Mainstreaming Citywide Sanitation

Opportunities and Challenges for Excreta Management

4-5 April, 2016

Venue:
Gulmohar Hall, India Habitat Centre,
New Delhi

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Programme Schedule

APRIL 4, 2016

	0930-1000 Registration – Tea/Coffee
1000-1015	Welcome address & objectives of workshop – Suresh Rohilla
1015-1100	Key theme presentation on 'Excreta Management' – Sunita Narain, CSE
1100-1145	**Session 1: Safe disposal and reuse of faecal waste** Speakers: • Resource recovery from faecal sludge pilot and lab-scale studies and bioprocess modeling - Kartik Chandran (Columbia Univ. USA) • Laboratory analysis of faecal sludge streams - standardised methods, procedures and support - Chris Buckley (UKZN, South Africa) • Faecal sludge characterization program for Indonesia - Lab to field and field to lab: David Robbins (GDS,USA) **Chair & Moderator: Chandra Bhushan, CSE**
	1145-1215 Tea / Coffee Break
1215-1330	**Panel Discussion - Mainstreaming faecal sludge/waste contamination, monitoring protocols and resource recovery** Speaker: Jayant Bhagwan (WRC South Africa) - Responses and directions Panelists - J S Kamyotra (CPCB), B.K.Sinha (BIS),N.B.Mazumdar (ILFS), Rohit Kakkar (CPHEEO) **Chair & Moderator: Chandra Bhushan, CSE**
	1330-1415 Lunch
1415-1530	**Session 2: Septic tank - treatment and faecal waste disposal** • FS containment in Indian cities - Bhitush Luthra (CSE, New Delhi) • Status of FS containment & transportation situation of small town in Karnataka – Rajesh Pai and K. Kanakraj (BORDA, Bengaluru) • Onsite treatment system 'Johkasou' – Meena Sharma (MU, Jaipur) • Dry hygiene toilet- Prof. K Munshi (IIT, Mumbai) • Septic tank - disposal system and treatment with a focus on "bio-digester" - Manoj Jha (Arkins Ltd, New Delhi) **Chair & Moderator: Roshan Shrestha, BMGF**
	1530-1600 Tea/Coffee Break
1600-1700	**Contd-** • Decentralised wastewater treatment – Chhavi Sharda (CSE, New Delhi) • Vermi-filtration for faecal waste treatment – Sudipti Arora (BLIB, Jaipur) • Continous aerobic multi-stage soil biotechnology for water recycling – Chandrashekar S (VEC, New Delhi) • Reuse of faecal waste for agriculture – Vishwanath S (Biome Envn. Solutions, Bengaluru) **Chair & Moderator: Madhu Krishna, BMGF**
	1700-1730 Q&A

APRIL 5, 2016

0930 - 1130	**Session 3: Tools for decision making to upscale / include FSM in sanitation plans – International case studies** • Case studies in faecal sludge management for sanitation improvement - David Robbins (GDS, USA) • Faecal sludge management – Case studies illustrating scientific support to eThekwini Municipality, Durban, South Africa- Chris Buckley (UKZN, South Africa) • Technological options of FS treatment in urban areas - Case study in Beijing – Shikun Cheng (UST, Beijing) • Faecal sludge to fuel plant: Outcomes from Rwanda - Ashley Mushpratt (Pivot Works, Rwanda)

Programme Schedule

	• Bangladesh experiences: Policy and practices around faecal sludge management – Hasin Jahan (Practical Action, Bangladesh) • Co-composting of faecal sludge with municipal solid waste – Abdullah Al Muyeed (WaterAid, Bangladesh) • Case study - Decentralized wastewater treatment in New York city- Kartik Chandran (Columbia Univ.USA) **Chair & Moderator: Sunita Narain, CSE**
	1130-1200 Tea/Break
1200-1315	**Contd-** • Approach and tools for mainstreaming citywide FSM service – Rajeev Munankami (SNV, Bangladesh) • Shit Flow Diagrams - An advocacy tool for improving understanding of urban sanitation – Suresh Rohilla/ Bhitush Luthra (CSE,New Delhi), Claire Furlong (WEDC, UK) & Oscar Veses (Univ. of Leeds, UK) • Business models of FSM technologies - Kalanithy Vairavamoorthy & Chaitanya Rao (IWMI, Sri Lanka) • SANIPATH study in Vellore - Routes to environmental contamination – Gangandeep Kang (CMC, Vellore) **Chair & Moderator : Suresh Rohilla, CSE**
	1315-1400 Lunch
1400-1530	**Session 4: Policies for decision making to upscale /include FSM in sanitation plans** • Sanitation safety planning for safe use of wastewater , excreta and grey water – Payden (WHO, New Delhi) • Experience in preparing city owned City Sanitation Plan – Sarah Habersack (GIZ, New Delhi) • SANIPLAN - Integrated FSM tools for citywide assessment and planning – Dinesh Mehta, Meera Mehta & Aasim Mansuri (CEPT, Ahemdabad) • Think systems, think option – tools for holistic and long term sanitation planning - Sujaya Rathi (C-Step, Bengaluru) • Blue Water - Putting water quality data in India to productive use by integrating historical and real-time sensing data- Sandeep Sandha & Biplav Srivastava (IBM Research, New Delhi) **Chair & Moderator : Arne Panesar, GIZ**
	1530-1600 Tea / Coffee Break
1600-1630	**Presentation by State Mission Director (SBM/AMRUT/NMCG) -** Mainstreaming citywide sanitation – Issues & challenges • Vasuki K - Director, Suchitwa Mission, Kerala • K.Kanna Babu - Director, Municipal Administration, Andhra Pradesh • Sanjit Rodrigues - Managing Director , GSIDC, Goa • Mission Director AMRUT / SPMG NMCG - U.P, Bihar and Maharashtra state **Chair & Moderator: Sunita Narain, CSE**
1630-1730	**Session 5: Policy integration challenges and opportunities** • Shashi Shekhar - Secretary MoWR & Mission Director NMCG • Neeraj Mandloi – Joint Secretary MoUD & Mission Director AMRUT • Praveen Prakash – Joint Secretary MoUD & Mission Director SBM • A.K.Mehta – Joint Secretary MoEFCC & Chairman CPCB **Chair & Moderator: Shashi Shekhar, MoWR**
1730-1745	**Launch event & Group photo** • *CSE Capacity Building Programme on Preparation of CSP for Urban Local Bodies in Ganga Basin* • *CSE - UNESCO IHE Online Course on Faecal Sludge Management*
	1745-1800 Closing Remarks

About Centre for Science and Environment, New Delhi

CSE is an independent public interest research organisation that aims to promote an informed public opinion in favour of environmental sustainability and sustainable development. The centre was established in 1980 to analyse and study the relationship between environment and development.

The centre's work is widely acknowledged for its intellectual leadership and the institution has grown into globally as well as India's most influential environmental NGOs. Some prominent domestic and international awards include the 2005 Stockholm Water Prize and the Prince Albert II of Monaco Foundation Water Award in 2008. The centre is recognised by the Government of India as:

- National Knowledge Resource Centre (KRC) in the area of sustainable drinking water and sanitation by the Union Ministry of Drinking Water and Sanitation.
- Centre of Excellence (CoE) in the area of sustainable urban water management by the Union Ministry of Urban Development.
- Empanelled Agency in Town Planning, Public Health and Engineering under Atal Mission for Rejuvenation and Urban Transformation (AMRUT) by the Ministry of Urban Development (MoUD).
- Nodal Institute for conducting short- and long-term training programmes for environment regulators by the Union Ministry of Environment and Forests (MoEF).

Key programmes at CSE include - sustainable urban transport and air quality; sustainable water management; sustainable industrialization; sustainable green buildings; food and toxins; renewable energy and climate change, environmental education.

The centre is working across India, South Asia and Africa.

Background

Over the past years, many countries of the developing world are struggling to find solutions to immediate problems of poverty, hunger, water scarcity and pollution, the entire world is faced with the catastrophe of climate change. Thus, Centre for Science and Environment (CSE) realizes the need to expand its areas of work in the field of environment and most importantly, focus on how the significant changes can be made. There is a strong demand for intra-regional flow of information thereby interlinking of global knowledge and experience.

The global framework for addressing sustainable development and climate change is transforming rapidly in response to emerging science as well as the evolving trajectory of national policy action in different regions of the world. All streams of concerns - health, climate change, energy security and local imperatives of sustainable development are converging. CSE uses knowledge to bring change and is involved in enhancing capacities of different stakeholders for mainstreaming best practices of Sustainable Water Management.

Urban areas today are experiencing significant service delivery gaps – water supply, solid waste management, sanitation, mobility, housing, environmental quality. It is imperative that the cities and urban areas leapfrog these challenges by adopting innovative practices, introduce information and communication technologies and build capacities to manage this transition. Learning from successful experiences would enable urban areas to accelerate the change process.

CSE's water programme in India has evolved to help establish policy principles, innovative technologies and implementation strategies for water and wastewater management. The programme efforts have been directed towards meeting the twin goals of laying the foundations for a water prudent society and adapting for climate resilience.

About the Workshop

CSE is organizing a two day workshop which will be attended by over *150- 180 key sector policy makers*, national/state functionaries, professionals, NGOs, international donor agencies and researchers who are involved in promoting sustainable and affordable sanitation – thereby mainstreaming citywide sanitation. The objective of the workshop is to promote active exchange of experiences of national and international opportunities and challenges in excreta management.

The technical sessions will focus on

Session 1: Safe Disposal and Reuse of Faecal Waste
This session will discuss fundamental issues addressed in any laboratory dealing with faecal waste. How have labs contributed to technology solution and policy? What did they do – projects/analytics? Also discuss FSM in practice: from lab to field and field to lab – questions of a practitioner.

Session 2: Septic tank - disposal system and treatment
This session will discuss the different types of on-site systems – septic tanks (as per IS standards) or improved, various types of containment, disposal system and treatment with example from towns / cities across India.

This session will continue to discuss some national experiences of on-site /decentralised faecal waste treatment systems including potential and barriers in reuse of faecal waste for agriculture. The session will discuss this technologies in details in terms of science – how it work, where it works and when it works (including regulations, performance monitoring and assessment)?

Session 3: Tools for decision making to upscale / include FSM in Sanitation Plans – International Case Studies
The session will present international case studies on – how does city include FSM / on-site waste management in sanitation plans and experience sharing on cost, regulation, land requirement, efficacy of treatment.

Session 4: Policies for decision making to upscale /include FSM in Sanitation Plans
This session presents tools / policies for decision making to upscale / include FSM in sanitation plans. Both BMGF supported and other key actors will present on – How to support assessment in terms city's situation in terms of faecal waste management, include interventions in sanitation plans addressing sanitation for all. The select tools will be tested in CSE's proposed handholding process on capacitating urban local bodies for preparing City Sanitation Plans in Ganga basin cities.

Session 5: Policy Integration Challenges and Opportunities
The session presents experiences and issues of state / cities in developing city wide sanitation plans. The aim is to discuss the barriers and brainstorm policy integration challenges in both national (Atal Mission for Urban Rejuvenation & Urban Transformation, Swacch Bharat Mission, National Mission on Clean Ganga and others) and state programmes.

The workshop is also a launch event for :

- CSE initiative on - ***Capacity building of ULBs in Ganga Basin for Preparation of City Sanitation Plans*** **and** ***setting up India's first referral laboratory on Faecal Waste*** (http://www.cseindia.org/content/capacity-building-initiative-citywide-sanitation-ulbs-ganga-basin).
- ***CSE - UNESCO IHE Netherlands Online Certificate course on Faecal sludge/septage Management*** starting on dated: 4 April 2016. http://cseindia.org/fsm/onlinecourse.html (also can be accessed via - Swacch Bharat e learning portal for city officials: https://swachhbharat.cloudapp.net/

Abstracts

Technical Session1: Safe Disposal and Reuse of Faecal Waste

- **Resource recovery from faecal sludge pilot and labscale studies and bioprocess modeling- Kartik Chandran, Columbia University, USA**

The prospect of recovering resources such as energy and chemicals from waste streams such as faecal sludge and wastewater could potentially promote more widespread sanitation and wastewater treatment efforts. Our team developed a pilot-scale research program to explore the possibility of converting faecal sludge to biodiesel, biogas and volatile fatty acids (VFA).
The program was implemented in Kumasi, Ghana and subsequently improved at Columbia University, New York. The research facility in Kumasi, consisted of twelve, 10m3Puxin anaerobic digesters in series fed with public septage faecal sludge. Based on limitations experienced and identified during pilot-scale operation, a novel configuration, consisting of step-feeding the FS to the reactors in series was further developed and optimized at lab-scale. Pilot performance results were also used to calibrate a bioprocess simulation model to describe the constituent biochemical reactions involved in anaerobic carbon cycling during faecal sludge treatment. Application of the model can permit extension of similar processes for management of and resource recovery from alternate faecal sludge and wastewater streams.

- **Laboratory analysis of faecal sludge streams – standardised methods, procedures and support- Chris Buckley, UKZN, South Africa**

Accurate quantification and analysis of faecal sludge streams are essential for the design and operation of a faecal sludge management project. Through funding from the Bill & Melinda Gates Foundation the Pollution Research Group at the University of KwaZulu-Natal, Durban South Africa has been involved in the analysis and quantification of a range of faecal sludge streams. A dedicated faecal sludge laboratory and associated test sites are being established for both analysis and process (transformation) trials. A high importance is placed on the health, safety and ethical aspects of faecal sludge sampling and sample handling. Prior to initiating a faecal sludge analysis programme it is necessary to have well defined objectives in order to guide the sampling techniques and laboratory analyses undertaken.Within Durban faecal sludge can be sources from ventilated improved pit latrines, urine diversion toilets and community ablution blocks. While the first two systems are dry, the last system operates with a water use of 13 L/p/d. Representative sampling systems are in the process of being improved and developed. For dry storage systems and sludges from wet systems the pathogen of concern are helminths and Ascaris in particular. For the enumeration of Ascaris eggs techniques have been validated for the presence of viable eggs in

a mixed or soil matrix. Through the Gates foundation funding, the Pollution Research Group staff are available to assist in all aspects of faecal sludge sampling and analysis.

- **Faecal sludge characterization program for Indonesia - Lab to field and field to lab- David Robbins, Global Development Services, USA**

Accurate data pertaining to the volume, strength and characteristics of faecal sludge is critical in making effective technology decisions in support of organized faecal sludge management programs. To obtain accurate data, a sampling and analysis program is required to first obtain representative samples, and then analyze them to obtain accurate results. This presentation describes a program launched in 2016 in Indonesia to accomplish this specific goal. The presentation describes the sampling and analysis planning process, pre-sampling checklists, field activities, documentation and laboratory protocols. Specific attention is given to-

Lab to field including:
- Understanding the requirements for the data that is needed;
- Preparation of a sampling plan; and
- Safe sampling practices.

and

Field to lab including:
- Conducting the sampling;
- Field preservation methods;
- Documentation (Chain of custody);
- transportation of the samples - hold times; and
- Quality Assurance / Quality control.

The presentation concludes with the practical application of the data in the use of the FSM Tool kit for effective technology decision-making.

Panel Discussion

- **Responses and directions for FSM – Jayant Bhagwan, Water Research Commission, South Africa**

In the absence of strong standards and regulations, for sanitation technologies and their operation and maintenance, we will be faced with serious issues in dealing with emanating faecal sludges. Many developed countries are managing sludges from off the grid sanitation systems, for example the USA has some 40% of its households using onsite sanitation systems in the form of septic tanks etc. In developing countries the lack or absence of these standards and regulation creates many challenges and adds to growing environmental health problems to already critical situation. It is therefore imperative for government to establish sound policies and an enabling environment for the management and safe disposal of faecal sludges emanating from household sanitation systems. This presentation covers how the scientific understanding of faecal sludges and its consequences is requiring and driving national policies and framework.It will highlight the need for ongoing faecal sludge characterization and monitoring to support scaling up and proper decision making for interventions, as well as research needs and strategies to support reuse and recovery from sludges.

Technical Session 2: Septic tank - Treatment and faecal waste disposal

- **FS containment in Indian cities – Bhitush Luthra, Centre for Science and Environment, India**

India is getting urbanized at a good rate but mostly in an unplanned way. Due to lack of facilities like sewerage network from the municipalities, the onus of disposing excreta away from the houses is on the residents. The households just want to get rid of the problem as soon as possible, without understanding the ill effects their actions can cause to environment and

finally to their own health. They have discovered different ways of constructing these containment systems. Whether these systems really contain excreta is a question to be asked.

- **Status of faecal sludge containment and transportation situation of small town in Karnataka- Rajesh Pai and Kanakeshwar Kanakraj, BORDA, India**

Devanahalli is a small town, part of rural Bangalore with 6400 households spread across 23 wards and has an ideal population of 30000. Devanahalli is currently the site of India's first Faecal sludge treatment plant, and FSM implementation. Incubation of Faecal Sludge Management [FSM] implementation and its study at Devanahalli was supported by the fact that currently there is no provision- under ground drainage connection and faecal sludge treatment facility. The Town Municipal council was keen to solve the problems related to sanitation problems. This presentation details the overarching issues faced, existing gaps in management of faecal sludge collection ,transportation ,and disposal in context to the small town of Devanahalli.

- **Onsite treatment system ' Johkasou' - Meena Kumari Sharma, Manipal University, India**

On-site sanitation facilities produce faecal sludge (FS) or septage in large quantities that needs to be managed.It has been reported that microbial characteristics of FS are much higher than that in the stool sample. It indicates that disposal of untreated septage into the surrounding areas significantly pollutes the environment and poses serious risks to public health. On-site sanitation facilities have been in practice popularly in the rural and peri-urban areas of the developing countries like India where centralized treatment facilities are not feasible. The people living in these areas utilize the on-site sanitation facilities like dry toilets, pit latrines, aqua privies, public ablution blocks without sewage connection and conventional septic tank (CST) for the management of domestic wastewater. Among various on-site sanitation systems, CST is the most popular one due to several beneficial features, such as simple design and low cost involvement. However, the treatment efficiency of CST is quite low, which is a major concern that needs to be addressed soon to safeguard the environment and public health. Hence, there is need to work towards developing and implementing more efficient on-site sanitation systems. Johkasou based integrated settler and filter based on-site sanitation systems have shown appreciable potential for effective treatment of wastewater as a suitable alternative to CST. These systems are equally effective for the treatment of toilet flush water only.

- **Hygienic toilet (Dry sanitation system)- Prof. K. Munshi, IIT Bombay, India**

Open defecation is a severe problem that many developing countries are facing. There are about 2.6-3 billion people lacking proper sanitation. Children take the brunt of insanitory conditions which lead to epidemic diseases like diarrhoea /Cholera etc. The crisis is especially acute for girls, many drop-out of school once they reach puberty just because of inadequate or non-existant lavatories.Annual amount of urine and solid excrement of one person consist equal amount of nutrients what is needed to grow grain for one person's annual food requirements. Utilization of composted human feces and urine (separated from feces) as organic fertilizers completes the human nutrient cycle by enriching the farming soil with nutrients. Also eliminates or reduces the need to buy industrial fertilizers.Conventional flush water toilets and sewerage system are too expensive to build and maintain. Huge water requirements makes it unsuitable in water scarce areas. Valuable nutrients in human excreta are wasted and create undesirable pollution in water bodies where it is discharged. There is therefore a need to design and develop simple and safe sanitation system which is cost effective and contextual for the society. Many attempts have been made in this direction. The aim of the project was to look at all the available options and recommend a new design suited specifically to both urban and rural India, where open defacation and water scaricity is a problem.

- **Septic tank- disposal system and treatment with a focus on "bio-digester"- Manoj Jha, Arkins Creations Pvt. Limited, New Delhi**

Excreta management is a very serious challenge for the country at large, not only from the social & hygiene perspective but also from economic, environmental and sustainability point of view. Even after 68 year of independence, the situation on ground has not changed much/to the level as this should have changed.Main reason for this lack of desired sustainable progress is continued dependence of non-sustainable solutions, both at policy formulation as well as implementation level. Current reliance on either sewer based systems followed by a power intensive or maintenance intensive or septic tanks and twin pits/dry pits where sewers are not available is non-sustainable, technologically, commercially and environmentally. Septic tanks have failed to meet the challenge of excreta management and have rather given rise to another serious problem of septage management. Bio digester technology and its variants can address the problem of excreta and septage management effectively. The approach and technologies proposed in the presentation are as under:

Approach-

- In-situ treatment of sewage/septage.
- Minimal conveyance of sewage/septage where in-situ treatment is not feasible.
- Decentralized/modular/mobile treatment systems to be deployed.

Technologies-

- Bio digester technology based on accelerated & assisted anaerobic decomposition of waste in stages of electrolysis, acidogenesis, acetogenesis and methanogenesis processes,
- Anoxic treatment for nutrient removal.
- Aerobic treatment.
- Bio sand treatment.
- Vertical/horizontal flow constructed wetland treatment.
- Modular combinations of above technologies.

For different levels of pollution and treatment requirement, spaces as well as financial constraints, different combinations of the above mentioned solutions are deployed. Above approaches and combination of technologies are scalable and sustainable, both ecologically & economically and capable of addressing the challenge of city wide excreta management effectively.

- **Decentralised wastewater treatment – Chhavi Sharda, Centre for Science and Environment, India**

Faecal Sludge Treatment is not complete without the treatment of the liquid part or the effluent coming out from the containments like septic tanks. A Decentralised wastewater treatment system (DWWTs) can serve as an extension to the existing septic tanks to provide treatment of the liquid waste for local reuse or for safe disposal into the environment. DWWTs is a combination of various unit processes in a particular combination which gives optimum treatment for its objective at low cost and no energy inputs. DWWTs can provide primary, secondary and tertiary treatment for wastewaters from any containment from residential areas, commercial institutions and public entities like school, hospitals etc. Implementation of any successful DWWTs encompasses an approach, not just the technical considerations and construction but also to take into account site specificities in terms of local site conditions, terrain, economic and social situation.

- **Vermi-filtration for faecal waste treatment – Sudipti Arora, BLIB, India**

New on-site sanitation technologies need to be developed which reduce the frequency of emptying and which not only contain, but also treat the waste, so that handling and disposal are safer activities. The emergence and increasing prevalence of pathogens has been a pressing threat to human health and has challenged the ability to treat infections and diseases in humans. Hence, to reduce hazardous effects on the environment, the removal of pathogens from faecal waste should be accorded high importance**.** Worm-based sanitation systems or vermifiltration may provide a solution since they can reduce the solids in the system, due to the net loss of biomass and energy when the food chain is extended. Vermifiltration involves the inoculation of earthworms in traditional filtration systems to further enhance the efficiency of waste treatment. Vermifilters, a natural engineered system, which is based on the symbiotic relationship between earthworms and microorganisms, was first developed by Professor Jose Toha in 1992 at the University of Chile (Aguilera, 2003). The central concept behind vermifilters is that microorganisms perform biochemical degradation of waste material, while earthworms regulate microbial biomass and activity by directly or/and indirectly grazing on microorganisms. Earthworms present in the VF can also remove the harmful pathogens from wastewater by devouring them and by discharge of antibacterial coelomic fluid and antimicrobial properties of the microorganisms (Arora et al. 2014). This technology will provide an additional, affordable and superior technology option for those using on-site sanitation, which will overcome the problems associated with emptying traditional on-site sanitation systems.

- **Continuous Aerobic Multi-Stage Soil Bio Technology (CAMUSSBT) for water recycling- Chandrashekar Shankar,Vision Earthcare, India**

The Basic SBT technology was developed and patented at IIT Bombay over nearly 30 years of research effort. Over the last few years Vision Earthcare's (VEC's) Research, Development and Deployment team (RDD) has commercialized CAMUSSBT concept nationally. Nearly 70 such water recycling facilities are now adding value in terms of water security and providing

health and sanitation benefits to communities nationwide. A typical plant inlet and outlet water meets the very stringent norms as promulgated by CPCB. The CAMUSSBT at Virar was set up in 2012 and has been maintained by the VEC Operations team for the last 4 years. In this plant VEC has been able to demonstrate exceptional treated water quality from very low flows during initial phase where the occupancy was < 10% to today where the occupancy has reached approximately 50% and water supply is only 60 LPCD which then translates to high COD in the inlet water. Virar being a water scarce locality almost all the water is being provided by tankers at great cost of about Rs 100 per KL. In contrast the CAMUSSBT plant is able to recycle water at a total cost of Rs 8 per KL (inclusive of all O&M costs).

The second case study talks about the Jambudiyapur Small Bore Sewer (SBS) network and CAMUSSBT treatment equivalent to 54 families at a 5060 LPCD. The project created toilets, bath and wash facilities for all families. The generated waste water from all such facilities was collected using SBS technology from Canada's Clearford Inc a world leader for SBS wherein ClearDigest Smart Digester tanks predigested the suspended solids, ClearConvey network of sealed HDPE piping convey the clear waste water liquid to an end of the line STP using Vision Earthcare's CAMUSSBT system.

The project is envisaged to showcase the power of Clearford SBS and CAMUSSBT in order to provide a low cost decentralized sewerage, sanitation, water recovery system which can be deployed effectively and also managed locally. VEC and Clearford are working with urban/rural and municipal administration to scale such systems nationwide. The SBS system is built at a shallower slope since the solids are captured by the Solids Separating tanks and has superior longetivity due to use of HDPE which do not suffer from corrosion and abrasion issues that concrete hume pipes in convention sewer suffer from.

- **Reuse of faecal waste for agriculture – Vishwanath S, Biome Envn. Solutions, India**

In Karnataka, Honeysuckers have been operating for the last 12 years or more. After a judgement of the High Court on the abolishing of manual scavenging Honeysuckers were provided to all the towns and municipalities in the state. The 174 taluk Panchayaths have also been provided with Honeysuckers to help assist Gram Panchayats in emptying of pit toilets.

In the informal sector the Honeysuckers empty sludge and water onto agricultural lands where the waste is used as a fertilizer and a soil amendment. Simple safety precautions will enable elimination of all negative health and environmental externalities . The Sanitation Safety Planning tool of the WHO provides such a methodology.Farmers and agriculturists can become great allies in the management of sludge from pit toilets and septic tanks. The presentation will discuss some such examples.

Technical Session 3: Tools for decision making to upscale/include FSM in sanitation plans- international Case Stidies

- **Case studies in faecal sludge management for sanitation improvement - David Robbins, Global Development Services, USA**

Faecal sludge management is a good first step for communities, municipalities and cities interested in affecting long term and sustainable sanitation improvement. This presentation presents three case studies from local governments that are achieving this goal at vastly different scales. Highlighted are programs in the Philippines, Myanmar and Indonesia:

- The Indonesia example is for a very large 600 cubic meter per day system for a city of approximately 2 million people. It uses highly mechanized technologies to conduct faecal sludge treatment in a small space;
- In the Philippines, the case study of Dumaguete City is presented, which is an 80 cubic meter per day system. It has been operational for 6 years, and uses natural technologies to treat the faecal sludge with no mechanization; and
- The Myanmar case, which describes a small-scale neighborhood faecal sludge management program for 600 families generating just 2 cubic meter per day (small scale neighborhood system) usingthe lime stabilization process coupled with on-site biosolids dispersal.

Interestingly, all three provide the service for approximately $1 per family per month. Each program was planned using a SeptageMangement Planning Toolkit, developed by USAID in 2008.

- **Faecal Sludge Management – Case studies illustrating scientific support to eThekwini Municipality, Durban, South Africa- Chris Buckley, UKZN, South Africa**

The Pollution Research Group at the University of KwaZulu-Natal in Durban South Africa provides scientific support to the Water and Sanitation Unit of the eThekwini Municipality. This provides a level of confidence to the sanitation planners to innovate in their approach and to investigate different ways of providing water and sanitation services to the unserved in a rapidly changing situation which has a high level of poverty and is water scarce.

Examples will be described in which

- quantitative microbial risk assessments were undertaken to improve dry sanitation emptying techniques
- commercial products to reduce pit filling rates were shown to have no beneficial effect
- pit sludges should not be discharged into domestic wastewater treatment works
- the addition of a covering agent in urine diversion toilets did not enhancing the loss of water from faeces
- Ascaris eggs remained viable after five years storage in faecal sludge systems
- An effective solid waste management service would extend the service life of pits by 25%
- Area estimates have provided for agricultural land required for irrigation of crops to remove nitrogen and phosphorus to acceptable levels for indirect discharge to water bodies.
- Filling rates of sludge in pour-flush (low-flush) toilet sumps.

- **Technological options for faecal sludge treatment in urban areas: case study in Beijing- Dr Shikun Cheng, University of Science and Technology Beijing, China**

Every day, human beings produce excreta all over the world, which especially would bring about serious environmental pollution to urban areas if it could not dispose properly. However, collection and sustainable disposal of human faeces remain a big challenge for many developing countries. In urban areas, due to the high population density, this problem is particularly present.The majority of cities in the developing countries cannot provide adequate disposal mechanisms for human faeces for many reasons: lack of proper planning, lack of financial means, overwhelming over-urbanization, etc. As a consequence, waste ends up in places where it does not belong.

From the viewpoint of technology, human faeces can be treated in urban areas by means of mainstream technology. In short, they are separation, landfill, anaerobic digestion, and composting as well as combination of these units. This presentation will introduce three cases for human faeces treatment in Beijing, which is the capital of P. R. China and a world-class metropolis. These cases could be treated as technology mainstream for human faeces treatment in urban areas. For Case 1, human faeces is collected from public toilet in the peri-urban areas and fed into 400 m3 biogas digester after pretreatment and disinfection. The bio-slurry from the digester can be used as bio-fertilizer in the surrounding greenhouse production. For Case 2, the plant is build next to wastewater treatment plant (WWTP). human faeces is separated first. The solid part is transported to landfill while the liquid part is send to WWTP for further treatment. The whole process is sealed with odour control unit. For Case 3, the plant is build inside of a WWTP, human faeces is treated together with kitchen waste. After solid-liquid separation and coagulation, the solid part of human faeces is used for composting together with solid part of kitchen waste and other additives. The composting product is used for municipal greening.

- **Faecal sludge-to-fuel plant: Outcomes from Rwanda- Ashley Mushpratt, Pivot Ltd. Rwanda**

In August 2015, Pivot commissioned a demonstration Pivot Works plant in Kigali, Rwanda that converts faecal sludge into a burnable fuel for industry. The plant receives approximately 100 m3 faecal sludge per day containing enough solids to produce roughly 1-ton Pivot Fuel. Pivot Works comprises the five key processes. Grit screening, flocculation, mechanical dewatering, solar drying, and thermal drying. The final product is an energy-dense fuel, which is sold in powdered form for blowing into kilns and boilers. The process has an average net energy recovery of 90% when accounting for energy inputs. At the Pivot Works plant in Kigali, liquid effluent from the dewatering process is released into the city's original dumping pit. However, effluent treatment is being designed in preparation for commercial expansion and indicative technologies. The key benefit of Pivot Works for cities is the dramatic cost reduction it affords over conventional sewage treatment options. The cost savings are realized through two means. First, Pivot's novel approach of removing the majority of total solids and particulate BOD (biochemical oxygen demand) in faecal sludge at the head of their process renders the subsequent effluent

homogenized and depleted of organic constituents. Therefore, downstream treatment is simplified and can be accomplished sans aeration and without the usual trade-off of a large footprint. Second, for urban-scale plants, operation and maintenance costs of the Pivot Works process are significantly offset, if not fully covered, through revenue from Pivot Fuel. We estimate that if serving a city of 1 M people, a Pivot Works plant would have a production potential of upwards of 25 t Pivot Fuel per day. The break-even point for Pivot Works is 12 t Pivot Fuel per day, meaning the solution is best suited for urban populations of 500,000 or more.

- **Bangladesh experiences: Policy and practices around faecal sludge management - Hasin Jahan, Practical Action, Bangladesh**

Bangladesh achieved remarkable success in sanitation coverage over the last two decades.With the special drives of the Government and active engagement of development partners, local government institutions and communities, open defecation had been reduced to only 1% in 2015. Millions of pit latrines were constructed without considering the mechanism of sludge management, which resulted in reduced open defecation but created a second generation sanitation problem of 'faecal sludge management'. About 80,000 tons of faecal sludge is generated every day in the country, of which, only 960 tons (about 1%) are treated. The rest is dumped improperly in the open or in the waterbodies/drainage system polluting the environment and causing severe health hazard. Recycling of the faecal sludge by converting it into organic fertilizer/compost would be one of the practical solutions. Bangladesh uses around 3.5 million tons of fertilizer every year of which 2.6 million tons are imported. Government provides huge subsidy for the fertilizers. On the other hand, excessive use of chemical fertilizers are deteriorating the soil structure and reducing fertility. Under these circumstances, even if we could use a certain portion of faecal sludge converting into compost, it would be a huge gain for the country especially use of this compost could improve the soil heath and save the environment.

The presentation describes Practical Action Bangladesh's efforts around faecal sludge management. It undertook an action research on faecal sludge management considering the entire sanitation value chain and now is scaling up this at city scale. Practical Action is trying to link up sanitation sector with agricultural sector for leveraging the maximum benefit. Its policy work includes contributing in developing institutional and regulatory framework for faecal sludge management for the country and looking at the prospective in promoting compost for protecting soil health. This presentation will highlight the comprehensive experiences of Practical Action on its action research, scale initiative and efforts towards linking up policy and practice work around faecal sludge management.

- **Co-composting of faecal sludge with municipal solid waste – Abdullah al Muyeed, WaterAid, Bangaldesh**

This presentation discusses the potentials and performance of combined treatment of faecal sludge (FS) and municipal solid waste (SW) through co-composting. The objectives were to investigate the appropriate SW type, mixing ratio and the effect of turning frequency on compost maturity and quality. The FS was dewatered and dried initially on solar drying beds and the leachate was further treated in constructed wetland. Solid waste was combined with dewatered FSin mixing ratios of 3:1 by volume and aerobically composted for 6 weeks. Four composting cycles were monitored and characterised to establish appropriate SW type and mixing ratio. Two different turning frequencies with every 3rd day turning and turning at end of week were also monitored throughout the decomposition period. Samples were taken at every turning and analysed for total solids (TS), total volatile solids (TVS), total organic carbon (TOC), pH, ammonium and nitrate nitrogen (NH_4–N and NO_3–N) and total Kjeldahl nitrogen (TKN). Temperature, C/N ratio, NO_3–N/NH_4–N ratio and cress planting trials were chosen as maturity indicators. Result showed that there was significant effect of different turning frequencies on the temperature changes and the quality of mature compost. The 3rd day turning has more aerobic decomposition rate than the other turning pattern and the temperature graph also represents that the case with turning at end of week take more time to end degradation than the case with 3rd day turning. The final product contained average C/N ratio of 18 and NO_3/NH_4-ratio of about 9, while TVS was about 25% TS and the NH_4–N content was reduced to 0.03%. A co-composting duration of 6 weeks was indicated by the cress test to achieve a mature and stable product. The turning frequency of 3rdday is recommended as it saves labour and still reaches safe compost with fairly high nutrient content. This paper also examines the suitability of use of end product as soil conditioner in agricultural purpose. It was also found that the constructed wetland is efficient in treatment of leachate of FS from the dry bed by reducing pollutants (BOD, COD, NH_4-N) in an average of more than 70%. The results of this action research will attribute to functional operation of the co-compost plant and also contribute to faecal sludge management (FSM) study further.

- **Case study. Decentralized wastewater treatment in New York City- Kartik Chandran, Columbia University, USA**

By some accounts, about 70% of the world's population will reside in major global cities by 2050.For some of these cities, the model of centralized wastewater treatment may not be feasible owing to the capital cost of expanding existing treatment facilities or building new ones footprint or just the footprint required. Decentralized, distributed systems for treatment of sewage and other organic streams offer an attractive alternate to the centralized treatment model. This presentation focuses on the application of decentralized organic carbon and nutrient removal to select high-rises in Manhattan with the main objective of water reuse. Extension of such processes for incorporating added organic waste streams and simultaneous water reuse and decentralized nutrient recovery is also discussed.

- **Approach and tools for mainstreaming citywide FSM service- Rajeev Munankami, SNV, Bangladesh**

SNV Netherlands Development Organisation under its Urban Sanitation and Hygiene for Health and Development framework is implementing a project "Demonstration of pro-poor market-based solutions for faecal sludge management in urban centers of Southern Bangladesh" under the leadership of local authorities and in partnership with local academic institutions, utility and INGOs.It is the first city-level programme in Bangladesh where innovative partnerships and service modalities compatible within local regulatory framework and responsive to socio-economic conditions, initiated in the entire sanitation value chain.The programme started with a Baseline assessment of Impact (quantitative) and Outcome (qualitative) indicators covering local level focused sanitation and FSM situation, an area that severely lacked reliable data or any data at all.The interest and capacities of the local authorities and relevant stakeholders were addressed in outcome indicators whereas the sanitation status of the populace was addressed by quantitative survey after reaching agreement on impact indicators. Based on the baseline findings various enabling conditions were defined and agreed upon and interventions were designed in cooperation with the local authorities.

The project is working closely with the communities of manual emptiers to develop service models that are safe, affordable and can generate employment and income. Initiatives are underway to bring these informal actors under local authority by developing their database and incentivizing them by ensuring their occupational safety and health and certification.Different service/business models have been developed and being tested in order to attract wider investment. A paradigm shift on the thinking of FSM as a sole institutional obligation and functional responsibility of the local authority to a viable service-partnership modality with adequate scope for private sector participation and inclusion of diverse independent certified professionals which has a potential for revenue generation is required. A second key component is behavior change communication that can increase demand for safe services, is being tailored to the different social groups in the city and towns based on the outcome of formative research. Various smart enforcement mechanisms along with awareness campaigns are being organized. Furthermore, the project is working with local authorities to create an appropriate enabling policy and regulatory environment for services at the local level, and is guiding stakeholders through a process of informed choice for the selection of treatment and/or re-use technologies. GIS based integrated information management system are designed and mainstreamed within local authorities for planning, decision making and monitoring tools for the provision of FSM services.

Sustainable and inclusive urban sanitation services in cities, depend on the capacity of localgovernments who can ensure compliance with minimum standards and key regulations.Relevant local authorities are fully engaged in every steps of the interventions planning and implementation to ensure that the capacity remains for long-term support and future monitoring.

- **Shit Flow Diagrams: An advocacy tool for improving understanding of urban sanitation- Bhitush Luthra, Centre for Science and Environment, India**

The Water and Sanitation Program (WSP) of World Bank commissioned a study in 2013 to examine global trends in Faecal Sludge Management (FSM) using 12 city case studies as a basis. Building on this work, a group of institutions active in the field of excreta management convened in June 2014 to further develop the service delivery assessment tool and Shit Flow Diagrams, or SFDs, developed by WSP which clearly and simply show how excreta is or is not contained as it moves along multiple pathways from defecation to disposal or end-use. The diagrams are an easy-to-understand advocacy and decision support tool, understandable and suitable also for non-technical people and have since become widely used to illustrate and

visualize excreta flows in urban settings. SFDs focus the discussion on where the real sanitation gaps are, therefore guiding priorities and interventions.

- **Business models of FSM technologies - Kalanithy Vairavamoorthy & Chaitanya Rao, IWMI, Sri Lanka**

Improved access to sanitation is one of the major policy goals throughout developing countries. On-site sanitation systems such as septic tanks and pit latrines are the predominant solution for access to toilets in both urban and rural areas in developing countries. With limited public funding to expand piped sewerage network in many low-income countries, on-site sanitation systems and faecal sludge management represent a comparatively lower cost solution with the additional advantage of lower water and energy requirements for pumping and flushing increasingly larger sewage networks. However, for onsite sanitation system, investments in safe collection, disposal and treatment of faecal sludge remains a challenge. Further, barriers in lack of understanding of business models combined with assessing their economic viability hampers appropriate emptying and treatment services. This paper presents deep-rooted work undertaken by IWMI to analyze the economic viability of faecal sludge management (FSM) through the lens of business model. IWMI has analyzed over 30 successful FSM cases from across Asia, Africa and Latin America through field study, literature review, and structured interviews and from this analysis it has developed 18+ business models. IWMI has developed a multi-criteria framework to do feasibility assessments and develop viable business models for faecal sludge management in Ghana, Sri Lanka, Bangladesh, India, and Nepal. This framework is applied to our ongoing work in Gangaghat and Mughalsarai on Ganga Basin and thepaper will present initial results from the ongoing study along with the examples of selected business models applicable to Indian context.

- **SANIPATH study in Vellore- Routes to environmental contamination- Gagandeep Kang, Christian Medical College, India**

Urban water supply and sanitation challenges policymakers to manage water safety and faecal sludge inside and outside the household. The overall goal of SaniPath study is to identify the domains and pathways of exposure to faecal contamination that may pose the greatest risk in low-income urban environments with poor sanitation. The study developed and tested multi-disciplinary methods to identify sources of faecal contamination in the public (public water supplies, public latrines, produce) and private (households, nurseries) domains, and document behaviorthat leads to exposure. We tested rapid assessment tools in urban communities in Vellore, Tamil Nadu, where there is in-depth information on enteric disease incidence and etiology to determine if wecan detect a relationship between faecal contamination in the environment, exposure behavior andenteric disease incidence or etiology patterns in the population living in this setting. We were able to determine the frequencies of exposure behaviors to potential vehicles of faecal contamination (ie. drinking water, raw produce) and locations with faecal contamination (ie.open drains, surface waters) and the proportion of study children, family membersand neighbors who are exposed to faecal contamination through these different transmission routes. We examined the distribution of faecal indicator bacteria concentrations across environmentalsample types (drinking water, surface waters, open drains, produce eaten raw, soils, and swabs from public latrines) and by geographic samplinglocations in the study neighborhoods. We also used spatial analyses to examine sources of faecal contamination and movement of faecalcontamination in the study neighborhoods to determine if there are geographic "hot spots"of greater faecal contamination and/or risk of exposure Surveys and spatial analysis examined the presence and clustering of sanitation and faecal sludge management (FSM) practices in 200 households. Faecal contamination was measured in environmental samples within 50 households and household drains, with enteric infection quantified from stool specimens from children under five in these households. Neighborhoods differed significantly in sanitation coverage (78% vs. 33%) and spatial clustering. Across neighborhoods, 49% of toilets discharged directly into open drains ("poor FSM"). Children in these households had 3.78 times the prevalence of enteric infection when compared to children in other households, even those without toilets. Drains in poor FSM clusters had higher levels of enteric pathogens than elsewhere in the neighborhood. Conversely, children in households with a toilet that contained waste in a tank ("good FSM") had 55% lower prevalence of enteric infection compared to the rest of the study area. Household toilets in low sanitation coverage areas were associated with increased faecal contamination on floors where children played, while those in a high coverage areas were associated with reductions in household faecal contamination and enteric infection in children when coupled with good household hygiene and FSM practices. This study highlights the contributions of both sanitation coverage levels and FSM in environmental faecal contamination and, subsequently, enteric infection prevalence in urban settings.

Technical Session 4: Policies for decision making to upscale /include FSM in Sanitation Plans

- **Sanitation safety planning for safe use of wastewater, excreta and grey water - Payden ,World Health Organisation, India**

There are two major issues in sanitation – to provide access to improved sanitation and secondly to ensure treatment and safe disposal of wastewater. Sewage from cities, small towns and communities are often not treated or partially treated and disposed in water bodies which are sources of drinking water. In addition, rapid population growth, industrialization and changing climate poses huge stress on water resources which forces communities to use wastewater in agriculture.The health risks associated with this practice have been long recognized.

The underlying purpose of sanitation interventions is to protect public health. Management and investments in improvements on sanitation systems should be made based on adequate understanding of the actual health risks posed by the systems and how these risks might best be controlled.

The Sanitation Safety Planning (SSP) is a step-by-step risk based approach to assist in the implementation of the 2006 WHO Guidelines for Safe Use of Wastewater, Excreta and Greywater. However, the approach can be applied to all sanitary systems to ensure the system is managed to meet health objectives. SSP assists users to:

- systematically identify and manage health risk along the sanitation chain;
- guide investment based on actual risks, to promote health benefits and minimize adverse health impacts;
- provide assurance to authorities and the public on the safety of sanitation-related products and services.

SSP provides a structure to bring together actors from different sectors to identify health risks in the sanitation system and agree on improvements and regular monitoring. The approach ensures that efforts target the greatest health risks and leads to improvement over time. It can be used both at the planning stage for new schemes, and to improve the performance of existing systems. SSP underscores the leadership role of the health sector and helps to bring a human health perspective to traditional non-health sectors like sanitation engineering and the agricultural sector.

- **Experience in preparing city owned City Sanitation Plan – Sarah Habersack, GIZ, India**

In India city-wide plans for sanitation but also other sectors such as housing and mobility are most often not prepared by the Urban Local Bodies themselves but by external experts. The assumption behind this mechanisms is that the Urban Local Bodies don't have the capacities and the resources to undergo such planning processes themselves. The consequence is that plans lack implementation and are not perceived by urban decision makers as helpful tools for developing their cities. Projects are finally implemented in an isolated manner without understanding the sanitation sector in the whole city. GIZ in cooperation with CSE has challenged this assumption and embarked on a Training and Handholding Programme for Urban Local Bodies in 3 states to capacitate city officials to prepare and implement City Sanitation Plans on their own. The objective was to create ownership of the city for planning their sanitation system in an integrated manner and to introduce a systematic and comprehensive planning process to be able to take informed decisions on future sanitation projects. The presentation will guide through the strategic approach of this programme and share learnings after completing the major part of the process in all three states. It will question the necessity of Urban Local Bodies preparing their own city-wide plans and open the discussion on what capacities need to be built to actually improve the sanitation situation on the ground.

- **SANIPLAN - Integrated faecal sludge management tools for citywide assessment and planning- Dinesh Mehta, Meera Mehta and Aasim Mansur, CEPT, India**

CEPT University has developed a web-based tool for Citywide Integrated Faecal Sludge Management (IFSM) planning that enables assessment and planning across the full sanitation service chain. The tools are organized around five key areas: a) Service Performance, b) Technology Options, c)Institutions Regulations Policy, d)Private Service Providers and e)Financial Assessment. Assessing the current situation of FSM in these five areas is important to develop a FSM plan that is technically appropriate and financially feasible at local level. Assessment in each area entails review of available information at city level, identifying information gaps, and conducting field studies where necessary.

The IFSM planning process is facilitated by SANIPLAN, a decision support tool that has three main areas: a) assessment of service performance across the full service chain, b) designing an action plan to ensure service improvements across the chain, and c) developing a financing plan for both capital and O&M costs for the full plan period. SANIPLAN, was used for preparation of several City Sanitation Plans in Maharashtra by the CEPT team.. It is a tool that supports more informed stakeholder participation during planning process. Based on local priorities, the users can identify key actions for service improvement, and a Financing Plan that ensures funding for both capital and operating expenditure.

- **Think systems, think options - Sujaya Rathi, C-STEP, India**

Holistic and long-term sanitation planning requires an integrated assessment of various aspects (land use, water, urban activities, and demographics) and appropriate technologies. In the Indian context, there are many technologies catering to on-site solutions, small decentralized options and large scale centralized options. There is a need for awareness, data collection and constant updating, and knowledge collation. This so that the decision-maker is able to consider all the options, especially user-friendly, affordable and sustainable non-networked solutions that can be scalable in order to increase rate of sanitation coverage in the cities.

In this context, a decision support tool was developed by CSTEP to facilitate an integrated approach to the sanitation investment planning process for urban local bodies in India. The tool is envisioned to provide stakeholders the information and knowledge of existing and new technologies in a manner that allows them to compare alternatives, assess cost/benefits and make informed decisions. The presentation will entail details of the tool in its current version.

- **Blue Water: Putting water quality data in India to productive use by integrating historical and real-time sensing data- Sandeep Sandha and Biplav Srivastava, IBM Research, India**

Water is unique in its role as a life preserver. It is important to all members of a society. However, if one is looking for quality data in India to make data-driven decisions, one is lost. This is surprising given that there is a rich history of data collection in the country and looks forward to adopting real-time water sensing in a big way. In this talk, we will discuss our work on collating and integrating historical open pollution data and new, real-time sensing data, along citizen-centeric usage like drinking, irrigation or industrial need. The talk will cover current issues around data management practices for water that have prevented their widespread dissemination, combining multiple pollution sensing techniques, data platforms for integration, novel analytics to aid routine decisions, field experiments on Yamuna at Delhi, Hindon at Meerut and Ganga at Haridwar, and mobile apps – Ganga Watch and Neer Bandhu (Water Friend) - we have released.

Speaker's Profile

Workshop on Mainstreaming Citywide Sanitation - Opportunities and challenges in Excreta Management

Suresh Kumar Rohilla
Programme Director-Water Programme
Centre for Science and Environment
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Dr. Rohilla is has over 22 years of experience working with national / international NGOs, government and academics. He leads the water programme at Centre for Science and Environment, New Delhi. He is involved in policy advocacy, research and capacity building aimed at mainstreaming water and environmental sustainability in South Asia and Africa. He is Head of the Centre of Excellence in Urban Development sustainable Water Management Area of the Ministry of Urban Development and the National Key Resource Centre of the Ministry of Drinking Water Supply and Sanitation, Government of India. Some of his previous assignments include – Director Environment & Development (Living Ganga Programme) at World Wide Fund for Nature - India; Associate Professor (Environment Management and Sustainability) at Administrative Staff College India, Hyderabad and Lecturer in Environment Management and Sustainability at University of Bradford, U.K; Director (Technical) at the National Capital Regional Planning Board, Ministry of Urban Development and Director - Natural Heritage Division, Indian National Trust for Art and Cultural Heritage (INTACH), India. He holds a doctoral degree from Queen's University Belfast and post graduation degree(s) from Jawahar Lal Nehru University and School of Planning & Architecture, New Delhi. He is recipient of the British Chevening Indian Young Environmental Manager Fellowship (2001), Fulbright Nehru Environmental Leaders Programme Fellow (2012) and Government of Netherlands Fellowship (2014). He has been an affiliated Visiting Professor / Researcher at University of California – Berkeley in U.S.A.

Sunita Narain
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She has been with the Centre for Science and Environment (CSE) since 1982. She is currently the Director General of CSE and the Director of the Society for Environmental Communications and publisher of the fortnightly magazine, Down To Earth. She is a writer and environmentalist, who use knowledge for change. She was listed among the world's top 100 public intellectuals by foreign Policy Journal, was awarded the Padma Shri in 2005. The same year, she won the prestigious World Water Prize by the Stokholm Environment Institute. Ms Narain serves on several important policy bodies in India, including the Prime Minister's Council for Climate Change, the National Security Advisory Board and the National Ganga River Basin Authority. In 2012, she has authored the 7th State of India's Environment Reports, Excreta Matters, which presents a comprehensive analysis of urban India's water and pollution challenges.

DAY 1: International Speakers

Kartik Chandran
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Mr. Kartik Chandran, an American engineer and associate professor of earth and environmental engineering at Columbia Engineering, has been named a 2015 MacArthur Fellow for his work in "transforming wastewater from a pollutant requiring disposal to a resource for useful products, such as commodity chemicals, energy sources, and fertilizers." In 2011 he received a $1.5 million grant from the Bill & Melinda Gates Foundation grant to develop a transformative new model in water and sanitation in Africa. His work is focused on integrating microbial ecology, molecular biology, and engineering to transform wastewater, sewage, and other "waste" streams from problematic pollutants to valuable resources.

Chris Buckley
Head of the Pollution Research Group
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Chris Buckley is a research professor in the School of Engineering and head of the Pollution Research Group (PRG) at the University of KwaZulu-Natal, Howard College Campus, Durban, South Africa. He has been involved in contract research in water and effluent management at the University of Natal (now University of KwaZulu-Natal) since 1976. He was a member of the Minister's National Water Advisory, National Waste Management Strategies and Action Plans for South Africa, National Sanitation Task Team, and review committee for the BMGF funded Sanitation Research Fund for Africa and worked with various organizations like Department of Science and Technology, National Strategy for the Manufacturing Sector. He was a South African representative at the European Cleaner Production Roundtable in Denmark, the Asia Pacific Cleaner Production Roundtable in Australia and the First African Cleaner Production Roundtable in Nairobi, the Bonn Nexus conference in 2011 and the 7th World Water Forum in Korea. He has acted as a project reviewer for the South African National Research Foundation:the Department of Arts, Culture Science and Technology Lead and Innovation funds; the British Science and Engineering Research Council; the Singapore National Science Council and the Australian CRC for Waste Management and Pollution Control. He was a visiting professor at INSA Toulouse (France).

David Micheal Robbins
President
Global Development Services
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David Robbins has been working in the field of on-site wastewater management for 27 years and in 17 countries mostly in Asia and Latin America. He is an independent consultant specializing in helping local governments to develop decentralized wastewater and faecal sludge Management programs. In 2008 he led a team funded by USAID to develop their SeptageManagement Toolkit, still widely used throughout the region. More recently, as a consultant for USAID in the Philippines, he developed their Implementer's Guide to Lime Stabilization for Faecal Sludge Treatment, and helped launch the technology through pilot programs in cities devastated by Typhoon Hayian in 2014. As a consultant for OXFAM, he developed their Leader's Guide to Septage Management, currently being

implemented throughout the Philippines for municipalities and small cities. His current work is focusing on developing small scale FSM programs for Internally Displaced Peoples camps in Myanmar.

Jayant Bhagwan
Executive Manager - Water use and Waste Management
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Mr.Jayant Bhagwan, is the Executive Manager of the key strategic area of Water Use and Waste Management at the South African Water Research Commission, which focuses on the management of water and wastewater in the Domestic, Mining and Industrial sector. He has been instrumental in creating the portfolio of research projects and innovations related to water supply and wastewater management. He completed his Masters Degree in Tropical Public Health Engineering from Leeds University, UK. He held the posts of the President of the Water Institute of Southern Africa, Chairperson of the Minister of Water Affairs and Forestry Water Advisory Committee, as well as international advisory positions with the Water Supply and Sanitation Collaborative Council, IWA-Global Development Agency and UNEP. He continues to be actively involved in a broad range of areas in the field of water supply, wastewater and sanitation, with current focus being on sanitation technologies for the future, technology innovation and application, social franchising of O&M, conduit hydropower, benchmarking, reuse and reclamation of effluents.

Roshan Raj Shrestha
Senior Program Officer
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He is currently working at Bill & Melinda Gates Foundation as a Senior Program Officer with Water, Sanitation and Hygiene (WSH) team based in Seattle, USA. He is co-leading the WSH program in India and also a Technical Lead for South Asia. He worked seven years with UN-Habitat in different capacities prior to joining the foundation. He completed M.Sc. – Botany, Ecology in TU, Nepal; a post-graduate course on Limnology and Ph.D. in Applied Natural Science (1996-1999) from Austria. He has received several national and international awards, among them Mahendra Vidhay Bhushan "Class A" in 2000, the Third World Academy of Sciences Award in 2000, the Kathmandu Metropolitan City Environment Award in 2004, a team member for World Bank's Development Market Global Competition award in 2003 and Top 10 Kyoto World Water Prize in 2006.

National Speakers

Chandra Bhushan
Deputy Director General
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Chandra Bhushan is the Deputy Director General of Centre for Science and Environment (CSE). CSEis one of India's premier pubic interest research institutions. Bhushan has a diverse and distinguished track record in research, writing, management and policy advocacy. he has researched and written about issues ranging from industiral pollution to energy and climate change and from water crisis in Indian sub-continent to political economy of natural resource extraction. Bhushan has authored many books and publications on industrial pollution, energy and climate change. He has been part of many national and international groups and committees. He was the co-chair of the technical working group of Global Reporting Initiative. He is member of many comittees of the Bureau of Indian Standards and is also a member of the board of the National Accreditation Board for

Education and Training in India. Bhushan has also served on various government committees including memeber of a number of working groups / subgroup for preparing India's 12th Five Year Plan. His current research assignments include HFC's, energy efficiency and low carbon development in industries.

J.S.Kamyotra,
Director
Central Pollution Control Board
kamyotra.cpcb@nic.in

J. S. Kamyotra is presently serving as Scientist 'F' at CPCB. He has been the Member Secretary of Central Pollution Control Board, the country's premier environment decision making body, for 5 years. Mr. Kamyotra has over 30 years experience working in policy formulation, development of environmental standards, establishment of real time monitoring networks in the areas of air quality, water and noise pollution. He has also been responsible for the development of India's first indigenously developed mobile air quality monitoring van.

B.K. Sinha
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Mr B.K. Sinha is a B. Tech in Civil Engineering from 'IIT BHU' with specialization in Structural Engineering. He is also an M.Tech in 'Master of Urban & Regional Planning' from the prestigious 'School of Planning & Architecture', New Delhi. Thereafter he completed 'Post Graduate Diploma in Management'. He is also a 'Certified Lead Auditor' for 'Quality Management Systems' as per ISO 9000 as well as 'Environmental Management Systems' as per ISO 14000. Mr Sinha has more than 25 years of experience while working in the Bureau of Indian Standards. He has immensely contributed for domestic as well as international industries/organizations in the field of a large variety of 'product certification' including Hallmarking, 'System certification', NABL certified 'Product Testing Laboratory' and 'Standardization' in the field of Civil Engineering. Mr Sinha is credited with many publications in various journals of Quality, Standardization and Civil Engineering fields. At present, he is the Head of Civil Engineering department of BIS at ManakBhawan, New Delhi.

N B Mazumdar
Technical Advisor
IL&FS Environmental Infrastructure & Services Ltd**.**
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He has over 33 years of experience in waste management, sanitation, renewable energy and financing of infrastructure projects. He specializes in the field of municipal solid waste management, onsite affordable sanitation, biogas technology and decentralized waste water treatment (DEWATS).

Currently he is associated with IL&FS Environmental Infrastructure & Services Ltd. as Senior Technical Advisor for design, implementation and operation of solid waste management projects. He had worked as consultant to TERI on consolidation of waste management, environmental issues and renewable energy activities. He was deeply involved with on-site sanitation, biogas technology and decentralized waste water management while working as Director, Sulabh International Institute of Technical Research and Training. Presently he is Chairman, Expert Committee, MoUD for revision of the 'Manual on Municipal Solid Waste Management', member of committee drafting the revised MSW 2015 Rules (MoEF&CC) and 'IRC Guidelines on

Use of Recycled Construction and Demolition Waste in Road Works' and on the BIS Panel working on alternative aggregates (from processed C&D waste) and Municipal Solid Waste Management.

Rohit Kakkar
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His current work involves working on Government of India's flagship programmes where he is reponsible for designing and conducting evaluation of Swachh Bharat Mission and Mission on Smart Cities. He has previously served as a Joint Director for Defence Headquarters in India and as Joint Director for ADG (Design and Consultancy) where he was responsible for the design of WASH (Water,Sanitation, Hygiene schemes)

Bhitush Luthra
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Mr Luthra holds a Masters degree in Environmental Engineering and Management from Indian Institute of Technology Kanpur. He is involved in research and training on subject related to decentralized wastewater treatment and septage management. His field of interest includes sanitation, water and wastewater treatment (conventional/non-conventional methods), septage treatment

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He holds a Master's Degree in management with specialisation in strategy from Imperial College London, UK. He has a wide range of experience in Skill development and water and sanitation sector. He has good exposure in managing, planning and execution of large scale pan India projects, market research, liasoning with Non-Governmental Organizations and Governmental Organizations.Presently he is working with Consortium for DEWATS Dissemination (CDD) Society, as Asst. Project Manager .Indian first Faecal sludge treatment plant (FSTP) and managing Gates foundation project on Faecal Sludge Management (FSM) at CDD society. He is also working on septage policy implementation at Karnataka state level.

Rajesh Pai H.
Senior Technical Advisor
BORDA
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Rajesh Pai H. holds a Bachelors degree in Civil Engineering from Manipal Institute of Technology, Manipal, Mangalore University (1998). He has undertaken a professional certificate course in Urban Infrastructure Planning from Centre for Environmental Planning and Technology (CEPT), Ahmedabad in 2009. He holds a wide-ranging experience for more than 15 years in the development sector mainly

in the implementation of sanitation related project of various scales. His domain expertise is in the planning, design and implementation of the projects and programmes related to decentralised wastewater treatment projects (DEWATS), community based sanitation (CBS) systems &public sanitation and faecal sludge management for small and medium towns. He is well experienced in handling technical designs, project management, research and development, capacity building and training workshops related to rural/urban sanitation, conservation of natural resources and environmental protection in coordination with beneficiary communities, private organizations, Non-GovernmentalOrganizations and Governmental Organizations. He has also been engaged in formulating city sanitation plans for different cities of India and supported MoUD, GoI for evaluation of city sanitation plan submitted by different cities.

Meena Kumari Sharma,
Professor (Associate)
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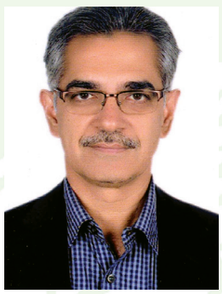
Prof. Meena Sharma is cureently working as Associate Professor, Department of Civil Engineering Manipal University Jaipur. Her area of interest are Sustainable On-Site & Small-scale Wastewater Treatment Systems, Management of On-site Sanitation Systems, Septage /sludge treatment systems , Aerobic Post-treatment Systems and Electro-chemical Treatment Process etc. Dr Meena did her Doctoral degree in Environmental Engineering, (2016) on the topic " Integrated Settler and Anaerobic Filter Based Onsite Sewage Treatment Systems" from Indian Institute of Technology Roorkee, Roorkee, Uttarakhand



Manoj Jha
Managing Director
Arkin Creations Private Limited
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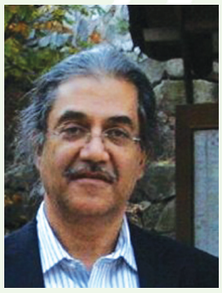
After completing his engineering degree from Ranchi University in 1983 in production engineering started his professional career with Tata Motors Ltd Jamshedpur as a graduate engineer trainee. Since 1983, worked in several automotive and engineering industries besides Tata Motors like Eicher Tractors, Minda Group, Tenneco Automotive Ltd, Escorts Ltd and finally Hindustan Motors Ltd in various functions and capacities and rose upto the level of CEO & Managing director. During his professional career, he was instrumental in launching many Greenfield projects, developing and launching new products conceptualize and establish several innovative products, processes and systems.

After spending over 33 years' experience in the industry and achieving fair success in all spheres of enterprise, started own social enterprise in 2012 working in the areas of sanitation, waste & waste water management as one
believes that today India needs these basic services urgently not only for continuing our march to become a global superpower but even for our basic health, hygiene, dignity & survival. During the short period of our enterprise, we
have been able to develop & establish several projects, processes, tie-ups with some global players in this field and established a good name for ourselves in the country.

Chhavi Sharda
Senior Research Associate
Centre for Science and Environment
chhavi@cseindia.org

Ms Sharda is post graduate in Environmental Engineering. She holds PG Diploma in Urban Environmental Management and Law. She has been conducting technical sessions in capacity building programs for municipal functionaries, practitioners, academicians, policy makers on decentralized wastewater treatment for water sensitive planning and urban lake conservation since two years. She has documented various case studies on decentralized wastewater treatment systems across India. She also supports technical consultations to support implementation of decentralized wastewater treatment projects. She has keen interest in improving her knowledge on sustainable water/ wastewater management approaches.



Professor K.Munshi
Former Head, IDC, IIT Bombay
Director, CTech Labs Pvt. Ltd.
munshi999@yahoo.com

K Munshi is the professor and former head of Industrial Design Centre, Indian Institute of Technology, Bombay (top Indian Institute and the centre of academic excellence). He also sits as the founder director of C Tech Labs Pvt. Ltd. – a joint venture with IIT Bombay. He obtained Bachelor's degree in Mechanical Engineering with Post–graduation in Product Design from IIT Bombay and Royal College of Art, London. He was UNESCO Fellow at Technical University of Hannover, Germany, Universite de Technologie de Compiegne, France, and has worked with some of the leading design groups in Europe – SottsassAssociati, Milano, Italy. He also is the Founder member & past vice-president, Society of Industrial Designers of India (SIDI).An eminent and prolific researcher, K.Munshi has made an invaluable contribution towards area of Development Policy, R&D Management, Interactivity, New Product Development, Methodology B, Design-Ergonomics Integration and Pedagogy. His direction to product design programmes for various successful innovative products and design programmes for international markets has generated successfully more than million units. He has supervised and guided more than 75 product design and development projects. He took up the post of Management Adviser for new product & strategies at Crompton Greaves Ltd. and 'Adviser to the President', Power Systems Group from 1996-2000 where he introduced the concept of Methodology, Monitoring & Mentoring in their Technology Cells.

He is also Management Adviser and Design & Development Consultant to more than 40 industrial organizations. He is an active Member of various Government of India Committees for making recommendations on technology transfer, technology up gradation, formation of Design Council, member Human Engineering Panel, DRDO, CII Technology Committee etc. & faculty selection committees for IITs and IIS. His papers are published in international conferences in Switzerland (Ergo design), France (Interactivity),Hungary (Design for Traffic Safety), Japan (Water), Hong Kong (Design & Development) Netherlands, Canada & Israel (Science & Technology Education) etc.

Prof. Kishor Munshi has been awarded for 'Excellence in Design Consulting' by CDC, Government of India and IF Award in Germany for "Good Design" and has number of patents to his credit.

Sudipti Arora
Research Scientist
Dr. B. Lal Institute of Biotechnology, Jaipur
sudiptiarora@gmail.com

Sudipti Arora Currently working as a Resaerch Scientist at Malviya National Institute of Technology (MNIT), Jaipur, has a PhD degree from Indian Institute of Technology Roorkee (IITR), Roorkee, India on Performance Evaluation and Microbial Community Dynamics of Vermifiltration. She recieved Young Scientist Award at 8th Congress Uttarakhand State Science and Technology Congress, 26-28th December 2013, Doon University- Dehradun.

Chandrashekar Shankar
Director
Vision Earthcare
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Dr.Chandrashekhar Shankar is Director of Research and Product Development at Vision Earthcare Pvt Ltd (VEC) a Green Tech startup incubated in SINE (Society for Innovation and Entrepreneurship) at IIT Bombay. VEC has been instrumental in developing and promoting a novel waste water treatment technology called Soil Bio Technology (SBT), conceived at the Department of Chemical Engineering IIT Bombay and patented in India and USA. VEC has been able to successfully commercialize SBT nationally under the brand name CAMUS.

S. Vishwanath
Director, Biome Environment Trust, Bangalore
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He is an urban and regional planner by education and has done post-graduation from Rotterdam, The Netherlands in urban environmental management. Since 14 years he has been working on urban water issues especially rainwater harvesting, gray water reuse, ecological sanitation systems and sustainable water management issues in urban areas. He has also contributed in rural areas on drinking water solutions in Fluoride affected areas, ecological sanitation systems, and poly-houses with rainwater harvesting systems, ground water recharge systems and integrated rural water management systems. He is an advisor to Arghyam, prestigious trust providing grants for water and sanitation projects in India and running the India Water Portal. He is an adjunct faculty at Azim Premji University, Bangalore. He is on board to many organizations and also freelance writer.

Madhu Krishna
India Consultant
Gates Foundation
India
Madhu.Krishna@gatesfoundation.org

Madhu Krishna has worked with the Gates Foundation team for over 14 years, as an India consultant across a range of programs. She provides support to the foundation teams with her deep experience on policy and advocacy issues. She worked as a core team member on the Reinvent the Toilet Fair hosted by the foundation in March 2014 in New Delhi, bringing together a range of development and government ministry partners to see and discuss options for non-networked sanitation and innovations, funded under the Reinvent the Toilet Challenge. Other clients that she has worked for in the areas of maternal and child health, family planning and strategy formulation include FHI, Digital Green, Landesa, PATH and Intrah Health.

DAY 2: International Speakers

Shikun Cheng
Research Associate
University of Science and Technology Beijing
China
chengshikun_1985@aliyun.com

He has done his PhD in biogas, biomass, and waste treatment from University of Science and Technology Beijing. Key publications include: "Feasibility of 'Greenhouse System' for household greywater treatment in nomadic-cultured communities in peri-urban Ger areas of Ulaanbaatar, Mongolia: way to reduce greywater-borne hazards and vulnerability", "evaporation treatment on biogas slurry from anaerobic fermentation", "evaluation of a closed-loop sanitation system in a cold climate: a case from peri-urban areas of Mongolia"

Abdullah Al-Muyeed
Technical Adviser-WASH
WaterAid
Bangladesh
abdullahal-muyeed@wateraid.org

Dr Abdullah Al-Muyeed received his B.Sc. (Civil) Eng. and M.Sc (Civil and Environmental) Eng. at Bangladesh University of Engineering & Technology (BUET), Dhaka and his Ph.D from the University of Tokyo, Japan, as a prestigious Monbusho scholar. His professional experiences cover graduate and post graduate level teaching and research in renowned universities of Bangladesh and abroad for a decade. He has more than 35 technical papers in National and International Journal and Conference Proceedings. He also worked as Environmental Consultant in different World Bank projects. He wrote three text books on environmental engineering and one of the book titled "Water and Environmental Engineering" received the prestigious University Grants Commission Award (UGC) 2012, the highest academic recognition in Bangladesh. Aiming to contribute in the professional sector to improve environmental condition of the country, Dr Muyeed has been working in developing sector as Technical Adviser in WaterAid Bangladesh country office since 2014. He has been working relentlessly to provide innovative sustainable solutions particularly on second generation sanitation that includes environmental pollution, wastewater treatment, faecal sludge treatment/management, waste management.

Kalanithy Vairavamoorthy
Practice Leader for Applied Research
International Water Management
Sri Lanka
k.vairavamoorthy@cgiar.org

Dr. Kala is Practice Leader for Applied Research and Knowledge Transfer at International Water Management Institute (IWMI).He was also the founding Director of the School of Global Sustainability, the Director of the Patel Centre for Global Solutions and a tenured Professor in the Department of Civil and Environmental Engineering, at the University of South Florida, USA. Furthermore he is Professor of Sustainable Urban Water Systems at UNESCO-IHE and TU Delft, in the Netherlands. He was the director of SWITCH, a 25 million euro EU research project for Integrated Water Management for the City of the Future. Also, expert in urban water systems operating under future global change pressures and their implications on water governance.

Hasin Jahan
Chief Executive Officer
Practical Action
Bangladesh
hasin.Jahan@practicalaction.org.bd

She is a Civil Engineer with an MSc in Water and Environmental Management from UK and a development professional having specialized work experience in water, sanitation and agriculture sectors. She has proven experience in managing large scale projects targeting poor and vulnerable population in geographically and technically challenged contexts of Bangladesh. In Bangladesh, her presence in the media, national level events and policy dialogues is distinguished. Currently she is working as the Country Director of Practical Action in Bangladesh. Ms Jahan leads the Bangladesh country programme of Practical Action. Ms Hasin Jahan remained active in integrating programme and policy work at different levels. She has taken up an exclusive initiative to develop a full service value chain for 'faecal sludge management' and promotion of 'product value chain' for organic compost generated from the faecal sludge in partnership with relevant government and non-government agencies, academic/research institutes and private sectors.

Krishna Chaitanya
Researcher-Business Model Analysis and Enterprise Development
International Water Management Institute
Sri Lanka
k.c.rao@cgiar.org

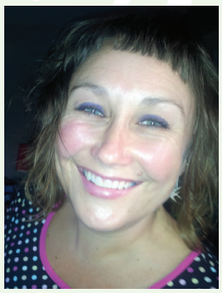
Mr. Krishna Chaitanya Rao is a Researcher at International Water Management Institute (IWMI). He is a Reynolds Fellow in Social Entrepreneurship. Prior to joining NYU, Krishna ran S3IDF (www.s3idf.org) in Southern India for 8 years, which provides business development support, technological know-how, and co-financing of small and medium size enterprises. Krishna has extensive experience in providing decentralized small scale infrastructure solutions for the poor through an enterprise based approach in the areas of energy, water, transport, telecommunication, and sanitation. At IWMI, Krishna supports the Resource Recovery and Reuse (RRR) group with his practical experience in enterprise and business plan development in reuse of faecal sludge, urine, wastewater and solid waste.

AshlayMusprat
Chief Executive Officer
Pivot Ltd
Rwanda
ashley@waste-enterprisers.com

Ashley Muspratt is a waste-to-energy entrepreneur focused on using business to solve human waste management challenges in developing cities. Ashley's academic background includes a Ph.D. from UC Berkeley's Energy & Resources Group and an M.S. from the university's Civil and Environmental Engineering department. Her business background evolved over a childhood spent working at and helping manage her parents' small businesses. Ashley is driven in her work by a passion for protecting the environment and a penchant for tackling global challenges.

Rajeev Munakami
Senior Advisor, SNV Bangladesh
rmunankami@snvworld.org

He is a graduate from IIT Roorkee and has Masters on Sustainable Energy Systems and Management. He started his working career from Centre for Rural Technology Nepal, since then he has lead and managed a number of programmes for both government agencies and I/NGOs. He has extensive experience in Community Level Planning, Technology Transfer and Promotion & Dissemination of Appropriate Technologies. He also has experience in leading a sector through multi-stakeholders sector development approach and Programme Development and Programme Management. He has a good track record of resource mobilisation for different Government and not for Profit Organisations. Currently he is leading Faecal Sludge Management Programme in Bangladesh supported by Bill & Melinda Gates Foundation and UKAID.



Claire Furlong
Research Associate in Urban Sanitation
WEDC (Water, Engineering and Development Centre)
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She is a Research Associate in Urban Sanitation at the Water, Engineering and Development Centre, Loughborough University. She has over 10 years' experience in the in water, sanitation and hygiene sector. Her present work focuses on different aspects of faecal sludge management in cities (http://www.susana.org/en/sfd). She is an environmental engineer with over 20 years' experience and expertise in developing and trialling novel technologies and methods. She has successfully managed over 40 environmental projects and has experience of working successfully in: Mexico, Peru, India, Bangladesh, Pakistan, Vietnam, Tanzania, Madagascar, Uganda, Myanmar, Ethiopia and Liberia. Additionally she has worked with many of the leading institutions and organisations in this sector including WaterAid, Oxfam, Water for People, SNV, ACTED and the London School of Hygiene and Tropical Medicine and has links to local universities and companies across the globe.

Before coming to WEDC Claire led a four country consortium trialling a worm-based on-site sanitation system in real world scenarios funded by USAID. She previously spent two years developing this technology while working at Imperial College, London.

Oscar VesesRoda
Research Associate
University of Leeds
United Kingdom
o.veses@leeds.ac.uk

Dr. Oscar Veses has been working in WaSH sector since November, 2015. He has produced SFDs for several cities located in Africa and Asia including Bahir Dar, Bishoftu and Calcutta, among others. Previously, he worked for 4 years in developing tools to carry out sediment quality assessments in the University of Zaragoza (Spain).

Dr. Arne Raj Panesar
Head of Programme
Sector ProgrammeSustainable Sanitation
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
arne.panesar@giz.de

Dr. Arne Raj Panesar is heading the sector programme "Sustainable Sanitation" at Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Before taking over his current position, he was coordinator for the Bill and Melinda Gates Foundation in the Department Asia and Latin America since 2012. He was furthermore coordinating GIZ`s climate related portfolio in Asia and country manager India at GIZ head quarter in Eschborn since 2010.

From 2007-2010 he was project officer in the sectoral programme "Sustainable Sanitation – ecosan" and involved in the creation of the global network "Sustainable Sanitation Alliance",of today more than 200 organizations focusing on sustainability aspects in sanitation and wastewater management.

He has a constant relation to India with his father being of Indian origin. From 1989-1991 during his M. Sc. studies, he was in New Delhi at the Jawaharlal Nehru University (JNU) with a fellowship from the German Academic Exchange Service (DAAD).He visited the Indian Himalayas regularly (1993-1997)for field work during his Ph.D. From 1990 to 2007 he was working as a consultant for GIZ, UNESCO, Swiss Water Institute (Eawag) and others, mainly in the field of water and sanitation.In addition to his work at GIZ he was a member of the board of directors (since 2009) of the cooperative society "Energie in Bürgerhand" in Freiburg,where he is active in the transformation of Germany into a country that is based on green energy and its efficient use. In the same role he was responsible for water-issues (from 2004-2006) in the umbrella association of environmental German NGOs, the "BundesverbandBürgerinitiativenUmweltschutze.V."and again as member of the board of directors (2002-2004) he was active in the NGO-Group "Forum Vauban", that supported citizens participation in the UN-Habitat Dubai Award winning eco-model district Vauban in Freiburg. Dr. Panesarholds a M.Sc.in Biology and a PhD in Aquatic Ecology (magna cum laude) both from the Abert-Ludwigs-Universität, Freiburg imBreisgau,in Germany.

National Speakers

Payden
Regional Adviser for Environmental Health
World Health Organisation
India
payden@who.int

Ms Payden is the Regional Advisor for Water, Sanitation and Health in the WHO South-East Asia Regional Office. She manages the drinking water quality, sanitation, waste management and climate change and health programs in eleven member countries of WHO. She has supported countries in development of drinking water quality standards and guidelines, water and sanitation policies, and guidelines for management of healthcare wastes. She has assisted in a number of programs on health adaptation to climate change and health vulnerability assessment. She has organized high level conferences and workshops on climate change and health in the region. She also supported various capacity development initiatives in the areas of drinking water safety, healthcare waste management, sanitation and climate change and health.

Gagandeep Kang
Head
Wellcome Trust Research Laboratory
Christian Medical College
gkang@cmcvellore.ac.in

She is currently Head of the Wellcome Trust Research Laboratory at the Christian Medical College (CMC) in Vellore, India. Over the past two decades, she has built a research program that has conducted key studies to understand enteric infectious diseases in impoverished communities. Working in partnership with non-governmental organizations and the government, she has carried out phase I-III studies of rotaviral vaccines and provided laboratory support for vaccine development in India and for other developing countries. SHe has established water and sanitation studies that explore social, behavioural and infra-structural determinants of water contamination and defecation practices.

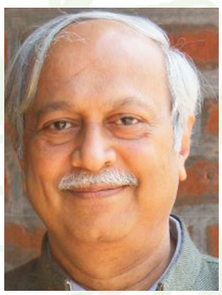
Professor Kang has built a strong inter-disciplinary research program that uses careful and detailed field epidemiology with molecular tools for characterization of infectious agents and host response to infection to understand and change factors that affect transmission, development and prevention of enteric infections and their sequelae. Observational, interventional and mechanistic studies on the environment, enteric infection and nutrition have demonstrated the complex relationships between gut function and physical and cognitive development.Based at an outstanding medical college, she has established a strong training program for students and young faculty in clinical translational medicine aiming to build a cadre of clinical researchers studying relevant problems in India. Dr. Kang has published over 200 papers in national and international journals. She is an Associate Editor for PLoS Neglected Tropical Diseases and for Tropical Medicine and International Health, on the editorial board of Scientific Reports and is on several review committees for national and international research funding agencies.

SarahHabersack
Sustainable Habitat Team
GIZ- India
sarah.habersack@giz.de

Sarah Habersack is a social scientist and expert in organisational development and capacity development. She has a Master in International Development Science from the University of Vienna as well as a Master in Organisational Development and Coaching from ARGE Bildungmanagement/Sigmund Freud University of Vienna. She works as a technical advisor for Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) GmbH in India for the technical cooperation projects "Support to the National Urban Sanitation Policy" and "Inclusive Cities Partnership Programme". She coordinates training programmes for Urban Local Bodies as well as activities on integrated urban planning and sanitation planning. She has a long standing experience in trainings, innovative pedagogy and institutional development in the urban sector.

Sujaya Rathi
Principal Research Scientist
Centre for study of Technology and Science
India
sujaya@cstep.in

Sujaya Rathi is a Principal Research Scientist at CSTEP and has been involved with sustainable urban development for 20 + years in India and USA. She has a Masters in Community and Regional Planning from Iowa State University, USA and Masters in Economics from Jadavpur University, India. She is a member, American Institute of Certified Planners (AICP). She is been involved in development of decision support tools for sanitation and transport. Currently she has developed a technology decision support tool for sanitation systems that will facilitate an integrated approach to the sanitation investment planning process for urban local bodies in India. She has worked extensively with city municipalities, Government of Karnataka, and Ministry of Urban Development. She has also been involved with the Planning Commission /NITI Aayog to develop future development scenarios for India and also developed a smart and sustainable city development reference framework for India.



Dinesh Mehta
Professor
CEPT Ahemdabad
India
dineshmehta100@yahoo.co.uk

He is joint project director for the Performance Assessment System (PAS) project. At CEPT University, he teaches urban finance and development planning. He was the Director of School of Planning, CEPT, Director of the National Institute of Urban Affairs, New Delhi, India and head of Urban Management Programme at UN-HABITAT, Nairobi. Dr. Mehta has a Ph.D. from University of Pennsylvania, a Masters in City and Regional Planning from Harvard University, and a Bachelor of Technology in Civil Engineering, from IIT Madras, India.

Meera Mehta
Professor
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mmehta1949@hotmail.com

Meera Mehta is joint project director for the Performance Assessment System (PAS) project funded by BMGF to CEPT University. She has over 35 years of experience in water, urban development and infrastructure finance. She joined CEPT in 1979 and was the Director of School for Planning before joining the USAID's FIRE Project in India (1994-1999) and later the World Bank in India and its Water and Sanitation Program in Africa (2000-2006). She has also consulted for a large number of international agencies, national and local governments, and leading international NGOs. She studied Architecture at under-graduate level and city and regional planning at post-graduate level. She has a doctoral degree in economics.

Aasim Mansur
Research Associate PAS Project
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He works with PAS Project, CEPT university as a research associate since 2010. He works on the aspect of Sanitation, which includes City Sanitation Planning under the PAS Project. He is actively engaged in supporting implementation of city sanitation plan in small towns of Maharashtra. He has focused on his work on integrated faecal sludge management. He was previously employed with Shapoorji Pallonji Co. Ltd as Planning and Execution Engineer. He studied B. Tech (Civil) from Nirma University, Ahmedabad and M. Tech in Planning (Infrastructure Planning) from CEPT University, Ahmedabad.

Sandeep S Sandha
IBM Research India
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He has worked extensively on IoT and data management for

water, natural sciences and health.He works in diverse area and his research interests include mobile computing, sensor networks, distributed computing and mathematical modelling. Sandeep has worked in Mobile Development group of IIT Roorkee for 4 years and was one of its initial co-founder. Beside mobile development Sandeep has experience in Distributed computing, Databases, Sensor Networks, Web development, Server Programming, Image Processing, Artificial intelligence and Numerical Analysis Techniques (XFEM, EFEM, FEM, FDM etc). Sandeep has done key contributions to many of the development and research projects which were funded by Govt., Univ. and Clients. Sandeep has co-authored and presented in several top journals and conferences which have been well recognized and appreciated by the scientific community. Currently Sandeep has 18+ months professional Industrial and 5+ years of research experience doing critical research contributions.

Biplav Srivastava
IBM Research
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Dr.Biplav Srivastava, Senior Researcher & Master Inventor, IBM Research and an ACM Distinguished Scientist and Distinguished Speaker, has over 21 years experience primarily in research, working with collaborators and customers around the world, resulting in many science firsts and commercial innovations, 100+ papers and 35+ US patents issued. He has been working on Smart City for 6+ years.

Shashi Shekhar
Secretary
National Mission For Clean Ganga
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secy-mowr@nic.in

Mr.Shashi Shekhar, is Secretary, Water Resources, River Development & Ganga Rejuvenation. He is a 1981 batch IAS officer of Tamil Nadu cadre. Before joinins as Secretary MoWR Mr.Shekhar, IAS served as Additional Secretary of Ministry of Environment and Forests, Government Of India since February 15, 2013. Mr.Shekhar served as the Managing Director of Tamil Nadu Minerals Limited, Tamil Nadu Transport Development Finance Corporation, Tamil Nadu Urban Development Fund, and Tamil Nadu Urban Infrastructure Financial Services Limited. He has held various senior positions in the State as well as the Central Governments.

Praveen Prakash (IAS)
Joint Secretary & Mission Director SBM
Ministry of Urban Development (Govt of India)
India
praveenprakashud@gmail.com

Mr Prakash graduated as an Electrical Engineer from IIT Kanpur in 1992 and is an IAS (94 batch). He has Masters in Public Administration from Maxwell School, Syracuse University, USA. He has experience of more than 20 years in administration with Government at various levels and departments. He has developed and successfully implemented national and state programs at municipal, district and state level.

Neeraj Mandloi (IAS)
Joint Secretary & Mission Director AMRUT
Ministry of Urban Development (Govt of India)
India
jsud@nic.in

Mr.Mandloi is an IAS (1993 batch) and is now currently serving as Joint Secretary at Ministry of Urban Development (Govt of India). He has work experience of more than 20 years dealing with land revenue management, finance rural development and employment and now urban development.

A.K. Mehta
Joint Secretary(IC&SD)
Ministry of Environment, Forest and Climate Change
Indira Paryavaran Bhavan
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Mr, Arun Kumar Mehta, Joint Secretary, Ministry of Environment, Forests and Climate Change, Government of India ,is J&K Cadre IAS officer of 1988 batch.

Vasuki, K.
Executive Director
Suchitwa Mission, Kerala
kvasukiias@gmail.com

Dr Vasuki graduated with a MBBS and is an IAS (2008 batch). She is now the Executive Director of the Suchitwa Mission in Kerala and is pushing the state a model to the whole nation towards its fight against waste and to showcase committed effort towards Swachh Bharat by 2019.

Sanjit Rodrigues
Managing Director
Goa State Infrastructure Development Corporation Ltd
Goa, India
email@gsidcltd.com

Mr. Sanjit Rodrigues joined the Goa State Civil Services (GCS) in 1998. He is a graduate in Economics from Goa University and specialized in Tourism and Hotel Management. He has worked extensively with Indian Hotels Ltd.(Taj Group) before joining the Civil Services. After joining Goa Civil Services, he has held various positions relating to infrastructure, urban development, revenue administration, tourism and industries. He has works as civic chief or Municipal Commissioner of Panaji City, the capital of Goa, and has worked extensively on issues of solid waste management using cost effective and decentralized techniques achieving good success. As the Managing Director of The Goa Infrastructure Development Corporation, he is spearheading large infrastructure projects across various sectors in Goa with a focus on speedy implementation and high quality. Mr. Rodrigues has over 17 years of entrepreneurial & leadership experience.

Workshop Coordinators

Ramesh Nair, Programme Manager- Water Programme, Centre for Science and Environment, New Delhi, India

Dr Nair has been awarded PhD degree in Limnlogy from Bhopal University and a researcher in water quality and wetland management. He has many years experience in WASH sector project implementation with national and international agencies in both urban and rural areas.

Rajratna Sardar, Programme Officer- Water Programme, Centre for Science and Environment, New Delhi, India

Mr. Sardar holds Master's Degree in Habitat studies from TISS, Mumbai. He has 5 years of experience in sector of city sanitation and urban planning with various municipal corporations of India. He has previously worked on national as well international projects in water and sanitation. Prior to this, he was also one of key resource person for the numerous training programmes and workshops for state and non-state actors working in urban sanitation. His areas of interests include sustainable and equitable sanitation services for urban areas.

Ridhima Gupta, Senior Research Associate- Water Programme, Centre for Science and Environment, New Delhi, India, ridhima@cseindia.org

Ms. Gupta holds a Masters degree in MSc Environment and Development, from the London School of Economics and Political Science. She has researched on the complexities of the linkages between environmental and economic development and has an understanding of environmental policy, management and evaluation in the developing country context.

Shachi Pandey, Research Assistant- Water Programme, Centre for Science and Environment, New Delhi, India, shachi@cseindia.org

Ms Pandey is post graduate in Environment Management from Forest Research Institute, Dehradun. She has researched in various aspects related to natural resources and its conservation. She is involved in coordination of trainings on sustainable water management and programme monitoring at Centre for Science and Environment. Her field of interest includes research in water ecology and its conservation and waste water treatment.

Contact details for Workshop Coordinators
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Mr Rajratna Sardar 8686785501
Ms Ridhima Gupta 9873969397
Ms Shachi Pandey 8586038991

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Mob: 088009 63227
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