Environmental, economic and energetic sustainability of anaerobic digestion plants in alpine regions.

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The anaerobic digestion (AD) of animal waste can be an opportunity for the development of mountain agriculture and to achieve the EU objectives to year 2020, but some limits must be still overcome. This work is based on the data collected from different feasibility studies conducted during the last years by Biomass and Renewable Energy Unit (FEM) in some areas of Trentino Province (Northern Italy). The final aim under discussion is the definition of guidelines useful to the application of AD in alpine regions.
The intensification and specialisation of animal husbandry (occurred in last twenty years) and the increase of tourism determined different problems related to the management of manure and to the use of landscape (insufficient storage capacity, increased ammonia emission, odours and also otherwise the retreat of meadows and pastures, purchase forage outside, etc…). A sustainable approach more consistent with the territory is needed. The AD, besides biogas production, has several environmental advantages such as better management of nitrate and agronomic value, abatement of bacteria and viruses, reduction of odour impacts, greenhouse emissions. In relation to specific situation and variable case different size of plants (consortium or single farms) are considered.
A first analysis regards the different concentration of animal husbandry in some areas and the consequent imbalance between livestock unit (LU) and agricultural available surface; the acceptable animal density defined by provincial Rural Development Plan (2007-2013) is 2.5 LU ha^{-1}. The farm size is more variable: there are areas with high concentration (4.40LU ha^{-1}, 3.4 LU ha^{-1}, 5736LU with far and high surface very difficult to get) and others with well balanced available surface (0.82 LU ha^{-1}, 1.44 LU ha^{-1}).
A second step regards the amount of liquid and solid manure respectively and the assessment of their biogas yield (generally 25-30 m³/t). Installed power of generator, as well as economic evaluation based on CHP, is more variable. In some cases power more of 70-100 KW occur only with the addition of other biomass to improve biogas production. Aside from maize silage, which in several areas of alpine region is more expensive and difficult recoverable, because bought outside or used for animal nutrition, the use of other biomass (agricultural and urban waste, milk whey, residues from the corn growing, …) could contribute to create a sustainable system. Additional environmental and economic assessments are made to digestate management and its agronomic value (solid-liquid separation post AD, phytoremediation of liquid phase, composting of solid, etc…). Another approach is the analysis of a single farming mountain plant (105 LU and waste of the processing of salami and milk whey). Gas production is about 300 m^3/day (with a CH_4 content of 55% and a calorific value of 5.3 kWh/m^3); by CHP is possible to yield power (189.000kWh_{el}/year) and heat (349700 $kWh_{thermic}$/year), part of which is used to cover own demand (11% power and 45% thermal energy).
Analysis of data collected, supported by a recent study approaching the economic aspect indicating the minimum size of AD plants, permitted to define the key-elements to guarantee energetic-economic and environmental sustainability of AD in the Trentino Province.