



## **UNESCO Chair in 'The Development of a Sustainable Geoenvironment'**

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# Geoenvironmental Research Centre



- The Geoenvironmental Research Centre (GRC) is based in the Cardiff School of Engineering, Cardiff University
- The school is established as a centre of excellence within Europe, with modern laboratories and state of the art computer facilities
- The mission of the GRC is to conduct research and development to provide solutions to land environment problems such as remediation of contaminated land, pollution control and risk assessment



## GRC: Research

- GRC carries out research on a broad front of problems, with its interest ranging from fundamental studies, through project based applications to commercial exploitation and development
- However, its commitment is to serve the local, national and international research need of the geoenvironmental industry





# GRC: Research areas



The Centre research focuses on

- Development of models of soil behaviour
- Regulations
- Risk assessment tools
- Laboratory experiments
- Field testing experiments
- Socio-environmental interactions



# GRC: Specialists Interest



The Centre contains specialists in

- Geotechnical Engineering
- Hydrology, Hydrogeology, Engineering Geology
- Environmental Science
- Process Engineering
- Soil Science, Chemistry, Biology, and Microbiology,
- Sustainable development

Able to co-ordinate and perform high quality, multidisciplinary research at the leading edge of the Geoenvironmental field



# GRC: Specialists Interest



Fields of research and expertise at the Centre include

- Energy losses from buildings to the ground
- Reactive pollution migration in soils
- Risk assessment and risk management
- Contaminated land and associated clean-up technologies
- Land regeneration, remediation and its regulations
- Landfill engineering
- Controlled bulk wastes and priority waste streams
- Processing and value-added treatment of industrial wastes
- Dynamics of local structures  
(sustainable development, social capital, public involvement)



# GRC: Staff



**Prof. Hywel R Thomas ~ Centre Director**

## ***Academic Lecturer***

Dr Steve Rees  
Dr Peter John Cleall  
Dr Michael Harbottle  
Dr Snehasis Tripathy

## ***Management Staff***

Dr Rob W. Francis

## ***Senior Research Associates***

Dr Talib A. Mahdi  
Dr Aleksandra Koj

## ***Research Associates***

Dr Martyn Jones  
Dr Lan Yi

## ***Administrative Staff***

Ms Pauline Townsend  
Mr Richard Maskell

## ***Research Assistants***

Dr Kenny Li  
Dr Rao M. Singh  
Dr Sagar Gummeneni

## ***Research Students***

Mr Phil Vardon  
Mr Yuhyi Tadza  
Mr Majid Sedighi  
Mr Hesham Elgabu  
Mr Ramkrishna Bag

## UNESCO Chair in 'The Development of a Sustainable Geoenvironment'

- The geoenvironment, as referred to in this proposal, encompasses all processes and impacts associated with the terrestrial environment, both at the surface and below the surface. The range of environmental problems include therefore:- Groundwater resources, including groundwater pollution, Contaminated and degraded land, including land regeneration, Waste disposal, including landfills and hazardous wastes in underground repositories and effects of Climate change, including desertification. In addition to the technical matters, social and health considerations are also of major importance and these dimensions are also accommodated in this application.

## Development objective (long-term)

- Environmental problems are costing the earth finite resources and are adversely affecting all of its inhabitants – they tend to migrate through a variety of transport media often unlimited by location of occurrence.
- Such problems do not respect national boundaries – they are world issues that pose complex challenges to the international community.
- Contaminated and degraded terrestrial systems are just the tip of the iceberg.
- Agro-industrial waste is a major source of land degradation across the planet.
- Adverse environmental conditions are increasingly determining poor health and poor quality of life for many people – worsening poverty for many communities.



- The proposal led by the UNESCO Chair is intended to contribute to stalling and where possible reversing the contamination and degradation of terrestrial systems and the associated surface and groundwater systems by providing a platform (through forums and networking) to exchange knowledge and experience to arrive at pragmatic solutions to geoenvironmental problems.

## Specific objectives:

- In the first phase, i.e. the current 2 year proposal, the Chair will focus on experiential learning using field demonstration projects designed to conserve and protect vulnerable groundwater resources in Rural India.
- Building on the solution sets developed in India the UNESCO Chair will use these as a template for testing and application in West Africa and consistent with priorities determined by NEPAD and Ministerial Meetings.
- In phase 2, to be carried out after the current 2 year term of the project, additional funding will be sought to extend this South-North-South exchange to other African countries.



## Sustainable Groundwater Management in Rural India Engineering/Health/Social aspects



- Sustainable activities are defined as activities where the needs of the present generation are met without compromising the ability of future generations to meet their own needs.
- One of the principles of sustainable development includes equitable inter and intra generational resource distribution.
- However, the statistics show an alarming unsustainable trend for India with regard to utilization of its water resources.
- Rapid population growth, urbanization and exploitation of groundwater resources have led to a greater demand for an increasingly smaller supply of water of acceptable quality across the country.
- India is already the second most populous nation in the world with the human population exceeding 1 billion.
- In India, overall water demand will increase from 646 BCM (Billion Cubic Meters) to 1050 BCM by 2025 (FAO estimates for 2000).



- Water pollution is a serious problem in India as almost 70% of its surface water resources and a growing number of its groundwater reserves are already contaminated by biological, toxic organic and inorganic contaminants.
- Groundwater accounts for over 80% of the rural domestic water supply and 45% of the irrigation water supply in India, although current estimates indicate that only 30% of the total potential groundwater reserves are being exploited.

- The implications for human health are of great concern. For instance, arsenic contamination has plagued parts of West Bengal and Bangladesh and has led to severe illness among the population, while high levels of fluoride have affected the health of nearly half a million Indians.
- Gender and class issues have restricted freshwater access for the marginalised members of society.
- Access to safe drinking water and sanitation is mostly restricted to urban areas, and even then, only to the affluent.
- As the principal users and collectors of water in rural Indian households, women continue to bear many of the costs associated with increasing water scarcity, while having the least amount of input into the use and allocation of the resource.



# ARSENIC IMPACT ON HUMAN HEALTH



- The problem of groundwater is not confined to purely engineering, social or health aspects alone but rather an issue requiring a multidisciplinary solution.
- Therefore, the study of sustainable groundwater problems can be better understood by adopting an integrated approach involving interaction of these disciplines.
- The principal research objective is therefore to promote the development of problem-oriented approaches and methodologies towards improved sustainable groundwater management in rural India.
- The novelty of the proposed project is an attempt to integrate three distinct fields of study, viz. Geoenvironmental Engineering, Health, and Social Sciences.

## Specific Objectives

- Preparation of International, Interdisciplinary and Intersectoral Projects
- Creation of joint MSc/PhD programme
- Joint research studies, involving student/staff exchanges
- Involvement of key stakeholders in order to ensure social and institutional legitimization, access to reliable data and identification of areas for potential business collaboration

## Work packages

NP	Title of work package	Action/Activities	Deliverable
i)	Involvement of key stakeholders	<ul style="list-style-type: none"> <li>- Establishment of Collaborative Partnership/ Consortium with key stakeholders (i.e. educational institutions, NGOs, Government Agencies)</li> <li>- Workshops engaging identified key stakeholders and relevant NGOs</li> <li>- Problem-specific interviews with key stakeholders</li> </ul>	- Creation of Geoenvironmental Engineering clusters
ii)	Preparation of International Projects	<ul style="list-style-type: none"> <li>-Multidisciplinary project proposals submitted jointly by Project Teams</li> <li>-subject-specific project proposals submitted independently by project partners</li> <li>-identification of funding sources to sustain/extend project activities</li> <li>-identification of funding sources to develop in-depth research in indicated areas</li> </ul>	Project proposals submitted to relevant External Support Agencies



iii)	MSc/PhD projects	<ul style="list-style-type: none"> <li>- To define objectives and outcomes of multidisciplinary MSc/PhD projects</li> <li>- To design and develop the new multidisciplinary course curriculum to be incorporated within the existing MSc programmes at Cardiff University and Indian Institute of Science</li> <li>- To develop distance learning modules</li> </ul>	<ul style="list-style-type: none"> <li>- MSc/PhD projects: <i>Sustainable Groundwater Management – Geoenvironmental/Health/Social aspects</i> promoting a holistic approach within a sustainable development framework</li> <li>- E-Learning modules for distance learning.</li> </ul>
iv)	Joint research studies identified by Project teams	<ul style="list-style-type: none"> <li>- Research visits</li> <li>- Expert group meetings</li> <li>- Case studies built around various water-related problems: fluoride, arsenic, synthetic organic, microbial contamination, health-nutrition-social/gender issues</li> </ul>	<ul style="list-style-type: none"> <li>- Research visits reports</li> <li>- Guidelines indicating emerging areas of research</li> </ul>



v)	E-forum/ interactive web portal	Project website	E-platform for communication
vi)	Dissemination of the project results	Publications International project Workshops Participation in relevant conferences Project website	Publications International project Workshops Participation in relevant conferences

## Expected output / results:

- The major impact of this initiative is expected to be the strengthening of capacity through the training of specialists who can lead their country's effort to achieve a sustainable geoenvironment. The other key impacts include initiation of international collaborative programmes based on new research streams between the member institutions requiring exchange of students working on MSc/PhD projects and research staff. This project will also offer a significant opportunity for business sectors in the UK, India and West Africa to be involved particularly in the large scale application of remediation techniques.

## Outputs (Detailed)

- Long term strategic multidisciplinary partnership will be established/strengthened with leading institutions in the UK, India West Africa leading to Geoenvironmental Engineering Clusters. (WP1)
- Establish close working partnerships with local business and NGOs. (WP1)
- Major joint proposals in the emerging areas of research. (WP2)



- MSc/PhD projects where students will be trained both in the UK and India in an internationally competitive curriculum, including distance learning. (WP3)
- Creation of a critical mass of multi-disciplinary scientists collaborating on groundwater related issues in all countries. (WP3)
- A new approach to Integrated analysis of Sustainable Groundwater and Contaminated Sites Management will be proposed. This essentially will be the outcome of MSc/PhD work in this area. (WP4)

- Exchange of students and research staff between the countries. (WP3 and WP4)
- Creation of knowledge and innovation networks and forums for exchange of experiences, including an e-forum and an interactive web portal. (WP1, WP5)
- Joint publications in journals and conference proceedings. (WP3 and WP6)

