# Supplementary Information

# Effects of hydrological regime and land use on in-stream *Escherichia coli* concentration in the Mekong basin, Lao PDR

Paty Nakhle[1], Olivier Ribolzi[1], Laurie Boithias[1,*], Sayaphet Rattanavong[2], Yves Auda[1], Saysongkham Sayavong[3], Rosalie Zimmermann[2,4,5], Bounsamay Soulileuth[6], Anne Pando[6], Chanthamousone Thammahacksa[6], Emma J. Rochelle-Newall[7], William Santini[1], Jean-Michel Martinez[1], Nicolas Gratiot[8,9] & Alain Pierret[6]

[1] Géosciences Environnement Toulouse (GET), Université de Toulouse, CNRS, IRD, UPS, Toulouse, France;
[2] Lao-Oxford-Mahosot Hospital-Wellcome Trust Research Unit (LOMWRU), Microbiology Laboratory, Mahosot Hospital, Vientiane, Lao PDR;
[3] Lao Department of Agriculture Land Management (DALaM), Ministry of Agriculture and Forestry, Vientiane, Lao PDR;
[4] Department of Environmental Sciences, University of Basel, Basel, Switzerland;
[5] Department of Medical Microbiology, Amsterdam University Medical Centers (UMC), Amsterdam, The Netherlands;
[6] Institut de Recherche pour le Développement (IRD), iEES-Paris, UMR 242 (IRD, SU-UPMC, CNRS, INRA, Univ. de Paris, UPEC), PO Box 5992, Vientiane, Lao PDR;
[7] Institute of Ecology and Environmental Sciences of Paris (iEES-Paris), Sorbonne Université, Univ Paris Est Creteil, IRD, CNRS, INRA, Paris, France;
[8] Univ. Grenoble Alpes, CNRS, IRD, Grenoble INP, IGE, F-38000, Grenoble, France;
[9] Asian Research Center on Water (CARE-Rescif), Ho Chi Minh City University of Technology, Block B7, 268 Ly Thuong Kiet Street, District 10, Ho Chi Minh City, Viet Nam.
* Corresponding author: laurie.boithias@get.omp.eu

**Table S1:** Summary of geographical and meteorological characteristics per group of sampled watersheds in Lao PDR. Altitude (m a.m.s.l.), slope (%), areal percentages of: forest (%), unstocked forest (%), paddy rice (%), other agriculture (OA, %), grassland (%), water (%), and urban (%), dams' reservoir area (Dams, ha), human density (HD, people $ha^{-1}$), livestock density (LD, animal $ha^{-1}$), rainfall during rainy season (mm $week^{-1}$) one week preceding the sampling in July 2016.

| Sampling sites | Altitude | Slope | Forest | Unstocked forest | Paddy rice | OA | Grass-land | Water | Urban | Dams | HD | LD | Rainfall rainy season |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (m a.m.s.l.) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (%) | (ha) | (people $ha^{-1}$) | (animal $ha^{-1}$) | (mm $week^{-1}$) |
| **Nou** | 887 | 30 | 30.7 | 56.6 | 0.1 | 2.9 | 2.7 | 1.4 | 0 | 1,570 | 0.2 | 0.4 | 108 |
| **Nsu** | 839 | 32.7 | 21.9 | 72.9 | 0 | 1.5 | 3.3 | 0.2 | 0 | 0 | 0.1 | 0.5 | 88 |
| **Npa** | 900 | 33.9 | 13.9 | 78.9 | 0.1 | 3.6 | 3.6 | 0 | 0 | 0 | 0.2 | 0.6 | 107 |
| **Nk20** | 950 | 31.6 | 31.8 | 56.3 | 0 | 3.3 | 8.4 | 0.1 | 0 | 3,056 | 0.2 | 0.5 | 124 |
| **A6** | 820 | 30.3 | 18.8 | 74 | 0.6 | 4.4 | 2.2 | 0 | 0 | 0 | 0.3 | 0.8 | 128 |
| **Nmi** | 345 | 13.9 | 31 | 47.1 | 4.8 | 16.6 | 0.3 | 0 | 0 | 0 | 0.2 | 0.6 | 128 |
| **Nsa** | 325 | 13.5 | 33.3 | 56.7 | 1.8 | 8 | 0 | 0.1 | 0 | 0 | 0.4 | 0.9 | 175 |
| **Ntho** | 235 | 5.62 | 25.6 | 60.1 | 9.5 | 4.7 | 0 | 0.2 | 0 | 0 | 0.3 | 1.5 | 206 |
| **Nlik** | 522 | 24.1 | 51.5 | 33.8 | 2.3 | 6.7 | 4.6 | 1.1 | 0 | 24,40 | 0.2 | 0.7 | 175 |
| **Nng_1** | 631 | 18.3 | 33 | 41.6 | 5.2 | 7.8 | 6.9 | 5.1 | 0.3 | 37,000 | 0.4 | 1.5 | 161 |
| **Nma** | 596 | 14.2 | 49.9 | 41.4 | 1.1 | 1.4 | 3.5 | 1.8 | 0.1 | 1,720 | 0.1 | 0.9 | 203 |
| **Ngn** | 990 | 25.4 | 31.8 | 51.5 | 0.6 | 4.1 | 7.6 | 4.4 | 0 | 0 | 0.1 | 0.7 | 117 |
| **Nxa** | 373 | 21.5 | 55.6 | 39 | 2.2 | 1.8 | 0.8 | 6.5 | 0 | 12,300 | 0.2 | 0.6 | 143 |
| **Nka** | 707 | 24.2 | 60.2 | 28 | 0.5 | 1 | 2.9 | 0.5 | 0 | 0 | 0.1 | 0.3 | 69 |
| **Nhi** | 310 | 16 | 31.1 | 27.6 | 5.3 | 1.1 | 2.7 | 1.7 | 0 | 0 | 0.2 | 0.4 | 83 |
| **Xbi** | 246 | 8.6 | 44 | 32.1 | 5.5 | 1.7 | 3.4 | 0.3 | 0 | 0 | 0.2 | 0.4 | 97 |
| **Xbg** | 237 | 4.7 | 44.9 | 36.8 | 9 | 1.9 | 2.3 | 1.2 | 0 | 0 | 0.3 | 0.5 | 126 |
| **Xbn** | 278 | 5.4 | 70.2 | 23.5 | 3 | 1.1 | 1.6 | 0.5 | 0 | 0 | 0.1 | 0.7 | 152 |
| **SR** | 244 | 3.4 | 44.9 | 17.2 | 16.9 | 19.5 | 0.9 | 0.3 | 0.2 | 55 | 0.7 | 0.9 | 172 |

**Table S2:** Model quality by number of components, the first component (Comp1) and the second component (Comp2) of the PLS analyses for dry and rainy seasons. The $Q^2$ cumulated ($Q^2$ cum) index measures the global contribution of the first two components to the predictive quality of the model. The $R^2Y$ cumulated ($R^2Y$ cum) index represents the sum of the coefficients of determination between the dependent variables and the two first components. The $R^2X$ cumulated ($R^2X$ cum) index is the sum of the coefficients of determination between the explanatory variables and the two first components.

| **Dry season** | | |
|---|---|---|
| **Statistics** | **Comp1** | **Comp2** |
| **$Q^2$ cum** | 0.290 | -0.297 |
| **$R^2Y$ cum** | 0.568 | 0.787 |
| **$R^2X$ cum** | 0.208 | 0.291 |
| **Rainy season** | | |
| **Statistics** | **Comp1** | **Comp2** |
| **$Q^2$ cum** | 0.481 | 0.477 |
| **$R^2Y$ cum** | 0.657 | 0.841 |
| **$R^2X$ cum** | 0.178 | 0.292 |

**Table S3:** Spearman correlation coefficients between *E. coli* concentration ([*E. coli*], MPN 100 $mL^{-1}$), total suspended sediment concentration ([TSS], g $L^{-1}$), electrical conductivity (EC, µS $cm^{-1}$), water level (m), and rainfall (Rainfall, mm $day^{-1}$), measured from July 2017 to December 2018 at the outlet of three watersheds in northern Lao PDR: Nam Ou (Nou), Nam Suang (Nsu), and Mekong (MK_17). Values in bold letters indicate significant correlation ($p < 0.05$).

| **Nou** | | | | |
|---|---|---|---|---|
| | [*E. coli*] | [TSS] | EC | Water level |
| [TSS] | **0.45** | - | | |
| EC | **-0.55** | **-0.76** | - | |
| Water level | **0.52** | **0.86** | **-0.82** | - |
| Rainfall | 0.24 | 0.25 | -0.17 | 0.25 |
| **Nsu** | | | | |
| | [*E. coli*] | [TSS] | EC | Water level |
| [TSS] | **0.66** | - | | |
| EC | **-0.72** | **-0.68** | - | |
| Water level | **0.72** | **0.77** | **-0.85** | - |
| Rainfall | **0.62** | **0.51** | **-0.50** | **0.49** |
| **MK_17** | | | | |
| | [*E. coli*] | [TSS] | EC | Water level |
| [TSS] | **0.44** | - | | |
| EC | **-0.30** | **-0.60** | - | |
| Water level | **0.48** | **0.71** | **-0.79** | - |
| Rainfall | **0.31** | **0.41** | **-0.33** | **0.36** |

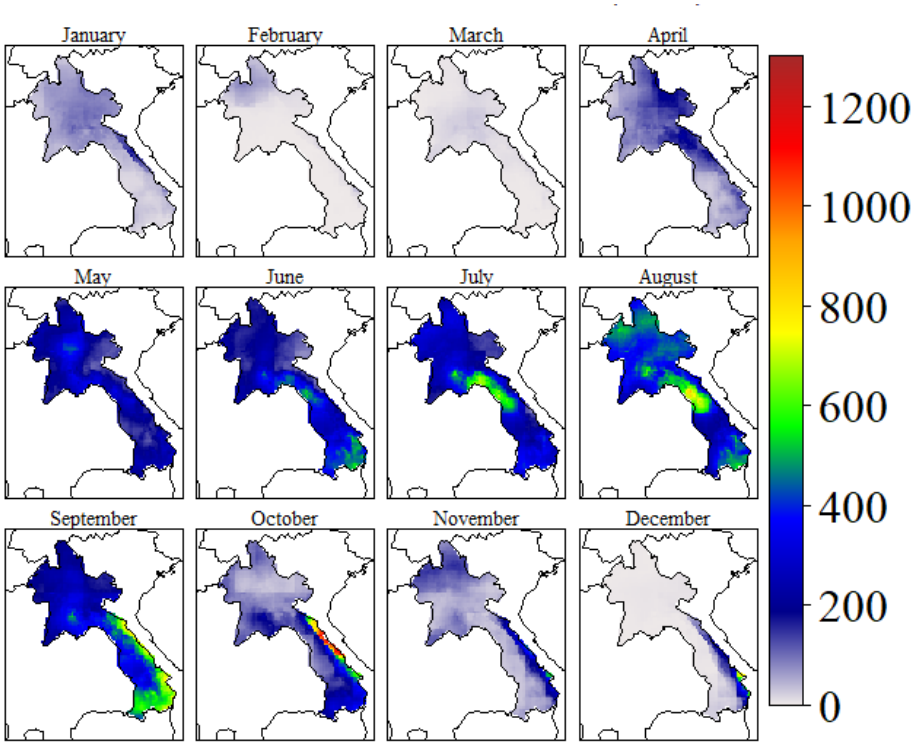


**Figure S1:** Spatial distribution of the cumulated rainfall (mm month$^{-1}$) during 2016 over Lao PDR, obtained from the Multi-Source Weighted-Ensemble Precipitation (MSWEP V2) data. Maps were generated using the "raster" package (https://rspatial.org/raster/) and "maptools" package (http://maptools.r-forge.r-project.org/) implemented in R (version 1.2.1335; http://www.r-project.org).