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# Project Description: Assessment of Odours from Livestock Farming

*Assessing annoying odours from agricultural activities and livestock farming increasingly poses a problem in environmental licensing and surveillance practice nationwide. Outside the boundaries of residential areas - where agriculture is privileged - as well as in rural areas, there are hardly any more development potentials resulting from the multitude of agricultural installations. Even the expansion of existing stables is met with opposition. The required setback distances can not be complied with. Therefore, five German federal states have instigated an investigation to work out a regulation system for odours from livestock farming based on a dose-response relationship between odour exposure and annoyance.*

In many controversies one argument is that livestock odours are customary in place, that is the presumed greater acceptance of these odours in the population in connection with a lower annoyance potential compared to industrial odours. Another argument consistently stated in this context is that different kinds of livestock (cattle, pigs, poultry) are presumed to give rise to different degrees of annoyance. At present, reliable systematic investigations are not available or not sufficient for guideline development. The annoyance response of people residing near livestock installations has been studied only randomly.

This is the point where the research project "Assessment of Odours from Livestock Farming" is located. It is conceived as a joint project of the German federal states Baden-Wuerttemberg, Mecklenburg-Western Pomerania, Lower Saxony, Saxony and North Rhine-Westphalia (NRW) and co-ordinated by the NRW State Environment Agency. Institutions involved are:

- Baden-Wuerttemberg
  - Ministry of Transport and the Environment (Ministerium für Umwelt und Verkehr (UVM))
  - Ministry of Nutrition and Rural Affairs (Ministerium für Ernährung und Ländlichen Raum (MLR))
  - State Institute for Environment Protection (Landesanstalt für Umweltschutz (LfU))
  - University Hohenheim - Institute for Agricultural Engineering (Universität Hohenheim - Institut für Agrartechnik)
- Mecklenburg-Western Pomerania
  - Ministry of the Environment (Umweltministerium Mecklenburg-Vorpommern (UM))
  - State Institute for the Environment, Nature Protection and Geology (Landesamt für Umwelt, Naturschutz und Geologie Mecklenburg-Vorpommern (LUNG))
- Lower Saxony
  - Ministry of the Environment (Umweltministerium Niedersachsen (MU))
  - State Agency for Ecology (Niedersächsisches Landesamt für ÷kologie (NL÷))
- North Rhine-Westphalia
  - Ministry of the Environment and Nature

- Protection, Agriculture and Consumer Protection (Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz (MUNLV))
- State Environment Agency (project management and coordination) (Landesumweltamt (LUA))
- MEODOR Immission Control GmbH (MEODOR Immissionsschutz GmbH)
- Saxony
  - Ministry of the Environment and Agriculture (Sächsisches Ministerium für Umwelt und Landwirtschaft (SMUL))
  - State Institute for Agriculture (Sächsische Landesanstalt für Landwirtschaft (LfL))
  - State Agency for the Environment and Geology (Sächsisches Landesamt für Umwelt und Geologie (LfUG))

A systematic investigation of the dose-response relationship between odour exposure and annoyance response of residents in the vicinity of agricultural installations is intended. Thereby, different kinds of livestock such as cattle, pigs and poultry are taken into account. Within the triennial project, odour exposure will be assessed by means of field inspection according to the Guideline on Odour in Ambient Air (GOAA 1995/1999) and guideline VDI 3940, including hedonic tone (pleasant-unpleasant quality) and intensity, and odour annoyance will be assessed by means of questionnaire surveys in the surrounding residential areas according to guideline VDI 3883 part 1.

## Objectives of the research project

The purpose of this field study is to develop the basics for a regulation system for odour immissions in the vicinity of livestock installations the basis of exposure-annoyance investigations. The concept for the assessment of odour immissions is based on dose-response relationships, so that statements about the degree of annoyance of the residents could be derived from the frequency of recognisable odour immissions. This dose-response relationship ought to be the basis to define if necessary the area when annoyance turns into a "significant" annoyance in terms

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of §3 BImSchG (Federal Immission and Ambient Pollution Control Act).

Besides, within the context of this research project further parameters, which are known or supposed to influence the annoyance response of the residents, are to be examined, so that these could be taken into account in the determination of immission values if necessary. On the basis of the scientific data obtained in the project the following hypotheses are to be reviewed in detail:

- With increasing odour exposure due to agricultural odours (odour frequency as percentage of hours per year) the degree of annoyance increases as well (dose-response relationship).
- Agricultural odours are more accepted by the population than industrial odours ("customary in place"). Odour annoyance is thus depending on:
  - The animal species; on the same exposure level odours from poultry management should have a higher annoyance potential than odours from pig installations, and odours from pig installations should have a higher annoyance potential than odours from cattle installations.
  - The amount of animals on the farm (livestock) / management of the installation
  - The personal attitude of the residents towards the odour source and agriculture in general
  - The structure of the residential area, for example the alteration of rural to urban areas
  - The duration of existence of the odour-causing installation
  - Occupancy: "moved to the countryside recently" against "resident for a longer time"

### Approach and methodology

The selection of the study areas will be done by visiting and evaluating the locality according to consistent criteria. Characteristic livestock odours (animal species, liquid manure, silage) are described according to

appropriate guidelines. The following animal species are expected to be included in the federal states: Baden-Wuerttemberg - 4 study areas (pigs); Mecklenburg-Western Pomerania - 1 study area (pigs); Lower Saxony - 3 study areas (cattle, pigs, poultry); Saxony - 1 study area (cattle); North Rhine-Westphalia - 2 study areas (cattle, poultry).

Odour frequency assessment is done by means of systematic field inspection using selected and trained panels according to guideline VDI 3940 and the methodology given in the GOAA. Here, hedonic tone and intensity are measured by means of a newly developed method on correspondingly modified record forms. This method was audited within the scope of the research project "Investigations on the Effect of Intensity and Hedonic Tone on the Degree of Annoyance". Odour annoyance responses are assessed through direct interviews with the residents at home. According to the sample questionnaire in guideline VDI 3883 part 1, the questionnaire will be adapted to the special questions of this project and accordingly extended. Within the framework of this project the following parameters (*Table 1*) will be assessed.

Beside these measurement categories necessarily required for exposure-annoyance assessment in every area under investigation

- The operating data of the installations are assessed in such a manner that the derivation of an emission data record for every relevant livestock is possible. In particular cases odour emission measurements are carried out.

- The meteorological circumstances throughout the term of the systematic field inspection are recorded by means of separate measurements or on the basis of transferable gauging stations in the neighbourhood.
- Dispersion modelling is conducted. Dispersion modelling is done to assure the representativeness of the results of the systematic field inspection.

### Practical relevance

The concept and the objective of the project are geared to get a scientific validated estimation of the relevance of the annoyance potential of characteristic livestock odours subsequently to the analysis of the results. Thereby, the influence of different animal species (cattle, pigs, poultry) as well as the influence of further factors (livestock, management of the installation, occupancy, structure of the residential area) on the degree of annoyance will be examined.

It will be investigated, to what extent odours from livestock could be evaluated according to the current regulations in the GOAA or if modifications may be required.

As a result of the participation of five German federal states with different agricultural structures it will be investigated, if generalisation of the results on other parts of the federal territory is possible.

In this context, it is expected that the results of the project will make a substantial contribution to a scientifically founded evaluation of agricultural odours.

Table 1: Measuring parameters for odour nuisance and reaction to molestation

	Technical Measurement Parameters of exposure / odour immission	Acquisition of the annoyance response of the residents /Effect assessment
<b>Approach</b>	Systematic field inspection with-observers (data record form)	Interviews at home using standardised questionnaires, 6-point scale:
<b>Frequency</b>	Frequency of recognisable odour immissions (as percentage of hours per year)	1-once a month and less to 6-several times a day
<b>Intensity</b>	7- point scale: 0-not perceptible and 1-very weak to 6-extremely strong for the average and the most intense impression	7- point scale: 0-not perceptible and 1-very weak to 6-extremely strong for the average and the most intense impression
<b>Hedonic tone</b>	9- point scale: minus 4-extremely unpleasant for the average, the most pleasant and the most unpleasant impression	9- point scale: minus 4-extremely unpleasant for the average, the most pleasant and the most unpleasant impression
<b>Annoyance</b> (Due to odours from installations, the agricultural odour has been identified and named clearly)		Annoyance thermometer: 11-point scale from 0-no disturbance at all to 10-extremely disturbed; Verbal scale: 6-point scale from 0-not annoyed to 5-extremely annoyed; Unacceptability judgement: yes or no
<b>Further Parameters</b>		Presumed influencing factors and confounders (animal species, live stock, installation management, occupancy, age, attitudes)