



جامعة ابن طفيل
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Ibn Tofail University

TOWARDS WATER AUTONOMY: UNIVERSITY INNOVATION AND TERRITORIAL IMPACT THROUGH THE WWTP AND SMART IRRIGATION

2024



SUSTAINABLE
DEVELOPMENT
IBN TOFAIL UNIVERSITY

Implementation of the Wastewater Treatment Plant (WWTP) on the Kenitra Campus

In a national context increasingly affected by water scarcity and the growing impacts of climate change, Ibn Tofail University (UIT) has committed to an innovative approach to address these challenges.

Aware of the necessity for sustainable water management, the University launched a transformative project: the establishment of a wastewater treatment, purification, and reuse facility on its campus in Kenitra. This project illustrates the capacity of a university to become a driver of change, combining technological performance, environmental responsibility, and social relevance. It is part of a broader strategy focused on circular economy principles and autonomy in water management.

Implementation of the Wastewater Treatment Plant (WWTP) on the Kenitra Campus

The wastewater treatment plant is based on a third-generation Membrane Bioreactor (MBR) system, combining aerobic biological treatment with membrane ultrafiltration and UV disinfection. The daily treatment capacity reaches **200 m³/day**,



<https://sd.uit.ac.ma/mise-en-place-dune-station-de-traitement-depuration-et-de-recyclage-des-eaux-usees/>

amounting to approximately **145,000 m³ per year treated in 2024**, representing a significant increase compared to 2023.

The facility includes a complete treatment chain consisting of a lifting station, pre-treatment, buffer tank, biological treatment, membrane filtration, as well as a sludge treatment system and an odor control unit.

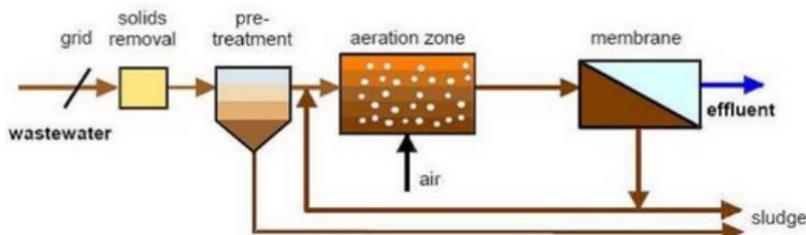


Table 1: Treatment Plant Performance - Year 2024

Parameter	Before Treatment	After Treatment	Reduction Rate (%)
COD (mg/L)	540	28	94.8%
BOD ₅ (mg/L)	380	21	94.5%
TSS (mg/L)	500	3.5	99.3%
Treated volume (m ³ /year)	—	145,000	—
Reused water (% of total)	—	85%	—
Valorized sludge (dry matter)	—	98%	—
Odor reduction	—	95%	—

- **COD (Chemical Oxygen Demand):** Measures the amount of oxygen needed to chemically break down organic and inorganic matter in water. A high COD indicates heavy pollution; a low COD after treatment indicates cleaner water.
- **BOD₅ (Biochemical Oxygen Demand over 5 days):** Represents the amount of oxygen required by microorganisms to decompose organic matter over 5 days. It's a key indicator of biodegradable pollution.
- **TSS (Total Suspended Solids):** Refers to the solids in water that can be trapped by a filter. Reducing TSS improves water clarity and quality.

The results for **2024** demonstrate the exceptional performance of the wastewater treatment plant implemented by Ibn Tofail University. The removal of pollutants is highly effective, with a **94.8% reduction in COD**, a **94.5% reduction in BOD₅**, and an impressive **99.3% reduction in TSS**, ensuring that the treated water meets and exceeds quality standards for safe reuse.

The treated volume reached **145,000 m³ this year**, with **85% of the water** being reused for the irrigation of green spaces, significantly reducing reliance on potable water and leading to estimated **savings of over 1.2 million MAD annually**. Furthermore, the **98%** dryness level of the valorized sludge highlights its suitability for use in agriculture as organic fertilizer, contributing to circular resource management. The **95%** odor reduction also enhances environmental comfort and community acceptance, especially near sensitive areas on campus.

Overall, these outcomes reflect the efficiency, environmental sustainability, and economic value of the wastewater treatment system, affirming Ibn Tofail University's role as a national model in sustainable water management and innovation.

The majority of the treated water is reused for irrigating the campus green spaces, significantly reducing dependence on potable water. The sludge resulting from the treatment process, once dewatered and stabilized, is used as organic fertilizer. The WWTP also serves as an educational and scientific platform for students and faculty, fully integrated into academic programs and research projects.

Irrigation Innovation: Mipotube System and Circular Economy



In 2023, Ibn Tofaïl University implemented the Mipotube subsurface irrigation system as an integral part of its sustainable water reuse strategy.

This advanced system is directly connected to the university's wastewater treatment plant and was developed in collaboration with INNARI, a German company specializing in innovative irrigation technologies.

One of the most distinctive features of the Mipotube system is its use of recycled rubber waste from the automotive industry. The pipes used in this system are manufactured entirely from this material, giving a second life to a type of industrial waste that is otherwise difficult to manage and harmful to the environment if left untreated. By incorporating this waste into a productive agricultural process, the university actively contributes to the circular economy—reducing the environmental burden of waste disposal while creating value from it.

Technically, the system is designed to deliver treated wastewater directly to the roots of plants, deep within the soil.



<https://sd.uit.ac.ma/economie-circulaire-de-leau-made-in-morocco/>

Unlike traditional surface irrigation, where significant volumes of water are lost through evaporation and runoff, the Mipotube system enables precise, moisture-efficient delivery. This results in water savings of up to 60%, better plant health, and reduced weed growth, as the soil surface remains dry.

The use of recycled rubber also improves the durability and flexibility of the pipes, making them more resistant to pressure, weather changes, and chemical exposure from treated water. Moreover, the buried system is invisible and protected, reducing the need for maintenance and making it ideal for urban and landscaped green spaces like those on the university campus.

From an environmental perspective, this approach addresses two critical sustainability issues at once: water scarcity and solid waste pollution. It demonstrates how smart design can turn environmental liabilities—such as wastewater and used tires—into sustainable resources for irrigation and agriculture.

Table 2: Mipotube System Results (2024)

Indicator	Estimated Value (2024)
Water savings compared to traditional irrigation	50-60%
Evaporation reduction	100% (subsurface irrigation)
Area irrigated using Mipotube	90% of green spaces
Recycled materials used	Automotive rubber

The results of the Mipotube subsurface irrigation system in 2024 highlight its strong contribution to water efficiency and sustainability. The system achieves water savings of 50-60% compared to traditional surface irrigation methods. This significant reduction is mainly due to the system's ability to deliver water directly to plant roots, preventing evaporation and minimizing runoff.

In fact, with 100% evaporation reduction, the Mipotube system ensures that no water is lost to the atmosphere, a major advantage in regions like Morocco that are prone to drought and high temperatures. Additionally, by covering 90% of the university's green spaces, the system has scaled beyond pilot phases and is now fully integrated into campus operations, showing its effectiveness at large scale.

One of the key innovations lies in the use of recycled automotive rubber to manufacture the irrigation pipes. This not only extends the lifecycle of industrial waste but also strengthens the physical durability of the system. It is a prime example of how a circular economy approach can be applied to both water reuse and waste valorization, making the project both environmentally sound and economically efficient.

Overall, the Mipotube system significantly supports Ibn Tofail University's sustainable development goals by conserving water, reducing waste, improving irrigation performance, and showcasing replicable innovation.



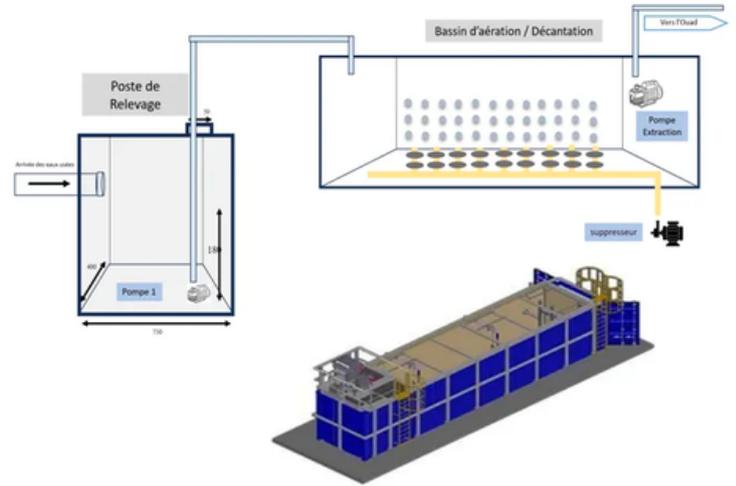
Territorial Deployment: Mobile Station in Tafinghout (Taroudant)

As part of the 2023 post-earthquake reconstruction plan, the University initiated the development of an innovative, compact, and mobile wastewater treatment plant in the village of Tafinghout, located in the province of Taroudant.

This project addresses the urgent need for sustainable sanitation infrastructure in newly established communities created for families displaced by the El Haouz earthquake.

The treatment station is designed to serve a resettlement village spread over 15 hectares, providing essential sanitation services to a population that previously lacked access to adequate wastewater management. Its mobile and modular design allows for rapid deployment and adaptation to remote or underserved areas.

The plant utilizes the Sequential Batch Reactor (SBR) technology, a highly efficient and flexible process well-suited for small to medium-sized communities. With a daily treatment capacity of 180 cubic meters, the system effectively handles domestic effluents, removing organic matter, nutrients, and pathogens. The treated water meets national and international environmental discharge standards, thus contributing to the protection of local ecosystems and public health.



<https://sd.uit.ac.ma/installation-wastewater-treatment-plant-commune-tafinghout-taroudant-province/>

This project demonstrates the University's commitment to sustainable development, technological innovation, and community support in times of crisis. It also serves as a pilot model for similar interventions in other rural or post-disaster contexts.



Table 3: Features of the Tafinghout Mobile Wastewater Treatment Plant

Parameter	Target Output Value
BOD ₅ (mg/L)	< 40 mg/L
COD (mg/L)	< 120 mg/L
TSS (mg/L)	< 30 mg/L
Capacity	180 m ³ /day
Technology used	Compact SBR (Sequential Batch Reactor)
Footprint	Reduced
Maintenance	Easy

The Tafinghout mobile wastewater treatment plant, launched by Ibn Tofail University in response to the 2023 El Haouz earthquake, was designed to deliver high-efficiency wastewater treatment within a compact and adaptable structure, ideal for rural and post-disaster environments.

The targeted output values demonstrate the station’s ability to produce clean, environmentally safe effluent:

- A BOD₅ level below 40 mg/L indicates a significant reduction of biodegradable organic matter in the treated water, minimizing risks to aquatic ecosystems.
- A COD level under 120 mg/L reflects low levels of residual chemical pollutants after treatment, ensuring compliance with environmental discharge standards.
- TSS levels below 30 mg/L confirm the effective removal of suspended solids, enhancing water clarity and reducing solid contamination.

With a treatment capacity of 180 m³/day, the station is capable of serving an entire newly built village designed to accommodate displaced families. It provides sanitation infrastructure equivalent to that of permanent urban facilities. The use of compact SBR (Sequencing Batch Reactor) technology enables high-performance treatment within a small footprint, making it especially suitable for temporary settlements or geographically constrained areas such as Tafinghout.

Moreover, its reduced land requirement and ease of maintenance make this system ideal for deployment in remote or underserved regions. It requires only limited technical intervention, allowing for local operation and ensuring long-term sustainability.

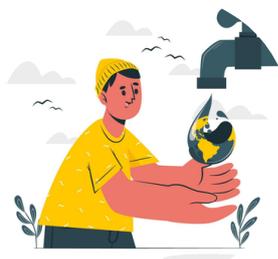
This initiative not only brings direct health and environmental benefits to a vulnerable population, but also reflects the University’s commitment to resilience, innovation, and territorial solidarity. It serves as a scalable model that can be replicated in other rural or post-crisis areas across Morocco and beyond.

Overall Impacts of the Project

The integrated wastewater management initiative led by Ibn Tofail University has produced multidimensional, measurable impacts that extend well beyond the university campus. This flagship project, which combines technological innovation with a strong social and environmental commitment, has become a national model for sustainable development in higher education.

Environmental Impact

The project plays a significant role in reducing environmental pollution by preventing the discharge of untreated wastewater into natural ecosystems. By treating and reusing over 145,000 m³ of wastewater annually, the university is helping to preserve groundwater reserves, which are under increasing pressure in Morocco due to drought and overextraction. Additionally, the project demonstrates a successful approach to waste valorization, notably through the transformation of sludge into organic fertilizer and the use of recycled rubber in the Mipotube irrigation system. By adopting subsurface irrigation, the project drastically reduces evaporation, thus minimizing water waste and enhancing soil health, contributing to a low water footprint campus.



Social Impact

On the social front, the project directly supports community well-being, especially through the deployment of the mobile treatment plant in Tafinghout, a rural village reconstructed following the 2023 El Haouz earthquake. The provision of safe wastewater treatment in this context not only improves sanitation and public health, but also fosters dignity, stability, and resilience for displaced families.

Furthermore, the project promotes social inclusion by engaging with rural territories and ensuring that innovative technologies are not limited to urban or privileged areas. It also serves as a platform for awareness and community engagement, regularly welcoming students, NGOs, municipal officials, and industrial actors to explore solutions for environmental protection.

Overall Impacts of the Project & updated information

1. Expanded Treatment Capacity and Water Reuse (2024)

- Wastewater treated increased to 150,000 m³/year (vs. 140,000 m³ in 2023).
- Daily reuse averages 465-465.7 m³/day for irrigation of 25% of campus green spaces.
- Reuse offset 100% of irrigation needs for the covered area.

2. Improved Water Quality Monitoring

- Effluent quality meets reuse standards:
 - DCO reduced from 540 to 31 mg/L
 - MES from 500 to 3.9 mg/L
 - Coliformes fécaux < 1000 CF/100 ml
 - Nematode eggs absent

3. Energy Efficiency: Energy consumption: 0.2 kWh/m³ (total 33,230.87 kWh in 2024).

4. Increased Educational and Outreach Activities

- More than 10 workshops annually involving 90+ participants.
- Demonstration platform used by students, professionals, and municipal staff.

5. Circularity and Sludge Reuse Studies

- Feasibility studies underway for sludge valorization in campus landscaping.
- Reinforces closed-loop approach and soil improvement goals.

6. Broader Visibility: Reinforced links with local authorities, civil society, and academic networks.

7. Environmental and Climate Impact: Enhances urban resilience through water reuse, pollution reduction, and flood risk mitigation.

8. Financial and Operational Updates

- Annual savings: 150,000 m³ reused water = approx. MAD 680,000.
- Low O&M costs due to efficient design and in-house operation.
- Revenue generation through training, research, and innovation



Educational and Scientific Impact

The wastewater treatment station is fully integrated into the university's academic and research activities. It functions as a real-world laboratory where students can gain practical experience in environmental engineering, chemistry, biology, and sustainability studies. It supports applied research projects, Master's theses, PhD dissertations, and hands-on training sessions for engineering and technology students. The interdisciplinary nature of the station, combining civil engineering, biotechnology, and environmental science—makes it a living lab that connects students with real challenges in climate resilience and resource management. This experiential learning approach also strengthens the university's research ecosystem and contributes to the development of green skills.

Economic and Technological Impact

Economically, the project has led to significant cost savings by reducing the university's dependence on potable water. By reusing 85% of treated water for campus irrigation, Ibn Tofail University avoids spending approximately 1.2 million MAD per year. These savings can be redirected toward academic and infrastructure development. The project also stimulates technological innovation through strategic public-private partnerships, notably with WATEC for water treatment technologies and INNARI for sustainable irrigation systems. These collaborations foster knowledge transfer, support local expertise, and open opportunities for future green tech deployment.



Conclusion

With this ambitious project, Ibn Tofail University is establishing itself as a key player in Morocco's ecological transition and circular economy. The success of the campus wastewater treatment plant, the adoption of the Mipotube system, and the deployment of the mobile station in Tafinghout demonstrate an integrated approach that combines technological excellence, territorial solidarity, and educational innovation. This model can inspire other universities, local authorities, and regions seeking to turn water-related challenges into sustainable opportunities.