Meng, University of Cambridge, Cambridge, England, UK
 Air pollution modeling; Low carbon manufacturing; Energy policy; Climate policy; Carbon footprint; Input output analysis; Learning curve
Sandro Nizetić, University of Split, Split, Croatia
 Clean Energy & Sustainable Engineering; Energy Efficiency; Mechanical Engineering; Thermodynamics & Fluid Mechanics; Energy and Exergy Analysis; Renewable Energy; Heating and Cooling; Energy Economics; Energy Savings; Energy use and integration
Michael Overcash
Yuanbo Qiao, Shandong University, Qingdao, China
 Sustainable development; Environmental economics; Eco-innovation; Environmental management; Environmental policy; Econometrics; Efficiency assessment; Land economics; Defense economics; Merger and acquisition
Jaco Quist, Delft University of Technology, Delft, Netherlands
 Sustainable Production and Consumption (SPC); Industrial Ecology; Circular Economy; Renewable Energy; Climate Adaptation; Urban Agriculture and Food
Darrel Reeve, Cleaner Production Australia, Eltham, Victoria, Australia
Matteo V. Rocco, Politecnico di Milano, Milano, Italy
 Exergy analysis; Thermoeconomic analysis; Energy conversion systems; Life Cycle Assessment; Input-Output analysis; Energy Modeling; Energy resources; Industrial ecology; Computational sustainability; Environmental policy
Hans Schnitzer, Technische Universität Graz, Graz, Austria
 Cleaner Production process intensification, resource and energy efficient technologies process assessment energy concepts, use of renewable resources innovations for urban quality of life with the focus on sustainable urban technologies systematic innovation
Malin Song, Anhui University of Finance and Economics, Anhui Bengbu, China
 Environmental regulation; Environmental efficiency; Sustainable development; Big data analysis
Mingxing Sun, Tsinghua University, Beijing, China
 Life cycle assessment (LCA); Material flow analysis (MFA); Cleaner production; Circular economy; Environmental policy; Extended producer responsibility (EPR); Bio-industry; Pulp and paper; Eco-efficiency; Waste management.

Renzhong Tang, Zhejiang University, Hangzhou, China
Susan Thorneloe, U.S. Environmental Protection Agency (EPA), Research Triangle Park, North Carolina, USA
 LCS, WM planning
Andrea Trianni, University of Technology Sydney, Ultimo, New South Wales, Australia
Arnold Tukker, Leiden University, Leiden, Netherlands
Sergio Ulgiati, Università degli Studi di Napoli Parthenope, Napoli, Italy
Venkata Krishna Kumar Upadhyayula, U.S. Environmental Protection Agency (EPA), Cincinnati, Ohio, USA
Bart van Hoof, Universidad de Los Andes, Bogotá, Colombia
Petar S. Varbanov, Brno University of Technology (VUT Brno), Brno, Czech Republic
Philip Vergragt, Tellus Institute, Boston, Massachusetts, USA
Harro von Blottnitz, University of Cape Town, Cape Town, South Africa
Mathis Wackernagel, Global Footprint Network, Oakland, California, USA
Timothy Walmsley, Brno University of Technology (VUT Brno), Brno, Czech Republic
 Process Integration including process modelling, optimisation and design; industrial energy efficiency, waste heat recovery, waste-to-energy; macro energy systems modelling, Footprint assessment and sustainability
Zhaohua Wang, Beijing Institute of Technology, Beijing, China
 Energy Economics and Policy; CO₂ Emission and Climate Change; Sustainable Production and Consumption; Big Data and Behavior
Yingfeng Zhang, Northwestern Polytechnical University, Xi'an, China
Yue-Jun Zhang, Hunan University, Changsha, China
 Carbon emission reduction; Low-carbon policy evaluation; Energy economics; Energy price; Energy finance; Energy efficiency; Carbon trading mechanisms; Econometrics; Data Envelopment Analysis (DEA); Input output method
Gyula Zilahy, Corvinus University of Budapest, Budapest, Hungary
Jian Zuo, University of Adelaide, Adelaide, South Australia, Australia
 Resource efficiency; Corporate sustainability; Solid waste management; Sustainable higher education; Green building; Stakeholder engagement; Renewable energy in buildings; Behavioural change; Social sustainability; Indoor environmental quality

Expanded Editorial Board

Javier Dufour Andia, Rey Juan Carlos University, Spain
 sustainability, life cycle assessment (LCA), life cycle sustainability assessment (LSCA), process optimization, energy modelling, bioenergy, biofuels, electricity, hydrogen, energy systems
Yee Van Fan, Brno University of Technology (VUT Brno), Brno, Czech Republic
 Solid waste treatment and management; Composting; Waste to energy; Emissions assessment and mitigation; Transportation Mode Choice; Life Cycle Assessment; Footprint and sustainability assessment; Biomass
Xavier Gabarrell Durany, Universitat Autònoma de Barcelona (UAB), Barcelona, Spain
 industrial ecology, ecodesign, circular economy, LCA, MFA, waste management, water management, energy-water-food nexus, regions and urban sustainable transformation
Xuexiu Jia, Brno University of Technology (VUT Brno), Brno, Czech Republic
 Water footprint; Water-energy-food nexus; GHG/carbon emissions; Economics and environmental management
Feng Li, Chinese Academy of Sciences (CAS), Beijing, China
 urban ecology, ecosystem services, urban land-use change, ecological infrastructure, ecological planning and management
Guozhu Mao, Tianjin University, Tianjin, China
 Environmental planning, cleaner production audit, industry ecology, infrastructure ecology, life cycle assessment, green building, circular economy, low carbon economy, alternative energy, CO₂ emissions
Shen Qu, University of Michigan, Ann Arbor, Michigan, USA
 Trade and the environment; Urban food-water-energy nexus; Water risk; Sustainable production and consumption
Joan Rieradevall Pons, Universitat Autònoma de Barcelona (UAB), Bellaterra, Spain
 Agourban, Sustainability cites, Life cycle assessment, Eco-design, Eco innovation services, Prevention and recycling of waste, Industrial Ecology, Rainwater, Biomass and Smart cities
Yi Yang, University of Minnesota, Minneapolis, Minnesota, USA

GUIDE FOR AUTHORS

Types of paper

The following types of contribution are published in *The Journal of Cleaner Production*:

Original article: Standard research papers of 6000–8000 words in length, with tables, illustrations and references, in which hypotheses are tested and results reported.

Review article: Review papers provide an extensive overview of recent developments in specific areas that fall within the scope of the journal. They are expected to have an extensive literature review followed by an in-depth analysis of the state of the art, and identify challenges for future research. Review articles are usually up to 12,000 words and must include a Methods section explaining how the literature for review was selected.

Technical note: Concise scientific summaries/reports of approximately 500 words of new products/technologies of relevance to the field of cleaner production. Illustrations may be included but not company logos.

Conference Reports: Reports on major international conferences of particular interest to The Journal of Cleaner Production, approximately 1000–2000 words.

Book Reviews: Reviews of approximately 500–1000 words on new books, software and videos relevant to the scope of The Journal of Cleaner Production.

Letters to the Editor: Letters designed to clarify or respond to the content of a paper previously published in the Journal or to raise questions about future directions of The Journal of Cleaner Production or other issues that a reader may wish to pose that are relevant to the mandate of the Journal.

Special Issue Proposal: Anyone who wishes to propose or coordinate a Special Issue of The Journal of Cleaner Production is invited to contact the Executive Editor, Dr. Yutao Wang (wang_yutao@hotmail.com).

Contact details for submission

Questions or Suggestions to the Editor-in-Chief: Anyone who wishes to pose questions, make suggestions or to propose to coordinate the development of a Special Issue of *The Journal of Cleaner Production* is invited to contact the Editor-in-Chief of the Journal, Prof. Donald Huisingh at the University of Tennessee: donalduisingh@comcast.net .

BEFORE YOU BEGIN

Ethics in publishing

Authors have a responsibility to present their work with the intellectual integrity that the scientific community expects. Before submitting a paper for consideration authors should familiarize themselves with the [Ethics Toolkit](#). Authors should ensure that they have written entirely original works, and if they have used the work and/or words of others, these should be appropriately cited or quoted. Authors should not concurrently submit a paper to more than one journal or primary publication, and should not submit a previously published paper for consideration.

For information on Ethics in publishing and Ethical guidelines for journal publication see <http://www.elsevier.com/publishingethics> and <http://www.elsevier.com/journal-authors/ethics>.

Declaration of interest

All authors must disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work. Examples of potential competing interests include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding. Authors must disclose any interests in two places: 1. A summary declaration of interest statement in the title page file (if double-blind) or the manuscript file (if single-blind). If there are no interests to declare then please state this: 'Declarations of interest: none'. This summary statement will be ultimately published if the article is accepted.

2. Detailed disclosures as part of a separate Declaration of Interest form, which forms part of the journal's official records. It is important for potential interests to be declared in both places and that the information matches. [More information.](#)

Submission declaration and verification

Submission of an article implies that the work described has not been published previously (except in the form of an abstract, a published lecture or academic thesis, see '[Multiple, redundant or concurrent publication](#)' for more information), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. To verify originality, your article may be checked by the originality detection service [Crossref Similarity Check](#).

Preprints

Please note that [preprints](#) can be shared anywhere at any time, in line with Elsevier's [sharing policy](#). Sharing your preprints e.g. on a preprint server will not count as prior publication (see '[Multiple, redundant or concurrent publication](#)' for more information).

Changes to authorship

Authors are expected to consider carefully the list and order of authors **before** submitting their manuscript and provide the definitive list of authors at the time of the original submission. Any addition, deletion or rearrangement of author names in the authorship list should be made only **before** the manuscript has been accepted and only if approved by the journal Editor. To request such a change, the Editor must receive the following from the **corresponding author**: (a) the reason for the change in author list and (b) written confirmation (e-mail, letter) from all authors that they agree with the addition, removal or rearrangement. In the case of addition or removal of authors, this includes confirmation from the author being added or removed.

Only in exceptional circumstances will the Editor consider the addition, deletion or rearrangement of authors **after** the manuscript has been accepted. While the Editor considers the request, publication of the manuscript will be suspended. If the manuscript has already been published in an online issue, any requests approved by the Editor will result in a corrigendum.

Article transfer service

This journal is part of our Article Transfer Service. This means that if the Editor feels your article is more suitable in one of our other participating journals, then you may be asked to consider transferring the article to one of those. If you agree, your article will be transferred automatically on your behalf with no need to reformat. Please note that your article will be reviewed again by the new journal. [More information.](#)

Copyright

Upon acceptance of an article, authors will be asked to complete a 'Journal Publishing Agreement' (see [more information](#) on this). An e-mail will be sent to the corresponding author confirming receipt of the manuscript together with a 'Journal Publishing Agreement' form or a link to the online version of this agreement.

Subscribers may reproduce tables of contents or prepare lists of articles including abstracts for internal circulation within their institutions. [Permission](#) of the Publisher is required for resale or distribution outside the institution and for all other derivative works, including compilations and translations. If excerpts from other copyrighted works are included, the author(s) must obtain written permission from the copyright owners and credit the source(s) in the article. Elsevier has [preprinted forms](#) for use by authors in these cases.

For gold open access articles: Upon acceptance of an article, authors will be asked to complete an 'Exclusive License Agreement' ([more information](#)). Permitted third party reuse of gold open access articles is determined by the author's choice of [user license](#).

Author rights

As an author you (or your employer or institution) have certain rights to reuse your work. [More information.](#)

Elsevier supports responsible sharing

Find out how you can [share your research](#) published in Elsevier journals.

Role of the funding source

You are requested to identify who provided financial support for the conduct of the research and/or preparation of the article and to briefly describe the role of the sponsor(s), if any, in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. If the funding source(s) had no such involvement then this should be stated.

Funding body agreements and policies

Elsevier has established a number of agreements with funding bodies which allow authors to comply with their funder's open access policies. Some funding bodies will reimburse the author for the gold open access publication fee. Details of [existing agreements](#) are available online.

Open access

This journal offers authors a choice in publishing their research:

Subscription

- Articles are made available to subscribers as well as developing countries and patient groups through our [universal access programs](#).
- No open access publication fee payable by authors.
- The Author is entitled to post the [accepted manuscript](#) in their institution's repository and make this public after an embargo period (known as green Open Access). The [published journal article](#) cannot be shared publicly, for example on ResearchGate or Academia.edu, to ensure the sustainability of peer-reviewed research in journal publications. The embargo period for this journal can be found below.

Gold open access

- Articles are freely available to both subscribers and the wider public with permitted reuse.
- A gold open access publication fee is payable by authors or on their behalf, e.g. by their research funder or institution.

Regardless of how you choose to publish your article, the journal will apply the same peer review criteria and acceptance standards.

For gold open access articles, permitted third party (re)use is defined by the following [Creative Commons user licenses](#):

Creative Commons Attribution (CC BY)

Lets others distribute and copy the article, create extracts, abstracts, and other revised versions, adaptations or derivative works of or from an article (such as a translation), include in a collective work (such as an anthology), text or data mine the article, even for commercial purposes, as long as they credit the author(s), do not represent the author as endorsing their adaptation of the article, and do not modify the article in such a way as to damage the author's honor or reputation.

Creative Commons Attribution-NonCommercial-NoDerivs (CC BY-NC-ND)

For non-commercial purposes, lets others distribute and copy the article, and to include in a collective work (such as an anthology), as long as they credit the author(s) and provided they do not alter or modify the article.

The gold open access publication fee for this journal is **USD 4050**, excluding taxes. Learn more about Elsevier's pricing policy: <https://www.elsevier.com/openaccesspricing>.

Green open access

Authors can share their research in a variety of different ways and Elsevier has a number of green open access options available. We recommend authors see our [green open access page](#) for further information. Authors can also self-archive their manuscripts immediately and enable public access from their institution's repository after an embargo period. This is the version that has been accepted for publication and which typically includes author-incorporated changes suggested during submission, peer review and in editor-author communications. Embargo period: For subscription articles, an appropriate amount of time is needed for journals to deliver value to subscribing customers before an article becomes freely available to the public. This is the embargo period and it begins from the date the article is formally published online in its final and fully citable form. [Find out more](#).

This journal has an embargo period of 24 months.

Elsevier Researcher Academy

Researcher Academy is a free e-learning platform designed to support early and mid-career researchers throughout their research journey. The "Learn" environment at Researcher Academy offers several interactive modules, webinars, downloadable guides and resources to guide you through the process of writing for research and going through peer review. Feel free to use these free resources to improve your submission and navigate the publication process with ease.

Language (usage and editing services)

Please write your text in good English (American or British usage is accepted, but not a mixture of these). Authors who feel their English language manuscript may require editing to eliminate possible grammatical or spelling errors and to conform to correct scientific English may wish to use the [English Language Editing service](#) available from Elsevier's WebShop.

Submission

Our online submission system guides you stepwise through the process of entering your article details and uploading your files. The system converts your article files to a single PDF file used in the peer-review process. Editable files (e.g., Word, LaTeX) are required to typeset your article for final publication. All correspondence, including notification of the Editor's decision and requests for revision, is sent by e-mail.

Referees

Please submit, with the manuscript a list of three qualified, independent, prospective reviewers who could perform quality peer reviews of your document. (Include their full names, affiliations and their current E-mail addresses.)

The Journal of Cleaner Production used 'Single-blind' reviewing, where the names of the reviewers are hidden from the Author, but the reviewer knows who the authors are.

PREPARATION

Peer review

This journal operates a single blind review process. All contributions will be initially assessed by the editor for suitability for the journal. Papers deemed suitable are then typically sent to a minimum of one independent expert reviewer to assess the scientific quality of the paper. The Editor is responsible for the final decision regarding acceptance or rejection of articles. The Editor's decision is final. [More information on types of peer review.](#)

Use of word processing software

It is important that the file be saved in the native format of the word processor used. The text should be in single-column format. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. In particular, do not use the word processor's options to justify text or to hyphenate words. However, do use bold face, italics, subscripts, superscripts etc. When preparing tables, if you are using a table grid, use only one grid for each individual table and not a grid for each row. If no grid is used, use tabs, not spaces, to align columns. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the [Guide to Publishing with Elsevier](#)). Note that source files of figures, tables and text graphics will be required whether or not you embed your figures in the text. See also the section on Electronic artwork.

To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

Article structure

Subdivision - numbered sections

Divide your article into clearly defined and numbered sections. Subsections should be numbered 1.1 (then 1.1.1, 1.1.2, ...), 1.2, etc. (the abstract is not included in section numbering). Use this numbering also for internal cross-referencing: do not just refer to 'the text'. Any subsection may be given a brief heading. Each heading should appear on its own separate line.

Introduction

State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Material and methods

Provide sufficient details to allow the work to be reproduced by an independent researcher. Methods that are already published should be summarized, and indicated by a reference. If quoting directly from a previously published method, use quotation marks and also cite the source. Any modifications to existing methods should also be described.

Theory/calculation

A Theory section should extend, not repeat, the background to the article already dealt with in the Introduction and lay the foundation for further work. In contrast, a Calculation section represents a practical development from a theoretical basis.

Results

Results should be clear and concise.

Discussion

This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

Conclusions

The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.

Appendices

If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Essential title page information

- **Title.** Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.
- **Author names and affiliations.** Please clearly indicate the given name(s) and family name(s) of each author and check that all names are accurately spelled. You can add your name between parentheses in your own script behind the English transliteration. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower-case superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address of each author.
- **Corresponding author.** Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. This responsibility includes answering any future queries about Methodology and Materials. **Ensure that the e-mail address is given and that contact details are kept up to date by the corresponding author.**
- **Present/permanent address.** If an author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

Abstract

A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

Graphical abstract

Although a graphical abstract is optional, its use is encouraged as it draws more attention to the online article. The graphical abstract should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide readership. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: Please provide an image with a minimum of 531 × 1328 pixels (h × w) or proportionally more. The image should be readable at a size of 5 × 13 cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. You can view [Example Graphical Abstracts](#) on our information site. Authors can make use of Elsevier's [Illustration Services](#) to ensure the best presentation of their images and in accordance with all technical requirements.

Highlights

Highlights are mandatory for this journal. They consist of a short collection of bullet points that convey the core findings of the article and should be submitted in a separate editable file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point). You can view [example Highlights](#) on our information site.

Keywords

Immediately after the abstract, provide a maximum of 6 keywords, using American spelling and avoiding general and plural terms and multiple concepts (avoid, for example, 'and', 'of'). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes.

Abbreviations

Define abbreviations that are not standard in this field in a footnote to be placed on the first page of the article. Such abbreviations that are unavoidable in the abstract must be defined at their first mention there, as well as in the footnote. Ensure consistency of abbreviations throughout the article.

Acknowledgements

Collate acknowledgements in a separate section at the end of the article before the references and do not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

Formatting of funding sources

List funding sources in this standard way to facilitate compliance to funder's requirements:

Funding: This work was supported by the National Institutes of Health [grant numbers xxxx, yyyy]; the Bill & Melinda Gates Foundation, Seattle, WA [grant number zzzz]; and the United States Institutes of Peace [grant number aaaa].

It is not necessary to include detailed descriptions on the program or type of grants and awards. When funding is from a block grant or other resources available to a university, college, or other research institution, submit the name of the institute or organization that provided the funding.

If no funding has been provided for the research, please include the following sentence:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Math formulae

Please submit math equations as editable text and not as images. Present simple formulae in line with normal text where possible and use the solidus (/) instead of a horizontal line for small fractional terms, e.g., X/Y. In principle, variables are to be presented in italics. Powers of e are often more conveniently denoted by exp. Number consecutively any equations that have to be displayed separately from the text (if referred to explicitly in the text).

Footnotes

Footnotes should be used sparingly. Number them consecutively throughout the article. Many word processors can build footnotes into the text, and this feature may be used. Otherwise, please indicate the position of footnotes in the text and list the footnotes themselves separately at the end of the article. Do not include footnotes in the Reference list.

Artwork

Electronic artwork

General points

- Make sure you use uniform lettering and sizing of your original artwork.
- Embed the used fonts if the application provides that option.
- Aim to use the following fonts in your illustrations: Arial, Courier, Times New Roman, Symbol, or use fonts that look similar.
- Number the illustrations according to their sequence in the text.
- Use a logical naming convention for your artwork files.
- Provide captions to illustrations separately.
- Size the illustrations close to the desired dimensions of the published version.

- Submit each illustration as a separate file.

A detailed [guide on electronic artwork](#) is available.

You are urged to visit this site; some excerpts from the detailed information are given here.

Formats

If your electronic artwork is created in a Microsoft Office application (Word, PowerPoint, Excel) then please supply 'as is' in the native document format.

Regardless of the application used other than Microsoft Office, when your electronic artwork is finalized, please 'Save as' or convert the images to one of the following formats (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below):

EPS (or PDF): Vector drawings, embed all used fonts.

TIFF (or JPEG): Color or grayscale photographs (halftones), keep to a minimum of 300 dpi.

TIFF (or JPEG): Bitmapped (pure black & white pixels) line drawings, keep to a minimum of 1000 dpi.

TIFF (or JPEG): Combinations bitmapped line/half-tone (color or grayscale), keep to a minimum of 500 dpi.

Please do not:

- Supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG); these typically have a low number of pixels and limited set of colors;
- Supply files that are too low in resolution;
- Submit graphics that are disproportionately large for the content.

Color artwork

Please make sure that artwork files are in an acceptable format (TIFF (or JPEG), EPS (or PDF), or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) regardless of whether or not these illustrations are reproduced in color in the printed version. **For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article.** Please indicate your preference for color: in print or online only. [Further information on the preparation of electronic artwork.](#)

Figure captions

Ensure that each illustration has a caption. Supply captions separately, not attached to the figure. A caption should comprise a brief title (**not** on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.

Tables

Please submit tables as editable text and not as images. Tables can be placed either next to the relevant text in the article, or on separate page(s) at the end. Number tables consecutively in accordance with their appearance in the text and place any table notes below the table body. Be sparing in the use of tables and ensure that the data presented in them do not duplicate results described elsewhere in the article. Please avoid using vertical rules and shading in table cells.

References

Citation in text

Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

Reference links

Increased discoverability of research and high quality peer review are ensured by online links to the sources cited. In order to allow us to create links to abstracting and indexing services, such as Scopus, CrossRef and PubMed, please ensure that data provided in the references are correct. Please note that incorrect surnames, journal/book titles, publication year and pagination may prevent link creation. When copying references, please be careful as they may already contain errors. Use of the DOI is highly encouraged.

A DOI is guaranteed never to change, so you can use it as a permanent link to any electronic article. An example of a citation using DOI for an article not yet in an issue is: VanDecar J.C., Russo R.M., James D.E., Ambeh W.B., Franke M. (2003). Aseismic continuation of the Lesser Antilles slab beneath northeastern Venezuela. *Journal of Geophysical Research*, <https://doi.org/10.1029/2001JB000884>. Please note the format of such citations should be in the same style as all other references in the paper.

Web references

As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.

Data references

This journal encourages you to cite underlying or relevant datasets in your manuscript by citing them in your text and including a data reference in your Reference List. Data references should include the following elements: author name(s), dataset title, data repository, version (where available), year, and global persistent identifier. Add [dataset] immediately before the reference so we can properly identify it as a data reference. The [dataset] identifier will not appear in your published article.

References in a special issue

Please ensure that the words 'this issue' are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

Reference management software

Most Elsevier journals have their reference template available in many of the most popular reference management software products. These include all products that support *Citation Style Language* styles, such as Mendeley and Zotero, as well as EndNote. Using the word processor plug-ins from these products, authors only need to select the appropriate journal template when preparing their article, after which citations and bibliographies will be automatically formatted in the journal's style. If no template is yet available for this journal, please follow the format of the sample references and citations as shown in this Guide. If you use reference management software, please ensure that you remove all field codes before submitting the electronic manuscript. [More information on how to remove field codes.](#)

Users of Mendeley Desktop can easily install the reference style for this journal by clicking the following link:

<http://open.mendeley.com/use-citation-style/journal-of-cleaner-production>

When preparing your manuscript, you will then be able to select this style using the Mendeley plug-ins for Microsoft Word or LibreOffice.

Reference formatting

There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the article number or pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct. If you do wish to format the references yourself they should be arranged according to the following examples:

Reference style

Text: All citations in the text should refer to:

1. *Single author:* the author's name (without initials, unless there is ambiguity) and the year of publication;
2. *Two authors:* both authors' names and the year of publication;
3. *Three or more authors:* first author's name followed by 'et al.' and the year of publication.

Citations may be made directly (or parenthetically). Groups of references can be listed either first alphabetically, then chronologically, or vice versa.

Examples: 'as demonstrated (Allan, 2000a, 2000b, 1999; Allan and Jones, 1999).... Or, as demonstrated (Jones, 1999; Allan, 2000)... Kramer et al. (2010) have recently shown ...'

List: References should be arranged first alphabetically and then further sorted chronologically if necessary. More than one reference from the same author(s) in the same year must be identified by the letters 'a', 'b', 'c', etc., placed after the year of publication.

Examples:

Reference to a journal publication:

Van der Geer, J., Hanraads, J.A.J., Lupton, R.A., 2010. The art of writing a scientific article. *J. Sci. Commun.* 163, 51–59. <https://doi.org/10.1016/j.Sc.2010.00372>.

Reference to a journal publication with an article number:

Van der Geer, J., Hanraads, J.A.J., Lupton, R.A., 2018. The art of writing a scientific article. *Heliyon*. 19, e00205. <https://doi.org/10.1016/j.heliyon.2018.e00205>.

Reference to a book:

Strunk Jr., W., White, E.B., 2000. *The Elements of Style*, fourth ed. Longman, New York.

Reference to a chapter in an edited book:

Mettam, G.R., Adams, L.B., 2009. How to prepare an electronic version of your article, in: Jones, B.S., Smith, R.Z. (Eds.), *Introduction to the Electronic Age*. E-Publishing Inc., New York, pp. 281–304.

Reference to a website:

Cancer Research UK, 1975. Cancer statistics reports for the UK. <http://www.cancerresearchuk.org/aboutcancer/statistics/cancerstatsreport/> (accessed 13 March 2003).

Reference to a dataset:

[dataset] Oguro, M., Imahiro, S., Saito, S., Nakashizuka, T., 2015. Mortality data for Japanese oak wilt disease and surrounding forest compositions. *Mendeley Data*, v1. <https://doi.org/10.17632/xwj98nb39r.1>.

Journal abbreviations source

Journal names should be abbreviated according to the [List of Title Word Abbreviations](#).

Video

Elsevier accepts video material and animation sequences to support and enhance your scientific research. Authors who have video or animation files that they wish to submit with their article are strongly encouraged to include links to these within the body of the article. This can be done in the same way as a figure or table by referring to the video or animation content and noting in the body text where it should be placed. All submitted files should be properly labeled so that they directly relate to the video file's content. In order to ensure that your video or animation material is directly usable, please provide the file in one of our recommended file formats with a preferred maximum size of 150 MB per file, 1 GB in total. Video and animation files supplied will be published online in the electronic version of your article in Elsevier Web products, including ScienceDirect. Please supply 'stills' with your files: you can choose any frame from the video or animation or make a separate image. These will be used instead of standard icons and will personalize the link to your video data. For more detailed instructions please visit our [video instruction pages](#). Note: since video and animation cannot be embedded in the print version of the journal, please provide text for both the electronic and the print version for the portions of the article that refer to this content.

AudioSlides

The journal encourages authors to create an AudioSlides presentation with their published article. AudioSlides are brief, webinar-style presentations that are shown next to the online article on ScienceDirect. This gives authors the opportunity to summarize their research in their own words and to help readers understand what the paper is about. [More information and examples are available](#). Authors of this journal will automatically receive an invitation e-mail to create an AudioSlides presentation after acceptance of their paper.

Data visualization

Include interactive data visualizations in your publication and let your readers interact and engage more closely with your research. Follow the instructions [here](#) to find out about available data visualization options and how to include them with your article.

Supplementary material

Supplementary material such as applications, images and sound clips, can be published with your article to enhance it. Submitted supplementary items are published exactly as they are received (Excel or PowerPoint files will appear as such online). Please submit your material together with the article and supply a concise, descriptive caption for each supplementary file. If you wish to make changes to supplementary material during any stage of the process, please make sure to provide an updated file. Do not annotate any corrections on a previous version. Please switch off the 'Track Changes' option in Microsoft Office files as these will appear in the published version.

Research data

This journal encourages and enables you to share data that supports your research publication where appropriate, and enables you to interlink the data with your published articles. Research data refers to the results of observations or experimentation that validate research findings. To facilitate reproducibility and data reuse, this journal also encourages you to share your software, code, models, algorithms, protocols, methods and other useful materials related to the project.

Below are a number of ways in which you can associate data with your article or make a statement about the availability of your data when submitting your manuscript. If you are sharing data in one of these ways, you are encouraged to cite the data in your manuscript and reference list. Please refer to the "References" section for more information about data citation. For more information on depositing, sharing and using research data and other relevant research materials, visit the [research data](#) page.

Data linking

If you have made your research data available in a data repository, you can link your article directly to the dataset. Elsevier collaborates with a number of repositories to link articles on ScienceDirect with relevant repositories, giving readers access to underlying data that gives them a better understanding of the research described.

There are different ways to link your datasets to your article. When available, you can directly link your dataset to your article by providing the relevant information in the submission system. For more information, visit the [database linking](#) page.

For [supported data repositories](#) a repository banner will automatically appear next to your published article on ScienceDirect.

In addition, you can link to relevant data or entities through identifiers within the text of your manuscript, using the following format: Database: xxxx (e.g., TAIR: AT1G01020; CCDC: 734053; PDB: 1XFN).

Mendeley Data

This journal supports Mendeley Data, enabling you to deposit any research data (including raw and processed data, video, code, software, algorithms, protocols, and methods) associated with your manuscript in a free-to-use, open access repository. Before submitting your article, you can deposit the relevant datasets to *Mendeley Data*. Please include the DOI of the deposited dataset(s) in your main manuscript file. The datasets will be listed and directly accessible to readers next to your published article online.

For more information, visit the [Mendeley Data for journals](#) page.

Data in Brief

You have the option of converting any or all parts of your supplementary or additional raw data into one or multiple data articles, a new kind of article that houses and describes your data. Data articles ensure that your data is actively reviewed, curated, formatted, indexed, given a DOI and publicly available to all upon publication. You are encouraged to submit your article for *Data in Brief* as an additional item directly alongside the revised version of your manuscript. If your research article is accepted, your data article will automatically be transferred over to *Data in Brief* where it will be editorially reviewed and published in the open access data journal, *Data in Brief*. Please note an open access fee of 500 USD is payable for publication in *Data in Brief*. Full details can be found on the [Data in Brief website](#). Please use [this template](#) to write your Data in Brief.

MethodsX

You have the option of converting relevant protocols and methods into one or multiple MethodsX articles, a new kind of article that describes the details of customized research methods. Many researchers spend a significant amount of time on developing methods to fit their specific needs or setting, but often without getting credit for this part of their work. MethodsX, an open access journal, now publishes this information in order to make it searchable, peer reviewed, citable and reproducible. Authors are encouraged to submit their MethodsX article as an additional item directly alongside the revised version of their manuscript. If your research article is accepted, your methods article will automatically be transferred over to MethodsX where it will be editorially reviewed. Please note an open access fee is payable for publication in MethodsX. Full details can be found on the [MethodsX website](#). Please use [this template](#) to prepare your MethodsX article.

Data statement

To foster transparency, we encourage you to state the availability of your data in your submission. This may be a requirement of your funding body or institution. If your data is unavailable to access or unsuitable to post, you will have the opportunity to indicate why during the submission process, for example by stating that the research data is confidential. The statement will appear with your published article on ScienceDirect. For more information, visit the [Data Statement page](#).

Submission checklist

When registering names in EES, please always enter full first and full last names.

It is hoped that this list will be useful during the final checking of an article prior to sending it to the journal's Editor for review. Please consult this Guide for Authors for further details of any item.

Ensure that the following items are present:

One Author designated as corresponding Author:

- E-mail address
- Full postal address
- Telephone and fax numbers

All necessary files have been uploaded

- Keywords
- All figure captions
- All tables (including title, description, footnotes)

Further considerations

- Manuscript has been "spellchecked" and "grammar-checked"
- References are in the correct format for this journal
- All references mentioned in the Reference list are cited in the text, and vice versa
- Permission has been obtained for use of copyrighted material from other sources (including the Web)
- Color figures are clearly marked as being intended for color reproduction on the Web (free of charge) and in print or to be reproduced in color on the Web (free of charge) and in black-and-white in print
- If only color on the Web is required, black and white versions of the figures are also supplied for printing purposes

For any further information please visit our customer support site at service.elsevier.com.

AFTER ACCEPTANCE**Online proof correction**

Corresponding authors will receive an e-mail with a link to our online proofing system, allowing annotation and correction of proofs online. The environment is similar to MS Word: in addition to editing text, you can also comment on figures/tables and answer questions from the Copy Editor. Web-based proofing provides a faster and less error-prone process by allowing you to directly type your corrections, eliminating the potential introduction of errors.

If preferred, you can still choose to annotate and upload your edits on the PDF version. All instructions for proofing will be given in the e-mail we send to authors, including alternative methods to the online version and PDF.

We will do everything possible to get your article published quickly and accurately. Please use this proof only for checking the typesetting, editing, completeness and correctness of the text, tables and figures. Significant changes to the article as accepted for publication will only be considered at this stage with permission from the Editor. It is important to ensure that all corrections are sent back to us in one communication. Please check carefully before replying, as inclusion of any subsequent corrections cannot be guaranteed. Proofreading is solely your responsibility.

Offprints

The corresponding author will, at no cost, receive a customized [Share Link](#) providing 50 days free access to the final published version of the article on [ScienceDirect](#). The Share Link can be used for sharing the article via any communication channel, including email and social media. For an extra charge, paper offprints can be ordered via the offprint order form which is sent once the article is accepted for publication. Both corresponding and co-authors may order offprints at any time via Elsevier's [Webshop](#). Corresponding authors who have published their article gold open access do not receive a Share Link as their final published version of the article is available open access on ScienceDirect and can be shared through the article DOI link.

AUTHOR INQUIRIES

Visit the [Elsevier Support Center](#) to find the answers you need. Here you will find everything from Frequently Asked Questions to ways to get in touch.

You can also [check the status of your submitted article](#) or [find out when your accepted article will be published](#).

© Copyright 2018 Elsevier | <https://www.elsevier.com>