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**Project acronym**: INNOQUA

**Project title**: Innovative Ecological on-site Sanitation System for Water and Resource Saving

**Innovation Action**

**Topic**: Water-1b-2015: Water Innovation: Boosting its value for Europe – Demonstration/pilot activities

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**Duration**: 48 months

# D5.1 – Demosite installation

| **Organisation name of lead contractor for this deliverable: NBK** | | |
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| **Dissemination Level** | | |
|---|---|---|
| PU | Public | × |
| CO | Confidential, only for members of the consortium (including the Commission Services) | |

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# Document history

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| **7** | | | |
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| **7** | | | |

# 1 Introduction

INNOQUA project aims to develop and demonstrate towards commercialization an innovative, modular and sustainable wastewater treatment system that integrates individual low cost, sustainable and biologically based technologies.
WP5 “Scenario implementation in demonstration sites” is a key step in the exploitation of the INNOQUA system as it includes the design, installation, operation and monitoring of different demonstrator under real environmental and operational conditions in different locations both in Europe (Ireland, France, Italy, Scotland, Turkey, Romania) and further afield: South America (Ecuador, Peru), Asia (India) and Africa (Tanzania).
The INNOQUA Project started in June 2016 (M01) and this deliverable D.5.1. describes the installed demo-sites.

## 1.1 Work Package 5 Objectives

The main objectives of WP5 as listed in the Grant Agreement are as follows:

- Develop full scale demonstration prototypes featuring for each of the target market a scenario identified, putting real scale/real-operation conditions,
- Design and deploy ICT systems and relevant remote sensing capability to each of the demonstration units in the pilot sites countries,
- Fully test performance of the aforementioned prototypes to include treatment performance, energy analysis, operational and maintenance analysis and long-term sustainability,
- Engagement with stakeholders and end-users to refine technology design, operation and maintenance,
- Host open days for stakeholders to view the technologies in action on-site,
- Document and synthesize all results. Technology guideline documents and specifications and brief technology fiches will be produced to ease the way for commercial exploitation.

## 1.2 The Role of Deliverable D5.1

This deliverable is a detailed list of all demosites installed within the INNOQUA project. This deliverable aims to give technical overview on each of the demosites with the information regarding: the integration of technologies, the particular design characteristics, the volume and type of influent wastewater, the targeted treatment/reuse standard, the geographical details and the contact information.
All monitoring data are not part of this deliverable, they will be presented in the deliverable 5.2.

## 1.3 Relationship with other Activities in the Project

The prototype testing phase of the project (WP4) set the basis for designing and installing of the real environmental conditions demo-sites (WP5) and provided technical recommendations on operation, monitoring and control of the full-scale demo-sites

By gathering most of the technical information about all demosites, this deliverable will be used as a reference for all other deliverables of WP5.

This WP5 will allow to assess the performance, in terms of treatment and energy requirements, but also correct the issues and provide the technical and the operational feedback including the installation requirements, the maintenance and the stakeholder's acceptance to better feed the activities of WP6 (results exploitation).

# 2 Demonstration strategy

## 2.1 Presentation of the demo-site strategy

Based on the research data gathered during the prototyping phase (WP4) from the pilot scale INNOQUA systems installed in Ireland (NUIG) and Spain (UDG), within WP5, 11 demo sites have been installed across 10 countries (France, Ireland, Italy, Romania, Scotland, Turkey, Ecuador, Peru, India and Tanzania) to demonstrate in real environmental and operational conditions the long-term viability of a modular and a locally sustainable solutions.

The WP4 provided an excellent understanding of the nature-based solutions and offered time to test the limit and to improve both the efficiency and the design of the technology. A similar deliverable which gathers the technical details about the pilot site is available under D4.2. Also, the results from this WP4 phase are presented in the updated version of the D4.3.

The modules include lumbrifilter (LF), daphnia filter (DF), bio-solar purification (BSP) and UV system (UV). They are all controlled and monitored by a monitoring and control unit (MCU), the fifth technology developed within the INNOQUA project. The pilot sites provide a robust platform for scientific research and act as a focus for local training and dissemination activities.

It is important to note that the French demonstration site leaded by Lombritek is not implementing the wastewater treatment solution itself. Indeed, this demonstration has implemented the Lumbricomposting unit. The methodology allows to close the loop of the circularity of the water treatment. The Lumbricomposting unit installed in France make the treatment and valorisation of the sludge from the aquaculture farm possible. The site aims to prove the replicability of the methodology to address the ultimate water treatment phase which is the sludge valorisation into a certified and marketable product.

Due to its modular configuration, the INNOQUA system can address multiple aspects of wastewater treatment and water re-use in water stressed communities, rapidly expanding cities and industries –both in developed and developing countries. The decentralised approach helps to reduce pressure on inadequate wastewater networks while reducing the water and energy demands of typical centralised wastewater treatments – supporting sustainable development.

Different integration of the INNOQUA technologies have been chosen depending on influent type and quality, treatment target (discharge and/or reuse quality standards) considering the climatic condition and space availability. In India and Peru, where the climatic conditions and the available space allow it, all the technologies have been installed working as two parallel integration (LF+DF+UV+MCU and LF+BSP+MCU) to assess best the long term suitability and sustainability of wastewater treatment with local reuse of the effluent as irrigation water.

All the unit are being monitored by the MCU for a remote accessible on-line monitoring. Different parameters important to follow the biological state of the system are being monitored: Dissolved Oxygen, Temperature and pH.

The efficiency of the demonstration sites will be presented and analysed in the upcoming D5.2

## 2.2 Approach for the development of D.5.1.

This WP has been equally impacted by the withdrawal of the industrial partner WTE. Thus, all demosites suffered a six-months delay in the reception of the tanks. As WP5 implementation was dependent of WP4 results, this delay, previously recorded within the WP4 couldn't be reduced in any significant way despite the strong involvement of the new industrial partner - REDI.

Being aware of the risk of delay, different measures have been adopted in time to tackle with this delay and allow a smooth installation:

A detailed gantt chart of WP5 activities was first developed in April 2018 and continuously updated as the work progressed. The detailed gantt chart was assessing the timeline of activities with a focus on installation:

- Demo-site design requirements and technology requirements:
    - Validate site and technology integration,
    - Lumbric breeding instructions,
    - Daphnia breeding instructions,
    - List of recommended fourniture/equipments (pumps/nozzle/septic tank, equalisation basins - depending on site requirements) necessary to install the INNOQUA system on demosite.
- On-site preparatory works:
    - Demosite managers needs their design done (technical project/plumbing/electrical works design),
    - Authorization (import/construction/installation) - if needed,
    - Installing plumbery and electricity network,
    - Procurement of tank accessories (pumps, nozzles, etc) according to specific,technical project and list recommended,
    - Site ready to receive tanks and to install the INNOQUA system,
    - Strat lumbric&/daphnia breeding,
    - Lumbrics/daphnia breeding in progress,
    - Lumbrics/daphnia population ready for inoculation.

- Manufacturing transport and installation:
    - Manufacturing tanks,
    - Tanks transportation,
    - Provide Onsite and Online monitoring component needed,
    - Demosite installation (tank positioning, connections: water works/electrical/pumps/MCU),
    - Demosite operational,
    - Demo-site inoculation and start-up.

Actions:

- In May 2018, the technology providers developed earthworms and daphnia breading instructions which were disseminated to all demo-site managers.
- The detailed list of required materials for the installation of the demosites and installation guidelines for each of the technologies were available in July 2018,
- During August 2018, specific meetings with each demosite manager were organised to validate the initial technical/drawing of each demosite,
- Communication between the consortium partners of WP4 and WP5 has been increased aiming to build communication bridges between this two important WP. A strong involvement of the different partners, especially of the industrial partner – REDI, was required to better understand the tank design made for the prototype (built by Inbrooll for the WP4 based on the design of the INNOQUA consortium). During this period, from August 2018 to November 2018, regular meetings and intense email exchanges were required to validate all demo-sites (technical design, tank sizes),
- A first validation meeting was on-site at the manufacturing headquarters of REDI – the industrial partner, were the first manufactured tanks (LF and DF) based on the approved size and design of Indian demo-site were validated by the consortium,
- All members involved in the implementation of WP5 participates at the visio-meeting organised every two weeks since the PM6 in Bangalore in January 2019. These meetings were designed to gather crucial information on the status of implementation (design validation, manufacturing, transport, installation, breading/purchase of earthworms/daphnia, authorization, installation, start-up, inoculation, operation, monitoring, etc) on all demo-sites, plan the future works and share lessons learnt on all implementation steps between different demo-site managers,
- To increase communication and accelerate the reply rate between different partners involved in the implementation, for each demosite, specific WhatsApp groups have been created including: the WP leader, the Project manager, the Technical Manager, the demosite responsible, the demosite manager, the industrial partner, and also all the responsible of the technologies installed on the demosite. It allowed and allows a direct communication and prompt answer for crucial issues,
- Extraordinary visio-meeting are also organised by the demosite manager and WP leader/demosite responsible as soon as a potential issue is identified or to assess and control the progress of work.

Once with the bankruptcy of Heliopure technology, the BSP modules within the demo-sites of India and Peru has been delayed for extra 6 months, time required for NBK and ECOIND taking over the responsibilities of BSP further development through lab scale experiments and innovative design towards a full scale demonstration BSP module of the INNOQUA system (which have been installed successfully in September 2019 (India and Peru) by NBK and ECOIND.

## 2.3 Table and map presenting the demosite

Below, the list of the different partners responsible of the demosite and the country where they are located and a map to represent where all the demosite are situated in the different countries.

*Table 1: The different demosite by location and responsible*

| PARTNERS RESPONSIBLE | COUNTRY | CITY | CONTACT |
|---|---|---|---|
| NUIG | Ireland | Craughwell | eoghan.clifford@nuigalway.ie |
| DE5 | Italia | Vasto | pietro.decinque@de5.it |
| NBK | France | Anglet | jbdussaussois@nobatek.inef4.com |
| SW | Scotland | Littlemill | Anna.Baran@scottishwater.co.uk |
| EKO | Turkley | Sinop | serkan.naneci@ekodenge.com |
| ECOIND, RMC | Romania | Suceava | costel.bumbac@incdecoind.ro |
| GYA | Ecuador | Quito | nsalmon@yes-innovation.com |
| BORDA | India | Bangalore | schellenberg@borda.org |
| BORDA | Tanzania | Dar es salam | herrera@borda.org |
| UCSM | Peru | Arequipa | joshelyn.pz@gmail.com |
| LBT | France | La Canourgue | p.soto@lombritek.com |

On the map, Figure 1,are represented the locations of different demo sites.

The INNOQUA systems developed at prototype level within WP 4 at Girona University (UDG) Spain and Galway National University (NUIG) Ireland have been kept onsite and are continuously monitored to test more parameters and bring more data for the design of the commercial version of the system.

Even though the previous plan was to recycle the protypes as showcases in India and Ecuador, the experience of demo-site implementation in terms of tanks transport and customs both in terms of expenses and necessary time, led us to the conclusion that building them on-site is more-suitable. Thus, local sourcing scenarios to build the showcases in Ecuador, India and Tanzania have been investigated and chosen. These showcases are being built with local materials within the budget previously planned for prototype transportation.

*Figure 1: Map of the pilot sites and demonstration sites location*

## 2.4 Demosite details

*Table 2: Details information for the different demosites*

| Partners responsible | Technologies integration | Installation Complete (YES/NO) | Date of start-up | Flow ($m^3$/day) | Type of wastewater | Yearly average temperature (°C) |
|---|---|---|---|---|---|---|
| NUIG | Lumbrifilter | Yes | 01/06/2019 | 0.1 | Milking parlour washings and animal waste | 12 |
| DE5 | Lumbrifilter + UV | Yes | 10/04/2019 | 2 | Domestic wastewater | 14,8 |
| NBK | Lumbrifilter + daphniafilter | Yes | 12/04/2019 | 0.75 | Tertiary building wastewater | 13,8 |
| EKO | Lumbrifilter + daphniafilter + UV | Yes | 15/07/2019 | 3 | Domestic wastewater | 8,5 |
| SW | Lumbrifilter + daphniafilter + UV | Yes | 01/09/2019 | 1.5 | Domestic wastewater | 14 |
| ECO+RMC | Lumbrifilter + daphniafilter | Yes | 26/04/2019 | 2 | Domestic wastewater | 7,9 |
| UCU + GYA | Lumbrifilter + daphniafilter | Yes | 05/08/2019 | 2 | Domestic wastewater | 13,9 |
| BORDA | Lumbrifilter + daphniafilter + UV + BSP | Yes | 01/06/2019 | 1.5 | Domestic wastewater | 14,5 |
| BORDA | Lumbrifilter + daphniafilter + UV | Yes | 01/08/2019 | 1.5 | Domestic wastewater | 25,9 |
| UCSM | Lumbrifilter + daphniafilter + UV + BSP | Yes | 01/09/2019 | 1 | Domestic wastewater | 23,6 |
| LBT | Lumbricomposting | Yes | 11/08/2019 | 60 $m^3$ / year | Waste from fish farming | 7,9 |

# 3 Presentation of the demosite

## 3.1 Ireland – NUIG

Table 3: Key parameters of the NUIG demosite

| Design capacity | Source of wastewater | Technology | Partner responsible | Dimension of the system |
|---|---|---|---|---|
| 0.1 $m^3$/day | Milking parlour washings and animal waste | Lumbrifilter | NUIG | Lumbrifilter tank: 3 $m^3$ |


*Figure 2: Integration of the NUIG demosite*

Table 4: Timeline of the NUIG demosite preparatory and installation works:

| Crt. No. | Action | Details |
|---|---|---|
| 1. | Specific technical design – Irish demo-site layout | September 2018 |
| 2. | Tanks design validation | October 2018 |
| 3. | Technical project for construction authorization | December 2018 |
| 4. | Tanks manufacturing | January 2019 |
| 5. | Tanks delivery | February 2019 |
| 6. | Authorization | February 2019 |
| 7. | Installation | April 2019 |
| 8. | Start-up | May 2019 |

Table 5: Description of the NUIG demosite:

| Altitude | Yearly average temperature °c | Max/min temperature °c | Annual rainfall |
|---|---|---|---|
| 50 m | 12 °C | + 18°C / 3°C | 1400 mm |

The demosite is located in the farm in Craughwell, home to 100 dairy cows, milked twice a day. Around 5,000 litres per day of wastewater goes to the dairy parlour sump, containing animal waste and parlour washings waste.

*Photo 1: Context view of the demosite*

BENEFICIARIES: The INNOQUA system will treat some of the wastewater produced by parlour washings from the facility, while the rest will be stored in a holding tank then emptied by slurry spreading at specific times and within regulations. Beneficiaries include farms and similar agricultural facilities.

CONFIGURATION: The INNOQUA system consists of a lumbrifilter and primary settlement tanks connected to the dairy farm's milking parlour

Table 6: Influent quality at the NUIG demosite:

| Quality Parameter | Influent quality* |
|---|---|
| | mg/L |
| TSS | 1880 |
| COD | 6133 |
| Total N | 255 |
| Total P | 32.8 |

*Average

**According to Wastewater Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007) and Environmental Protection Agency (EPA)

SPECIFIC SCIENTIFIC RESEARCH OBJECTIVES: To demonstrate the versatility of the INNOQUA process in treating agricultural wastewater and enable improved management of wastewater at dairy farms.

*Photo 2: The Innoqua system on the NUIG's demosite.*

LOCATION: Privately owned dairy and cattle farm in
Craughwell (31 km from NUI Galway)
County Galway
Ireland

## 3.2 Italy – DE5

Table 7: Key parameters of the DE5 demosite

| Design capacity | Source of wastewater | Technology | Partner responsible | Dimension of the system |
|---|---|---|---|---|
| 2 $m^3$/day | Domestic | Lumbrifilter + UV | DE5 | Lumbrifilter: 2 $m^3$ |

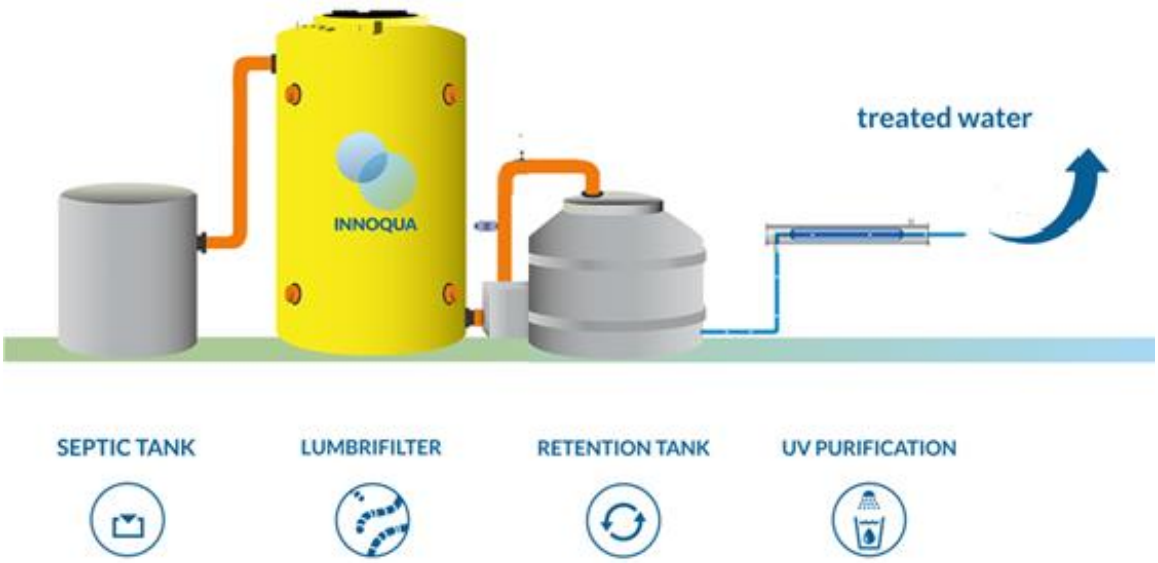


*Figure 3: Integration of the DE5 demosite*

Table 8: Timeline of the DE5 demosite preparatory and installation works:

| Crt. No. | Action | Details |
|---|---|---|
| 1. | Preliminary design of the system | 01/07/2017 |
| 2. | Construction of the surrounding infrastructures | 19/02/2018 |
| 3. | Schema update considering comments from technical partners (post meeting | 11/09/2018 |
| 4. | End of infrastructures construction | 30/05/2018 |
| 5. | First analysis (start date - end date) | 22/02/2019 - 01/03/2019 |
| 6. | UV-lamp arrived at demo site | 22/02/2019 |
| 7. | REDi tanks arrived at demo site | 28/03/2019 |
| 8. | MCU arrived at demo site | 02/05/2019 |
| 9. | REDI arrives for the first time | 03/05/2019 |
| 10 | Filing the Lumbrifilter with needed materials and starting to discharge in it | 24/05/2019 |
| 11 | Inoculation worms and continuing discharging in it | 07/06/2019 |

Table 9: Description of the DE5 demosite

| Altitude | Yearly average temperature °c | Max/min temperature °c | Annual rainfall |
|---|---|---|---|
| 0 m | 14.8 °C | + 22°C / +8°C | 710 mm |

This demosite is implemented in the city of Vasto located at the Adriatic coast of Italy in the region Abruzzo which is located in the centre of the Italian peninsula. The population amounts to approximately 42.000 people. The city is the 3rd of the administrative province Chieti regarding the territory extension: 71,35 km².

In terms of sanitation this is an important point because there are 19 village fractions which are not fully seved by the public sewage-network. The site is located close to the sea in a touristic region where the bathing water is monitored to respect the European bathing Directive, especially in terms of microbiological load (*E.coli*, *Enterococcus*).

*Photo 3: Context view of the demosite*

BENEFICIARIES: The INNOQUA system treats the wastewater from the Canale House: A single-family house with 4 inhabitants.

Table 10: Influent quality and treatment target of the DE5 demosite:

| Quality Parameter | Influent quality | Discharge limits * | Minimum removal* |
|---|---|---|---|
| | mg/L | | % |
| TSS | 149±60 | 200 | 50 |
| COD | 909±11 | 500 | 70 |
| BOD5 | 422±51 | 250 | 70 |
| Total N | 136±9 | 15 | |
| Total P | 12±1 | 2 | |

*According to D. Lgs. 152/2006 - L.R 17/2008 Regione Abruzzo

SPECIFIC SCIENTIFIC RESEARCH OBJECTIVES: To assess the potential for the INNOQUA technology to be implemented in really small building with a strong integration work and for a 4 PE system.


*Photo 4: Innoqua system on the DE5 demosite*

CONFIGURATION: In Italy the INNOQUA system consists of a lumbrifilter installed on the outflow from a septic tank. The system is completed by an UV disinfection system to ensure microbial quality suitable for discharge into coatline seawater .

LOCATION: c.da Canale,
66050 Vasto (CH)
Italy

## 3.3 France – Nobatek

Table 11: Key parameters of the NBK demosite

| Design capacity | Source of wastewater | Technology | Partner responsible | Dimension of the system |
|---|---|---|---|---|
| 0.6 $m^3$/day | Tertiary building Mainly black water. | Lumbrifilter + Daphniafilter | Nobatek | Lumbrifilter: 3 $m^3$ Daphniafilter: 1 $m^3$ |


*Figure 4: Integration of the NBK demosite*

Table 12: Timeline of the NBK demosite preparatory and installation works:

| Crt. No. | Action | Details |
|---|---|---|
| 1. | Specific technical design and validation with local authorities– | September 2018 |
| 2. | Preparatory works | November 2018 |
| 3. | Tanks design validation | October 2018 |
| 4. | Tanks manufacturing | January 2019 |
| 5. | Tanks delivery | 28th of February 2019 |
| 6 | Installation | March-April 2019 |
| 7. | Start-up | April 2019 |

Table 13: Description of NBK demosite:

| Altitude: | Yearly average temperature °c: | Annual temperature range max/min °c | Annual rainfall |
|---|---|---|---|
| 30 m | 13.8 °C | + 27°C / -5°C | 1200 mm |

The demosite is installed in the NOBATEK offices in the city of Anglet. This city is located in the western part of France close to the Spanish boarder. In France, where 70 billion peoples live, 20 % to 30% of the population are using onsite sanitation system. The INNOQUA system treats the wastewater from the headquarters of NOBATEK/INEF4. This office building is home to research and technology organisation built in 2009.

*Photo 5: Context view of the demosite, the Nobatek's headquaters*

BENEFICIARIES: The building host around 30 employees working on the green building technologies field, programming and energy efficiency and the open innovation management sector.

CONFIGURATION: In France the INNOQUA system consists of a lumbrifilter and a daphniafilter installed outside on a concrete platform. The system is plugged on the wastewater network and after treatment the water goes by gravity to the municipal network.

Table 14: Influent quality and treatment target of the NBK demosite:

| Quality Parameter | Influent quality | Discharge limits * |
|---|---|---|
| | mg/L | |
| TSS | 624±200 | 35 |
| COD | 1382±700 | |
| BOD5 | 533±200 | 30 |
| $N\text{-}NH4^{+}$ | 183±30 | |

*According to Arrêté du 7 septembre 2009

SPECIFIC SCIENTIFIC RESEARCH OBJECTIVES:

To assess the potential for the INNOQUA technology to be implemented on a tertiary building. This site provides an excellent real-life demonstration in a modern office building with an energy and environmentally aware demographic.

*Photo 6: Innoqua system on NBK demosite*

LOCATION: 67 rue de Mirambeau
Anglet - 64600
France

## 3.4 Scotland - Scottish Water

Table 15: Key parameters of the SW demosite

| Design capacity | Source of wastewater | Technology | Partner responsible | Dimension of the system |
|---|---|---|---|---|
| 1.5m$^3$/day | Domestic | Lumbrifilter + Daphniafilter + UV | Scottish Water | Lumbrifilter: 6 m$^3$<br>Daphniafilter: 3 m$^3$ |


*Figure 5: Integration of the SW demosite*

Table 16: Timeline of the SW demosite preparatory and installation works:

| Crt. No. | Action | Details |
|---|---|---|
| 1. | Specific technical design –Scotland demo-site layout | November 2018 |
| 2. | Tanks design validation | October 2018 |
| 4. | Tanks manufacturing | January 2019 |
| 5. | Tanks delivery | 4$^{th}$ March 2019 |
| 6. | Authorization | March 2019 |
| 3. | Technical project for construction authorization | June 2019 |
| 7. | Construction in workshop and Installation on site. | July - September 2019 |
| 8. | Start-up | September 2019 |

Table 17: Description of the SW demosite

| Altitude: | Yearly average temperature °c: | Max/min temperature °c | Annual rainfall |
|---|---|---|---|
| 90 m | 8.5 °C | + 14.8°C / +2.9°C | 706 mm |

This demosite is set in the village of Littlemill. This village is located in the north part of Scotland, in the Highlands. It has a population of approximately 16 people (number can vary in summer), living in approximately 14 households. The entire village of Littlemill is served by wastewater treatment works (WWTW) consisting of Submerged Aerated Filter (SAF).

BENEFICIARIES: The INNOQUA system will treat the wastewater from the Littlemill village.

*Photo 7: Context view of the demosite, aerial view of the housing*

Table 18: Influent quality and treatment target of the SW demosite:

| Quality Parameter | Influent quality | Discharge limits * |
|---|---|---|
| | mg/L | |
| TSS | 73±34 | 35 |
| COD | 383±53 | 125 |
| BOD5 | 185±30 | 25 |
| $N\text{-}NH4^{+}$ | 35±6 | 25 |
| $N\text{-}NO_3^{-}$ | 0.38±0 | |
| Total N | 39±3 | |

SPECIFIC SCIENTIFIC RESEARCH OBJECTIVES:

To assess the potential for the INNOQUA technology to be implemented at a small-scale domestic site with existing sewer system, and in potentially sever weather conditions.

*Photo 8: The Innoqua system on SW demosite*

CONFIGURATION: In Scotland the INNOQUA system consists of a lumbrifilter and a daphniafilter installed at a side stream of an existing WWTW SAF (Submerged Aerated Filter).

LOCATION: Littlemill WWTW, Nairn
IV12 5QL
Scotland

## 3.5 Turkey – EKO

Table 19: Key parameters of the EKO demosite

| Design capacity | Source of wastewater | Technology | Partner responsible | Dimension of the system |
|---|---|---|---|---|
| 3 $m^3$/day | Domestic | Lumbrifilter + Daphniafilter + UV | EKO | Lumbrifilter: 6 $m^3$<br>Daphniafilter: 3 $m^3$ |


*Figure 6: Integration of the EKO demosite*

Table 20: Timeline of the EKO demosite preparatory and installation works:

| Crt. No. | Action | Date |
|---|---|---|
| 1 | Specific technical design –Sinop demo-site layout | August 2018 |
| 2 | Approval for the installation of the UV system in Sinop | October 2018 |
| 3 | Tanks design validation | February 2019 |
| 4 | Shipment of tanks (lumbrifilter and daphnifilter) and MCU from Italy to Sinop | March-April 2019 |
| 5 | Shipment of UV lamp from the Netherlands to Sinop | May 2019 |
| 6 | Delivery of UV lamp to EKODENGE | 10th May 2019 |
| 7 | Tanks delivery | 24th of March 2019 |
| 8 | Installation lumbrifilter, daphnifilter, MCU and UV lamp | June 2019 |
| 9 | Start-up of the system | 9th of July |

Table 21: Description of the EKO demosite:

| Altitude: | Yearly average temperature °c: | Max/min temperature °c | Annual rainfall |
|---|---|---|---|
| 0 m | 14 °C | + 22°C / + 6°C | 668 mm |

The demosite has been built in Sinop located in the northern part of Turkey in the Black Sea Region. It has a population of 200,000 people living in city center and nearby villages. Almost 90% of the population have access to centralised sewage system but the rest of 10% are using septic tanks as the main form of sanitation.

*Photo 9: Context view of the demosite, view of the housing*

BENEFICIARIES: The INNOQUA system treat the wastewater from residential complex with 8 detached houses and a social building. A residential site is hosting approximately 55 people.

Table 22: Influent quality and treatment target of the EKO demosite:

| Quality Parameter | Influent quality | Discharge limits * |
|---|---|---|
| | mg/L | |
| TSS | 220 | 30 |
| BOD5 | 220 | 30 |

* According to the Article 28 of the Regulation on Water Pollution Control (Su Kirliliği Kontrolü Yönetmeliği 31.12.2004 Official Gazette No: 25687)

SPECIFIC SCIENTIFIC RESEARCH OBJECTIVES: To assess the potential for the INNOQUA technology to be implemented on residential housings.

*Photo 10: The Innoqua system on EKO demosite*

CONFIGURATION: In Turkey the INNOQUA system consists of a lumbrifilter, daphniafilter and a UV unit installed.

LOCATION: Lalaköy Köyü, Sahilkent Mahallesi
Doktorlar sitesi, Sinop
Turkey

## 3.6 Romania – ECOIND

Table 23: Key parameters of the ECOIND demosite

| Design capacity | Source of wastewater | Technology | Partner responsible | Dimension of the system |
|---|---|---|---|---|
| 2.4 $m^3$/day | Domestic (Touristic building+Offices) | Lumbrifilter + Daphniafilter | ECO +RMC | Lumbrifilter: 6 $m^3$ Daphniafilter: 3 $m^3$ |


*Figure 7: Integration of the ECOIND demosite*

Table 24: Timeline of the EKO demosite preparatory and installation works:

| Crt. No. | Action | Details |
|---|---|---|
| 1. | Specific technical design – Romanian demo-site layout | September 2019 |
| 2. | Preparatory works | February-March (influent line – pipes; platform for biofilter room) |
| 3. | Tanks design validation | October |
| 4. | Tanks manufacturing | 20th of February |
| 5. | Tanks delivery on-site | 26th of February |
| 6. | Technical project for construction authorization | December 2019 |
| 7. | Authorization | February 2019 |
| 8. | Installation | March-April 2019 |
| 9. | Start-up | April 2019 |

Table 25: Description of the ECOIND demosite:

| Altitude | Yearly average temperature °c | Max/min temperature °c | Annual rainfall |
|---|---|---|---|
| 407 m | 7.9 °C | + 25°C / -25°C | 600 mm |

The Romanian demo-site aims to demonstrate the long-term performance and suitability of decentralised wastewater treatment in real operational conditions in extreme weather conditions (-25 to +25 $^{0}$C).

Almost half of Romanian population lives in rural areas while only 10% of this population is connected to centralized wastewater collection and treatment systems – the remainder use or could use decentralized approaches. Moreover, agro-touristic/rural tourism has blossom during the last years creating also a potential niche market for decentralized wastewater treatment solutions.

*Photo 11: Context view of the demosite, the touristic building in winter and summer*

Due to high temperature variation, usual installation of decentralised wastewater treatment plants in Romania are either underground either in an underground/aboveground technical room. To keep the possibility of dissemination to larger audience and showcasing, the Innoqua system has been installed in an insulated biofilter room


*Photo 12: The Innoqua system on RMC + ECOIND demosite*

BENEFICIARIES:

The INNOQUA system will treat the wastewater from a touristic building (kitchen, toilets and showers) with 10 rooms, a restaurant (max. 80–100 places) and a conference hall (max. 40 places). The treated wastewater is discharged into nearby river

CONFIGURATION: Presettler - Lumbrifilter +Daphniafilter + MCU

Table 26: Influent quality and treatment target of the ECOIND demosite:

| Quality Parameter | Influent quality | Discharge limits * | Minimum removal* |
|---|---|---|---|
| | mg/L | | % |
| TSS | 100±25 | 60 | 70 |
| COD | 650±200 | 125 | 75 |
| BOD5 | 280±80 | 25 | 70 |
| $N\text{-}NH4^{+}$ | 32±5 | 3 | - |
| $N\text{-}NO_3^{-}$ | <0.01 | 8 | - |
| Total N | 58±5 | 15 | 70 |
| Total P | 4.5±1 | 2 | 80 |

* According to Romanian National Regulations for WWTPs <2000 p.e.

SPECIFIC SCIENTIFIC RESEARCH OBJECTIVES:

To assess the potential for Eastern European less deserved areas to transition towards sustainability, through the use of a robust, cold climate resilient and affordable wastewater treatment solution.

LOCATION : Ilisesti 788,
Suceava,
Romania

## 3.7 Ecuador – GYA

Table 27: Key parameters of the GYA demosite

| Design capacity | Source of wastewater | Technology | Partner responsible | Dimension of the system |
|---|---|---|---|---|
| 2 $m^3$/day | Domestic | Lumbrifilter + Daphniafilter | GYA - UCU | Lumbrifilter: 1.5 $m^3$<br>Daphniafilter: 2 $m^3$ |


*Figure 8: Integration of the GYA demosite*

Table 28: Timeline of the GYA demosite preparatory and installation works:

| Crt. No. | Action | Date |
|---|---|---|
| 1 | Preparation works 1 for the site of Quito: separation of the rainwater and wastewater collection system in the pilot site | April 2017 |
| 2 | Pilot site description: effluent requirements and technologies | April 2018 |
| 3 | Implementation plans | July 2018 |
| 4 | Tanks design validation and detailed implementation plan | November 2018 |
| 5 | Detailed budget planning (pumps, measurement equipment, monitoring process, etc.) and organization of the public tender processes | January 2019 |
| 6 | Preparation works 2: removal of the garden, digging of the implantation, concrete slab and walls, plumbing and electricity connections | January-March 2019 |
| 8 | Tank delivery in Guayaquil (Ecuadorian customs) | 6th of April 2019 |
| 9 | Delivery of the MCU; solutioning of some connection's issues | April 2019 |
| 10 | Delivery of the equipment (settlement tanks, pumps, etc.) | June 2019 |
| 11 | Delivery of the tanks in Quito | End of June 2019 |
| 12 | Start-up of the system | June 2019 |

Table 29: Description of the GYA demosite:

| Altitude | Yearly average temperature °c | Max/min temperature °c | Annual rainfall |
|---|---|---|---|
| 2832 m | 13.9 °C | + 14.1°C / +13.6°C | 1273 mm |

The demosite has been implemented in the city of Quito, the capital of Ecuador. It is located on the equator in the Andean region at 2800 m in altitude. It has a population of 2,6 Million people. Whereas the city is well covered with the municipal sewage network, more than 97% of the wastewater does not receive any treatment and is rejected, together with the rain water, in the local rivers.

BENEFICIARIES: The INNOQUA system treat the wastewater from a multifamily house located in the Miraflores district in the centre of the city. This building hosts 10 persons in 3 apartments and an office.

*Photo 13: Context view of the demosite, the multifamily house*

Table 30: Influent quality and treatment target of the GYA demosite:

| Quality Parameter | Influent quality | Discharge limits * | Minimum removal* |
|---|---|---|---|
| | mg/L | | % |
| TSS | 241 | 100 | |
| COD | 701 | 250 | |
| BOD5 | 418 | 100 | |
| $N\text{-}NH4^{+}$ | 93 | - | |

*Texto unificado de legislacion secundaria del Ministerio del Ambiente (TULSMA, 2015)- Libro VI, Anexo 1: Norma de calidad Ambiental y de descargua de efluentes - recurso agua: - discharge limits into freshwater

SPECIFIC SCIENTIFIC RESEARCH OBJECTIVES

To assess the potential for the INNOQUA technology to be implemented in Latin America but also to challenge the potential integration of the INNOQUA system in dense urban area.


*Photo 14: The Innoqua demosite on GYA + UCU demosite*

CONFIGURATION: In Quito the INNOQUA system consists of a lumbrifilter and a daphniafilter installed on the outflow from a settlement tank.

LOCATION: Armero OE7-261 y El Oro
Quito - 170521
Ecuador

## 3.8 Peru – UCSM

Table 31: Key parameters of the UCSM demosite

| Design capacity | Source of wastewater | Technology | Partner responsible | Dimension of the system |
|---|---|---|---|---|
| 1 $m^3$/day | Domestic + laboratories | Lumbrifilter + Daphniafilter + UV + BSP | UCSM | Lumbrifilter: 6 $m^3$<br>Daphniafilter: 1.5 $m^3$<br>BSP: 1.5 $m^3$ |

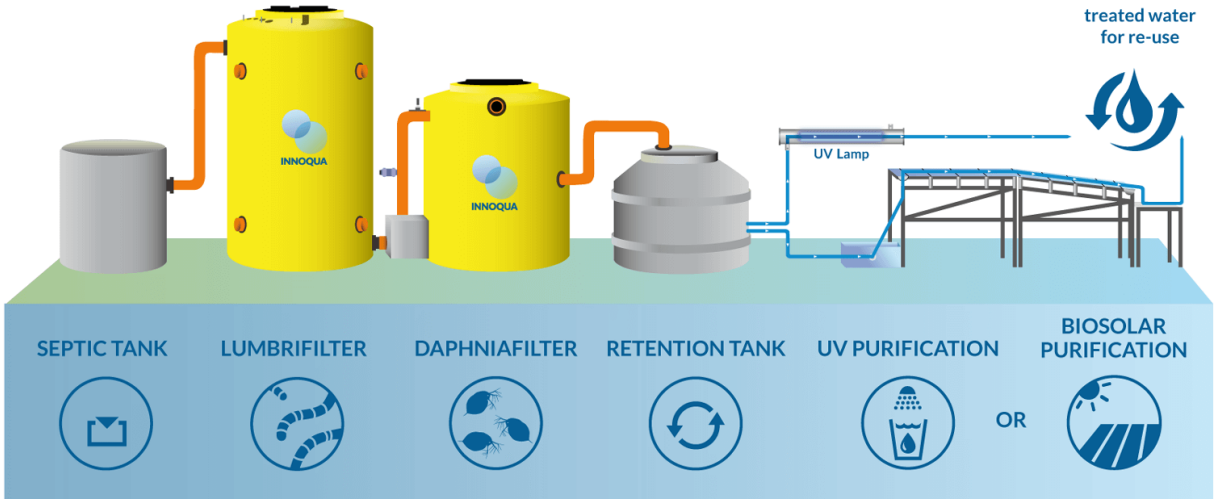


*Figure 9: Integration of the UCSM demosite*

Table 32: Timeline of the UCSM demosite preparatory and installation works:

| Crt. No. | Action | Details |
|---|---|---|
| 1. | First Specific technical design –Peruvian demo-site layout | August 2018 |
| 2. | Tanks design validation | December 2018 |
| 3. | Installation (civil engineering works) | May – June 2019 |
| 4. | LF and DF tanks delivery/arrival | 20th of April 2019 |
| 5. | MCU delivery/arrival | 14th of May 2019 |
| 6. | Final Specific technical design –Peruvian demo-site layout | July 2019 |
| 7. | Installation (reconfiguration/expansion according to suggestions) | July – August 2019 |
| 8. | UV delivery/arrival | 30th of July 2019 |
| 9. | MCU start-up for configuration | 6th of August 2019 |
| 10. | Start-up | September 2019 |

Table 33: Description of the UCSM demosite:

| Altitude: | Yearly average temperature °c: | Max/min temperature °c | Annual rainfall |
|---|---|---|---|
| 2348 m | 14.5 °C | + 15.3°C / + 13.2°C | 75 mm |

This demosite is installed in the city of Arequipa, located in the south region of Peru. It has a population of slightly more than one million people. Nearly 5% of the population lack access to water and 15% lack access to sanitation.

*Photo 15 Context view of the demosite, the university entrance*

BENEFICIARIES: The INNOQUA system treat the wastewater from Fundo Huasacache (one of the Campus of UCSM). This campus, with an area of 2000 $m^2$, is composed of classrooms, laboratories, greenhouses, sports and recreational spaces, and a small food court. It hosts approximately 350 students and 25 personnel each year.

All the waste water produced here – lacking proper treatment – ended up filtrating into the Socabaya river, located just outside the campus.

Table 34: Influent quality and treatment target of the UCSM demosite:

| Quality Parameter | Influent quality | Discharge limits * | Minimum removal* | Reuse limits** |
|---|---|---|---|---|
| | mg/L | | % | mg/L |
| TSS | 190 | 150 | | |
| COD | 800 | 200 | | 40 |
| BOD5 | 460 | 100 | | 15 |
| $N\text{-}NO_3^-$ | 18.5 | | | |
| Total N | 180.01 | | | 100 |
| Total P | 10.8 | | | |
| E. Coli | | | | 1000/100mL |

** According to Aprueba Límites Máximos Permisibles para los efluentes de Plantas de Tratamiento de Aguas Residuales Domésticas o MunicipalesDECRETO SUPREMONº 003-2010-MINAM

** According to Aprueban Estándares de Calidad Ambiental (ECA) para Agua y establecen Disposiciones Complementarias - Decreto Supremo - N° 004-2017-MINAM

## SPECIFIC SCIENTIFIC RESEARCH OBJECTIVES

To assess the potential for the INNOQUA technology to be implemented on a university campus where the water will be fully reuse for agricultural purpose and class.

*Photo 16: The Innoqua system on UCSM demosite*

CONFIGURATION: In Peru the INNOQUA system consists of a lumbrifilter (LF), a daphniafilter (DF), a BioSolar Purification System (BSP) and a UV system (UV) installed on the outflow from a septic tank. Different configurations are tested simultaneously: LF+DF+UV and LF+BSP.

LOCATION: Fundo La Banda s/n (Vía Paisajista),
Jacobo Hunter
Arequipa - 04001
Peru

## 3.9 Tanzania – BORDA

Table 35: Key parameters of the BORDA demosite

| Design capacity | Source of wastewater | Technology | Partner responsible | Dimension of the system |
|---|---|---|---|---|
| 1.5 $m^3$/day | Domestic | Lumbrifilter + Daphniafilter + UV | BORDA | Lumbrifilter: 6 $m^3$<br>Daphniafilter: 1.5 $m^3$ |

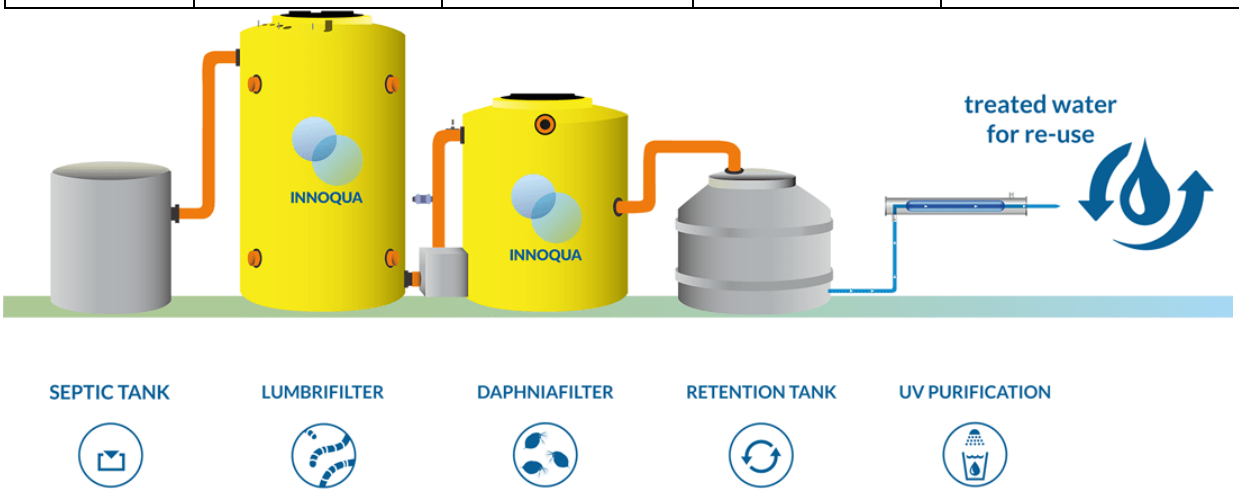


*Figure 10: Integration of the BORDA demosite*

Table 36: Timeline of the BORDA demosite preparatory and installation works:

| Crt. No. | Action | Date |
|---|---|---|
| 1 | Specific technical design –Tanzanian demo-site layout | August 2018 |
| 2 | Approval for the installation of the UV system in Mlalakuwa | December 2018 |
| 3 | Tanks design validation | February 2019 |
| 4 | Shipment of tanks (lumbrifilter and daphnifilter) from Italy to Tanzania | February 2019 |
| 5 | Shipment of UV lamp from the Netherlands to Tanzania | March 2019 |
| 6 | Site clearance and construction works in Tanzanian demosite | March 2019 |
| 7 | Delivery of UV lamp to BORDA Tanzania | April 2019 |
| 8 | Arrival of the tanks to Dar es Salaam, Tanzania | 2nd of May 2019 |
| 9 | Tanks delivery | 24th of May 2019 |
| 10 | Installation lumbrifilter, daphnifilter, MCU and UV lamp | June - July 2019 |
| 11 | Innoculation of lumbrifilter (15kg of earthworms) and start-up of the system | 19th of July |

Table 37: Description of the BORDA demosite:

| Altitude: | Yearly average temperature °c: | Max/min temperature °c | Annual rainfall |
|---|---|---|---|
| 16 m | 25.9 °C | + 27.9°C / + 23.8°C | 1089 mm |

This demosite is installed in the Mlalakuwa sub-ward located in the eastern part of Dar es Salaam. It has a population of 19,000 people living in approximately 1,000 households. Nearly 80% of the population use pit latrines (35%) and septic tanks (45%) as the main form of sanitation. Most of these facilities are emptied using illegal or unsafe practices, such as manual emptying with a bucket, “flooding out” or direct discharge to nearby water sources.

*Photo 17: Context view of the demosite, one of the five household*

BENEFICIARIES: The INNOQUA system will treat the wastewater from five households and will benefit 37 people from a middle and low-income community. The treated wastewater will be used for irrigation of an existing banana plantation.

CONFIGURATION: In Tanzania the INNOQUA system consists of a lumbrifilter, daphniafilter and UV lamp, installed on the outflow from a septic tank. The treated water is used for irrigation in a banana plantation.

Table 38: Influent quality and treatment target of the BORDA demosite:

| Quality Parameter | Influent quality | Discharge limits * | Minimum removal for discharge* | Reuse limit** |
|---|---|---|---|---|
| | mg/L | | % | mg/L |
| TSS | 95±15 | 100 | 70 | |
| COD | 511±10 | 60 | 75 | |
| BOD5 | | 30 | | |
| $N\text{-}NH4^{+}$ | 79±0 | | - | |

*According to Water Resources Management Act, 2009

SPECIFIC SCIENTIFIC RESEARCH OBJECTIVES: To assess the potential for Tanzania's sanitation sector to transition towards sustainability, through the integration of innovative decentralised sanitation systems with safe re-use of treated wastewater.

*Photo 18: The Innoqua system on BORDA - Tanzania demosite*

LOCATION: Mlalakuwa sub-ward
Kinondoni district
(Close to JW military base and Mwenge market)
Dar es Salaam, Tanzania

## 3.10 India – BORDA

Table 39: Key parameters of the BORDA demosite

| Design capacity | Source of wastewater | Technology | Partner responsible | Dimension of the system |
|---|---|---|---|---|
| 1.5 $m^3$/day | Domestic | Lumbrifilter + Daphniafilter + UV + BSP | BORDA | Lumbrifilter: 6 $m^3$ Daphniafilter: 1.1 $m^3$ |


*Figure 11: Integration of the BORDA demosite*

Table 40: Timeline of the BORDA demosite preparatory and installation works:

| Crt. No. | Action | Details |
|---|---|---|
| 1. | Specific technical design | September 2018 |
| 2. | Tanks design evaluation and validation | November 2018 |
| 3. | Technical project for construction authorization – interactions with community officers | November 2018 |
| 6. | System configuration, adaptation site design (UV system added) | December 2018 |
| 7. | Tanks delivery, Lumbrifilter and Daphniafilter | End of December 2018 |
| 10. | MCU delivery | January 2019 |
| 11. | UV lamp delivery | February 2019 |
| 12. | Installation of UV lamp, UV pumping tank | February 2019 |
| 14. | Electrical installation LF, DF and UV | May 2019 |
| 15. | Start-up of Lumbrifilter and Daphniafilter | April 2019 |
| 17. | BSP installation | Early September 2019 |
| 19. | BSP start up | September 2019 |

Table 41: Description of the BORDA demosite:

| Altitude: | Yearly average temperature °c: | Max/min temperature °c | Annual rainfall |
|---|---|---|---|
| 934 m | 23.6 °C | + 27.1°C / + 20.7°C | 831 mm |

This demosite is running in the Beedi Workers Colony is located in the south-western part of Bangalore, India. With a rapid urbanization and a growing population, water scarcity is becoming a major concern all over India and requires innovative and integrated approaches. The involved community is composed of more than 150 households with 5 persons per household on an average. Half of the community is connected to a decentralized wastewater treatment DEWATS, while the connection to a main sewerage system infrastructure is undergoing now.

*Photo 19: Context view of the demosite, the community.*

BENEFICIARIES: The INNOQUA system will treat the wastewater from ten households and will benefit people from a low-income community. The treated wastewater will be used for irrigating a community garden. With a high malnutrition observed amongst children in the community, the garden should provide vegetables and fruits to the nearby school to improve the diet of local children.

Table 42: Influent quality and treatment target of the BORDA demosite:

| Quality Parameter | Influent quality | Discharge limits * | Minimum removal* | Reuse limit ** |
|---|---|---|---|---|
| | mg/L | | % | |
| TSS | 3595±20 | 20 | | |
| COD | 3193±13 | 50 | | |
| BOD5 | 1050±50 | 10 | | ≤ 10 |
| E. Coli | | <100 | | None |

*According to the Government of India, Ministry of Urban Development, National Urban Sanitation Policy, 2008, 34

** According to the Karnataka State Pollution Control Board, November 16, 2007.

## SPECIFIC SCIENTIFIC RESEARCH OBJECTIVE

Sustainability transition in the wastewater sector and new alternative sanitation systems is this area where sanitation is a huge problem. A system able to provide treated water available for reuse using low energy and with low maintenance is required.

*Photo 20 The Innoqua system on BORDA- India demosite*

CONFIGURATION: In India the system includes a presettler, lumbrifilter as the first and secondary treatment stage, a daphniafilter and as tertiary treatment stages a biosolar purification or a UV lamp for final disinfection.

LOCATION: Beedi Workers Colony, BSM Extension,
Kengeri Satellite Town, Kommaghatta,
Bangalore 560060,
India

## 3.11 France – Lombritek

Table 43: Key parameters of the LBT demosite

| Design capacity | Source of wastewater | Technology | Partner responsible |
|---|---|---|---|
| 60m$^3$/year (agro-industrial sludge) | Waste from fish farming | Lumbricomposting | LBT |

Table 44: Timeline of the LBT demosite preparatory and installation works:

| Crt. No. | Action | Details |
|---|---|---|
| 1 | Letter of support for the Innoqua project, signed by the Director of the EPLEFPA of Lozère for the installation of a Demo Site in La Canourgue | November 2017 |
| 2 | Partnership agreement between LombriTek association and EPLEFPA, in the framework of the INNOQUA project | January 2018 |
| 3 | Agreement between LombriTek and EPLEFPA to present a complementary local financing file for major works | February 2018 |
| 4 | Application for the Certificate of Urbanism at the Town Hall of La Canourgue | February 2018 |
| 5 | Certificate of urbanism granted by the town hall of La Canourgue | April 2018 |
| 6 | Deposit of the project to the local financiers for obtaining the necessary subsidies to the project for the big works | November 2018 |
| 7 | License agreement to build the town of La Canourgue, after favourable opinion of the Departmental Unit of Architecture and Heritage | February 2019 |
| 8 | Grants granted by local funders (Occitan Region, Adour-Garonne Water Agency, Lozère Department, SDEE) | April 2019 |
| 9 | Phase-1 Works: earthworks, concrete slab, low wall, metal shelter, stainless steel grating and installation of electrical cabling | July 2019 |
| 10 | Phase-2: Earthworks and installation of the concrete slab | July 2019 |
| 11 | Phase-2: Construction of the lumbricomposting shed | August 2019 |
| 12 | Phase-1: Installation of equipment | August 2019 |
| 13 | Start of extraction of liquid sludge, filling of 4 containers (2m²) and thickening with untreated wood chips + green waste | August 2019 |

Table 45: Description of the LBT demosite:

| Altitude | Yearly average temperature °c | Max/min temperature °c | Annual rainfall |
|---|---|---|---|
| 556 m | 7.9 °C | + 20°C / + 5°C | 697 mm |

This demosite is implemented in La Canourgue, a French commune, located in the department of Lozere in region Occitania. The town is crossed by canals and has preserved a historic center consisting of narrow streets and historic buildings. It has a population of 2,100 people. Geographical location of the site, 160 km north of Montpellier (south of France).

*Photo 21: Context view of the demosite*

BENEFICIARIES: Agricultural high school Louis Pasteur

Table 46: Sludge quality and treatment target of the LBT demosite:

| Quality Parameter | Influent quality | Minimum removal for organic compost labellisation |
|---|---|---|
| | % | |
| Organic matter (OM) | 508 | >= 25% MB |
| Total Organic Carbon | 832 | |
| Total Nitrogen Kjeldahl | 86,40 | < 3% MB |
| Ammoniacal Nitrogen | 17,10 | - |
| Total Phosphorous | 114,00 | < 3% MB |
| Total Calcium | 562,00 | 70 |

| | | |
|---|---|---|
| Total Magnesium | 22,00 | 80 |
| Total Potassium | 9,39 | < 3% MB |
| Total Sodium | 2,88 | |

*According to Norme NF U 44-051: Amendements organiques - Dénominations spécifications et marquage.

*Photo 22: Lumbricomposting unit during one of our demosite visit*

CONFIGURATION: The sludge treatment system in two phases: in the first phase, a pumping, thickening and mixing of sludge with green waste occurs. The second step is composed of a fermentation (2 weeks), ripening process (10 weeks) and recovery of lumbricompost.

SPECIFIC SCIENTIFIC RESEARCH OBJECTIVES: Installation in France of a first demosite for the treatment of waste from fish farming and aquaponics, on a site with a national and international influence.

LOCATION: Ferme Aquacole de la Source du Frézal
LEGTA Louis Pasteur
Chemin Fraissinet
48500 La Canourgue
FRANCE

# 4 Conclusion

The deliverable D5.1 provides an overview of the installed demonstration sites. Despite the unfavourable circumstances (industrial partner withdrawal, BSP technology provider bankruptcy, etc), the consortium struggled to decrease as much as possible the delay of the installation works and the impact on the demonstration strategy as it has been described in the DoA, all of the demo-sites are installed, operational and under strict monitoring (see sampling and monitoring protocol in D.4.3.).

The deliverable was not intended and does not provide any treatment efficiency/ performance results of the INNOQUA systems installed. All the demonstration site are monitored through a common sampling and analysis protocol and the results will be presented in a global syntax document which is the D5.2 “Final monitoring report and assessment of each pilot site”; document which will include all water analysis and other technical parameters gathered during the whole demonstration phase.