AGRO'2014

9th IWA International Symposium on Waste Management Problems in Agro-Industries

Programme

-Organiser-
AGRO'2014 Organising Committee

-Co-organisers-
Japan Society on Water Environment
Kochi University
Japan Science and Technology Agency

Kochi, Japan

24-26 November, 2014

Welcome Message

On behalf of the organising committee of the ninth IWA International Symposium on Waste Management Problems in Agro-Industries (AGRO'2014), I would like to welcome all participants from all over the world to this symposium.

This series of symposia was initiated in Istanbul, Turkey, in 1989 to discuss and find solutions for environmental issues in such agro- industries as textiles, pulp and paper, leather, and various foodstuffs, including sugar, edible oils, and beverages. The wide interest among participating scientists and the high quality of their contributions helped establish a series of IAWQ symposia, with the second event being held again in Istanbul, in 1992. The third, fourth, and fifth symposia were held in Mexico City in 1995, Istanbul in 1998, and Shiga, Japan, in 2001. The sixth IWA specialty symposium was held in Seoul in 2003, and it primarily addressed the issue of "Strong Nitrogenous and Agro Wastewater." The seventh and eighth symposia were held in the Netherlands in 2006 and in Çeşme, Turkey, in 2011. AGRO'2014 will thus be the ninth of this series of regular scientific events organized under the same umbrella.

The AGRO series of symposia will continue to be the most effective platform for discussing waste-management problems in the agro-industries. Among other areas, contributions in AGRO'2014 are expected on the treatment and use of waste from stockbreeding, runoff and control of pollutants from agricultural areas, and climate change mitigation and adaptation by the agro-industries. In addition, AGRO'2014 aims to provide special forums, CREST and SATREPS sessions, to discuss innovative technologies and systems for the management of water and waste in agricultural areas.

The venue for AGRO'2014 is located across from Kochi Castle, which is listed as one of Japan's Important Cultural Properties. I hope that symposium participants will be able to exchange information in a relaxed atmosphere during their stay in Kochi, with its beautiful scenery, clean water environment, and traditional dishes made using fresh agricultural and marine products.

We hope you enjoy AGRO'2014 and your stay in Kochi.

Prof. Dr. Taku Fujiwara
Chair of AGRO'2014

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General Information of AGRO'2014

9th IWA International Symposium on Waste Management Problems in Agro-Industries

Date: 24 – 26 November, 2014

Venue: The Crown Palais New Hankyu Kochi, Kochi, Japan

Website: http://www.kochi-u.ac.jp/agro2014/index.html

Language: The official language of the symposium is English.

Registration desk

The registration/information desk will be opened during the following times at lobby of 3rd floor.

Sunday, 23 November, :14:00 – 18:00
Monday, 24 November, : 8:00 – 18:00
Tuesday, 25 November, : 8:00 – 18:00
Wednesday, 26 November, : 8:00 – 15:00

Secretariat

The symposium secretariat is located on the 3rd floor. For any inquiry, please feel free to contact our staff members there.

Welcome Cocktail

The welcome cocktail will take place on 24 November, at Room C and D on 3rd floor of the venue.

Conference Dinner

The conference dinner will take place on 25 November, at Room A and B on 3rd floor of the venue.

CREST Session and SATREPS (Ameli-eaur) Session

Two special sessions are organized on 24 November, at Room A, to discuss innovative technologies and systems for the management of water and waste in agricultural areas. CREST session is supported by Japan Science and Technology Agency, Japan and SATREPS session is supported by Japan Science and Technology Agency and Japan International Cooperation Agency.

Oral presentation

Presentations are limited to 15 minutes: 12 minutes for presentation and 3 minutes for discussion. Slide must be in Powerpoint or PDF format. Speakers are requested to copy their presentation file

directly to the computer in the presentation room, and to confirm its appearance on the screen, at least 20 minutes prior to the start of the session. (Room will be opened 8:30 in the morning.).

Poster presentation

Poster boards with 90 cm width and 210 cm height will be prepared in the Poster Presentation Room. The formal poster session is 16:00–18:00 on Tuesday, 25 November, however your poster can be on display for the duration of the conference. Poster presenters are required to stand by your poster, at least during the formal poster session, to answer questions and meet colleagues with similar research interests. Put your poster on the board with the identified presentation number between 8:00-12:00 on Tuesday, 25 November, and remove your poster after the presentation by 16:00 on Wednesday, 26 November.

Awards

"AGRO'2014 presentation award for young researchers"

"AGRO'2014 poster award for young researchers"

"AGRO'2014 presentation award for young researchers" and "AGRO'2014 poster award for young researchers" will be given for the outstanding presentations (oral and poster presentations) by the young researchers (below 36 years old at 26 November, 2014) including students from both industry and academia.

Lunch Distribution

Lunch can be available on 4th floor of the venue on 24 and 25 November. You can take the lunch box on 26 November.

Name Badge and Identification

All participants and accompanying persons must wear the conference identification badge at all time during the conference. Accompanying persons are not permitted to attend the conference sessions.

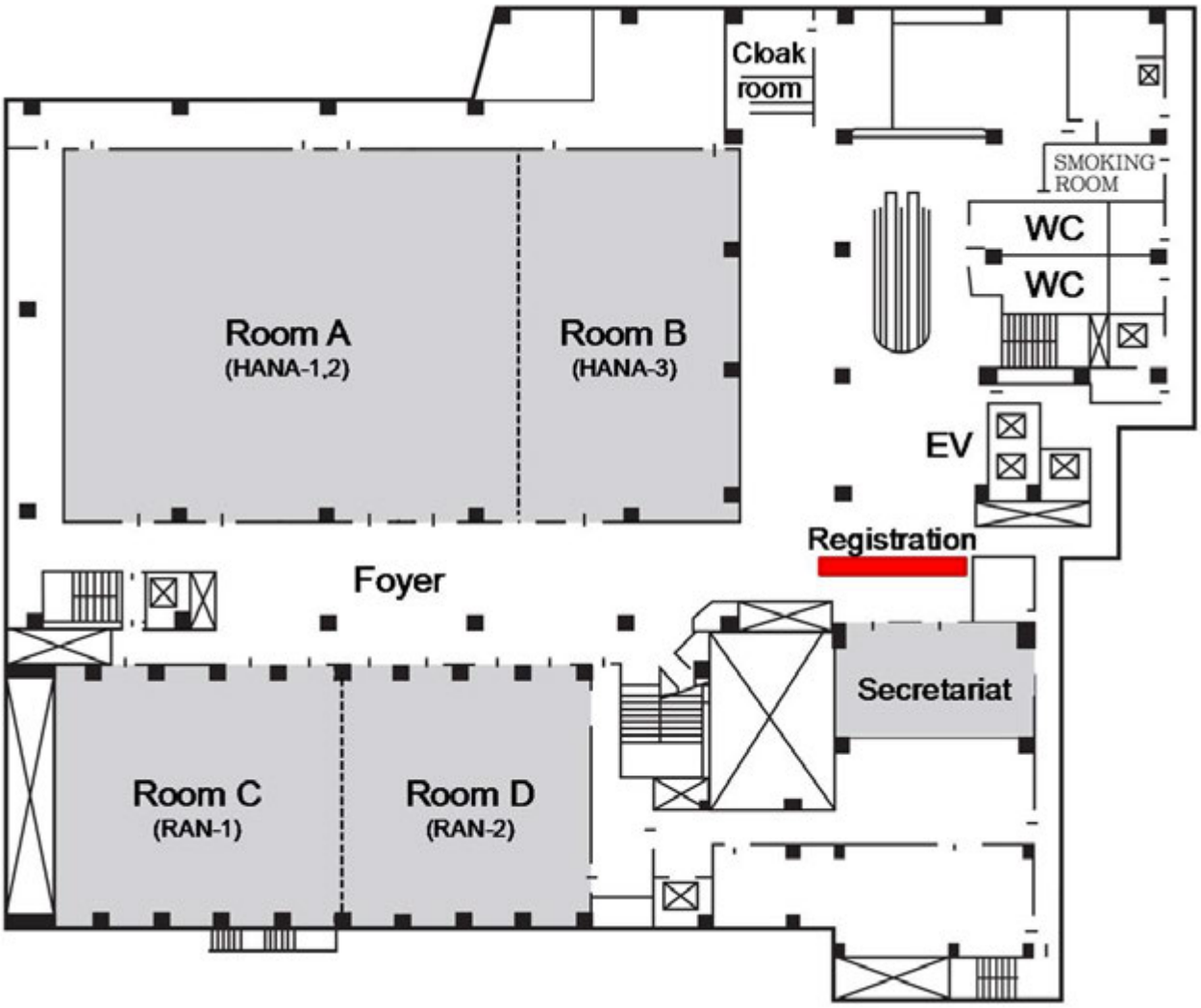
JSWE-IDEA International Activity Award

The Japan Society on Water Environment (JSWE) recognizes activities that are selected as excellent international activities that meet the goals of JSWE as JSWE-IDEA International Activity Award to encourage international interaction and cooperation, and provides grants to cover the partial or entire costs of the selected activity. AGRO'2014 organising committee is proud to announce that AGRO’2014 has received from JSWE for JSWE-IDEA International Activity Award of the Year 2014.

Venue Floor

The Crown Palais New Hankyu Kochi

3rd Floor



Programme at a Glance

Time	Monday, 24 November			
	Room A	**Room B**	**Room C**	**Room D**
9:00-9:20	**Opening Ceremony**			
9:20-9:50	**Keynote Speech 1** Prof. Dr. Olcay Tünay			
9:50-10:20	**Keynote Speech 2** Prof. Dr. Shinichiro Ohgaki			
10:20-10:45	Coffee Break			
10:45-12:00	**Session 1-1** Biological treatment of wastewaters and wastes	**Session 2-1** Chemical treatment of wastewaters and wastes	**Session 4-1** Resources recovery and reuse	
12:00-13:30	Lunch			
13:30-14:00	**Keynote Speech 3** Prof. Dr. Taku Fujiwara			
14:00-14:30	CREST Session			
14:30-15:00		**Session 2-2** Chemical treatment of wastewaters and wastes		
15:00-15:45		**Session 5-1** Advanced treatment processes and innovative technological applications		
15:45-16:15	Coffee Break			
16:15-16:40	**Keynote Speech 4** Prof. Dr. Amadou Hama Maiga			
16:40 (16:45) -18:30 (18:15)	SATREPS (Ameli-eaur) Session	**Session 5-2** Advanced treatment processes and innovative technological applications		
18:30-20:00			**Welcome Cocktail**	

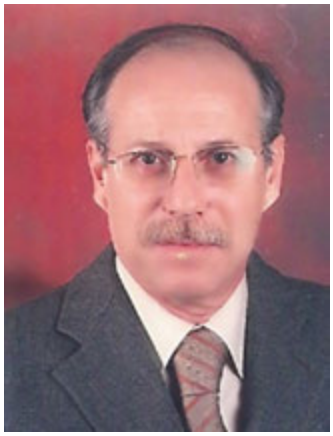
Time	Tuesday, 25 November			
	Room A	**Room B**	**Room C**	**Room D**
9:00-9:30	**Keynote Speech 5** Prof. Dr. Gianluca Li Puma			
9:30-10:15	**Session 5-3** Advanced treatment processes and innovative technological applications	**Session 1-2** Biological treatment of wastewaters and wastes	**Session 4-2** Resources recovery and reuse	**Poster and Exhibition**
10:15-10:45	Coffee Break			
10:45-11:15	**Session 5-4** Advanced treatment processes and innovative technological applications	**Session 1-3** Biological treatment of wastewaters and wastes	**Session 4-3** Resources recovery and reuse	
11:15-11:45	**Session 6** Modeling and design interaction			
11:45-13:30	Lunch			
13:30-14:00	**Keynote Speech 6** Prof. Dr. Seong-Wook Oa			
14:00-14:45	**Session 8** Treatment and use of waste from stockbreeding	**Session 1-4** Biological treatment of wastewaters and wastes	**Session 9-1** Run-off and control of pollutants from agricultural areas	
14:45-15:15	Coffee Break			
15:15-16:00	**Session 7-1** Sludge stabilization, utilization and disposal	**Session 1-5** Biological treatment of wastewaters and wastes	**Session 9-2** Run-off and control of pollutants from agricultural areas	
16:00-18:00				**Poster Presentation (Core time)**
18:00-20:00	**Conference Dinner**			

Time	Wednesday, 26 November			
	Room A	**Room B**	**Room C**	**Room D**
9:00-9:30	**Keynote Speech 7** Prof. Dr. Yoshito Yuyama			**Poster and Exhibition**
9:30-10:15	**Session 7-2** Sludge stabilization, utilization and disposal	**Session 1-6** Biological treatment of wastewaters and wastes	**Session 9-3** Run-off and control of pollutants from agricultural areas	
10:15-10:45	Coffee Break			
10:45-11:45	**Session 7-3** Sludge stabilization, utilization and disposal	**Session 11-1** The climate change mitigation and adaptation in agro-industries	**Session 9-4** Run-off and control of pollutants from agricultural areas	
11:45-13:30	Lunch			
13:30-14:00	**Keynote Speech 8** Prof. Dr. Banu Örmeci			
14:00-14:45	**Session 3-1** Nutrient removal and recovery	**Session 11-2** The climate change mitigation and adaptation in agro-industries	**Session 10-1** Innovative water and waste management system for agricultural area	
14:45-15:15	Coffee Break			
15:15-16:00	**Session 3-2** Nutrient removal and recovery	**Session 11-3** The climate change mitigation and adaptation in agro-industries	**Session 10-2** Innovative water and waste management system for agricultural area	
16:15-17:00	**Closing Ceremony**			

Keynote Speakers

Prof. Dr. Olcay Tünay

Professor in the Department of Environmental Engineering, Civil Engineering Faculty, Istanbul Technical University, Turkey



He received ME in Chemical Engineering and Ph.D. in Environmental Sciences from Istanbul Technical University. He conducted and joined national and international research projects mostly with European institutions. Major areas of research are; aquatic chemistry, chemical treatment of wastewaters, industrial pollution control and treatment and recovery of nutrients from human wastes.

Prof. Dr. Shinichiro Ohgaki

President of Japan Water Research Center (JWRC), Japan

Prof. Shinichiro Ohgaki is currently the President of Japan Water Research Center (JWRC). He used to be appointed to the President of National Institute for Environmental Studies, Japan since April 2009 to March 2013. He was a professor at the Department of Urban Engineering, the University of Tokyo until March 2009, and he is Prof. Emeritus. He was awarded PhD in the field of environmental engineering from the University of Tokyo in 1974. He has long experience of education and research in environmental engineering, water supply technology, urban environmental policy and sustainable development at Tohoku University, the University of Tokyo, and Asian Institute of Technology (AIT, Thailand).

He directed and managed the Graduate School of Engineering, the University of Tokyo, as a dean from April 2002 to March 2004. He served also as the vice-president to Science Council of Japan (SCJ).

He worked as a project leader in several great research projects. He directs currently as the research supervisor CREST Project related to sustainable water use under support of Japan Science and Technology Agency (JST)

In International Water Association (IWA), he was a steering committee member of Health-Related Water Microbiology Specialist Group, and one of the Vice Presidents from 2006 to 2008.

Prof. Dr. Taku Fujiwara

Professor in the Agriculture Unit at Kochi University, Japan

Prof. Taku Fujiwara completed his Ph.D. in Environmental Engineering at Kyoto University, Japan, in 1999. He is a Professor in the Agriculture Unit at Kochi University, Japan.

He is a research director of a national project launched in 2009 entitled "Development of an innovative water management system with decentralized water reclamation and cascading material-cycle for agricultural areas under the consideration of climate change" in CREST research area of Innovative Technology and System for Sustainable Water Use by Japan Science and Technology Agency.

As a Chair of AGRO'2014, he welcomes all participants from all over the world to this symposium.

Prof. Dr. Amadou Hama Maiga

Director General of the International Institute for Water and Environemental Engineering :2iE in Ouagadougou, Burkina Faso

Prof Amadou Hama Maiga, was graduated as Civil Engineer in 1979 . He has PhD degree in Water and Environment Sciences and Engineering from the Swiss Federal Institute of Technology Lausanne (EPFL). Before he joins the 2iE (formally EIER-ETSHER in 1986), he has worked as Engineer and as a lecturer at different companies in Switzerland and Mali.

At 2iE he has occupied positions of lecturer, Head of the Department of Sanitary Engineering, Director for Research. and Deputy Director Général. He has developped and leaded the laboratory of Pollution Control and Water Treatment of 2iE. He funded f the 2iE Journal "Sud Sciences et Technologie". He is member of many scientific committees and international Consortiums and Associations such as The Scientific Council of the Canadian Consortium for Research on Climate Adaptation: Ouranos; the Board of the African Water Association: AfWA; the Board of Section I "Water and soil" of the International Commission of Agricultural Engineering: CIGR; the Scientific Council of the French Inter-Agency for Research and Development (AIRD). Prof Amadou Hama Maiga is Governor for World Water Council since 2012.

Professor Amadou Hama Maiga was awarded of the 2009 Grand Prix of the Foundation of Suez Environment - for his research and innovative works on water supply to underprivilieged populations.

Prof. Dr. Gianluca Li Puma

Professor of Chemical and Environmental Engineering at Loughborough University, United Kingdom

Gianluca Li Puma is Professor of Chemical and Environmental Engineering at Loughborough University and leads "Environmental Nanocatalysis and Photoreaction Engineering" research in the fields of photocatalysis, environmental nanocatalysis, advanced oxidation processes, environmental applications, solar energy conversion and solar engineering. He is an international expert on solar photocatalytic detoxification for the removal of water contaminants. He is Editor of Journal of Hazardous Materials. He is also co-chairman of the 20th International Conference on Advanced Oxidation Technologies (San Diego, 2014) and ACS symposium on New Advances in the Chemistry and Application of Advanced Oxidation Processes for Removal of Contaminants of Emerging Concern (San Francisco, 2014).

Prof. Dr. Seong-Wook Oa

Professor of Railroad, Civil & Environmental Engineering, Woosong University, Daejeon, S. Korea

Prof. Seong-Wook Oa received M.S. and Ph.D. in Environmental Engineering from Korea University, Seoul, S. Korea. He is a full professor in the Department of Railroad, Civil & Environmental Engineering at Woosong University, and head of Soil Environmental Research Center since 1996. His research group has been studied in field of resource recovery and nitrogen control from animal wastes supported by Korea Ministry of Environment over the past 10 years. And also he has been trying to control the water resources via management of non-point sources in an agricultural area.

Dr. Yoshito Yuyama

Chief Researcher at the Renewable Resources Engineering Research Division, National Institute for Rural Engineering, NARO, Japan

He was born on January 16, 1960 in Ehime, Japan. He obtained Ph. D degree from Kyoto University in 1988.

He started his career as irrigation, drainage and environment engineering researcher at National Research Institute of Agricultural Engineering from 1984. He contributed as water management expert of JICA in Thailand for three years. He is now Chief Researcher of Renewable Resources Engineering Research Division, National Institute for Rural Engineering, NARO since April 2011.

His specialties are planning and evaluation of biomass use system, water management, water quality conservation, regional drainage analysis, wastewater treatment technology, and rural planning.

Prof. Dr. Banu Örmeci

Professor of Department of Civil and Environmental Engineering at Carleton University, Canada

Prof. Banu Örmeci completed her M.S. and Ph.D. in Civil and Environmental Engineering at Duke University (North Carolina, USA). She is a Professor and Canada Research Chair in Wastewater Treatment Engineering in the Department of Civil and Environmental Engineering at Carleton University (Ottawa, Canada), and is the recipient of several prestigious research, teaching, and mentoring awards. Her research focuses on wastewater and biosolids treatment. She is the Chairperson of the International Water Association (IWA)'s Specialist Group on Sludge Management.

Oral Presentations Programme

Time	Monday, 24 November			
	Room A	**Room B**	**Room C**	**Room D**
9:00-9:20	***Opening Ceremony***			
9:20-9:50	***Keynote Speech 1*** The role of chemical treatment in the control of pollution from Agro Industries *Prof. Dr. O. Tünay*			
9:50-10:20	***Keynote Speech 2*** Science and technology for sustainable water management *Prof. Dr. S. Ohgaki*			
10:20-10:45	*Coffee Break*			
	Session 1-1 ***Biological treatment of wastewaters and wastes*** ***Chair*** ***Prof. Hiroshi Tsuno***	***Session 2-1*** ***Chemical treatment of wastewaters and wastes*** ***Chair*** ***Prof. Gianluca Li Puma***	***Session 4-1*** ***Resources recovery and reuse*** ***Chair*** ***Prof. Tsuyoshi Imai***	
10:45-11:00	Innovative bioreactors for the treatment/reuse of milking parlor and swine wastewater for land limited application *L. Dong, A. C. Liu, C. Y. Chou, P. Y. Yang*	Sulphate control by ettringite precipitation in textile industry wastewaters *I. Kabdaşlı, A. Bilgin, O. Tünay*	Effect of pH on volatile and medium chain fatty acids production during anaerobic digestion process *E. Jankowska, J. Chwialkowska, M. Stodolny, P. Oleskowicz-Popiel*	
11:00-11:15	Feasibility study of applying anaerobic immobilized cells for treatment of domestic sewage *R. Y. Lin, A. C. Liu, C. Y. Chou*	Sequential resin fractionation method as a useful tool to characterize olive mill wastewater before and after chemical treatment applications *B. H. Gursoy-Haksevenler, I. Arslan-Alaton, T. Olmez-Hanci, O. Tunay*	Quantitative X-Ray diffraction (XRD) reveals the influences of calcium and ferric ions on struvite crystallization *H. Yan, K. Shih*	
11:15-11:30	Treatment of restaurant wastewater by combination system of anaerobic baffled reactor (ABR) and aerobic trickling filter *H. Sonaka, K. Nakahara, N. Yokote, D. Tanikawa*	Impact of ozonation on water quality change of sewage *A. Yoshida, T. Mizuno, Y. Kusuda, F. Nishimura*	Duckweed biomass as a renewable biorefinery feedstock: Ethanol and succinate production from *Wolffia globosa* *S. Soda, T. Ohchi, J. Piradee, Y. Takai, M. Ike*	
11:30-11:45	Effect of salinity on organic matter removal from polluted agriculture drainage water by moving bed biofilm reactor *M. Ateia, M. Nasr, C. Yoshimura, M. Fujii*	Using ultraviolet light and high temperature with sodium persulfate to catalyze the azo dye wastewater *M. C. Chang, J. S. Tang*	Pilot scale resource recovery from cattle paunch waste *C. M. Mehta, P. D. Jensen, D. J. Batstone*	
11:45-12:00		Eco-design of Fenton-like processes using laterites and activated carbons for the degradation of bio-reluctant organic compounds in wastewater *H. Karoui, B. Maba, G. M. R. Kpinsoton, Y. Richardson*	High solid anaerobic co-digestion of garbage, rice straw and rice husk *R. Yamamoto-Ikemoto, T. Gu, M. Takano, T. Tsuritani, S. Kitano, M. Okamoto*	
12:00-13:30	***Lunch***			

Time	Monday, 24 November			
	Room A	**Room B**	**Room C**	**Room D**
13:30-14:00	***Keynote Speech 3*** Development of an innovative water management system with decentralized water reclamation and cascading material-cycle for agricultural areas *Prof. Dr. T. Fujiwara*			
	CREST Session ***Chair: Dr. Masato Yamada***	***Session 2-2*** ***Chemical treatment of wastewaters and wastes*** ***Session 5-1*** ***Advanced treatment processes and innovative technological applications*** ***Chair: Dr. Fumitake Nishimura***		
14:00-14:15	Non-sterile simultaneous saccharification and fermentation of corn biomass to L-lactic acid without external nutrient addition *S. Akao, H. Nagare, M. Maeda, K. Kondo, T. Fujiwara*			
14:15-14:30	Emission and control of nitrous oxide and composition of ash derived from cattle manure combustion using a pilot-scale fluidized bed incinerator *K. Oshita, K. Kawaguchi, M. Takaoka, K. Matsukawa, T. Fujimori, T. Fujiwara*			
14:30-14:45	Sulfonamide antibiotic removal and nitrogen recovery from synthetic urine by the combination of rotating advanced oxidation contactor and methylene urea synthesis process *S. Fukahori, T. Fujiwara, R. Ito, N. Funamizu*	Degradation and detoxicity of tetracycline by an enhanced sonolysis *C. Wang, J. J. Jian*		
14:45-15:00	Beneficial utilization methods for fish processing by-products as fish feed additives *H. Fukada, N. Takahashi, N. Hosomi, T. Masumoto*	Synthesis of Fe/ZrO_2 catalyst to remove direct orange 26 from water by Fenton oxidation at wide pH values *N. Ayas, Y. Asci, M. Yurdakul*		
15:00-15:15	Novel recycling technique of paper sludge using ionic liquid -Preparation of functional materials for water purification- *H. Ichiura, M. Kamada, A. Ono, Y. Ohtani*	A comparative study of $HO^{\bullet}$- and $SO_4^{\bullet-}$-based AOPs for the degradation of non-ionic surfactant Brij30® *I. Kabdaşlı, C. Ecer, T. Olmez-Hanci, O. Tünay*		
15:15-15:30	Integrated evaluation of the innovative water and waste management system for agricultural areas *M. Yamada, T. Masuda, M. Matsuoka, T. Hase, T. Ishigaki, T. Fujiwara*	Sulfate radical based oxidation processes for decolorization of azo dye wastewater using nano iron catalyst *H. Y. Shu, M. C. Chang, H. W. Hsu*		
15:30-15:45	Discussion	Removal of endcrinedisrupting compounds from wastewater using polymer particles *A. Murray, B. Örmeci, E. P. C. Lai*		
15:45-16:15	*Coffee Break*			

Time	Monday, 24 November			
	Room A	**Room B**	**Room C**	**Room D**
16:15-16:40	***Keynote Speech 4*** Water resources management in West Africa: Threats from global changes, eutrophication and solids transport in water reservoirs in Burkina Faso *Prof. Dr. A. H. Maiga*			
	SATREPS (Ameli-eaur) Session ***Chair*** ***Prof. Naoyuki Funamizu***		***Session 5-2*** ***Advanced treatment processes and innovative technological applications*** ***Chair*** ***Dr. Shuji Fukahori***	
16:40-16:50	Political sociology of African peasants' dynamics faced with the new technology of compost toilet: case of Burkina Faso *T. Nabeshima*	16:45-17:00	Fabrication and characterization of CdS doped TiO_2 nanotube composite and its photocatalytic activity for the degradation of methyl orange *J. Jung, J. O. Kim*	
16:50-17:00	Land utilization and property system in Burkina Faso: A case study in Ziniaré *F. Hakoyama*			
17:00-17:10	Ceramic filters impregnated with colloidal-silver for point-of-use water treatment in rural and peri urban areas in Burkina Faso *Y. Konate, E. Bleu, M. Sou/Dakoure, A. H. Maiga*	17:00-17:15	Treatment of waste-milk containing tetracycline by magnetic activated sludge and contact oxidation process *Gaowa, Y. Sakai, M. L. Saha, I. Ihara*	
17:10-17:20	Microbial risk assessment associated with post-treatment of compost from the composting toilet *H. S. Darimani, R. Ito, M. Sou/Dakoure, N. Funamizu, H. Yacouba, A. H. Maiga*	17:15-17:30	Decomposition of pesticides in water by using a slurry type TiO_2 in water treatment apparatus *Y. Hashimoto, K. Hara, T. Takaoka, B. Sarangaraja, Y. Maruo, D. Ino, M. Aizawa*	
17:20-17:30	Maturity and hygienic quality of composts produced with various bulking agents in composting toilet for agriculture reuse *S. K. Sossou, M. Sou/Dakoure, N. Hijikata, B. Kamdem Djomou, A. H. Maiga, N. Funamizu*			

Time	Monday, 24 November			
	Room A	**Room B**	**Room C**	**Room D**
	SATREPS (Ameli-eaur) Session ***Chair*** ***Prof. Naoyuki Funamizu***	***Session 5-2*** ***Advanced treatment processes and innovative technological applications*** ***Chair*** ***Dr. Shuji Fukahori***		
17:30-17:40	Mobilizing communities for use of by-products of sanitation: Case study of the Ameli EAUR project. *M. Bologo/Traore, M. Sou/Dakoure, A. H. Maiga, T. Nabeshima, F. Hakoyama, S. Dicko*	17:30-17:45 Application of nitrite build-up for the nitrogen removal from ammonium-rich anaerobic digester supernatant with SBR process *K. Gil, J. Im*		
17:40-17:50	Salinity assessment in urine application as nitrogen source for vegetable cultivation *M. Sou/Dakouré, F. Kagabika, D. Sangaré, R. Lahmar, B. Sawadago, A. H. Maïga*	17:45-18:00 Development of a novel flotation process for enhancing oil recovery from palm oil mill effluent *T. V. Le, T. Imai, D. Ayukawa, H. T. Vo, T. Higuchi*		
17:50-18:00	Reuse of treated greywater for lettuce irrigation: effects on plant growth, yield and soil properties *B. Sawadogo, D. Sangare, M. Sou, N. Hijikata, Y. A. Kabore, A. H. Maiga, N. Funamizu*			
18:00-18:10	Design and operation of high rate algal pond treating greywater and producing reclaimed water and fertilizer *M. Takahashi, H. Derabe Maobe, M. Onodera, H. Satoh, T. Fukazawa*	18:00-18:15 Cultivation of a *S. platensis* with digested piggery wastewater *R. Liu, Q. Guo, W. Zheng, L. Chen, J. Luo*		
18:10-18:20	Potential of treated wastewater reuse for agricultural irrigation in Ouagadougou, Burkina Faso *A. Michinaka, H. Shigemura, R. Kawasumi, H. Yamashita, E. Takashima*			
18:20-18:30	Growth characteristics of salt-tolerant plants and salt accumulation in soil using organic composts *M. Murakami, T. Nakaso, N. Hijikata, T. Mouri, S. Nishimura, M. Fujimaki*			
18:30-20:00			***Welcome Cocktail***	

Time	Tuesday, 25 November			
	Room A	**Room B**	**Room C**	**Room D**
9:00-9:30	***Keynote Speech 5*** Advanced oxidation technologies for the treatment and reuse of agro-industrial wastewater and simultaneous production of renewable energy *Prof. Dr. Gianluca Li Puma*			***Poster and Exhibition***
	Session 5-3 ***Advanced treatment processes and innovative technological applications*** ***Chair*** ***Prof. Banu Örmeci***	***Session 1-2*** ***Biological treatment of wastewaters and wastes*** ***Chair*** ***Prof. Emine Çokgör***	***Session 4-2*** ***Resources recovery and reuse*** ***Chair*** ***Prof. Jong-Oh Kim***	
9:30-9:45	Partial nitritation (SHARON) of nitrogen-rich refinery wastewater with high C/N ratio *S. Milia, M. Perra, G. Cappai, A. Carucci*	Evaluation of treatment performance of a pilot-scale constructed wetland treating waste landfill leachate in thailand *Y. Ogata, T. Ishigaki, Y. Ebie, N. Sutthasil, C. Chiemchaisri, M. Yamada*	Production of calcium phosphate on the shell particles of Mizuhopecten yessoensis in urine *R. Ito, N. Funamizu*	
9:45-10:00	Practical use of new system for highly efficient recovery of energy from sewage and garbage *F. Shinya, H. Tsuboi, A. Miyata, M. Shimada, H. Yamashita*	Effects of filter media layer composition and depth on greywater treatment by vermifiltration *A. T. Adugna, H. A. Andrianisa, Y. Konate, A. Ndiaye, A. H. Maiga*	Effect of burned shell dosage on crystal species in synthetic cow urine *S. Kaneko, R. Ito, N. Funamizu*	
10:00-10:15	Long term nitrogen compound removal trend of a hybrid subsurface constructed wetland treating milking parlour wastewater throughout its seven years of operation *J. Harada, T. Inoue, K. Kato, H. Izumoto, X. Zhang, H. Sakuragi, D. Wu, H. Ietsugu, Y. Sugawara*	Removal of (α+β)-endosulfan and endosulfan sulfate from agricultural sewage in a HSBR-GAC system *I. López-Apodaca, P. Gortares, G. Ulloa, E. R. Meza-Escalante, G. Buitrón, D. Serrano*	Development of a new wastewater treatment process for resource recovery as carotenoid *H. Sato, H. Nagare, Huynh Thi Ngoc Chau, H. Komatsu*	
10:15-10:45	*Coffee Break*			

Time	Tuesday, 25 November			
	Room A	**Room B**	**Room C**	**Room D**
	Session 5-4 ***Advanced treatment processes and innovative technological applications*** ***Session 6*** ***Modeling and design interaction*** ***Chair*** ***Prof. Michihiko Ike***	***Session 1-3*** ***Biological treatment of wastewaters and wastes*** ***Chair*** ***Prof. Ryoko Yamamoto-Ikemoto***	***Session 4-3*** ***Resources recovery and reuse*** ***Chair*** ***Prof. Olcay Tünay***	
10:45-11:00	Bulk liquid pertraction of NaCl from aqueous solution using carrier-mediated transport *M. M. Naim, A. A. El-Shafei, A. A. Moneer, M. M. Elewa, W. G. Kandeel*	Anaerobic co-digestion of agro-wastes and pre-treated wastewater sludges *B. A. Alagöz, A. Erdinçler, O. Yenigün*	Adequate handling conditions of composting toilets using calcium lime and ash evaluated by microbiological safety of end product *N. Hijikata, R. Tezuka, S. Kazama, M. Ohtaki, D. Sano, K. Ushijima, R. Ito, S. Okabe, N. Funamizu*	***Poster and Exhibition***
11:00-11:15	Desalination of simulated seawater by purge-air pervaporation using an innovated fabricated membrane *M. M. Naim, M. M. Elewa, A. A. El-Shafei, A. A. Moneer*	Effect of pretreatment techniques on solubilization and hydrogen and methane generation by thermophilic anaerobic digestion of food waste *A. Menon, F. Ren, A. Giannis, J. Y. Wang*	Grey water treatment by slanted soil system in terms of phytotoxicity *K. Ushijima, N. Hijikata, E. Tanaka, N. Funamizu, R. Ito*	
11:15-11:30	Regression-based estimation of nitrogen concentration in groundwater using geographical and statistical information *M. Matsuoka, T. Fujiwara*	Expression of acidic failure for the methane fermentation in food waste digestion *Ngo Van Anh, Nguyen Thi Ha, Le Van Chieu, R. Goel, M. Terashima, H. Yasui*	Treated wastewater quality and the risk of intestinal helminthes infection for vegetable producer groups in Kossodo, Burkina Faso *N. W. Kpoda, M. Sou/Dakouré, A. H. Maïga, G. B. Kabré*	
11:30-11:45	Development of a model for evaluation of total recycling and waste treatment system of organic waste -A case study in Kochi prefecture, Japan- *T. Hase, Y. Watanabe, M. Yamada, T. Fujiwara*	Is it possible to treat faecal sludge of Ouagadougou with constructed wetland planted with *Oryzalongistaminata or Sporoboluspyramidalis* ? *T. Kouawa, A. Wanko, C. Beck, A. H. Maïga, R. Mose*	Basic study of local production and consumption of phosphorus from sewage in the Shigenobu River Basin *T. Fukushima*	
11:45-13:30	***Lunch***			

Time	Tuesday, 25 November			
	Room A	**Room B**	**Room C**	**Room D**
13:30-14:00	***Keynote Speech 6*** Resource recovery processes from animal waste as best available technology *Prof. Dr. S.W. Oa*			
	Session 8 ***Treatment and use of waste from stockbreeding*** ***Chair*** ***Dr. Tomonori Ishigaki***	***Session 1-4*** ***Biological treatment of wastewaters and wastes*** ***Chair*** ***Prof. Otto Nowak***	***Session 9-1*** ***Run-off and control of pollutants from agricultural areas*** ***Chair*** ***Prof. Taku Fujiwara***	
14:00-14:15	Feasibility of pig manure treatment by dry-thermophilic anaerobic co-digestion with rice straw *S. Riya, K. Suzuki, S. Zhou, A. Terada, M. Hosomi*	Effects of acetate addition on the recovery of anaerobic ammonium oxidizing bacteria in mixotrophic culture *P. Noophan, S. Phanwilai*	Decomposition characteristics of dissolved organic matter in paddy field *C. Jikumaru, T. Hama, Y. Kawagoshi*	
14:15-14:30	Long term assessment of phosphorus emission from cattle fattening *H. Tsutsui, H. Sakaguchi, X. Sun, S. Toda, K. Matsukawa, K. Oshita, M. Takaoka, T. Fujiwara*	Identification of 1,4-dioxane degradation genes of *Pseudonocardia* sp. D17 by microarray expression analysis *K. Sawada, D. Inoue, T. Tsunoda, Y. Aoki, M. Kuroda, M. Ike, K. Sei*	Phosphorus flow with soil particles in drainage canals of reclaimed paddy fields *I. Yoshinaga, K. Takaki, H. Ono, T. Hama, A. Retyce*	
14:30-14:45	Development of a technology for recovering resources from livestock waste *J. Kabaya, K. Ueda, R. Sakamoto, M. Tokuo, T. Suzuki, S. Sano, T. Sekito, Y. Dote*	Effects of nutrient and aerating conditions on selenium metabolisms by *Pseudomonas stutzeri* NT-I *M. Kuroda, Y. Higuchi, M. Yoshioka, S. Soda, M. Ike*	Evaluation of radiocesium outflow from paddy fields drainage during land preparation *S. Miyazu, H. Tsuji, N. Yoshikawa, T. Yasutaka*	***Poster and Exhibition***
14:45-15:15	*Coffee Break*			
	Session 7-1 ***Sludge stabilization, utilization and disposal*** ***Chair*** ***Dr. Xiaoqiang Chen***	***Session 1-5*** ***Biological treatment of wastewaters and wastes*** ***Chair*** ***Prof. Alessandra Carucci***	***Session 9-2*** ***Run-off and control of pollutants from agricultural areas*** ***Chair*** ***Dr. Shohei Riya***	
15:15-15:30	Anaerobic digestion of sewage sludge with high solid content and its use as fertilizer *T. Hidaka, H. Sawahara, T. Togari, J. Tsumori*	Gaseous emissions and modification of organic fractions in cattle slurry during anaerobic storage: Effect of acidification and biological additives *M. Y. Owusu-Twum, A. Polastre, L. M. M. Ferreira, J. Coutinho, H. Trindade*	Effects of pH and oxygen on phosphorus release from agricultural drainage ditch sediment in Kasaoka bay reclaimed land, Japan *H. V. Nguyen, T. Q. Tran, T. T. K. Ha, M. Maeda*	
15:30-15:45	Performance of sludge settling property under nitrite existing conditions *X. Yang, Y. Z. Peng, J. C. Song, S. Y. Wang, J. Wang, Q. Yang*	Nitrogen removal performance and bacterial community in mixed-culture with freshwater- and marine- anammox bacteria *Y. Yamashita, L. H. V. Khanh, D. V. Luong, Q. Wei, X. Huang, N. Hong, T. Hama, Y. Kawagoshi*	Effect of physical and morphometric factors on nutrient removal in agricultural ponds *M. Saito, K. Okubo, S. Onodera, S. Takagi, Y. Maruyama, Y. Shimizu, G. Jin, D. Aritomi*	
15:45-16:00	Performance comparison of primary sludge anaerobic digestion in two-stage with recycle and single-stage semi-continuous process *T. Hojo, Y. Y. Li, O. Nishimura*	Evaluation of chronic impact of sulfamethoxazole in acetate biodegradation and microbial composition at different culture histories *G. Kor-Bicakci, I. Pala-Ozkok, A. Ural, A. Rehman, D. Jonas, E. Cokgor, D. Orhon*	Point and non-point source nutrient loading simulation for the Takasaki River basin, Chiba - Japan *E. D. P. Perera, Y. Iwami, K. Fukami*	
16:00-18:00				***Poster (Core time)***
18:00-20:00	***Conference Dinner***			

Time	Wednesday, 26 November			
	Room A	**Room B**	**Room C**	**Room D**
9:00-9:30	***Keynote Speech 7*** Vitalization of rural area by converting waste of agro-industries to regional biomass resources *Prof. Dr. Y. Yuyama*			
	Session 7-2 ***Sludge stabilization, utilization and disposal*** ***Chair*** ***Prof. Masaki Takaoka***	***Session 1-6*** ***Biological treatment of wastewaters and wastes*** ***Chair*** ***Dr. Satoshi Akao***	***Session 9-3*** ***Run-off and control of pollutants from agricultural areas*** ***Chair*** ***Prof. Amadou Hama Maiga***	
9:30-9:45	Function of wood chips for composting of sewage sludge by the thermophilic and aerobic digestion *K. Hashimoto, T. Doi, T. Okuda, W. Nishijima, S. Nakai, K. Nishimura*	Full-scale anaerobic treatment of kraft pulp mill wastewater *K. Kamachi, Y. Tsukamoto*	Transportation of water and inorganic nitrogen components in the soil column of grain sorghum *R. Abukmeil, T. Fujii, N. Funamizu*	
9:45-10:00	Effect of ionic materials on microwave-assisted hydrolysis of waste activated sludge *J. H. Lee, J. M. Lee, S. H. Lee, J. S. Lim, T. J. Park, I. G. Byun*	Characterization of wastewater treatment by two microbial fuel cells in continuous flow operation *K. Kubota, T. Watanabe, T. Yamaguchi, K. Syutsubo*	Improvement of a catch crop system for reducing nitrate leaching and removing salts in greenhouses by pre-harvest flood irrigation *K. Kondo, T. Fujiwara, S. Yamane, D. Yasutake, M. Maeda, H. Nagare, S. Akao, M. Matsuoka*	***Poster and Exhibition***
10:00-10:15	Environmental impact and decomposition stability in soil of waste based biogas digestates as influenced by post-treatment methods *V. Wragge, K. Nielsen, C.-L. Ross, K. Sensel-Gunke*	Development of BR-UASB-DHS system for natural rubber processing wastewater *T. Watari, N. T. Thanh, N. Tsuruoka, D. Tanikawa, K. Kuroda, N. L. Huong, N. M. Tan, H. T. Ha, M. Hatamoto, K. Syutsubo, M. Fukuda, T. Yamaguchi*	Determination of TOC based swine manure pollutant loads and reduction rate via resource recovery processing *Y. Lee, S. W. Oa*	
10:15-10:45	*Coffee Break*			

Time	Wednesday, 26 November			
	Room A	**Room B**	**Room C**	**Room D**
	Session 7-3 **Sludge stabilization, utilization and disposal** **Chair** **Dr. Satoshi Soda**	**Session 11-1** **The climate change mitigation and adaptation in agro-industries** **Chair** **Prof. Naoyuki Kishimoto**	**Session 9-4** **Run-off and control of pollutants from agricultural areas** **Chair** **Prof. Kazunari Sei**	**Poster and Exhibition**
10:45-11:00	Biomass power system with sewage sludge incineration *T. Mizuno, T. Hoshi, S. Funaki, M. Shimada, T. Fujii, K. Oshita, M. Takaoka*	Environmental impact assessment of a sewage treatment plant under different operating conditions *I. Mishima, N. Yoshikawa, Y. Yoshida,K. Amano*	Erosion and nutrient enrichment under different tillage and weed control systems *I. S. Banuwa, Andhi, U. Hasanudin, K. Fujie*	
11:00-11:15	Enhancing toxic metal removal and methane production from sewage sludge by acidification with nitrite addition *F. Du, I. Pikaar, S. Freguia, Z. Yuan, J. Keller*	Effect of carbon sources on nitrous oxide emission in a Modified Ludzak Ettinger Process *K. Song, S. Riya, A. Terada, M. Hosomi*	Effect on red soil erosion control of cultivating buckwheat and sweet potato in the Southwest Islands of Japan *T. Kubota, T. Hara, H. Ikoma, N. Yamaguchi, I. Yoshinaga*	
11:15-11:30	Effective methane conversion in combined hyperthermophilic and thermophilic anaerobic digestion of coffee grounds *F. Nishimura, T. Oishi, T. Hidaka, Y. Takabe, T. Mizuno, H. Tsuno*	Effects of rice husk amendment and moisture content on N_2O and CO_2 productions in paddy soil *T. K. T. Ha, M. Maeda, Q. T. Tran, T. Fujiwara, H. Nagare, S. Akao*	The effect of redox status on the bacterial community structure and biodegradation rate of organic fractions of agri-industrial effluent in sand bioreactors *P. J. Welz, Z. Palmer, S. Isaacs, B. Kirby, M. Le Roes-Hill*	
11:30-11:45	Degradation characteristics of polylactide in thermophilic anaerobic digestion with hyperthermophilic solubilization *R. Suzuki, F. Nishimura, T. Oishi, F. Wang, T. Hidaka, Y. Takabe, H. Tsuno*			
11:45-13:30	**Lunch**			

Time	Wednesday, 26 November			
	Room A	**Room B**	**Room C**	**Room D**
13:30-14:00	***Keynote Speech 8*** Advanced wastewater treatment using microalgae: Effect of temperature on removal of nutrients and organic carbon *Fares A. Al Momani and Prof. Dr. B. Örmeci*			
	Session 3-1 ***Nutrient removal and recovery*** ***Chair*** ***Prof. Koichi Fujie***	***Session 11-2*** ***The climate change mitigation and adaptation in agro-industries*** ***Chair*** ***Dr. Taira Hidaka***	***Session 10-1*** ***Innovative water and waste management system for agricultural area*** ***Chair*** ***Prof. Seong-Wook Oa***	
14:00-14:15	Effects of common reed (*Phragmites australis*) on nitrogen removal and abundance of ammonia-oxidizing and denitrifying microorganisms in freshwater sediment *T. Toyama, Y. Nishimura, Y. Ogata, K. Sei, K. Mori, M. Ike*	Nitrous oxide emissions during biological soil disinfestation with different organic matters and plastic mulch films in laboratory-scale tests *M. Maeda, E. Kayano, T. Fujiwara, H. Nagare, S. Akao*	Comparison of bacterial communities harboring alkane hydroxylase genes among petroleum-contaminated soils and roots of planted grasses *S. Tsuboi, S. Yamamura, T. Nakajima-Kambe, K. Iwasaki*	***Poster and Exhibition***
14:15-14:30	Effect of formaldehyde/urea ratio on production rate of methylene urea *S. Kabore, R. Ito, N. Funamizu*	Nitrous oxide emission with submarine groundwater discharge in an agricultural watershed affected by significant fertilizer application *S. Onodera, K. Onishi, M. Saito, D. Aritomi, K. Onodera, Y. Maruyama, G. Jin, Y. Shimizu*	Salt removal from urine fertilized agricultural fields by rainfall and plant uptake *T. Fujii, N. Hijikata, K. Ushijima, R. Ito, N. Funamizu*	
14:30-14:45	Performance of hybrid constructed wetland system for piggery wastewater treatment *X. Zhang, T. Inoue, K. Kato, J. Harada, H. Izumoto, D. Wu, H. Sakuragi, H. Ietsugu, Y. Sugawara*		Effects of greywater irrigation treated by high rate algal ponds on soil chemical properties and vegetable production in dry season of Soudano-Sahelian climate conditions *D. Sangare, B. Sawadogo, M. Sou/Dakoure, N. Hijikata, D. M. Ouedraogo, H. Yacouba, M. Takahashi, N. Funamizu*	
14:45-15:15	*Coffee Break*			

Time	Wednesday, 26 November			
	Room A	**Room B**	**Room C**	**Room D**
	Session 3-2 ***Nutrient removal and recovery*** ***Chair*** ***Dr. Hideaki Nagare***	***Session 11-3*** ***The climate change mitigation and adaptation in agro-industries*** ***Chair*** ***Dr. Morihiro Maeda***	***Session 10-2*** ***Innovative water and waste management system for agricultural area*** ***Chair*** ***Prof. Hung-Yee Shu***	***Poster and Exhibition***
15:15-15:30	High efficiency phosphorus recovery from digested sewage sludge *T. Hagino, M. Ogoshi, Y. Okazaki, T. Matsubayashi*	Sustainable wastewater treatment in small scale tapioca factory *U. Hasanudin, T. P. Utomo, E. Suroso, B. R. Shivakoti, K. Fujie*	Establishment of RNA recovery method suitable for analyzing active microbial populations in cattle manure composting samples *D. Inoue, K. Sawada, S. Shikama, K. Sei, T. Fujiwara*	
15:30-15:45	Evaluation of phosphorus removal by iron electrolysis using X-ray absorption fine structure measurement *I. Mishima, K. Ikeda, Y. Yokoyama, J. Nakajima*	Zero emission system for sustainable agriculture in Asia *O. Higashi, Y. Shiratori, T. Kitaoka, H. Shirakawa*	Development of a waste water site strategy *J. Leonhäuser, U. Birkenbeul, H-T. Heideker*	
15:45-16:00			Palm oil mill effluent treatment and utilization to ensure the sustainability of palm oil industries *U. Hasanudin, R. Sugiharto, A. Haryanto, T. Setiadi, K. Fujie*	
16:15-17:00	***Closing ceremony***			

Sustainable Wastewater Treatment in Small Scale Tapioca Factory

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Abstract: Small scale tapioca factory usually located in nearby residential area; hence the wastewater has to treat properly to avoid environmental pollution. The objectives of this study are to estimate bioenergy potential from small scale tapioca factory and to evaluate the treated wastewater utilization as liquid fertilizer. Green House Gases (GHGs) emission reduction was also estimated. Wastewater generated from each ton of cassava was measured. COD, pH, TN, and TP concentration of fresh and treated wastewater were analyzed. Covered lagoon system was implemented to treat the wastewater. About 2.75 m^3 of wastewater with average COD concentration 9,648 mg/l was produced from each ton of cassava in small scale tapioca factory. During anaerobic digestion, 92% of COD was removed. Through this system, tapioca wastewater has potential to generate 27.76 kWh of renewable energy per ton of cassava. The treated wastewater contained about 1.15 kg of Nitrogen and 0.05 kg of Phosphorous per ton of Cassava with pH about 6.47. Tapioca wastewater treatment using covered lagoon system has successfully to reduced methane emission about 5.7 kg CH_4 or 119.88 kg CO_2e per each ton cassava. Utilization of tapioca wastewater for renewable energy and liquid fertilizer increased the sustainability of small scale tapioca industry.

Keywords: tapioca, wastewater, bioenergy, greenhouse gases, liquid fertilizer

Introduction

Lampung Province was well known as the biggest producer of Cassava (*Manihot esculenta Crantz*.) in Indonesia. Cassava production in Lampung Province was about 38 percent of national cassava production (Statistik Indonesia, 2013). Cassava is raw material of tapioca, bioethanol, food, and other industries. Dealing with tapioca processing, there are various scale of tapioca factories in Lampung Province. There are many small scale tapioca factories and commonly located nearby residential area. Regarding to environmental regulation, small and medium scale industries are not selected on Environmental Ranking Program (PROPER Program), but they have to follow the national or local regulation of wastewater effluent standard. PROPER result of 2012-2013 showed that 34.1% and 0.95% of the selected companies have red (bad) and black (very bad) ranking, respectively (KLH, 2013). It is mean that Government of Indonesia needs more effort to improve the status compliance of companies/industries to follow the environmental regulation.

Solid biomass that is generated from tapioca processing in form of skin, tips, and *onggok* (*Cassava* fiber) are used for cattle feed. There is no significantly effort yet to utilize this biomass for other important purposes like energy source. The potential of implementation low carbon and zero discharge could be generated from tapioca wastewater. Renewable energy was generated from tapioca wastewater through anaerobic digestion by converting organic matters to methane gas. Tapioca factory wastewater has very high amount and concentration of organic matter and usually was treated using anaerobic digestion in open deep lagoon to reduce environmental load until fulfil environmental standard (Hasanudin, 2007). The methane potential of tapioca industry has investigated. Manilal et al. (1990), using laboratory scale equipment, measured this potential for effluent mixed with cow dung and urea. The methane potential from anaerobic sludge obtained from an anaerobic pond of a tapioca starch factory was measured using a specific methanogenic activity test (Rajbhandari et al., 2004). Kamahara

et al. (2010) was investigated biogas production rate in anaerobic ponds of tapioca starch factories.

Big amount of GHG, mainly methane was emitted from this system. However, nowadays there is a change of environmental paradigms that waste treatment is not only to meet the environmental standard but also to produce benefit from it such as renewable energy or bio-products. Capturing and utilization of methane gas as an alternative energy all at once have advantages to prevent environmental pollution, lowering environmental load, reduce GHG emission, produce renewable energy, and replace fossil fuel as a source of energy in tapioca-industries (Hasanudin, 2012[a]). The utilization of tapioca industrial wastewater for generates heat and electricity has changed the face of tapioca industry from deficit energy to self-sufficiency energy. Currently more than ten tapioca industries in Lampung Province have been installed and operated biogas plant and utilized the biogas for generate heat and/or electricity. Biogas plant has also reduced the environmental load about 90% (Hasanudin, 2012[b]). The effluent from biogas plant could be used as a liquid fertilizer which is has high concentration of nitrogen and phosphorous. The objectives of this study are to estimate bioenergy generated from small scale tapioca factory and to evaluate the possibility of treated tapioca wastewater utilization as liquid fertilizer. Green House Gases (GHGs) emission reduction was also estimated in case the wastewater was converted to bioenergy.

Material and Methods

Study was conducted in small scale tapioca factory, PD. Semangat Jaya, village of Sri Rejeki, Sub District Negri Katon, District of Pesawaran. GHG emission from tapioca wastewater was estimated through measurement and calculation of some parameters of quality and quantity of wastewater produced from their factory. Co-benefit impact from the implementation of wastewater treatment system was also evaluated. Parameters, frequently, sampling location, measurement methods, and quality control system in this monitoring system were described in Table 1.

Wastewater sampling and laboratory analysis were conducted to measure pH, COD (Chemical Oxygen Demand), TSS (Total Suspended Solid), TN (Total Nytrogen), TP (total Phosporous) in some stream of wastewater treatment plant. Samples were collected at least 3 hour after tapioca factory start operation. Methane (CH_4) concentration in the biogas from bioreactor A and B were also measured using gas chromatography (Shimadzu GC 2014) with thermal conductivity detector (TCD) and 4 meter length of shin-carbon column. Helium gas was used as carrier gas with flow rate 40 ml/min. The schematic diagram of sampling location was described in Figure 1. Flow meters were installed at Q streams to measure the wastewater flow rate. Also, gas flow meter was installed at G. Secondary data from other tapioca industry (PT. GGPC) which is has more accurate instrument to measure biogas production was also utilized to calculate Green House Gases (GHG) Emission Reduction (ER).

Table 1 Monitoring of tapioca wastewater and biogas quality

Parameter	Frequency	Sampling location	Method	Replication
pH	Twice a week or depended on factory activities	C_{in} and C_{out} for wastewater and G for biogas (Figure 1)	On-site	Duplo
COD			At laboratory	
TSS				
TN				
TP				
CH_4	Twice during study			

Monitoring of production rate (ton of cassava/day) and water consumption in PD. Semangat Jaya was also done to evaluate the performance of the tapioca factory. The amount and moisture content of cassava, starch, and their byproducts (cassava fiber and skin) were also measured to cross check the flow rate data. Table 2 described monitoring parameter for estimated wastewater production in tapioca factory.

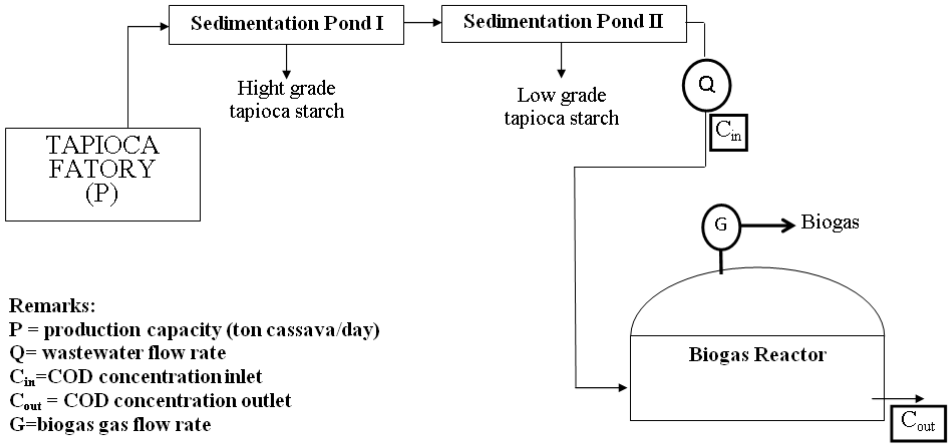

Figure 1 Schematic diagram of sampling location

Table 2 Monitoring parameter for estimation of wastewater production in tapioca factory

Parameter	Frequency	Sampling location	Method	Replication
Water consumption	Twice a week or depended on factory activities	Mill	On-site using flow meter	6 times
Wastewater production		2nd sedimentation pond effluent		
Moisture content • Cassava • Tapioca • Cassava fiber • Cassava skin	Twice a week or depended on factory activities	Tapioca Mill	At laboratory	6 times

In the calculation of GHG Emission Reduction, the small scale of tapioca factory which has not wastewater-biogas-energy-liquid fertilizer (WBE-LF) system was used for baseline setting. In this factory, the wastewater was treated using anaerobic process in open lagoon. The effluent of this wastewater treatment plant was discharged to the water body. GHG emission and eutrophication were occurred due to this wastewater management system. The potential of GHG emission in this tapioca factory was determined as default value. Through this study, the default value of GHG emission from tapioca wastewater was also established, which is very important to make easier and more accurate on GHG emission reduction calculation.

Results and Discussion

Overview of Observed Biogas Plant

Observed biogas plant was installed in PD. Semangat Jaya Tapioca Factory that had maximum production capacity about 80 ton of Cassava/day. Cover in the ground anaerobic reactor (CIGAR) technology was implemented to treated wastewater from the factory. Biogas produced from biogas reactor was utilized for an alternative energy, such as: energy for drying and cooking.

The effluent from CIGAR which has COD concentration about 780 mg/L was utilized as liquid fertilizer for several crops, such as: Cassava, Eggplant, and Giant grass in surrounding factory. High concentration of C-organic, nitrogen and phosphorous in the effluent has potential to utilized as liquid fertilizer. Model of wastewater-biogas-energy-liquid fertilizer (WBE-LF) system in PD. Semangat Jaya was described in Figure 2.

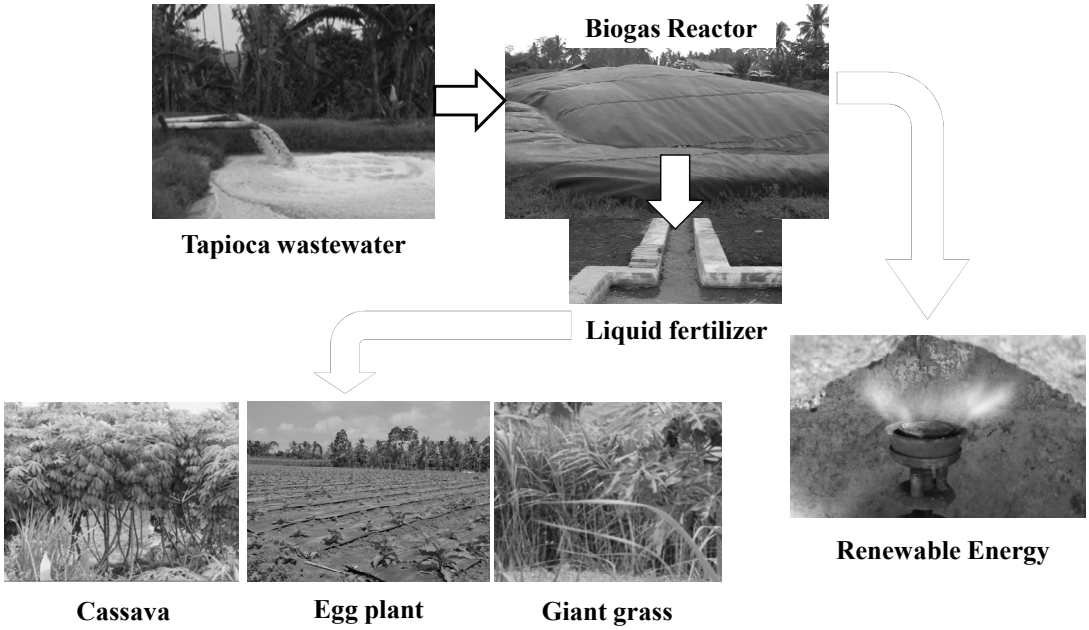

Figure 2 Wastewater Treatments and Utilization in Observed Biogas Plant

Tapioca Wastewater and Biogas Quality

Results showed that observed tapioca factory in average processed 27.150 ton of cassava per day and produced 74.545 m^3 of wastewater. The wastewater was treated in biogas reactor to reduce the environmental load and produce biogas, simultaniously. The average of COD_{in} and COD_{out} are 9,647.5 mg/L of and 781.7 mg/L, respectively (Table 3).

Table 3 Quality and Flow Rate of Wastewater from Observed Tapioca Factory

Observation number	Processed cassava (ton)	Produced wastewater (m^3)	COD_{in} (mg/L)	COD_{out} (mg/L)
1	27.730	78.356	10,595	510
2	22.790	66.472	7,980	975
3	30.706	71.804	11,870	705
4	16.800	55.978	10,070	700
5	32.000	93.340	6,610	910
6	32.930	81.317	10,760	890
Average	27.159	74.545	9,647.5	781.7

Estimation of GHG emission was calculated using equation (1). IPCC default value was used to estimate methane production based on COD removed during anaerobic decomposition. Table 4 described calculation result of GHG emission potential from tapioca wastewater if they have not methane recovery or utilization system (R=0).

$$CH4 = \sum_{i} [(TOW_i - S_i)EF_i - R_i]$$ .....(1)

Where:
CH_4 = methane emission (kg CH_4/day)
TOW = Total organic compound in the wastewater (kg COD/day)
S = Sludge from organic compound in the wastewater (kg COD/day)
EF = Emission factor (kg CH_4/ kg COD)
R = recovery of methane (kg CH_4/day)
i = type/name of industry

Table 4 Methane Emission from Observed Tapioca Factory without methane recovery system

Observation number	TOW (kg/d)	Si (5% TOW)	EF (kg CH_4/ kg CODr)	R (=0)	CH_4 emission (kg CH_4/d)	CO_2 emission (kg CO_2e/d)
1	790.72	39.51	0.25*)	0	187.68	3,941.22
2	465.64	23.28			110.59	2,322.36
3	801.69	40.08			190.40	3,998.44
4	524.51	26.23			124.57	2,616.54
5	532.04	26.60			126.36	2,653.54
6	802.60	40.13			190.62	4,002.96
Average	652.78	32.64	0.25	0	155.04	3,255.76

*) IPCC (2006)

Table 4 described that CH_4 emission calculation without methane recovery system (R=0), from the tapioca factory is about 155.04 kg CH_4/day or about 5.71 kg CH_4/ton Cassava. Energy generated from tapioca wastewater was calculated using methane LHV (Low Heating Value) of 50.0 MJ/kg (Anonim, 2014) and 35% energy conversion efficiency. Based on methane emission, tapioca wastewater has potential to generate renewable energy about 27.76 kWh per ton of Cassava. Tapioca factory like PD Semangat Jaya with 27.159 ton Cassava/day capacity has potential to generate renewable energy about 31.4 KW of electricity from their wastewater.

Without methane recovery system (R=0), tapioca wastewater treatment plant has potential to emitted about 119.88 kg CO_2e/ton Cassava. Based on this result, small scale tapioca factory like PD Semangat Jaya with 27.159 ton Cassava/day capacity has potential to emitted about 3255.76 kg CO_2e/day. Methane recovery system will reduce the greenhouse gas emission from tapioca wastewater. Table 5 described greenhouse gas emission potential from small scale tapioca factory which is successfully to recover 90% of methane.

Table 5. The Potential of GHG emission from Observed Tapioca Factory with 90% recovery

Observation number	TOW (kg/d)	Si (5% TOW)	EF (kg CH_4/ kg CODr)	R (=0.9)	CH_4 emission (kg CH_4/d)	CO_2 emission (kg CO_2e/d)
1	790.72	39.51	0.25*)	168.91	18.77	394.12
2	465.64	23.28		99.53	11.60	232.23
3	801.69	40.08		171.36	19.04	399.84
4	524.51	26.23		112.11	12.46	261.65
5	532.04	26.60		113.72	12.64	265.35
6	802.60	40.13		171.56	19.06	400.29
Average	652.78	32.64	0.25	139.53	15.50	325.58

*) IPCC (2006)

Emission Factor (EF) of tapioca wastewater was also measured based on secondary data from biogas plant (Figure 3). The average EF factor was about 0.325 m^3 CH_4/kg COD removed or about 0.23 kg CH_4/kg COD removed. Kamahara et al. (2010) found that methane emission factor from anaerobic pond of tapioca wastewater treatment plant are 0.16-0.31 gCH_4/g COD removed (the average was 0,23 0.23 kg CH_4/kg COD removed). In palm oil mill effluent treatment, Yacob et al. (2005) found that the emission factor was 0.237 kg CH_4/kg COD removed.

The correction of EF is very important because COD removed is not only produce methane but also produce microorganism sludge and other compounds. Using 0.23 kg CH_4/kg COD removed as an emission factor, the potential of GHG emission was about 3180.36 ton CO_2e/day, its only 2.3% lower than calculation result using IPCC default value. Its mean the measured emission factor is reliable to use as default value in tapioca wastewater. The GHG emission potential from tapioca wastewater using measured EF was described in Table 6.

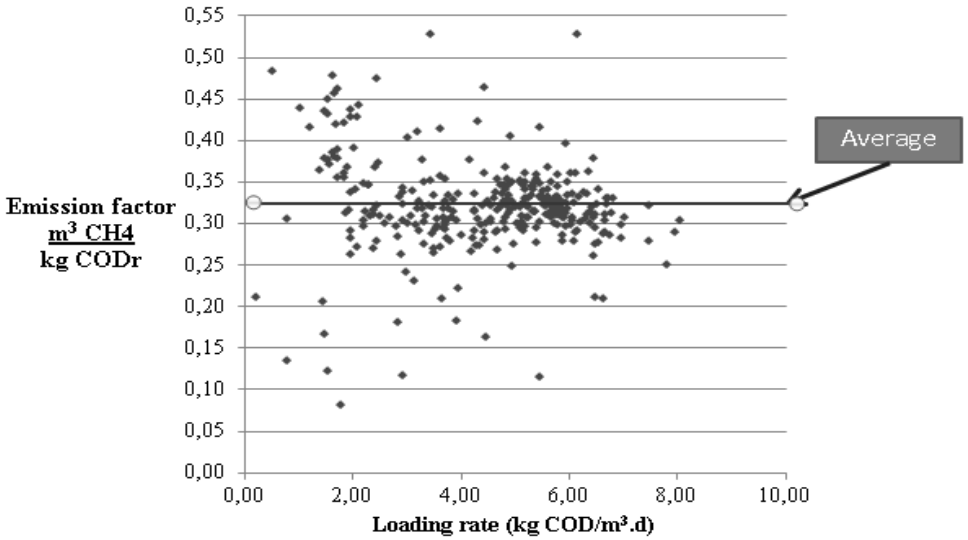

Figure 3 Emission factor from secondary data from PT. GGPC.

Table 6 The Measured EF and GHG emission from Tapioca Wastewater

Observation number	**TOW** (kg/d)	**Measured emission factor** (kg CH_4/kg CODr)	**CH_4 emission** (kg CH_4/d)	**CO_2 emission** (kg CO_2e/d)
1	790.72	0.23	183.33	3,849.95
2	465.64		108.03	2,268.58
3	801.69		185.99	3,905.84
4	524.51		121.69	2,555.43
5	532.04		123.43	2,592.09
6	802.60		186.20	3,910.26
Average	652.78	0.23	151.45	3,180.36

Based on this above calculation that GHG emission potential from tapioca wastewater tapioca industries had significant contribution on increased global warming potential (GWP). The Cassava production in Indonesia is about 25,494,507 ton/year (Statistik Indonesia, 2013). If 80% of cassava production in Indonesia is converted to tapioca, the contribution of tapioca wastewater on GHG emission is about 2,445,025 ton CO_2e/year or about 0.32% of National target on GHG emission reduction (Bappenas, 2011).

TN and TP Concentrations of Tapioca Wastewater

Monitoring of nitrogen and phosphorous concentration in the wastewater was done to evaluate the impact to eutrophication and their potential to utilize as liquid fertilizer. Table 7 described total nitrogen (TN) and total phosphorous (TP) concentration in each stage of wastewater treatment plant. It also indicated that TN and TP relatively not change during anaerobic digestion in biogas reactor. Anaerobic digestion decomposed macro-molecule of nitrogen and phosphorous compounds to become simple molecule, such as NH^{4+} and PO_4. These molecules were still measured as TN and TP.

Table 7 Total Nitrogen and Total Phosphor in Tapioca Wastewater

Date	Sampling Location	COD (mg/L)	pH	TSS m(g/l)	N (mg/L)	P (mg/L)
Nov 02, 2013	Eff. Sedimentation-I	10805	5.49	3476	373.4	21.8
	Washing wastewater	4535	4.92	1408	219.3	4.1
	Eff. Sedimentation-II	10595	3.85	561	328.3	22.7
	Outlet Biogas reactor	510	6.49	418	402.4	17.2
Nov 12, 2013	Eff. Sedimentation-I	11305	5.49	1573	350.6	28.3
	Washing wastewater	3510	4.92	836	189.5	4.7
	Eff. Sedimentation-II	7980	3.85	1062	317.2	23.7
	Outlet Biogas reactor	975	6.49	434	415.3	18.2
Nov 17, 2013	Eff. Sedimentation-I	11480	5.87	1311	364.01	26.83
	Washing wastewater	2705	4.63	647	210.11	3.26
	Eff. Sedimentation-II	11870	4.3	4750	336.12	24.14
	Outlet Biogas reactor	705	6.54	325	434.2	18.9
Nov 19, 2013	Eff. Sedimentation-I	11230	5.24	2572	359.2	30.4
	Washing wastewater	3440	4.68	1294	227.0	5.1
	Eff. Sedimentation-II	10070	4.12	814	320.6	29.3
	Outlet Biogas reactor	700	6.36	376	406.9	19.0

The effluent of observed biogas reactor was utilized as liquid fertilizer. The average of TN and TP concentrations in the effluent of biogas reactor were 412.6 and 17.0 mg/L, respectively. Considered to the amount of wastewater produced is 2.75 m^3/ton of cassava, the contribution of treated tapioca wastewater was 1.13 kg of TN and 0.05 kg of TP per ton of cassava. High concentration of TN and TP in treated tapioca wastewater were potential to promote euthrophication, but in other side is very important for crops nutrients.

Conclusions

About 2.75 m^3 of wastewater with average COD concentration 9,648 mg/l was produced from each ton of cassava in small scale tapioca factory. Using covered lagoon system about 92% of COD was removed. Through this system, tapioca wastewater has potential to generate 27.76 kWh of renewable energy per ton of cassava. The small scale tapioca factory with 27.159 ton Cassava/day capacity has potential to generate renewable energy about 31.4 KW of electricity from their wastewater. Tapioca wastewater treatment using covered lagoon system has successfully to reduced methane emission about 5.7 kg CH_4 or 119.88 kg CO_2e per each ton cassava. The treated wastewater contained about 1.15 kg of Nitrogen and 0.05 kg of Phosphorous per ton of Cassava. High concentration of TN and TP in treated tapioca wastewater were potential to promote euthrophication, but in other side is very important for

crops nutrients. Utilization of tapioca wastewater for renewable energy and liquid fertilizer increased the sustainability of small scale tapioca industry.

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