



BOOK OF ABSTRACTS

5th International Dry Toilet Conference

17-22 August 2015 | Tampere, Finland



DRY TOILET 2015

5th International Dry Toilet Conference
17-22 August 2015 Tampere, Finland

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WELCOMING YOU – AND YOUR SOLUTIONS – TO DT2015!

Since 2003, The International Dry Toilet Conference has brought together experts of sustainable sanitation as well as grass root actors who put ideas into practice. Every third year we have heard of new findings and practices that have been implemented around the world. The 2015 conference will be no exception.

In addition to the latest discoveries, this year we want to focus on solutions. It is vital to spread the word on best practices as well as knowledge on challenges that still limit sustainable sanitation. From scientists to volunteer workers, the experiences will be shared and discussed here. To gain more insight to these important matters, this year the conference will include workshops in addition to traditional sessions.

In order to gain concrete results from the solutions presented at the conference, it is necessary to not only listen to the presentations, but also actively participate in the discussion. This forum is ideal for mingling and making new connections – which might lead to future projects, cooperation and success stories.

It is no coincidence that The International Dry Toilet Conference gathers delegates from all over the world every time. The benefits for the “ecosan community” are clear, and many find new ideas and support for their own projects time and time again. Also the organisers remain faithful to the event. The venue this year is TAMK University of Applied Sciences, but the other partners University of Tampere and Tampere University of Technology still remain part of the organising committee. This year, a new partner, University of Jyväskylä, is responsible for the pre-conference workshop. Also several organisations are supporting the event by participating to the exhibition or in other ways, not to mention the congress bureau TAVICON who is in charge of the practicalities.

Without the support from our partners, this conference could not have been organised, so they deserve our warmest gratitude.

I also wish to thank the hardworking employees of The Global Dry Toilet Association of Finland, as they have made this conference a reality. For a small NGO, this event is a tremendous, yet gratifying effort.

But most of all, thank You for being part of this event. Without You the conference would lack its main ingredient – the ideas, the insights, the innovations.



Mia O'Neill
Chairperson
Global Dry Toilet Association of Finland

GREETINGS FROM THE CONFERENCE SECRETARY!

As I write my greetings to you all, the summer has fallen upon us. As the summer starts, many Finnish people contact our organization inquiring about different dry toilet models. We have over 500.000 summer cottages in Finland and many of them still have an outdoor dry toilet, or nowadays even a fancier indoor model. For many here in Finland the outdoor dry toilet is a place of silence and of tranquility and we Finnish people are quite accustomed to the idea of dry toilets. In this light it is easy to understand why the Global Dry Toilet Association of Finland has been so successful in Finland and why it makes sense to organize the International Dry Toilet Conference in the Finnish scenery.

It is often said, that we are very lucky here in Finland. We have a fairly sophisticated sewage system, proper wastewater treatment facilities and for the time being enough fresh water for our needs. This is not the case in most of the countries in the world. Most of us already know the gloomy statistics related to the lack of proper sanitation facilities. Many people risk their health and even end up losing their lives because of inadequate sanitation. Up to 90 % of all wastewater in the world go to waterbodies untreated. On top of this the world is in dire need of fertilizers that we human beings produce but flush to our water bodies every day. Solving these issues might seem like a mighty task, but the International Dry Toilet Conference is also a reminder, that there are many people in the world working towards and succeeding in resolving these issues. Since 2003 the conference has offered us important information about dry toilet technologies and raised the status of sanitation situation in the world. This year the conference program is full of experiences, success stories, ideas and innovations offering us tangible solutions to the challenges of sanitation and nutrient recycling. I am very excited about the program and I am certain that the conference will be a very fruitful platform for all actors working in the sanitation field!

I can't wait to meet you all in Tampere and want to welcome you with an open heart to the 5th International Dry Toilet Conference and to Tampere in August 2015.



Karoliina Tuukkanen
Conference secretary
Global Dry Toilet Association of Finland

SCIENTIFIC COMMITTEE

Finnish Members:

- **Pekka E. Pietilä** (Mr) Tampere University of Technology, Department of Chemistry and Biotechnology. President of committee
- **Eeva-Liisa Viskari** (Ms) Dr., Head of the Degree Programme of Environmental Engineering, Tampere University of Applied Sciences
- **Harri Mattila** (Mr) DTech, Principal Lecturer, HAMK University of Applied Sciences
- **Harri Mäki** (Mr) PhD, researcher, free researcher, research associate, CuDyWat, North-West University, South Africa
- **Helvi Heinonen-Tanski** (Ms) Ph.D., Adjunct professor emerita, University of Eastern Finland
- **Petri Juuti** (Mr) Dr. Adjunct Professor, Senior Researcher, University of Tampere
- **Sari Huuhtanen** (Ms) Project Manager, Global Dry Toilet Association of Finland
- **Tapio Katko** (Mr) DTech (Civ.Eng), Adjunct Professor, Tampere University of technology
- **Tuula Tuhkanen** (Ms) Dr. Prof., Department of Biological and Environmental Science, University of Jyväskylä

International members:

- **Dana Cordell** (Ms) Australia, BE (Eng)(Hons1)(UNSW), MSc (LiU), PhD (UTS), PhD (LiU), Chancellor's Postdoctoral Research Fellow and Research Principal at the Institute for Sustainable Futures at the University of Technology, Sydney.
- **Joachim Behrendt** (Mr) Germany, Dr.-Ing., Technische Universität Hamburg-Harburg Institut für Abwasserwirtschaft und Gewässerschutz
- **Kamal Kar** (Mr) India, Founder of CLTS, Dr., The CLTS Team, Institute of Development Studies at the University of Sussex, Brighton
- **Naoyuki Funamizu** (Mr) Japan, Prof. Environmental Engineering Department, Graduate School of Engineering, Hokkaido University

ORGANIZING COMMITTEE

- **Mia O'Neill** (Ms) (Chairperson)
- **Karoliina Tuukkanen** (Ms)
- **Antero Luonsi** (Mr)
- **Seija Haapamäki** (Ms)
- **Renja Yrjönen** (Ms)
- **Karoliina Sunell** (Ms), Tavicon Ltd.
- **Maarit Särkilahti** (Ms)
- **Marja Palmroth** (Ms)
- **Pia Banerjee-Rikkonen** (Ms), Tavicon Ltd
- **Saana Raatikainen** (Ms)
- **Tuula Tuhkanen** (Ms)

MEMBERS OF THE SCIENTIFIC COMMITTEE



DSc(CivEng) Pekka Pietilä has over 30 years' experience in water and sanitation both in private and public sector. His experience includes consulting engineering tasks in Finland and overseas, development cooperation tasks in Africa, and research and teaching duties at universities in Finland and overseas. He has served as the Chairman of the Organizing Committee in DT2009 and the Chairman of the Scientific Committee in DT2012.



Dr. Eeva-Liisa Viskari is a Principal Lecturer (Ph.D.) and Head of the Degree Programme in Energy and Environmental Engineering at Tampere University of Applied Sciences, School of Industrial Engineering. She has studied environmental hygiene at University of Kuopio, where she finished her M.Sc. in 1991 and Ph.D. in 1999. Since 1999 she has been working as a senior lecturer in Tampere, TAMK University of Applied Sciences. During the past ten years, dry sanitation, nutrient cycling and safe use of human excreta have become one of her research and teaching interests.



Dr. Harri Mattila is working in HAMK University of Applied Sciences in Hämeenlinna, Finland as Principal Lecturer in environmental engineering. The title of his doctoral dissertation (2005) was Appropriate Management of On-Site Sanitation. Dr. Mattila has a long working history including both public and private employers. The Lake Pyhajarvi Restoration Project where he worked as Project Manager in 1995-2000 gave him good experience in on-site sanitation solutions. He has also been involved in developing cooperation projects in water supply and sanitation almost ten years out of which totally six years in Eastern Africa.



Dr. Harri Mäki has a Doctor's degree in history from the University of Tampere. His doctoral thesis was about the history of water supply in South African towns in 1850–1920. After his doctorate, he spent one year as a Post-Doctoral Fellow at the School of Basic Sciences at North-West University, South Africa. After that he has been working mostly as an independent researcher. Lately, he has worked for one year as a researcher in the Finnish Postal Museum.



Dr. Helvi Heinonen-Tanski has worked some 40 years as research worker and teacher at Universities of Helsinki and Eastern Finland (before University of Kuopio). She has studied sanitation, microbiology of water and wastewater treatments and use of human urine and wastewater sludge as fertilizers. She is author of some 100 articles and has supervised 19 doctoral thesis and more than 120 M. Sc. thesis. She has retired but continues as visiting scientist. She is grandmother for two children and hopes that also other children in other countries will have pure water and safe sanitation. Nature protection and mushroom picking belong to her hobbies as can be seen in the picture.



Dr. Petri Juuti is historian and Adjunct Professor/Docent in Finnish History (in University of Turku, Finland), Adjunct Professor in Environmental History (in University of Tampere, Finland), and in History of Technology (in University of Oulu, Finland). His major area of interest is environmental history, especially the interaction between the society and the nature has been in the focus in his research projects. He is also interested in water history, urban environment, city-service development, urban technology, pollution, public policy, political history, development studies, social and economic history. He is the author or co author of more than 30 referee articles and over 30 books. He is also an extraordinary professor in the Research Niche for the Cultural Dynamics of Water (2013-2016) in North-West University, South Africa and member of the executive council of International Water History Association, IWHA (2009-).



Ms Sari Huuhtanen has MSc. in Sustainable Business Risk Management (University of Glamorgan, UK, 2010) and BSc. in Environmental Engineering (HAMK University of Applied Science, Finland, 2000). Previously she has worked e.g. for HAMK University of Applied science and TAMK University of Applied Science as a project coordinator. Since 2006 Huuhtanen has worked as a Project Manager in Global Dry Toilet Association of Finland (NGO), having responsibilities to ran association's projects for developing countries (Zambia, Tanzania and Swaziland, 2006-2016).



Dr. Tapio S. Katko, Adjunct Professor, (Civ. Eng) holds the UNESCO Chair in Sustainable Water Services at Tampere University of Technology. His career of 35 years covers 4 years abroad. He has authored or co-authored 36 monographs and many publications on water and sanitation services evolution, management, institutions, policy and governance.



Tuula Tuhkanen is a Professor of Environmental Science and Technology in the University of Jyväskylä, Department of Biology and Environmental Sciences since 2013. She was a professor of Environmental Technology in Tampere University of Technology from 1998-2013 and before that a Senior Instructor of Water Hygiene in the University of Kuopio. In 1985 she has worked as a water and sanitation delegate for the Federation of Red Cross and Crescent Societies in Sudan. Since then, global water, sanitation, environment and health problems have been a crosscutting theme in all her research and teaching.



Dr. Dana Cordell is a Research Principal at the Institute for Sustainable Futures, University of Technology Sydney, where she undertakes and leads research projects on sustainable food, sanitation and resource futures. Many projects involve high-level stakeholder engagement to improve the societal outcomes and foster mutual-learning. In 2008 Dr Cordell co-founded the Global Phosphorus Research Initiative (GPRI) which now represents six leading research institutes across Australia, Europe and North America. In addition to transdisciplinary research, the GPRI facilitates networking and public debate among policy-makers, industry, scientists and the public regarding the risks and opportunities for food systems associated with global phosphorus security. Dana's research contributions to the emerging field of global phosphorus security has led to numerous prestigious recognitions including one of Australia's top science prizes the Eureka Prize for Environmental Research (2012), a position in 100 Women of Influence (2013) and the Top 100 Most Influential People (Sydney Magazine, 2012).



Joachim Behrendt is currently working as Senior Research Engineer and Vice Director at the Institut of Wastewater Management and Water Protection at Hamburg University of Technology (resource oriented sanitation, biofilm processes, industrial wastewater, membrane processes). He has studied Environmental Technology and had obtained the conferral of a doctorate at Berlin University of Technology.



Dr. Kamal Kar, a specialist in livestock production, agriculture and natural resources, is widely regarded as the pioneer of CLTS. He has done pioneering work in the Indian subcontinent and has introduced CLTS in more than 51 countries across Asia, Africa, and Latin America. The prestigious Foreign Policy Magazine of Washington DC selected Dr Kar amongst the Top Hundred Global Thinkers of the world in 2010 and the Asian Development Bank declared him as the Water Champion of 2011. In addition to his long association with the Institute of Development Studies (IDS) at the University of Sussex, UK, he is also associated with a number of international development sector organisations, such as DRG of WHO, WASRAG of Rotary International, etc.



Prof Naoyuki Funamizu is a professor at the Faculty of Environmental Engineering in Hokkaido University, Japan. His main research topics are wastewater reclamation and reuse, and sustainable sanitation systems. Currently he is the leader of an extensive project on sustainable sanitation system based on the concept “don’t mix” and “don’t collect” wastewater supported by Japan Science and Technology Agency, CREST. Prof Funamizu also has comprehensive experience in working with the International Water Association (IWA). He worked as a secretary of the specialist group on wastewater reclamation and reuse of IWA from 2004 to 2005. He is the director of Japan Society on Water Environment and secretary general of the division of Environmental Engineering, Japan Society of Civil Engineer. Prof Funamizu has published more than 100 papers on sanitation and water issues.

MEMBERS OF THE ORGANIZING COMMITTEE



Dr. Mia O'Neill has been the chairperson of Global Dry Toilet Association of Finland since 2010. She finished her PhD dissertation in 2015, studying the feasibility of ecological sanitation globally as well as the matters affecting it. Her background is in environmental policy and environmental engineering, and she works as Project Manager in the Environmental School of Finland SYKLI.



Dr. Antero Luonsi, Doctor of Science (Tech.), works as Senior Advisor of Water Supply and Sanitary Engineering at the Pirkanmaa Economic Development, Traffic and the Environment Centre. Earlier research orientation was related particularly to forest industry mass balances and wastewater treatment, sequencing batch reactor and membrane bioreactor development. He has worked for over twenty years in IWA (International Water Association) specialist group for the forest industry, and during 2000 - 2006 as the chair of the group. From 2007-2010 he has worked as secretary of committee for rural wastewater management in the Finnish Ministry of the Environment.



Tavicon Ltd is a Professional Congress Organizer, PCO, established 1987 in Tampere. Tavicon specializes in organizing congresses, conferences, meetings, seminars and symposiums.



Maarit Särkilahti has completed Master's degrees in environmental policy as well as in environmental engineering. She is currently working as a teaching associate in Tampere University of Technology, Department of Chemistry and Bioengineering. She has been active in developing e-learning in environmental engineering.



Dr. Marja Palmroth is working as a university teacher at Tampere University of Technology (TUT) at the Department of Chemistry and Bioengineering since August 2013. She teaches courses related to Environmental Engineering. She got her doctoral degree from TUT in 2006 and her MSc from TUT in 1998. She has previously worked at TUT, University of Oulu and at Lund University (Sweden) in research related to dry sanitation, landfill mining, bioenergy, drinking water treatment, soil remediation and environmental monitoring.



Saana Raatikainen, Master of Administrative Sciences, works as Environmental coordinator at the University of Tampere and is responsible for the sustainability issues at the University. She is a local councilor in Lempäälä, a member of technical board and Lempäälä water supply and sewerage public utility board and head of sustainable development working group. She is also a province delegate in Pirkanmaa.

COMPLETE TIMETABLES OF THE WEEK

Monday 17 August - Wednesday 19 August

The 5th Pre-conference workshop on safe water supply and sanitation at Tampere University of Applied Sciences, organized by professor Tuula Tuhkanen, tuula.a.tuhkanen@jyu.fi
(free of charge)

Wednesday 19 August

8.15 - 12.00 Registration at Tampere University of Applied Sciences,
street address Kuntokatu 3, 33520 Tampere

9.00 – 15.30 **Finnish Dry Toilet Seminar** in “Suomi-päivä” (only in Finnish)

9.00 – 15.30 Dry Toilet Exhibition

16.00 – 19.00 **Tampere water history sightseeing** (T. Katko)

18.30 – 20.00 Registration and information at Hotel Cumulus Koskikatu

19.30 – 21.00 Get-together party at Hotel Cumulus Koskikatu,
street address Koskikatu 5, 33100 Tampere

Thursday 20 August

8.00 - 17.30 Registration and information at info desk at TAMK

9.00 - 17.00 Dry Toilet exhibition

9.00 – 9.20 Opening ceremony: Juha Pyykkö, Director, Unit for International Environmental Policy (KEO-60), Ministry for Foreign Affairs of Finland

Markku Lahtinen, Principal of TAMK at lecture hall A3-27

9.20 - 10.00 Keynote speaker Dr. Dana Cordell, Australia at lecture hall A3-27

10.10 – 11.30 Parallel sessions

	Engaging Stakeholders Lecture Hall E1-06	Innovative Solutions Lecture Hall A3-24	Food security/Nutrient recycling Hall A3-27
10.10	Ganga Datta Nepal Nepal	Gina Itchon Philippines	Pushpa M India
10.30	Noah Chongo Zambia	Gerryshom Munala Kenya	Azahar Ali Pramanik Bangladesh
10.50	Yubraj Shrestha Nepal	Joseph Jenkins USA	Tynar Musabaev Kyrgyzstan
11.10	Neda Abbas Nejad Iran	Moses Pumpuni Ghana	Imasiku Nyambe Zambia

11.30 – 12.30 Lunch and coffee at cafeteria '1/2 Q' and time to visit the exhibition

12.30 – 14.30 Parallel sessions

	Engaging Stakeholders Lecture Hall A3-27	Innovative Solutions Lecture Hall E1-06
12.30	Nam Raj Khatri Nepal	Anara Choitonbaeva Kyrgyzstan
12.50	Obed C. Kawanga Zambia	Mynepalli K. C. Sridhar Nigeria
13.10	Anurag Gupta India	Samuel Autran Dourado e Souza Brazil
13.30	Shreerendra Prakash Pokharel Nepal	Ruysei Ito Japan
13.50	Janina Murta Australia	Karamat Ali Pakistan
14.10	Dena Fam Australia	Tynar Musabaev Kyrgyzstan

14.30 - 15.30 Coffee at the exhibition area / time to visit the exhibition

15.00 Brief excursion to indoor dry toilet at Tampere University of Applied Sciences

15.30 - 17.10 Parallel sessions

	Nutrient Recycling Lecture Hall A3-27	Residues in Outputs Lecture Hall E1-06	Engaging stakeholders Lecture hall A3-24
15.30	Steve Kabore Japan	Elijah Ngumba Finland	Ayumi Matsuzaka Germany
15.50	C.A. Srinivasamurthy India	Sanna Jaatinen Finland	Abdujalilov Jamshed Tajikistan
16.10	Nelson Ekane Sweden	Ronald Musiige Uganda	Sari Huuhtanen Finland
16.30	Santtu Palokangas Germany	Matias Andersson Finland	Hezron Magambo Zambia
16.50	Eeva-Liisa Viskari Finland		Kamal Kar India

19.00 - 20.30 Evening reception hosted by the City of Tampere at The Finnish Labour Museum Werstas.

Address: Väinö Linnan aukio 8, 33210 Tampere (Dress code: smart casual)

Friday 21 August

8.00 - 17.30 Registration and information at info desk at TAMK

9.00 - 9.30 Keynote speaker Professor Naoyuki Funamizu (Japan) at Lecture Hall A3-27

9.40 - 11.40 Parallel sessions

	Engaging Stakeholders Lecture Hall A3-24	Cultural Challenges Lecture Hall E1-06	Nutrient Recycling Lecture Hall A3-27
9.40	FinWaterWEI II	Pamela White Finland	Shuto Kaneko Japan
10.00	Peter Chukwuma Nigeria	Christian Chibuzo Maduka Nigeria	Mia O' Neill Finland
10.20	Karim Savadogo Burkina Faso	Nathaly Guzmán Figueroa Finland	Seth Akah Ghana
10.40	Ireen Ng'ambi Swaziland	Babatope Babalobi Nigeria	C.A. Srinivasamurthy India
11.00	Namaste lal Shrestha Nepal	Beshah M. Behailu Ethiopia	Bipin Poudel, Kamal Adhikari Nepal
11.20	Yaba Laxmi Shrestha Nepal	Maria Söderström Finland	Jan Cebula Poland

11.40 - 12.40 Lunch at cafeteria '1/2 Q'

12.40 - 13.40 Poster sessions / coffee at cafeteria '1/2 Q'

13.40 - 15.00 Parallel sessions

	Innovative Solutions Lecture Hall A3-24	Nutrient Recycling Lecture Hall A3-27	Large urban areas and mass events Lecture Hall E1-06
13.40	Bodjawah, E-M, Aalto Anna Ghana/Finland	Obed C. Kawanga Zambia	Emma Roach Germany
14.00	Narayan Wagle Nepal	Berta Moya Diaz-Aguado UK	Peter Chukwuma Nigeria
14.20	Beatrice Mukasine Rwanda	C.A. Srinivasamurthy India	Hamish Skermer Australia
14.40	Jan Cebula Poland	S. Vishwanath India	Jonna Heikkilä Finland

15.00 - 15.30 Coffee at cafeteria '1/2 Q'

15.10 Brief excursion to indoor dry toilet at Tampere University of Applied Sciences

15.30 - 16.30 Parallel sessions

	Food Security Lecture Hall A3-27	Cultural Challenges Lecture Hall A3-24
15.30	Kamal Adhikari, Bipin Poudel Nepal	Azhar Ali Pramanik Bangladesh
15.50	Chakra Bahadur Chand Nepal	Sanna-Leena Rautanen Finland/Nepal
16.10	Dr. Suman Kumar Shakya Nepal	Emmanuel Mutamba Zambia

16.30 - 17.15 Final plenary and closing ceremony at lecture hall A3-27, including poster award for the poster chosen by the scientific committee and panel discussion "A way forward".

19.00 - 23.30 Conference dinner at [Country Bistro Maisansalo](#).

Departure from Mustalahti Harbour at 19.00

(NB! A guided walk to the Mustalahti Harbour through Tampere sights leaves from Cumulus Hotel Koskikatu at 18.20)

Saturday 22 August

8.00 - 9.00 Information at Hotel Cumulus Koskikatu

9.00 - 16.00 Full day trip to [Mänttä Serlachius Museums](#)

More information about the social programme and conference dinner can be found [here](#).



DRY TOILET EXHIBITION

The Dry Toilet Exhibition will be held on Wednesday 19 August from 9:00-15:30 and on **Thursday 20 August** from 9:00-17:00. It will take place in front of the main B-building entrance at Tampere University of Applied Sciences. The following exhibitors will participate:



sustainable
sanitation
alliance



BIOLAN



SUOMEN VESIENSUOJELUYHDISTYSTEN LIITTO RY

LIST OF TOPICS

1. Engaging different stakeholders in achieving sustainable dry sanitation solutions.
2. Dry sanitation as a solution in large urban areas and mass events
3. Solutions to nutrient recycling, including developed countries
4. Solutions to food security
5. Innovative cost effective solutions to dry sanitation
6. Solutions to cultural challenges and stigmatization (incl. disabilities) of dry sanitation
7. Effects and solutions of organic and un-organic residues in re-using excreta

TIMETABLE FOR TOPIC 1

Thursday 20 August

10:10	Lecture Hall E1-06	Ganga Datta Nepal	Nepal
10:30	Lecture Hall E1-06	Noah Chongo	Zambia
10:50	Lecture Hall E1-06	Yubraj Shrestha	Nepal
11:10	Lecture Hall E1-06	Neda Abbas Nejad	Iran

12:30	Lecture Hall A3-27	Nam Raj Khatri	Nepal
12:50	Lecture Hall A3-27	Obed C. Kawanga	Zambia
13:10	Lecture Hall A3-27	Anurag Gupta	India
13:30	Lecture Hall A3-27	Shreerendra Prakash Pokharel	Nepal
13:50	Lecture Hall A3-27	Janina Murta	Australia
14:10	Lecture Hall A3-27	Dena Fam	Australia

15:30	Lecture Hall A3-24	Ayumi Matsuzaka	Germany
15:50	Lecture Hall A3-24	Abdujalilov Jamshed	Tajikistan
16:10	Lecture Hall A3-24	Sari Huuhtanen	Finland
16:30	Lecture Hall A3-24	Hezron Magambo	Zambia
16:50	Lecture Hall A3-24	Kamal Kar	India

TOTAL SANITATION PRACTICES IN NEPAL - A CASE STUDY OF AMARAPURI VILLAGE/NAWALPARASI

Ganga Datta Nepal
DWSS/Government of Nepal
nepal_ganga@yahoo.com

Thursday 20.8, 10:10 in Lecture Hall E1-06

The Objective of Research is how the people change their village. It is estimated about 62% (NPC, 2011) people in Nepal have access to toilet. So we are moving ahead to improve this situation to meet the national target of sanitation for all by 2017. Towards the achieving this goal; Community Led Total Sanitation (CLTS) is an innovative way to achieve communities free from open defecation. It changes people's behaviour by shifting mindsets – to focus their desire for, and triggering them to build a sanitation system themselves. It is a community-driven approach to improve sanitation behavior among the community peoples in developing countries; it represents a strategic shift in focus from creating awareness to community people for the toilet construction for individual households to one that seeks to create ODF communities/ villages through behavioral changes in the entire community. The change happened in communities learnt that everyone in the village is negatively affected by the unsanitary practices of some. "CLTS is a simple but effective strategy to empower communities in taking a decisive step towards achieving something on their own to be proud of. It motivates communities to take collective action in partnership with local governments, development organizations, and civil society organizations.

Process: Amarapuri Village promoted 100% open defecation free households to minimize the risk of contamination for all, breaking the cycle of faecal-oral contamination. Contrary to most conventional sanitation approaches which aim simply at providing toilets, CLTS promoted collective behaviour change intervention as the key to sustainable and improved sanitation. That innovative approach at Village level started orientation to Total Behavior Change (TBC) Triggerer i.e. natural leaders of village; community conducted their own appraisal and analysis of their sanitation situation and took became open defecation free status at first. Triggerers brought attention to the villagers on sanitation related topics, provides facts (e.g. faecal-oral hazards can only be reduced if open defecation is completely banned from the community as a whole), and provokes a discussion about open defecation and the feelings of disgust and shame associated with it. It enabled communities to set their own goals and fulfill them with minimal (external) financial inputs. In some settings, communities have extended CLTS beyond latrine construction to that of hand washing station, which also innovated towards total behaviour changed community.

Result: After declaration of ODF status major TBC activities were started in community; VDC is cleaned and people are conscious on household wastes and point of use of water. As the information from local Health Post Office, patients of Diarrhea, Dysentery and Typhoid has been significantly reduced from this year. Now, they have declared as ODF, TBC and Healthy village and they are proud being the first village of Nepal, declared TBC and Healthy village. Lesson learnt is community need to aware on hygienic behaviour.

Keywords: Defecation, Sanitation, Behavior, Community, Triggerer

INCLUSIVE STAKEHOLDER PARTICIPATION FOR SUSTAINING DRY SANITATION SOLUTION IN PERI-URBAN AREAS: A MADIMBA COMMUNITY EXPERIENCE, ZAMBIA.

Chongo, N.*; and Kawanga, C.O.

*Network for Environmental Concerns and Solutions, Zambia
ncnoahchongo@gmail.com, ngo.necosinfor@gmail.com

Thursday 20.8, 10:30 in Lecture Hall E1-06

Stakeholder engagement and/or participatory practice is increasingly becoming a part of mainstream business practice and central to public policy decision-making and delivery. It is being used as a solution to improve communications, obtain wider community support or buy-in for projects, gather useful data and ideas, enhance public sector or corporate reputation, and provide for more sustainable decision-making. Therefore, stakeholder engagement should be at the heart of any “sustainable development” agenda. Without engaging stakeholders, there can be no common enduring agreement, ownership or support for a particular project. A venture is more likely to succeed, especially in the long-term, if it takes into consideration the environment in which it operates and endeavours to meet the needs of the stakeholders affected by it. Stakeholder engagement could also be viewed as a form of risk management. Many projects, but not necessarily all, will need to engage with a wide range of stakeholder groups, each with their own concerns, needs, conflicts of interest and levels of influence. In order for the pieces of the project plan to be effective, planners and project managers need to understand who the stakeholder groups are, what their issues are, and what motivates them. Global Dry Toilet Association of Finland embarked on the second project in Zambia in 2008 in Lusaka’s Madimba community. Madimba has an area of 1.2 km² accommodating approximately 6000 habitants. The local cooperation partner working in the area is Network for Environmental Concerns and Solutions (NECOS), whose members are also living in the same community and have been working to improve the living environment of the community. Lack of appropriate infrastructure and sewerage systems, rain water drains, roads and waste management etc. has caused a lot of health and social problems in Madimba. A particular challenge in the area has been the high level of ground water table which causes flooding especially during the rainy season. Challenging environmental conditions connected with poor sanitation and water supply, which have been mainly based on pit latrines and shallow unprotected wells, have resulted into health risks to the residents. The paper discusses practical experiences of inclusive engagement of all stakeholders and creating an enabling environment to address the socio-economic, cultural and gender related aspects in implementing dry Toilet Sanitation in Madimba Community. It points out best approaches and initiatives that have been tried and tested for the project sustainability. Challenges of stakeholder participation at community level has been highlighted in this paper. This paper further discusses and recommends key principles and process guidelines that can help city stakeholders to develop appropriate and affordable solutions to sanitation problems, taking into account technology issues, management arrangements, institutional challenges and demands for improvement from different stakeholders. It is hoped that presenting this project experience would motivate more open and constructive debate as regards limitations and obstacles for inclusive stakeholder participation on what needs to be learnt to scale up best options in dry sanitation sustainable solutions.

Keywords: Inclusive, Sanitation, Stakeholder, Participation, Solution.

LESSONS LEARNED FROM COMMUNITY MOBILIZATION TO IMPROVE SANITATION IN A RURAL VILLAGE IN NEPAL

Yubraj Shrestha*, and **Raimo Lilja**
Community Development Forum (CODEF), Nepal
shresthayubraj@hotmail.com

Thursday 20.8, 10:50 in Lecture Hall E1-06

Livelihood and Environmental Awareness Project (LEAP) operates in Devichaur VDC, Lalitpur district Nepal since 2010. The development partners are KEMA (Finnish NGO) and Community Development Forum CODEF (Nepali NGO). The project will be completed in 2015. Gender and Social Inclusion, WASH, Income Generating Activities and Capacity Building are the key components of the project.

The Devichaur Village Development Committee (VDC) area comprises of 556 households and a population of 2883, having 80% ethnic (Tamang) inhabitants. The VDC has been declared as Open Defecation Free (ODF) zone since July 2014, which means that there is not human excreta openly seen and most (98%) of the household have a hygienic water seal toilet. The baseline situation in 2010 was that only 29% of households had a toilet in use. Outbreaks of water borne diseases were common and caused a significant risk especially to small children.

Elements that contributed to the success:

- mobilization of women's groups. 21 women groups were established with 340 members covering the VDC. They implemented the village level awareness campaign.
- input of the Female Community Health Volunteers (FCHV). They visited the households with a sanitation and hygiene checklist.
- CODEF coordinated between the community, Village WASH Coordination Committee (VWASHCC) and district office to implement the national sanitation and hygiene master plan
- matching funds were provided for latrine construction in the beginning, later switched to a policy where only the ultra poor received financial support.
- people were motivated with the integrated approach where WASH was only part of an integrated project with a strong IGA (income generating activity) component
- a national level top down political pressure to show progress with the Millennium Goals as well as national target "WASH universal coverage by 2017."

Challenges included ultra-poor households, high illiteracy rate, landless people, mistakes made in construction, high cost of concrete and transport. Poor maintenance of toilets is a sustainability risk. Problems in health statistics prevent reliable monitoring of environmental health.

The key activities carried out were: Sanitation strategic plan formulation, cluster level campaign, school level campaign and monitoring, sanitation training to committee members, local political leaders, toilet mason training, hardware support to poor families, triggering exercise, exposure visits, "sanitation card", innovative means of conveying sanitation and hygiene messages.

Now the community is scaling up sanitation and post ODF activities (water supply and water safety management, preventive health care like hand washing at critical times, animal hygiene). People have realized that ODF and sanitation is a precondition for certain income generating activities, such as home stay tourism and increased production of high quality milk.

Keywords: WASH ODF Sanitation in rural communities, integrated approach to sanitation, community lead sanitation

USING OF YOUTH `COOPERATION AND INNOVATION AS POTENTIAL FORCES AND FUTURE EXPERTS FOR DELIVERY HI TECH SOLUTIONS AND CULTURAL CHALLENGES FOR DRY TOILETS (ECOSAN SYSTEM) IN VILLA GARDEN REGION IN PARAND CITY

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Thursday 20.8, 11:10 in Lecture Hall E1-06

Association of Persian Agenda 21(APA21) is a nongovernmental and nonprofit organization. Accordance to Article 25 of Agenda 21, executive cooperation youths as further professionals are crucial in accessing to sustainable development. Thereby, in these project youths' ideas and creativity as target group play a vital role. Parand City- with increasing population- is a new established and developing city including villas and apartments. The current population is about 100.000 and it is up posed to populate twice as many as the current population. Parand's climate is dry and is located on the margin of desert. This city is the most modern and the nearest city to the international airport and in 30 kilometer from Tehran- capital of Iran. Water supply system of Parand is supplied from Tehran. All villas garden regions of this city contain gardens and they are an appropriate place to use the dry toilet (ecosan) systems.

In running of this project, a questionnaire was developed. Students in high school and universities, citizen in villas region of this city were queried. Questions are included four different parts: 1- the subjects' Interest and contribution to organic healthy products, 2- their' opinions on the huge volume of water used in flushing tank for discharge of faeces 3- Their interest rate to get familiar with the dry toilet system (Alternative), 4- their knowledge about pollution of drinking water in cities (result of analysis in attachment 1). In the next phase, dry toilet system and the use of urine and compost in the home garden and growing of organic products were taught. In searching for ecosan system in internet, almost all projects of ecosan and dry toilets are in rural area and villages. It's a negative challenge for introduce this system for modern city with hi tech system. Therefore we suggest that establish " International team for promotion of hi tech Ecosan (dry toilet) system". Viewpoints, cultural challenges, strategies and plans for hi tech toilets in the project area were presented for performing in this project. (using of special pockets under faeces part and suction system to pit in garden in directly, allocate small sponsors and subsidize for buying hi tech toilets for houses as pilot projects, showing of using of urine and faeces on growing of flowers (attachment 2), designing poster and game for present hi tech system (same as sida puzzle but for cites and hi tech system), ...)

The initial plans and ideas for hi tech Ecosan toilet were presented to Engineers of Cooperative utilities constructing villa garden region and residents interested in the proposed Ecosan system for complete and planning. The owners of some of the under construction buildings became volunteer to apply and contracture dry Toilet system, septic system and fertilizing of their gardens with gray water, ecosan system.(Pictures in attachment 3) . Since the establishment of the modern cities- including lots of villas regions- around the big cities such as Tehran are increasing, this project is a suitable pilot project for the same cities.

Since water saving in Ecosan system increase the possibility to access consumed water for more people, and having access to the health water is the right of every human being, promoting Ecosan system from the perspective of human rights and MDGs were considered and discussed

Keywords: youth & sustainable development, hi tech solutions and further experts, International team, ecosan and human rights,

FUTURE OF ECOLOGICAL SANITATION (ECOSAN) GLOBALLY

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Thursday 20.8, 12:30 in Lecture Hall A3-27

EcoSan is holistic concept, to save water, prevent contamination and pollution of water and return the nutrients of human excreta back to the soil. The ecosan concept considers human excreta as resource rather than as waste as earlier understood. For EcoSan, toilets are specially designed such that urine and faeces are separated. Urine is collected in a tank and used regularly in the farm with appropriate mixing with water. Similarly faeces are allowed to decompose in chamber for about 6 month before applying in the farm and then used as manure. Since urine is chemically richer than NPK fertilizer farmers feels that vegetables grown with urine use is tastier and giving a higher yield.

EcoSan Sanitation is mainly for nutrient recovery and water saving. Technology is continuously improving. Concept is spreading worldwide. Many agencies are doing research, practice and trainings internationally. Urine can be used safely after one month storage. Public health is main concern need to be careful. EcoSan helps to improve local ecology and adaptation and mitigation of CC. Concept and principles remains same but system will change in the future.

EcoSan is the way towards clean environment. It has potentiality to recover nutrient, save water and energy and linked to climate resilient. But due to current barrier relating to social, technical and economical it is not spreading at it sounds potentially good. Paper explores ways to synergy the global effort for future of EcoSan globally. Paper will also get in to better form after the experienced gained in the conference.

Future of EcoSan bright because of following reasons:

- 1- Increasing environmental concern globally will give positive pressure to go for EcoSan as best options of sanitation
- 2-Because of its potentiality for low carbon emission in comparison to other options will be appreciated
- 3-Due to recovery of nutrient in a close loop in will attract many reconfirming which demands ecological sanitation options.
- 4-Improved technology for EcoSan will automatically overcome current social barriers and every one and every setting will be in position to accept the ecological sanitation options.
- 5-Its potentiality to operate with low water will address water scarcity and complexity of sewerage system will be also overcome.
- 6-EcoSan becomes solution for many schools and institution where water is scarcity.

Here following actions has been proposed for the future of EcoSan:

- 1-Promote EcoSan promotion and resource center in every country with regional and global hub.
- 2- Research and development for technology addressing comfort of every social groups.
- 3-Global forum for ecological sanitation and information sharing
- 4-Everyone contribute to common effort with scope for innovations
- 5-Linkage establishment with health, sanitation, water, energy, tourism, agriculture, food safety, climate change, ecology etc.
- 6- Equity analysis for need of diverse group and potentiality of contribution from diverse group
- 7-Creating value for ecological sanitation through linkage establishment with all aspects of life as possible.

Keywords: Ecological sanitation, Future prospective, Global

TRADITIONAL-LEADERSHIP STRUCTURES, A SOLUTIONS FOR INCLUSIVE SANITATION SERVICE DELIVERY

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Thursday 20.8, 12:50 in Lecture Hall A3-27

The traditional leadership structure are proved to be a solution to effective and inclusive sanitation service delivery to reach the marginalised, people with disabilities and to break the cultural stigmatization associated to dry sanitation in the rural communities in Chieftainess Mungule of the Lenje speaking people of Zambia.

The paper discusses a three years comparative Inclusive, Innovative Sanitation for Peri Urban and Rural Areas in Lusaka Zambia (InSPUR-Project) 2014 – 2016. The project is implemented based on a comparative leadership structures, the traditional-cultural structure (Chieftainess) and the civic leadership structure (Local Government or Councils). The project is implemented by Network for Environmental Concerns and Solutions (NECOS) with the financial support from its International partner Global Dry Toilets Association of Finland (GDTAF). The project has so far constructed 35 urine diversion dehydrated dry toilets for the year 2014 of which 25 through the traditional leadership structure while 10 through the Local Government or Council structure.

The paper brings out a comparative strategic leadership structures for planning, design and implementation of an inclusive, Innovative Sanitation for Peri Urban and Rural Areas in Lusaka Zambia (InSPUR-Project) 2014 – 2016, a running project implemented for a one year period. The project also addressed the inclusiveness, service delivery among the marginalized peri urban and rural communities focusing on inclusiveness and stigmatization associated to dry sanitation especially in rural communities where strong beliefs and norms.

It also discusses the challenges, opportunities, negatives and positive experiences during the planning, design and implementation of a comparative Inclusive, Innovative Sanitation for Peri Urban and Rural Areas of Lusaka Zambia (InSPUR-Project) 2014 – 2016.

Keywords: Traditional, Inclusive, Sanitation, Services

ECOSAN TOILETS- AN ALTERNATIVE TO CONVENTIONAL SANITATION FOR VULNERABLE LOCATIONS

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Thursday 20.8, 13:10 in Lecture Hall A3-27

The paper describes experience of WaterAid India in introducing EcoSan toilets in Chhattisgarh, initiative of its first kind in the State. WaterAid has recently been experimenting with various technologies that cater for the specific needs of communities in a particular area. One such effort is underway in the Korba district of Chhattisgarh state, where some areas have high water table. This geological feature means a high risk of failure for leach pit toilets because of water contamination, which prompted to explore the possibility of introducing EcoSan toilets in the affected areas. The initial intervention was in a handful of families in one village, and was later extended to hard rock and water scarce areas in the State as well. Water is a scarce resource and in rural India the burden of fetching water for drinking and household chores is on women and girl members of families. In spite of gradually increasing sanitation coverage by construction of conventional toilets, access to sanitation facilities does not solve the problem of open defecation. This is because the conventional latrines require precious scarce water resources for flushing latrines to keep excreta out of sight. In such situations other community accepted sustainable solutions are needed. Therefore, considering the present context and sanitation situation of the country, there is a need for a holistic approach to call for hygienic, sustainable and ecofriendly alternatives and hence, EcoSan toilets.

This paper argues that acceptance of ecological sanitation, and its recent experience in using the approach mean that Ecological Sanitation (EcoSan) could be very valuable. It could confront these problems and provide potential "added value" to the livelihood link through agricultural and horticulture production and water and environment conservation. This paper highlights acceptance and use related issues, lessons learned and challenges experienced for scaling up.

Keywords: EcoSan toilet, high water table, vulnerable locations, water scarce areas, hard-rock areas

AN ECO-SAN RESOURCE CENTER FOR ALL. CASE STUDY OF ECO-SAN RESOURCE CENTER NEPAL

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Thursday 20.8, 13:30 in Lecture Hall A3-27

This paper draws on the ideas and experiences of the authors on promoting ecological sanitation (Eco-san) started from 5 households of Darechowk Village Development Committee (VDC) to the establishment of the first Ecosan resource centre in Nepal. The Centre has been working since 2009 in Chitwan district and is successfully delivering its services to line agencies/departments of the Government of Nepal, several I/NGOs, the eco-tourism sector and interested communities in many parts of Nepal. After declaring the VDC as an Open Defecation Free (ODF) zone, 47% (764) among the total households of the VDC are now using urine collected from the urine diversion toilets as fertilizer for the crop production and hence improving their livelihoods. On average, people of Darechowk Eco-san village are selling their vegetable products at 150,000 rupees (equivalent 1500 US Dollar) annually.

Government of Nepal policies to promote total sanitation have favoured the development and acceptance of sanitation solutions. Ecological sanitation had been tested in Nepal since 2002, but the focus on making Chitwan district an ODF district generated creative approaches in advocacy, training and follow-up in communities. A breakthrough was made when Darechowk School adopted a school-led community sanitation programme promoting ecosan as a solution for this active rural community that produces vegetables and oranges. Through urine application, farmers are saving energy and costs in terms of getting fertilizer and through recycling are also protecting the environment. For creation of the Eco-san village, the credit goes to the Resource Center, school level eco-clubs and the school community, and the local motivated users. Many nationals have shown interest in the resource centre on Eco-san, including the prime minister of Nepal, while several teams from abroad have visited (Bhutan, Myanmar, Korea, Pakistan, Norway, Sweden, and Holland) the centre and the eco-san village. A Swiss student has completed her Master's Degree internship at the Eco-san village in 2012 studying conversion of urine to struvite. During 2014 a student from Norwegian University of Applied science completed her Master thesis on user satisfaction and UDD application again. Faculty from the same university visited our resource centre late in 2014.

The center has been supporting the villagers surrounding its location in several ways. It has collected and distributed urine from many functions and festive events (e.g. 7000 litres of urine from Chitwan festival). By the joint effort of the SEWA Nepal and other organizations, Chitwan district was declared as ODF district in 2011.

The services of the resource centre are not limited to Darechowk. Its strategic location on a crossroads in central Nepal, has allowed expanding its training and demonstration services all over Nepal. Promotion of sustainable eco-san approaches through capacity building trainings, demonstration latrines and Ecosan information in Nepali to interested people of divisional and sub-divisional offices of Department of Water Supply and Sewerage, Finland supported water and sanitation development projects, local bodies (DDCs and VDCs) and I/NGOs in all five development regions of Nepal.

It has also undertaken appropriate technology development in squatting-pan design and for hand washing in water scarce areas. Further developments are planned for sanitation services linked to rainwater harvesting so as to ensure effective use of limited water for sanitation and livelihood. The Eco San resource centre has shown to be effective in promoting ecologically sustainable solutions to sanitation round the country at low cost.

Keywords: Ecological Sanitation, ODF, Advocacy, Resource Centre, VDC

CHALLENGES IN ACHIEVING 'LEAP-FROG': ADDRESSING SANITATION ASPIRATIONS IN DEVELOPING COUNTRY CONTEXTS

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Thursday 20.8, 13:50 in Lecture Hall A3-27

In many developing country contexts there remains potential to leap-frog to more sustainable sanitation solutions, as significant investments in sanitation infrastructure are yet to be made. This is the case in both urban and rural settings. In addition, in many rural settings, water availability limits the usefulness of water-based sanitation. And yet, through numerous research projects undertaken in Asia and Pacific, it is evident that the aspiration for water-based sanitation is prevalent, and space to debate relative merits of different sanitation solutions remains limited, amongst both communities and governments, and also amongst development agencies.

This paper draws on a sequence of research projects undertaken on sanitation in Vietnam, Indonesia Laos and Timor-Leste to raise questions about what would constitute strategic approaches to better socialise dry toilet solutions in each of these developing country contexts. Each research project dealt with different aspects of sanitation choices, planning and design, including both peri-urban and remote rural contexts. This paper analyses the perceptions, aspirations and espoused barriers to dry sanitation of relevant community members, non-governmental organisations, government staff and other development agencies. For example in Vietnam, our research provided empirical evidence of the high cost-effectiveness of a peri-urban nutrient recycling sanitation option. However the limited capacity of existing institutions to address sanitation and the influence of development agency funding for water-based sanitation solutions meant that recycling of urine was considered overly complex and not a viable solution. In remote areas of Timor-Leste and Indonesia, our research found that despite lack of consistent access to water, non-governmental organisations implementing sanitation programs promote water-based solutions, insisting that this is the aspiration of community members, and that meeting such aspirations is critical in ensuring uptake of hygienic sanitation options.

Consideration of these and other stakeholder perspectives through various theoretical lenses (e.g. political economy analysis, actor network theory, causal layered analysis and systems thinking) can help inform approaches to facilitate change. Political economy analysis highlights how current incentives shape the behavior of different actors, causal layered analysis considers the values and myths that underlie existing perceptions and actions. Actor network theory and systems thinking provide useful tools to explore change processes going forward and the key points of leverage within institutions. This paper will present potential pathways to better socialise dry sanitation and nutrient recycling options in the relevant case study countries, with a focus on actions to facilitate change within development agencies and government stakeholders.

Keywords: developing country; sustainable sanitation; social change

TRANSLATING STORY TELLING INTO PRINCIPLES FOR DESIGNING DRY SANITATION IN RURAL NATIVE ALASKAN COMMUNITIES

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Thursday 20.8, 14:10 in Lecture Hall A3-27

In this paper we report on a project funded by the Alaskan Government (Department of Environment and Conservation), the Alaskan Water and Sewer Challenge (AWSC), in which the authors were selected as part of an international team to conduct social research and community engagement with two rural indigenous Alaskan communities in the design of innovative water and sanitation systems. In developing a methodology for social research and community engagement the authors adopted a story telling approach - narrative inquiry - to not only gain a rich complex picture of the barriers and opportunities of implementing alternative sanitation options in practice but also as a critical preliminary stage in developing design principles for dry sanitation systems for these communities. The narrative qualities of human experience mean personal interaction with sanitary technology can't be captured by empirical methods or by summarising the experience using statistical methods alone. Such an approach is insufficient and restrictive; in contrast story telling offers a way of generating insider knowledge through a collaborative, transparent and reflexive view of sanitary practice.

In seeking stories of success and failure of sanitation systems in two rural Alaskan communities twenty-five stakeholders working in the region were interviewed including community members, local tribal council leaders, utility operators, public health professionals and government funded engineers. Stories were collated as qualitative data, thematically analysed into principles for designing low tech, low cost water and sanitation. These principles guided the development of a suite of options including dry urine diversion systems.

This paper argues for the value of story telling as a legitimate, culturally appropriate method of engaging indigenous communities. There are a number of ways in which stories have been used in this project including as a way of eliciting historical experiences of using, managing and regulating sanitation systems in these communities, as a way of sharing intimate practices as well as providing insight into how and why people continue to use sanitation systems (i.e. the honey bucket) detrimental to public and environmental health. While story telling is a time intensive approach to community engagement, it was critical in generating openness and trust between the authors and community members and in some cases led to invitations into residents homes to view water and sanitation systems, rather than the researchers requesting permission.

In conclusion, this paper advocates for story telling as a way of (1) expanding the suite of culturally sensitive research methods, (2) as a precursor to the development of technological design of water and sanitation systems (3) and as a way of identifying and incorporating cultural and social preferences into the design and assessment of technological options.

Keywords: story telling, urine diversion, Alaska water and sewer challenge, practices, rural indigenous communities

THE TEMPLE OF HOLY SHIT - A PUBLIC DRY TOILET PROJECT IN URBAN AREA

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Thursday 20.8, 15:30 in Lecture Hall A3-24

We are Collective Disaster, an international and multidisciplinary team and looking for new forms of collaboration by engaging in & creating social and participatory situations.

Realized project

Temple of Holy Shit (Usine du Trésor Noir) is a public dry toilet and terra-preta sanitation system, whose purpose was to convert the biowaste and bodily waste produced by the park and its visitors into a rich type of soil (terra-preta substrate) for the gardens in and around the area. The project had been selected for Parckdesign2014, which was a biennial dedicated to public space planning initiated by the Brussels Ministry for Environment, Energy and Urban Renovation (IBGE) and ran as a pilot project in the neighborhood for six months in 2014.

Acceptance in the community

The value of this work lies in its ability to communicate the concept of terra-preta and compost and its potentiality to create more sustainable mindsets, while, at the same time, offering a social space for the neighborhood.

The project was largely multidisciplinary, drawing connections between the milieus of architecture, public art installation, art and science and socially engaged art. Since the installation relied very much on its usability, the project was fully reaching its ambitions via activation of the installation. Apart from a dry toilet and terra-preta production facility, the design included a playground with slides and a stage for performances. Collective Disaster developed a program over the course of the summer that is rendering the 'Usine' a social space, where the different local social groups could meet and engaged together in activities. The program included activities such workshops about composting and terra-preta, educational games for children and grown-ups, and a round-table discussion on topics such as sustainable infrastructure, human waste, socially engaged art and the relation of art and science.

By producing a substantial amount of terra-preta substrate, a micro-economy could be developed around this valuable resource together with some jobs for the (unemployed) people of the neighborhood. The idea of creating a micro-economy around new tendencies of society (e.g. urban farming) is a key-concept of the project. We believe to the potentiality of art to inspire social initiatives.

Future business model

What we proposed for the Blue Responsibility Award competition is a business model based on collaboration between public institutions and grassroots social initiatives, while making (temporary) use of non-used public properties. With an initial seed-funding from public institutions and under the management of neighborhood NGOs, such spaces can become accessible to the public as educational, social and production centers, namely providing a social space with edible forest and dry toilet, where the visitors can hang out and harvest their own fruits that are grown in terra-preta substrate made out of the visitors own waste. Therefore, some cash flow will be incorporated from the selling of the agricultural products produced by terra-preta substrate as well as from educational activities offered to school and families. In this case there will be profit for the local NGO but also for the public institution that will have supported a healthy business model which bridges education, culture and sustainability. Temple of Holy Shit won the 2nd prize at the competition. Please watch the video presentation: <https://vimeo.com/106395914>

Keywords: community, the relation of art and science, circulation of nutrient, terra preta substrate

ECOSAN PROMOTING IN NORTHERN TAJIKISTAN AND IT'S SOLUTIONS

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Thursday 20.8, 15:50 in Lecture Hall A3-24

While cleaning units does not work properly in big cities and towns of northern Tajikistan, the sanitary and hygiene situation is catastrophic in vulnerable areas like Jamoat Tagoyak of Spitamen district. More than 80% of social cleaning sites do not work in the region and all the waste merges with underground water it causes different problems: pollution of drinking & irrigation water systems, increase of infectious diseases, increase of maternal and child mortal, etc. Lack of resources (financial, technical, and human) creates barriers to solve the issue in local level. Even this is not a priority issue for local authorities. To solve, or at least to mitigate, the results of this problem alternative hygiene and sanitation actions should be implemented by interested parties.

Taking into consideration the above problem, ASDP Nau have previously initiated RR&CCA project which contained component on organization of cleaning works via implementation of awareness raising on sanitation, education and technical demonstrations on ecological sanitation and reduction of disease level caused by anti-sanitation conditions in target area. Distribution of experience on ECOSAN approach (this approach has multiple effect as building sustainable ecological toilets with principles of separate urine from excrements, transformation of human waste into useful organic compost, and its further usage on intensive agriculture) were the main activities fulfilled in the frame of the previous pilot project. This approach has close link with agriculture where the main issue on local level is lack of technology on processing human waste, and people's mentality according to which human waste considers to be forbidden to use in agriculture. Analyses show that more than 80% of farmers do not use cattle waste in agriculture, but for heating and cooking purposes. Hence, the action intends to give applicable technology of composting human waste as an alternative source for agricultural use & change local community's mentality. As far as the results were positive and project team could somehow change local people's mentality to use dry and ecological toilets, current action plans to expand this positive experience via conducting trainings in target region.

Keywords: pollution, solution, mentality, ECOSAN

BEST PRACTISES IN ENGAGING DIFFERENT STAKEHOLDERS IN ACHIEVING SUSTAINABLE DRY SANITATION SOLUTIONS - EXPERIENCES IN CO-OPERATION BETWEEN FINLAND AND ZAMBIA

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Thursday 20.8, 16:10 in Lecture Hall A3-24

Finnish NGO, Global Dry Toilet Association of Finland (GDTF), has implemented dry sanitation improvement projects with its local partners in Africa since 2006. Currently GDTF has five (5) Finnish Government funded projects in three (3) countries (Zambia, Swaziland and Tanzania). The experiences gained from the projects have been used to create best practices to make sure that the projects are environmentally and economically well planned and implemented, as well as will achieve sustainable results for the local people and the environment. Projects have improved WASH-sector (water, sanitation and hygiene) and waste management for example by training and by construction of facilities. They have also widely increased knowledge, information dissemination within different stakeholders and been part in the development of countrywide policies. Improved sanitation (dry toilets) and better water quality (new water sources) along with increased hygiene knowledge and better practices have led to decreasing of many waterborne diseases such as bacterial and parasitic infections. For example in the first ended project in Masaiti (Zambia) (2006-2013) the diarrheal diseases diagnosed in the local clinic were dropped even from 85 % of the highest figure (3083 cases in year 2008) compared to 484 cases in the year 2013 when the project ended. These results were achieved with holistic and participatory approach, considering not only sanitation facilities but people's ability to improve their WASH widely, starting from their hygiene knowledge and behavior, leadership skills, technical know-how, operation and maintenance skills, fundraising and sustainability aspect, just few to mention. Understanding of the whole concept of dry toilets from planning and construction to end use is very important for the sustainable results, and lots of efforts have been put on that part of the projects, especially on training and sensitization. Local co-operation partners (NGO's and traditional groups), local authorities and local government have supported the projects with their resources leading to better and more comprehensive results.

The primary feature of the Lusaka project (2008-2016) has been the advocacy and political lobbying as well as increased public and private partnerships. Training sessions have not just been organized in local level and for the beneficiaries but also in the government and district level. The aim has been that dry toilets would be included as formal method of sanitation, especially in sensitive areas, where pit latrines are not suitable. Co-operation in the advocacy has been made e.g., with NGO WASH Forum. Cooperation has also been done with the local university, namely University of Zambia (UNZA) in order to make curriculum for ecological sanitation to train and to do research e.g. with environmental health students. Also students from several Finnish universities such as University of Jyväskylä, Tampere University of Applied Science (TAMK) and Häme University of Applied Science (HAMK) have been carried out practical training and thesis researches as volunteer basis, which also have helped projects to gain better results and understanding than just with limited project workforce and resources.

Long-lasting results cannot be achieved without the local people and their full participation and commitment. This includes local residents, authorities, central government and the other stakeholders. A sense of ownership will require the payment towards the cost of the toilet, at least in part, or at best fully by the beneficiaries. Different payment methods can be used (cost sharing, loans etc.) to make the investment achievable for all. Also local entrepreneurship is encouraged to make project achievements more sustainable and increase the possibilities to improve livelihood through WASH-related business. Positive attitudes and political climate as well as open discussion and co-operation between local authorities', government, government agencies and policy makers are very important for the long-term results. Laws and policies should be clear and encourage for the better sanitation. The projects should influence the residents and decision-

Keywords: dry toilet, stakeholders, co-operation, universities, government

TIMETABLE FOR TOPIC 1

Friday 21 August

9:40	Lecture Hall A3-24	FinWaterWEI II	
10:00	Lecture Hall A3-24	Peter Chukwuma	Zambia
10:20	Lecture Hall A3-24	Karim Savadogo	Burkina Faso
10:40	Lecture Hall A3-24	Ireen Ng'ambi	Swaziland
11:00	Lecture Hall A3-24	Namaste Lal Shrestha	Nepal
11:20	Lecture Hall A3-24	Yaba Laxmi Shrestha	Nepal

ENGAGING DIFFERENT STAKEHOLDERS IN ACHIEVING SUSTAINABLE DRY SANITATION SOLUTIONS IN SUB SAHARAN AFRICA

Peter Chukwuma

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Friday 21.8, 10:00 in Lecture Hall A3-24

Dry sanitation entails the disposal of human waste without the use of water as a carrier. It reduces the demand on water available for domestic use. Initially dry sanitation solutions were designed for use in remote areas for practical and environmental reasons. Improved technology has led to attractive dry sanitation products which can serve as alternative to conventional systems. There has been a lot of interests in dry sanitation solution as alternative to conventional systems and a review of the subject indicates that it really does work. In developing countries they can be a low-cost, environmentally acceptable sanitation option. Surprisingly, new concepts in dry sanitation systems are not widely deployed in sub-Saharan Africa where the products are highly needed due to limited access access to regular water supply and sanitation amenities.

In Nigeria, exposure to western culture and improvement in standard of living have made water cistern the preferred toilet system to the majority of the populace. However lack of sustainable water supply has been a huge setback in the use of water cisterns especially in public places and in mass events. People resort to open defecation due to non-availability of toilet facilities or poor sanitary conditions of the available toilets. Water supply challenges will remain a daunting task in Sub Saharan Africa hence any sanitation system that is water based is not likely to meet the desired objective. Dry sanitation will therefore be a game changer in the drive to sustainable sanitation in Sub Saharan Africa. The major challenge will be to engage stakeholders to accept and support dry sanitation

Achieving sustainable dry sanitation solution is hinged on effective mapping and management of the key stakeholders. Stakeholder Management entails identifying key stakeholders and winning their support.

This paper outlines strategy to successful engagement of key stakeholders to embrace sustainable dry sanitation solutions. It examines the following issues as they relate to stakeholder engagement

Principles and Standards for Effective Stakeholder Engagement

Why do stakeholder engagement?

Stakeholder Engagement in dry sanitation Policy Development

Tools for the Stakeholder Engagement Process

Ensuring the Stakeholder Process is Engaging and Participatory

Stakeholders Mapping

Stakeholders Analysis

Planning Stakeholders Management

Stakeholders Communication Strategy

The paper also looks at the barriers to acceptability of the dry sanitation concepts in Sub Saharan Africa. It will also attempt to assert why Stakeholder Engagement is crucial to winning support for sustainable dry sanitation solutions in Sub Saharan Africa.

Keywords: Communication, Management, Mapping, Planning, Strategy

BRIDGING SECTORS TO ENABLE UPSCALING OF ECOLOGICAL SANITATION - ATTEMPTS IN BURKINA FASO AND NIGER

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Burkina Faso

Friday 21.8, 10:20 in Lecture Hall A3-24

Productive/ecological sanitation has been implemented in pilot projects in many places in SSA (Sub Saharan Africa), but there are few, if any, examples where dry toilets have been implemented at large scale while maintaining a strong focus on safe excreta recycling. Sanitation professionals rarely have the competence, mandate or interest to credibly support communities and households with excreta recycling. In addition, regulations and responsibilities related to recycling are often unclear and as a result experiences at scale are still lacking in spite of the multiple benefits productive sanitation could bring for health, environment and agriculture.

This paper describes initiatives in Burkina Faso and Niger that aimed to raise awareness and interest among key sectors as a first step to enable large scale implementation of productive sanitation. These countries are mainly rural with relatively low sanitation coverage: Burkina Faso is 73% rural with 75% open defecation in rural areas, while Niger has 82% rural population with 89% open defecation in the rural areas (JMP 2014). There have been several, mainly NGO-driven, innovative ecosan projects in rural areas in both countries (Dagerskog, 2014) as well as an urban ecosan project in Ouagadougou, the capital of Burkina Faso (Dagerskog, 2010). In parallel national sanitation policies and programs have been developed and started to be implemented with limited integration of productive sanitation beyond including the urine diverting double vaults toilets among the accepted toilet models.

Productive sanitation has the explicit goal of enabling the safe recycling of human excreta, and it will therefore be important to create demand for the end product as much as for the toilet. The awareness and know-how on the reuse of sanitation products (organic fertilizers) is promoted with more credibility by the agriculture sector. It should therefore be high priority both to involve agriculture professionals in productive sanitation initiatives, and to investigate how excreta recycling (not only the toilets) can be enabled in national regulations and policies.

In Burkina Faso, national stakeholders gathered in a two-day workshop in 2009 to formulate a framework of actor responsibilities and actions needed for large scale implementation of ecological sanitation. 21 key activities were identified and responsibilities were assigned to different actors and an institutional framework was created, with the Directorate for Sanitation, Waste water and Excreta to be the main coordinating body. However, there was no clear funding or other incentive to take the next step and this national initiative has still not taken off.

In Niger there was an expression of interest to form a national working group on productive sanitation following seminars organized by the Triple Green research project on urine reuse and supplementary irrigation carried out by the University of Niamey, SEI and WSA. A multi-stakeholder working group was then supported in 2012 with funds from the project as well as in kind contribution by the Ministry of Agriculture. The platform served well for information sharing and capacity building, but failed to get a Ministerial Decree signed that was prepared to make the working group an official task force within the Agricultural Ministry, due to lack of funding for activities at scale.

To take productive sanitation to the next level in Burkina Faso and Niger, these first attempts need to be built upon and continued. Recommendations for future initiatives will be made based on learnings from these experiences.

Keywords: Up-scaling, productive sanitation, cross-sector collaboration, Burkina Faso, Niger

THE ROLE OF NETWORKS IN STRENGTHENING OF ENVIRONMENTAL AWARENESS AND THE CIVIL SOCIETY IN SWAZILAND

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Friday 21.8, 10:40 in Lecture Hall A3-24

Background

Organisational Capacity Building for Environmental Education and Community Development Project (2013-2014, second phase 2015-2016) is implemented in cooperation with Green Living Movement (GLM) Swaziland and Green Living Movement (GLM) Finland. The project aims to enhance the organisational capacity of GLM Swaziland and to increase environmental awareness in the two partner communities in the capital city Mbabane, namely Dlangeni and Msunduzi. The activities include training and education for the communities on dry sanitation, waste management and sustainable management of natural resources as well as workshops on organisational management for GLM Swaziland and other NGOs in order to strengthen the local civil society.

Implementation

In order to change the models of operation in the society, multi-level cooperation is essential. Networking on a communal level is a way to reach individuals whereas cooperation with other NGOs and the authorities enables working with a greater volume. GLM Swaziland has been participating in the WASH Forum where different stakeholders meet to discuss and to take part in workshops covering issues related to water, sanitation and hygiene. The forum is a good ground for networking with other NGOs and participants, which include higher-level actors such as the Ministry of Health. Networks have enabled dissemination of awareness on dry sanitation through requested trainings while cooperation with respected institutions such as the University of Swaziland (UNISWA) has supported GLM's credibility. Additionally, GLM is involved in extending PELUM Association to Swaziland, which is a major regional network for members of the civil society in Africa.

Results

Networking with the authorities has enabled GLM to enter new communities and to attract new target groups. It has enhanced the capacity of the organization and sustainability of the project enabling continuity and strengthening the cooperation. Additionally, GLM has gained essential experience on facilitation and a stable status as an NGO working on dry sanitation in Swaziland. The positive attitude towards the project themes on the communal, organizational and administrative level has been gained through consistent work in terms of forums, meetings and workshops. Training of Trainers (ToT) is a great tool for disseminating information and through actualization and visible results, the trained themes will attract even more interest.

Conclusions

With the support of its sister organisation in Finland and in Zambia, GLM Swaziland has gained a strong role in the growing civil society of Swaziland and has connected with actors in all levels of the society. Additionally, increased amount of requests to be trained indicates that the market for environmental education has mushroomed. GLM will continue networking with authorities and NGOs as well as other actors such as churches, which could play an important role in the communities.

Keywords: Networking, Cooperation, Environment, Education, Civil Society

FOOD SCARCITY IN PRACTICES OF TRADITIONAL COMPOST TOILET BY SHERPA COMMUNITY IN KHUMBU REGION (MT. EVEREST) OF NEPAL

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Friday 21.8, 11:20 in Lecture Hall A3-24

Nepal is one of most tourist destination in the world due to great Himalayan range in its northern boundary which follows international border with Tibetan autonomous region of China. Especially, to conserve the world highest ecosystem in the northeastern region of Nepal, 3 villages Chaurikharka, Namche and Khumjung in Solukhumbu District named as Sagarmatha National Park and Buffer zone. Recognizing the global importance of sagarmatha (Mt. Everest) as the world's highest mountain, the park was declared a UNESCO World Heritage Site in 1979. The khumbu region is anciently inhabited by Sherpa people. This ethnic caste group comprises of 90% of total population of this region. There are 48 settlements in the National Park and Buffer Zone area.

Traditionally, trade and livestock farming are major economy of Sherpa community. After opening of international mountaineering expedition in 1950 and inflow of foreign trekkers in this region, tourism is fostered as major economy of Sherpa people.

Traditional agriculture is still common practice by the Sherpa. The agriculture production is very limited due to short growing season and steep topography. Only about 22% of the households are entirely dependent on agriculture and about 37% are said to be partially involved. With only less than 10% of land is cultivated. Food deficiency is common phenomena in this region. The food is not enough here for more than 6 months. For other days, they have to purchase from neighboring village and city. Potato is most widely grown crops in this region. Potato is main crop that is grown skillfully upto 4000 m elevation. Agriculture in Khumbu is mainly dependent on monsoon rain. Besides potato, other main agriculture crops grown in this region are barley, maize and buckwheat and local fruit such as apple, peaches, plum and pears. Vegetables such as mustard green, cabbage, carrot, radish, onion, cauliflower etc are grown as well. Most village homes are built near agriculture field where each house constructed traditional compost toilet. Fields are fertilized once a year with composted livestock manure and human waste. A traditional composting toilet can be either a permanent or temporary structure, depending on the family's economic status. Locally a toilet is called a 'Chyakhang' where Chya means manure and khangba means house. Thus the Chyakhang is a 'house for manure production'.

In few decades, with promotion of rapid tourism growth in this region, there are increasing numbers of construction of flush toilets for tourist facilities in trekking route in other hand traditional compost toilets were restricted to off-trekking route only. Due to modern flush toilets, direct discharge of effluents into natural rivers especially threat to major rivers such as Dudhkoshi and Bhotekoshi. Short season of agriculture, lack of accessible road, change in profession to tourism, shortage of labour for farming during tourism season have raised lots of challenges for livelihood of people mainly in remote village of this region. The dependency on food supply from urban area is rapidly growing nowadays. This has not only threat to practice of tradition toilet and agriculture system but also raise food scarcity among this community in this world great Himalayan region.

Keywords: Sherpa Community , tradition compost toilet, organic farming, food scarcity



TIMETABLE FOR TOPIC 2

Friday 21 August

13:40	Lecture Hall E1-06	Emma Roach	Germany
14:00	Lecture Hall E1-06	Peter Chukwuma	Nigeria
14:20	Lecture Hall E1-06	Hamish Skermer	Australia
14:40	Lecture Hall E1-06	Jonna Heikkilä	Finland

SANITATION PARADIGM SHIFT WITH DRY TOILET SOLUTIONS AT MUSIC FESTIVALS IN GERMANY

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Friday 21.8, 14:00 in Lecture Hall E1-06

Music festivals in Germany are mass events with often more than 10,000 visitors. They frequently take place in remote areas without adequate sanitation infrastructure. Currently, sanitation management at these events is usually based on mobile chemical toilets, which does not provide a user friendly sanitation solution and frequently leads to dysfunction of small treatment plants of rural communities.

Dry toilets have begun to be seen as an alternative solution with an increase of festivals offering a small amount of dry toilets alongside chemical toilets. This paper looks into the current situation of dry sanitation at mass events in Germany. The paper further shows the potential of dry toilets at mass events by looking at examples of large scale waterless sanitation at European festivals and gives an overview of actors in the scene. Additionally the challenges which companies face while establishing a dry sanitation solution for mass events in Germany, especially in terms of the legal framework will be described.

At present four companies provide dry toilets and hand-washing facilities as mobile sanitation solutions for music festivals in Germany. Altogether, they have a capacity of 140 mobile composting toilets. Approximately 60,000 people have been reached in total in 2014 by implementing dry toilet solutions on 110 events in Germany. The companies do not have the capacity to serve a complete festival with dry toilets yet.

Scaling-up of the German dry toilet scene remains a challenge, which is currently complicated by an unsupportive legal framework. As dry toilets at mass events are a relatively new development, the legal framework for composting and reusing the collected biomass has not been established yet. The legal disposal of the collected biomass is, instead of being an economic benefit, an expense factor. It remains a challenge to reform relevant regulations towards nutrient recovery.

Dry toilet sanitation at music festivals is widely spread in other European countries, the Glastonbury Festival (UK) with approximately 200,000 visitors and more than 1,000 dry toilets and the “BOOM” festival in Portugal with 20,000 people and a complete dry sanitation coverage being prominent examples. These best practices identify dry sanitation as a viable option for mass events and highlight an unused potential for the German providers.

The described business activities have the potential to reform the sanitation supply on mass events all over Germany and promote its use in other potential markets, such as public areas and private households. Besides the technical component a change towards sustainable sanitation at mass events is an entry point for users to the topic. Furthermore it raises awareness and therefore contributes to mainstream sustainable sanitation.

Keywords: Composting toilet, sanitation as a business, legal framework, Germany, mass events

DRY SANITATION AS A SOLUTION IN MASS EVENTS – EXPLOITING THE MARKET POTENTIALS IN NIGERIA

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Friday 21.8, 14:00 in Lecture Hall E1-06

The nexus of marketing is in identifying a need in the society and providing goods or services to satisfy the need. Studies have shown that sanitation is still a big burden Sub Saharan Africa. With a present population of over 170 million people and demographic growth rate of above 5%, Nigeria will remain a viable market for products or services that address the need of the populace. Mass event is very common in Nigeria where extended family system is widely practiced. Large crowds usually gather to witness celebrations like weddings, traditional marriages, funerals, child dedication, birthdays, cultural festivals, anniversaries, Coronations etc. Other activities that attract huge gathering include sporting events, Church programmes, Political rallies, Schools, Markets, mass transit stations, recreational centres. Often the arenas hosting mass events lack sanitary facilities and where sanitation facilities exist they are usually poorly managed due lack of adequate water supply. People resort to open defecation due to non-availability of toilet facilities or poor sanitary conditions of the available toilets at mass events centres. Mass events in Nigeria is one of the biggest source of environmental pollution but behind this problem lies a huge market for dry sanitation products which can serve as alternative to conventional sanitary systems. Dry sanitation system will provide the much needed convenience for the populace and help reduce environmental pollution resulting from open defecation that is prevalent in mass event arenas.

Dry sanitation entails the disposal of human waste without the use of water as a carrier. It reduces the demand on water available for domestic purposes. In Nigeria, water cistern is the prevalent toilet system to the majority of the populace in the urban areas while pit latrines and open defecation are common in rural and semi-urban settlements. Lack of sustainable water supply has been a huge setback in the use of water cisterns especially in public places and in mass events. Dry sanitation will be a welcome solution in mass events in Nigeria.

This paper outlines the market potentials that exists for Dry Sanitation solutions during mass events in Nigeria. It portrays how organisations in dry sanitation solution businesses can tap into the opportunities that mass events offer for their products in Nigeria. The paper also made forays into market penetration strategies leveraging on product differentiation. The paper asserts that businesses can take advantage of the dysfunctional sanitary systems in Nigeria and the huge population to gain substantial share of the market for dry sanitary products.

Keywords: Differentiation, Penetrate, Segment, Strategy, Viability

VALUE-CHAIN AND ENTREPRENEURSHIP CREATION FOR DRY SANITATION IN MNYMATSINI, SWAZILAND

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Friday 21.8, 14:40 in Lecture Hall E1-06

Mbabane Dry Sanitation and Waste Management Project (2014-2016) aims to improve the sanitation conditions and waste management in three project communities in Swaziland: Mnyamatsini, Malagwane and Mangwaneni. The project is implemented in collaboration between Turku University of Applied Sciences Ltd. (TUAS), the Global Dry Toilet Association of Finland (GDTF) together with the University of Swaziland (UNISWA) and the Green Living Movement (GLM) Swaziland as local partners. Mbabane Dry Sanitation and Waste Management Project utilizes the best practices and lessons learned of the former project, Msunduza Dry Sanitation Project (2007-2013).

Methodology

This paper provides an overview of the challenges and opportunities that the project encounters in defining the value chain of dry sanitation. The determination of the potential barriers in commercializing the organic fertilizers from the built dry toilets is essential when it is considered as a livelihood for the project's target group. In 2014-5, two sets of qualitative semi-structured interviews were conducted reviewing the perceptions of the inhabitants of Mnyamatsini, decision makers of the field and potential business partners towards entrepreneurship and value-chain creation around dry sanitation. While 29 interviews in the community were made addressing the inhabitants' view on the possible livelihood from dry sanitation, representatives of the Ministry of Agriculture and the Ministry of Health were interviewed also regarding the regulations related to human-originated fertilizers. Additionally, operators of organic fertilizers, investors and possible business partners were interviewed to get a wider perspective about the potential markets.

Results

Whilst the analysis of the interviews is still ongoing (will be ready by the time of submitting the final conference paper), some trends can be found. While the attitudes towards entrepreneurship and use of human-originated fertilizer in food production were found positive, both the interviewed community members and the authorities called for laboratory tests, which would authenticate the safe use and the nutrient value of the fertilizers. Additionally, even though the university has brought valuable credibility and visibility to the project, the support of the local authorities towards dry sanitation and the use of fertilizers was important for the community members. The local enterprises and the grocery shops expressed their interest for the future products from the project.

Conclusions

The involvement of local enterprises has brought attention to the economic value of the dry toilets, one of the key motivational factors for the communities. Proving the economic benefits, creating a wide multi-level network and working for visibility increases discussion around dry sanitation and eases the stigma of the rather controversial topic. While the self-initiative and the motivation of the Mnyamatsini community members enables bringing a new concept for the markets and creating a possible livelihood, they do still require the support and trust of the local authorities for a sustainable entrepreneurial success.

Keywords: Dry Sanitation, Value-Chain, Entrepreneurship, Network

TIMETABLE FOR TOPIC 3

Thursday 20 August

10:10	Lecture Hall A3-27	Pushpa M	India
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15:30	Lecture Hall A3-27	Steve Kabore	Japan
15:50	Lecture Hall A3-27	C.A. Srinivasamurthy	India
16:10	Lecture Hall A3-27	Nelson Ekane	Sweden
16:30	Lecture Hall A3-27	Santtu Palokangas	Finland
16:50	Lecture Hall A3-27	Eeva-Liisa Viskari	Finland

EFFECT OF HUMANURE AND SEWAGE SLUDGE APPLICATION ON GROWTH AND YIELD OF TOMATO CROP

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Thursday 20.8, 10:10 in Lecture Hall A3-27

A field experiment was conducted in farmer's field near Bangalore during 2014 to study the effect of humanure and sewage sludge application on growth and yield of tomato crop. In the experiment three fecal sludges as nutrient sources along with three levels of recommended dose of fertilizers (75, 100 and 150 percent of recommended doses of fertilizers) and were compared with FYM alone and recommended dose of fertilizer were evaluated with thirteen treatments, replicated thrice in RCBD design.

The growth (plant height and number of branches plant⁻¹) and yield parameters (test weight, average no of fruits plant⁻¹ and yield) were recorded. Significantly higher plant height (133.85 cm) and average number of branches plant⁻¹ (10.95) were recorded in treatment T₁ which received 150 % P through pit toilet sludge + balance N and K through fertilizers to supply 150 % N & K and was on par with T₃ (133.44 cm and 10.64) and T₉ (133.20 cm and 10.37) which received 150 % K through humanure + balance N and P through fertilizers to supply 150 % N & P and 150 % P through sewage sludge + balance N and K through fertilizers to supply 150 % N & K at 90 DAT followed by 60 DAT and 30 DAT respectively. The lower plant height (103.99 cm) and average number of branches plant⁻¹ (6.35) were recorded at 90 DAT followed by 60 DAT and 30 DAT in treatment which did not receive any fertilizers and manures

The yield parameters viz. test weight (1311.12, 1291.08 and 1246.33 grams), average number of fruits plant⁻¹ (40.99, 40.08 and 39.82) and yield (53.12, 52.58 and 52.34 tonnes ha⁻¹) showed significance differences among the treatments and were higher in T₆ (150 % P through pit toilet sludge + balance N and K through fertilizers to supply 150 % N & K) followed by T₃ (150 % K through humanure + balance N and P through fertilizers to supply 150 % N & P) and T₉ (150 % P through sewage sludge + balance N and K through fertilizers to supply 150 % N & K) and were on par with each other. The humanure and sewage sludge applied treatments recorded higher yield compared to recommend dose of fertilizer + FYM applied plot (T₁₀), only fertilizer applied plot (T₁₁) and only FYM applied plot (T₁₂) i.e. 50.91, 49.92 and 44.59 tonnes ha⁻¹. The lower yield parameters viz., test weight (919.10 grams), average no of fruits plant⁻¹ (33.56) and yield (38.06 tonnes ha⁻¹) were recorded in control plot (T₁₃).

Keywords: Sewage sludge, Humanure, Tomato crop

EFFECT OF FORMALDEHYDE/UREA RATIO ON THERMAL PROPERTIES OF METHYLENE UREA FROM HUMAN URINE

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Thursday 20.8, 15:30 in Lecture Hall A3-27

The use of dry toilet is an answer to sustainable sanitation through the need of water saving and reuse of human excreta. Urine diverting dry toilet allows a better valorisation of these excreta as compost via feces or direct application of urine as fertilizer. The latter appears to be an easy method for farmers in developing countries but in such an application, urine can be easily washed out by rain or by streaming water.

A solution to the above mentioned problem is the use of slow released fertilizer. Production of slow released nitrogen fertilizer – methylene urea – from human urine has been proposed (Ito, 2013). Formaldehyde reacts with urea in urine and precipitated as solid polymer particles of methylene urea. During the recovery, the precipitates from high Formaldehyde/Urea (F/U) ratio were softer comparing to those from low ratio. We thus assumed that the F/U ratio might influence some physical properties of the polymer.

The main objective of this research was to know the effect of Formaldehyde/Urea (F/U) mixture ratio on the thermal properties of the polymers. These properties are closely related to the ability of the fertilizer to be easily degraded or not. For this research, three levels of F/U (0.5, 1, 5) were used for the manufacture of methylene urea and thermal analysis was performed on the samples.

Preparation using synthetic urine was done at 25°C in a water bath during 24 hours of reaction and then dried at 105°C for another 24 hours. All samples were then subject to TG-DTA (Thermo Gravimetric-Differential Thermal Analysis). SII Exstar 6200 device was used for a simultaneous TG-DTA with flowing purge gas technique using nitrogen for furnace atmosphere control at 100ml/min. 45 µL alumina open crucible pan was used as reference and as sample container. Samples weight was about 10mg and experiments were replicated 3 times. Temperature regime applied to the samples was from room temperature up to 800°C at 10°C/min. However, for better peaks resolution, heating rate was reduced to 1°C/min within the range of 150-400°C. DSC (Differential Scanning Calorimetry) was also performed later under the same conditions of gas and temperature, using opened aluminium crucibles as reference and sample holder.

Observations were made on several parameters such as weight loss, rate of degradation, extrapolated onset of degradation, peak temperature of degradation, heat capacity, temperature of the beginning and end of degradation, enthalpy of degradation. However, for this abstract, only some of them are considered and are shown respectively for ratio F/U=0.5, F/U=1 and F/U=5. Peaks temperatures of degradation were decreasing and identified at 264; 253 and 237°C. Degradation rate was increasing and was about 186, 219 and 254 µg/min. 10% of weight loss occurring during heating from room temperature to 150°C was noticed in all samples. Visual observation showed no change in the physical condition of the polymer and assumption was that the weight loss was due to easy volatile matters. The areas under the melting peaks of DSC, represented the enthalpy of degradation. The value was decreasing and was 1383, 1015 and 654 mJ/mg. This result supported the observation done during the synthesis of the polymers. Precipitates from lower F/U ratio were softer and enthalpy for their degradation was also lower.

It was possible to evaluate the effect of F/U ratio on the thermal properties of methylene urea from human urine. Increase of the ratio led to material with lower degradation peak temperature, higher degradation rate and lower enthalpy of degradation.

Keywords: TG-DTA; DSC; Heating rate; Degradation; Polymer

EFFECT OF HUMAN URINE AS LIQUID FERTILIZER ON GROWTH AND YIELD OF COWPEA AND SUNFLOWER

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Thursday 20.8, 15:50 in Lecture Hall A3-27

In the country like India; different types wastes are generated by high density population. Among these wastes, the anthropogenic waste becomes problematic in terms management. These anthropogenic wastes include human urine, kitchen wastes, fecal matter and large quantity of water. Meanwhile, India is facing shortage of fertilizers due to increased percent of cropping intensity and large dependence on inorganic fertilizers by neglecting the organic wastes usage available in the country. Among the human wastes, urine has been found to be rich in nutrient elements. Based on modest calculation even if 30 percent of urine produced in the country is collected and used as a liquid fertilizer, it is possible to save nearly seven million tons of N, P and K fertilizers. However, the use of human urine in agriculture is not possible with the present system of toilets and urinals in urban centres as they do not have facility to be separate out fecal matter and urine. However, the ecofriendly toilet called 'ECOSAN' toilet or the modified gents toilet it is easy to collect urine and thereby it can possible to use in crop production.

In this study human urine and cattle urine were compared with nine different combinations and they were compared with recommended dose of fertilizers. Human urine was collected from modified gents toilet and used as liquid fertilizer to grow cowpea and sunflower crops. The experiments were conducted in red sandy loam soil of the farm at University of Agricultural Sciences, Bangalore, India during rabi -2013. The quantity of human urine, cattle urine, FYM and gypsum applied for different treatments was worked out based on the nitrogen requirement of crops. The balance of phosphorus and potassium were applied through single super phosphate and muriate of potash, respectively.

The results of experiment indicated that, plots received 40% Rec. N through FYM as basal + 60% N through human urine recorded higher plant height (59.2 cm), number of leaves (59.6), pod length (19.1 cm), number of seeds pod-1 (15.0) compared to all the other treatments in cowpea. As a result of better growth and yield parameters, application of 40% Rec. N through FYM as basal + 60% N through human urine recorded higher seed yield of cowpea (15.2/ha). The same trend of results was also observed in sunflower crop also with higher seed yield of 23.1 q/ha in 40% Rec. N through FYM as basal + 60% N through human urine applied plot. Thus it is concluded that, human urine is a wholesome liquid fertilizers and if used in crop production it help in the rejuvenation of soil fertility, enhance the yield of crops, helps to save money on fertilizers and solve the problem of unscientific sanitation leading to environmental pollution.

Keywords: Human urine, cattle urine, cowpea and sunflower

JUDGMENTS OF RISKS AND BENEFITS: A PSYCHOMETRIC INVESTIGATION OF PERCEPTIONS OF PRACTICES, TECHNOLOGIES AND SYSTEMS INVOLVING THE USE OF EXCRETA AS FERTILIZER IN AGRICULTURE

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Thursday 20.8, 16:10 in Lecture Hall A3-27

Recirculation of nutrients from human excreta (faeces and urine), wastewater, animal excreta, and other types of manure in closed loop systems has been practiced long before the advent of chemical fertilizers. Even though this practice has prevailed since time immemorial, public resistance to the use of treated and untreated human excreta (“toilet to farm”) and wastewater in agriculture in particular still exists within communities and among individuals. Little is reported on the psychological mechanism underlying human perception and judgment regarding the use of human excreta in agriculture. A good understanding of such psychological processes may provide useful insights for risk communication which takes into account decisions or judgments reflecting the best available knowledge and preferences. An examination of psychological processes may also enable us understand why some people continue handling and using human excreta in agriculture in an unsafe manner, whereas some emphasize proper risk management, and others completely dread the practice.

Psychologists have shown that risk and benefit are inversely related in people’s minds because an affective feeling is referred to when the risks or benefits of specific hazards or risky activities are judged. That is if an activity such as the use of human excreta in agriculture is ‘liked’ or profitable, people judge its risks as low and its benefits as high and vice versa if the activity is ‘disliked’ or dreaded.

Closed loop systems involving the use of human excreta in agriculture present both benefits and risks. When properly and safely managed, these systems have the potential to improve soil quality by adding organic matter and nutrients to the soil to boost crop productivity. However, the hygiene and safety aspects of the practice are not always appropriate. When closed loop systems are poorly managed, they pose severe threat to human and environmental health and may potentially exacerbate the sanitation and hygiene conditions in areas where these basic services are inadequate.

Using psychometric methods, we empirically investigated the role of affect in judgment and decision-making processes regarding the use of different types of excreta and fertilizers in agriculture. Different technologies and hygiene practices within the sanitation system were also included in the list of aspects being judged. The aim was to examine risk as a feeling to improve understanding on the risk-benefit trade-off people make regarding human excreta and its use as fertilizer in agriculture. Respondents were farmers and students in selected communities in Uganda and Rwanda.

Our findings reveal an inverse relationship between perceived risks and perceived benefits of the practices and technologies judged by both farmers and student in both contexts. These findings are consistent with that of other investigations of risk as a feeling. For the purpose of risk communication, our findings are useful in communicating the complex picture of risks and benefits of using human excreta as fertilizer to stakeholder groups as well as to the public at large.

Keywords: excreta, fertilizer, affect heuristics, perception of risk and benefit, judgment.

LOWCOST DOMESTIC STRUVITE TECHNOLOGY FOR THE TREATMENT OF URINE FROM URINE DIVERTING DRY TOILETS (UDDT'S) IN RURAL AREAS OF KYRGYZSTAN

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Thursday 20.8, 16:30 in Lecture Hall A3-27

Objectives

Struvite technology offers one solution for sustainable phosphorus recovery from human excreta in rural areas in low income countries. Sometimes the religion, personal settings or local situation does not allow the direct agricultural application of human urine as a fertilizer. Objective of this study was to find if struvite technology is possible for phosphorus recovery and re-use in Kyrgyzstan in cases where urine use in agriculture is not directly possible. In addition to this, user interphase feedback was recovered from the users for further technological development of the technology.

Methodology

A cast iron struvite reactor was built according to the guidelines given by Etter et al. (2011) The reactor drawings are presented below. The reactor was tested a number of times before leaving it to a rural household that was subjected as test user. User feedback was collected qualitatively from the household with a questionnaire to gather information about the user interphase, user opinions and user preferences for further development. Struvite was made by using MgO and source separated urine. The struvite was filtered with a cotton cloth. Struvite was filtered, dried and collected for weighing. After this the reactor was given to an agricultural household and user experiences were collected quantitatively with a survey. Due to missing laboratory equipment, only literature references for urine phosphorus content were used, a reference value of 370mg/L given by Etter et al. (2011).

Results

The reactor was used several times with source separated urine with a volume of 80 liters influent for feasibility tests. An average collected struvite yield was per average 45g±5g per batch of 25 liters urine making the reactor efficiency around 60-65 % when urine P concentration was assumed being 370 mg/L. The reactor was tested four times and towards the end, as the filter cake was formed, yields were higher than during the first test run. However, most important substrate MgO was not freely available in Kyrgyzstan and difficult to purchase. The complete price with metal works included of the reactor was in total 4000 coms (57 euro). This is relatively high but in line with Etter et al. 2011. Further results of the feasibility can be presented at the seminar later on.

Conclusion

The reactor can provide a partial solution to phosphorus recovery from households that are not interested in urine re-use due to social, religious, hygienic or technical reasons. Finding a reliable magnesium source is the biggest bottleneck for struvite production in Kyrgyzstan at the moment.

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- [2] Wendland, C. et al 2012 Experiences with urine diverting dry toilets (UDDTs) for households, schools and kindergarten in Eastern Europe, the Caucasus and Central Asia (EECCA), http://www.wecf.eu/download/2011/February/SSP-06_Jan2011_16-221.pdf

Keywords: Struvite, UDDT, phosphorus recovery

RE-THINKING INFRASTRUCTURE IN FINLAND - MODEL FOR RECLAIM AND REUSE URINE AND TOILET COMPOST

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Thursday 20.8, 16:50 in Lecture Hall A3-27

Enhancing nutrient reuse is essential in the future. At the moment reuse of cattle manure and slurry is rather efficiently organised in Europe. Especially the reuse of other than animal manure based fertilizer products have not been studied in detail in Finland. While the fertilizer prices are expected to increase in the future and the availability of fertilizers might become more challenging it is important to look into other alternatives. Especially the possibilities for large scale reuse of toilet based fertilisers – dry toilet compost and source separated urine – have not been studied in Finland so far. Until now the research has concentrated on small laboratory or field scale pilot tests, but a large scale agricultural reuse and research has not been implemented. A big challenge in Finland and also in Europe is the maintenance of water and wastewater infrastructure. At the moment there is already underground reparation dept worth billions of euros in the sewerage. Therefore now might be a good time to start rethinking this infrastructure so that the source separation of urine would be possible. This would also simplify the wastewater treatment at the other end of the pipe.

The project described in this paper aims at creating a model and test large scale utilisation of toilet based fertiliser products, develop and test technologies for the collection and management, acquire official acceptance and permit for using these fertilisers in agriculture in Finland and demonstrate the efficiency and safety of the use of these products. In addition the cost-efficiency of the alternative models and systems is estimated. The project is implemented during years 2015-2016.

This is the first time in Finland when this kind of large scale project implementation is possible. That reflects a change in mindset. Overall the project theme is very sensitive and therefore a lot of work is needed in influencing to the attitudes and prejudices of public, decision makers, politicians and officials towards the reuse of toilet fertilizers. Thus one important part of the project is to produce solid scientific proof about the benefits and efficiency of these fertilizer products and show with the model also the opportunities of alternatives in closing the nutrient loop in communities.

Keywords: URINE, REUSE, FERTILISER, INFRASTRUCTURE, LOGISTICS

TIMETABLE FOR TOPIC 3

Friday 21 August

9:40	Lecture Hall A3-27	Shuto Kaneko	Japan
10:00	Lecture Hall A3-27	Mia O'Neill	Finland
10:20	Lecture Hall A3-27	Seth Akah	Ghana
10:40	Lecture Hall A3-27	C.A. Srinivasamurthy	India
11:00	Lecture Hall A3-27	Bipin Poudel, Kamal Adhikari	Nepal
11:20	Lecture Hall A3-27	Jan Cebula	Poland

13:40	Lecture Hall A3-27	Obed C. Kawanga	Zambia
14:00	Lecture Hall A3-27	Berta Moya Diaz-Aguado	UK
14:20	Lecture Hall A3-27	C.A. Srinivasamurthy	India
14:40	Lecture Hall A3-27	S. Vishwanath	India

PHOSPHORUS RECOVERY FROM SOURCE-SEPARATED URINE BY USING FIXED-BED COLUMN REACTOR WITH SCALLOP SHELL; EFFECT OF HRT ON RECOVERY RATIO

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Friday 21.8, 9:40 in Lecture Hall A3-27

Phosphorus is one of the essential fertilizers for food production. Facing the coming source scarce and increasing demand in the world, phosphorus recovery technologies from waste stream have been recognized to be inevitable. In this situation, source-separated urine has been attracted much attention as a new source because of its high phosphorus contents. It reported that calcium phosphate can precipitate on the surface of the crushed scallop shells by immersing them into synthetic urine. However reaction rate were rather low in his report, and this could be an obstacle for practical application. In this study, fixed-bed column reactors were prepared to increase the reaction rate by enlarging the contacting surface area of shells. To design the reactor, hydraulic retention time (HRT) is of fundamental importance. Thus the objective of this research is to study the relationship between HRT and phosphorus recovery ratio.

As an experimental setup, scallop shell particles were packed into column, then the synthetic urine was continuously supplied from upside. The solution was retained in the column to keep contact time with the shell particles. The HRTs were adjusted by height of fixed-bed, inner diameter of columns and flow rate of the supplied solution. Concentrations of calcium, magnesium, phosphate were analyzed with ICP-OES, those of ammonium were analyzed with indophenol method and pH were measured with pH test papers in the effluent. Following batch experiment was conducted to know the effect of urea hydrolysis in urine on phosphate precipitation. Shell particles were added to 500 ml of synthetic urine in a glass bottle with Ca/P ratio 60, and then the bottle was shaken on a shaking machine. Urease was added at 8 hours to hydrolyze urea. Concentrations of calcium, magnesium and phosphorous were monitored during the experiment with the same method as explained above. pH were measured with a pH meter and dissolved inorganic carbon were analyzed with a TOC analyzer.

As a result, increasing recovery ratios of phosphorus were observed with increase in HRT till 12 hours, which showed 72% of recovery ratio in average. With the case with 24 and 48 hours, however, recovery ratio decreased to be 54%, 56% respectively. It should be noted that high ammonium concentrations were observed at high HRT, which resulted from urea hydrolysis. Thus urea hydrolysis may have negative effect on recovery ratio of phosphorus. Batch experiments showed that phosphorous concentration decreased at the beginning by calcium phosphate precipitation, and then it increased after urease addition. Here, phosphorus was released because a transition of precipitated calcium phosphate to non-phosphate crystal, probably calcium carbonate, occurred after hydrolysis. Analysis of saturation index (SI), which is expressed in this formula; $SI = \log (\text{Ion activity product of the ions forming the crystal} / \text{Solubility product of the crystal})$, showed that increase of carbonate concentration by hydrolysis made more favorable condition for calcium carbonate precipitation than that of calcium phosphate. This can explain why hydrolysis reduced recovery ratio of phosphorus.

This study showed that higher HRT resulted in higher recovery ratio till 12 hours, while recovery ratio decreased by urea hydrolysis with HRT higher than 12 hours. Batch experiment clarified that hydrolysis made more favorable condition for calcium carbonate precipitation than that of calcium phosphate. This can explain why hydrolysis reduced recovery ratio of phosphorus.

Keywords: Urea hydrolysis, Saturation index, Crystal transition, Calcium carbonate, Calcium phosphate

THE FUTURES OF ECOLOGICAL SANITATION

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Friday 21.8, 10:00 in Lecture Hall A3-27

Several issues, including development of infrastructure, wealth, environment, policies and attitudes, affect the future of ecological sanitation as a sanitation option. Some stakeholders promote sustainable sanitation practices both in developing economies as well as in modern ecocities, while others strive for waterborne sanitation even in rural and peri-urban areas. Clearly it is a matter of environment and culture that impacts the general form of sanitation chosen for a particular case but sustainability has become an important factor also in terms of sanitation.

This paper introduces the research conducted amongst Finnish ecosan experts to find out their views on the feasibility of ecological sanitation in the future. In 2013, a two-round online Delphi survey was conducted to determine the opinions of experts in various fields, including policy makers, scientists, farmers and NGOs. The results ($n_1=44$, $n_2=22$) indicate that even though ecological sanitation has a growing potential, it remains a secondary option to waterborne sanitation methods. The consensus reached by the experts during the two rounds reflects on the need there is for sustainable methods but they remain doubtful about the future solutions.

As an outcome of the expert opinions gathered in the Delphi survey, four futures scenarios were drawn to examine the potential uses ecosan might have in the future. From a future deeply revolving around the flush toilet, to an increasingly sustainable and ecological option, the futures scenarios paint potential pictures of where the sanitation situation of the world might be heading. It is to be noted that no future is likely to be similar to any scenario as such but rather a combination of the given scenarios. Yet, trends towards more or less sustainable practices can be detected.

The results of the research indicate that according to the experts there is a growing need for more sustainable sanitation practices. Nevertheless, there often is a lack of political will or knowledge to attempt new solutions outside the accepted norm – in this case, the flush toilet. It could be argued that changes will occur only when there is a dire need for them, not sooner, as changes require effort from policy as well as practical level. The matters affecting to the sustainable practices include the global sanitation crisis as well as the lack of nutrients (namely phosphorus) but even these facts alone are not enough to change the current toilet norm. The change emerges from attitudes rather than rational behavior – not even given facts can force us to change our mindset quite so easily.

Keywords: Futures research, Delphi, ecological sanitation

WASTE TO WEALTH AND HEALTH: EVALUATION AND COMMUNITY APPRECIATION OF HUMAN URINE AS FERTILISER IN THE HO MUNICIPALITY OF GHANA

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Friday 21.8, 10:20 in Lecture Hall A3-27

ABSTRACT

Urine has been used as equal or even better substitute for inorganic fertiliser for crop production around the world. Collection of urine for application to crops has been made possible through Urine Diversion Dry Toilet systems (UDDT). UDDT offers a solution for two major problems in the developing countries including Ghana. That is, improving state of sanitation and offering a safe and affordable fertiliser for increased food production towards greater food security. Current statistics reveal that Ghana is significantly lacking behind on Millennium Development Goal targets with less than 10 per cent of rural population having access to improved sanitation.

North-South Local Government Co-operation of City of Lahti in Finland and Ho Municipal Assembly in Ghana has identified ecological sanitation development as a key area for co-operation. Currently, the co-operation is providing essential support to meet sanitation and hygiene needs as well as to introduce nutrient recycling for increased crop production in Ho Municipality with UDDT programs.

The feasibility of UDDT solutions and nutrient recycling has been studied throughout the implementation of school and household pilots. The school pilot has been ongoing since 2009 and is currently extended to six schools. The household pilot was launched in 2014 to support the training of latrine artisans and the technical development of household UDDT models. The Agricultural Engineering Department of Ho Polytechnic and the Ministry of Food and Agriculture (MoFA) have been involved in the pilots to study and evaluate the possibilities of improving the local food security through the utilisation of the organic fertilisers for small scale vegetable and cereal production.

During 2011-2014, the studies have involved comprehensive field trials and laboratory testing. The trials have confirmed the advantage of crop response to urine in the yields of vegetables (cabbage, garden egg and chilies) and cereal crop (corn) used. The urine grown crops also had higher protein and lower fat contents showing prospects for the promotion of health when consumed. The urine grown crops passed the Ghana food safety standards confirming them wholesome for human consumption.

In 2014, data was gathered to assess the community acceptance of the use of the urine in crop production. Eight farming zones with an average of 700 farming households in each were selected based on proximity to the urine demonstration farms in the Municipality. Purposive sampling procedure was used to administer interview questionnaires to farmers and Technical Officers (T.Os) of the farming zones exposed to the demonstration to study the perceptions of environmental, socio-cultural, food security, safety and economic aspects of urine fertiliser use. The responses were analysed using descriptive statistics.

Findings suggest that majority of the farmers and the T.Os were astonished at the crops positive response to urine. Reservations were, however, expressed by farmers concerning the stench of the urine during application. Still, the results indicate a definite readiness to adopt the use of urine fertiliser if it could be readily available and accessible. This calls for multiplying the UDDT's in these communities for higher and safer food security and improved sanitation.

Keywords: urine fertiliser, food security, social acceptance, nutrient recycling, urine diversion dry toilet (UDDT)

ENRICHMENT OF BIOCHAR USING HUMAN URINE FOR EASY HANDLING AND TRANSPORTATION

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Friday 21.8, 10:40 in Lecture Hall A3-27

Biochar is a fine grained, highly porous charcoal that is used as a soil amendment. Fine graded biochar is, rich in total carbon but, poor in nutrients content. On the other hand, human urine is slightly acidic and rich in nutrients. Hence, attempts were made to enrich biochar to solve the handling and transportation problems.

A preliminary trial was conducted in the laboratory to study the extent of loss of ammonia by volatilization and methods to prevent the same for adoption during preparation of enriched biochar. Biochar and distilled water were mixed in different proportions in beakers, human urine alone (different volume) was taken in six sets of beakers and different ratios (1:10, 1:7.5, 1:50, 1:2.5) of biochar and human urine were filled in to another six sets of beakers. To three sets of beakers, concentrated H₂SO₄ was added at the rate of (0.1, 0.2, 0.3 ml respectively) and another three sets of beakers were maintained without adding sulphuric acid and pH was measured. Immediately after recording the pH values, the entire quantity of biochar and human urine mixture were transferred into 250 ml conical flasks and covered using small polythene sheets with rubber band. Before covering the flasks, red litmus paper was fixed to polythene sheets by using cellophane tape, so that the litmus paper was in hanging position inside the flask. These six sets of biochar and human urine mixtures were kept for three days to observe for ammonia volatilization in both sets. The change in colour of red litmus paper was recorded at different time intervals. From these observations the quantity of sulphuric acid required to prevent volatilisation loss of ammonia from human urine was arrived at in terms of ml of H₂SO₄/litre of human urine.

Also a pilot scale experiment was conducted under green house conditions to prepare enriched biochar using human urine in different ratios. Six polythene sheets of 3m×2m were placed separately on the floor of the green house. Below the polythene sheets soil was placed in a rectangular shape so that shallow pond like structures were constructed. A known weight of biochar (25 kg) was placed in these plastic containers, human urine was added at different quantities on weight/volume basis (1:2, 1:1.75, 1:1.5, 1:1.25, 1:1, 1:0.75) and allowed to dry for three days and this was repeated up to 30 days. Total quantity of urine added to enrich the biochar was calculated. The enriched biochar was dried and analyzed for nutrient composition. The results indicated that the total N, P and K contents (0.72 to 1.67, 0.4 to 0.55 and 1.27 to 1.7 per cent from 1:0.75 to 1:2 ratios respectively) of enriched biochar were found to be more than unenriched biochar. Enriched biochar (1:0.75 to 1:2) contain total calcium, magnesium and sulphur in the range from 0.32 to 0.64, 0.25 to 0.37 and 0.66 to 0.83, per cent respectively. The total iron, manganese, copper, zinc and boron contents were also high in 1:2 enriched biochar.

Keywords: Biochar, Human urine and Enrichment

ECOLOGICAL SANITATION: SOLUTION FOR THE PUBLIC PLACES AND MASS EVENTS, EXPERIENCES FROM NEPAL

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Friday 21.8, 11:00 in Lecture Hall A3-27

In Nepal, Ecological Sanitation (EcoSan) toilets were first introduced to the households of Siddhipur in 2002 by the Department of Water Supply and Sewerage (DWSS) with the support of WHO Nepal. These toilets were dry toilets and were not easily accepted as Nepalese are anal cleansers. Hence, with some modifications DWSS piloted urine diverting toilets, also known as Wet-EcoSan toilets, in Birgunj, Nepal so that the anal cleansers also adopt the new technology. There was a long debate on the hygienic perspective and the safety of the users of EcoSan. For few years, it was out of imagination to think it as a solution for the public places or mass event.

DWSS and UN Habitat constructed a first public EcoSan toilet at Sunwal, Nawalparasi. It was constructed in the busy highway and hundreds of passengers used it. Urine was collected in big tanks and was transferred to the vegetable gardens using Rickshaws. There was a competition among the vegetable producers to use the Urine in the field as fertilizer. There was a system established of using one after another.

Similarly, with the support of DWSS and different stakeholders, few public EcoSan toilets were constructed in Darechowk, Chitwan. The campaign "take a pee and get one rupee" was famous as the EcoSan toilets build in Darechowk awarded one rupee to the users while other public toilets charged 2-5 rupees.

Mr. Shreerendra Pokhrel, a sanitation champion, for the first time collected urine in the mass event. He collected urine from the Maoist Plenum (first after the Maoist became public) where thousands of people had gathered. This got highlighted in local and National Newspapers. This news was spread all over the country and people started talking about urine as a fertilizer. Excited from this, Mr. Pokhrel with the support of different stakeholders, started to collect urine from different fairs and festivals that occurs frequently in Nepal in different cities. These days Urine collection has become a fashion in every mass event.

Proper maintenance of the public toilets, storage, transport and proper use of the collected urine are the big challenges faced. There are no scientific studies in Nepal about the safety of the users using urine collected from the public places and the mass event. It would be easier to convince people if we could prove scientifically that the urine collected are safe to handle and use.

Keywords: EcoSan, urine, mass event, public places

APPLICATION OF HUMAN URINE FROM DRY TOILETS AS NATURAL FERTILIZER IN ONION (*ALLIUM CEPA* L.) CULTIVATION - AN CHLOROPHYLL INDICATOR STUDY

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Friday 21.8, 11:20 in Lecture Hall A3-27

Scientific research confirmed that improper use of mineral fertilizers is responsible for soil degradation, especially its organic fraction, resulting in systematically decreasing crop yields. To counteract this tendency ecological cultivation methods are applied, including human urine collected using dry toilet systems. However, specific requirements of small-scale cultivation fields require new research providing reliable data concerning optimal dose and application form of this natural fertilizer.

Onion (*Allium cepa* L.), one of the most often used vegetables, was used as a research object focusing effect of natural fertilizer dosage and its distribution method on chlorophyll content in the plant. Chlorophyll was purposefully selected as a convenient indicator of plant quality, providing direct information about N, P, K assimilation, thus biological efficiency of the fertilizer dose/form variant.

Human urine was collected using modified the gents lavatory, reflecting the idea of dry toilet, and stored hermetically sealed for 3 months in temperature 20°C for fermentation (5.6 g total Kjeldhal N/dm³). Experimental cultivation field covered 36 sectors – each of 1 m², 10 rows with 10 plants, with ca. 10cm distances between the plant rows. Test time was 14 weeks. Model agricultural field was constructed assuming Latin square approach. The 6 fertilization modes were tested: mineral fertilizer (ammonium nitrate 170 kg N/ha), fermented human urine (60, 120, 170, 240 kg N/ha), as well as cultivation without any fertilization (reference probe). Mineral fertilizer was dosed as granules while natural fertilizer represented by human urine – in a liquid form after water dilution in proportion of 1 :5 Each fertilization mode was repeated 6 time to fulfill the mentioned 36 sectors. The prepared plant samples (18 – 3 samples representing each from 6 fertilization modes) were analyzed using spectrophotometer UV/VIS Cary 50 Scan Varian with the spectrophotometric method for determination of chlorophyll a and b contents.

Based on spectrophotometer analysis one was able to determine some correlation between fertilizer type (natural, mineral – simultaneously distribution form: granules, liquid solution) and its dose on chlorophyll a and b contents in the *Allium cepa* L. In all 6 samples characteristic peaks occurred at: 434, 460, 584, 617 and 665 nm wavelength, characteristic for chlorophyll absorption spectra. However, diversification in absorbance was clearly observed – the highest absorbance values were attributed to sample representing human urea as a natural fertilizer with doze of 120 kgN/ha. The lowest absorbance values, practically overlapping, suggesting the lowest chlorophyll content corresponded to non-fertilized plants (chlorophyll a 2.6614 mg/dm³, chlorophyll b 2.563 mg/dm³), as well as to plants fertilized with ammonium nitrate (chlorophyll a 2.6714 mg/dm³, chlorophyll b 2.5812 mg/dm³). All four samples representing results of human urine application demonstrated distinctly higher chlorophyll content (chlorophyll a 3.147–4.2836 mg/dm³, chlorophyll b 2.668–3.1234 mg/dm³), what speaks for better condition of plants and can be regarded as an evident proof of human urine superiority over mineral fertilizers like ammonium nitrate. Higher chlorophyll content can be used as both indicator of nutritional advantages, but its higher content is also favorable in respect to *Allium cepa* L. taste and nutrient properties. Human urine dose of 120 kgN/ha also turned out to be better for chlorophyll a and b contents in the plant than recommended by scientific reports dose of 170 kgN/ha.

Keywords: human urine, natural fertilizer, onion *Allium cepa* L., chlorophyll, nutrients assimilation

URINE DRIP FERTIGATION OF TOMATOES; A SOLUTION TO CHEMICAL FERTILIZER

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Friday 21.8, 13:40 in Lecture Hall A3-27

The price for chemical fertilizers are increasing in Zambia and the challenges posed by chemical fertilizers to marginalised small holder famers especially female headed households, agriculture ecological zones and the soil fertility cannot be over emphasised. Madimba is one of the peri urban communities of Lusaka with more than 200 small holder urban farmers with rented farm land with sizes ranging from 0.2 to 0.5 Lima. The crop yield is substantively below to sustain household food security for peri urban poor.

The paper discusses a twenty six (26) weeks comparative study of humanurine drip fertigation and the liquid chemical fertilizers (poly-feed and Muilt -K) in a greenhouse technology demonstration. The project collects human excreta (urine and faecal matter) from 100 urine diversion dry toilets constructed in Madmba community (2008 -2013) by Network for Environmental Concerns and Solutions (NECOS) with the financial support from its International partner Global Dry Toilets Association of Finland (GDTAF), while the Greenhouse technology was supported by the Student Union of Helsinki University. A 1,200 litres polythene urine tank with retention time of three months at the temperature between 20Co ∞ 30 Co. Land of 20m x 8m = 160m² under a green house was prepared for the planting of 325seedling of tomatoes. Lime application based on 100g/ m² 160 m² =? 100 = 1, x = 160, » 16000g ÷ 1000 = 16kg of Lime.

Urine drip fertigation application ratio of urine & water mixture of (1 part urine per 3 parts of water). The seedlings transplanting took place on 7th July, 2014 and the application started one (1 week) after seedling transplanting of Tomatoes in the Greenhouse until the harvest period. As a general rule of thumb, use 0.7 L/m² of urine at every fertigation. Based on the given total surface area in the Green house of 160m² x 0.7L= 112litres of urine and capacity of drip fertigation tank of 500 liters and the mix ration of 1 part urine to 3 parts tap water applied as follows 112 liters (L) + (112x3)=336 liters of Water =448litres with tank allowance of 500L-448L= 52L.

Urine fertilization by the use of urine drip system constructed in a Green house technology is a concept demonstrated in Madimba community for the period of 24 weeks. The Tomatoes seedlings as a crop received a balanced nutrient supplied which includes but not limited to nitrogen, phosphorus, potassium, and sulfur. The urine reaches the root zone directly and there was no leave contact, which might have damaged the plants.

Harvesting started on 12th September, 2014 to 31st December, 2014 of barely 8 weeks shows a total of 46 Boxes of Tomatoes translating into 10,243 actual fruits excluding wastage. It is evident, that instance Urine Drip Fertigation of Tomatoes introduced in a green house technology is the best Solution to Chemical Fertilizer such as Poly feed and Muilt-K which are also used in a liquid form.

Keywords: Urine drip fertigation, agriculture

MAXIMISING THE VALUE OF HUMAN WASTE DERIVED FROM DRY TOILETS AS FERTILISER IN MADAGASCAR

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Friday 21.8, 14:00 in Lecture Hall A3-27

Soil fertility is low in many parts of Africa due to reduced application of fertilisers (about 8kg/ha, one tenth of the world average¹), leading to reduced crop productivity and hence decreasing income for local farmers. Another issue prevailing in Sub-Saharan Africa (SSA) is the safe treatment and disposal of human waste. It is estimated that between 65% and 100% of sanitation in SSA is provided by on-site sanitation systems², which require emptying and appropriate treatment and disposal to prevent public health and environmental hazards. Transforming human waste into soil conditioners is one way to resolve these challenges in a sustainable manner, creating an economic incentive for treating and revalorising toilet waste and producing an organic soil amendment to improve soil fertility and achieve full nutrient recycling.

A project is now underway in Madagascar funded by Loowatt (a UK SME which has designed a novel dry toilet and pioneers human waste composting in Madagascar), investigating the feasibility of full nutrient recycling of human wastes into soil by producing a soil conditioner and fertiliser that is attractive to the local area where it is produced. The study is based on a case study in the capital of Madagascar, Antananarivo, which will serve as an example of the challenges and opportunities of human waste recycling and set the path for its realisation in other countries. The project will include field scale and glasshouse trials with maize and tomato as test crops applied with treated human waste materials. The aim is to demonstrate and compare the fertilising potential 3 different types of soil amendments derived from human waste, namely pasteurised digestate from anaerobic digestion (AD), compost and vermicompost from AD digestate and straw. The agronomic value of the fertilisers and their environmental and health safety will be determined through nutrient (nitrogen, phosphorus, potassium, magnesium, manganese, iron, zinc, calcium), heavy metals (copper, zinc, lead, cadmium, nickel, chromium) and microbiological (E.coli and Helminth eggs) soil analyses supplemented by nutrient analysis of the crops harvested from the trials. This project will also explore business models that can be utilised to create a fertiliser market for such products by carrying out an analysis of the fertiliser supply chain in the area of Antananarivo as well as interviews with local farmers to explore current fertiliser consumption habits and needs.

Field trials were carried out in Antananarivo until March 2015 on a 200m² plot of land divided into blocks with 5 different fertiliser treatments applied (digestate (D), compost (C), vermicompost (V), chemical fertiliser (F) and control) at 5 different rates arranged in a randomised block design with three replicates. Glasshouse pot trials started in the UK in April 2015 with 9 fertiliser treatments (D, C, C+D, C+ F, V, V+D, V+F, F and control). Results from field trials and initial fertiliser market analysis will be presented.

Keywords: human waste, fertiliser, nutrient recycling, crop trial, Madagascar

CHARACTERIZATION OF FECAL SLUDGE AND SEWAGE SLUDGE, THEIR EFFECT ON GROWTH AND YIELD OF SOYBEAN (GLYCINE MAX L.) AND FINGER MILLET (ELEUSINE CORACANA)

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Friday 21.8, 14:20 in Lecture Hall A3-27

Urbanisation is essential for social development but considered as a curse, when the wastes it generates is considered. One of the huge wastes generated by high density population of urban centres is anthropogenic waste from clocsettes through internal drainage system. It consists of human urine, faecal matter and large quantity of water. Most urban/civic bodies have the onerous task of their disposal. Bangalore city alone generates 1100 million litres of waste water (sewage) and 1100 tons of sewage sludge per day. But due to appreciable level of nutrients contained in these anthropogenic wastes, their ideal and productive disposal mechanism is to use them for agricultural purposes. In this context, an experiment was conducted at University of Agricultural Sciences, Bangalore during kharif-2014 to study the effect of fecal sludge and sewage sludge on growth and yield of soybean. Before initiation of the experiment, three of wastes which were used in the experiment viz., decomposed human excreta from ecosan pits(humanure), human excreta from soak pit toilets and sewage sludge from sewage treatment plant were analysed for their nutrient composition.

Characterization of the wastes reveals that ash mixed humanure was rich in potassium (2.44 %), medium in phosphorus (0.63 %), other nutrients were in appreciable amounts. Whereas, human excreta from soak pit toilets and sewage sludge from sewage treatment plants were found to be rich in phosphorus (0.46 % and 0.78 %, respectively) and potassium (0.16 % and 0.24 %, respectively) as compared to other nutrients. After characterization, the three fecal sludges were used as nutrients sources along with three levels of recommended dose of fertilizers (75, 100 and 150 % of RDF) and they were compared with recommended dose of fertilizer +FYM. The quantity of humanure was added based on the potassium content and the quantity of sludge from soak pit toilets and sewage sludge treatment plant were worked out based on phosphorus requirement of crop. The balance quantities of nutrients required in each treatment were supplied through inorganic fertilizers. The results indicated that, the treatment which received 150 % K through humanure + balance N and P through fertilizers to supply 150 % N and P recorded higher plant height (61.3 cm), more number of branches (7.7), more number of pods per plant (45.6) and 100 seed weight (14.0). As a result of better growth and yield parameters, application of 150 % K through humanure recorded higher seed yield of soybean (2868.1 kg/ha) compared to all other treatments except the plots which received 150 % RDP through human excreta from soak pit toilets and sewage sludge. The yield enhancement was found to be 20 % more from 150 % K through humanure over 100 % RDF+ FYM. From the above results it can be concluded that use of these anthropogenic wastes can solve the problems of their disposal and also reduces the reliance on scarce/costly fertilizers for crop production.

Keywords: Humanure, pit toilets sludge ,sewage sludge and soybean.

THE REUSE OF FAECAL SLUDGE FROM PIT TOILETS BY FARMERS IN THE INFORMAL SECTOR IN THE TOWN OF DEVANHALLI IN THE STATE OF KARNATAKA, INDIA

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Friday 21.8, 14:40 in Lecture Hall A3-27

The enumeration of septic tanks and pit toilets first emerged in India in the census of 2011. Much attention has since been focussed on the management of these on-plot systems.

The town of Devanahalli is located at a distance of 35 km. north of the state capital city of Bengaluru in Karnataka State India. The census of India 2011 indicated that the population of the town is about 37,000. There is no underground sewerage system in the entire town. A recent survey indicated the presence of 95 septic tanks, 2014 single pit toilets, 141 with twin leach pits and 109 houses resorting to connecting their toilets directly to the storm water drain or resort to open defecation.

The citymunicipality has one Honey-sucker or vacuum sludge emptying truck. In addition 2 private Honey-suckers operate in the town. An estimate suggests that combined up-to 22 toilets are emptied in a month. Each Honey-sucker has a capacity of 4 cu. mt. Hence 88 cu.mt. of septage is converted to fertilizer every month. In the absence of a sewage treatment plant or a sludge treatment plant both the municipal vehicle and the private tankers empty sludge into a pit dug by a farmer on the outskirts of the city. The pit is about 7 mts x 7 mts x 1.5 mts depth.

This single pit is capable of receiving all the 22 truck loads a month. In addition farm yard manure is mixed by the farmer to the dry sludge. This mixed waste is then used as manure for a grape orchard.

This method of informal management of septage from pit toilets and its conversion to fertilizer is practised in about 213 towns of Karnataka State, India. Based on the experience of Devanahalli town a septage management plan is suggested which will include the farmers as part of the solution. This will follow the principles of the Sanitation Safety Plan as prescribed by the W.H.O.

An epidemiological survey has indicated no significant impact on the workers operating the Honey-sucker, the farm workers who apply the sludge on the field or the consumers of grapes.

Keywords: Pit toilets, Septage, management, Sanitation safety Plan, fertilizers.



TIMETABLE FOR TOPIC 4

Thursday 20 August

10:30	Lecture Hall A3-27	Azahar Ali Pramanik	Bangladesh
10:50	Lecture Hall A3-27	Tynar Musabaev	Kyrgyzstan
10:50	Lecture Hall A3-27	Imasiku Nyambe	Zambia

Friday 21 August

15:30	Lecture Hall A3-27	Kamal Adhikari, Bipin Poudel	Nepal
15:50	Lecture Hall A3-27	Chakra Bahadur Chand	Nepal
16:10	Lecture Hall A3-27	Suman Kumar Shakya	Nepal

DRY TOILETS CONTRIBUTE IN SAFE & NUTRIENT FOOD FACILITIES AMONG POOR HOUSEHOLDS

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Thursday 20.8, 10:30 in Lecture Hall A3-27

374 poor households including 1063 men and women, 163 <5 children and 6 physically challenged people of Bangpur village in Gomostapur Upazila of Chapainawabgonj district, located in the semi-arid area of Bangladesh and Babupara, Noyapara and Ailmara villages of Bandarban Hill district badly suffered from food crisis in lack of water during dry seasons.

Excessive use of chemical fertilizers and synthetic pesticides badly contributes in hiking food price, degrading soil quality and water holding capacity. Due to lack of relevant studies, there is no accurate data on the bad impacts of utilizing chemical fertilizers and synthetic pesticides. Field experience reveals that food cost has inclined more than 80% compared to 7-8 years correlated with price hike of fertilizers, pesticides and cost of irrigation. It has also been experience that one hectars farmland needed 100 kg chemical fertilizers and 250 gm synthetic pesticides and 1500BDT for irrigation purpose before 10 years. Compared to previous figure, the same area of lands need 300 kg chemical fertilizers, 1000 gm pesticides and 3500BDT since the last 3-5 years, which is almost triple than those of previous years. This situation is difficult for the poor people to afford foods, which results in starving, consuming lower quantities of foods with lower calories and contaminated foods led them into various malnutrition related diseases.

SPACE, a local NGO, facilitated the poor people with innovative initiatives including installation of 48 dry toilets for water conserving and reuse of treated human urine and feces as organic fertilizers in farm, 48 vermi-compost units for converting kitchen wastes into organic fertilizers and water saving washing mechanism for utensil cleaning along with reuse of waste water in small farming. SPACE also facilitated in social preparation to the people through awareness and hygiene promotion activities, training for safe handling and application of treated human and kitchen wastes in agriculture. SPACE also imparted human value-based WASH education to target people for water saving utilization and use of rainwater for drinking and other domestic purposes during rainy seasons.

Field findings reveal 100% households use, clean and manage urine and feces for recycling, 100% households recycle kitchen wastes by vermi-composting, 97% families practice water saving wash using ash and small water and reuse waste water in agricultural fields after recycling. 100% families save water using dry toilets. Field reports further reveal that 100% households produce various vegetables and fruits using recycled wastes, safely and hygienically handled those for applying in farming. As results, they got more yields utilizing organic fertilizers produced human and kitchen wastes; production cost reduced more than half and they can produce vegetables year-round using treated human urine, feces and household wastes as organic fertilizers. Field reports further indicate that 87% women are involved in small farming and produce food crops; 96% families have chemical free fresh adequate foods round the year. 100% of them know ways in securing health and foods utilizing their own resources. Remaining people of the same and neighboring areas come to see and show interests in accepting the mechanism.

Keywords: Food Crisis; Malnutrition; Organic Fertilizers; Small Farming; Adequate Foods

PRODUCTIVE SANITATION THROUGH UDDT IN SCHOOLS

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Thursday 20.8, 10:50 in Lecture Hall A3-27

The Secondary public school Aravan has 370 students, from grades 1 to 11th with ages ranging from 6 years old to 16 years old. The school is very sustainable; they have a school garden of 25 sots of cotton and 35 sots of rice. (The Kyrgyz measuring unit converts to 1 hectare equals 100 sots.) The urine from the UDDT is used to irrigate and fertilize the rice fields, whereas cotton is being fertilized by feces. This year they harvested around 1 ton of rice which was sold for 50 soms (1 \$) per kilogram. They are giving one sack of rice for each child and 5,000 soms for the cafeteria. The rest of the money is saved for a greenhouse.

The school pays a lot of attention towards sanitation and hygiene of the students. In 2010 the staff participated on an Ecosan training and have conducted yearly campaigns to teach the children about hygiene and sanitation as well as how to use the Ecosan toilets. The yearly campaign also includes the importance of hand washing. The school has put a lot of effort on hand washing, there is a hand washing basin in every class. The campaign is held in the beginning of September when the new school year starts and new children arrive to the school. During parent meetings the children are asked to bring their own towels and soap.

The Ecosan toilets have two 1 m³ urine containers which are filled in one year. The feces chambers take three years to fill up and when emptied contained seven wheelbarrows of dried feces each. They use saw dust and ashes as dry material which is donated from the neighbors and parents, the ash comes from the neighboring baker's ovens and sawdust is received from other common people and sometimes bought. The boys and the girls use different toilet rooms and the boys' toilet is equipped with a urinal. The rooms have four stalls with two chamber openings each out of which other is in use while other is sealed. The old pit latrine is still in use until it fills up and is closed but most of the children prefer the Ecosan toilet over the pit latrine. When asked why they like the Ecosan toilets better, the children said it is cleaner and new, it is nice to use the Ecosan toilets.

Keywords: Ecosan, UDDT, Kyrgyzstan

ECOLOGICAL TOILET EMERGING AS A SOLUTION TO FOOD SECURITY IN NEPAL

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Friday 21.8, 15:30 in Lecture Hall A3-27

In Nepal, it is estimated that approximately 3.4 Nepalese require food assistance and a staggering 6.4 million are chronically food insecure. In the past, there were culture of using human waste and animal waste as a fertilizer in the field. Most of the communities in the hills and mountains still use human faeces to fertilize their farms and the Newar communities in the capital city are well known for their practice of using human waste in their farms. However, because of the influence of the rapid modernization, many households are forgetting their good practices and adopting unsustainable options of sanitation and using chemical fertilizers. Looking at this, the Government of Nepal started to promote Ecological (EcoSan) toilet not only as an option of toilet but also as a solution to food security, livelihood and climate change. Nepal is vulnerable in terms of the impact of the climate change. EcoSan is both mitigation and adaptation option to climate change. Many communities are already experiencing many adverse effects due to the climate change. Water sources have dried up due to unfavourable climate and the food production is declining gradually. The EcoSan is therefore proven to be the better option as an adaptation to climate change.

Mr. Jeevan Maharjan, a farmer in Siddipur, used human faeces and urine, grew cauliflower, cabbage, leaf vegetables, potatoes and garlic and attracted so many seekers of organic vegetable products from city areas in the Kathmandu valley. Besides, some women in his locality also started selling such organic vegetables which in turn contributed to uplift their economic condition. Some farmers at Khokana in Lalitpur district wisely and widely applied urine for growing vegetables and wheat. In the same manner, some locally motivated farmers at Sunawal in Nawalparasi district started collecting and applying urine in mass scale in collaborative manner. The messages on such success motivated the toilet users in Sabaithawa, Surkhet, Dang and other districts also to apply urine for vegetables and crops.

The collection and application of urine in mass level got wider popularity by a noble initiative of Mr. Shreendra Pokhrel, a committed activist of ecological toilet and resident of Darechowk village in Chitwan District. With his restless efforts, Darechowk is emerging as a learning zone and demonstration site for ecological sanitation where one can find urine-based farming among local households. And there is an exchange of urine among local residents to fulfil the need of organic fertilizer. It is likely that the scaling up of these locally held micro-level initiatives thus appear as an effective means to popularize organic products, generate additional income, increase the nutrient intake, maximize the surplus of food grain from the marginal land and ultimately contribute to food security at local ecology especially in the context of worsening soil and climatic conditions aggravated by the climate change.

Keywords: Organic product, marginal, ecology, food security.

PRODUCTIVE SANITATION SUCCESSFULLY LINKS TOILETS AND LIVELIHOODS

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Friday 21.8, 15:50 in Lecture Hall A3-27

This paper looks at systems for productive sanitation being trialled in the Rural Village Water Resources Management Project (RVWRMP), Nepal (funded by the Governments of Finland and Nepal). The purpose of RVWRMP Phase II is to achieve improved well-being and reduced poverty via the improved use of water resources – including work focused on improved nutrition, food security and livelihoods. The project works in the far west of the country, facing the challenges of remoteness, rugged terrain, food insecurity, water scarcity, climate change and the post-conflict legacy.

Optimizing the use of local resources, the project has supported mostly farm based livelihoods activities as a cross cutting theme in 46 remote Village Development Committees (VDC). These improve food security, nutrition and income generation, making the users able to pay for operation and maintenance (O&M) of water supply and sanitation systems beyond the project implementation. The project piloted eco latrines in some VDCs to sensitize the users on the use of human urine, which is a valuable source of nitrogen, potassium, some phosphorus and trace elements, for their crops. Due to social barriers and maintenance problems, the eco latrines have been used in only a few households.

More recently, the livelihoods and sanitation movement sensitized farmers to use human waste, mostly human urine, in place of expensive and usually unavailable artificial fertilizer, for market oriented production. Collection takes place simply, in bottles, and is applied mainly via drip irrigation systems. Application of human urine increased vegetable production and income in the project communities. Additional annual income per household from vegetables ranges from NRs 30,000-100,000 in intensive production areas. The early results of the urine use have developed a sense of competition among the community people in both using human urine and cultivating more vegetables. Even farmers with very limited land are able to generate income with the application.

Productive sanitation via urine use in the project is still at the early stage and changing attitudes takes time. An experimental trial was run at the Regional Soil Testing Centre, but even government staff found it difficult to change to urine collection and use. Composted faeces application is still a step too far for almost everyone. Farmers who were culturally reluctant to use human urine and unaware of its benefits have seen the good results and are stepping towards productive sanitation, adapting it in line with endogenous practices of using cow dung and urine. The number of users is increasing, mostly the female farmers who are driving the activities. Income levels of the project beneficiaries have risen and their livelihoods have improved, including the 25% below the poverty line in the project communities. In turn, the improved incomes complete the cycle, supporting O&M and sustainability of water and sanitation infrastructure.

Keywords: RVWRMP, livelihoods promotion, productive sanitation; food security; urine

ECOLOGICAL SANITATION; SOLUTION TO POLLUTION AND FERTILIZER

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Friday 21.8, 16:10 in Lecture Hall A3-27

Ecosan (Ecological sanitation) is a concept where human waste is considered a resource. It helps maintain sanitation, cleanliness of the environment, prevention of spread of diseases and resolves any issues regarding human waste management. Ecosan systems enable the recovery of nutrients from human faeces and urine. It helps increase the fertility of soil, and production of crops.

Many studies have been carried out regarding the Ecosan in Nepal since 2003 to date. Research conducted by Environment and Public Health Organization regarding urine application as fertilizer for crops was very helpful for the promotion of Ecosan toilets in Nepal. The research results showed that, despite the fact that urine has a high concentration of Nitrogen, and should be just as effective as nitrogenous fertilizers, it isn't. This is mostly because of the lack of proper application methods; the direct application of urine with the help of furrow machines. It was found that urine is much more effective if it is applied at the base of the plant in 3 split dosages. This was obtained after an experiment was conducted where the yield of tuber potatoes was measured when treated separately with Nitrogenous fertilizers and urine in different dosages. According to a survey results, more than 50% of the people who answered said that the production of the crops had increased after the application of faeces and urine.

Research conducted regarding pathogen die-off rate in faeces in Ecosan revealed that pathogens needed to be stored for up to 6 months in order to rid the faeces of all harmful pathogens. So, in order to increase the pathogen die-off rate, certain measures were taken. People were asked to put ash, sawdust and lime in the faeces vault since it would increase the pH; ash and sawdust was to be added in order to reduce moisture and reduce odour as well. Different designs for the toilets and the vault systems are to be modified such that the faeces is exposed to sunlight and heat. Also, measures such as, use of heating equipment and thermal composting were to be done in order to increase the temperature.

Till date more than 3000 Ecosan toilets are constructed in Nepal. It has an attempt made to improve the sanitary condition of the community and acknowledge the inhabitants to follow sound sanitation practices. The source based sanitation facility minimized the cost for construction and operation. It cut off the use of water to flush toilets as it is for conventional system. In that respect, ecosan is a sort of dry toilets. Water is used only to clean anus and washing hands thereafter. This paper argues that Nepal's historical acceptance of ecological sanitation, and its recent experience in using the approach set out in the evidence presented here mean that ecological sanitation could be very valuable. It could confront these problems and provide potential added value to the livelihood link through agricultural production and water and environment conservation.

Keywords: Protects the environment, conserves waste, recovers and recycles nutrients and organic matter

TIMETABLE FOR TOPIC 5

Thursday 20 August

10:10	Lecture Hall A3-24	Gina Itchon	Philippines
10:30	Lecture Hall A3-24	Gerryshom Munala	Kenya
10:50	Lecture Hall A3-24	Joseph Jenkins	USA
11:10	Lecture Hall A3-24	Moses Pumpuni	Ghana

12:30	Lecture Hall E1-06	Anara Choitonbaeva	Kyrgyzstan
12:50	Lecture Hall E1-06	Mynepalli K.C. Sridhar	Nigeria
13:10	Lecture Hall E1-06	Samuel Autran Dourado e Souza	Brazil
13:30	Lecture Hall E1-06	Ruysei Ito	Japan
13:50	Lecture Hall E1-06	Karamat Ali	Pakistan
13:50	Lecture Hall E1-06	Tynar Musabaev	Kyrgyzstan

TERRA PRETA SANITATION SYSTEM FOR POST-DISASTER TRANSITIONAL COMMUNITIES: A CASE STUDY FOR LOW- RESOURCE SETTINGS

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Thursday 20.8, 10:10 in Lecture Hall A2-24

The frequent occurrence of disasters is a reality which communities all over the world face at present. Mortality and morbidity occur not only as a direct result of the disaster but continue to occur among post-disaster survivors especially when they are settled in evacuation camps. These camps provide temporary dwellings which are often poorly constructed since they are intended as short-term solutions. Often, sanitation and sanitation facilities are the most neglected aspects in the planning of these camps.

Actual experience with several disasters in the last 4 years in the Philippines has led to the realization that existing post-disaster sanitation solutions are often not practical and suitable for use in developing countries since they are expensive to maintain. An example is the Portalet which is often the immediate sanitation solution recommended after a disaster. However, aside from inadequate numbers of these toilets being provided, the budget for cleaning and evacuation is often not provided or is assumed to be the responsibility of the local government unit. As a result, when these toilets are full, people refuse to use them and go back to open defecation, thus defeating their purpose and leading to outbreaks of sanitation – related infectious diseases. This experience led to the inspiration to search for a better sanitation solution for communities after a disaster.

This case study is about a sanitation system solution using dry toilets and terra preta sanitation (TPS) for post-disaster evacuation camps which can be constructed and put in place rapidly, will safeguard health and hygiene, at a cost affordable to developing countries. It is designed for a maximum of 300 persons or 60 families (5 members / family). This case study highlights the following:

1. Low-cost, easy to put up facilities;
2. Minimum maintenance since only urine is designed to be collected and re-used;
3. Hygienization of feces through the use of terra preta sanitation;
4. Linking of sanitation and agriculture;
5. Provision of a food source as well as a source of income for the post-disaster community

This sanitation system has been field tested after several disasters in the Philippines namely, Tropical Storm Washi in 2011, the Visayas Earthquake and Supertyphoon Haiyan in 2013.

Keywords: disaster, dry toilet, terra preta sanitation

MANAGING HUMAN WASTE IN INFORMAL SETTLEMENTS: BIO-DIGESTER IN KIBERA INFORMAL SETTLEMENT, KENYA

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Thursday 20.8, 10:30 in Lecture Hall A2-24

Human waste can become an eye-sore when not properly disposed off. It is estimated that every human waste generates about 300g of human waste per day. In Kenya's largest informal settlement, Kibera – with a population of over one million people - the phenomenon of the “fly toilet” is a daily scourge to life here. Umande and its partners have built 57 bio-centres in Nairobi. Bio-centres have turned the mountains of odorous human waste from a problem into an asset. The purpose of this paper is to demonstrate how innovative solutions can be made to tackle sanitation challenges and turn envisaged waste into a resource. A survey of the constructed bio-centres in Kibera was made to assess the versatility of the bio-centres. It was revealed that the bio-centres in Kibera have collected 60,000kg of human waste and turned it into biogas. They have further improved access to proper sanitation to the community and built the capacity of community-based organizations to design, plan, construct, manage, and market ecological sanitation services. These bio-centres have reduced methane emissions to the environment and are definitively scalable renewable energy source options in the informal settlements.

Keywords: bio-centre, human waste, informal settlement, Kibera.

COMPOSTING AS A SANITATION ALTERNATIVE IN HAITI

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Thursday 20.8, 10:50 in Lecture Hall A2-24

Jenkins presented at the 2009 Dry Toilet Conference about using thermophilic composting as a sanitation alternative, whereby the “humanure” toilet exists only as a collection receptacle where urine, feces and paper are collected and covered by a carbon-based material such as sawdust to prevent odor and block flies and vermin. The collected material is then composted in a simple, separate, outdoor, containerized static pile system developed by Jenkins in which the compost does not require turning. The static pile also acts as a receptacle for scrap food material, animal mortalities, yard and garden residues and discarded agricultural organic material.

Jenkins also presented at the 2012 Dry Toilet Conference about how this system was employed in post-earthquake Haiti at schools and orphanages. Since that time, the system has also been implemented at a Habitat for Humanity village project as well as at other locations in Haiti.

The 2015 presentation will review what has happened in Haiti as of December 2014, what has worked and what has not, what problems developed and what successes were realized, with analyses and recommendations.

Keywords: humanure, Haiti, thermophilic composting, compost toilet, sanitation

OPPORTUNITIES TO STIMULATE LOCAL ECONOMIES THROUGH SUSTAINABLE SANITATION AND ENERGY INNOVATIONS FOR HOME COMFORT IN RURAL AREAS IN KYRGYZSTAN

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Thursday 20.8, 12:30 in Lecture Hall E1-06

This study was conducted to investigate the opportunities for upscaling sustainable local-made technologies for more comfort and better hygiene conditions in rural areas of Kyrgyzstan.

The population of the Kyrgyz Republic remains largely rural with 64 % of its population residing in rural areas. Rural inhabitants face many problems in daily life: lack of safe sanitation, WASH related diseases, energy poverty (lack of heating, light and fuel) and low nutritional status. The project Home Comfort, which gained support from the EU, has created local capacity for improved rural living standards through sustainable energy and sanitation innovations.

The innovations included:

- Urine diverting dry toilets (UDDT) for comfortable and safe sanitation and production of fertilizers
- Solar water heaters (SWH) for hot water by solar energy
- Energy efficient stoves (EES), which allow people to save on wood and coal

The technologies have been successfully adapted and implemented, and they are appreciated by the villagers, especially by women. The combination of UDDT and solar water heaters made it possible to implement full bathrooms with a similar standard than in the cities.

For this study, a survey with questions about the current situation and the demand for innovative technologies was conducted among 407 rural residents in Issyk Kul and Naryn oblast. Additionally, interviews have been held with householders and project managers, and guest books at demonstration centres were reviewed.

The EES and SWH have good economic pay-offs compared to the traditional ways of heating or bathing. In fact, the savings they generate are respectively € 800 and € 1400 over a period of 10 years.

The results show that villagers, who often face challenges in their daily routines, are ready to take risks to improve their comfort and security. This is confirmed by the high number of self-financed replications of the technologies.

About 60% of the respondents (24% women) indicated to be willing to take a microcredit for one of the technologies. 6 to 11% of the respondents are willing to invest the full cost of the technologies, and 23 to 30% half of it. Yet, some barriers have been identified since some people are not able to invest the full amount of an innovation. Increased availability of microcredit with low interest rates, enabling political frameworks and additional capacity building are needed to overcome these barriers.

Keywords: sustainable sanitation, finance, ecological sanitation, UDDT, micro finance

A NOVEL DRY TOILET COMPLEX DESIGN FOR A MARKET COMMUNITY IN NIGERIA WITH DIVERSE CULTURAL PRACTICES

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Thursday 20.8, 12:50 in Lecture Hall E1-06

In Nigeria, 34 million people still lack sanitation and toilet facilities at the end of Millennium Development Goals. They practice open defecation which is deplorable particularly in urban areas and public places. The common fecal disposable methods accepted by communities are Ventilated Improved Pit Toilet and Septic Tank system. The dry or waterless toilet and urine diversion toilets are not yet introduced in the country, though they have proven advantages in terms of sanitation, resource recovery/ conservation and affective pathogen removal.

Women Friendly Initiative (WFI), a prominent Non-governmental Organization in Nigeria received a grant to initiate a waterless toilet in a market community in the Nation's capital, Abuja. This paper presents our efforts in developing a new toilet complex design and installation in a popular market, Kuje with 199 stalls and diverse cultures. A needs assessment appraisal revealed that the market is insanitary and littered with packaged fecal wraps; some preferring use water for anal cleaning while others tissue paper; women bitterly demanded exclusive toilet privacy from males and for menstrual pad disposal due to religious and gender preferences. The market has 3 poorly managed 'pay and use' toilets with 'pour flush' type used by men only, inadequate, and water is bought from vendors.

We developed a novel composting toilet complex design. It has 8 toilet units (4 each for men and women) with urine diversion, a separate urinal, bathing facility, a composting chamber, roof rain water harvesting, and a handwashing facility with soap and a mirror. The women urinal has a menstrual disposal outlet which gets into a tank (not seen by anybody) and burnt at regular intervals. The dry toilet has twin units side by side. The main unit has a urine diversion partition suitable for men and women. In the main unit feces drops on to a screw type auger controlled by a hand pedal which allows a calculated amount of sawdust/ash to fall on the fecal matter and pushes into a primary tank. The number of strokes determines quantity of cover material which will also act as moisture absorbent. The feces-sawdust/ash mixture will remain in the primary tank for some weeks and then it is manually transferred into a secondary composting pit where a caretaker allows the contents to cure until a proper compost quality is obtained. The urine is diverted into a storage tank which is sold to farmers for use on farms. Those who use water for anal cleaning, the user moves his bottom to the adjacent unit which has a water spray hose, when pressed releases a small amount of water which is drained into a soakaway pit. Male and female caretakers manage the facility.

An Organizational structure, a user Manual and documentation skills are provided with gender equity for user fee collection, compost making, sale of fertilizer and urine, and regular upkeep of the complex. The members are drawn from the market community and include traders, farmers, Local Government staff and a representative from WFI. Users and Managers are given training for sustainable use and management.

Keywords: Dry toilet, Market community, Composting, Urine diversion, Women friendly

COMPOST-BASED SANITATION: A LOW-COST STRATEGY FOR TURNING THE TOILET PROBLEM AT MEKELLE UNIVERSITY (ETHIOPIA) INTO A SOLUTION

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Thursday 20.8, 13:10 in Lecture Hall E1-06

The main objective of this project was to implement a sustainable sanitation system based on composting from a case study at a university campus in Mekelle, Tigray, Ethiopia. Mekelle has not only shortage of water as well as poor water and soil quality, but also lacks sanitation systems adapted to users culture. A one-year pilot project started in July 2013 from a questionnaire survey and incursion around the seven districts of the city of Mekelle in order to investigate the condition and location of public water points, latrines and waste disposals. These primary data collected, combined to context analysis, resulted in a theoretical and practical intervention at the College of Health Sciences (CHS), Mekelle University. In addition to inform and discuss the sanitation gap in the city of Mekelle, a established work group formed by local staff, students and volunteers, designed, planned and constructed 8 compost based dry-toilets for male users at the student dormitories in CHS. Importance is placed in a low cost solution, making use of existing resources on campus and staff capacity while giving the added value of rich soil for campus horticulture. Toilets are designed around users behavior such as squatting and open defecation. The pilot is still running with high acceptance by its users and is ready for scale-up.

Keywords: Sustainable Sanitation, Compost-based Dry Toilets, Thermophilic Composting, Technology Transferring and Environmental Education

DESIGN OF COMPOSTING TOILET FOR MIDDLE AND LOW INCOME COUNTRIES - SURVEY IN INDONESIA AND ZAMBIA

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Thursday 20.8, 13:30 in Lecture Hall E1-06

To improve sanitation in developing countries, we have proposed an agro sanitation model consisting of dry toilet, agriculture field, and transportation system. A composting toilet is under designing to realize the model. The interface design of the composting toilet should be well designed to be accepted by the people. In most case, people evaluates it from the view point of appearance, touch feelings, simplicity of the operation, color, size, order etc. This study aims to disclose the points for acceptance by people in middle and low income countries and conducted two surveys with a mock-up model of a new type of composting toilet at LIPI in Indonesia and at Kanyama area in Zambia and to fabricate a model of the composting toilet designed based on the result. As a result, most of interviewer in Indonesia has squatting type toilets, but some people are not satisfied with their toilet. They showed a behavior to flush their wastes before washing their private parts after defecation. Most of them accepted the size of the mock-up to be installed in their house, however some felt it's too big or too high. Target price was suggested around USD 50. The solution for collection of compost and urine should be proposed, because the position of the toilet in their house is far from the entrance resulting in the worker passing rooms with compost and urine. On the other hand, most of interviewer in Zambia has sitting type toilets and are satisfied with the toilets. Half of them accepted the size of the mock-up to be installed in their house, however some felt it's too big or too high, while one felt the toilet bowl is too small. Target price was suggested around USD 100. The arrange of the rooms in their houses is similar to Indonesian house, but an solution to make direct access collecting compost and urine from outside of a house may be possible, since there is space between houses. Then, a model of composting toilet produced to demonstrate a part of the agro sanitation model. It has a liquid-solid separation system, an urine-gray water separation system, a composting reactor, and a ventilation system. People just sit and push a button without being conscious of the separation because all operation is automatic. The reactor is replaceable, while a worker collects the compost by replacing the reactor. Urine can be stored in a tank placed near the toilet, then a worker also collect. The collected compost and urine will be transported to the agricultural field, and used as fertilizer after post treatment to ensure sanitation.

Keywords: current practice, cost, room layout,

DRY TOILET: A SOLUTION FOR DROUGHT HIT THARPARKAR IN PAKISTAN

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Thursday 20.8, 13:50 in Lecture Hall E1-06

Pakistan is a country of 173.51 million people (2010) of which 63.05 million live in urban and 110.46 million in rural areas. The country is experiencing growth in urbanization as more than 36% population now lives in urban areas as compared to 33% in 1998-99 (Ref. Economic Survey 2009-10). Its population growth rate of 2.05% is the highest in South Asia region. Pakistan has high infant mortality rate of 65 per 1000 deaths and under-five child mortality rate is 95 per 1000 deaths. UNICEF estimates that some 20-40 percent of hospital beds in Pakistan are occupied by patients suffering from water and sanitation-related diseases. USAID reports that 60 percent of the total number of child mortality cases in Pakistan is caused by water and sanitation related diseases. The World Health Report (2010) points out that 16% of all under-five children death occur because of diarrhea alone. This situation may be attributed largely to poor water and sanitation conditions in the country.

Pakistan being a signatory to the MDGs declaration is committed to extending improved sanitation to 67% of its population by 2015. The PSLM Survey 2010 shows that 78% households had access to flush or dry latrines in Pakistan in 2008-9 compared to 57% households in 2001-2. Further, the number of households without any toilet facility decreased from 43% to 22% during this period. However, devastating floods of 2010 and 2011 have changed the situation altogether. The current level of sanitation coverage in Pakistan has gone down to 45% (WaterAid UK). This shows a significant decline in the sanitation facilities available in Pakistan. This decline in sanitation coverage is not totally attributed to the devastating floods but there are some measurement and methodology issues as well, which needs to be taken care. The Water and Sanitation Authorities (WASAs) in major cities and Tehsil Municipal Authorities (TMAs) in small towns/rural areas are responsible institutions for water and sanitation provisions. However, WASAs and TMAs are subject to lack of technical expertise, funds, equipment and other logistical support. Understaffing is a common problem at the local level and available staff is not well-trained in community mobilization, participative planning, monitoring & evaluation and other technical aspects of their jobs.

Southern Pakistan, Tharparkar especially has been victim of drought and severities of climate change and therefore water availability is extremely low which has resulted in human and livestock life, health and livelihood problems in the area. Drinking water supply and sanitation are the most affected areas. Great struggle is required to cope the problems arising in the area.

The paper will highlight problems emerging due to lack of clean drinking water and safe sanitation, suggest cheaper and practicable sanitation especially dry toilet methodologies, identification of areas where dry toilet concept can be introduced, suggest improvements in services of WASAs and TMAs for promotion of dry toilet concept, propose measures to enhance full participation of community organizations in the dry toilet drive as a mean of sanitation provision and thereby improving the living standard of communities in drought hit areas of Tharparkar.

Keywords: Rural sanitation, improved living standards, improved sanitation services, new dry toilet sanitation methodologies.

TREATMENT OF URINE FROM URINE DIVERTING DRY TOILETS - APPLYING STRUVITE AND TERRA PRETA TECHNOLOGY IN KYRGYZSTAN - LOW COST SOLUTIONS FOR SMALL SCALE AND LARGE SCALE PRODUCTION.

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Thursday 20.8, 14:10 in Lecture Hall E1-06

The organization CAAW has more than 15 years experiences with urine diverting dry toilet (UDDT), they have been successfully implemented in Kyrgyzstan. Even in highly religious settings the UDDT can be well accepted such the example of the Moslem school shows. They significantly increase the living conditions in rural areas due to hygienic aspects and increased comfort especially for women and children.

UDDT is also a tool that can bring serious financial benefits to its users when used correctly. Benefits come from income generated by higher agricultural yields and improved health condition due to improved sanitation levels. Capture and re-use of nutrients is a very important concept that will become even more topical in the future globally. Implementing existing but also developing new technologies in places where they are needed the most is of utmost importance. These technologies not only create wealth to their users but also sustainability and environmental impact reduction. Nutrient recovery, resources-oriented sanitation and ecological sanitation work together to provide available nutrients for agricultural reuse in developing and developed countries. As phosphate and nitrogen fertilizers are becoming more expensive, ability to produce own high quality fertilizer is of a high value.

Struvite and Terra Preta technologies can offer a simple yet effective method to recover nutrients from human waste with relatively low costs. Both of these technologies suit to low income countries because of their simple production process and low costs. They offer high quality soil conditioner (terra preta) and phosphorus fertilizer (struvite) produced directly from source separated human waste. Domestic production of struvite and Terra Preta is possible to organize with some training and design help. This can help local users and communities to receive a higher benefit from their crop yields and increase the income coming to their household.

First results showed that the production of struvite and terra preta of urine from UDDT is possible in the rural setting in Kyrgyzstan.

Terra preta is a product of lacto-fermenting and composting technology. As materials are needed organic waste, charcoal or biochar, human excreta (urine and/or faecal matter) and lacto fermenting inoculum. Pilot demonstrations were done with different mixtures of these materials and in different set ups. The pilots are currently under investigations but first results look very promising so that the process is feasible. The feasibility study currently carried out will determine under which conditions such as price of charcoal, transport costs, acceptance and demand of the product, terra preta production is a feasible option for urine treatment.

Struvite is the mineral product of the chemical process adding magnesium to the urine and can be used as solid fertilizer. A simple domestic struvite reactor with local material was successfully tested. The feasibility study currently carried out will determine under which conditions such as price of magnesium, transport costs, acceptance and demand of the product, struvite production is a feasible option for urine treatment.

The paper will give the final results of the feasibility studies.

Keywords: UDDT, Struvite, Terra Preta

TIMETABLE FOR TOPIC 5

Friday 21 August

13:40	Lecture Hall A3-24	A. Aalto, E-M. Bodjawah	Finland/Ghana
14:00	Lecture Hall A3-24	Narayan Wagle	Nepal
14:20	Lecture Hall A3-24	Beatrice Mukasine	Rwanda
14:40	Lecture Hall A3-24	Jan Cebula	Poland

FROM WASTE TO WEALTH: OVERCOMING THE BARRIERS TO SANITATION DEVELOPMENT WITH CO-DESIGN OF LOW-COST URINE-DIVERSION DRY TOILET TECHNOLOGY

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Friday 21.8, 13:40 in Lecture Hall A3-24

Current statistics reveal that Ghana is significantly lacking behind on Millennium Development Goal targets with less than 10 per cent of rural population having access to improved sanitation. In Ghana, the adoption rate of household toilets is relatively low compared to other countries of similar economic status. This is especially due to the common practise of shared toilets. Furthermore, other contributing factors include households' lack of investment capital and absence of strong socio-cultural norm that would encourage toilet ownership.

The lack of sanitation facilities is equally pertinent in Ho Municipality, Volta Region, where open-defecation is a wide-spread practise especially in the rural areas. In Ho, the previously advocated sanitation facilities for rural areas are Kumasi Improved Ventilated Pit toilets (KVIP), Mozambique lined, Mozambique unlined, Samplat and Rectangular pit latrines. The cultural acceptability of these pit latrine technologies is low due to the offensive odours and hot vapour that are associated with spreading of diseases. Moreover, stony ground or water-logging have hindered toilet construction in some areas.

North-South Local Government Co-operation of City of Lahti in Finland and Ho Municipal Assembly in Ghana has identified ecological sanitation development as a key area for co-operation. Since 2009, Urine Diversion Dry Toilet (UDDT) technology has been introduced to Ho Municipality through a technical pilot at local schools to determine technical, economic and socio-cultural sustainability before larger-scale implementation. Based on various studies, the potential of the UDDT technology for Ho was deemed very promising and extension to households was initiated.

The household pilot of the UDDT was started in June 2014 as the building of the first pilot model was built to a community based on the institutional design. The building process involved local artisans who were trained on the technology in the course of the construction process. Simultaneously, the interest for ecological sanitation has grown significantly as a result of the extensive field demonstrations with urine fertiliser and related radio outreach program. There is a definite growing public interest for acquiring a UDDT facility, especially among farming communities. However, the price of the facility has been forming a barrier for extended implementation.

Following the first pilot construction, specialists and students from Lahti University of Applied Sciences, engineers from Ho Municipality's Works department and the local artisans have been involved in the co-designing effort to adjust the cost-structure of the original design. Fluctuating material prices, distance and locals' unfamiliarity with the household-oriented UDDT technology have formed challenges to the design process and the intention is to continue the co-designing process in the coming years as the expertise is accumulated. However, even in the first re-design piloted in December 2014, the price of the facility has already been halved. This was achieved by reliance on local materials on sub-structures.

It is acknowledged that further efforts in the technical design, cooperation with local artisans and material suppliers along with mobilisation of local stakeholders is needed to increase affordability. Still, the waste-to-wealth aspect of the UDDT has certainly added an unprecedented motivation for toilet ownership potentially unlocking major development backlog in the sanitation sector.

Keywords: cost-efficiency, co-design, nutrient recycling, urine diversion dry toilet (UDDT)

REACHING THE MOUNTAIN FOR SOLUTION: SUSTAINABLE DRY SANITATION PRACTICES

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Friday 21.8, 14:00 in Lecture Hall A3-24

In Nepal, the sanitation and hygiene condition of ecological zones such as Mountain, Hill and Terai (southern plains) is not in the same status. Around 62 % Nepalese are using a sort of latrines. Sanitation coverage in the Hill, Terai and Mountain is 76%, 50% and 60% respectively. Similarly, the sanitation coverage in urban and rural area is 91 and 55 percentage (CBS, 2011). Lomangthan VDC lies at an altitude of 3,600 meter in the rural area of Mountain zone, so it is a very incredible village to study dry sanitation. In Nepal, the economic cost of inadequate sanitation results in productivity loss equivalent to NPR 10 billion a year, number of people who have diseases due to unsafe drinking water and poor sanitation is 72% and the number of children who died due to poor hygiene and sanitary conditions in the last decade is around 700,000 (NSMP, 2011).

Mountain zone is mainly an unreached place in terms of infrastructure, education, health and transportation so there is very less opportunity to improve life. Most of the community depends on local products, technology and practices. It's really very difficult to reach mountain as to develop or change the community so that local practice, local material and locally made to be promoted for the sustainability of the result. Due to very cold area, community use traditional dry latrine, where people started to using latrine.

The community construct traditional dry latrine inside house that help to save them from cold as well as product organic fertilizer. The people depend on dry latrine as a factory producing fertilizer for farming. There is hardly accessibility of road, market, chemical fertilizer, manufactured goods of latrine whereas water seal pan is not suitable due to cold area. Community has adopted a traditional dry toilet like social practice because all people feel comfortable to use it.

Dry latrine reduces use of water in the cold area, product organic fertilizer and decrease expenditure for materials. Moreover, the dry latrine increases agricultural products, decrease dependency in centralized technology and market whereas it supports to use locally made skill and local material that is always available in the village with comparatively economic cost. It is required sustainable sanitation mainly where is lower accessibility and poor people so dry sanitation is a sustainable tool of solution in the unreached a remote mountain zone.

The paper presents a case study of Lomangthang VDC, where located a historical place made of mud. All most all households have been using dry latrine since practiced. Sanitation, sustainability, traditional practice and benefit of dry latrine and its adaptation are the focus areas of this paper. The paper will attempt to explain how dry latrine solve problems, challenges and benefit of users.

Keywords: Sustainable dry sanitation, reaching mountain area, use of fertilizer, benefit and solution

ECOLOGICAL SANITATION, SCALABLE MODEL FOR ALTERNATIVE SANITATION IN RWANDA

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Friday 21.8, 14:20 in Lecture Hall A3-24

The Ecosan in Rwanda is a pilot project funded by The Netherlands Development Organization (SNV) Rwanda that aims at contributing to Green Economy by improving environmental management (reduce water pollution) and increasing agricultural production which are critical to poverty reduction, building climate resilient and green economic growth with positive effect on human health (reduced incidences of water-borne diseases) through access to productive ecological sanitation (Ecosan) technologies. Ecological sanitation is an approach which is characterized by a desire to "close the loop" (mainly for the nutrients and organic matter) between sanitation and agriculture in a safe manner. Ecosan systems safely recycle excreta resources (plant nutrients and organic matter) to crop production in such a way that the use of non-renewable resources is minimised. The project targets two volcanic region districts Burera and Nyabihu (2 Sectors each) – 2000 families in 10 communities - 3600 students in 20 Schools.

Specifically the project has the following anticipated objectives: improved awareness on benefits of ecological sanitation for health and agricultural production, improved local capacities in construction, O&M of Ecosan, awareness through demonstrative Ecosan models in schools and households, Action research and social learning implemented on Ecosan and lessons learned used to inform policy development.

Project Approach builds on strengthening local capacities (Local Capacity Builders (LCBs) and Local masons), involvement of beneficiaries, focus on rehabilitation of existing infrastructures, building a scalable model, experience documentation, evidence-based advocacy for replication, and building Public Private Partnership around public toilets.

The key results attributed to the Ecosan project in Rwanda include 10 villages mobilized for Ecosan with more than 400 Households willing to construct Dry toilets; 20 schools' representatives, 30 community mobilizers, 30 masons, 4 cooperatives trained in Operation and Maintenance and business oriented ecosan; 40 Households trained and supported to construct Ecosan model latrines; 4 new blocks of Ecosan constructed in schools, 2 blocks rehabilitated in public places; and 1 district-wide forum has been organized.

Around 71,780 people in Burera and Nyabihu districts have been reached by messages on benefits of ecological sanitation for health and for agricultural production through: Community meetings, Sanitation stakeholders' forums and Awareness campaigns (community work and radio spots).

The project will improve sanitation and hygiene practices in schools and villages. During the first phase of the project, it is investigated there is a need to boost awareness on the benefits of Ecosan for health and agricultural production. After the construction phase, follow up visits will be organised to beneficiary households to support them in the operation and maintenance of their toilets while training them on the use of urine and recycled faeces in agriculture. We have also learnt that Ecosan technology is revolutionising environmental care and reducing open defecation in Burera and Nyabihu districts. SNV is hopeful that the new model can be replicated across Rwanda once the initial project phase is complete.

Keywords: urine diversion, Ecosan, reuse of nutrients, health, reducing water pollution

APPLICATION FOR HALLOYSITE SORBENT FOR AMMONIA AND ODORS REMOVAL FROM DRY TOILET FACILITIES

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Friday 21.8, 14:40 in Lecture Hall A3-24

Common application of dry toilets is strongly connected with elaboration of new, efficient and inexpensive methods of its safe and environmentally friendly exploitation. To be an attractive technological approach in the present market, practically no harmful effects should be observed. One of potential crucial factors significantly influencing the future development of dry toilets is undoubtedly ammonia and odors emission connected with biological processes of liquid urine and faeces decay. These processes occur spontaneously during both these human metabolic products collection and sterilization (liquid urine). Because of dry toilet idea and practical requirements (safe and convenient handling), ammonia and odors removal methodology should be equally effective both in application to liquid urea and to solid faeces.

Many gaseous ammonia removal methods are reported in literature, like absorption in aqueous solutions, catalytic oxidation to N₂ or NO, advanced aqueous phase oxidation with chemical oxidizers (ozone, peroxone), electrochemical oxidation or hypochlorination. Methods of nitrogen excretion reduction, convenient in animal breeding by proper diet manipulation, seem to be not suitable directly for human population. These methods require also complex biological processing like urease inhibitors, reduction of manure pH, etc. or application of expensive catalysts working in high temperatures (500 degrees C).

Considering dry toilets construction some special requirements should be met, like compact size, not troublesome handling and possible low costs. Adsorption on acidic solids (zeolite clays, graphite oxides, etc.) seems to be attractive for direct application. Such multifunction sorbents should make reduction of NH₃ formation by effective lowering of free NH₄⁺ ions in environment through sorption/ion exchange, as well as by equally effective sorption of gaseous NH₃ already formed.

One of the promising naturally occurring minerals seems to be halloysite with its unique surface properties. It is a two-layer mineral belonging to kaolinite subgroup (Al₂Si₂O₅(OH)₄nH₂O), demonstrating affinity to the monovalent cations, playing important role in inner-sphere and interlayer cation-water structure complexes, as well as having water layer of 7–10.1 Å interlayer distance. Halloysite unit is composed of two sheets: Si-tetrahedral (oxygen surface negatively charged) and Al-octahedral (external surface with hydroxyl groups with hydrogen outstanding demonstrating positive charge). Surface charge of halloysite can be strongly modified by cation substitution, especially of Al atoms in octahedral layer for divalent atoms (e.g. Mg, Fe), trivalent Fe or four-valent Ti, while Si in the tetrahedral structure can be replaced by Al. In result important changes in local microstructure are observed, with the unique possibility of new specific bonds formation, in various places of halloysite structure, together with cavity trapping mechanism.

Halloysite powders were successfully applied for ammonia emission lowering in model dry toilets. Specific surface area of halloysite used was 90 m²/g. Application of such sorbent for liquid urea (water dilution of originally collected urea 1 : 1, dose 10 g/dm³) and solid faeces (unmodified structure, dose 50g/kg) in a hermetic system for 1 month resulted in sorption of 250 mg/g (liquid system) and 20 mg/g (solid system).

(or purposefully modified - activated) halloysite can be promising variant in ammonia emission lowering technology. Its low costs (thus no necessity of regeneration) can be deciding economical factor, while universal application, wide sorption/binding properties (of not only ammonia but also other co-present odor substances), easy handling and working in room temperature are design factors influencing its potential use in dry toilets technology.

Keywords: ammonia emission, odors emission, halloysite, sorption, ammonia and odors removal



TIMETABLE FOR TOPIC 6

Friday 21 August

9:40	Lecture Hall E1-06	Pamela White	Finland
10:00	Lecture Hall E1-06	Christian Chibuzo Maduka	Nigeria
10:20	Lecture Hall E1-06	Hisayo Katsui, Nathaly Guzmán Figueroa	Finland
10:40	Lecture Hall E1-06	Babatope Babalopi	Nigeria
11:00	Lecture Hall E1-06	Beshah M. Behailu	Ethiopia
11:20	Lecture Hall E1-06	Maria Söderström	Finland

15:30	Lecture Hall A3-24	Azahar Ali Pramanik	Bangladesh
15:50	Lecture Hall A3-24	Sanna-Leena Rautanen	Finland/Nepal
16:10	Lecture Hall A3-24	Emmanuel Mutamba	Zambia

CHANGING ATTITUDE TO ACHIEVE TOILET ACCESS FOR ALL IN NEPAL

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Friday 21.8, 9:40 in Lecture Hall E1-06

Finland supports two WASH related projects in Nepal – the Rural Village Water Resources Management Project, operating in far and mid west Nepal (<http://www.rvwrmmp.org.np/>); and the Rural Water Supply and Sanitation Project, Western Nepal (<http://www.rwsspwn.org.np/>). Both are fully aligned with the Nepal Sanitation and Hygiene Master Plan, which has a target of basic sanitation for all by 2017. This will be a significant change, given that in project areas, open defaecation was the norm until recently. This paper describes some of the barriers to toilet access and our efforts to overcome them.

Many of the areas where the projects function have never had toilets earlier. We now have many VDCs (the smallest administrative area) declared Open Defaecation Free (ODF). However, after this achievement in some areas of the far west, a new issue has arisen. Queries by visiting technical staff have revealed that in some locations, menstruating women are not allowed to use toilets as they may “make the toilets dirty”. In other cases, women have claimed that it will offend the gods if they use the toilet. In other words, cultural behaviours towards menstruating women are causing exclusion from toilets and therefore open defaecation.

Toilets are a new thing in the villages, there is no tradition of exclusion – so there has been an extrapolation from exclusion from other household sites. The main problem is touching the same water container (used for washing and flushing) as other household members – in this case we are usually trying to convince household members to provide a separate container within the toilet. However, others argue that the whole toilet will be contaminated by the menstruating woman. Project staff are exploring ideas to get past these barriers. With community discussions and good awareness raising (especially using religious leaders), attitudes in most districts towards tap access are gradually changing.

Another group facing access problems throughout the country are people living with disabilities. People with physical disabilities and the frail elderly who find it hard to walk or squat might find it difficult to use toilets in rural areas – either at home, or in institutions such as schools. If they need help from a family member in order to use the toilet, it is not very dignified for either person. The project teams are raising awareness regarding toilet design and simple structures such as toilet chairs, rails and ropes, which can assist with access.

However, the most significant change needed is in attitudes. A tool supporting all our work is the Human Rights Based Approach and Gender and Social Inclusion Strategy and Action Plan. The right to sanitation is mainstreamed across all activities and project tools, focusing on the right to sanitation that is safe, hygienic, secure, socially and culturally acceptable, provides privacy and ensures dignity. This requires considerable hands-on support from the Nepali and international project staff.

Keywords: Gender, Human rights based approach, toilet access, menstruation, disability

SOLUTIONS TO CULTURAL CHALLENGES AND STIGMATIZATION ASSOCIATED WITH DRY SANITATION IN ABAKALIKI, SOUTH EASTERN NIGERIA

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Friday 21.8, 10:00 in Lecture Hall E1-06

World Health Organization (WHO) defines sanitation as group of methods to collect human excrete and urine as well as community waste waters in a hygienic way, where human and community health is not altered. Sanitation methods aim to decrease spreading of diseases by adequate waste water, excreta and other waste treatment, proper handling of water and food and by restricting the occurrence of causes of diseases. Dry sanitation is a type of sanitation in which human waste is disposed without the use of water. This method reduces the demand on water available for use by the public either in the rural or urban locations.

Abakaliki an emerging urban city in South Eastern Nigerian, due to exposure to Western civilization joined the league of cities where it has become a norm to adopt water cistern technology as a toilet system. The city also faces same acute challenge of sustainable water supply like any other in its category due to increased cost of producing water, dilapidated water production facilities, population explosion, red-tape, bearucracy and corruption.

Despite the benefits dry sanitation technology due to low cost and option it offers as environmentally acceptable alternative, there are several challenges associated with introduction and acceptability of the technique in Nigeria. These challenges include: issues of culture and stigmatization.

Achieving a sustainable dry sanitation culture in Nigeria is attainable when the a workable solution is achieved against cultural factors and stigmatization. In this paper, we are going to examine the identified challenges facing the adoption of dry sanitation option in Abakaliki South Eastern Nigeria and attempt at proffering solutions to them.

The paper will examine in details the two major terms of the topic: “Culture and Stigmatization” and outline strategies to solutions of the challenges facing dry sanitation option in Nigeria by detailing the following issues:

- Culture and Stigmatization in dry sanitation:
- “Old habits die hard”: The cultural barriers against Dry Sanitation?
- Stigma and psychological connotations of dry sanitation
- Financial and economic perspectives of dry sanitation in Nigeria
- Stakeholder mapping and engagement as effective tools for overcoming challenges against dry sanitation technology acceptability in Nigeria.
- Communications and outreach strategy as panacea to cultural barriers and stigma against dry sanitation technology.

The paper will also use case studies and comparative analogies of similar new initiatives of water and sanitation reforms of USAID Sustainable Water and Sanitation in Africa project in Abakaliki to provide solutions to dry sanitation issues in Nigeria.

Keywords: Culture, Stigma, Communications, Stakeholders

REDUCING INEQUALITIES IN DEVELOPMENT PRACTICE: A CASE STUDY OF WATER AND SANITATION SECTOR

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Friday 21.8, 10:20 in Lecture Hall E1-06

This is an interdisciplinary, problem-oriented research that aims at reducing inequalities through research process and findings particularly for persons with disabilities in the Global South.

This paper focuses on water and sanitation sector which is fundamentally important for any human being. However, even when one of the Millennium Development Goals of access to clean water has been achieved in time, the need of such access for persons with disabilities in the Global South is paid little attention to. For instance, too many children with disabilities are hindered from going to schools due to lack of safe and clean sanitation facilities. This is particularly valid for girls with disabilities.

When it comes to development cooperation, disability mainstreaming has been challenged in most development practices. The United Nations Convention on the Rights of Persons with Disabilities has been ratified by 150 countries out of 193 member states, which is globally a “major milestone” (UN News Center, 2014). However, even after the era of the Convention, persons with disabilities in the global South have too often been left behind from practice of national and international development efforts. For instance, less than 1% of the Finnish Official Development Aid is allocated for disability-specific projects and programmes, while 99% of its mainstream development cooperation activities have huge difficulties in including those at the risk of inequalities such as persons with disabilities. Therefore, the research investigates on disability mainstreaming in water and sanitation sector.

Methodology: Continuous personal interviews to stakeholders, focus group discussion and observation are essential methods in comprehending the complexity of both mainstreaming and disability-specific development practices and their impact to each other, if any. In Tanzania, a slum was visited in October 2014 to interview persons with disabilities and their families on their experiences on water and sanitation. Leaders of the slum were also interviewed to find out about participation of disabled people in water and sanitation projects and experiences working with disabled people. In Nepal, a Finnish-Nepalese bilateral development cooperation project on water and sanitation will be visited in December 2014 to clarify challenges and opportunities for persons with disabilities in participating in water management.

The paper presents preliminary findings from the above mentioned fieldworks.

Keywords: disability, mainstreaming, development, sanitation, inequalities

USING THE MEDIA TO BREAK INSTITUTIONAL, CULTURAL, POLICY, AND RELIGIOUS BARRIERS TO USE OF ECOSAN TOILETS IN NIGERIA

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Friday 21.8, 10:40 in Lecture Hall E1-06

The use of Ecological Toilets (ECOSAN) is yet to be popularly adopted in Nigeria, Africa's most populous country. Apart from pioneering projects under the European Union Water Supply and Sanitation Programme in a few states, and by the Public Health Department of the University of Ibadan, in South West Nigeria, construction and use of ECOSAN toilets as a sanitation technology is yet to be popularized in Nigeria; no thanks to the failure of several tiers of government to adopt it as a viable sanitation technology in Nigeria. This is partly due to several prejudices, bias, misconceptions, and ignorance driven by institutional, cultural, policy, and religious factor on the ECOSAN toilets.

To address this challenge, the WASH Media Network, comprising Journalists reporting water supply and sanitation issues for various media outlets in Nigeria has decided to produce a 'Media Handbook on ECOSAN toilets in Nigeria'; with the following strategic objectives:

1. To act as a briefing note for Journalists on ECOSAN toilets and enable them popularize its use through feature articles, news stories, commentaries, and documentaries.
2. Document success stories of the use of pilot ECOSAN toilets in Nigeria; and its challenges for the information of sector service providers, policy formulators, and sanitation marketers.

Methodology

1. Review of secondary literature on ECOSAN toilets. This is already achieved.
2. Field visits to ECOSAN toilets sites in Nigeria to document success stories and challenges from users through Interviews, on the spot observations, and Focus Group Discussions. This is partially accomplished.
3. Production of the Handbook in soft and hand copies and circulation to sectoral stakeholders in Nigeria. (In progress, to be accomplished before the Dry Toilet conference)

Results

The field visits to ECOSAN toilet sites have revealed the following:

1. Community ownership and management is key to sustainability of ECOSAN toilets
2. Various ECOSAN types should be constructed for children, adults, men, and women. Children avoid using ECOSAN toilets visited because it is not considered safe, while women prefer the squatting positions rather than sitting positions for ECOSAN toilets to avoid contacting diseases through their private organs.
3. Physical accessibility is key to use of ECOSAN toilets in communities
4. ECOSAN toilets would be popularized if information on its successful use is available in the public domain.

Lessons

1. A block Of ECOSAN toilet with two vaults could be constructed for as low \$2500
2. Human urine produced from ECOSAN toilets is being used as a bait/trap to catch wild animals, when poured on farmlands by villagers. This potential needs to be further investigated.
3. ECOSAN toilet is the most viable sanitation situation where there is a rocky terrain.
4. ECOSAN toilets have low maintenance cost, as it may not be evacuated for up to 6 years.
5. It is important to involve artisans such as plumbers and welders in the community management committees for ECOSAN toilets.

Keywords: Nigeria, dry toilets, mass media

DRY TOILET SANITATION AS AN ALTERNATIVE SOLUTION TO THE RURAL ETHIOPIA

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Friday 21.8, 11:00 in Lecture Hall E1-06

According to the UN World toilet day press release, about 34 million or (36%) of the population are experiencing open defecation in Ethiopia (UN, 2014). Moreover, the national government's reports on the sanitation coverage also show that a lot needs to be done in the sector. Even, when we are talking about the remaining proportion that has toilet, it is very unlikely to guarantee sanitized community, unless every member of a family and every household of a village has proper sanitation practice. However, this can be developed through contentious education and behavior based training beyond the supply of the sanitation facilities.

Flush toilet used is limited in the country because of high capital cost and rare house connections of water systems. For the rural where the per capita demand is below 15 liters per day it is unthinkable to install flush toilets. Thus, a very common toilet type in the rural and towns of the country is pit latrine. Pit latrine appreciates "drop and forget" the resourceful human wastes. This practice literally causes water pollution where the groundwater table is shallow and takes important nutrients out of its cycle and bring a nutrient deficiency particularly phosphorous. On the contrary, the productivity of land is gradually declining and the need of fertilizer is rising while the population growth is increasing ever beyond the capacity that the existing farmlands can hold to feed. On the other hand, the nutrient rich human wastes dumped or buried to causing environmental pollution.

The objective of this paper is to explore the existing sanitation situation of the rural Ethiopia and to see the opportunities and challenges in implementing dry toilet sanitation as an alternative solution to bridge the gap between environmental pollution and nutrient stresses. This paper is based on field experiences of rural Ethiopia. A household survey (n=1806) was done on sanitation practices (hand wash, toilet and use, open defecation and daily water consumption). In addition to the survey, the first author made his observation on the provision of sanitation facilities and extent of use.

In the presence of toilets, still rural communities often practice open defecation. The reasons behind this includes attitude, distribution of toilet in the community and the nature of the livelihood of the community. Almost all households are relay on farming. Thus, men and boys usually spend their days away from home at the farm. However, toilets constructions at the farm is not the focus of national development where there are villages without it. Although some efforts are made to construct toilets along roads for passengers and at grazing fields for cattle keepers, the management of the systems is so poor and they are not used after few weeks services. Thus, people are still practicing open defecation.

The positive aspect of the tradition of the rural community is that they have a tendency to use their feces as a fertilizer by defecting in their own farm when they are using their farm to grow non-row edible crops like maize, sorghum and the likes. The possible threats that could challenge the implementation of dry toilet in rural areas are low-economic potential of the individual households and need of a number of such facilities per household (at home and at the farm). Therefore, implementation of dry toilet schemes could be successful if it implemented with subsidies and adequate training to excel the sanitation behavior of the communities in rural Ethiopia.

Keywords: Dry Toilet, pit latrine, nutrients, behavior, Sanitation

TRAINING MANUAL FOR THE USE OF DRY TOILETS IN SOUTH AFRICA

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Friday 21.8, 11:20 in Lecture Hall E1-06

Within a cooperation between the South African municipality Makana and the Finnish municipality Raseborg a project to enhance the use of improved dry toilets (DT's) in the rural areas of Makana was conducted. The step from no sanitary facilities to the use of dry toilets is very important from many perspectives, but nevertheless not an easy one.

Students from Novia University of Applied Sciences were engaged to aid at the introduction of improved sanitation. Two students first conducted a feasibility study, mapping the needs of the residents in the villages, informing them about dry toilets and discussing about different options for the choice of new DT's with the municipal management.

The municipality invested in dry toilets and placed them in different villages. However, the inhabitants didn't have knowledge enough about the use of the toilets, so after a while they were abandoned. This was also partly because nobody really had got the responsibility for the maintenance of the DT's. When a toilet container was full or when a door had broken, people returned to previous patterns.

A new group of Novia students were sent out to solve the problem. They studied the situation, realized the problems and made a training manual suitable for all ages and illiterates as well. They trained the users on the spot, showing in practice how to use the toilet facilities. They trained trainee teachers as well to go on with the training for both new and more experienced users in the communities. To solve the maintenance problem, they had discussions with the authorities about regular maintenance.

The on-site training was about how to use dry toilets properly and how everybody should maintain the cleanness of the toilet. This session made it possible for the trainees to understand every single thing that they need to know about the usage of the dry toilets. After that, two or three of them in each village made demonstrations to show what they had understood. In addition to that, the students informed the trainees about the importance of sanitation, hygiene and how diseases are spread. They also told the trainees how to utilize the nutrients by composting.

The Novia students conclude their report by giving a long list of recommendations for the future use of the dry toilets. The recommendations concern proper construction of the DT buildings, appointed persons responsible for the maintenance and composting, regular monitoring of the DT facilities and good instructions regarding the use of the facilities, to mention a few of them.

Keywords: Dry Toilet, improved sanitation, behavior

MULTI-STAKEHOLDER'S ENGAGEMENT LEAD IN SUSTAINABLE SOLUTION FOR DRY TOILETS - AN EXPERIENCE OF SPACE IN BANGLADESH

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Friday 21.8, 15:30 in Lecture Hall A3-24

Nature and characteristics of dry toilets demand engagement of different stakeholders for effectively implementation the program and achieving the defined objectives. Despite encouraging achievement, there are still several reservations among different level of people concerning health safety, social acceptance, affordability, cultural adaptability and sustainability of dry toilets. The policy-makers, administrators, journalists, engineers, agriculturists, medical practitioners, civil society leaders, sanitation activists and private sector operators are still not fully convinced of dry toilets because of reuse principles of human excreta in crop productions and economic activities. The dry-toilet actors frequently face common obstacles, such as, use patterns, excreta management and handling, reuse of human urines and faeces fertilizers in farming when they go to introduce and implement dry toilets program. Users also do not show interests at primary stage due to unfamiliarity, knowledge gaps, misinterpretation, social stigma and resistance, higher cost involvement than pit latrines etc. Besides, majority portion of people are not aware of adverse impacts of conventional toilets.

Realizing the contexts, SPACE, a local NGO in Bangladesh, started piloting of dry-toilet at early of 2006. Later on, it has facilitated in installation of over 1000 dry toilets in different parts (Hill Tracts, semi-arid areas, coastal zones, marshlands etc.) of the country through piloting, Action Research and scale-up projects and also mobilizing the community resources. At the initial stage, SPACE faced huge challenges and obstacles created by government high officials, community and religious leaders, end users, media people, development partners and sanitation activists during implementation of dry-toilet projects. In purpose to overcome the impediments and bring about sustainable solutions, SPACE organized an internal consultation session in participation of its relevant staffs which was facilitated by an external consultant. The session clearly identified the needs for engaging different stakeholders for expected implementation of the projects. SPACE, accordingly, had prepared lists of stakeholders ranging from community to policy level. The list included user groups, school-children and teachers, community and religious leaders, local elected bodies, Local Government institutes, local masons, dealers, Health workers, Agriculture workers, media people, NGO workers, private entrepreneurs etc. Analyzing potentials, roles, comparative advantages and perception levels of stakeholders, SPACE formulated various types of activities and developed suitable BCC materials. It conducted audience-friendly awareness activities, conducted rooted advocacy, maintained networking with identified stakeholders, demonstrated few dry toilets and ensured tangible instances of health and economic benefits. SPACE ensured efficient use, O&M, excreta management, safe handling and application those in productive activities. SPACE also organized spot visits engaging the government officials while they became convinced to dry-toilets for sustainable sanitation, improving environmental and human health. Synergetic results of engaging stakeholders, costs of dry-toilets became affordable and multi-options have been devised; 100% households shared 30% to 50% of installation costs, over 90% toilets found well-managed, over 80% households use treated urines and human faeces in farming and plantation. Major learning involves engaging multi-stakeholders in implementation contribute in enhancing effective dry toilet implementation and sustenance of results. All dry-toilet activists can follow the learning for wider replication at their own places.

Keywords: Obstacles; misinterpretation; awareness; networking; advocacy

SOLUTIONS TO CULTURAL CHALLENGES IN SCALING UP DRY SANITATION IN NEPAL

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Friday 21.8, 15:50 in Lecture Hall A3-24

The Government of Nepal has the vision of universal sanitation coverage for its citizens by 2017. This entails that open defecation should end in all 75 districts. The Rural Water Supply and Sanitation Project in Western Nepal Phase II has contributed to the sanitation movement from the beginning. Out of its 14 working districts, eight have declared the complete district as Open Defecation Free (ODF). Out of 713 Village Development Committees (lowest tier of local government) in our working districts, 490 have declared themselves ODF by December, 2014. This success builds on the people's own drive to construct, use and maintain their toilets. The effort cannot be supply (subsidy) driven given the sheer amount of missing toilets. For this purpose, the sector stakeholders in Nepal have widely adapted various behaviour change communication and triggering tools. There are still millions of people defecating in the open, regardless of the relative success.

The purpose of the study was to explore how the existing behaviour change communications strategies could be used as a solution to address challenges linked to dry sanitation in Nepal. This was done by seeking insights and do-able recommendations on how to improve the present strategies, practices and tools that do not seem to encourage dry sanitation solutions at the moment. The choices continue to be water-flushed two-pit or one-pit solutions. This study also explores the work done with sanitation marketing and post-ODF support services.

This study used the Water and Sanitation Program's (WSP) theory of sanitation behaviour as the external frame of reference. According to WSP, programs wishing to bring about large scale and sustainable sanitation behaviour change must seek to bring about the following:

- Demand for improved sanitation: Do those who do not use improved sanitation have the opportunity to change? Are people aware of a dry sanitation options, and have opportunities to change accordingly? Do people have the ability to change? Do those who do not use improved sanitation have the motivation to change? What are some of the incentives?
- An effective sanitation supply chain: Are latrine building service providers and suppliers able to provide affordable and desirable solutions? How aware is the market on options such as dry toilets and safe use of urine in agriculture? How complex does the existing sanitation supply chain make the sanitation shopping process, especially for dry sanitation options? Do implementers have the opportunity, ability, and motivation to carry out their work?
- An enabling environment for sanitation programming: Do decision makers understand the program and prioritize dry sanitation? How do policy-level choices influence the technology choice?

The study was guided by the above questions. For the purposes of this study, the primary behaviour of interest was simply Ending Open Defecation. This means that people should want to construct improved (dry) latrines at home by themselves. This study explored the behaviour change determinants and barriers as identified during the field work done in those communities where some households were using dry sanitation solutions, or at least urine diverting options, even if the livelihoods aspect was not the primary focus of the study.

Keywords: BEHAVIOUR CHANGE COMMUNICATIONS, NEPAL, SANITATION MARKETING

BREAKING NEW GROUNDS IN DRY SANITATION: FINDING SOLUTIONS TO STIGMATISATION USING PAST EXPERIENCES

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Friday 21.8, 16:10 in Lecture Hall A3-24

A new dry sanitation project called Community Dry Sanitation Initiative (CSI) was launched in January 2014 in Monze district in Zambia by the Green Living Movement (GLM) a local partner of the Global Dry Toilets Association of Finland (GDTAF). CSI is the fourth such project in Zambia. Others had earlier been implemented in Masaiti and Lusaka districts from 2006 and 2011 respectively while the third one had been launched in Livingstone at the same time as the CSI.

Monze district lies in the southern part of Zambia, 198 km south of Lusaka, the capital of Zambia. It is a rapidly growing town mainly due to increased agricultural activities in its surrounding communities and increasing population of immigrants. The CSI Project site (Freedom Compound) is an unplanned settlement on the edge of Monze central business district. It has an estimate population of 7000 inhabitants.

The state of the environment in Freedom Compound is in dire need of attention. The sanitation situation particularly poses serious threat to lives of the people. Shallow pit latrines are the common type of toilets found in Freedom Compound while water is accessed mainly from shallow wells. Like many similar unplanned settlements in sub-Saharan Africa and Zambia in particular, the adverse effects affect human health and social life for women, men the young and old. The local Government authority in Monze district like other similar district authorities in Zambia is overwhelmed by a milliard of social demands including sanitation, water supply and waste management.

The CSI project focus is to improve the environment and sanitation situation through education, construction of composting dry toilets and provision of safe drinking water. It is expected that the interventions would provide lasting solutions to the current and potential social and environmental health challenges the project area faces.

During the CSI project life span dry toilets will be built in public places such as markets, schools, health posts and churches and for individual families under a cost-sharing plan. This component of the project (dry toilets) has the potential to attract stigmatisation and resentment as seen in past similar projects.

This presentation discusses attempts to collect experiences and lessons from past dry sanitation projects to inform solution-finding processes in the CSI project especially in dealing with the challenge of stigmatisation. It explores the causes of stigmatisation through which solutions could be found such as illiteracy, religious beliefs and traditional and cultural norms and beliefs.

Keywords: Dry toilet, sanitation, drinking water

TIMETABLE FOR TOPIC 7

Thursday 20 August

15:30	Lecture Hall E1-06	Elijah Ngumba	Finland
15:50	Lecture Hall E1-06	Sanna Jaatinen	Finland
16:10	Lecture Hall E1-06	Ronald Musiige	Uganda
16:30	Lecture Hall E1-06	Matias Andersson	Finland
16:50	Lecture Hall E1-06	Lakachew Yihunie	Ethiopia

SUPPRESSING ANTIBIOTIC AND ANTIVIRAL POLLUTION IN NAIROBI RIVER BASIN THROUGH URINE RECOVERY

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Thursday 20.8, 15:30 in Lecture Hall E1-06

The occurrence of Pharmaceuticals and Personal Care Products (PPCPs) in the urban hydrological cycle has become the focus of worldwide attention in recent years as questions about their potential threats to the natural environment and human health have been raised. Discharges from wastewater treatment works have been identified as the primary point source of pharmaceuticals into the water systems. However, significant populations in cities within the developing countries such as Nairobi-Kenya reside within the informal settlements that are characterized by poor sanitation system. As a result wastewater from these settlements is not subjected to any form of treatment and ends up contaminating the rivers and other water sources within the locality. In addition, the rate of disease prevalence especially HIV/AIDS is highest within the informal settlements. As of 2012, the rate of HIV/AIDS adult prevalence rate in Kenya was approximately 6.2% and 65% of the HIV patients were under antiretroviral therapy (mostly antibiotics and antiviral drugs). Since pharmaceuticals are only partially metabolized by the human body a large proportion is excreted into the environment unchanged or in the form of their components (metabolites and/or conjugated compounds) largely through urine, the amount of pharmaceuticals released by about 2.5 million informal settlement dwellers in the Nairobi area is significantly high.

In this study, it was established that the concentration of selected antibiotics and antiviral drugs in rivers within informal settlements was higher than in wastewater treatment plant effluent and multiple folds higher compared to rivers in the formal settlements. Given that each individual produces 1–1.5 L of urine per day (about 500 L per year), there is a high crop nutrient potential in the urine of this population. Provision of safe and sustainable form of sanitation such as urine diverting dry toilets (UDDTs) and urine recovering urinals within the settlements presents the most viable, acceptable and economical strategy of improved sanitation and suppressed pollution in Nairobi River Basin. In addition, the urine and fecal matter generated can be centrally handled for treatment and nutrient recovery. Due to the wide range of pollutants that can occur in human waste and the public perception towards its use in the growth of food crops, the waste can be utilized in selected farmlands for production of biomass for energy production.

Keywords: Antibiotics, Antiretroviral, UDDT, HIV/AIDS

EFFECT OF SIX MONTHS STORAGE ON PHARMACEUTICAL CONCENTRATIONS IN SOURCE SEPARATED URINE

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Thursday 20.8, 15:50 in Lecture Hall E1-06

The source separation of urine has gained more interest over the years since it contains most of the nutrients excreted by humans. Thus, it is deemed suitable for fertilization purposes. World Health Organization (WHO 2006) recommends six-month storage of collected urine to reduce the risks of pathogens in it. It is also known that most of the pharmaceuticals us humans ingest end up in the urine either as the parent compound or as conjugates and transformation products, which can have different characteristics than the original substance.

The aim of this study was to investigate how six month storage affects the concentrations of seven pharmaceuticals commonly used in human immunodeficiency virus (HIV) and related conditions treatment. Three antivirals and four antibiotic pharmaceuticals were amended in separately collected urine which was thoroughly mixed and divided into 150 mL portions in plastic jars. Urine was collected from healthy volunteers receiving no medication. Urine was left standing for six months and samples were taken at the beginning and monthly thereafter to follow the concentration of the compounds. Samples were analysed using a HPLC-UV method developed earlier (Pynnönen and Tuhkanen 2014) to study the effect of storage on the compound concentration as well as with LC-ESI-MS/MS to detect possible transformation products.

Interestingly, only one of the pharmaceuticals (antibiotic rifampicin) disappeared completely during storage although it was the largest of the compounds considering molecular mass. Inspection with mass spectrometer revealed, that although the parent compound was gone, there were four possible transformation products present in the urine samples. For all the other pharmaceuticals, the change in concentration was small and though some transformation products were discovered, the parent compounds were also present in the samples after six months.

This study indicated that six months long storage doesn't remove the risks posed by pharmaceuticals present in urine. Based on the results obtained in this experiment, use of source separated urine in edible crop fertilization seems impractical, because although the concentrations used in this experiment were quite high, they might be present in some areas where large part of the population is receiving HIV-treatment. The use of urine in energy crop production might thus be a safer re-use option.

Keywords: SOURCE SEPARATION, URINE, PHARMACEUTICAL, STORAGE

OVERCOMING THE FEAR TO USE THE SANITIZED EXCRETA - A BOOST TO AGRICULTURE PRODUCTIVITY IN UGANDA

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Thursday 20.8, 16:10 in Lecture Hall E1-06

In diverse cultures in Ugandan communities ecological sanitation is less respectable with mysterious attachments and perceptions towards excreta contact and reuse.

Uganda's 10 year national ecological sanitation strategy aims at achieving at least 15 % of the total sanitation coverage in the country by 2018 (Huba 2008). Ecological sanitation promotion in the social and mindset of the population poses a challenge to the strategy.

This paper will discuss a successful methodology used in the promotion of application of the dry toilet sanitation products in Mukono, putting under consideration the experiences from local farmers, challenges and recommendations in boosting agricultural productivity and achievement of food security in the developing parts of Uganda.

Initially there was great resistance to the approach and application of the sanitized excreta as soil fertilizers to boost agricultural productivity due to the perception that these products must be contaminated and lack of discipline in using this new technology, land tenure systems.

Based on the information obtained from a needs assessment which was done using a participatory approach an awareness campaign was designed to sensitize the communities to make the dry toilet technology suitable and sustainable, bearing in mind the low toilet coverage in these areas.

This was through making the use of sanitized excreta and urine socially and culturally acceptable to the community through marketing and awareness creations, stressing their importance, emphasizing proper operation and maintenance as well as creating links with farmers within and outside the communities to often make use of these products to boost agricultural productivity.

Approaches being used in this promotion are; Regular community sensitizations on use and maintenance of the dry toilet, construction of demonstration units in the communities of dry toilet types being promoted, regular field visits to monitor their usage and maintenance, use of information education communication materials (IEC), establishing demonstration gardens on the application of excreta use and marketing use to farmers outside the community environments.

People have gradually managed to appreciate the usefulness of the dry toilet despite the cultural and individual perceptions, beliefs and fears as a solution to boosting agricultural productivity and security after realizing the yields when they apply this technology.

Keywords: dry toilet, Excreta use, Culture, Sanitation

ASSESSING THE SOCIAL POTENTIAL OF ECOLOGICAL SANITATION IN IMPROVING WASTE MANAGEMENT AND FOOD SECURITY IN THE TAITA HILLS, KENYA

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Thursday 20.8, 16:30 in Lecture Hall E1-06

The research aims at investigating the possibility of implementing ecological sanitation solutions in the Taita Hills, Kenya, therefore contributing to sustainable local development. The approach taken to this aim is that of a description and analysis of sociocultural preferences regarding sanitation and the idea of reusing human excreta in agricultural production.

Poor sanitation circumstances are a widely acknowledged and researched issue in the field of human development. In addition to putting a burden of disease on affected populations, lack of proper sanitation facilities are identified as both a cause and a consequence of poverty. Sanitation solutions also play a notable role in the interaction between settlements and the natural environment.

Ecological sanitation includes a wide range of technologies and other solutions with the aim of improving sanitation and simultaneously diminishing pollution, most notably of water bodies. An important aspect of ecological sanitation solutions in agricultural areas is the possibility of treating waste to produce fertilizers suitable for use in local farming. This would enable communities to close the cycle of nutrient flows as nutrients withdrawn from the soil in the form of agricultural produce would be returned as fertilizer. In addition, local, low-cost production of fertilizers can be a sustainable way of weakening dependence of international fertilizer markets, thereby improving rural livelihoods. The possibility of improved access to suitable fertilizers is also a key aspect of improved food security.

Understanding local perceptions and attitudes regarding sanitation is crucial in finding socioculturally applicable, acceptable and sustainable ecological sanitation solutions. This study uses semi-structured stakeholder interviews and expert interviews to investigate those attitudes, as well as to gain insights on current sanitation and farming practices. Involvement of the local views in the research process is enhanced by the use of a participatory ranking exercise, thereby enabling local views and preferences to find practical and specific expression. Current sanitation solutions and their connection to the environment are also included in the study framework. The results of the fieldwork are investigated with a qualitative content analysis to present a comprehensive picture of the current sanitation situation in relation to local livelihoods, to describe local attitudes towards different sanitation solutions and to describe how ecological sanitation solutions might be implemented that improve local livelihoods and food security. Through this, a framework is produced that can be used for further work on ecological sanitation in the Taita Hills area and other similar contexts.

The ultimate objective of the study is to assess the feasibility and potential of using ecological sanitation to improve food security and sanitation in the study area. The results of this study point to the conclusion that reusing human waste cannot be considered as a taboo in the Taita Hills but could be promoted through locally designed solutions that emphasize simplicity of use as well as education and training regarding ecological sanitation. Comparison between results gained from the different methods point to the conclusion that the more participatory section of the study demonstrated more reserved attitudes towards ecological sanitation among the stakeholders.

Keywords: Ecological sanitation, food security, sustainable development, participatory action methodology



POSTER PRESENTATIONS

Friday 21 August

Posters will be presented at the cafeteria "1/2 Q" on Friday 21st at 12.40 - 13.40. The best poster chosen by the scientific committee will be awarded. The award will be given during the final plenary and closing ceremony on Friday 21st from 16.30 - 17.15 in lecture hall A3-27.

FUNCTIONALITY OF DRY SANITATION SYSTEMS IN NAKURU, KENYA

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Poster presentation

Inadequate safe and sufficient drinking water, and sanitation is a problem of governance and management in Kenya. While there has been efforts to increase water supply coverage, efforts to increase and improve sanitation coverage has been minimal and if considered, the efforts have always been directed towards centralised systems that also compete for the scarce water. Over the last five years, Kenya's development partners have scaled up campaigns for dry sanitation systems in unsewered urban and peri-urban areas. However, major sustainability challenges threaten to undermine these efforts. World over, low rates of functionality as a measure of sustainability haunt development partners. This paper is an outcome of a study conducted to evaluate the functionality of the dry sanitation systems through a purposive survey conducted between July and October 2014 covering Nakuru Municipality in Kenya. Both qualitative and quantitative data was captured. The surveys found out that only 20% of the systems are functional and that only two years after commissioning, 50% of the systems no longer function. Dry sanitation systems are ecological and dynamic in nature. The sustainability of these systems can be enhanced if the users are influenced. Considering the low level of service of dry sanitation systems in Nakuru, the expansion program is threatened. There is need therefore, to further investigate the local sustainability challenges in order to keep the functionality rates high.

Keywords: Challenges, Dry Sanitation, Functionality, Sustainability

SOLAR POWERED DRY TOILET FOR COLD CLIMATE: RESULTS FROM A PILOT STUDY

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Poster presentation

The dry toilet is a common facility in cabins and remote areas throughout Scandinavia. However, the cold climate and extended periods of freezing temperatures reduce the compost processes' speed and efficiency. The result is suboptimal functioning of the toilet – slower composting rate, increased moisture and odors. Some of the existing dry toilet designs provide working solutions for cold climate but they commonly depend on electricity or extensive storage.

In an on-going pilot study, an experimental design of a dry toilet is tested for its functionality. The objective of the study is to test the ability of the design to provide an improved solution for cold climate. Solar power is the driver of heat and electricity production in the toilet and a novel ventilation system provides an odorless toilet room and heat to the composting process. The methodology consist of airflow measurements, registration of temperature, and registration of the light input to the solar panel. The light registration analysis provides the amount of the time during which there is a heat input into the system. The study is ongoing, and it is expected that the findings will confirm that the innovative design will result in enhanced functionality and will extend the active composting period within a year for cold climate. The use of the renewable solar energy makes the toilet a sustainable and autonomous unit and by its increased functionality – more attractive as a choice of a sanitation technology.

Keywords: Dry toilet, solar power, ventilation, composting, odor

DOMESTIC SCALE TREATMENT OF WASTEWATERS IN SAND FILTERS WITH WASTE GYPSUM OR BIOTITE LAYER

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Poster presentation

In countries where electricity and tap water are regularly available people tend to use high volumes of water in spite they can have dry toilets. These waters used will then later form grey wastewater. The grey wastewaters can also contain enteric microorganisms originating from human body washings (especially washing small babies). In areas as in Finnish rural areas where fishing and hunting are usual hobbies these activities can also increase the concentrations of enteric microorganisms in wastewater. Since the volume of these wastewaters can be high, they should be treated before releasing them to nature. In rural areas outside of sewage pipes the households must self build and maintain their wastewater treatment so that the treatment system must be easy and trustful in different situations. In rural areas there is usually space in home plots so that built sand filters serving one or possible two or three households are one possibility.

We have studied the treatment of domestic wastewaters in sand filters fortified with either gypsum or biotite layer. Gypsum and biotite as by-products of mining industry were selected since they are supposed to bind well phosphorus and their price can be low. We have tested the efficiency of sand filters under different wastewater loads e.g. normal, low, high or no loads and thereafter again normal load to know how sand filters can treat wastewater in variable situating mimicking situations when the numbers of inhabitants varies.

The results indicate that the wastewater effluent contained only low concentrations of phosphorus and some other chemical parameters. In additions the numbers of different enteric microorganisms were low. Thus it would be possible to lead these treated wastewaters into surface water bodies.

Keywords: phosphorus reduction, enteric microorganisms, domestic wastewaters, soil filters

MAXIMISING THE VALUE OF HUMAN WASTE DERIVED FROM DRY TOILETS AS FERTILISER IN MADAGASCAR

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Poster presentation

Soil fertility is low in many parts of Africa due to reduced application of fertilisers (about 8kg/ha, one tenth of the world average¹), leading to reduced crop productivity and hence decreasing income for local farmers. Another issue prevailing in Sub-Saharan Africa (SSA) is the safe treatment and disposal of human waste. It is estimated that between 65% and 100% of sanitation in SSA is provided by on-site sanitation systems², which require emptying and appropriate treatment and disposal to prevent public health and environmental hazards. Transforming human waste into soil conditioners is one way to resolve these challenges in a sustainable manner, creating an economic incentive for treating and revalorising toilet waste and producing an organic soil amendment to improve soil fertility and achieve full nutrient recycling.

A project is now underway in Madagascar funded by Loowatt (a UK SME which has designed a novel dry toilet and pioneers human waste composting in Madagascar), investigating the feasibility of full nutrient recycling of human wastes into soil by producing a soil conditioner and fertiliser that is attractive to the local area where it is produced. The study is based on a case study in the capital of Madagascar, Antananarivo, which will serve as an example of the challenges and opportunities of human waste recycling and set the path for its realisation in other countries. The project will include field scale and glasshouse trials with maize and tomato as test crops applied with treated human waste materials. The aim is to demonstrate and compare the fertilising potential 3 different types of soil amendments derived from human waste, namely pasteurised digestate from anaerobic digestion (AD), compost and vermicompost from AD digestate and straw. The agronomic value of the fertilisers and their environmental and health safety will be determined through nutrient (nitrogen, phosphorus, potassium, magnesium, manganese, iron, zinc, calcium), heavy metals (copper, zinc, lead, cadmium, nickel, chromium) and microbiological (E.coli and Helminth eggs) soil analyses supplemented by nutrient analysis of the crops harvested from the trials. This project will also explore business models that can be utilised to create a fertiliser market for such products by carrying out an analysis of the fertiliser supply chain in the area of Antananarivo as well as interviews with local farmers to explore current fertiliser consumption habits and needs.

Field trials were carried out in Antananarivo until March 2015 on a 200m² plot of land divided into blocks with 5 different fertiliser treatments applied (digestate (D), compost (C), vermicompost (V), chemical fertiliser (F) and control) at 5 different rates arranged in a randomised block design with three replicates. Glasshouse pot trials started in the UK in April 2015 with 9 fertiliser treatments (D, C, C+D, C+ F, V, V+D, V+F, F and control). Results from field trials and initial fertiliser market analysis will be presented.

Keywords: human waste, fertiliser, nutrient recycling, crop trial, Madagascar

WATER RESOURCES SAVING: A POSSIBLY CONTRIBUTION FROM A GREYWATER COLLECTION, TREATMENT AND REUSE IN A PUBLIC BUILDING

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Poster presentation

In 2014 Sao Paulo, the most economically important city of Brazil, residents are facing the worst drought in eight decades which is threatening drinking supplies. The main reservoir system Cantareira has almost reached rock bottom. Another problem is that Sao Paulo's rivers, which are the water sources, are completely polluted. In this context, water reuse is an important tool that can contribute to the reduction of the pressures from human activities on water resources and to reduce the demand for potable water for purposes that do not require high quality water. In public buildings the rational water consumption and water reuse can generate significant reduction in water savings expenses.

Therefore, the main objective of this study was to evaluate a greywater collection and treatment system from lavatories, showers and washing machine aiming the non-potable reuse in buildings. The specific objectives were: to characterize in terms of quality and quantity the greywater from each source, to monitor a pilot system for synthetic greywater treatment and for real greywater treatment, to analyze the quality of the effluent after treatment, to compare the pilot system with other greywater treatment processes, and to indicate potential non-potable uses for treated water. In an existing building in the University of Sao Paulo campus, the wastewater collection drains were modified to allow the segregated wastewater collection and the greywater characterization and treatment. To evaluate the greywater generation three water flow meters were installed in water inlet of each greywater source (washing machine, showers and lavatories). The greywater treatment included a moving bed biofilm reactor (MBBR) and a settling tank at pilot scale. The evaluation of greywater treatment was conducted based on the periodic monitoring of several physicochemical water quality parameters during the operation of the experimental system. Based on the results, amongst the three greywater sources, the greywater from showers had the highest E. coli count while the lavatories greywater had the highest total coliforms count. The removal efficiencies of BOD and COD were 59% e 70% respectively. In addition there was low removal of phosphorus and there was not Total Nitrogen Removal during the treatment. In comparison with other studies with MBBR for wastewater treatment the COD, BOD and nutrient removal in this study were low. The quality of treated water could not be used for flushing toilet due to the high turbidity. We concluded the greywater generation data and raw greywater characterization are essential for greywater reuse planning. Currently we are monitoring the pilot system with real greywater and doing the analyses of effluent samples to evaluate the process.

Keywords: Water reuse, Greywater, Sustainable Sanitation, Water Conservation, Sustainability

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