Social aspects of livestock waste management in Cyprus

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Abstract

This work examined the social perception of the population towards the management of livestock waste in Cyprus. A questionnaire was developed and distributed to population residing relatively close to livestock waste production and management facilities. The responses showed that the greatest problems as perceived by the population are odour issues, health issues and the adverse impact on property values. The participants in the survey assessed traffic and noise as minor problems.The majority of people (73%) replied that land spreading of livestock waste is the dominant livestock waste management practice currently implemented in Cyprus. Only a small part reported not to be at all informed concerning livestock waste management. The participants in the survey believe that livestock waste management activities cannot significantly improve the employment level in Cyprus.

Introduction

The total livestock waste production in Cyprus is 1,850,000 t/yr. The large volumes of livestock waste produced cannot be applied on land, while many installations are close to residential areas. The potential biogas production from the anaerobic digestion (AD) of livestock waste in Cyprus: 37,000,000 m^3/yr based on the biogas yield per tonne of livestock waste; 20 m^3/t(Theofanous et al., 2014) The theoretical thermal and electrical generation is185 GWh/y and129.5 GWh/y(Theofanous et al., 2014,Zehnder, 1988). Thus, the treatment of livestock waste through anaerobic digestion in Cyprus can be an attractive option, since an important amount of energy can be generated (185 GWh/y heat and 129.5 GWh/y electricity) and at the same time the issues of managing livestock waste can be effectively tackled.Effective livestock waste management has several social, environmental and economic benefits. The main objective of this work is to define and apply sustainable indicators and criteria in order to depict the social aspects of livestock waste management (LWM) in Cyprus.

Methodology

A sustainable development indicator (SDI) is a quantitative tool that analyses changes, while measuring and communicating progress towards the sustainable use and management of economic, social, institutional and environmental resources. The main criteria and target indicators (Table 1) used for the social assessment are selected based on scientific, functional and pragmatic criteria(Bossel, 1999; Bell and Morse, 2003).

Table 1. Social indicators for livestock waste management (LWM) in Cyprus

Criterion	Indicator (current and/or future)	Unit	Estimation Method
Quality of life	Land demand for livestock waste management	km^2/t waste	Estimation and expert judgment
Quality of life	Noise exposure	Ordinal scale	Extent to which residents feel highly affected by noise. Estimation and expert judgment
Quality of life	Odour exposure	Ordinal scale	Extent to which residents feel highly affected by odour. Estimation and expert judgment
Quality of life	Contribution to traffic (traffic load)	Km/ton waste	Estimation and expert judgment
Quality of life	Risk perception in livestock waste management	Ordinal scale	Questioner
Quality of life	Visual impact	Ordinal scale	Questioner
Employment	Direct employment	person-years/GWh	Labour due to waste transport, plant construction and conducting
Employment	Indirect and induced employment	person-years/GWh	indirect employment relates to sectors serving the bioenergy projects, and induced employment relates to jobs created by the stimulation of general economic activity
Employment	Under and postgraduate student internship opportunities	person-years/plant	Estimation and expert judgment
Employment	Employment quality	Ordinal scale	Work qualifications expressed as average years of education for workforce

A brief analysis of indicators is presented below:

   A.   Criterion: Impact on employment

A.1 Indicator - Direct employment (person-years/GWh): It is measured by the average amount of labour in person-years per GWh of electric energy produced. Direct labour includes the labour required to build, operate and decommission the plant, and to operate the plant. Direct employment for livestock waste management in Cyprus would be 0.24 person-years/GWh based on lifetime of 40 years(EU Report)(http://www.livewaste.org/).

A.2 Indicator - Indirect and induced employment (person-years/GWh):It is measured by the average amount of labor in person-years per GWh of electric energy produced. Indirect jobs are: agriculture operator, soil analysis, environmental analysis, biomass transportation, component design, component fabrication, and component supply. Direct employment for livestock waste management in Cyprus would be 0.37 person-years/GWh based on lifetime of 40 years (http://www.livewaste.org/).

A.3 Indicator - Under and postgraduate students' internship opportunity (person-year/waste treatment plant):It is measured by the number of students in person-years per livestock waste treatment plan. This indicator is derived from the fact that a high and innovative technological level characterizes the proposed treatment process in this project.Based on the innovation of the applied technology up to 2 student-year per livestock waste treatment plant could be occupied in an internship program.

   B.   Criterion: Quality of life

B.1 Noise exposure: (Ordinal scale): It considers the amount of noise caused by the LWM plant, as well as transport of livestock waste to and from the plant (e.g. transportation of chemicals and/or waste). The evaluation of the indicators is based on questionnaire survey that was submitted to the Cypriot population.

B.2 Odour exposure (ordinary scale):The indicator is based on the amount of odour caused by the LWM, and/or manure

disposal. It is evaluated based on questionnaire survey that was submitted to the Cypriot population. Odour from waste treatment facilities is an important factor of the social acceptability of a LWM system.

B.3 Contribution to traffic (traffic load) (km/ton waste or ordinary scale): The indicator quantifies the freight traffic by lorry caused by the treatment of 1 tonne of livestock waste. Traffic load expressed as km/t waste can be evaluated by life cycle assessment (LCA). The impact of the traffic load on population is also estimated by questionnaire survey.

B.4 Risk perception: (Ordinal scale):The indicator is related tothe citizens' fear of negative health effects due to normal operation of the electricity generation technology. The resulting NIMBY ("Not in my backyard!") attitude is very common concerning installations for the treatment or deposition of waste. The indicator quantifies the population risk perception towards waste pre- and treatment plants by means of a questionnaire that involves seven key factors affecting public risk perception: trust, voluntary versus involuntary, control, benefit/reward, understanding, gender and catastrophic potential.

B.5. Visual impact (Ordinal scale):This indicator measures the visual impact of the treatment waste plants, taking into account the visibility, fragility and contour quality.

The social aspects concerning livestock waste management and its impact on Cypriot population were evaluated by questionnaire survey using the methodology that is described in the above session (questionnaire is available in http://www.livewaste.org/). The respondents of the survey were equally distributed in terms of sex, while the age range was between 20 and over 70 years old. Concerning the education level the following categories were identified: 58% respondents with secondary school education, 25% respondents with university education and 17% with primary education. In terms of the employment level the respondents worked in public administration (33%), service industry (25%) and in the agricultural sector (17%).

Results and Discussion

People were asked how well informed they feel about the livestock waste management system in their city and to indicate the source of the information. Only few of the respondents declared not to be at all informed concerning LWM (17%). The highest number indicated to be completely (42%) or moderately informed (33%). The majority of the respondents specified to have received information about livestock waste management from TV and brochures (55%).

The major problems indicated by respondents were odour emission, health issues and property value, assessing with 3.8, 3.7 and 3.7 out to 5 respectively. The participants in the survey assessed traffic and noise as minor problems providing a score of 2.16 and 2 out of 5 respectively.

The majority of the respondents answered that land spreading without any prior treatment or composting is the most common method to the question "how the livestock waste is treated in your city/town". It was a common opinion that the existing treatment system was not adequate compared to the requirements. The participants in the survey (50%) confirmed this by stating that the functionality of the existing LWM system was quite bad and bad. The most important problem related to livestock waste operation seems to be odour emission, while traffic was identified as a minor issue. Finally based the participants in the survey believe that livestock waste management activities cannot significantly improve the employment level in Cyprus.
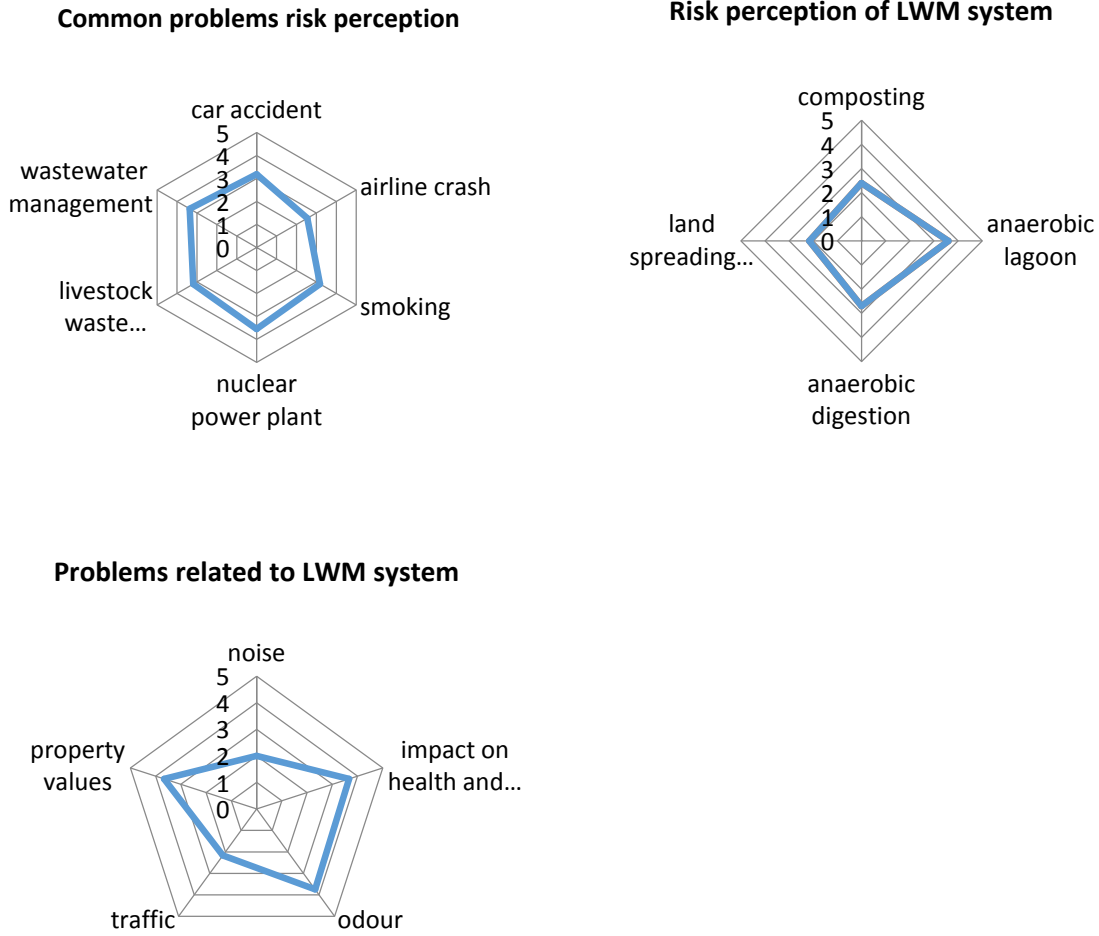
Common problems risk perception

car accident
airline crash
wastewater management
smoking
livestock waste…
nuclear power plant

Risk perception of LWM system

composting
anaerobic lagoon
land spreading…
anaerobic digestion

Problems related to LWM system

noise
impact on health and…
property values
odour
traffic

Figure 1. Problems and risk perception related to LWM

Awareness of LWM system

17%
42%
33%

- completely
- medium
- no idea

Information source

60%
50%
40%
30%
20%
10%
0%

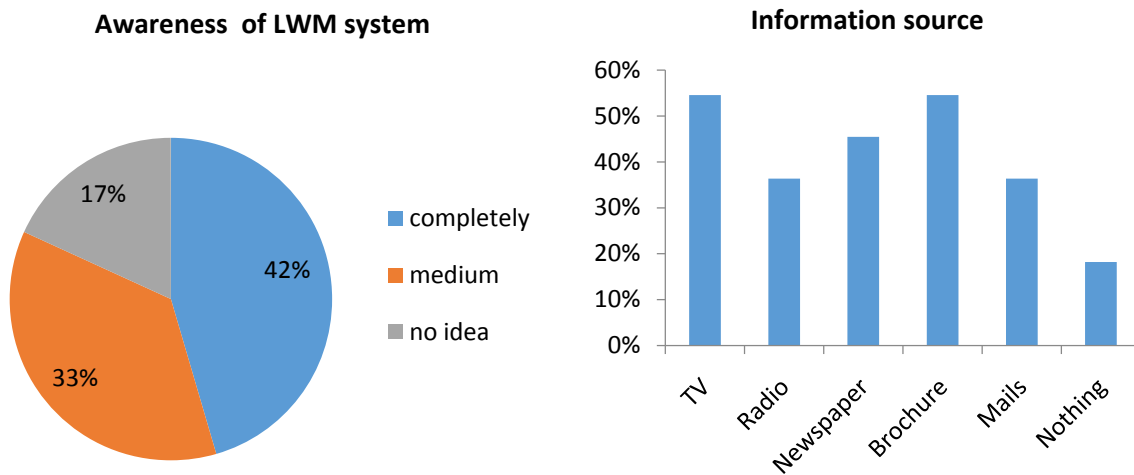TV Radio Newspaper Brochure Mails Nothing

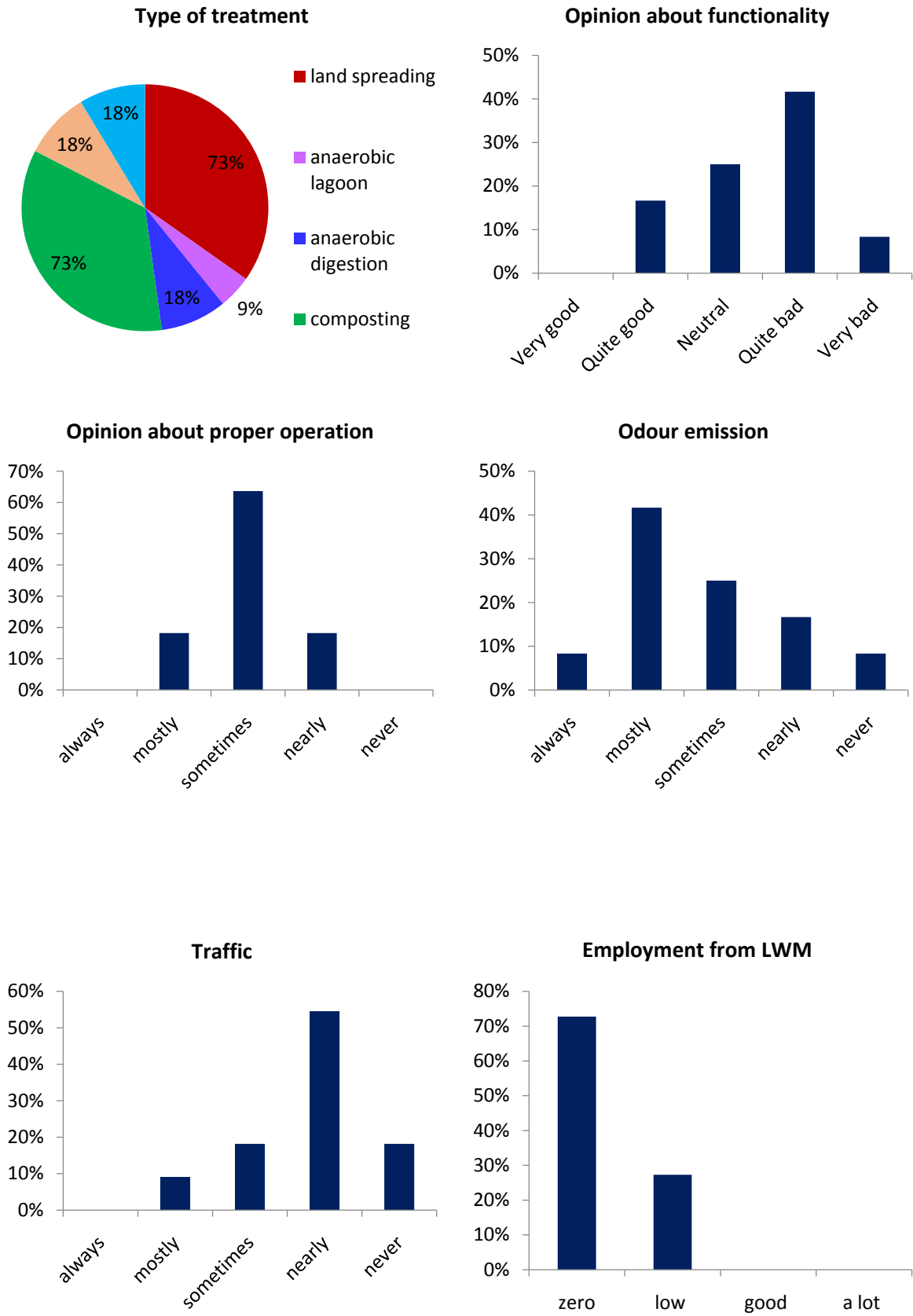**Figure 2. Awarenes of people related to LWM**

Figure 3. Perception of public concerning the type of treatment used for livestock waste, the functionality of LWM, whether the treatment systems are properly operated, whether LWM results in odour emissions, traffic problemsand in the creation of jobs

Conclusions

The results of the current study on the social effects of LWM in Cyprus revealed:

- The main nuisance concerning livestock waste management is related to odour emissions. The impact on health and the decrease of property values were also important issues Mitigation measures should be considered.
- The participants in the survey assessed traffic and noise as minor problems.
- The majority of people (73%) replied that land spreading of livestock waste is the dominant livestock waste management practice currently implemented in Cyprus.
- Only a small part reported not to be at all informed concerning livestock waste management.

Acknowledgements

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