Supporting Information for

Contaminated characteristics variation in different aquaculture modes: a case study in Northern China

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Text S1. Sample collection and analysis

The samples were collected in a 2 L polypropylene bottles, which were washed with methanol and rinsed with water samples before collection. All collected water samples were adjusted to pH 3 using H_2SO_4, and methanol (5%, v/v) was added for the inhibition of microbial activity, then stored in an incubator with ice bags and transported to the laboratory. All samples were processed within 48 h. Sampling was repeated three times at each sampling point.The pH value was monitored by electrode method, the suspended matter was measured by gravimetric method, the permanganate index was measured by acidic potassium permanganate method, the Cu and Zn were measured by inductively coupled plasma atomic emission spectrometry, the TN was measured by alkaline potassium persulfate digestion ultraviolet spectrophotometry, the TP was measured by ammonium molybdate spectrophotometry, the sulfide was measured by methylene blue spectrophotometry, and the total residual chlorine was measured by N, N-diethyl-1,4-phenylenediamine titration. HPLC-MS/MS was performed in a AB Triple Quad 5500+ to detect the antibiotics found during the extraction process in MRM mode. Positive electrospray ionization (ESI) was used to determine all antibiotics. The chromatographic column used was a C18 column. During the sample analysis, the sample was injected at 2 μL. The mobile phase is composed of eluent A (Milli-Q water containing 0.1% formic acid) and eluent B (acetonitrile containing 0.1% formic acid). The flow rate was kept at 0.2 mL min^{-1}.

Text S2. Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) are carried out in the process of sample extraction and HPLC-MS/MS analysis. Every 15 samples, the quality control standard solutions was introduced into the sample sequence to verify validate the reproducibility and sensitivity of the instrument. The sequence of each sample consisted of a solvent blank, a procedure blank, and a mixture of standard solutions to check the performance of the apparatus and possible contamination. The concentration of antibiotics was measured by internal standard. A series of mixed solutions of antibiotic with concentrations of 5, 10, 20, 50, 100 and 200 μg/L were analyzed as linear calibration curves ($R2 > 0.99$). The limit of detection (LODs) was 0.09 – 0.60 ng/L, and the limit of quantification (LOQs) was 0.30–2.00 ng/L. The recoveries rate of antibiotics in water was measured by standard addition method, and the recoveries rate was 55-112%.

Table S1 The latitude and longitude of typical aquaculture farms

serial number	longitude	latitude
S1	114°01'12.7308"	34°47'38.8500"
S2	114°06'06.7248"	34°48'26.2836"
S3	114°04'42.9240"	34°51'49.2804"
S4	114°14'35.5272"	34°29'12.5268"
S5	113°26'43.6452"	34°53'40.0236"
S6	112°37'36.4008"	34°48'51.4836"
S7	112°06'59.7888"	34°53'30.0948"
S8	113°25'44.1120"	32°22'44.8680"
S9	112°38'23.1468"	32°50'50.1468"
S10	114°57'34.5672"	31°57'28.7676"
S11	113°40'19.4088"	33°17'37.9284"
S12	113°50'16.7892"	34°01'12.7992"

Table S2 Parameters of TN and TP in aquaculture ponds from different aquaculture modes in Henan, North of China.

Mode	TN(mg/L)			TP(mg/L)		
	Min	Max	Mean	Min	Max	Mean
M1	2.42	2.75	2.59	0.58	0.66	0.62
M2	3.4	3.87	3.64	0.12	0.24	0.18
M3	0.91	6.67	4.96	0.13	0.41	0.22
M4	18.1	37.1	29.28	0.98	5.14	2.2
M5	2.67	20.4	11.14	0.28	4.5	1.72

Table S3 Toxicity data and *PNECs* values of antibiotics for the most sensitive species.

Antibiotics	Sensitive aquatic species	Toxicity types	*AF*	*PNEC* (ng/L)	Reference
SDZ	Selenastrum capricornutum	acute	1000	2200	(Eguchi et al., 2004)
SDM	Daphnid	Chronic	100	1560	(Zhang et al., 2023)
SMR	Lemna gibba	Chronic	100	127.7	(García-Galán et al., 2009)
SM2	Daphnid	acute	1000	1200000	(Jiang et al., 2022)
DOX	Daphnid	acute	1000	8210000	(Sikorski and Bęś, 2024)
ENR	Vibrio fischeri	acute	1000	28.8	(Chen et al., 2022)
NOR	Vibrio fischeri	acute	1000	103.8	(Backhaus et al., 2000)
FF	Daphnid	acute	1000	2300	(Freitas et al., 2018)

Table S4 The RQ value of the sampling point.

Sampling	RQ							
	SDZ	SDM	SMR	SM2	DOX	ENR	NOR	FF
S1-A1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
S1-A2	0.000	0.000	0.000	0.000	0.000	0.747	0.000	0.000
S1-A3	0.000	0.000	0.000	0.000	0.000	73.958	0.000	0.000
S2-A1	0.000	0.000	0.000	0.000	0.000	0.309	0.000	0.000
S2-A2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
S2-A3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
S3-A1	0.000	0.000	0.000	0.000	0.000	13.646	0.000	0.000
S3-A2	0.000	0.000	0.000	0.000	0.000	21.215	0.000	0.000
S4-A1	0.000	0.000	0.000	0.000	0.000	0.944	0.000	0.002
S4-A2	0.000	0.035	0.000	0.000	0.000	1.250	0.000	0.001
S4-A3	0.000	0.000	0.000	0.000	0.000	0.604	0.000	0.001
S5-A1	0.000	0.000	0.000	0.000	0.000	1.368	0.000	0.000
S5-A2	0.000	0.000	0.000	0.000	0.000	2.903	0.000	0.000
S6-A1	0.000	0.000	0.000	0.000	0.000	2.000	0.000	0.000
S6-A2	0.000	0.001	0.000	0.000	0.000	1.802	0.000	0.000
S7-A1	0.000	0.001	0.000	0.000	0.000	0.729	0.000	0.000
S7-A2	0.000	0.002	0.000	0.000	0.000	0.503	0.000	0.000
S8-A1	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
S8-A2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
S9-A1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
S9-A2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
S10-A1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009
S10-A2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008
S10-A3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
S11-A1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
S11-A2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
S12-A1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001

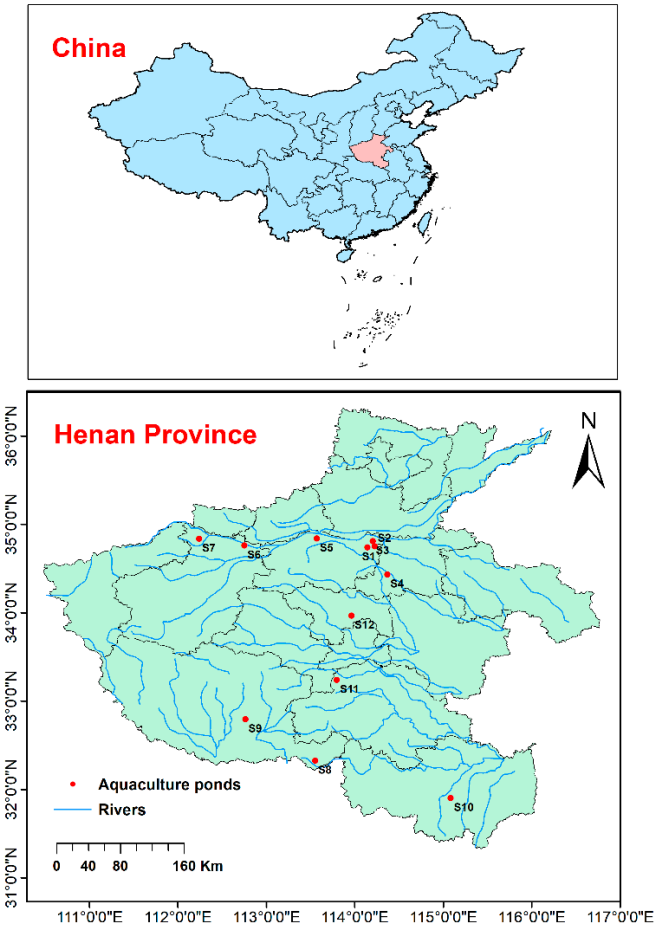


Fig. S1. Location of the study area and sampling sites.