

# IGCS BULLETIN

## *From the Editors' Desk*



Dear Readers,

Last year was a busy time at IGCS with the commencement of a number of collaborative research projects sanctioned, funded by the Department of Science and Technology. We also enjoyed a regular influx of visiting research scholars and students from Germany, which will steadily increase this year.

This first issue of 2015 is packed with information about ongoing and upcoming activities in research and training, which is visible in the exceptional volume of this issue. In particular, in March the IGCS Winter

School 2015 about urban water management will take place at IIT Madras, while in June the Summer School on rural water management is due, which will be held at Kiel University.

Our feature article, co-authored by Franziska Steinbruch and Georg Hörmann showcases a study of the Pallikarnai wetland in Chennai. It presents a kind of archetypal case of landuse conflicts related to rapid urban growth.

Thanking you,  
**B S Murty** and  
**Christoph Woiwode**  
Editors

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Prof. B. S. Murty



Prof. Chr. Woiwode

## IGCS NEWS

### IGCS organized DAAD Alumni Networking Event

#### “Globalization, sustainability, lifestyles – Think globally, act local-

The Indo-German Centre for Sustainability (IGCS) at the Indian Institute of Technology Madras (IITM) organized a two-day DAAD-funded Alumni Networking event for Indian DAAD scholars from 6-7<sup>th</sup> November 2014 in Chennai. The organizing team was composed of the two German IGCS Visiting Professors, Franziska Steinbruch and Christoph Woiwode, Prof. B.S. Murty, the Acting Director of IGCS-IITM and Ms. Padma and Mr. Prashanth of the DAAD Regional Office in Chennai.

The overarching topic of this event was “Globalization, sustainability, lifestyles – Think globally, act locally”. It attracted the participation of DAAD alumni from across India. The workshop was attended by 14 Alumni. The workshop was enriched by contributions from the two invited Indian resource persons, Aarti Mohan, Editor-in-Chief of *The Alternative* in Bangalore, and Lalit Kishor Bhati, Architect and Urban Planner from Auroville as well as the German resource person, Dr. Till Stellmacher, Senior Researcher at Centre for Development Re-

search in Bonn, Germany (Figure 1). The role of these experts was twofold. First, each of them contributed with his/her professional knowledge in the fields of globalization, sustainability and lifestyles from different angles and cultural backgrounds and thus contributed to setting the stage and guide discussions. Second, all of them had experience with interactive methods in workshops and thus acted as facilitators throughout the process.

#### The Alumni

The participants came from as far as from Punjab, West Bengal, Maharashtra and Puducherry. They did not know each other before. All of them conducted studies at German universities between 1987 and 2014 with the support of DAAD fellowship programs as part of their professional or academic development. All of them mentioned that the studies in Germany constituted turning points in their personal development and paved career opportunities. They expressed their gratitude for the DAAD support.



The professional background of the participants ranged from natural to social and human sciences. Most of the participants were not specifically trained in the topic of the workshop but perceived it as one of general interest and individual relevance. These alumni are currently continuing their academic studies, or are working in academia, or have joined companies.



### The Networking Event

The intention of the Alumni event was to provide a platform networking and exchange, tracking and guidance of Alumni in their professional careers, as well as knowledge update. The IGCS organizing team explored different tools for interactive learning and sharing. The networking was developed around shared ideas and concerns guided by keywords such as Globalization, Sustainability, Accountability and Transparency, Global crises, Lifestyles, Culture, and Social Responsibilities.

The workshop began with a welcome address delivered by Prof. B.S. Murty and a brief overview by Prof. Woiwode and Prof. Steinbruch. The first morning was used for individual introductions in small groups at personal and professional levels which set the stage for shared interests along the workshop's topic (Figure 2). On the first afternoon the event was shifted to a different scene. The participants were taken to the Sustainability Museum ("Suseum") in Nungambakkam in Chennai, where a guided tour was provided by Ms. Uma, Director, through the many different elements of lifestyles, sustainable

living and how each one can make choices and changes in the personal behaviour towards sustainable living. An example of how such individual lifestyle changes can gain societal and political range was mentioned by Dr. Stellmacher who pointed out that the famous German "Energiewende" was a result of several decades of societal adjustment during which environmental consciousness and sustainability became mainstreamed at societal level. The workshop continued with some brainstorming discussions in the installations of the Sustainability Museum (Figure 3). At the end of this day, three main points were identified by the participants for continuous and in depth discussions. The first day was completed in great atmosphere by a joint dinner with food from North and South India.

The second day was reserved for analyses and discussions generated by the participants during an exercise called World Café. The introduction was given by the three resource persons who delivered short presentations. Dr. Stellmacher spoke about "Re-thinking sustainable development: A critical reflection". He introduced the terms and history of sustainability and sustainable development, the current discussion and situation with regard to global crises, specifically energy, environment, and climate and triggered interesting thoughts from the participants with regard to India's standing. Ms. Aarti Mohan then demonstrated in her presentation that many initiatives exist within India towards sustainable living and a green economy, how with media and knowledge-sharing an effect of cross-fertilization is achieved, and that small city initiatives have grown over the years to a country-wide phenomenon.





Mr. Lalit K. Bhati introduced the participants to the founding ideas of Auroville, the planning of Auroville as an urban, international settlement aiming at self-sustainability, and the restoration of a deserted piece of land into a liveable space with recovered water resources and biosphere. He showed how urban development can be planned based on a participatory and sustainable systems approach.

The participants then centred their discussion on three fairly complex questions which were the results of the brainstorming session of the previous day. Each participant could choose to join a “café” table discussion for some time and then to roam to the next “café” table, where another discussion was going on (Figure 8). Since all participants, except for the “café” table hosts got the opportunity to know all the discussion points and to contribute to each, although complex, the questions ended up being tackled in a comprehensive fashion and the findings were presented as concerted outcomes. The alumni used the opportunity to get to know each other and learn something new. They received a certificate of

participation. The IGCS team found that an interactive and intuitive process of exchanging ideas works well in a facilitated environment with participants of different career stages and background.

Many participants left inspired and expressed their wish to follow up on what was discussed during the workshop. For that purpose the participants created a facebook page. In their feedback, many highlighted that the platform for networking through this kind of workshop was very good and that it could have been extended for one or two more days. Many found the workshop program wonderful and recognized that the interactive approach was very new to them and that it helped creating a constructive atmosphere for learning and sharing.

Participants also made recommendations for future events. Among those came the ideas to bring DAAD Alumni from Asia together to talk about sustainability, and to compile contents into a sustainability course which could be delivered across India.



**During the World Café session - Serious and constructive discussions.**

## IGCS Energy Workshop on “Improving Energy Sustainability - Conventional and Renewable”

Indo-German Centre for Sustainability (IGCS) organised a two-day Symposium on ‘Improving Energy Sustainability - Conventional and Renewable’ on 4 and 5<sup>th</sup> December 2014. The IGCS Energy Workshop was inaugurated by his Excellency Mr. Achim Fabig, German Consul General, Chennai. Prof Krishna Vasudevan, IGCS Energy Area Coordinator-India welcomed the dignitaries and spoke on the need, relevance and purpose of the workshop. Prof F. Behrendt, IGCS Energy Area Coordinator-Germany gave the introductory remarks and he has highlighted the need for such workshops to take stock of energy requirements and the research needs. He cited the case of mobile communications and their phenomenal non-linear rise in the last decade. He welcomed Prof Ajit Kolar, former IGCS Energy Area Coordinator and commended his contribution to the IGCS activities in Energy Sphere since its inception. He also welcomed the new incumbent: Prof Krishna Vasudevan.

Prof. S. K. Das, Dean (Acad. Research), IIT Madras, presided over the function. He spoke about the genesis of five IITs in the country. He reminded the signing of the first Indo-German Agreement in 1959, for the establishment of an Indian Institute of Technology at Madras and during its 50<sup>th</sup> year celebration in 2009, the birth of IGCS. He stressed the need for inclusive development for a country like India where aspirations of less privileged have to be internalised. He spoke on the role of energy in meeting the development goals without adversely impacting environment. The Chief Guest for the occasion Mr. Achim Fabig, German Consul General, Chennai spoke on the lopsided energy consumption patterns in the world and need for sustainable energy mix. He stressed the need for energy security, energy equity and energy sustainability. He emphasised the need for employment of renewable energy technologies at present juncture. He wished fruitful deliberations at the workshop.



There were three technical sessions spanning two days comprising of 12 invited lectures. Prof Behrendt, delivered a very informative lecture on **Bio-mass Pyrolysis and Gasification - Products and Problems**. He touched upon the state-of-the-art technologies in Germany in the domain of Biomass Pyrolysis. He touched upon the role of molecular level processes and multi-scale approach for reactor modelling in Biomass Pyrolysis. He presented very interesting aspects of what does gasification do to biomass and resultant product spectrum.



Prof Vinu made an instructive presentation on **Thermochemical conversion of biomass, coal, algae and MSW to fuels and useful intermediates**. He presented salient aspects of fast pyrolysis. He spoke in great detail on co-pyrolysis of biomass and plastics; catalytic fast pyrolysis of waste engine oils and microwave pyrolysis of Biomass. He discussed various steps involved in 'biomass to biofuels' through fast pyrolysis. Ms Sabrina Krugel, IGCS Scholar from TU Berlin, presented the work carried out by her on **Fast Pyrolysis Characterization of Medium and High-Ash Coals of Indian Origin** at IIT Madras under the guidance of Dr Vinu and Dr Sreenivas Jayanti.



The second Technical Session devoted mainly on the topics related to Gas Turbines. It started with an illuminating talk by Prof C.O. Paschereit, Hermann-Fottinger-Institut, Institute

of Fluid Mechanics and Acoustics, TU Berlin, on the topic '**Taming Turbulent Flames**'. He dealt the intricate issues of Combustion Dynamics and effective control approaches. This was followed by another interesting talk by Prof Satya Chakravarthy, Dept of Aeronautical Engineering, IIT Madras. He spoke on '**Trends in gas turbine combustion**' presenting available various industrial gas turbines and their merits and demerits. He touched upon IGCC issues and emerging technologies. He also discussed activities of joint initiative by IITM and IISc at National Centre

for Combustion Research and Development supported by DST. The other important lectures in this session include: '**QBlade: open source wind turbine design**' by Mr. David Marten, Hermann-Fottinger-Institut, TU Berlin, He spoke about Open source wind turbine calculation software: QBlade. He spoke about its sophisticated interface features. This was followed by a talk on '**Load Control for Wind Turbines**' by Mr Alena Bach and talk by Mr Christian Navid Nayeri, Hermann-Fottinger-Institut, TU Berlin on the topic: '**Vortex generators for wind turbines as retrofit performance boosting**'. There were active discussions after each presentation.

IIT Madras for establishing a 500 kWh pilot steam generation plant. This was also the site for a field visit organised for the workshop participants in the latter half of the second day.



The second day's presentations started with a talk by Mr Joshua Gray, Hermann-Fottinger-Institut, TU Berlin on '**Windgas and the combustion technology to make it worthwhile**'. Prof. Sundararajan of IIT Madras spoke about the efforts at **Direct Steam Generation** from Solar thermal energy. He highlighted the work undertaken by researchers at IIT Madras for establishing a 500 kWh pilot steam generation plant. This was also the site for a field visit organised for the workshop participants in the latter half of the second day.

Dr. Kalternborn from Maschinenfabrik Reinhausen spoke on Germany's experience in achieving **High Penetration of Renewable Energy Sources** in the electricity grid. He highlighted the challenges in the development of future electrical grids. Some possible ideas like the voltage regulated transformer and solid state transformers were presented to tackle the

difficulties caused by decentralised power integration into the grid. Prof. Sreenivas Reddy of IIT Madras spoke of the research work in the area of **Solar CPV Systems for Poly Generation** and Dr. Anand of IIT Madras spoke about the challenges of **Bio-Diesel** as a fuel for the future.

The workshop concluded with a visit to the direct steam generation pilot plant set up in a school named Paathashaala, situated at a distance of about 60 km from IIT Madras. The pilot plant generate steam by direct heating of water from solar thermal sources. Prof. Sundararajan spoke about the uniqueness of the system. The small scale plant currently operational is proposed to be scaled up to 500 kWh to supply power to the school and neighbouring villages. The visit also enabled the participants to get a glimpse of the south Indian countryside.

**Field visit to the direct steam generation pilot plant set up in a school named Paathashaala, situated at a distance of about 60 km from IIT Madras**



## Project Work of German Students Group: “Urban Resilience and Adaptation to Climate Change in Chennai”

In March 2014 a group of 15 Bachelor students from the School of Spatial Planning, Technical University Dortmund in Germany, conducted a two week long field trip as part of a one year long studio work. Intensive preparation including literature review, generating a conceptual framework and a research methodology preceded this excursion. During their visit, the German students interacted with IIT Madras students who work on the Buckingham Canal to share their ideas and experiences. IIT Madras students also facilitated field visits and provided support as interpreters to German students.

After completing the project, which is an integral part of the study program similar to real world planning exercises, the group delivered a comprehensive more than 200 pages long final report in autumn 2014, which is available for download from the IGCS website (see below). Supervised by Mrs. Ariana Fuerst and Dr. Johannes Lückenkötter, the field work was guided by IGCS Visiting Professor Dr. Christoph Woiwode. The following paragraphs summarise the main content of the report.

### Summary of the Final Report

Impacts of climate change are noticeably intensifying all over the world. Besides mitigation strategies, which aim to reduce greenhouse gas emissions, strategies to adapt cities to the consequences of climate change become more and more important for urban planning, both in developed countries and in the global South. Chennai, a fast-growing city on the South-Eastern coast of India, has about 6.5 million inhabitants. Similar to many other megacities in South Asia, it is located in the Low Elevation Coastal Zone which is threatened by rising sea-level. The climate in Chennai is characterised by heavy rainfall and cyclones during the monsoon season. The frequency and intensity of these extreme meteorological events is expected to increase because of climate change.

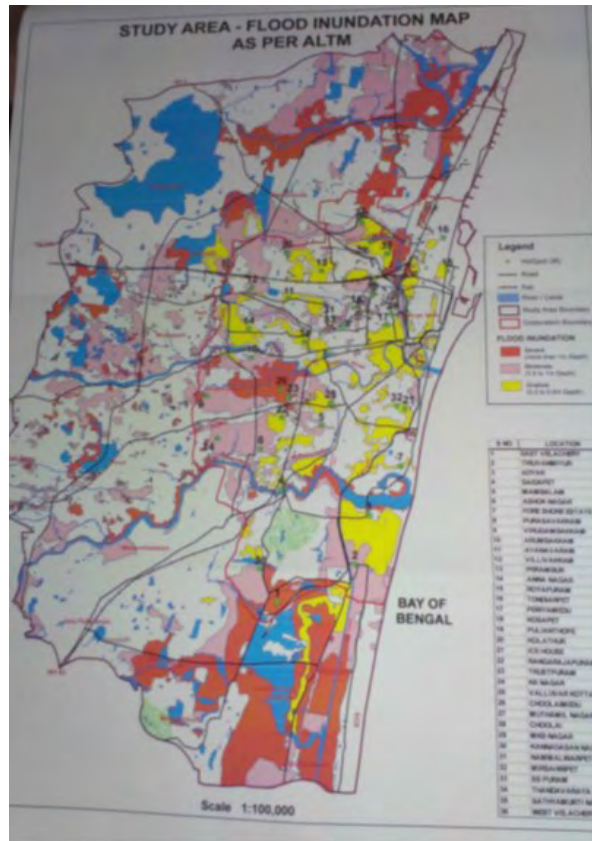


Figure 1: Map of Inundation Hotspots in Chennai



Figure 2: Inundated Squatter Settlements in Chennai



Urban growth is a major challenge for the City of Chennai, especially for infrastructure systems such as water drainage. Drainage systems are often undersized and badly maintained. Wastewater is usually directly led into rivers and canals. This aggravates the frequent appearance of floods during monsoon season. Another challenge urban growth imposes on the city is the exclusion of many poor inhabitants from the regular housing market. This leads to informal settlements along rivers and canals. Therefore, the poorest inhabitants of Chennai are the ones who are the most vulnerable towards flooding.

Even though climate change adaptation has been recognised as an important task by Chennai’s politicians and the administration, many researchers and NGOs criticise that the vulnerability of Chennai’s poorest inhabitants does not improve. A lack of cooperation between the stakeholders involved in flood protection, such as urban and regional planning departments and water authorities, is one of the main causes for this problem.

After giving the theoretical background that describes climate change, urban flooding in slums, environmental governance, and adaptation to urban flooding, the final report analyses the measures taken by stakeholders concerned with flood adaptation in Chennai. The stakeholders involved include planning authorities, disaster risk management organisations, and the slum dwellers themselves. The analysis is based on the review of scientific literature, official planning documents, interviews with experts, and site visits of slum areas, with a focus on the cooperation of the stakeholders concerning these measures. In order to improve the resilience of the city’s most vulnerable inhabitants, the conclusion makes specific suggestions for the improvement of the cooperation and outlines proposals for further research.

CAUSES	TYPES OF FACTORES	ELEMENTS
Direct Factors	Increase in rainfall	Due to global climatic change
	Urbanisation	Encroachment of all water bodies, wetlands, etc.
		Construction of transportation networks all along the major watercourses
		Increase in concreted spaces which stops percolation of water in the ground
		Decrease in open areas/ green spaces
Lack of transportation facilities (esp. in slums)		
Topography	Plain terrain lacking natural gradient for free run-off	
Indirect Factors	Inadequate & poor drainage system	Sewage systems were planned originally before 4 decades and only few minor modifications made which is far below the required capacity
		Heavy situation all along the drainage channels
		Lack of coordination between the agencies
	Disposal of solid waste & other debris	Attitude of people
		Lack of management measures by the agencies
Vehicle parking on roads	Increase in concrete spaces	
	Discrepancies between public & local authority	

**Table: Causes of Flooding in Chennai**  
(Source: Lavanya 2012: 117)



Download the full report here: [http://www.igcs-chennai.org/wp-content/uploads/2015/01/Final-Report\\_F04-Chennai\\_2014\\_TU-Dortmund\\_Urban-Resilience.pdf](http://www.igcs-chennai.org/wp-content/uploads/2015/01/Final-Report_F04-Chennai_2014_TU-Dortmund_Urban-Resilience.pdf)

## 5th National Research Conference on Climate Change at IIT Delhi

Dr. Christoph Woiwode attended the conference held at the Indian Institute of Technology Delhi on December 19-20, 2014. The conference was organised by Indian Institute of Technology Delhi, Indian Institute of Technology Madras, Indian Institute of Science Bangalore and Centre for Science and Environment under the banner Indian Climate Research Network (ICRN). Being the 5th in the series, the conference covered topics related to the scientific, technical, economic and policy aspects of climate change in South Asian countries. The main purpose of this event is to nurture and enhance a dedicated network of climate researchers, as well as to develop the capacity of climate research and action in India. This was reflected in the format and the target group of young researchers of the event. Hence the conference primarily provided a platform for young re-

searchers to present their work. Most time was given over the two days to a total of 44 poster presentations to enable a diverse coverage of topics and to better facilitate dialogue between scholars. However, before each poster was presented, time was provided for a two minute statement about each research project. This helped the audience to better choose which posters to visit afterwards. Research topics covered a wide range of themes such as “An explanatory Analysis of Indian Rainfall Data using Wavelet Methods”, “Adaptation to Climate Change for Food Security in the Indian Sunderbans Delta”, “Enablers of Multi-Stakeholder Collaborations that Facilitate Urban Climate Change Resilience in Surat”, or “Vulnerabilities to Disasters and Governance in Coasts: A co-evolutionary Approach”. Day two especially saw selected presentations by experts and young scholars on landuse and land cover change and climate, practice to research in energy use, and vulnerability to heat stress, among others.

## Upcoming IGCS Events

### Seminar-cum-Workshop on “Micropollutants in Water and their Hazards”

will take place from January 12–13, 2015. Venue: ICSR Hall II, IIT Madras. Contact: Prof T.S.Chandra (chandra@iitm.ac.in)

### IGCS Workshop “Promises and Challenges of Biodiesel as sustainable Fuel for the Future”, 19-21 February 2015, at IIT Madras

The Workshop will focus on Technologies in the energy domain with emphasis on biodiesel as sustainable fuel for future use. Coordinators: Prof. Dr. Pramod S Mehta, IIT Madras IC Engines, India, and Dr. Roy Hermanns OWI Oel-Waerme-Institut GmbH. More information can be found on the Workshop website : [https://sites.google.com/site/IGCS\\_Workshop\\_on\\_Biodiesel/](https://sites.google.com/site/IGCS_Workshop_on_Biodiesel/)

### IGCS Winter School 2015

“Sustainable Water Management in Urban Areas” will take place at the Indian Institute of Technology Madras from 2 – 15 March, 2015. The aim of this winter school is to learn how to sustainably develop and manage the water resources infrastructure in urban areas.

### IGCS Summer School 2015

“Sustainable Water Management in Rural Landscapes” is scheduled from May 27 – June 10, 2015 at Kiel University (CAU Kiel) Department of Hydrology and Water Resources Management. The aim of this summer school is to learn how to manage these regions with an interdisciplinary and holistic approach. Deadline for applications is March 1, 2015.

For information about the IGCS Schools visit: <http://www.igcs-chennai.org>

## Pilot Study on “Climate Change and socio-cultural Transformation for sustainable living in urban India”

Dr. Christoph Woiwode, IGCS Visiting Professor, received a grant as partner in this pilot project with Sathish Selvakumar from the Indian Institute for Human Settlements (IIHS), Bangalore. Purpose of the internal grant from IIHS is to provide seed funding to explore novel research themes. Focusing on Bangalore and Chennai, the study is carried out from December 2014 to March 2015 to collect empirical data on socially innovative sustainability initiatives.

Transition research emphasizes the necessity of understanding socio-cultural changes in individual and collective transformation of values, beliefs, norms and worldviews in response to complex, wicked problems like climate change. Globally, these changes will have to take place primarily in urban areas, where the majority of people live and where lifestyles, production and consumption patterns are comparatively more unsustainable in terms of resource requirements and carbon footprints than in rural areas, especially in emerging economies like India. Research is required to understand the processes of social and cultural change of people, groups and communities in cities towards behavioural changes viewed as more sustainable or eco-friendly. This study looks for transformative mo-

ments at the level of the individual, the group and at the level of community.

Against this background, this research will help to understand what it would take for rapid changes in lifestyle choices to happen in a city like Bangalore / Chennai. It will help to forward the understanding of creating cities and transforming cities that have low carbon lifestyles. Empirical instances studied in this initial project will be used to feed into a larger, action and transformation/transformational research project to be carried out with partners in Germany that would develop and test ‘transformative urban community development’ methods.



## Environment News...

### German Environment Minister visits India for Indo-German Forum

German Environment Minister Barbara Hendricks is visiting India on January 28 and 29, aiming at strengthening the bilateral cooperation in the field of environment. She is accompanied by a high-ranking business delegation.

Minister Hendricks and her Indian counterpart Shri Prakash Javadekar will inaugurate the second Indo-German Environment Forum in New Delhi on January 28. The two-day event will focus on identifying the necessary framework, challenges and solutions for waste and water management, resource efficiency and sustainable urban development. During her visit, Minister Hendricks will also hold bilateral meetings with Minister of Urban Development Venkaiah Naidu, Minister for Power, Coal & New & Renewable Energy Piyush Goyal, and Minister of Water Resources, River Development & Ganga Rejuvenation Uma Bharti. The Indo-German Environment Forum, organised by the Indian Ministry of Environment and Forest, German Ministry for the Environment, Nature conservation and Nuclear Safety, Asia-Pacific Committee of German Business, and the Federation of Indian Chamber of Commerce and Industry brings together over 300 representatives from the government, industry and civil society.

Germany and India have been long-standing environmental cooperation partners. As part of the International Climate Protection Initiative, the German Environment Ministry has been supporting projects in India since 2008. The first Indo-German Environment Forum was held in 2008 in New Delhi.

[http://www.india.diplo.de/Vertretung/indien/en/\\_\\_\\_pr/Climate\\_\\_Sustainability\\_\\_News/BMin-Hendricks-visit.html?archive=3255528](http://www.india.diplo.de/Vertretung/indien/en/___pr/Climate__Sustainability__News/BMin-Hendricks-visit.html?archive=3255528)



## IGCS Research News



Dr. Kirsten Hackenbroch visited the IGCS as a postdoctoral research fellow in September 2014. She is currently a lecturer at the Institute of Environmental Social Sciences and Geography, University of Freiburg, Germany.

During her stay at the IGCS she carried out research on current discourses of sustainable urban development in Chennai with Prof. Dr. Christoph Woiwode and Prof. Dr. Cella [Rajan](#). After meeting the colleagues at the IGCS and familiarising herself with the IIT Madras, Kirsten met officials at the City Corporation of Chennai and the Chennai Development Authority to understand which paradigms guide current everyday planning processes in the city. She also met with persons from research institutes, advocacy groups, civil society organisations and NGOs to discuss their visions for urban development of Chennai.

During field trips she explored the nature of the ongoing expansion of the city toward its fringes, specifically looking at the upcoming real estate projects, the ongoing village transformations and the construction of IT and education “industry” parks. Currently she analyses the data she has collected during her research stay, seeking to understand the assemblages of the urban (sustainable) development discourse in Chennai. Within the BA course “Urbanization and Development” of the Humanities Department, Kirsten gave a lecture on “Contested Space: Negotiating Public Space and Land in Dhaka”.

Currently, Kirsten and the IGCS professors develop a plan for continuing the research activities kick-started during her stay at the IGCS. In 2015 the aim is to look at how specific sustainability initiatives contribute to the urban development discourse, what defines their ability to contribute, and how new visions for planning the city emerge. The idea is to integrate several Master thesis projects within this continued research. Kirsten will return to IGCS in March to continue with her research.

## Research Students at IGCS

Thomas Eichmeier holds Bachelor degree in Engineering and is currently a master student in Environmental Engineering, Chair of Urban Water Management and Sanitation, at Bauhaus-Universität Weimar. Thomas joined IGCS from November 2014 to March 2015. In his thesis, supervised by Dr. Christian Springer (Bauhaus-Universität Weimar) and Prof. Dr. Ligy Philip from IIT-Madras, he studies “Pharmaceuticals in the Water of Chennai City – A Case Study of Velachery”. The pollution of the environment by different kinds of micropollutants, like pharmaceuticals and pharmaceutical residues is increasingly getting more in focus during the last two decades. Worldwide over 100 different active ingredients have been detected. Nonetheless, very little is known about occurrence and fate of pharmaceuticals in the environment.

In order for a better risk assessment according to drug residues in aquatic systems, more data about pharmaceuticals in water bodies is needed. In scope of this Master thesis, in total 20 households will be visited for sample collection



within 4 months. More than 50 samples will be collected from taps, borewell and wells, spread out all over Velachery. After solid phase extraction, the samples will be analyzed of Ibuprofen, Diclofenac, Carbamazepine, Triclosan and Naproxen by using GC/MS.



B.Sc. Nils Heldt, student of environmental engineering from Bauhaus-University Weimar, Germany, joint IGCS from November 2014 to March 2015 to conduct a research project for his master thesis. His topic is the 'Identification of locally available structural

material as co-substrate for unstabilized septage composting in Chennai, India.' Under the supervision of Dr. Christian Springer from Bauhaus-Universität Weimar and Prof. Dr. Ligy Philip from IITM he investigates different sources of structural materials. Nils focuses on the structural behavior of these 'low cost' materials that he mainly found within the sector of agricultural waste or side products. He talked to local boards and authorities and did several fieldtrips to local farmers and plantations to gain knowledge about possible user conflicts and to collect samples. Besides classical composting parameters like C/N ratio, water content, dry matter and organic dry matter, he conducted a compressing test and examined the water holding capacity. His final aim is to provide knowledge about the possible feasibility of these materials as septage sludge conditioner.

B.Sc. Erik Heldt, student of environmental engineering from Bauhaus-Universität Weimar, Germany, joint IGCS in November 2014 and is working on the topic of septage management under supervision of Dr. Christian Springer from Bauhaus-Universität



Weimar and Prof. Dr. Ligy Philip from IIT-Madras.

Treatment of septage is an upcoming problem in India. Due to the lack of sewage systems especially in the rural parts of India many households are forced to use septic tanks. The residue called septage has to be treated in a sufficient way to avoid the spread of diseases, contaminations of water bodies and environmental damage. Within the scope of his master thesis Erik wants to proof whether composting of septage under local conditions is possible and if the process of composting can ensure a full stabilization (hygienisation) of the septage. In case it dose ensure a full stabilization it could be a sustainable way to treat septage and to keep the valuable nutrients within the nutrient cycle while using compost as a natural fertilizer. Therefore he is collecting samples at local sites in Chennai and process them in pilot scale composting tests.

### Regional Dialogue of 15<sup>th</sup> Delhi Sustainable Development Summit (DSDS)

IGCS partnered with The Energy Research Institute (TERI), New Delhi in conducting the Chennai regional dialogue of 15<sup>th</sup> Delhi Sustainable Development Summit (DSDS) on December 1<sup>st</sup>, 2014 in the I.C. & S.R Auditorium of IIT Madras. Prof. Ligy Philip, Area Coordinator (Waste Management) of IGCS was the co-organizer. This half a day event was inaugurated jointly by Dr. A. Vancheeswaran of TERI and Dr. K. Ramamurthy, Dean, IIT Madras. Dr. Pradipto Ghosh, Distinguished Fellow & Director, TERI & Former Secretary, Ministry of Environment & Forests, Government of India set the tone for discussions with the inaugural address on SDGs – The Post-2015 Development Path. There were two discussion sessions: one

on "Chennai as a smart city: Opportunities and Challenges" and the other on "Scaling up of Drinking Water and Sanitation in Tamil Nadu". First session was moderated by Dr. Ashwin Mahalingam of IIT Madras, while the second one was moderated by Dr. Pradipto Ghosh. Prof. Krishna Vasudevan, Area Coordinator (Energy) of IGCS was one of the speakers in the first discussion session. Speakers were drawn from governmental organizations, industry and academia. The event was well attended by several stake holders from Chennai and generated lively debate. The issues that were brought out during this regional dialogue were carried to the main DSDS-2015 event that was held from February 5<sup>th</sup> to 7<sup>th</sup> in New Delhi.

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## FEATURE

# Towards Integrated Water Management of Pallikaranai Wetland in Chennai City, India

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### 1. Introduction

The Pallikaranai Marshland in Southern India is part of a former freshwater lake-marshland landscape stretching from the Adyar River located in Chennai City to the backwater system of Muttukadu, near Mamallapuram, south of Chennai City, running parallel to the coast of the Bay of Bengal, about 30 km into the inland. The area became part of the municipal area of the Chennai Corporation in 2011 and is delimited by the former villages of Velachery to the north, Perungudi to the east, Pallikaranai and Kottivakkam to the south, and Kovilambakkam and Madipakkam to the west. In recent years the importance of urban wetlands for flood mitigation, groundwater recharge and water pollution remediation beside the ecological and recreational relevance have been raised. The case of Pallikaranai Marshland provides an illustrative example of utilization of water resources, challenges and solutions in the context of a rapidly expanding mega-city.

### 2. Restoration or Replacement

Restoration of wetlands can be done with different measures. These could be the revival of fundamental hydrological systems, the removal of pollution sources, the reintroduction of vital wetland fauna or flora, or the removal of human encroachments. An enabling and balancing environment will be necessary to spur restoration efforts, consisting of an appropriate legal framework, supporting economic development priorities, professionals for the implementation or maintenance, and an engaged society. Restoration

requires that an overall goal and the target conditions are defined prior, against which the efforts are measurable and defensible. Restoration aims at the recovery and preservation of a *status quo* founded on values acceptable to society, such as for example, rich biodiversity or cultural heritage. Especially in fast transforming urban areas restoration finds itself substituted by the professionally planned construction or the appearance of unwanted new wetland systems which may gain importance as a replacement for ecosystem and hydrological services of destroyed wetlands.

The Pallikaranai Marshland once occupied a plain low-lying area of about 5000 ha separated from the coast by a ridge of dunes with a South-North oriented drainage pattern (Figure 1). Settlements followed the linear alignment of the dune ridges on both sides of the plain. In the early 20<sup>th</sup> Century to about the late 20<sup>th</sup> Century this marshland appeared to be a seasonally inundated pasture land located at the southern outskirts of Chennai (formerly Madras).

Plains and depressions are frequently used as dump yards of waste of nearby cities, and so it happened to the Pallikaranai Marshland. With increasing demand for land for housing and industrial development, the peripheral areas of Chennai initially reserved for agricultural use or classified as waste land were reclassified. Thus, the marshland got fragmented into different land uses, mostly into residential and rehabilitation areas. This land planning process was considered as a kind of reclaiming of otherwise useless or under-



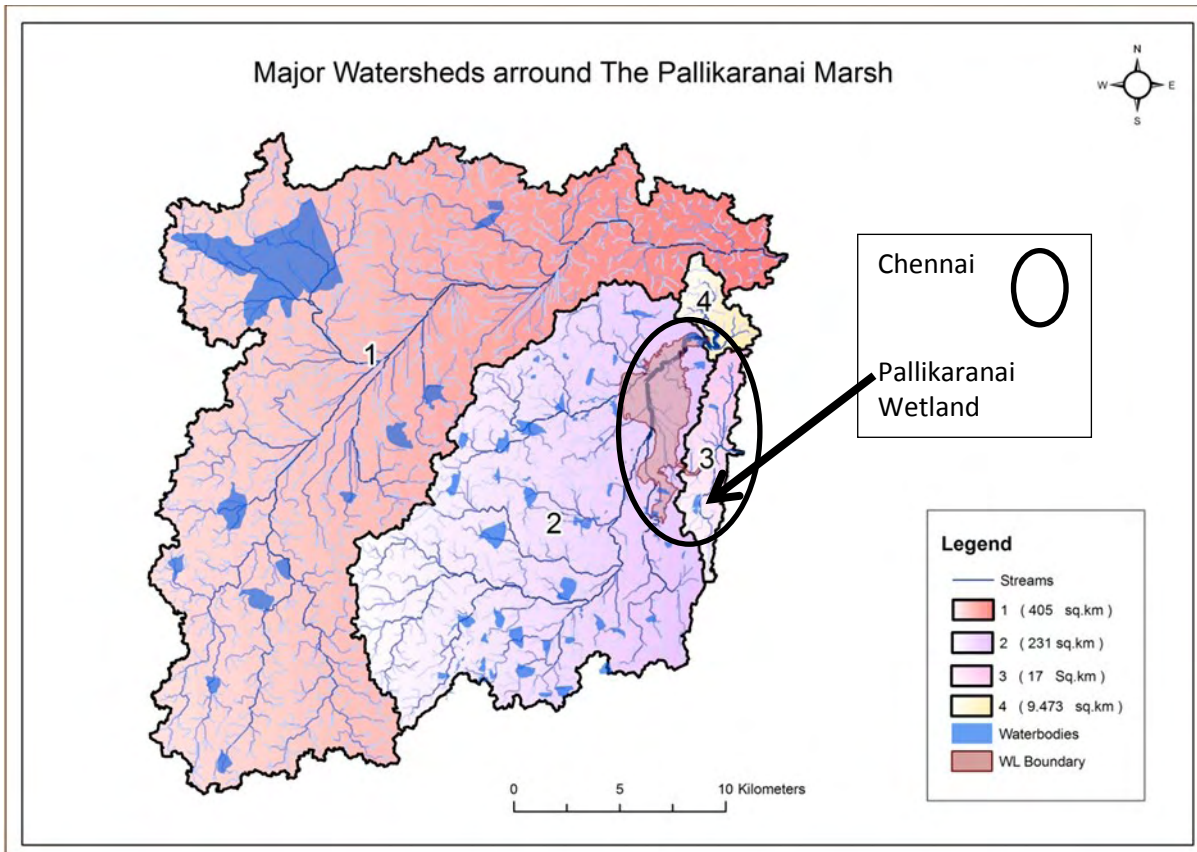


Figure 1: Watershed delineation based on ASTER digital elevation data and GIS software (Care Earth Trust).

valued land. As a result settlements, institutions of higher education and IT companies put up infrastructures and the marshland was reduced from 5000 ha to a mere 605 ha by 2013. A sewage treatment plant was built in Perungudi in 2006 at the edge of Pallikaranai Marshland which from thereon released its treated water into the plain. The continuous release of water transformed the plain into a perennial shallow lake that enclosed the dumpsite. The outflow of this lake was then connected through the Okkiyammaduvu Lake - a perennial water body- with the Buckingham canal (built in 1806 for transportation, serving today as sewer) switching surface flow North-South. This artificially maintained shallow lake began to attract increased numbers of water birds. Attention raised by conservationists to the diversity and density of especially birds, fishes and amphibian led in 2007 to the declaration of 317 ha in the southernmost portion of the wetland as a forest reserve (bird

sanctuary) (Figure 2). Thus, Pallikaranai Marshland changed into a permanent freshwater lake confined to the remaining 10% of the original size of the plain. The water budget is not maintained by precipitation-run-off, but the discharge of the sewage treatment plant.

In this situation, three scenarios are possible: 1) Level the remaining plain to gain land for constructions and build a drainage canal from the sewage treatment plant to the Buckingham canal, or 2) Restore and maintain the lake as a landscape element that can easily be maintained due to the water supply from the sewage treatment plant and integrate the lake with other land uses in its vicinity, or 3) Restore the wetland to its primary state as a biodiversity hot spot of national importance and remove incompatible forms of land use.

Originally Chennai City had about 150 wetlands, tanks and lakes. Today only about 27 remain and are

either polluted or obsolete. As a result of the decreasing number of lakes and wetlands water bodies like Pallikaranai become even more important as replacement areas for mobile species such as birds. They also are valuable urban recreational areas. Therefore restoration efforts should aim at the maintenance of the lake, its shorelines, water quality and quantity, and biodiversity.

### 3. Integrated Water Management Options

For an integrated, sustainable water management approach, technical and legal solutions must go hand in hand with ecological and socio-economic interventions. Furthermore, the correct temporal order of interventions is crucial in the restoration of ecological systems such as wetlands. For Pallikaranai wetland a restoration plan based on sustainable water management principles is required. It should serve as a guiding document for all immediate interventions as well as for the monitoring of the restoration efforts.

Many studies were conducted since the lake formed. These studies dealt with land use change, groundwater dynamics, biodiversity monitoring, and pollution remediation from the dump yard. There is also an adaptive management plan for the forest reserve. Interventions on the Pallikaranai wetland, however were conducted ad-hoc or left incomplete.

#### 3.1. Technical solutions

Several engineering solutions are proposed in the order as follows:

##### 3.1.1 Improve water quality

The priority should be directed to the main source of pollution, i.e. the dump yard in the northern part of the Pallikaranai wetland should be isolated from the lake. As an interim solution, the culverts connecting the northern with the southern parts of the wetland could be closed to prevent leaching of hazardous



**Figure 2: Large numbers of water birds on power line that crosses Pallikaranai Wetland (Mueller, 27/08/2014).**

substances from the dump yard into the lake. Then the dump yard requires encapsulation and isolation to inhibit the mobilisation of harmful pollutants and the leakage into the open water body and the groundwater. The outflow from Perungudi sewage treatment plant has to avoid the passage of water through the dump yard and be drained directly into the conservation area, where water is needed. The ongoing research will propose remediation methods to deal with seepages from the dump yard. A complete removal of the dump yard may be the best solution, however the whereabouts would raise many other concerns.

Once the main sources of pollution and water supply of the wetland are under control, attention can focus on the lake and especially the conservation area.

Several naturally shaped basins could be constructed inside the existing single water body and water could be cascaded between basins. The differential movement of water would have positive effects on the water quality and would create many habitats and niches. Dredging should be avoided, because it disturbs breeding birds, destroys soil microorganism, changes flow patterns and remobilises contaminants.

**3.1.2 Maintain water quantities**

Because water is supplied permanently from the sewage treatment plant the Pallikaranai wetland will require a controlled outlet to maintain the required water quantity in the lake and to release the surplus for flood control. This could be done through a surface outlet such as a sluice at the Buckingham canal or through a groundwater recharge area such as the Okkiyammaduvu Lake.

**3.1.3 Maintain lake shorelines**

Encroachment of buildings and informal dump sites into the lake should be controlled. The lake shorelines need to be redesigned in such a way that biodiversity is maintained or increased, and people can enjoy the lake, for instance along walkways.

**3.2 Ecological solutions**

A gap analysis of ecological niches and nutrient fluxes should be conducted to better understand whether and which species may be missing to enable closed life cycles. The lake water depths and marshland's inundations-drying-cycles should be controlled to a seasonal, ecological water demand cycle of aquatic species.

Species communities and selected key species should be monitored frequently to detect any changes in the ecological systems. Pallikarani Marsh could serve as a sanctuary to which species from de-functioning wetlands of Chennai City could be evacuated and given a new shelter in a better environment.

A balance has to be found between the use of the lake for recreational or commercial purposes such as fishing and the requirements of aquatic communities such as nesting periods.

**3.3 Policy and institutional framework**

Pallikaranai Marsh may have to be classified into a lake, and accordingly administrative responsibilities should shift to another authority, to provide the appropriate institutional framework for its protection and management. The declaration as forest reserve was recognized as inadequate and other forms of protecting the status of aquatic ecosystems have to be explored.

A management plan for the entire lake should be elaborated as policy guidance outlining goals and measures to restore Pallikaranai wetland to the desired standard. The management plan should be applicable to all interventions and types of activities conducted in or around the lake. It should also include those taking place distant from the lake which affect the lake such as groundwater abstractions.

Considering all lost versus all newly constructed or



**Figure 3: Housing and work space close to Pallikaranai Wetland potentially adding to living quality and value of properties (Mueller, 27/08/2014).**

recovered wetlands and lakes in an overall balance of ecosystems services to the City of Chennai, then Pallikaranai wetland, once cleaned up and properly maintained, would be adding to the positive side of such an equation. Benefits gained by removing a wetland or lake could at least partially be used to compensate opportunity costs and

to cover operational costs for the wetland maintenance. This could take place in the form of biodiversity offsets.

**3.4 Socio-economic solutions**

The presence of a freshwater ecosystem with abundant wildlife is attractive for recreation, and is serving as an incentive for a good living and working environment (Figure 3). It usually increases the value of



properties when they have a nice view on a lake with birds or with direct access to the waterfront. Constructions should incorporate the lake into the design and use of space of any buildings. Stakeholders such as property holders around the lake need to be engaged in the restoration and maintenance of the lake. The benefit of an improved living quality should provide the motivation to take care of the maintenance of the lake. An association or other platform of stakeholder engagement could be useful to channel efforts, interventions and concerns. Commercial and recreational activities based on the lake could also be managed by a stakeholder association.

### 3.5 Monitoring and information dissemination

Biological monitoring has been conducted by Care Earth Trust at Pallikaranai Marsh for almost 20 years and should be continued. Restoration as well as maintenance of the aquatic ecosystem has to be accompanied by ecological monitoring. Water quantity and quality of the lake, groundwater levels around the lake as well as the nutrient fluxes in and out of the lake should be controlled on a regular basis for decision taking.

## 4. Conclusions

The former Pallikaranai Marshland has developed into a perennial lake due to the release of treated water from the sewage treatment plant in Perungudi. Because the number of other lakes and wetlands in the region has substantially decreased, large numbers of water birds have moved to Pallikaranai Marshland. The restoration and maintenance of the Pallikaranai Marshland as a lake creates a new aquatic ecosystem in an urban environment. Such an effort would act as conservation and could be considered as a compensation for the biodiversity losses in other parts of the city.

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## Forthcoming Conferences

### ECSEE 2015 - The European Conference on Sustainability, Energy and the Environment

9th to 12th July 2015, Brighton, United Kingdom. Enquiries: [ecsee@iafor.org](mailto:ecsee@iafor.org)

Web address: <http://iafor.org/iafor/conferences/ecsee2015/>

### SDC 2015 - 3rd Annual Sustainable Development Conference

5th—7th July, Bangkok, Thailand. Enquiries: [vilic@tomorrowpeople.org](mailto:vilic@tomorrowpeople.org), Web address:

<http://www.sdconference.org>

### 15th Delhi Sustainable Development Summit "Sustainable Development Goals and Dealing with Climate Change"

5th to 7th February 2015, New Delhi, India. Web address: <http://dsds.teriin.org/2015/>

### International Conference on Sustainable Energy and Built Environment

12–13 March 2015, VELLORE, India, rganized by VIT University, Venue: VIT University, Vellore, Tamil Nadu

Web address: <http://www.asceis-ices.com/conference.php>

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