Biogas

Title	Environmental impact of biogas: A short review of current knowledge
Author Name	Valerio Paolini, Francesco Petracchini, Marco Segreto, Laura Tomassetti, Nour Naja & Angelo Cecinato
Journal Name	Journal of Environmental Science and Health, Part A Toxic/Hazardous Substances and Environmental Engineering
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Abstracts	The social acceptance of biogas is often hampered by environmental and health concerns. In this study, the current knowledge about the impact of biogas technology is presented and discussed. The survey reports the emission rate estimates of the main greenhouse gases (GHG), namely CO2, CH4 and N2O, according to several case studies conducted over the world. Direct emissions of gaseous pollutants are then discussed, with a focus on nitrogen oxides (NOx); evidences of the importance of suitable biomass and digestate storages are also reported. The current knowledge on the environmental impact induced by final use of digestate is critically discussed, considering both soil fertility and nitrogen release into atmosphere and groundwater; several case studies are reported, showing the importance of NH3 emissions with regards to secondary aerosol formation. The biogas upgrading to biomethane is also included in the study: with this regard, the methane slip in the off-gas can significantly reduce the environmental benefits.
Keywords	Air quality; anaerobic digestion; biogas; digestate; renewable energy; secondary aerosol; waste management

Title	Intercropping forage sorghum with maize is a promising alternative to maize silage for biogas production
Author Name	Dulan Samarappuli & Marisol T.Berti
Journal Name	Journal of Cleaner Production
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Volume and Issue	194
Pages	515-524
Abstracts	Maize (Zea mays L.) silage is the preferred feedstock choice for biogas production. However, other feedstocks or mixed feedstocks might have lower environmental impact than silage maize. The objectives of this study included: 1) to determine if forage sorghum [Sorghum bicolor (L.) Moench] and forage sorghum-maize intercropping can be a viable option to replace maize in forage and biogas production, and 2) to assess the environmental impact of systems involving maize and forage sorghum intercropping and comparing the impact of those, with conventional monocrop rotations. Replicated experiments were conducted in Carrington, Fargo, and Prosper, ND, in 2013 and in Fargo, ND in 2014. Maize for silage and grain and two forage sorghum cultivars (Brown Mid Rib (BMR) and non-BMR) were grown in monoculture and in intercropping. Treatments were a total of twelve; four monocultures, four inter-row intercropped maize-sorghum, and four within-row intercropped maize-sorghum. Results across environments indicated non-BMR forage sorghum monocultures produced similar or higher biomass yield compared with maize monocultures and maize-forage sorghum mixed cultures (inter-row and within-row). Biogas yield and forage quality produced by forage sorghum monocultures, and mixtures containing forage sorghum were similar to that of maize. Thus, forage sorghum can replace, at least in part, silage maize as feedstock for feed or biogas. Forage sorghum and forage sorghum-maize intercropping had lower environmental impact compared with maize in all categories evaluated. In conclusion, intercropping of forage sorghum with maize is a promising alternative to maize silage for forage or as feedstock for biogas production.
Keywords	Silage; Intercropping; Biogas yield; LCA; Global warming potential

Title	**Searching for possibilities to improve the performance of full scale agricultural biogas plants**
Author Name	Simon M. Wandera, Wei Qiao, Dalal E. Algapani, Shaojie Bi, Dongmin Yin, Xiangyang Qi, Yueling Liu, Jacek Dach & Renjie Dong
Journal Name	Renewable Energy
Volume and Issue	116
Year	2018
Pages	720-727
Abstracts	Biogas plants have been widely used to both reclaim bio-energy from agricultural waste and to treat waste; however, the efficiency of these biogas plants has yet to be determined. In this study, the performance of five full scale biogas plants treating chicken manure (CM), pig manure (PM), a mixture of chicken and pig manure (MM), dairy manure (DM), and maize straw (MS) were investigated. The results showed that CM had the highest total energy (16.4 KJ/g-TS) and the MM had the highest bio-available energy (10.2 g-COD/g-TS). The CM plant adopted a suitable hydraulic retention time (HRT) but the other plants used a much longer HRT than necessary. The methane production from CM, PM, MM, and DM was improved by 12%, 22%, 32% and 25% with the addition of trace metals, and this also resulted in an increment in the methanogenic activity for CM, PG, MM and MS. The pH stability of all the biogas plants was maintained at an acceptable level; nevertheless, the high pH and ammonium in the CM digester negatively affected the methanogenic activity. The results, therefore, conclusively indicated that the operation of the biogas plants could be more effective.
Keywords	Full scale biogas plants; Performance evaluation; Animal manure; Maize straw

Title	**The impact of biogas plants on regional dynamics of permanent grassland and maize area —The example of Hesse, Germany (2005–2010)**
Author Name	Nicola Lüker-Jans, Dietmar Simmering & Annette Ottea
Journal Name	Agriculture, Ecosystems & Environment
Year	2017
Volume and Issue	241
Pages	24-38
Abstracts	The fostering of bioenergy by European and German energy policies in recent years has led to a strong increase in the cultivation of energy crops, especially maize for biogas production. Contemporaneously, in Germany the area of permanent grassland has significantly decreased. In this context, energy maize is often discussed to affect the conversion of grassland. The aim of this study was to examine the area changes of maize and permanent grassland and to analyse if there is a relationship to biogas plants. For comparison, livestock farming as another possible influencing factor was implemented, too. The study was conducted at two spatial levels: the first was the German federal state Hesse as a whole, the second were five Hessian sub-regions clustered by prevailing agricultural land use and land-use change from 2005 to 2010. Correlation and regression analyses revealed the association of biogas plants and livestock density to three variables of agricultural land use, i.e. maize area, expansion of maize area and conversion of permanent grassland to arable land. Negative correlations between biogas plants and maize area were significant for Hesse and three sub-regions (−0.21 to −0.42). However, the positive correlations between livestock density and maize area were higher (0.33–0.66). Biogas plants were considerably negative related to the expansion of maize area on all spatial levels (−0.29 to −0.42). Conversion of grassland was less but still significantly related to biogas plants and livestock density. Biogas plants and livestock density can serve as an indicator for land-use change, especially for permanent grassland and maize area.
Keywords	Agricultural land-use change; Permanent grassland loss; Bioenergy; Livestock density; Different spatial scales; Correlation and multiple linear regression analysis