Title: Municipal wastewater treatment and biomass production through a Short rotation coppice system in India using willows, poplars and bamboo

Name: **Mirko Hänel**[1,2,3]

1 Technology Transfer Center (TTZ) Bremerhaven, Hausburgstrasse 17, 10249 Berlin, Germany,
2 Department of Biology, Aquatic Biology, Aarhus University, Ole Worms Allé 1, 8000 Aarhus C, Denmark, 43 Centre for Water Technology WATEC, Aarhus University
3 Centre for Water Technology WATEC, Aarhus University

Abstract

Wastewater fertigated Short rotation coppice (wfSRC) have been used successfully to treat different sources of industrial and municipal wastewater and at the same time produce valuable biomass in an economic and sustainable way. To evaluate the performance of a wfSRC system under Indian conditions a vegetation system based on willow, poplar and bamboo has been set-up in Aligarh (UP) and will be evaluated over a 3-year period in terms of pollutant removal capacity and biomass production. Municipal wastewater is conducted, screened and grit removed, stored in an equalisation tank and applied to the wfSRC without primary treatment. The chemical compositions of wastewater and drainage water has been regularly monitored. Surface soil and biomass samples at the beginning and on a yearly base have been also collected. The chemical parameters monitored in the raw wastewater and drained waters include DOC, COD, TN, NO_3–N, NH_4–N, PT, PO_4-P, eC, pH OD following standard methods. Electrical conductivity, organic matter content (%), NO_3–N, available P, cation exchange capacity, cations, heavy metals, field capacity and hydraulic conductivity were analysed for the soil.

Keywords: Wastewater fertigated/irrigated Short-rotation coppice/plantation (SRC, SRP) in India, nature-based wastewater treatment systems, irrigated/fertigated biomass (willow, poplar, bamboo) production systems

Wastewater fertigated Short Rotation Coppice systems (wfSRC) have their origin in agro-forestry tree plantations for producing biomass for energy or material production. Currently, investment and operating costs of existing technical wastewater treatment plants (WWTP) are high due to costs factors such as energy, applied chemicals, infrastructure (machinery and equipment), land, trained staff and monitoring. Additionally, , wastewater are rich inNitrogen (N), phosphorus (P) and water, which are the most limiting factors for plant growth. A critical factor to maximise both the yield of wood and the efficiency of wastewater treatment, is the balance of N, P and potassium (K) in the influent wastewater and in the plant biomass (Ericsson, 1981). There is a great imbalance between suitable locations and conditions for the application of wfSRC systems, which can be found in many developing countries in Asia, Latin America and Africa and locations of actual implemented and ongoing R&D activities in this field (mainly Europe, North America) (Guidi et al., 2015) (Moya et al., 2019).

The field trial is carried out in North India at the research station of the Aligarh Muslim University (AMU). The average annual rainfall in the area are 816 mm and the yearly average temperature is 24.7°C (varying from 8°C to 40°C).

The wfSRC system has been designed to treat municipal wastewater with a capacity of 2500 PE and wastewater volume of up to 375 m3/d. The wastewater is pre-treated by means of a screen and a grit removal. The wastewater is distributed evenly through a furrows irrigation system, previously constructed and installed on site. The application of wastewater started by the end of March 2022. The system consisted of an area of 7500 m^2 (planted surface of 6336 m^2), divided in three sections, where *Populus sp., Salix Alba and Bambusa vulgaris* are planted and managed under short rotation periods. A complex monitoring and control system based on soil sensors (moisture, salinity, pH), water traps, weather station and cameras have been implemented and data are continuously recorded.

The biomass quality will be evaluated once per year measuring fresh and dry weight, ash and chlorophyll content. Additionally, biomass growth is evaluated every four weeks by direct measurements of the height, thickness and number of shoots of the different species planted.

Considering the lack of existing wastewater treatment infrastructure in many rural areas in India, a favourable climate and large and unexploited biodiversity on suitable tree species, there is a unique application potential for wfSRC in India especially for rural areas. The trials are supposed to demonstrate that wfSRCs are a low-cost and efficient alternative to the construction of cost-intensive, high standard technical treatment systems (Conti et al., 2018., Dimitriou & Rosenqvist, 2010). By producing and marketing valuable woody biomass, the treatment process of selected wastewater types could be turned from a cost-intensive to a profitable high-productive scheme that can benefit environmental quality as well as producing enough income that will cover the expenses demanded by the operation of the systems and even some profit.

Biography

Mirko Haenel is Research Director at the Technology Transfer Centre at the University of Applied Science (Bremerhaven, Germany) where he has been working for more than 21 years. Currently, he is also enrolled in the PhD Programme of the Department of Biology, Aquatic Biology, at Aarhus University. He has extensive experiences in applied research projects focusing on innovations in the field of Sustainable Water, Energy and Landscape Management. His key expertise is the development and promotion of water and wastewater treatment and reuse as well as waste management concepts.

He has been responsible for the Scientific Coordination and Management of more than 45 national and international R&D projects in FPVI, VII and H2020. Currently, he is coordinating as European coordinator the EU-INDIA project “PAVITR”: 821410 – H2020 which deals with innovative and nature-based water and wastewater treatment solutions.

Presenting author details

Full name: Mirko Hänel
Personal email id: L3G46450M
Mobile Number: +491634944866
Telephone Number: +4947180934191
Twitter account:
Linked In account:
Session name/ number:
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