Supplementary Materials:

Supplementary Table S1. Removal efficiency of organic and nutrients from domestic wastewater by using VFCWs.

Parameter	Substrate	Plants	Removal efficiency %	Comments	Climatic Conditions	Ref.
BOD_5 COD Nitrate Phosphate	•Gravel •Soil	•*Iris pseudacorus* •*Echinodorus palaefolius* •Combination between the two plants	•For the system with *Iris pseudacorus*: 30, 19, 51, and 87, respectively. •For the system with *Echinodorus palaefolius*: -40, 28, 58, and 99, respectively. •For the combination system: 6, 51, 46, and 95, respectively.	➢ No significant difference between using one plant species or a combination of species in enhancing the treatment efficiency. ➢ All experiments in this study show better performance in removing nutrients than organic pollutants.	Avg. Temp.: N.A Humidity: N.A	[64]
BOD_5 COD TSS Ammonia-N TN TP *coliform* bacteria Fecal *coliform* bacteria	Coarse sand	•*Phragmites australis* •*Glyceria aquatica L*	•For the system with *Phragmites australis*: 96, 96, 91, 88, 55, 87, ~100, and 98, respectively. •For the system with *Glyceria aquatica L*: 98, 94, 93, 86, 54, 88, ~100, and 98, respectively.	➢ There were no significant differences in removal efficiency between plant species.	Avg. Temp.: N.A Humidity: N.A	[66]

BOD COD TSS Ammonia-N TP	Coal slag	*Cyperus alternifolius*	60, 64, 80, 50, and 40, respectively.	➢ The analysis results indicate that the temperature has negligible treatment effects on COD, TP, and TSS removal efficiencies. ➢ Ammonia-N removal efficacy was affected by seasonal temperature changes.	Avg. Temp.: 20.7°C	[88]
BOD COD Ammonia-N TKN TP	Zeolite	*Phragmites australis*	96, 94, 93, 91, and 70, respectively	➢ High removal efficiency for nitrogen mostly refers to the used media (zeolite). ➢ Vegetation has a positive impact on increasing the removal percentage of organic pollutants and nutrients.	Avg.Temp.: N.A Humidity: N.A	[91]

Sup Table S1 (cor

Parameter	**Substrate**	**Plants**	**Removal efficiency %**	**Comments**	**Climatic Conditions**	**Ref.**
TN TP	•Midsized artificial	*Canna indica L.*	•For MSAS-based system:	➢ Existing plants in the system enhance the	Avg. Temp: N.A Humidity: N.A	[72]

	sand slag (MSAS). • Coal burn artificial slag (CBAS). • Blast furnace artificial slag (BFAS)		24 and 45, respectively. • For CBAS-based system: 30 and 60, respectively. • For BFAS-based system: 22 and 89, respectively.	removal efficiency for the nutrient compared to the unplanted system.		
BOD_5 COD TSS Ammonium-N	• Fine sand • Gravel	*Heliconia psittacorum*	• For planted sand-based systems: 97, 92, 87, and 83, respectively. • For planted Gravel-based systems: 52, 59, 0, and 45, respectively.	➢ Using fine sand as filter media improves the removal of organic pollutants and ammonia- N. ➢ Enhancing the TN removal by the presence of the plant.	Avg. Temp.: 20.7°C Humidity: 81%	[56]
COD TSS Ammonium-N TN TP	• Blast furnace granulated slag with gravel and sand. • Gravel and sand of different sizes	*Phragmites australis*	• For slag-based system: 49, 64, 88, 41, and 63, respectively. • For gravel-based systems: 40, 62, 58, 44, and 9, respectively	➢ Better efficient in removal with slag beds than with gravels.	Avg. Temp.: N.A Humidity: N.A	[73]

COD TKN	Fine sand Gravel	• *Cyperus alternifolius* • *Vetiveria zizanioides*	• For the system with *Cyperus alternifolius*: 76 and 65, respectively. • For the system with *Vetiveria zizanioides*: 67 and 56, respectively.	➢ Different HLR has been studied, the lowest one 20 cm/d achieved the maximum treatment efficiency.	Avg. Temp.: 27 °C Humidity: N.A	[62]
OP Ammonium-N TN	Gravel	*Phragmites australis*	96, 98, and 85, respectively.	➢ Intermittent aeration increases the treatment efficiencies for organic and nitrogen pollutants.	Avg. Temp.:14.7 °C Humidity: Sub-humid continental monsoon climate.	[71]
COD Ammonium-N TN	• Gravel • Washed sand	*Oenanthe javanica*	95, 99, and 53, respectively.		Avg. Temp.: 19°C Humidity: N.A	[70]

Sup Table S1 (cor

Parameter	**Substrate**	**Plants**	**Removal efficiency %**	**Comments**	**Climatic Conditions**	**Ref.**
BOD COD TSS TN TP	• Gravel with various sizes • Sand	• *Typha latifolia* • *Phragmites australis*	Average removal percentage: 80, 79, 59, 73, and 63, respectively.	➢ The treated water still needed measurements for heavy metals and microbial to decide if it could be able to reused for irrigation.	Avg. Temp.: N.A Humidity: N.A	[69]

BOD COD TSS TKN Ammonia-N Phosphate	Gravel	• *Canna* • *Phragmites australis* • *Cyprus papyrus*	Average removal percentage: 90, 88, 92, 53, 57, and 62, respectively.	➢ The system is effective for household wastewater and adjusts with national regulations for treated water reuse in irrigation.	Avg. Temp.: N.A Humidity: N.A	[68]

BOD_5; five-day Biochemical Oxygen Demand / COD; Chemical Oxygen Demand / TSS; Total Solid Suspend / TN; Total Nitrogen / TP; Total Phosphorus / TKN; Total Kjeldahl Nitrogen / HLR; Hydraulic Loading Rates / OP; Organic Pollutants/ Avg. Temp.; Average Temperature/ N.A; Not Available

Supplementry Table S2: HCW and their removal efficiency for different pollutants from domestic wastewater.

Parameter	HCW type	Substrate	Removal efficiency %	Comments	Ref.
BOD_5 COD TSS Ammonium-N Nitrate- N TKN TP Cu Pb Cr	• HCW: with 4 substrate layers. • Modified HCW (MHCW-1): with seven substrate layers. • Modified HCW (MHCW-2): with seven	From bottom to top: • HCW: coarse gravel, medium gravel, filtration sand, and woodchips. • MHCW-1 & MHCW-2: coarse gravel, medium gravel, filtration sand, coarse gravel, medium gravel, filtration	• HCW system: 36, 77, 76, 64, 35, 25, 20, 60, 45, and 25, respectively. • MHCW-1 system: 54, 77, 76, 62, 33, 34, 27, 77, 73, and 38, respectively. • MHCW-2 system: 71, 79, 80, 64, 42, 41, 33, 80, 72, and 38, respectively.	➢ The removal of nitrate-nitrogen, TP, TKN, and heavy metals was more efficient in the systems with more substrate layers. ➢ Removal percentages of BOD_5, TSS, and Cu have achieved maximum value with the MHCW-2 system	[15]

	substrate layers and earthworm.	sand, and woodchips.			

Sup Table S2 (cont.)

Parameter	HCW type	Substrate	Removal efficiency %	Comments	Ref.
BOD_5 COD Ammonia-N	Saturated VF - Free-drained VF - HF	• Crushed rock in saturated VF and HF. • Sand in a free-drained bed.	95, 84, and 78, respectively.	➢ The system provided highly efficient organic matter and nitrogen removal. ➢ Replace gravel with sand as filtration substrate in the second bed has a significant effect on ammonia nitrogen removal	[92]
BOD_5 Ammonia-N TN Escherichia coli	VF-HF-VF	Gravel Wood mulch Zeolite	Average removal percentages: 97, 99, 72, and ~100, respectively.	Non-traditional media have enhanced the removal of nitrogen and organic pollutants.	[87]
BOD COD TSS Ammonia-N Phosphate-P faecal coliforms faecal enterococci	VF-HF	Basaltic gravel Lapilli	Average removal percentages: Gravel-based system: 86, 79, 95, 88, 24, ~100, and ~100, respectively. Lapilli-based system: 90, 77, 96, 85, 21, ~100, and ~100, respectively.	-	[135]
BOD COD TSS Ammonium-N TN	FWS-FWS- HF	-	Average removal percentages: 87, 58, 87, 75, 53, 33, 68, and 73, respectively.	This system shows an efficient removal percentage for organic pollutants, heavy metals, and ammonia	[136]

TP Zn Cu				nitrogen but not for phosphate and nitrate nitrogen.	
BOD_5 COD TP	HF-VF		The removal efficiencies for summer, autumn, winter, and spring were: BOD_5: 88, 85, 73, and 74, respectively. COD: 89, 87, 83, and 86, respectively. TP: 97, 98, 95, and 98, respectively.	The effect of seasonal changes on pollutant removal efficiency has been studied. The removal percentage for TN in all systems was very low.	[137]

Sup Table S2 (cont.)

Parameter	**HCW type**	**Substrate**	**Removal efficiency %**	**Comments**	**Ref.**
COD TSS Ammonia-N TN TP	Towery HCW with three stages (HF-FWS-HF)	From bottom to top: Washed gravel Fine gravel Soil	Average removal efficiency: 85, 89, 83, 83, and 64, respectively.	The design shows an increase in the removal efficiency of the TN mainly by nitrification and denitrification mechanisms.	[85]
COD TN TP	IVFCW	Gravel	Removal efficiency Mean of both systems: 61, 14, and 52, respectively.	Low temperatures have a negative effect on nutrient removal.	[65]

BOD COD TSS Ammonia-N Nitrate-N molybdate-reactive phosphorus	ICW	Sludge	For the new system (one year of operation): 99, 97, ~100, 99, 94, and 99, respectively. For the mature system (five years of operation): 95, 89, 97, 58, -11, and 34, respectively.	In the long term, ICW are efficient in removing organic pollutants (BOD, COD, SS) and ammonia-nitrogen from domestic wastewater is better than the removal efficiency of nitrate-nitrogen and phosphorus.	[86]
COD Ammonia-N TN TP	IVFCW	Waste bricks of different sizes.	Maximum removal: 67, 72, 57, and 92, respectively.	The effect of different hydraulic loads (0.15, 0.25, and 0.35 m/day) has been studied. High removal percentage of TP.	[89]
BOD_5 TSS Ammonia-N TP	IHCW	From bottom to top: Washed gravel Pea gravel Washed sand	96, 97, 88, and 88, respectively.	The system is cost-effective and does not need any operational energy inputs. The system could be feasible for single-family use in developing countries.	[63]

BOD_5; five-day Biochemical Oxygen Demand / COD; Chemical Oxygen Demand / TSS; Total suspended solids / TN; Total Nitrogen / TP; Total Phosphorus / TKN; Total Kjeldahl Nitrogen / VF; Vertical Flow / HF; Horizontal Flow