Noise in Europe

A briefing from the NGO Community

There is increasing concern about noise pollution in Europe[1]. People frequently complain about noise annoyance, and most EU citizens live in areas which have disturbing levels of noise. Controlling this form of pollution has now become a priority, as science makes progress in establishing how much harm noise causes. The European Commission's recently adopted Directive on noise[2] is a first step in containing the problem. What follows is a briefing designed to give an insight into the issues.

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Noise and its sources

Noise can be defined as unwanted sounds[3]. They are characterised by their intensity (expressed in decibel, dB) and their frequency (expressed in Hertz, Hz). Noise is mainly caused by traffic (road, rail, aircraft), industry and leisure activities.

What are the impacts of noise?[4]

The specific effects of noise on individual human health are difficult to establish, mainly because individuals' sensitivity to noise is highly variable. However, recent studies show that noise is a major source of stress, with physiological reactions including accelerated heart rhythm, increased amounts of hormones produced and dilation of the pupils[5]. Noise also increases the stress already present from difficult social, familial or professional relationships as well as the health problems and can intensify the development of mental disorder.

Other general impacts of noise include:

• Hearing impairment (though damage only occurs at very high noise levels - around 85 dB (A) - so this is not the most important effect);
• Intelligibility of speech
• Physiological effects, such as tiredness (from muscle contraction) and hypertension (from contraction of blood vessels);
• Sleep disturbance[6];
• Performance in cognitive tasks (from lack of concentration and precision in actions);
• Decrease of children's ability to comprehend, concentrate and assimilate. Young children in the process of acquiring language and reading skills are particularly at risk;
• Mental health problems.

Noise from numerous sources will typically have some combination of effects; such as interfering with speech in the day and disturbing sleep at night. It is important to note that the effects of noise are often more severe on vulnerable subgroups; such as the elderly, young children, blind people and people in hospitals or rehabilitating at home.

To these general effects must be added more specific ones. The duration of a noise event, and its tone, can also influence perceived annoyance. For example, an aircraft's tone is perceived as threatening (it integrates notions of fear) and is therefore typically more annoying than the same level (intensity and frequency) of train noise. Some types of tone are even considered relaxing (wave noise, bird song) and therefore cannot be treated as noise.

Another specificity to take into account is what is called the emergence of a noise (the size of fluctuation from the background noise level[7]). This characteristic is very important when considering night-time noise[8], as emergence is one of the most important causes of sleep disruption. This is in turn responsible for a series of severe health effects, which were acknowledged by the European Commission as long ago as its green paper on future noise policy[9].

More colloquially, any European citizen can tell of the effects of noise on her/ his quality of life.

Measuring noise

In order to set limits, we need to determine the noise level. This is not simple since, as has been mentioned, noise is a partly subjective experience. But at least two things can be measured: intensity and frequency. The human ear is able to distinguish a large amount of noise intensity (from 1 dB to 125 dB, which is the start of the pain threshold) and that is partly why a logarithmic scale is used. An increase of 3 dB means the total intensity of noise has doubled.

We also are able to perceive a wide range of frequencies: about 15 to 20 000 Hz (a dog-whistle has a frequency higher than 20 000 Hz). In fact we can say that noise is a "disordered" mixture of sound characterised by variable intensity and frequency.

The interaction between these two characteristics also has a major influence on how a noise is perceived (two sound of the same intensity are perceived differently, according to their frequency). To take this particularity into account we use the dB (A) or "corrected decibel" measurement. The more annoying frequencies are given more weight. The dB (A) is now the most commonly used unit and is the basis for all the other indicators. The problem is that the dB (A) only serves for 'snap-shot' measurements.

To evaluate annoyance over a certain period of time we therefore use indicators of total energy received, expressed in dB (A); for instance the L(A)eq measure for daytime noise and the Lden (day, evening and night) for noise over a 24 hour period.

• *Which indicators? See following page.*

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The scale of the problem

Europe is drowning in noise. More than half of the Union's citizens are exposed to an unacceptable level of transport noise. The WHO reports that more than 30% of European Union citizens are exposed to levels of noise which disturb sleep; and 5-15% of all citizens suffer serious noise-induced sleep disturbance[10].

Critically, the scale of the problem is growing together with Europe's roads and airports. With a 3 dB increase in noise equivalent to a doubling in the total intensity of noise, this problem requires immediate action. The WHO says that[11]:

"In contrast to many other environmental problems, noise pollution continues to grow and it is accompanied by an increasing number of complaints from people exposed to the noise. The growth in noise pollution is unsustainable because it involves direct, as well as cumulative, adverse health effects. It also adversely affects future generations, and has socio-cultural, aesthetic and economic effects."

In other words, we cannot ignore the problem of noise pollution, and the threat to human health it represents. And with this pollution increasing across Europe, the need to act now to protect Europe's citizens is very great.

Given the considerable impacts of noise on human health, it is important to set limits on noise emission. Humans have always legislated on noise: even ancient Romans had rules on noise from wagon wheels.

Why EU-wide noise standards are needed

There are two main reasons why noise standards need to be set at a European level: to protect the health of EU citizens and to support the effective working of the common market.

Competition

Regions and countries, even within the European Union, typically see themselves in competition with each other. In addition, short-term interests very often define a region's political actions. This has led interest groups to play regions and even countries off against each other to ensure for themselves the best possible operating conditions. This is particularly noticeable in the case of airports.

The European Community is responsible for taking steps to ensure that such pressures do not result in lack of protection for the European citizen and voter.

This is an especially cogent fact in the case of noise, where the costs are typically borne by society rather than by those who are responsible for causing the pollution. The residents living closest to the source of noise pollution are of course the most affected; but the whole society pays the human health costs (see above).

In the medium- to long-term it is economically, and politically, worse to accept noise problems than it may initially appear.

The fact that the authorities in Strasbourg refused to allow the company, DHL to set up increased air operations at Strasbourg airport shows that it had recognised this fact. They saw that the short-term gains from increased employment in the area would be more than offset by the costs (see below). This is unusual in Europe.

The case of TNT[14] is a good example of why actions need to be taken at a European level. TNT used to be based at Cologne airport. When the authorities refused permission to TNT to expand its activities, the firm looked for another European base. Many airports competed to offer TNT the most favourable possible conditions. Monetary and legislative incentives were offered quickly, and without impact studies. The decision had to be taken as quickly as possible so as to not lose the supposed golden opportunity. This led to a series of short-term considerations and decisions being taken, without consideration of citizen's health and well-being. TNT moved to Liege airport. It was immediately evident that the noise costs were very high; but within the last two years it has become clear that the health costs from noise pollution are far heavier for Liege than the economic gains.

It is clear that European-level legislation is the best way to implement standards which will protect the European citizen while not providing a competitive advantage for particular regions in the European Community. In other words, European standards are the best way of ensuring a level playing field when there is the potential for inter- or intra-national competition based on environment and health standards to protect citizens.

Sufficient protection of citizens' health

Protection of the health and well-being of members of the public against harmful effects of environmental pollution is a shared responsibility between the Community and the Member States[15]. Some aspects can best be covered at the EU level, others at national and local level.

Given the lack of effective action (based partly on the inter-regional and -national competition mentioned above) taken to date by governments and local authorities to protect their citizens from this pollution, the Community needs to provide Europe-wide standards.

Guidelines for noise levels

The exact limit values for noise levels will differ according to source. The general principle should, however, be that the relative risk to human health from noise should be no more than other hazards which the European Community controls and has already legislated on; for example, the same level of risk accepted in the daughter Directive[12] for ambient air pollution limits of SO2, NOx, particulate matter and lead.

The case of aviation noise is set out here as an example. For guidelines on all forms of environmental noise, see the WHO guidelines on Community noise.

When establishing a limit on aircraft noise, two limits - both an overall limit (expressed in Lden) and a night time limit - should be considered. The Commission's proposed noise Directive adopts these indicators.

According to the WHO guidelines for community noise, the total energy received during the night (expressed in Laeq,8h) should not exceed 30 dB (A) indoors if sleep disturbances are to be avoided. If we assume, following the WHO guidelines, that the difference between outside and inside noise (windows open) is 15 dB (A), then the limit should be set at 45 dB (A).

Using the same assumptions the number of events with a peak level (Lmax) exceeding 60 dB (A) should be limited.

The WHO insists on preserving quiet areas, and the Commission Directive also stresses this need. One way to achieve this could be by setting limits to emergence levels. So for the overall limit the upper threshold should be 55 dB (A)[13]. This is an upper limit because the fact that aircraft noise is perceived as more annoying is not taken into account (a penalty of 5 dB could be set) and because these are general limits that could be lowered to protect the more sensitive persons (elderly, children, etc). Moreover using an average of energy received is not sufficient to assess aircraft noise, for the reasons mentioned above.

Which indicators?

The indicators used to assess noise should be representative of the real annoyance perceived and easily usable to set threshold. For example to assess aviation noise, other indicators (relating to the emergence and peak levels) should complement the well-known and commonly used Lden indices (which measures the total energy received over a 24 hour period). Additionally the nature of the tone should be taken into account (as it already is in many countries, where annoyance thresholds for rail noise are 5 dB (A) higher than for other sources).

Comments on the proposed Directive

While the Commission's proposal for a framework Directive on noise is a good initiative, it is far too weak to adequately protect Europe's citizens from the major environmental and public health threat which noise poses. Although earlier drafts were stronger, the final version fails to provide real protection for Europe's citizens.

This is very strange, because the Community used an excellent model when legislating over a comparable issue: air quality. If we use the same evaluation and risk analysis methods as a basis, it is clear that the risk of major health problems induced by noise is far more visible and numerically observable than for many other pollutants. The Directive should therefore be altered to include more concrete measures. It should also require the Commission to produce a series of source-specific daughter-directives within two years of adoption of the framework Directive.

The daughter-directive on Ozone calls for alert thresholds for vulnerable groups within society, which are of course more stringent than the general thresholds. As large groups of society are especially vulnerable to the effects of noise, a noise framework Directive should also include alert thresholds for vulnerable groups. These should be contained within the concept of sensitive zones (see below).

Some of the main concerns with the proposed Directive are:

• The absence of limits for noise sources. Earlier drafts of the Directive contained such limit values, which were based on sound research concerning 'annoyance' and guidance from the World Health Organisation.

• Neighbourhood noise and noise from work-places were included in earlier drafts, but have since been removed. They should be included within the Directive's scope due to their major contribution and impact.

• The Directive only calls for action plans for fairly highly populated agglomerations. Yet the public may be suffering from noise in areas outside such agglomerations. The concept of 'sensitive zones' should therefore be introduced. Such zones would include all residential areas and should be protected by limit values. This concept is already being introduced into some Member State legislation. Noise maps and action plans should be prepared if there is good reason to believe the area's population suffers from unacceptable noise disturbance.

• The definition for noise sources will exclude (for example) many small but noisy airports. Research has shown aircraft noise to be more annoying than other transport noise. Airport use is also prone to strong seasonal variations, especially where charter operations are commonplace, and this should be taken into account. The same can be said of road and rail noise.

Parliamentarians now have a window of opportunity to provide minimum limit values or guiding indicators, and to broaden the scope of the Directive so that all people suffering from noise are included. This would be in line with WHO community noise guidelines and would go a long way towards protecting Europe's increasingly vocal citizens from the noise they are complaining so bitterly about.

Good and bad practice in Europe

A European example worth following

The regional authorities in Strasbourg refused the courier company, DHL, access to Strasbourg airport. This followed a comprehensive report from Vallet and Muzet, which showed how severe the costs of repairing the damage caused by noise would be. In other words the authorities were unable to grant the company access in the face of the evidence: the cost to human health of the additional aviation traffic would outweigh the direct benefits from increased employment that the company would bring it.

Worst practice on noise policy in Europe

The award for worst practice on noise policy in Europe is shared by many national and local authorities. Of particular interest as regards aviation are the examples of Heathrow and Schiphol airports.

Heathrow

The situation is so bad at Heathrow that a group of citizens living near the airport took their case to the European Court of Human Rights in April 2000. The Court accepted the case and asked the UK government to justify its decision to allow night flights at Heathrow airport.

Presently a total of 16 flights are allowed between 4h00 and 6h00, and flights are unrestricted after 6h00. The case centres around article 8 of the European Convention of Human Rights, which states that people have the right to enjoy their homes. As English law defines "night" as 23h30-7h00, the group believes allowing flights before 7h00 is an abuse of human rights. Since April, the Court has asked the UK government for additional information, and is expected to release its ruling in the near future.

Schiphol

A number of national and about 50 local groups (represented by a local umbrella organisation) in the Netherlands have taken the government to court repeatedly over the last three years about noise levels around Schiphol airport. There are three different noise issues.

They have twice brought a case to court over the environmental license granted to Schiphol. The government must award an airport with an environmental license for it to operate legally. Schiphol should be governed by a planning document which was created for Schiphol, and which is a planning instrument with a legal status. The court has twice decided that the environmental license which the government has awarded Schiphol is invalid, as it does not correspond with the planning document. To date, the airport still operates without a legal license and the transport ministry needs to submit a new license to the courts for approval.

Each year Schiphol airport must come up with an operating plan for the following year. Three times there has been a legal battle over this annual operating plan, which Schiphol airport

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Good and bad practice in Europe

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had submitted and which the transport ministry had approved. In each case the citizens' groups argued the operating plan violated the noise standards set out in the legally-based planning instrument for the airport. In each case the court rejected the case on the grounds that the annual plan does not have a legal status and can therefore not be evaluated using the court system.

Additionally, the groups have gone to court a number of times over specific violations of noise limits. These cases have been mostly unsuccessful, although there have some small successes, notably when Schiphol was forced to close a runway at night for a one-month period.

It is interesting to note that the number of complaints about noise from Schiphol airport is growing significantly over time, and the complaints are coming from an area of about 5000km2 - which comprises significant parts of 2 provinces in the Netherlands.

Explanation of terms

Emergence

is defined as the difference between two dynamics of noise. This means the difference between the normal or background noise dynamic and the one in which the source of noise is analysed.

In the case of aviation this means analysing normal fluctuations from the average background noise, without aircraft noise (not every noise fluctuation at an airport is due to aircraft noise, but can also be caused by normal everyday activities); and doing the same with aircraft noise included. The difference between the two is the emergence and is entirely attributable to aviation noise.

One possible way to measure the dynamic of a noise consists of calculating L5 - L95 where L5 (or L95) is the noise threshold crossed for 5% (or 95%) of the period analysed. L5 approximates the average value of the peak levels and L95 is equivalent to the value of the background noise. Doing that for two periods of the same duration, one with and one without aircraft flights, enables one to estimate the emergence of the aircraft noise[16].

Annoyance

(feeling of being annoyed) is a subjective notion, especially in the case of noise. People differently perceive noise differently, depending on many factors (age, health, mental state and even the time at which the noise occurs); and are therefore differently annoyed by noise. The term, "annoyance" only includes the conscious effects of noise.

Calculating or measuring?

Noise levels can be measured or computed. Calculating indicators such as Lden or Lnight is usually cheaper and easier than measuring them. Computation is also the only method that can be used for prediction purposes. The problem is that Member State computation methods do not currently meet the requirements for modern harmonised methods recommended in the Directive[17]. Member States will thus have to adapt their existing methods (by including EU noise definition and indicators), or adopt an existing method which is recommended by the Commission.

Notes

1 Noise is the only environmental impact for which the public's complaints have increased since 1992.

2 Proposal for a Directive of the European parliament and of the Council relating to the assessment and management of environmental noise, adopted on 26 July 2000, COM(2000)468 final.

3 "Physically, there is no distinction between sound and noise. Sound is a sensory perception and the complex pattern of sound waves is labelled noise, music, speech etc. Noise is thus defined as unwanted sound." WHO guidelines for community noise (2000), p. vii. Available at http://www.who.int/peh/noise/noiseindex.html

4 Description follows WHO guidelines for community noise. See this publication for a full description and specific information.

5 Evidence from several studies indicates that noise causes changes in blood pressure, increase in stress hormones and can increase the risk of heart disease.

6 Most people have experienced transportation noise disturbing their sleep. Public questionnaires show it is perceived as a major environmental noise effect. Noise causes difficulty in falling asleep, alterations in sleep stages and awakenings. The primary effects are a range of physiological impacts. Secondary effects can include reduction in perceived sleep quality, fatigue, decreases in well-being and performance. Psychosocial effects have also been reported. WHO recommends that nighttime, out doors, sound levels should not exceed 45dB (Laeq).

7 See the Annex for a detailed explanation of this concept.

8 This is why the WHO guidelines call for a frequency analysis in areas where environmental noise includes prominent low-frequency components. An example would be night-flights.

9 The Commission's Green Paper on Future Noise Policy COM(96)540 final.

10 Page 3, Commission proposal for a Directive relating to the Assessment and management of environmental noise, COM(2000)468.

11 WHO guidelines for community noise (2000), p. vii

12 This daughter Directive sets maximum permissible limits of concentration in the air of these four pollutants. Above these levels the pollutants are considered unsafe for humans. Similarly, levels of noise above the WHO guidelines are considered a threat to human health.

13 The WHO guidelines on Community noise say that in order to prevent the majority of people from being seriously annoyed by noise, the maximum overall upper limit should be set at 55dB (A) (LAeq). Preventing the majority of people from being moderately annoyed requires a maximum upper limit of 50dB (A) (LAeq).

14 TNT is a freight delivery company which operates during the night. TNT moved its operations from Cologne to Liege in 1998.

15 The Commission's proposal is based on Article 175 of the Treaty.

16 This method of calculation is based on the approach taken by Nicolas Plom, civil engineer and acoustics expert; and court-appointed expert in the Liege airport case.

17 COM(2000)468 final

Annex 3: The NGO community

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