Simplified Case Study

The focus of this case study is the 130 MLD sewage treatment plant (STP) at Jajmau in Kanpur, India, one downstream village that reuses the treated effluent for irrigation purposes and a novel technology from the Pavitra Ganga Project.

Jajmau STP

The 130 MLD STP at Jajmau treats domestic wastewater ('sewage') from the area. The treatment process includes preliminary screening, primary clarifier, aeration tanks, secondary clarifiers, and mechanical sludge dewatering (Figure 1).

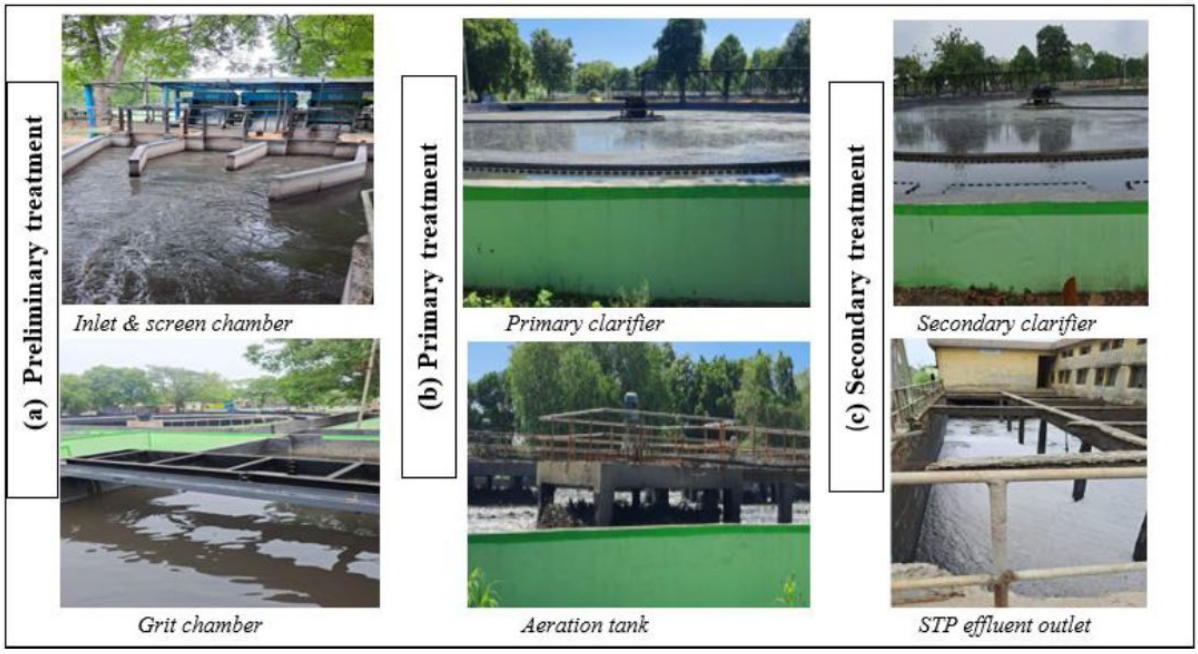

Figure 1: The main three treatment processess at Jajmau STP, Kanpur (Babalola, 2022)

An approximate process flow of the treatment process can be found in Figure 2.

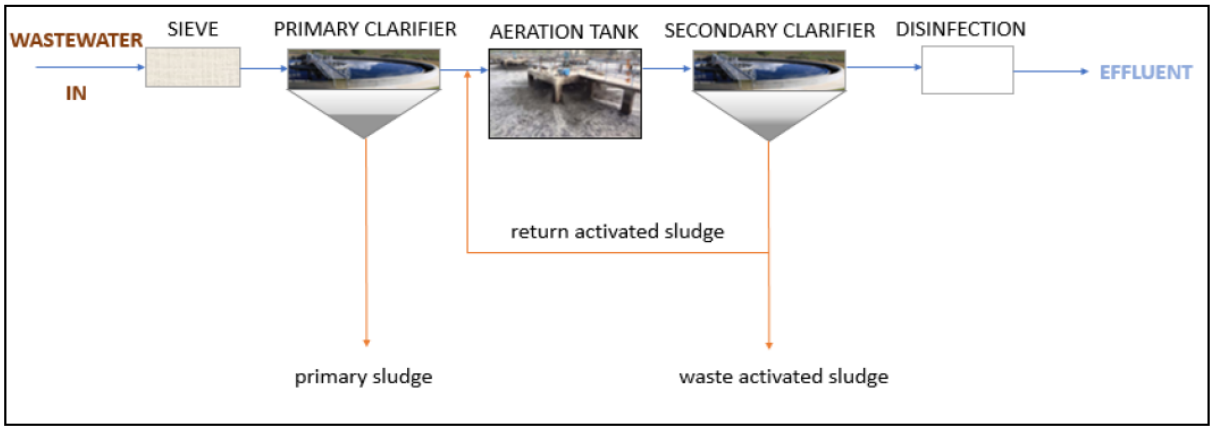

Figure 2: Process flow at Jajmau STP, Kanpur (Babalola, 2022)

The preliminary screening is labelled as sieve, mechanical dewatering of sludge is not included and the system does not include disinfection. The dried sludge from the STP goes to a landfill, while the treated

effluent flows into channels which is reused by farmers in local villages. The effluent quality from Jajmau STP and the Indian Standards for STP effluent quality can be found in Table 1.

Table 1: Effluent quality at Jajmau STP and the Indian standards

Standard or Sample	*E. coli* (CFU per 100mL)
Indian STP effluent quality discharge standard[1]	230
Influent to the Jajmau STP	3.26×10^8
Effluent from Jajmau STP	6.51×10^6

The Village

The village has 180 household. The farmers living in the village use treated effluent for irrigation of their crops. They use flood irrigation to grow crops such as rice and wheat which they consume at home. Examples of the channels and flood irrigation can be seen in Figure 3. In Table 2 the quality of the irrigation water can be found with the threshold outlined in the WHO guidelines.

Figure 3: The flow of the effluent from the STP through the irrigation channels to the agricultural fields in the village (a) STP effluent pipes, (b)-(c) channels with effluent pipes, (d) irrigation channel next to the field, (e) effluent being used for flood irrigation (Babalola, 2022)

Table 2: WHO Guidelines for reuse of effluent with quality threshold and the quality of the effluent being used

Standard or Sample	*E. coli* (CFU per 100mL)
WHO threshold for safe reuse in labour-intensive irrigation[2]. Required pathogen reduction by treatment.	Log 3 reduction
Reduction achieved in Jajmau STP	1-2 Log reduction
Effluent quality of treated wastewater in the irrigation channels	1.71×10^6

The Novel Technology

The Pavitra Ganga Novel technology considered is a combination of an integrated permeate channel (IPC) membrane in sequence with a constructed wetland plus (CW+). The schemes and photos of each technology can be found in Figures 4 and 5. This is a secondary treatment step which comes after preliminary screening and primary sedimentation. The IPC membrane aims to produce permeate with

1.Adjusted for the exercise as different units and indicator organisms are used. The actual Indian standard can be found here: Tribunal, N.G. NGT Orders Stricter Norms for Effluent Discharge from Sewage Treatment Plants. Available online: https://www.theweek.in/wire-updates/national/2019/05/03/lgd11-green-stps.html (accessed on 6 December 2020).

2 WHO Guidelines for the Safe Use of Wasterwater Excreta and Greywater; World Health Organization: Geneva, Switzerland, 2006; Volume 1.

no suspended solids or coliforms, and very little organic matter and CW+ aims to reduce excess nutrients and heavy metals. The effluent quality from these CW+ can be found in Table 3.

See videos on the CW+ here: https://pavitra-ganga.eu/en/constructed-wetland-plus

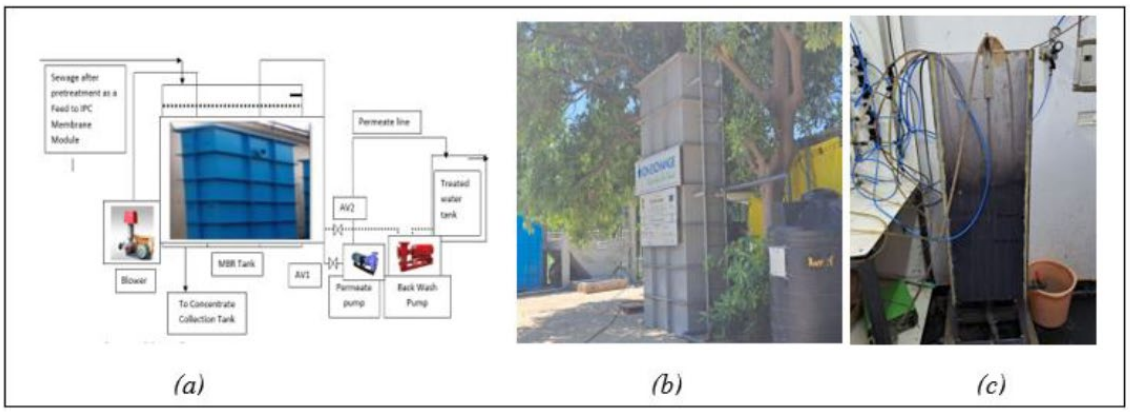

Figure 4: The IPC membrane in Kanpur (a) flow scheme of IPC-membrane (ion exchange); (b) installed full-scale IPC membrane in Jajmau innovation site (c) prototype of IPC- membrane operating on a small scale at IIT Kanpur (Babalola, 2022).

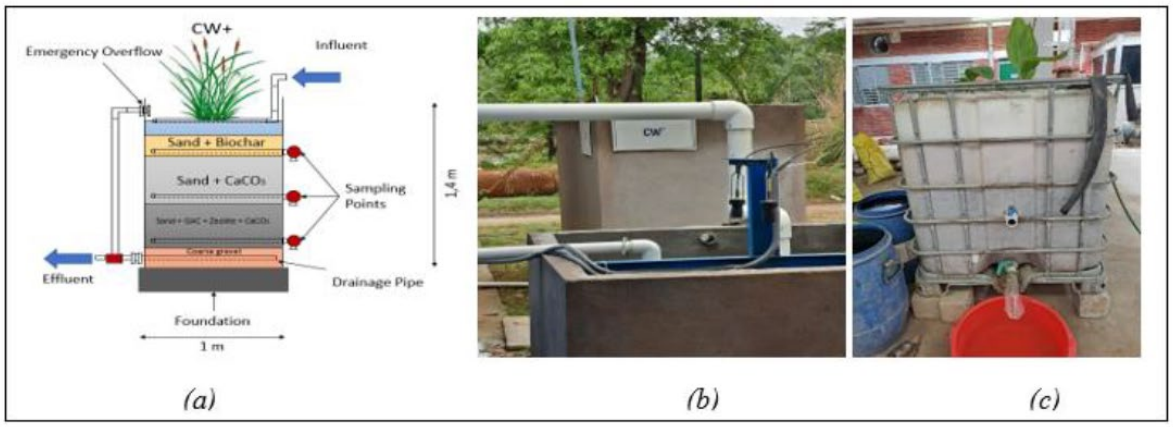

Figure 5: The CW+ in Kanpur (a) flow scheme of CW+, (b) installed pilot-scale CW+ in Jajmau innovation site, (c) prototype of CW+ operating in small scale at IIT Kanpur (Babalola, 2022).

Table 3: Effluent quality from the CW+ and the Indian STP effluent discharge standards

Standard or Sample	*E. coli* (CFU per 100mL)
Indian STP effluent quality discharge standard[1]	230
Effluent quality of the CW+	11*

* This is above a 6 log reduction in *E. coli* look at the influent quality in Table 1.

All data in this simplified case study has been obtain from:

Babalola, F.M.; Breitenmoser, L.; Furlong, C.; Campling, P.; Hooijmans, C.M. Occupational Health Risk Assessment for Wastewater Treatment and Reuse in Kanpur, India. Int. J. Environ. Res. Public Health 2023, 20, 6072. https://doi.org/10.3390/ijerph20126072

Babalola, F.M.; Exploring the impacts of novel technology on the occupational and community health risks associated with wastewater treatment and reuse in Kanpur, India. MSc Thesis. IHE, Delft, 2022