सत्यमेव जयते

SWINGS

SAFEGUARDING WATER RESOURCES IN INDIA WITH GREEN AND SUSTAINABLE TECHNOLOGIES

www.swingsproject.com

ISWATS Conference, Pune (India), 22th April 2016

Outline

1. Aim and Objectives
2. SWINGS consortium
3. Work packages
4. Project execution: Pilot plants implementation, start up and operation, monitoring, decision support system.
5. Technological innovations (at AMU, Kalyani, IGNTU)
6. Outcomes, achievements and future prospects

Aim

To develop / deploy optimized schemes for low cost effective wastewater management (municipal ww) in order to make full use of water resources (irrigation, cleaning, public and/or private demands, aquaculture farm feed) and to minimise energy demands as a treatment option for rural and energy scarce towns in India.

SWINGS

Consortium

European partners

aimen — Spain

AARHUS UNIVERSITY — Denmark

UPC — Spain

LIMNOS — Slovenia

HELMHOLTZ ZENTRUM FÜR UMWELTFORSCHUNG UFZ — Germany

Kiliangwater — Denmark

AUTARCON — Germany

DHI — Denmark

SolarSpring — Germany

irstea — France

Indo-Europe
Water Technology Program

Indian partners

AMU

UPJN

Kalyani

ANN

IGNTU

UPPL

CBE

aarvee associates architects engineers & consultants pvt. ltd. — AARVEE

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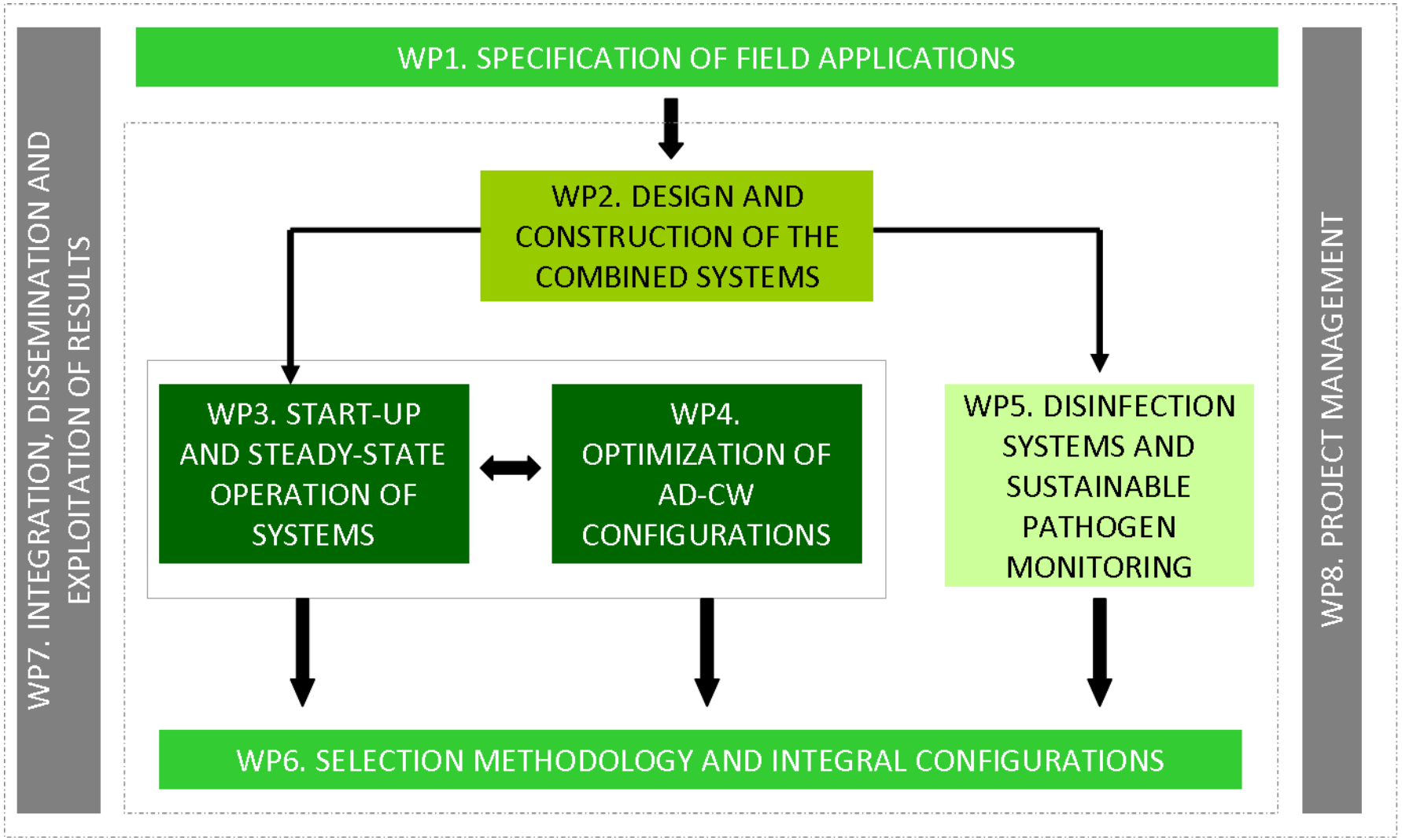
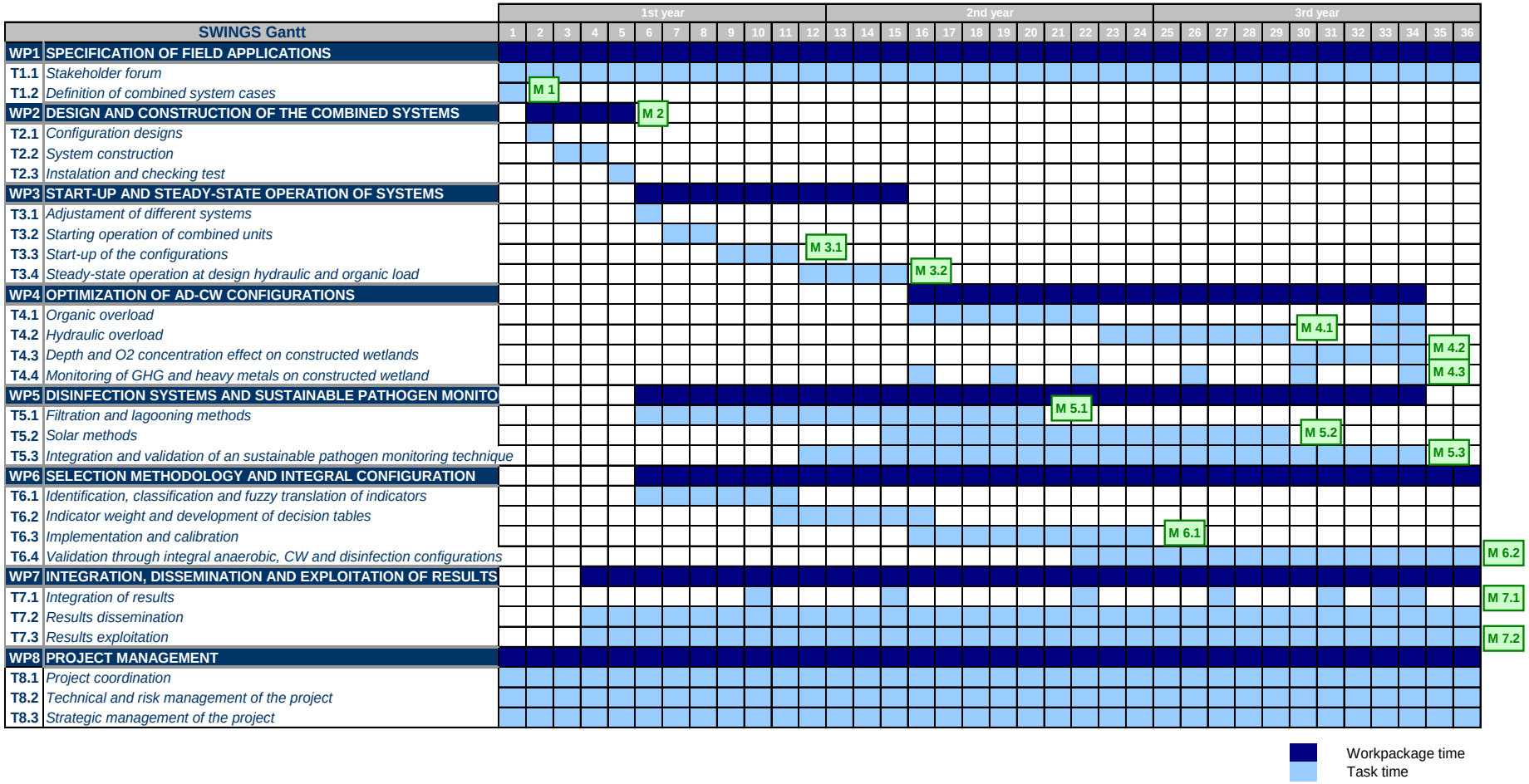
Work packages



Gantt Chart


1st year
2nd year
3rd year
SWINGS Gantt
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
WP1 SPECIFICATION OF FIELD APPLICATIONS
T1.1 Stakeholder forum
T1.2 Definition of combined system cases
M 1
WP2 DESIGN AND CONSTRUCTION OF THE COMBINED SYSTEMS
M 2
T2.1 Configuration designs
T2.2 System construction
T2.3 Instalation and checking test
WP3 START-UP AND STEADY-STATE OPERATION OF SYSTEMS
T3.1 Adjustament of different systems
T3.2 Starting operation of combined units
T3.3 Start-up of the configurations
T3.4 Steady-state operation at design hydraulic and organic load
M 3.1
M 3.2
WP4 OPTIMIZATION OF AD-CW CONFIGURATIONS
T4.1 Organic overload
T4.2 Hydraulic overload
T4.3 Depth and O2 concentration effect on constructed wetlands
T4.4 Monitoring of GHG and heavy metals on constructed wetland
M 4.1
M 4.2
M 4.3
WP5 DISINFECTION SYSTEMS AND SUSTAINABLE PATHOGEN MONITO
T5.1 Filtration and lagooning methods
T5.2 Solar methods
T5.3 Integration and validation of an sustainable pathogen monitoring technique
M 5.1
M 5.2
M 5.3
WP6 SELECTION METHODOLOGY AND INTEGRAL CONFIGURATION
T6.1 Identification, classification and fuzzy translation of indicators
T6.2 Indicator weight and development of decision tables
T6.3 Implementation and calibration
T6.4 Validation through integral anaerobic, CW and disinfection configurations
M 6.1
M 6.2
WP7 INTEGRATION, DISSEMINATION AND EXPLOITATION OF RESULTS
T7.1 Integration of results
T7.2 Results dissemination
T7.3 Results exploitation
M 7.1
M 7.2
WP8 PROJECT MANAGEMENT
T8.1 Project coordination
T8.2 Technical and risk management of the project
T8.3 Strategic management of the project
Workpackage time
Task time

Deliverables

1.Documentation of all of the pilot trials (5 Nos.) at different locations in India (D1.1, D2.1, D2.2, D2.3).

2.Documentation on integrated, optimized, and techno-economical aspects of the treatment methods/combinations (D2.4, D2.5, D3.3, D4.5, D7.3).

3.Documentation on overall performance evaluation by piloting proven technologies for solving water challenges and safe-guarding water resources (Reuse aspects) (D3.4, D4.5, D5.1, D5.2, D7.5).

4.Development of DSS and guidelines for technology application and design, and operating manual (D6.2, D6.3, D6.4).

5.Integration of Results for exploitation and dissemination through Websites, Conferences, Workshops and peer reviewed publications (D7.1, D7.2, D7.4).

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Location of pilot plants

Aligarh Muslim University, (AMU, Aligarh)

Kalyani University, (KLY, Kalyani)

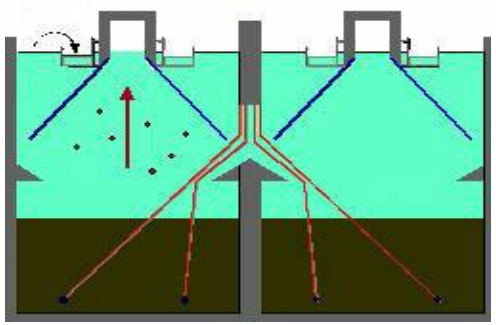
Indira Gandhi National Tribal University, (IGNTU, Amarkantak)

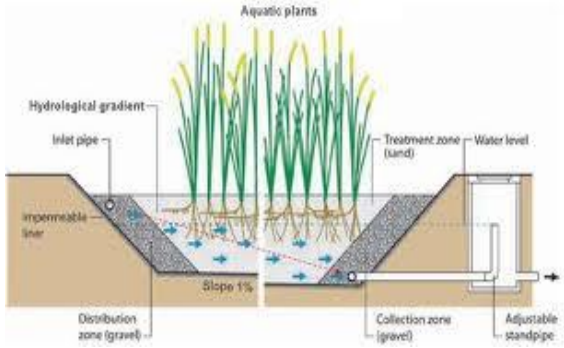
Technologies at AMU

Primary treatment (Anaerobic digestion)

Secondary treatment (Constructed wetlands)

Solar-driven disinfection





AO

UASB System

Vertical Flow and Horizontal Flow Sub-Surface CWs

UV

French System

Aquaculture Pond

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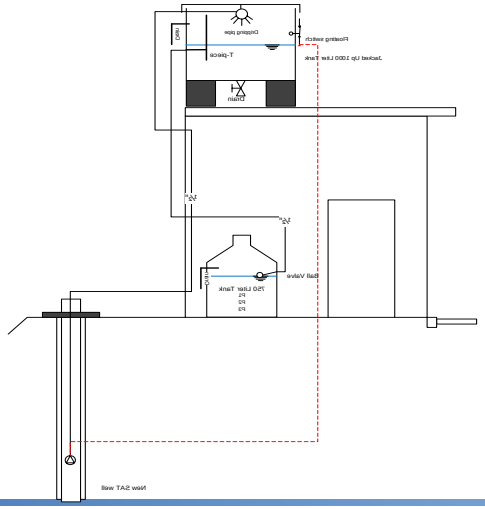
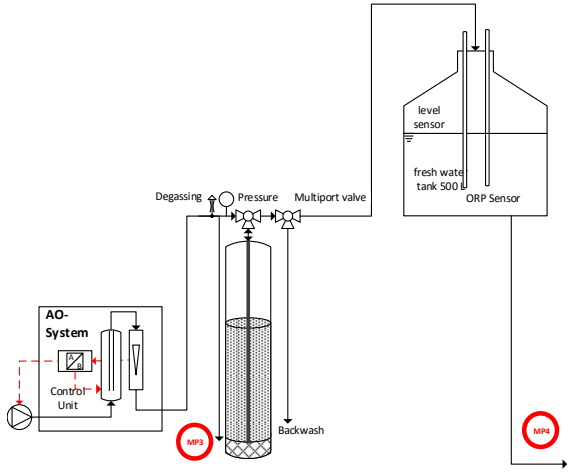
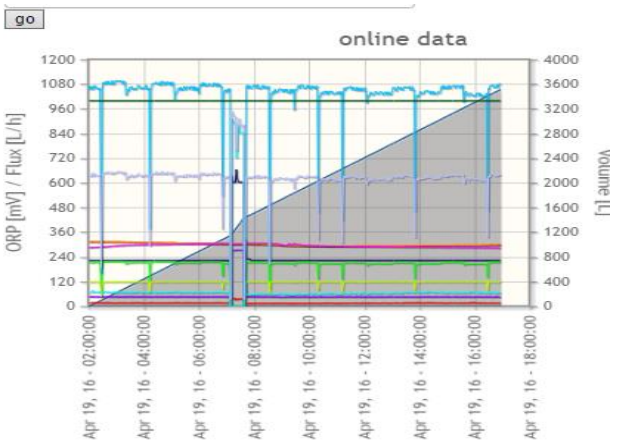
Technologies at Kalyani

Bank F /SAT → Solar driven disinfection → Monitoring, evaluation







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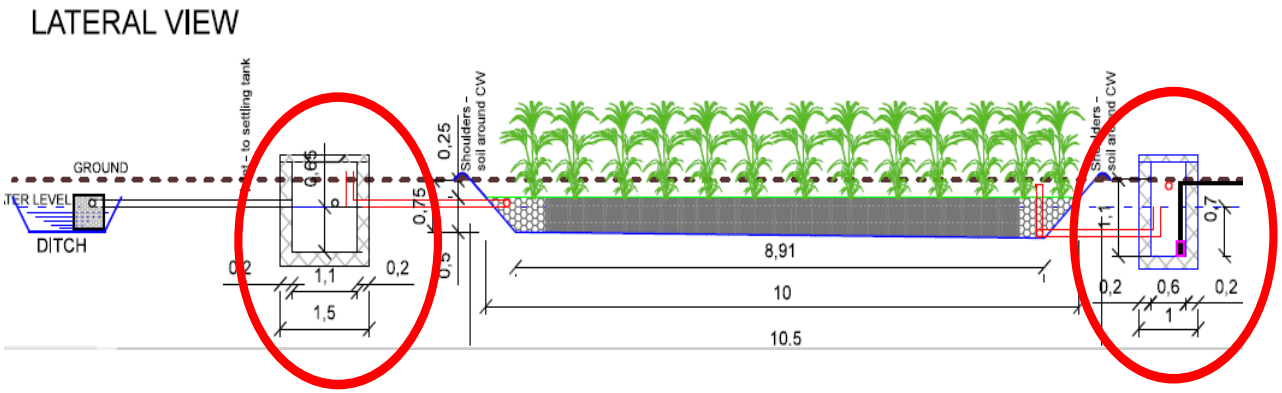
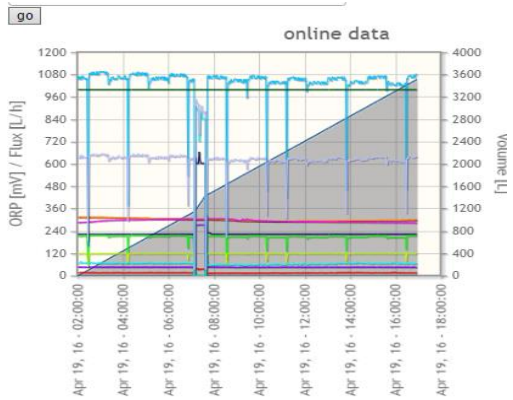
Technologies at IGNTU

Effluent polishing gravel bed → Solar driven disinfection → Operation, monitoring





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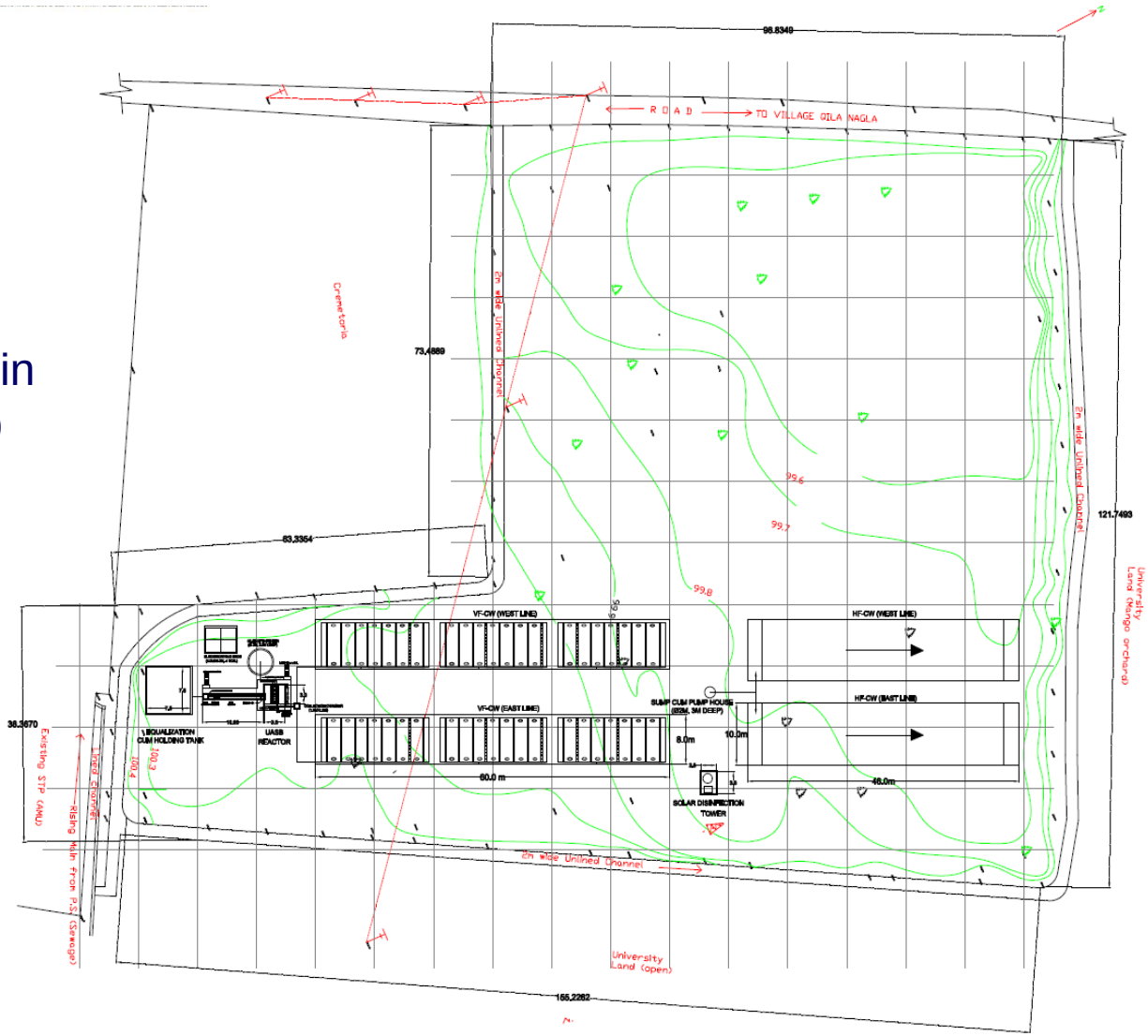
AMU site

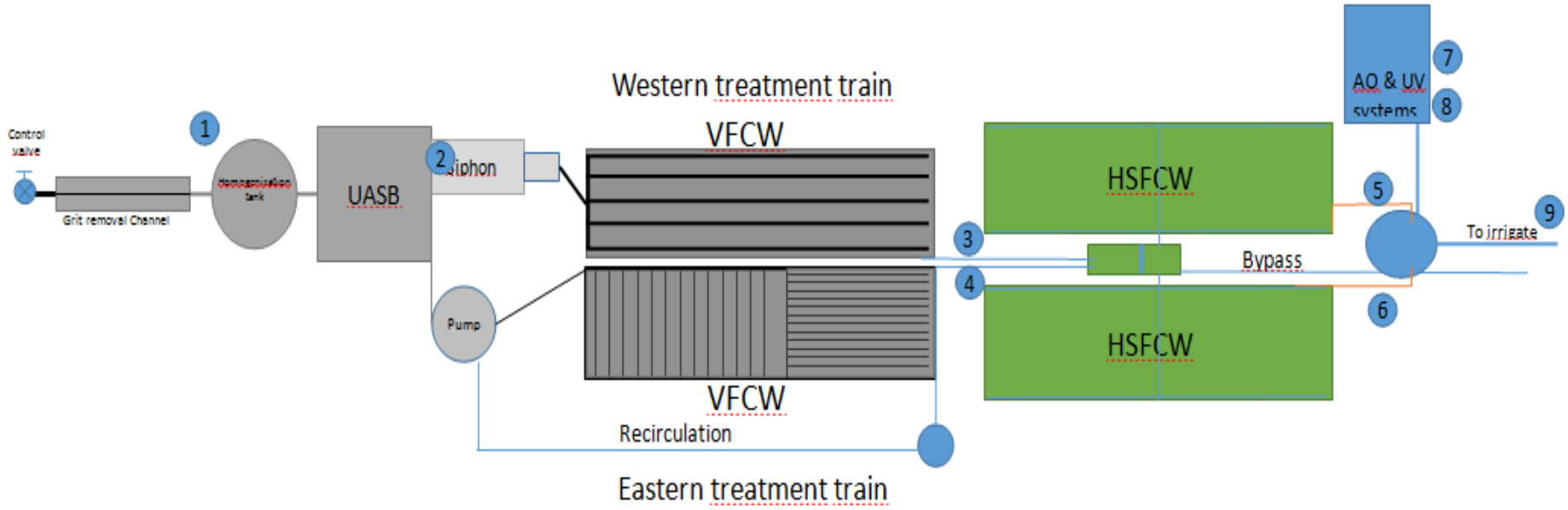
- Anaerobic digestion + vertical flow + horizontal flow
- Solar-driven disinfection systems (UV and AO)
- French CW + aquaculture

AMU AD-CW pilot plant design

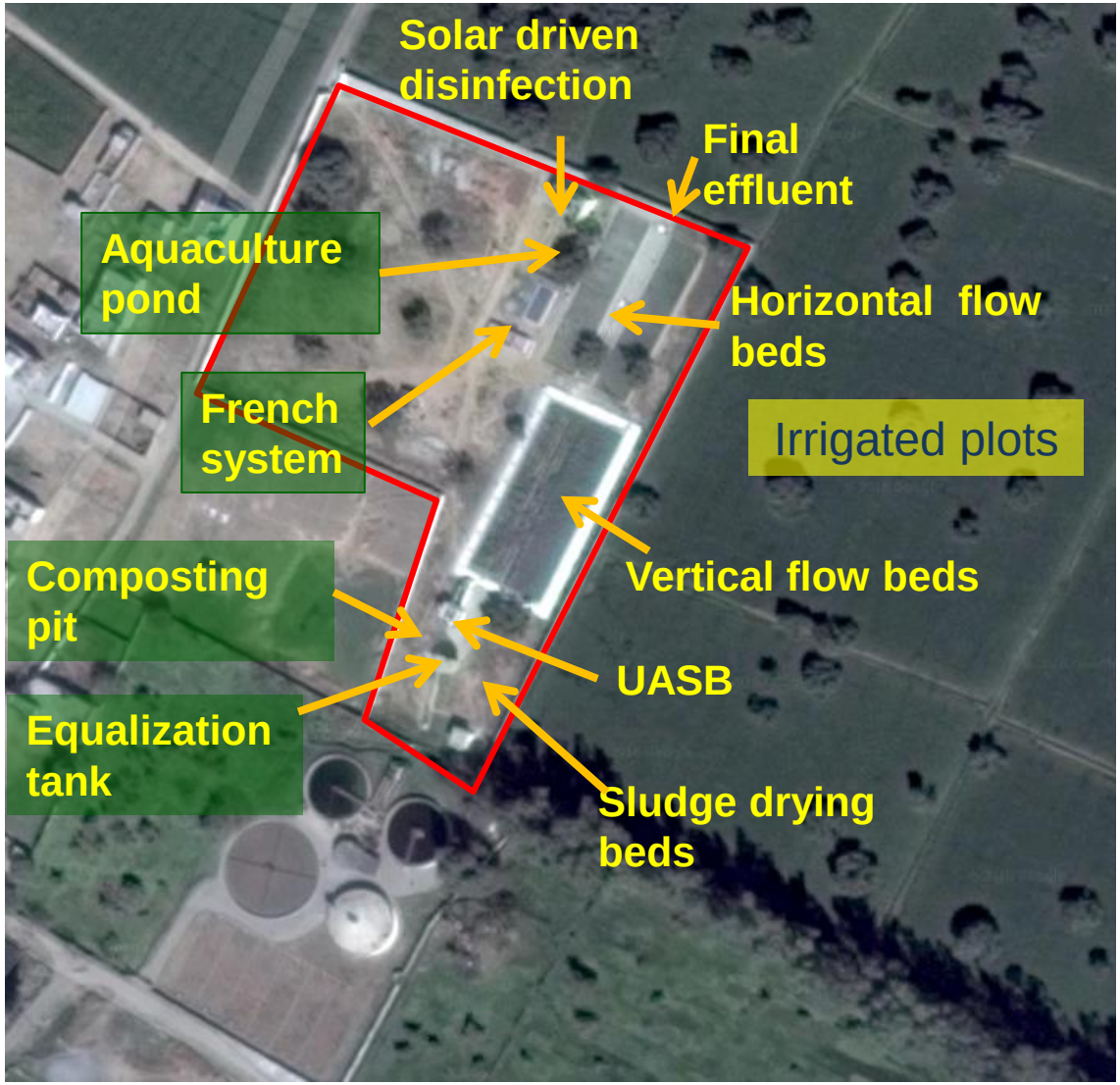
AMU plant train in topography map



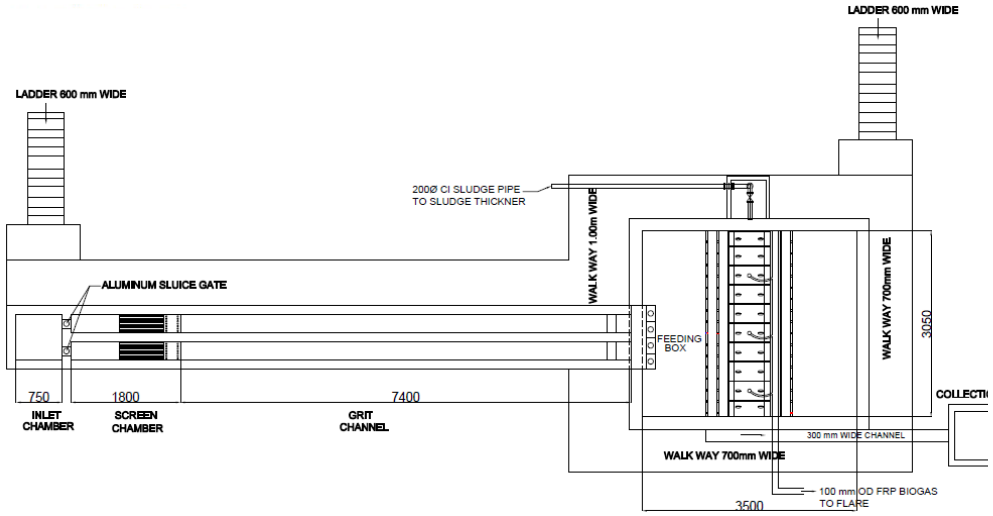
AMU AD-CW pilot plant design

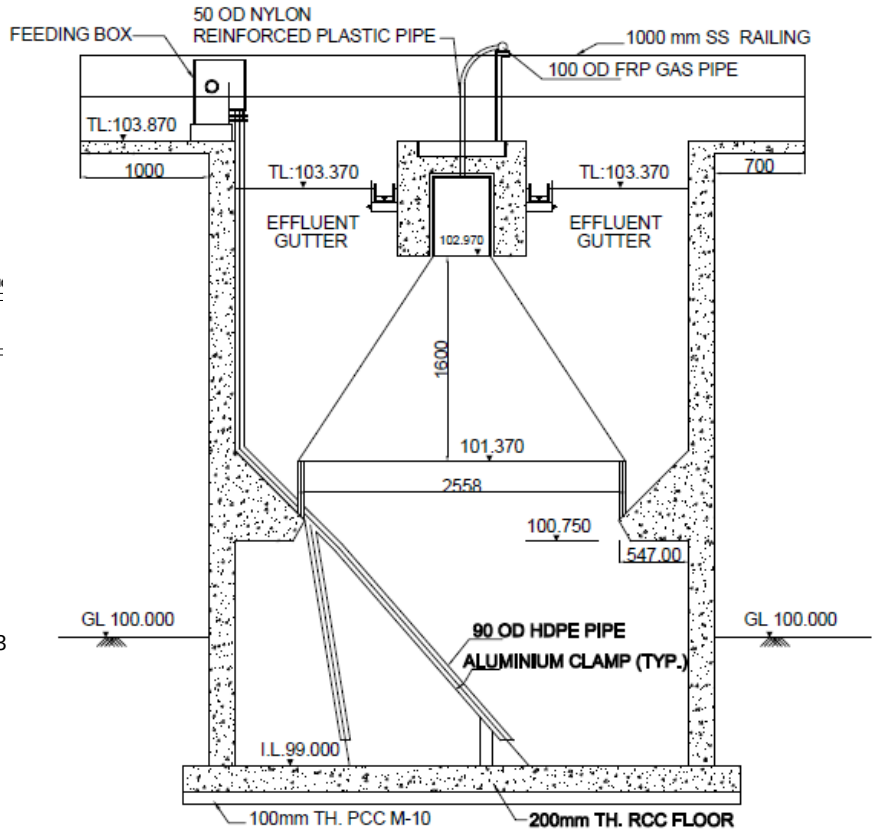


AMU AD-CW pilot plant construction



AMU AD-CW: Equalisation tank and UASB design





Design parameters for UASB

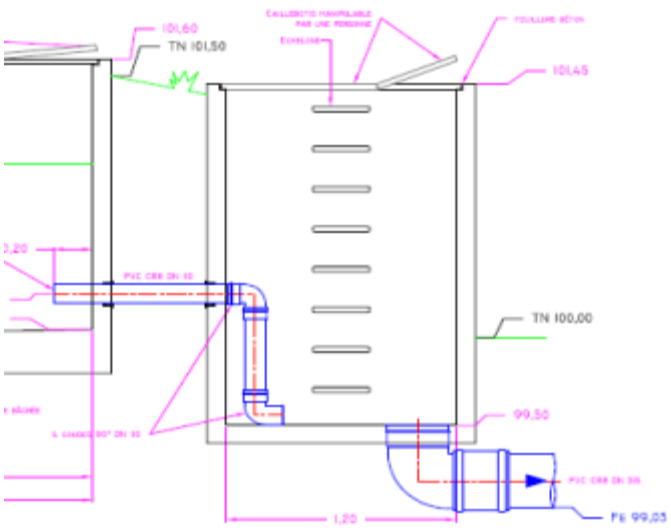
Dimensions (length/width/depth)	3.54/ 3.04/ 4.87	m
Volume	51.13	m^3
Sludge Bed Concentration	65 - 75	Kg TSS/m^3
Upflow Velocity at Avg. Flow	0.52-0.54	m/h
Min. hydraulic retention time (HRT)	7.0	hrs.
SRT at design temp.	35-40	days
VSS destruction in Reactor	50	%

AMU AD-CW: Equalisation tank and UASB construction

AMU AD-CW: UASB construction

AMU AD-CW: equalisation tank and UASB start-up and steady state

AMU AD-CW: Syphon construction for West Train



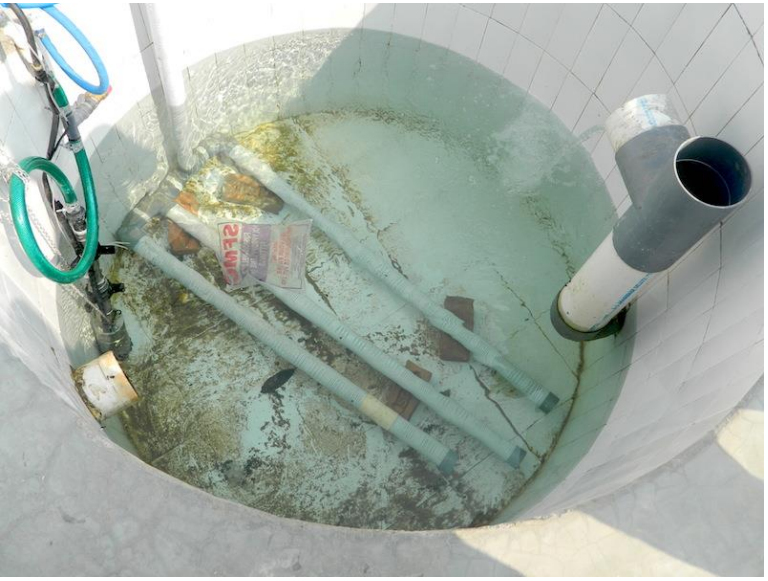
AMU AD-CW: West and East VF-CWs construction

AMU AD-CW: West and East VFCWs construction

AMU AD-CW: West and East VFCWs construction

AMU AD-CW: West and East HFCWs construction phase

AMU AD-CW: Planting of the beds and final effluent



HF CW at AMU –Sustainability for Plantation Process

Solar-driven disinfection systems

AMU French system

AMU FS pilot plant (30 PE) design

VF FS design

Flow	30	m^3/d
Dimensions	3.5/ 3.5/	
(length/width/depth)	0.8	m

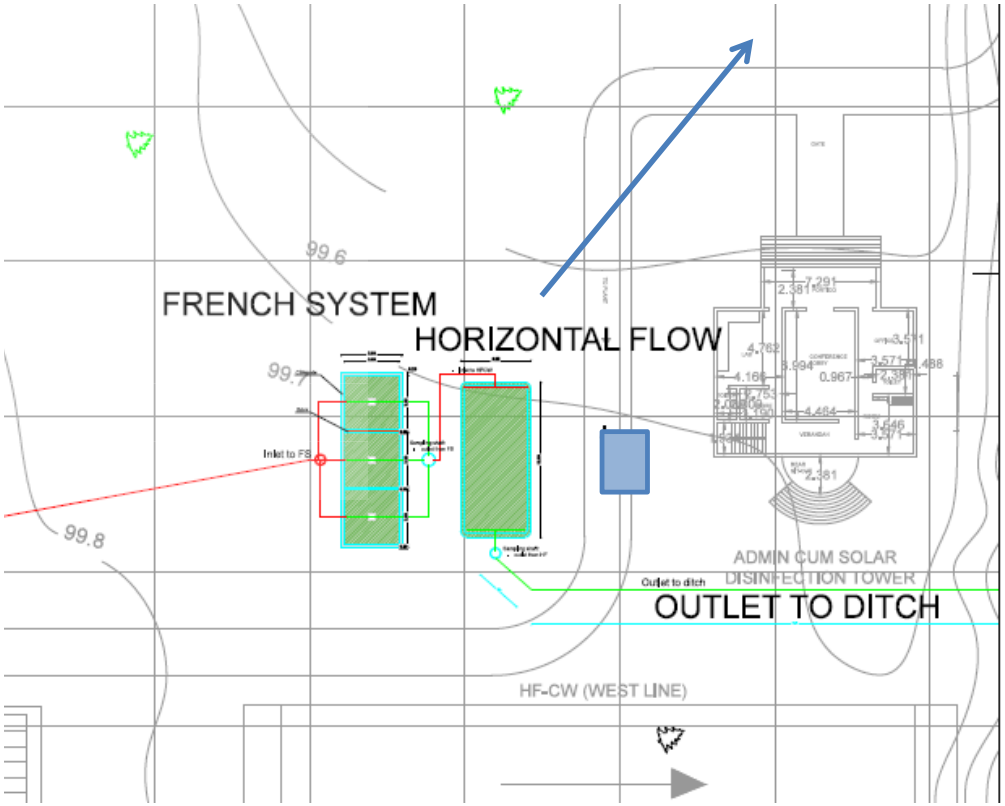
HF system

Dimensions	10/ 4.5/	
(length/width/depth)	0.5	m

Aquaculture pond

Volume	180	m^3
Diameter/ depth	15/ 12	m

AMU French system in topography map



AMU FS pilot plant under construction

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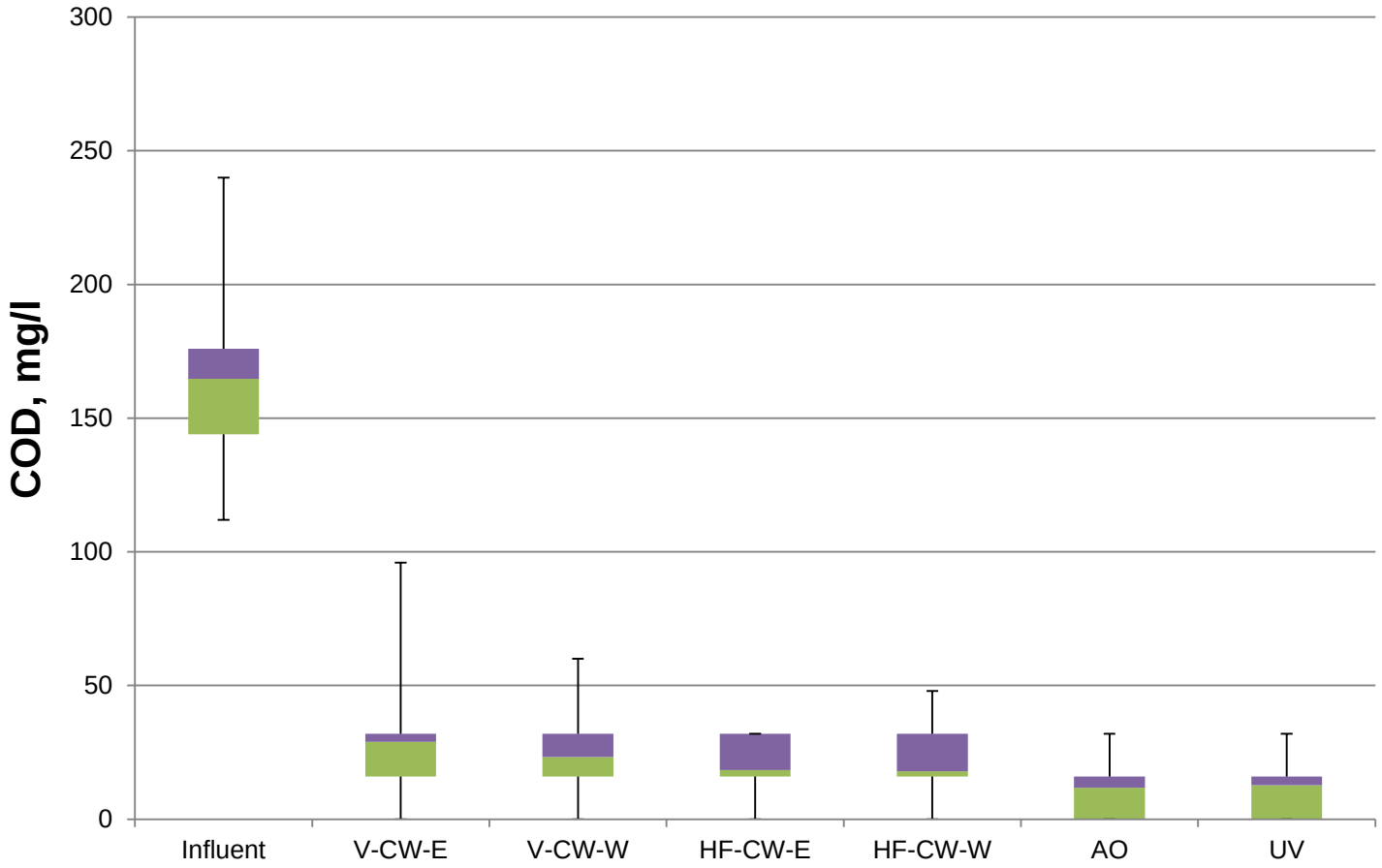
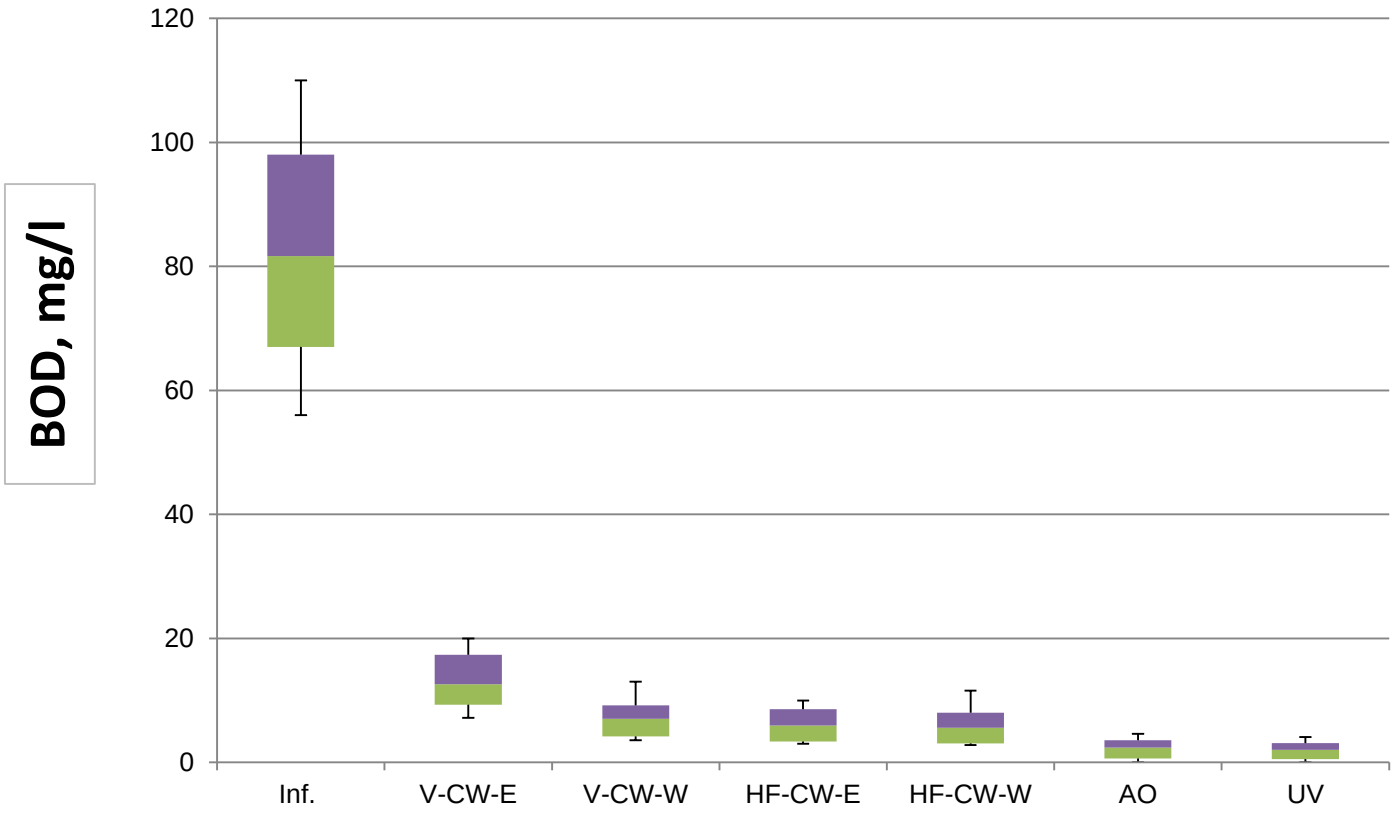
AMU FS pilot plant current status

Results of AMU Pilots

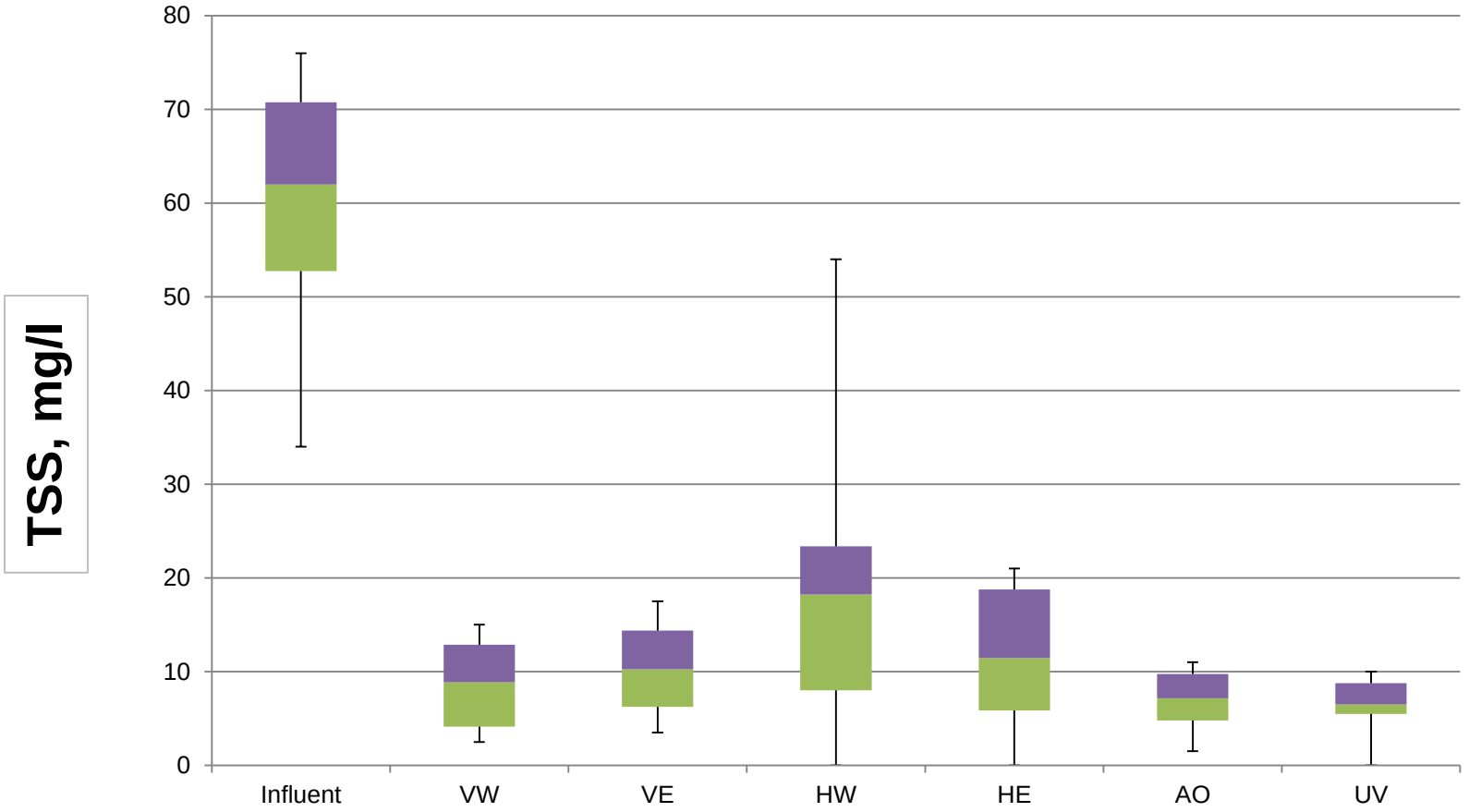
AMU AD-CW - steady state condition



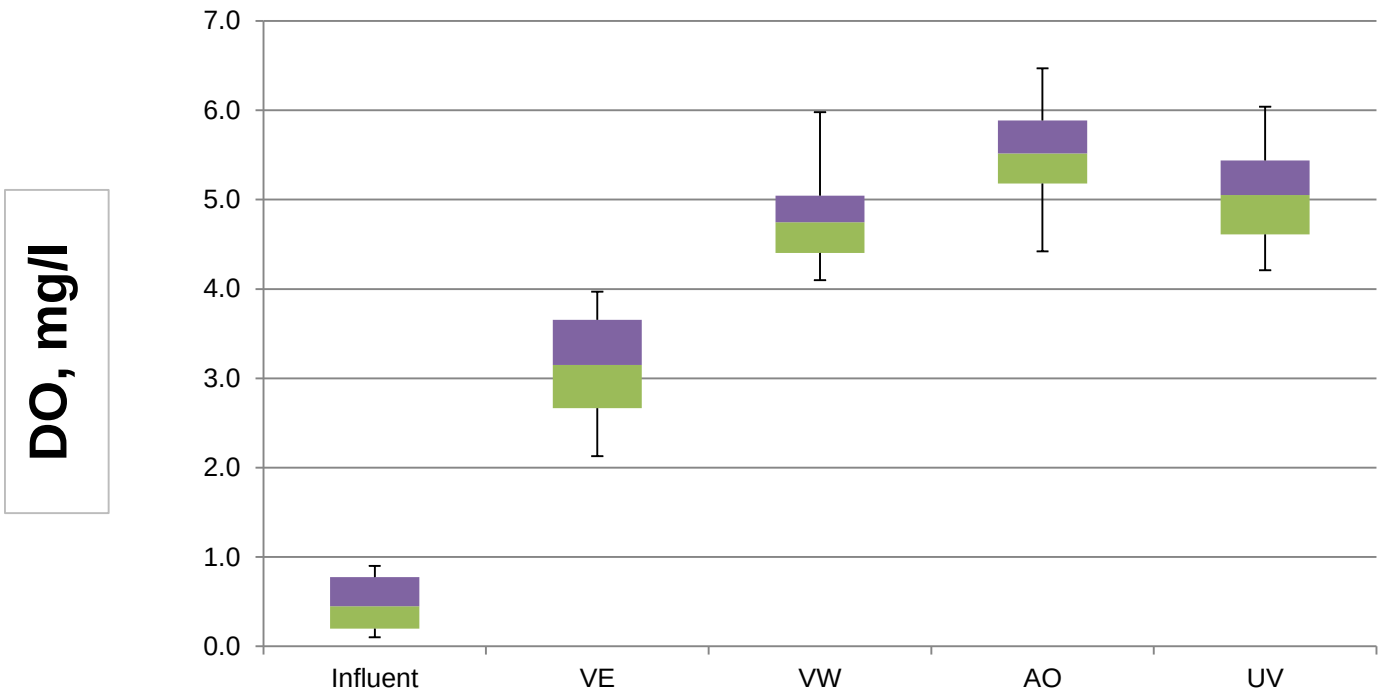
AMU AD-CW - steady state condition



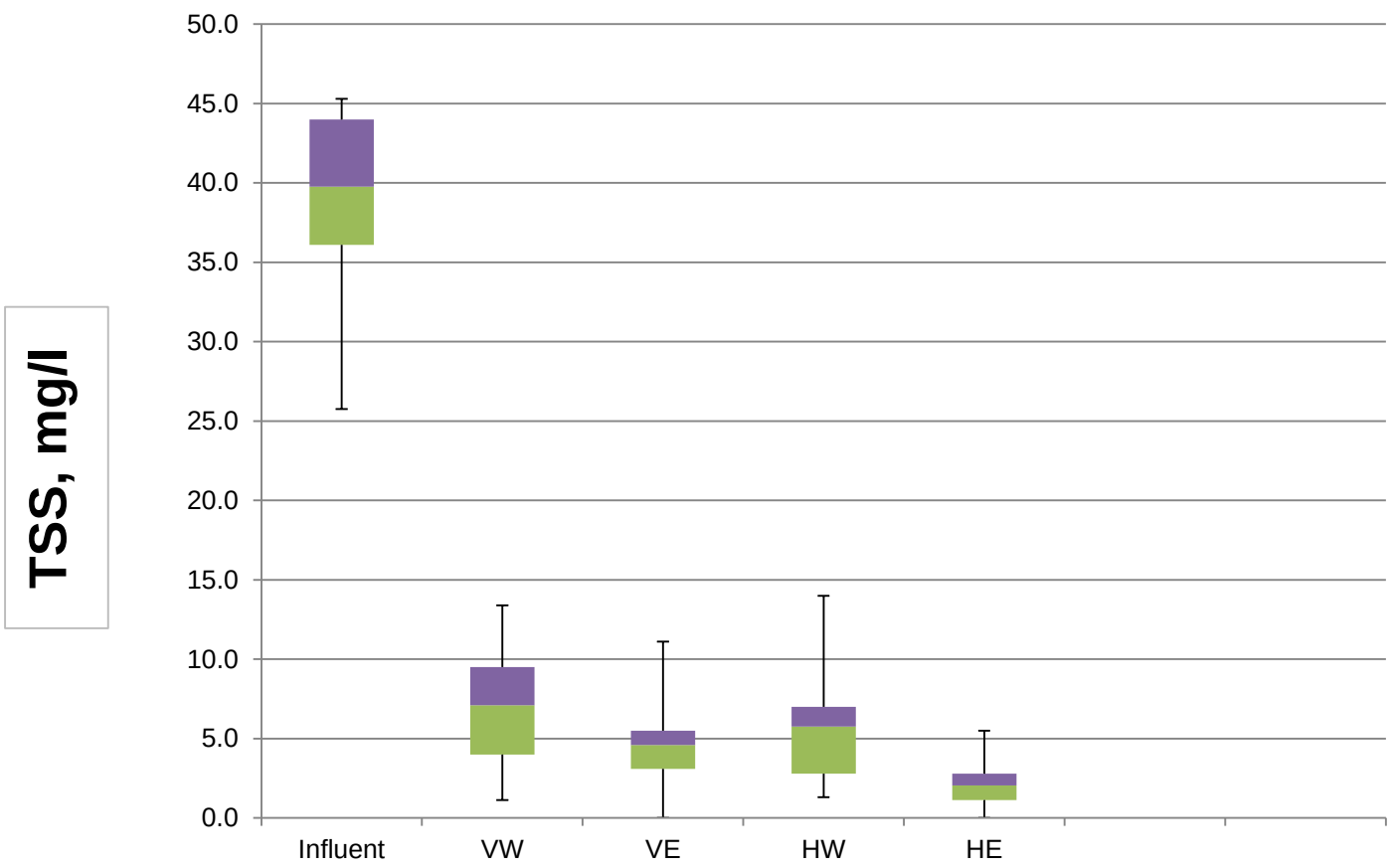
AMU AD-CW - steady state condition



AMU AD-CW - steady state condition



AMU AD-CW - steady state condition



Decision Support System

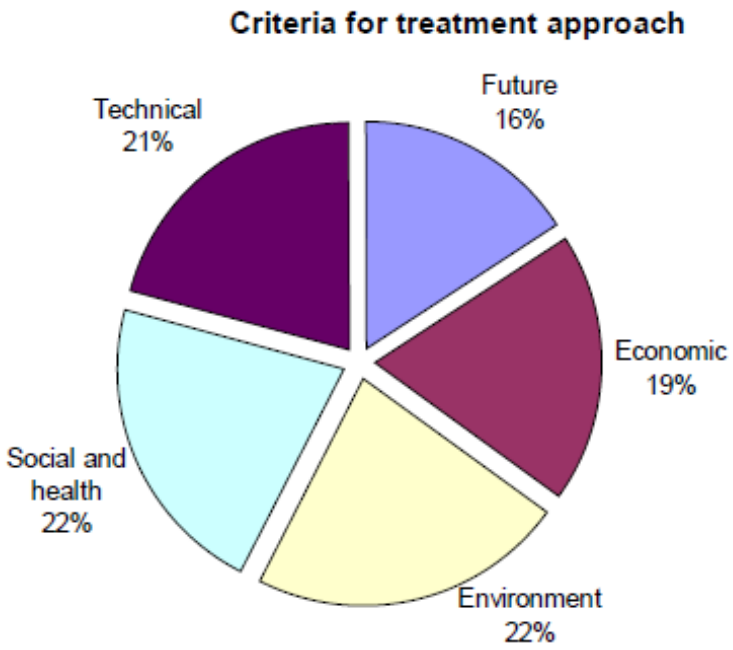
The Decision Support System (DSS) is to assist potential users (planers, decision makers of local authorities, etc.) in the selection of appropriate configurations of wastewater treatment technologies that can be used in a specific context or project.

The DSS includes three main components:

- A technological module based on the characteristics of the technologies integrated into the DSS and on the conditions of the project
- A criteria-selection module assessing the project through criteria whose importance is defined by the user
- An economic module providing a Dynamic Costs Comparison (DCC) (similar to a Life-Cycle Cost Assessment (LCCA)) assessing the cost of different treatment options

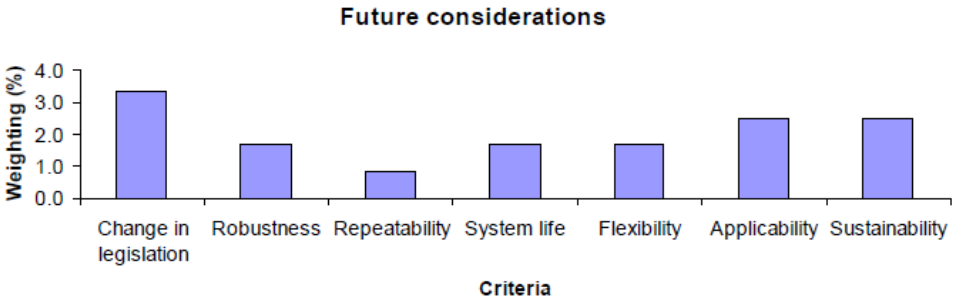
Decision Support System

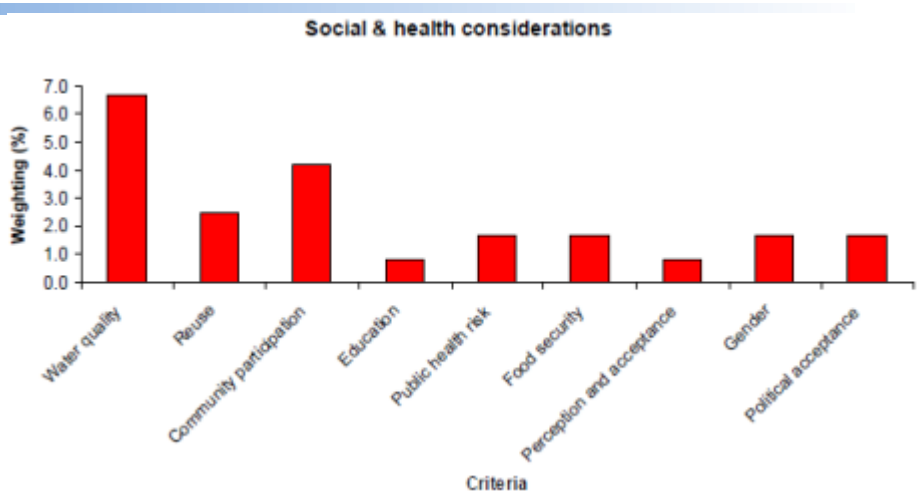
- An initial evaluation process was undertaken on the 25th April KO meeting 2013 (Delhi) to identify criteria for the assessment of WW treatment approaches
- Five broad criteria groups were selected: Future considerations, Economic considerations, Environmental considerations, Social and Health considerations and Technical considerations
- The initial results indicate that the broad criteria groups are approximately equal in importance or value with exception of Future considerations (16%)

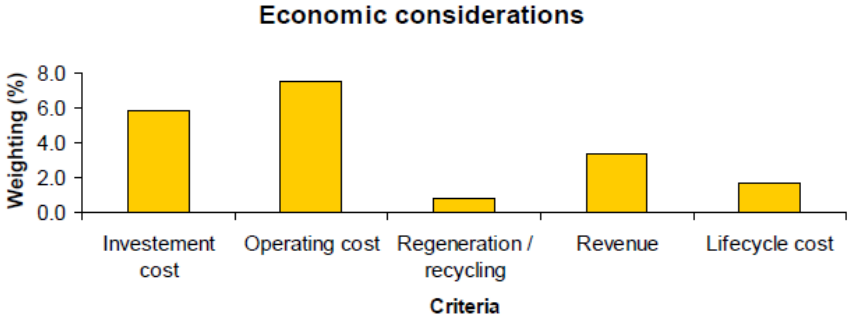


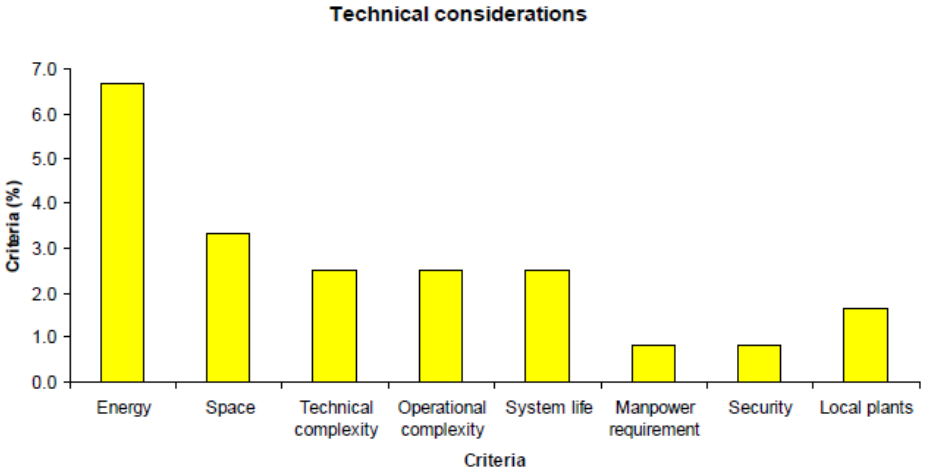
- Each criteria group was divided on sub-criteria and all of them were also weighted

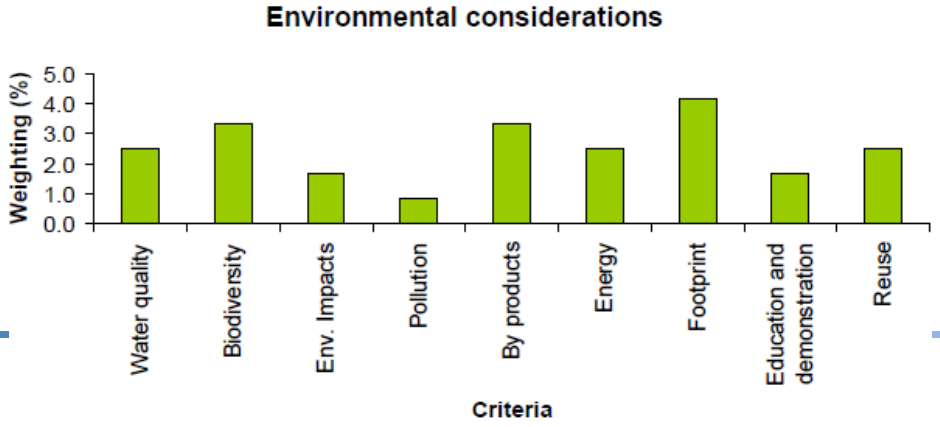
Identification, classification and fuzzy translation of indicators



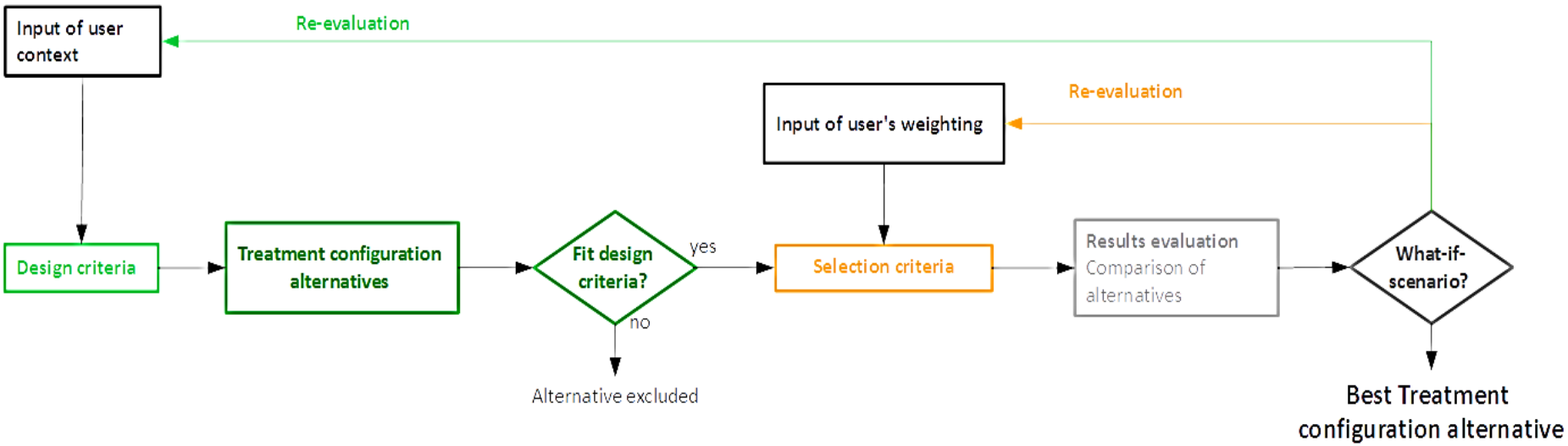








DSS logical process



DSS Validation

• Microsoft® Excel 2010 has been used to develop the DSS

• The DSS contains a user's interface, a database with facts about the technologies (applications, criteria, etc.), a treatment configuration alternative computation tool and a tool based on the programming language VBA to present the final results

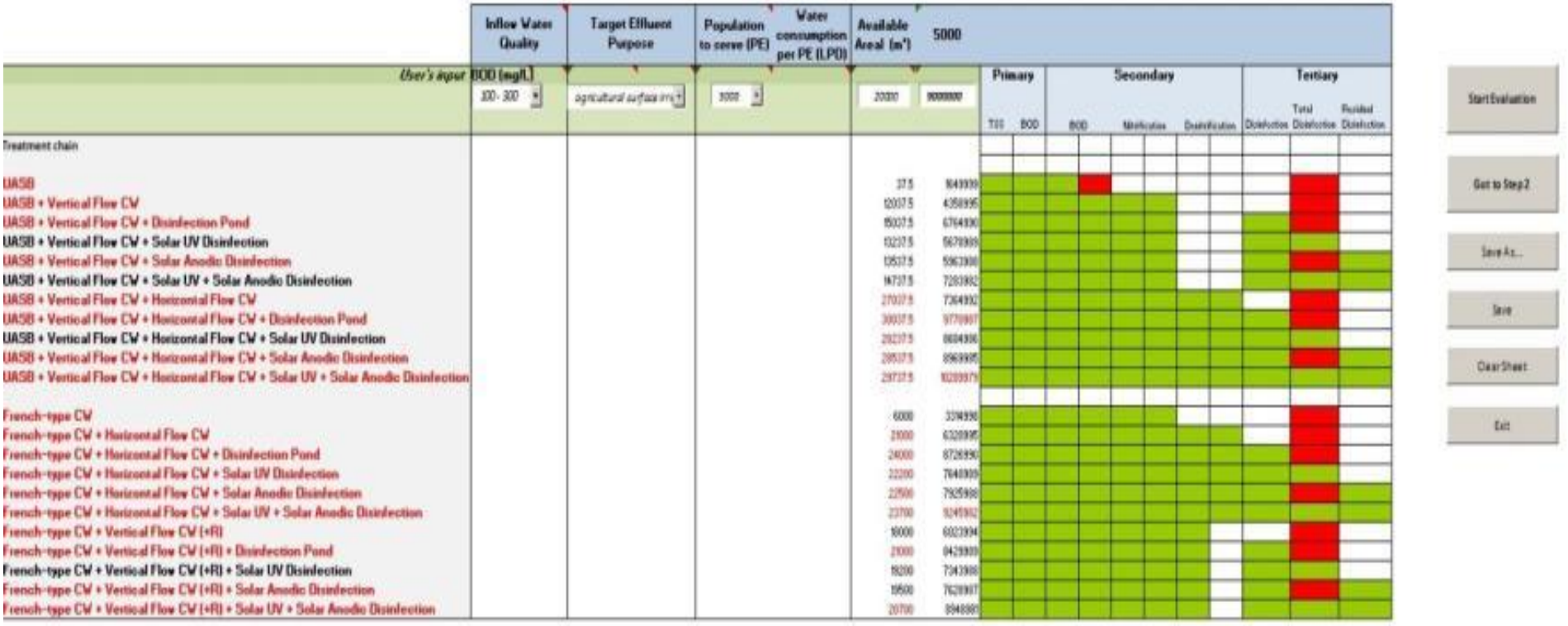
• The user interface consists of an excel sheet where the user enter the frame parameters of the project:

- The organic load of the wastewater.
- The wastewater production.
- The population served.
- The area available.
- The budget available.

DSS validation: Treatment level of the SWINGS technologies

Technology	Treatment level
Up-flow anaerobic sludge blanket reactor (UASB)	Primary
French-type Constructed Wetland (FCW)	Primary/secondary
Vertical flow constructed wetland (VFCW)	Secondary
Horizontal Subsurface flow constructed Wetland (HSSFCW)	Secondary/Tertiary
Disinfection Pond (DP)	Tertiary
Solar UV Disinfection (SUD)	Tertiary/ Disinfection
Solar Anodic Disinfection (SAD)	Tertiary/ Disinfection

DSS validation: User interface for design



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Technological innovations

Technological innovations

- Combination of anaerobic reactor (UASB) with constructed wetlands technology in order to prevent clogging and reduce demanded surface.
- Implementation of syphon methodology reducing energy demand of the plant.
- Implementation of vertical constructed wetland with internal recirculation.
- Combination of vertical and horizontal constructed wetlands to improve nutrient removal efficiency.
- Implementation of French system constructed wetlands treating raw wastewater (without primary treatment).
- Implementation of solar driven ultra violet (UV) and anoxic oxidation (AO) disinfection technology.
- Combination of bank filtration methodology with solar driven UV and AO disinfection technology.

Events, Outcomes and Future Prospects

Stakeholders' forums

KALYANI Stakeholder Forum

AMU Stakeholders Forum and International workshop on benchmarking of sewage treatment plants

Training workshop for water quality analysis

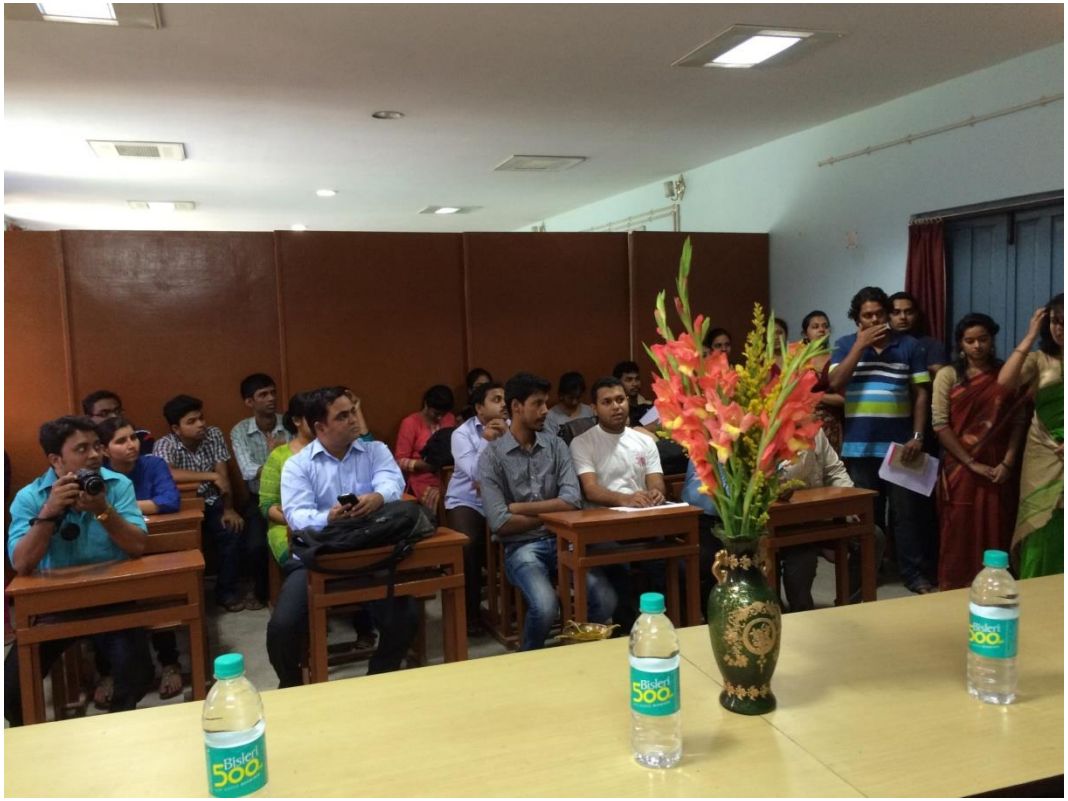
"Laboratory methods and practices for the evaluation of wastewater"

- To make measurements and lab results comparable among the systems so SWINGS partners and the scientific community can profit from breakthrough research

- The methods established in the Research Centers increase the quality of the research and become a normalized work procedure for the future

Training workshop for water quality analysis

- Experimental setup
- Sampling techniques
- Lab equipment care
- Traceability
- Quality assurance.
- Nutrient cycles and wastewater quality



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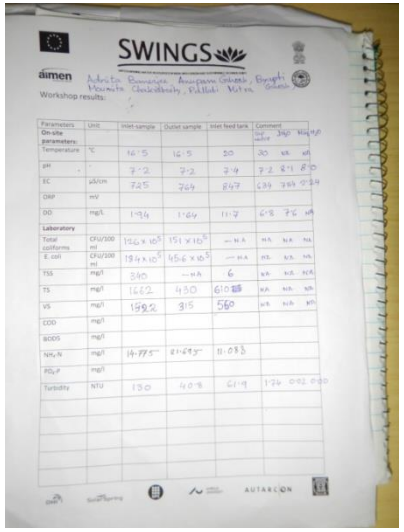
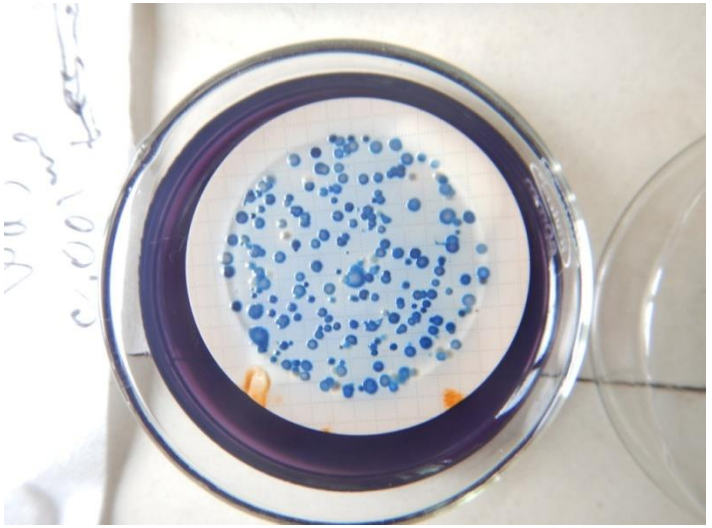
Training workshop for water quality analysis

- Physico-chemical parameters determination in wastewater
  - Onsite parameters
  - Solids, COD, BOD_5, NH_4-N, PO_4^-
- Data analysis and interpretation



Training workshop for water quality analysis

- Microbiological determination
  - Total coliforms
  - Fecal coliforms
  - E. coli



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Training workshop for water quality analysis

- Greenhouse gas emission analysis in constructed wetlands

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Technical meetings and other Cluster Activities

Ist Global Partners Meet & Kick-Off in India

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Exchange of students

Dissemination and exploitation

• Development of the project own web site (www.swingsproject.com) with an extranet published papers, documents, results, newsletters, etc.

• Press releases in magazines and newspaper

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Dissemination and exploitation

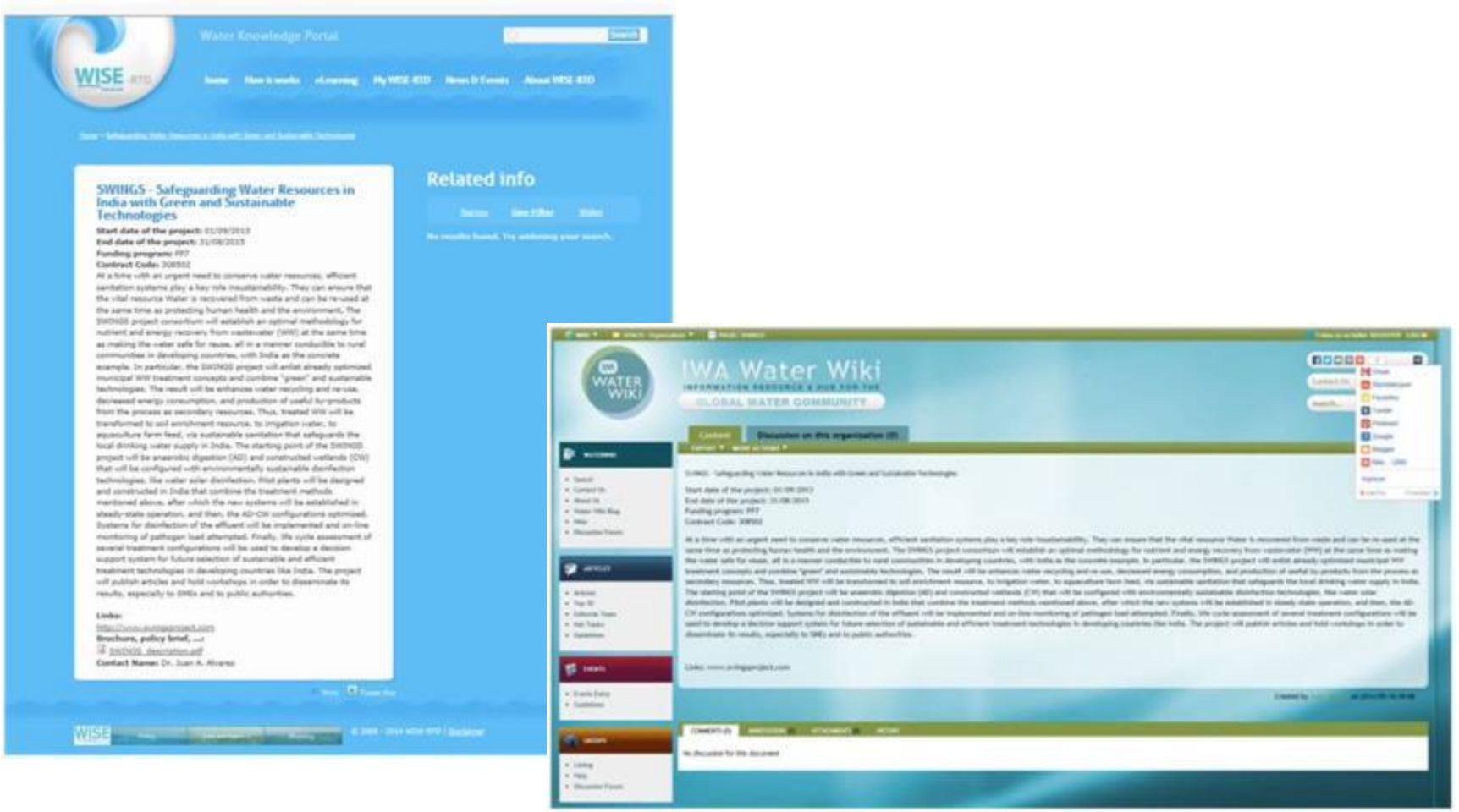
- Producing 3 Newsletters, 3 Leaflet and 2 videos.

Dissemination and exploitation

- Attending and presenting papers to 22 specific International Conferences

Dissemination and exploitation

- Project description on WISE-RTD portal and IWA WaterWiki plattform to characterise it in the context of EU water policies



Dissemination and exploitation

- Submitting 3 papers to scientific journals under Open Access

Implementing advanced CW technology in India: SWINGS a cooperation project aimed at providing integral domestic wastewater treatment and reuse.

Arias, C. A.[a], Istenič D.[c], Molle, P.[g] Kilian, R.[f], Avila, C.[b], Brix H.[a], Otter, P.[g], Rolletschek, M.[h], Khalil, N.[i]& Alvarez, J.A.[j]
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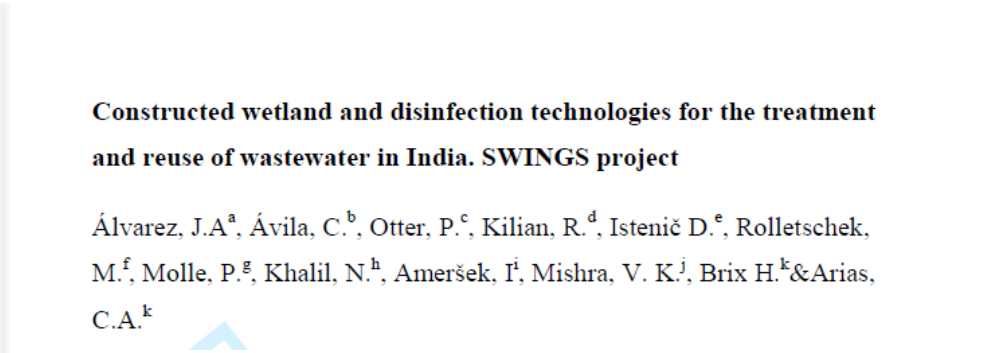
Abstract

Keywords; Constructed wetlands, international cooperation, water reuse, wastewa technology



Environmental Technology

Constructed wetland and disinfection technologies for the treatment and reuse of wastewater in India. SWINGS project

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SWINGS, treatment wetland technology and knowhow transfer for the treatment and reuse of wastewater in India

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Dissemination and exploitation

- Newsletters and Media


THE HINDU

Features » Metroplus

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Waging war for clean water

CLEAN IT UP Aligarh Muslim University has provided land in its campus for recycling millions of litres of waste water and recharging the moat around the historic Aligarh Quila

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Aligarh Muslim University embarks on a holy war for waste water reuse

In the 19th Century the great English poet Coleridge wrote, 'Water, water everywhere, nor any drop to drink'; times, in the not too distant future, the lines could be rewritten 'water, water nowhere, nor any drop to drink'. the world is witnessing an acute shortage of water which, according to many estimates, would develop into a n water crisis in a decade or so. India is on the brink of a major water crisis. There is every possibility that water only religion or language, would be the cause of future conflicts. The need to address the water crisis was reali the Supreme Court of India which directed the Union Ministry of Science and Technology to prepare a plan d The plan document is appropriately subtitled 'War for Water'.

Aligarh Muslim University has made this war for water its own holy war. The university provides the lead in a


SWINGS

Safeguarding Water Resources in India with Green and Sustainable Technologies

India- EU Joint R&D Water Technology Project

http://www.swingsproject.com

Introduction to SWINGS

Key Objectives

concept

Outcomes

Application

Funded by the Department of Science and Technology, Government of India and European Commission


INTRODUCING THE SWINGS PROJECT

SWINGS is a cooperation project aimed at implementing integral domestic wastewater treatment and reuse using constructed wetlands and solar driven disinfection technology

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Hanhu Liu[f], Jun Zhai[f]

Safeguarding water resources in India with green and sustainable technolo cooperation project, financed under the umbrella of the joint operation in water technology and management: researc here the funding is provided by the FP7 program and the Dep gy of the Government of India (DST) and aimed at implement nd wetland and disinfection technology for the treatn d reuse of the treated waters. The consortium includes 20 pa and 10 from India and in Europe is coordinated by AIMEN arh Muslim University (AMU) is responsible for the coor geographical location of the partners. The consortium MEs, NGOs as well as local municipal bodies that w f all the sectors of society.

Indian partner and their geographical location b) European partners (modified from Alvarez J.A. *et al.*). A list with the complete names provided at the end of this document.


NEWSLETTER

EU -India cooperation in water technology and management

A joint Newsletter to report the progress of EU India Cooperation in Water Technology and Management

SWINGS


एएमयू में यूरोपीय संघ की मदद से बन रहा ट्रीटम

अब पौधे करेंगे सीवरेज वा

विशेष

एएमयू छात्रा के साथ नौकरी का झांसा देकर ठग लिया


National page HT 7/8/14

HINDUSTAN TIMES, NEW DELHI
THURSDAY, AUGUST 07, 2014

IVE TO THE ISSUE OF FLYOVERS IN AGRA AND HAS ASSURED EARLY ACTION..

AMU joins hands with European nations for water recycling

HT Correspondent

ALIGARH: Aligarh Muslim University is spearheading the campaign for cleaning rivers. The university is the lead partner in an Indian-European Union joint water technology project which also includes countries like Spain, Denmark, France and Germany.

The project titled SWINGS (Safeguarding Water Resources in India with Green and Sustainable Technologies) has 10 partners from Europe and 10 from India.

Aligarh Muslim University is its coordinating agency.

Funded by the Department of Science and Technology, Government of India and the European Commission within the prestigious Seventh Framework Programme, the SWINGS project would deploy and develop 'Optimised cost-effective wastewater technologies for municipal waste water for reuse for irrigation, cleaning and aquaculture farm feed'.

Dr Nadeem Khalil, assistant professor of Civil Engineering at the Zakir Hussain College of Engineering and Technology at the Aligarh Muslim University who is the motivating spirit behind this project, says, "This project has immense national and international importance. The technology may have great significance for Indian conditions. It is cost effective, sustainable, and simple to maintain without major operational cost, unlike others."

Aligarh Muslim University has provided 4 acres of land behind the Barula bypass for the project.

AMU intends to recycle millions of litres of waste water and recharge the moat around the ancient Qila. Vice-chancellor Zameeruddin Shah is very enthusiastic about the fact that the success of this project would help the proc-

pioneerspeak

THE TECHNOLOGY MAY HAVE GREAT SIGNIFICANCE FOR INDIA. IT IS COST EFFECTIVE, SUSTAINABLE, AND SIMPLE TO MAINTAIN WITHOUT MAJOR OPERATIONAL COST, UNLIKE OTHERS.

NADEEM KHALIL, assistant prof, Zakir Hussain Engg College

SWINGS PROJECT

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ess of cleaning up our rivers.

"It is well known that water finds its own level," says Shah, "and one cannot prevent drains from flowing and polluting our rivers. However, if the same water is purified, to a large extent its wastage would be minimal. There is fresh hope in preventing our rivers from becoming fairly drains."

pressions

ASHUTOSH SINGH

SWINGS

Peer-reviewed publications	
Total number	14*
No.involving exclusively EU authors	5
No.with at least one Indian and one EU author	9

Joint Workshops/conferences organised	
Total no. number	5
India-EU Water projects	Bangalore 2012
UFZ Wetland Workshop	Leipzig (DE) 2013
NAWATECH project workshop	UPC (SP) 2013
Indo-German workshop on science based Master Planning for bank filtration water supply in India	Dreden (DE) 2014
International seminar on sustainability and the future of environmental engineering	Kalyani Univ. 204

SWINGS

Visits of European Scientists to Indian Partner	
No. of visits	65
No. of persons	33
Total person-days	788

Visits of Indian Scientists to European Partner	
No. of visits	4
No. of persons	9**
Total person-days	22

Indian graduate students whose thesis was focused/based on the project	
No. of graduate students	6
No. of persons weeks spent in EU	4.5

EU graduate students whose thesis was focused/based on the project	
No. of graduate students	3
No. of persons weeks spent in EU	42.5

Indian post-docs whose research was focused/based on the project	
No. of postdocs	0
No. of persons weeks spent in EU	0

EU post-docs whose research was focused/based on the project	
No. of postdocs	10
No. of persons weeks spent in India	40.6

Achievements

1. New research and demo water and wastewater training facilities (AMU, KALYANI and IGNTU).
2. Application of a low cost methodology to detect pathogens in treated water. Compliance with international standards
3. Strong involvement of community in building of the pilot plants

Application of a sustainable E. Coli. monitoring technique

Compartment Bag Test (CBT), as the simplest method and probably the only available methods which is applicable in low resource rural settings. Objectives:

- to analyse the usability of the CBT kit and the Merck chlorine test (CT) in a low resource rural setting

- to compare the results of the CBT with the ISO 9308-1

- to test the applicability of the combination of the CT and the CBT for operational monitoring and verification of the efficiency of the disinfection (chlorination) at AMU, KU and IGNTU.

Future prospects

- Demonstration Project (SWINGS Replica) under Ganga Clean-Up Mission at Ramghat, Narora
- AO Drinking water station for 2,000 PE in MP
- AO drinking Water Pilot Site in Haridwar and Dehradun (Uttarakhand)
- Solar Driven Arsenic Exclusion (SolArEx - Project), WB
- Kilian Water building large CW systems in Denmark
- Future mobility projects for Indian scholars training in Europe
- Determination of design parameters
- WSP and BE combined with solar driven disinfection, Kalyani WB

1000 PE CW system
Roenienberg, Denmark

7000 PE CW system
in Ramghat, UP


THANK YOU!
SWINGS
SAFEGUARDING WATER RESOURCES IN INDIA WITH GREEN AND SUSTAINABLE TECHNOLOGIES