BOOK OF ABSTRACT

I. SESSION DESCRIPTION
II. SESSION PROGRAM
III. ABSTRACTS

I. SESSION DESCRIPTION

ID: S10

Circular Bioeconomy – a solution to the global challenges of climate change, decreasing natural resources and environmental degradation?

	Title	Name	Organisation	E-mail
Host:	Prof.	Marianne Thomsen	Aarhus University, Denmark	mth@envs.au.dk
Co-host(s):	Assoc. Prof.	Lorie Hamelin	Federal University of Toulouse, France	orie.hamelin@insa-toulouse.fr
	Dr.	Chawapich Vaidhayakarn	The Biodiversity-Based Economy Development Office (Public Organization) Thailand	diddking@gmail.com

Abstract:

In the transition towards a low fossil carbon economy, scarcity of resources represents a global societal challenge. It underpins the need for circular (self-sustaining) resource management systems supplying human needs while ensuring ecosystem health and preserving production systems, within finite planetary boundaries. As resources get scarcer, circulating them within the economy is increasingly valuable. Given the urgency to stabilize global climate, re-circulating carbon along with inducing negative emissions are well-acknowledged necessities in order to reach the Paris Agreement goal of limiting global mean surface temperature to 1.5°C (or well below 2°C) . Parallel to increasing scarcity of resources, there are increasing global demands for clean water-, soil- & air, arable land, healthy food and sustainable consumer products, among others. These demands all put pressure on the boundaries of our finite planet and call for preservation and enhancement of ecosystem services as an inherent characteristic of the Circular Bioeconomy. Both for developed and developing countries there is an opportunity of using the circular regenerative bioeconomy as a developmental framework across multiple sectors of the economy. The vision is to develop a framework, which incorporate ecosystem health preserving resource flows as a precondition for economic growth and to develop key performance progress indicators a circular bioeconomy that

contribution to social, environmental and economic sustainability development and ensure prosperity from local to global scale.

Goals and objectives of the session:

To answer the following questions:
1. In light of the Sustainable Development Goals, what should be the key parameters characterizing the performance of circular regenerative bioeconomic value chains?
2. How do we measure key performance parameters of existing production and consumption systems and their transition into climate neutral systems self-supplying production systems?
3. How do we measure the capacity of manmade systems to interact with nature in a way to restore/sustain heathy ecosystems and services; e.g. the provision of resources in a circular bioeconomy?
4. How do we ensure that the various forms of emerging use of primary and secondary biomass resources are restorative by design?

Planned output / Deliverables:

1. Propose key performance progress indicators in a circular bioeconomy
2. Develop a framework for how to measure ecosystem service preservation from circular resource flows in a circular regenerative bioeconomy
Session contributions for the open Journal Sustainability, Special issue "Ecosystem services in a bio- and circular economy"
https://www.mdpi.com/journal/sustainability/special_issues/Ecosystem_Services_Circular_Economy

Related to ESP Working Group/National Network:

Sectoral Working Group: SWG 10 – ES in the circular (bio-)economy

II. SESSION PROGRAM

Date of session: Thursday, 24 October 2019
Time of session: 10:30 – 12:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
10:30–10:40	Adriana Machiori	Silva	Wuppertal Institute for Climate, Environment and Energy, Wuppertal, Germany Alexander von Humboldt International Climate Protection Fellowship, Germany	Applying circular economy principles in forest landscape restoration (FLR) to design out deforestation in Brazilian Biomes
10:40–10:50	Dominika	Teigiserova	Aarhus University, Denmark	Building strong sustainability and transparency within circular bioeconomy of food waste
10:50–11:00	Marianne	Thomsen	Aarhus University, Department of Environmental Science, Denmark	Biowaste-derived fertilizers – are they improving soil ecosystem health and services ?
11:00–11:10	Chawapich	Vaidhayakarn	Biodiversity-based Development Office (Public Organization) Thailand	Ecosystem Services in the Forest-based circular Bioeconomy development: A transformational change from conservation-based approach to green economy in Thailand
11:10–11:20	Steffen	Walk	Institute of Wastewater Management and Water Protection, Bioresource Management Group, Hamburg University of Technology (TUHH), Hamburg, Germany	Improving the quality and quantity of source-separated kitchen waste in areas of different socio-economic characteristics: A case study from Lübeck, Germany
11:20–11:30	Pooja	Yadav	Post doctoral researcher, Sweden	Assessment of Environmental Impact of Power Production from Biomass-Based Industrial Waste
11:30–12:00			DISCUSSION	

III. ABSTRACTS

The abstracts appear in alphabetic order based on the last name of the first author. The first author is the presenting author unless indicated otherwise.

1. *Type of submission:* ***Abstract***

S. Sectoral Working Group sessions: S10 Circular Bioeconomy – a solution to the global challenges of climate change, decreasing natural resources and environmental degradation?

Applying circular economy principles in forest landscape restoration (FLR) to design out deforestation in Brazilian Biomes

First author: Adriana Marchiori Silva
Affiliation: Wuppertal Institute for Climate, Environment and Energy, Wuppertal, Germany
Alexander von Humboldt International Climate Protection Fellowship, Germany
Contact: marchiori.silva@gmail.com

In 2018, 12 million hectares of tropical forests disappeared worldwide [1]. Until 20 years ago, the Amazon Rainforest performed a important environmental service of retaining CO2. Nowadays the forest can be considered carbon neutral [2], with a high probability to turn into a degraded savannah if the deforestation rate exceeds 25% (current rate is about 17%) [3]. Brazil is the deforestation leader, mainly due to the deforestation-linked commodities, which are also affecting other biomes. On the other hand, there are massive land restoration opportunities, which are at the heart of natural based solutions to boost cost-effective CO2 mitigation through 2030. This research is to propose a novel approach to forest restoration economy, a vision underpinned by circular economy principles, to halt deforestation in all Brazilian biomes. In order to offer a disruptive alternative to the historical pathways and the deforestation vicious cycle that Brazil is locked in, the study suggests an integrative framework to move from a linear model for ecosystem degradation to a circular model for ecosystems restoration, enabling a long-term value creation through inclusive bioeconomy applied to ecosystem services, including local communities in the solution design. The research focus are the upstream activities, to bringing the links in the value chain closer together in order to achieve an effective upward and downward traceability. Additionally, a deep dive analysis of the effectiveness and mitigation potential of the promised restoration at a country level and companies deforestation pledges have significance for the main output of the study: a roadmap for private and public sector to promote value chain collaborations, contributing to the post-2020 progress of those commitments. These findings highlights that circularity can

be an adaptation and a governance tool to secure the resilient of forests and its environmental services as well to address deforestation-free commodity supply chains, thriving communities.

Keywords: Circular economy, inclusive bioeconomy, deforestation, restoration, nature based solutions

2. *Type of submission:* ***Abstract***

S. Sectoral Working Group sessions: S10 Circular Bioeconomy – a solution to the global challenges of climate change, decreasing natural resources and environmental degradation?

Building strong sustainability and transparency within circular bioeconomy of food waste

First author: Dominika Teigiserova
Other author(s): Marianne Thomsen
Affiliation: Aarhus University, Denmark
Contact: d.tgsrv@gmail.com

There is a strong need to harmonize food waste (FW) definitions, terms and food waste hierarchy in order to properly quantify and adopt valorization of this resource into the circular economy (CE). It is especially crucial for the coherent formation of regulatory instruments and tracking the progress of national and international goals (such as SDG 12.3) towards FW reduction. We have clarified the terminology towards more transparent understanding, such as terms “surplus food” which is important for social aspect, health and safety reason, term “loss” that we propose to be omitted, “food waste” classification, as well as “recovery” and “recycling” of FW. Inedibility and edibility are highlighted as a key factor in FW valorization. We propose to distinguish FW into five categories: i) avoidable – edible ii) unavoidable– naturally inedible (pits) iii) unavoidable– industrial residue iv) partly unavoidable– becomes inedible due to natural causes (weather) v) partly unavoidable– becomes inedible due to ineffective management. While avoidable FW can be prevented, unavoidable should be used as a secondary resource for CE without the risk of the rebound effect. We suggest an updated framework for closing the loop with FW, including industrial examples.

We further address strong sustainability, which sees the preservation of the critical natural capital (CNC) as an important part of human well-being as opposed to weak sustainability,

which perceives natural and manufactured capital as substitutable. CNC is a complex set of services provided by nature that cannot be directly substituted by human capital, including food systems. Our efforts should focus on maximizing food waste as a resource, including "getting" the most from the unavoidable waste fraction.

We include several examples of businesses in Denmark using FW fraction as a driver, which highlight that including ecosystem services could be beneficial for business expansion and industrial ecology formation and local production.

Keywords: food waste, circular bioeconomy, strong sustainability, industrial ecology, transparency

3. *Type of submission:* ***Abstract***

S. Sectoral Working Group sessions: S10 Circular Bioeconomy – a solution to the global challenges of climate change, decreasing natural resources and environmental degradation?

Biowaste-derived fertilizers – are they improving soil ecosystem health and services ?

First author: Marianne Thomsen
Other author(s): Elisavet Angouria-Tsorochidou, Michele Marini, Manfred Klingmair, Dario Caro
Affiliation: Aarhus University, Department of Environmental Science, Denmark
Contact: mth@envs.au.dk

Biowaste-derived fertilizers represents a solution to mitigate scarcity of phosphorous, which is a key resource for all biological life on earth. Resource scarcity underpins the need for using biowaste as a secondary resource in the transition into circular nutrient management and technology systems.

Capturing and reusing nutrients, such as phosphorous, contained in secondary bioresources (manure, organic household waste, sludge, and macroalgae biomass) for combined energy and natural fertilizer production have the potential of inducing negative emissions, obtained through soil organic carbon sequestration as an instrument to mitigate global climate change at the local level. Producing high quality fertilizers that preserves and enhances soil ecosystem

provisional services in terms of safe food products however represents a global societal challenge.

In parallel to increasing scarcity of resources, there are increasing global demands for clean soil, water and air, and arable land, healthy food and sustainable consumer products.

We quantify the potential for climate change mitigation and water quality restoration, increased nutrient self-supply and soil organic carbon stock obtained from closed-loop industrial ecology nutrient management systems. However, in light of concerning level of dietary intake of cadmium, we discuss the need for soil ecosystem health restoring technologies producing high quality fertilizers with reduced content of micro-pollutant cadmium (Cd) thereby mitigating the Cd accumulation in agricultural soils and food crops.

Keywords: Cadmium, fertilizer quality, soil quality, food safety

4. *Type of submission:* ***Invited speaker abstract***

S. Sectoral Working Group sessions: S10 Circular Bioeconomy – a solution to the global challenges of climate change, decreasing natural resources and environmental degradation?

Ecosystem Services in the Forest-based circular Bioeconomy development: A transformational change from conservation-based approach to green economy in Thailand

First author: Chawapich Vaidhayakarn
Affiliation: Biodiversity-based Development Office (Public Organization) Thailand
Contact: diddking@gmail.com

Forest sector play a vital part in sustainable development for the developing countries, as a source of natural materials for economic production and other non-consumptive values for the well-being of human society. The concept of ecosystem services has been applied in the forest management sectors to conserve the natural resources, and provide livelihood outcomes to the grassroot level. An incentive-based mechanism such as Payment for Ecosystem Services (PES) has linking communities, private sectors, and government agencies to ensure the ecosystem services provide by forests. Recently, the push forward of Bio-Circular-Green economy (BCG) model in Thailand has emphasize the cooperation in building

'Bioeconomy' through the public-private-people partnership in five sectors – bio-energy, bio-chemicals, food, animal feed, and bio-pharmaceuticals. The 'Circular' aspect is move toward the zero-waste industries to achieve the 'Green' growth target on counterbalance the socioeconomic dimension and mitigate the global environmental problem such as climate change and air pollution. The bottom-up approach for the multi-stakeholder engagement in circular-bioeconomy development relevant with forest ecosystem services here will provided a cases to demonstrate ongoing collaboration between multi-sectors. The developmental pathway focusing on transformational change from the conservation, restoration based PES scheme to the forest-based industries is expected to enhance the local livelihood and the country's green economy goal with the recommendations to strengthening supportive innovations, and science-policy interface for the forest-based circular-bioeconomy development.

Keywords: Circular-bioeconomy, forest-based bioeconomy, payment for ecosystem services, transformational change, green economy

5. *Type of submission:* ***Abstract***

S. Sectoral Working Group sessions: S10 Circular Bioeconomy – a solution to the global challenges of climate change, decreasing natural resources and environmental degradation?

Improving the quality and quantity of source-separated kitchen waste in areas of different socio-economic characteristics: A case study from Lübeck, Germany

First author: Steffen Walk
Other author(s): David Wardle, Stefan Deegener, Ina Körner
Affiliation: Institute of Wastewater Management and Water Protection, Bioresource Management Group, Hamburg University of Technology (TUHH), Hamburg, Germany
Contact: steffen.walk@tuhh.de

Kitchen waste (KW) belongs to the waste fractions with a high valorization potential. At present KW is far from being effectively utilized since a large portion, often more than 50%, is not being source-separated and disposed of in the residual waste (RW) bin. However, the source-separated KW which is included in bio-waste (BW), tends to still be contaminated with macro-impurities creating difficulties in valorization processes. In the case of a local scale circular

economy, KW separation and quality particularly need to be improved at source in order to allow for the valorization to high quality products without the use of expensive pretreatment.

A method aiming at improving source-separation of KW was investigated in two areas with different socio-economic characteristics in Lübeck, Germany. The low-income (A) and the high-income (B) area were comprised of 37 and 46 households respectively. BW bins for mutual collection of garden waste and KW were already available in both areas before the investigation, however, with varying degrees of source-separation performance. For the investigation BW bins were removed and each household was therefore provided with a 5 - L bucket which was collected three times per week.

In result, the share of source-separated KW to total generated KW increased in both areas from 17.4% to 60.3% (A) and from 16.6% to 65.7% (B) when comparing before and after the introduction of the new collection system. Simultaneously, macro-impurities (including paper) in the BW reduced from around 6.1% to 0.6% (A) and from 13.6% to 1.2% (B).

Based on these findings, the newly implemented collection system has the potential to significantly improve the quality and quantity of source-separated KW which is a precondition for an effective valorization.

This research topic is part of the EU project DECISIVE (Funding H2020 n°689229, http://www.decisive2020.eu/).

Keywords: Kitchen waste management, Food waste, Waste valorization, Circular economy, Socio-economic assessment

6. *Type of submission:* ***Abstract***

S. Sectoral Working Group sessions: S10 Circular Bioeconomy – a solution to the global challenges of climate change, decreasing natural resources and environmental degradation?

Assessment of Environmental Impact of Power Production from Biomass-Based Industrial Waste

First author: Pooja Yadav
Affiliation: Post doctoral researcher, Sweden
Contact: pooja.yadav@slu.se

Pulp and paper industries have a significant role in the national bio-energy production in many European countries. The waste generated from the pulp and paper industry such as black liquor, bark, sawdust, plastic rejects, wood chips and sludge. This energy rich pulp and paper industry wastes are sources of energy that can be used as feedstock in boilers for steam, electricity and heat production. The present study focused on the utilization of pulp and paper industry waste as feedstock in a fluidized bed boiler (FBB) and the resulting environmental impact. The system boundary of the present study includes the transportation of the feedstock from different sources by truck, train and ship the handling of the feedstock within the pulp and paper mill and finally the input of feedstock in the FBB. Life cycle assessment (LCA) methodology were used for the assessment of environmental impact of whole process. Simapro LCA software (version 8.5.2) and the ecoinvent database were used to obtain background data for the life cycle model. 112888 MWh electricity production has taken as functional unit. The impact assessment method used was ReCiPe (World-H) midpoint. The transportation of the feedstock phase had the highest environmental impact on global warming, ozone depletion, terrestrial acidification; freshwater ecotoxicity, terrestrial ecotoxicity impact categories in comparison to handling and FBB phases. While FBB had higher impact in marine eutrophication, marine ecotoxicity, human carcinogenic toxicity; human non-carcinogenic toxicity and ionization radiation.

Keywords: Bioenergy; Life cycle assessment; Industrial waste