

The management of agrozootechnical waste in mountain areas, A study case for the Suceava County, Romania

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Introduction

Our society generates a large spectrum of waste in ever increasing quantities. Even though the European national legislation imposes regulations for the management of each waste category based on the *polluter pays* principle, we are still confronted with an insufficient recycling or waste recovery system. Instead of becoming material resources, waste turn out into pollution sources for the natural ecosystems and human communities.

The Suceava County situated in the Northeast of Romania, has 53% of its surface covered by mountains, rich in exploitable mineral resources and valuable natural ecosystems. About 29% of the population relies heavily on the agrozootechnical activities, the exploitation of mineral resources and tourism (which began to develop in recent years through support and development programs).

The present paper proposes an analysis of the ways in which agrozootechnical wastes in the Suceava County are managed and an evaluation of their impact on the environment and human communities.

Methods and materials

The data sources used for this paper are as follows: the database of the National Institute of Statistics, the database of the Environmental Protection Agency Suceava, the County Waste Management Plan for Suceava County 2020-2025, the Code for Good Agricultural Practices for Water Protection against Pollution with Nitrates from Agricultural Sources (2021), the Veterinary Sanitary and Food Safety Directorate Suceava (DSVSA).

The methods used: statistical data processing in Excel; greenhouse gas emissions estimations using the 2006 IPCC Guidelines for National Greenhouse Gas Inventories - Volume 4 Agriculture, Forestry and Other Land Use - Chapter 10: Emissions from Livestock and Manure Management.

Results & Discussions

In the mountainous area of the Suceava County, due to the closure of 70% of high-capacity milk processing units at the beginning of the 21st century, animal husbandry is currently carried out in individual households and small farms (with under 50 animals). These farms were developed by large alongside the small milk processing enterprises. The establishment of these small processing enterprises were the result of several financing systems, the founding of the National Agency for the Development of the Mountain Area with headquarters in Vatra Dornei (in the Suceava County) and the possibility of obtaining the labels/certifications “Produced in Bucovina” and/or “mountain product” (which could then ensure a safe and profitable market). The number of agrozootechnical holdings by residence (urban or rural) together with the categories of animals (cattle or sheep) are presented in table 1.

Table 1. The number of zootechnical holding in the Suceava County

Holdings with cattle		Holdings with sheep	
Rural	Urban	Rural	Urban
549	55	20	4

Manure, liquid, and semi-liquid animal excrement that are not properly managed represent a source of groundwater, surface water, soil and air pollution (table 2). We would like to mention that the Suceava County has a rich hydrographic network with a hydrographic density of 0.361 km river/km², superior to the national average.

Table 2. Aspects regarding the pollution of environmental factors by livestock waste

Environmenta l factor	Type of impact	Impact quantification
Ground water	Nitrates pollution	5 areas vulnerable to nitrates were identified; the nitrate concentration exceeds 50 mg/l in the groundwater in the 5 mountain areas. There is not sufficient data currently for a complete assessment of water quality in underground bodies

Surface water	The decomposition of waste leads to the decrease of O ₂ in the water	In 7 of the 14 control sections in the mountain area of the watercourses, the ecological status of the water bodies, for the nitrate indicator, is good, the rest is very good
Air	Greenhouse gas emissions: CH ₄ , N ₂ O and CO ₂ equivalent	The most important source of GHG in agriculture comes from the livestock sector. In the mountainous area of the Suceava County, there are mainly cattle and sheep.

Methane emissions result from enteric fermentation and manure management. Quantities of nitrous oxide produced directly from manure storage, before it was applied to agricultural land or had another use, were estimated. The results are presented in table 3.

Table 3. The estimated quantities of CH₄ and N₂O from the zootechnic activities

	CH ₄ (tons) emissions		N ₂ O (tons) emissions
	Enteric fermentation	Manure management	Manure management
Cattle	7667	417	20
Sheep	405	9,8	3

CH₄ and N₂O were converted to CO₂eq, using the latest values established for global warming potentials (GWP) relative to CO₂, extracted from the IPCC Fifth Assessment Report (AR5) (28 for CH₄ and 265 for N₂O). 231.65 kiloton CO₂eq resulted from the breeding of 61285 cows, respectively 12.41 kiloton CO₂eq from the breeding of 42722 sheep from the mountain area of Suceava county.

Conclusions

The impact generated by livestock husbandry in the mountainous area of the Suceava County has mostly affected the air quality through the GHG emissions. The main cause of GHG emissions is the non-compliance with the conditions imposed by the Code of good Agricultural Practices for manure management. Although the Ministry of Environment has financed - with the municipalities as beneficiaries and managers of the investments - the creation of communal platforms for manure and the related collection system from the population, composting stations, and vegetation curtains for the protection of surface waters, there still is only one platform in the mountain area bordering the hill area. This unit serves just one of the 49 territorial-administrative units in the mountain area. A favoured element in limiting GHG emissions from animal husbandry is the existence of the forest fund, forests and forest vegetation covering approx. 63% of the surface of the administrative units located in the mountainous area of the county.

Since in half of the 14 water quality control sections, the nitrate loading is above the established admissible limit value, a correct management of the manure is necessary, in appropriate systems for the storage and use of manure.

Mountain ecosystems in the Suceava County are positioned at altitudes between 800 – 1000 m and are very fragile. In this mountainous area many water courses spring out (water is considered a strategic resource) and feed Romania's largest hydrographic basin. Therefore, according to our study, the quality of life of the human communities in this mountain area with a population density of 82.6 inhabitants/km², and the health of the ecosystems depends on the implementation of a sustainable management of livestock activities.

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