



Land use planning and airports - The conflict between residents and aircraft noise

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Institute for
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Abstract

This paper gives an overview on the PhD-Study 'Land use planning in airport regions' which will be conducted in cooperation between the German Aerospace Center, Department of Airport and Air Transport Research and the Department of Economic Geography of the Humboldt-University Berlin.

The background of the topic is the protest of residents in the vicinity of airports against aircraft noise, specifically night flights. The main objective of this dissertation is to identify possible flaws in land use planning processes and airport master planning. Based on a detailed survey of general fundamentals of regional planning and the air transport sector, an empirical analysis of a typical airport region in Germany will be conducted. The primary research methods will be interviews with experts and stakeholders and a statistical analysis of certain socio-economic factors assisted by a Geographic Information System (GIS). The study will conclude with recommendations to improve the organization of regional planning processes and suggest new regional development policies.

1 Introduction

Aircraft noise is a serious problem for people living in the vicinity of airports. Particularly night flights are perceived as having strong impact on the health situation and life quality. Especially in countries with a high population density and geographical constraints aircraft noise is a serious issue. It is affecting the residents and has also a strong influence on the stakeholders in the air transport business. Costs for sound insulation of houses have to borne by airports and airline companies. In addition to that restrictions of flight operations or night curfews lead to a reduction of operational flexibility and revenue for the airport operator and airline companies. It has also repercussions for employment and tax revenues which in turn might have a negative effect on the surrounding communities. A further implication for airports is the expansion for capacity reasons which, in general, leads to resistance from the residents. One example is the Brussels Airport where DHL was faced with a strong opposition on the part of local communities as a result of planned increase in night hub operations [1]. DHL was forced to abandon the Brussels hub and will move to Leipzig/Halle in Germany. Similar problems can be observed in the expansion process of Frankfurt and, to a lesser amount, in Munich.

Several attempts were made to identify the reduction potential of aircraft noise. One was the interdisciplinary research project 'Quiet Air Traffic' of the German Aerospace Centre considering technical measures at the aircraft, new approach and departure procedures, the impact of aircraft noise on health, and political instruments to influence night flights. The project discussed technical solutions and is optimistic about solving the aircraft noise problem. However, due to the long life cycles of aircraft, the implementation of improvements will only be successful in the long run. One reason is that the replacement of older and louder aircraft in Europe is nearly completed. Therefore, a strong reduction of aircraft noise at source cannot be expected on a short notice. The key for a short and medium term solution can only be found at the political level. The project showed that an integrated land use planning might be a potential way to reduce the impact of aircraft noise [2].

The presented PhD-Study is taking a close look at the land use planning processes in Germany over the last fifty years. It aims at identifying possible improvements and changes to abate the conflict between residents and the air transport stakeholders. The dissertation will focus on a typical airport region in this case on the Cologne Bonn Airport region. The Cologne-Bonn Airport is facing similar problems associated with aircraft noise and will be

investigated in order to get empirical results about the theoretical assumptions. As a result, synthesis guidelines for regional development policies will be set and suggestions for a better integration of airport master planning and regional planning processes will be made.

2 Theoretical Background and Main Objectives

Aircraft noise is not a new phenomenon. In 1952 a commission of the President of the United States analysed the interaction between airports and their neighbours [3]. One part of the research already considered aircraft noise as one of the major problems for the people living near airports. It mentioned further that, on one hand, planning authorities had not given enough attention to the well-being of residents and, on the other hand, residents are made responsible for not informing themselves sufficiently about airport operations and their possible implications. Three years later a symposium about aircraft noise was held in Germany where airport planners, aircraft and engine manufacturers and regional planners discussed the impact of aircraft noise [4].

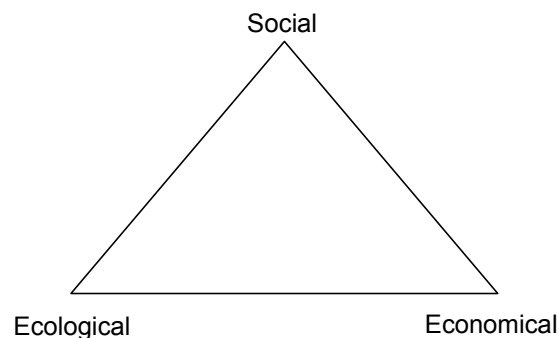
Since these early years of air travel the aircraft industry has achieved massive reductions at the source. The noise footprint from a modern jet around an airport has been reduced by factor 9 compared to an aircraft from 1970 [5]. However, the intriguing question resulting from these facts is: Why is aircraft noise still felt by residents to be disturbing? The answer lies in a simple geographical consideration. Settlements around airports have expanded massively and moved closer and closer towards the airports. In addition to that air transport has quintupled since 1970 only in the European Union [6]. So the amount of noise has declined and the events of noise have increased, and hence an increasing number of people is affected. Obviously the land use planning tools then used (and that are possibly still in use today) were neither sufficient to protect the residents nor the air transport stakeholders' economic interest. When discussing the land use planning a definition of the term is inevitable. The Canadian Institute of Planners defines:

*"[Land Use] Planning means the scientific, aesthetic, and orderly disposition of land, resources, facilities and services with a view to securing the **physical, economic and social efficiency, health and well-being** of urban and rural communities" [7]*

This definition shows the ideal situation how the land use planning processes should be implemented. Its content can be expressed by means of a simple figure which is known as the triangle of sustainability (see Figure 1). The ecological component includes the physical

efficiency as well as the health and the well-being of communities. As a result of this, the economic and social efficiency have to be brought into a balance. Every attempt to solve the aircraft noise problem should be related to the balance of social, ecological and economical requirements. Therefore, the main objective of this PhD-Research is to combine and harmonise these three aspects.

Figure 1: Triangle of sustainability (Source: own presentation)



The public discussion about environmental impacts of aircrafts in general and aircraft noise in particular is lead by three main groups: users, residents and politics [8]. The users group consists of economic stakeholders like airports (infrastructure), airlines (aircraft as noise generator) as cause for the noise and air traffic control as the responsible institution for flight guidance. The residents consist of citizens affected by aircraft noise in municipalities surrounding airports. The communities and land-use planning authorities form part of the political level. They should make neutral decisions and find compromises between the residents and economic stakeholders.

The analysed groups consist of stakeholders having more or less conflicting goals (see Figure 2). The airport operator as a company has to make a financial profit. Further, airports are in competition in certain airline markets and, therefore, have an interest to be as attractive as possible for potential new airlines. On the other hand, airports in Germany are mostly under public ownership like cities, counties or the Federal States leading to a conflict of interests. A similar conflict exists for air traffic control which is privatised but still under the Federal Government ownership. Only airlines in private ownership can act without conflicting goals. The residents are also confronted with colliding interests of an undisturbed night versus employment generated by airport and airline activities. In addition to this, citizens are profiting from the regional economic influence of airports. The communities have strong

interests in the well-being of their citizens but employment, tax revenue and growth of the cities are also important drivers in decision processes. Land use planning authorities have also the difficulty to find a balance between the well-being of communities and environmental concerns on the one side and employment and transregional economic effects of the airport on the other side.

Figure 2: Conflicts of interests of the different stakeholders (Source: own design)

	Stakeholder	Conflicts	
User	Airport Operator	Revenue Competition	Interests of owners
	Airline		
	Air Traffic Control	Revenue Service orientation	Interests of owners
Resi- dents	Citizens	Undisturbed night	Employment Regional economic impact
Politics	Communities	Well-being of residents	Growth of the city Employment
	Land use planning Authorities	Well-being of communities Environmental concerns	Employment Location factor for regional and transregional economy

This implies that at the political level it is not feasible to have a neutral position regarding the aircraft noise problem because other interests being primarily economic by nature are important drivers in decision making processes. This leads to the first hypotheses:

- (i) *Political decisions are not neutral because of conflicting interests.*

Further explorative hypotheses are:

- (ii) *Tools for land use planning processes are not sufficient to stop conflicts regarding aircraft noise.*
- (iii) *Airport master planning is not transparent or does not exist.*
- (iv) *The prices of land and rental rates of properties in noise exposed communities are cheaper than in non affected comparable communities.*
- (v) *Night flights are essential for certain operators and alternatives do not exist.*
- (vi) *Airports and their users have a strong impact on employment and the financial welfare of the surrounding communities.*
- (vii) *Airports are important location factors for regional economy.*

3 Methodology

The structure of the dissertation (see Figure 3, p. 7) consists of three main parts. The theoretical set up is based primarily on a comprehensive desk research and interviews with experts in the specific fields. Subsequently, the second major part will be the empirical analysis based on interviews with experts and stakeholders. In addition, secondary statistical data will be reviewed and implemented in a Geographical Information System (GIS). The third part will consist mainly of the synthesis. Introduction, synopsis and an outlook part will frame the dissertation.

General fundamentals of regional planning and air transport

In the discussion about aircraft noise residents often demand restrictions of night flights. Economic stakeholders refer to the fact that people should acquire better information about the aircraft noise possible impact on the specific house location. This raises the question whether the sole responsibility lies on the residents. It might have been possible to stop or at least reduce the current problems caused by the intervention of land-use planning authorities. Thus this PhD-Study will examine the different levels of spatial planning and the land-use policy of the last decades. Further, it is important to gain understanding of the possibilities and limitations of the different planning instruments on regional and communal levels.

While considering the development of municipalities around airports the growth of settlements becomes evident. One of the reasons for this ascent is the suburbanization process. These processes have to be examined with the specific focus on their impact on the airport regions. Parallel to the development of the communities, the air transport sector experienced a massive growth. Despite technical efforts and the success in reducing aircraft noise for single aircraft the sheer amount of flights is causing disturbance. It is necessary to examine the reasons for the growth of air travel and transport. Liberalisation, deregulation and globalisation are important drivers in this interrelation. An important issue will also be to consider the reason why flights are scheduled at night and whether there exist alternatives. One aim of this part of the analysis is to give an outlook of future trends in air transport and their possible implications on airports and the surrounding region.

In the debate about night flight supporters often refer to the regional economic impact of airports and the related industries. Employment is one of the major arguments on the part of regional politicians, airport operators and airlines. Direct and indirect jobs are important

factors in the debate, particularly in times of high unemployment. Besides that airports are important location factors and have relevance as taxpayers. This argumentation will be critically reviewed and correlated with the possible negative effects.

Empirical Analysis

The validity of the results from the theoretical part will be investigated for a certain airport region. The empirical analysis will include a regional focus and an airport focus. In the regional focus the development of communities and land use planning tools of the specific airport region will be researched. On the airport side the development of the airport, the regional economic impact and operational measures to reduce the impact of noise which are already in use are in the foreground.

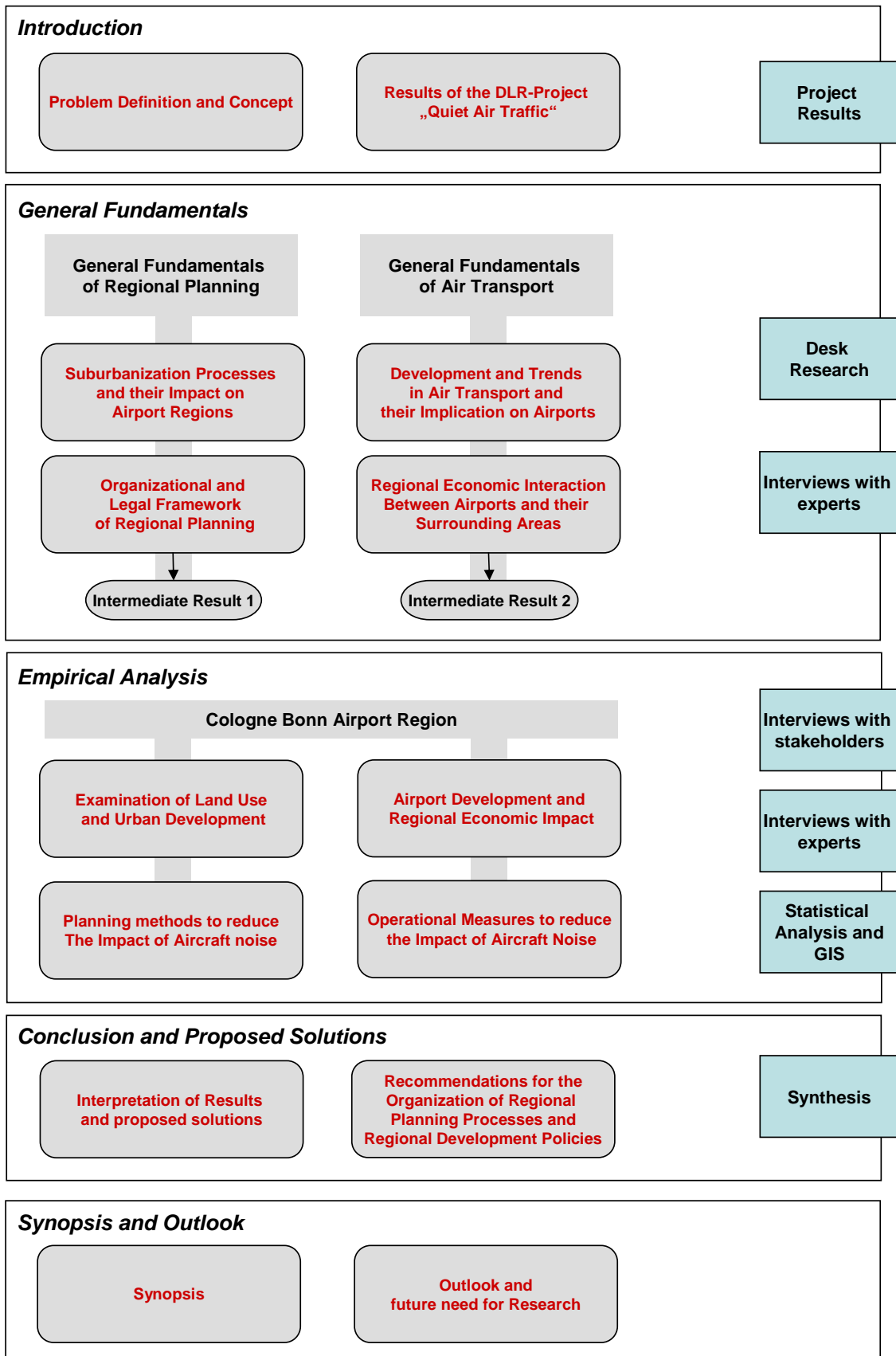
Important questions will be:

- (i) *How has the population developed in the surrounding municipalities?*
- (ii) *What were the aims of the planning authorities on the municipal level and what was the overall concept used for spatial planning?*
- (iii) *What is the airport's historical development and what can be expected for the future?*
- (iv) *How is the airport integrated in the regional planning processes and does a master plan exist?*
- (v) *How are planning issues communicated between the different stakeholders?*
- (vi) *What is the economic impact of the airport?*

Conclusions and proposed solutions

In this section results of the theoretical and empirical part will be interpreted. Specifically the main flaws in planning processes regarding airports and municipalities are focused. The overarching aim of the PhD-Study is to give recommendations to the organizational structures of regional planning and to suggest changes in spatial planning processes. The focus will be on airports which are already experiencing problems with their surrounding communities with regard to securing the planning reliability of new airport projects. The main objective will be to find solutions incorporating the economic, ecological and social dimensions as stated in Figure 1, p.3.

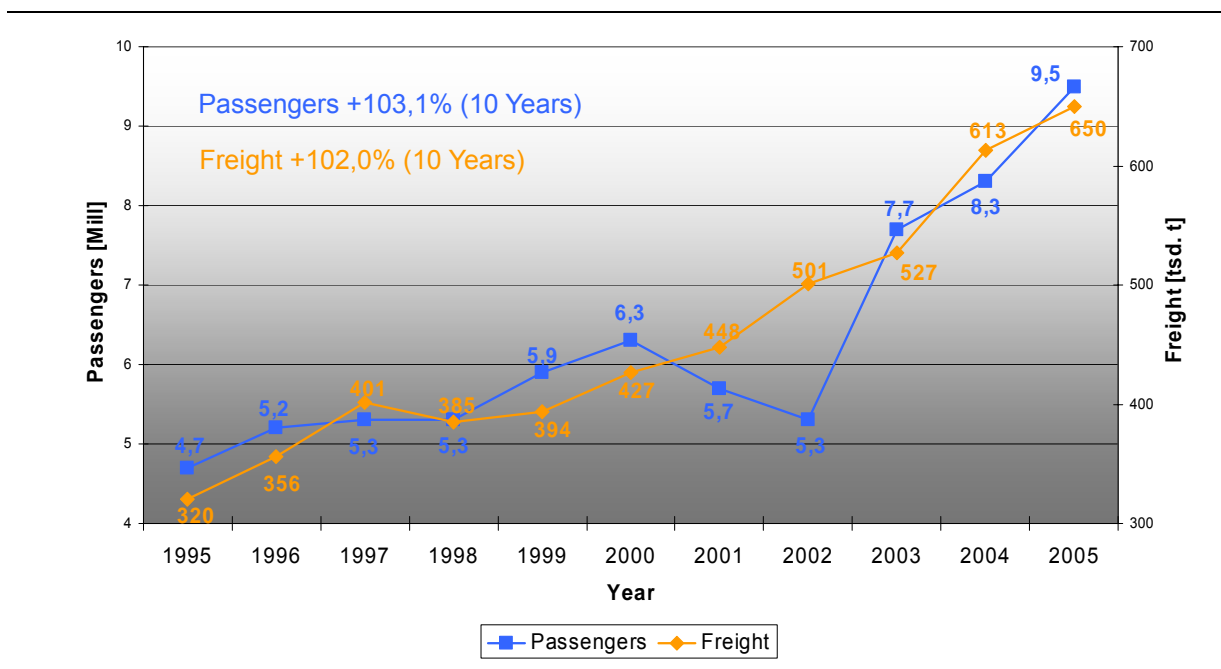
Figure 3: Concept of the PhD-Research (Source: own design)



4 Example: Cologne Bonn Airport Region

The Cologne Bonn Airport region in Germany was chosen because it contains major aspects of the aircraft noise problem. The airport is located 13 km south-east of Cologne operates on a 24 hrs basis. Three runways are available the four directions of which are open during the night.¹ Only chapter-3-aircraft on the bonus list² are allowed in the time between 10 p.m. and 6 a.m. The airport is one of only a few airports without a night curfew in Germany and is highly frequented by several integrators with a high amount of night flights. United Parcel Service (UPS) uses Cologne Bonn as its European hub and DHL operates a secondary hub³. Paris and Frankfurt based FedEx also operate a daily service from Cologne to Memphis. With 650.000 t freight in 2005 the airport is ranked number 2 after Frankfurt in terms of freight volume. In the last ten years the freight sector experienced a growth of 102 % (see Figure 4)

Figure 4: Freight and Passengers at Cologne Bonn Airport, 1995-2005
 (Data: German Airport Association)



The passenger side is showing similar figures. In the last ten years the passenger numbers went up by 103 % to 9,5 Million (see Figure 4). This growth is primarily related to the start of low-cost-airlines Germanwings and Hapag Lloyd Express that both decided to start their

¹ Runway 14L/32R (3.815m), Runway 14R/32L (1.866m), Runway 24/06 (2.459m); open at night: 14L/32R, 24 landing, 06 start, 32L landing

² Bonuslist: The Federal Ministry of Transport has defined a list of notably quieter Chapter-3-Aircraft

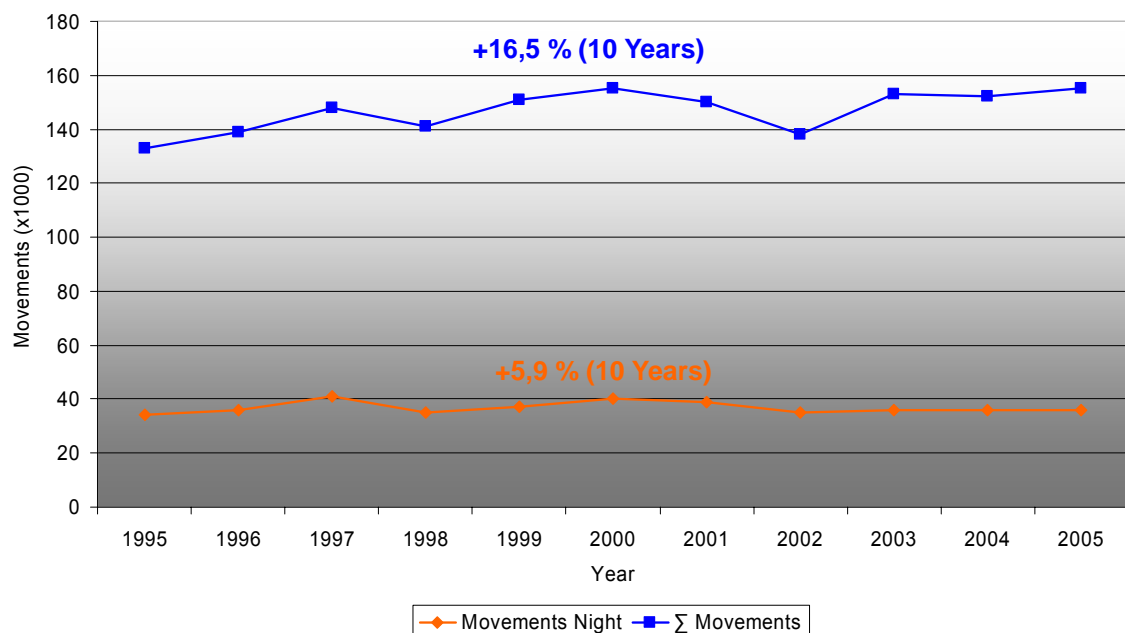
³ DHL will move to the new Leipzig Halle hub and reduce its operations in Cologne

operations at Cologne Bonn Airport in 2002. Besides the night flights from the integrators there are further departures and arrivals are carried out by charter airlines.⁴

The shares of the airport are distributed as follows: Federal Republic of Germany (30,04 %), the Federal State of North-Rhine Westphalia (30,04 %), the City of Cologne (31,12 %), the City of Bonn (6,06 %), the County Rhine-Sieg (0,59 %) and the County Rhine-Berg (0,35 %) [10].

While freight volume and the number of passengers more than doubled in the last ten years the total number of aircraft movements per year rose only by 16,5 % during the same time (see Figure 5). The number of movements at night rose even in a less amount by 5,9 %. Related to the strong increase in traffic volume this leads to the conclusion that bigger aircraft are in use and/or the load factor is higher than before.

Figure 5: Movements day and night at Cologne Bonn Airport, 1995-2005
(Data: German Airport Association)



After this short introduction about the specific situation at Cologne Bonn Airport the focus changes to the surrounding communities. Three municipalities will be reviewed: The city of Lohmar and the City of Cologne suburbs Wahn and Wahnheide. The city of Lohmar is located 3 km south-east of the main runway 14L/32R hence the residents experience a high noise

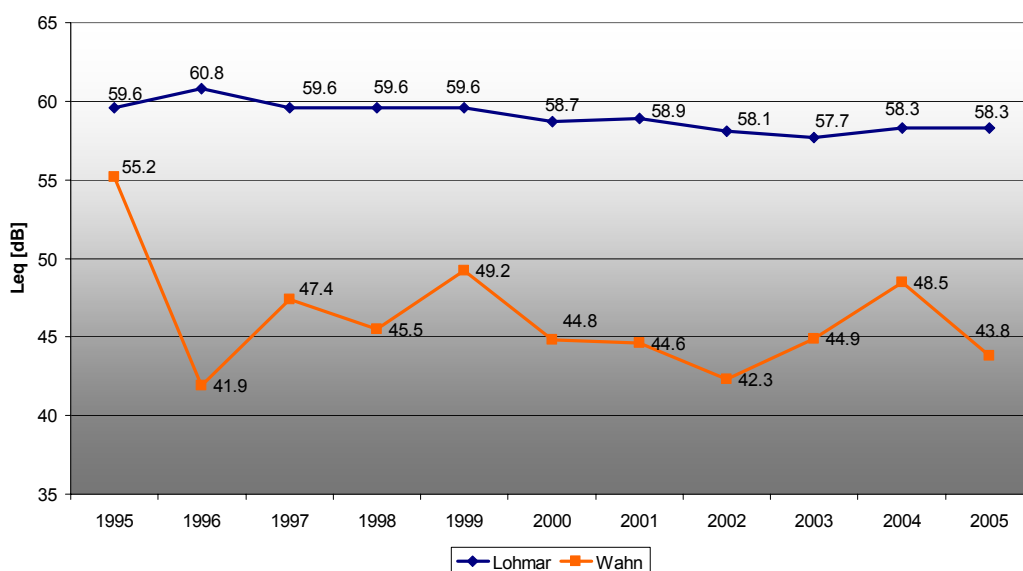
⁴ In the week 06-11.10.2006 in average 90 Movements per night of which 10 are passenger flights

level in the night. A wide area of the city falls within the night protection zone where a minimum of six movements of more than 75 db[A] occur.

Wahn and Wahnheide are located west of the airport and are suburbs of Cologne. Wahnheide is bordering the airport fence and is only 1.1 km from the runway threshold while Wahn is a further 1.3 km away. The two suburbs are affected by take-offs on runway 24 and landings on runway 06. Fortunately these runway directions are closed at night (see footnote 1 on p.8) thus the noise levels are considerable lower than in Lohmar. Consequently Wahn and Wahnheide are not part of the night protection zone but the airport recognizes the ground noise problem. Consequently, the airport operator finances noise insulation in certain areas.

In Lohmar and Wahnheide the airport operates noise monitoring stations whose results are published on the airport web site. In general an increase in aircraft size is feared to have a negative result on noise emissions. Bigger aircraft are believed to be louder than smaller aircraft. A further assumption is that due to a higher load factor the climb rates are lower and therefore the aircraft will fly in a lower altitude above residential areas. This assumption is not necessary true as shown in Figure 6.

Figure 6: Leq-noise-level at monitoring stations Lohmar and Wahn, 1995-2005
(Data: Cologne Bonn Airport)



The blue line represents the noise curve of Lohmar over the last 10 years. The equivalent noise Level Leq decreased by 1,3 % from 1995 to 2005 while movements and traffic volume

increased. But the numbers are also showing that nearly no improvement has been achieved in the noise situation of the considered city. The residents experience about the same noise level over the day today compared to 10 years ago. Furthermore, the noise incidence has increased. The noise curve of the monitoring station Wahn shows a much more erratic shape. This monitoring station is located at the approach and departure area of the crosswind runway which is used in certain meteorological conditions. Therefore, there are phases of a higher use resulting in a higher Leq. This curve does not allow a valid statement and is displayed to keep up appearances.

In the considered municipalities the population has increased dramatically. Lohmar rose from 3.374 inhabitants in 1961 to 9.558 in 1999. A similar situation can be seen for Wahn which nearly tripled its population. Wahnheide roughly doubled its population from 1961 to 1970 but experienced stagnation thereafter (see Figure 7). The statistical data can be confirmed by superimposing topographical maps from 1958 and 1999. This shows the massive enlargement of these residential areas (see Figures 8-10).

Figure 7: Population development in Lohmar, Wahn, Wahnheide, 1961-1999
(Data: Rhein-Sieg-Kreis and City of Cologne)

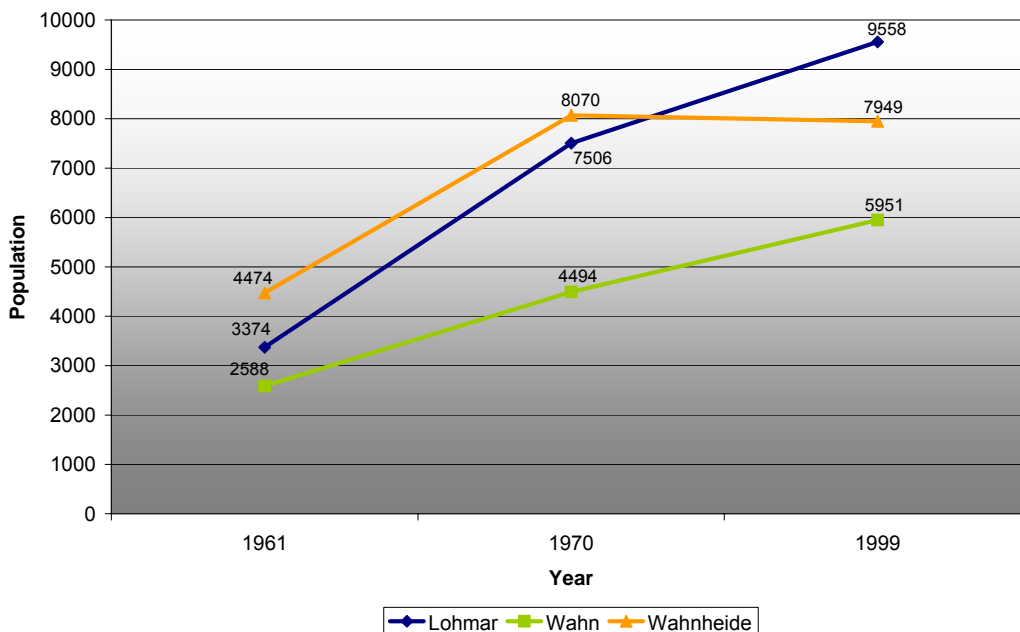


Figure 10: Topographical map, Wahn and Wahnheide 1958

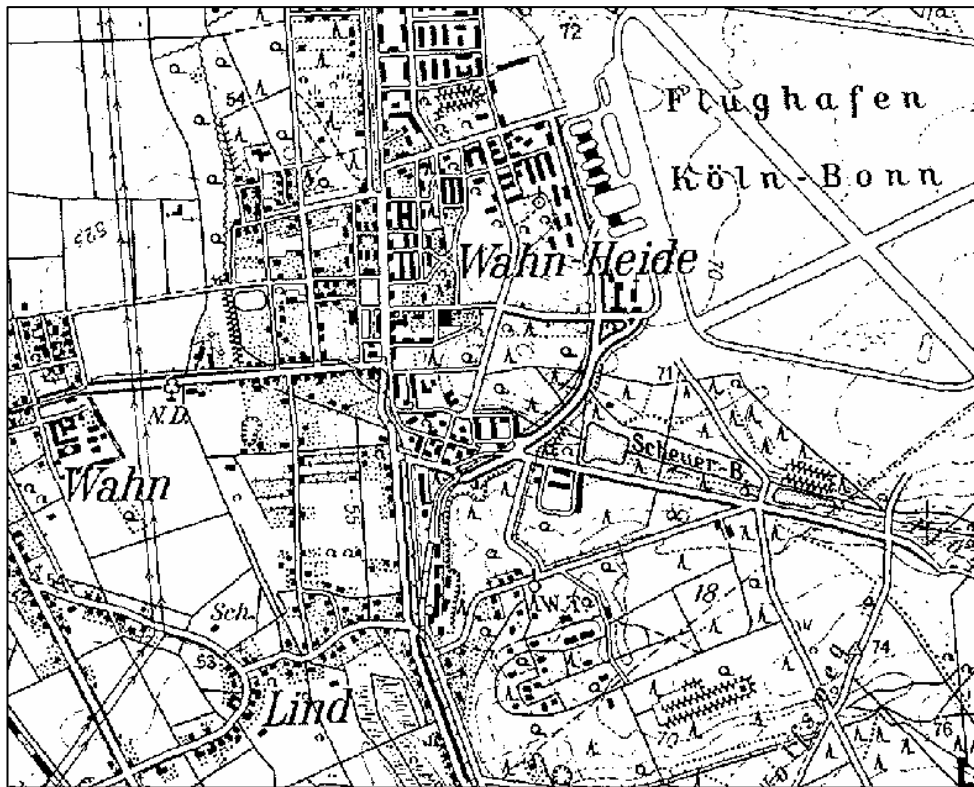
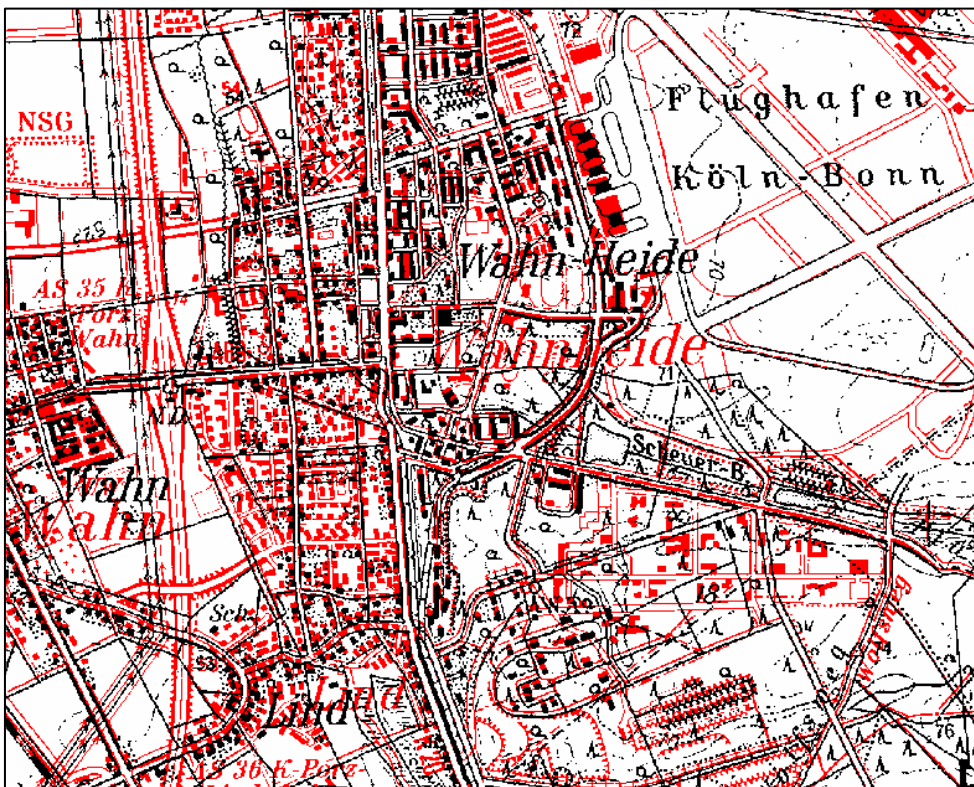


Figure 11: Topographical map, Wahn/Wahnheide 1998, superimposed over map from 1958



5 Further research

The research so far has showed that further analyses in certain fields have to be performed. Regarding land use development socio-economic factors like welfare recipients and unemployment rates have to be mapped to analyse possible regional impacts of aircraft noise. Standard land values might help to answer the question of the influence of aircraft noise on price development of houses, flats and land. To get a valid result a regression analysis between noise level and standard land values seems to be appropriate. The frequently used approach with the hedonic price model is not adequate to examine the dissertation in the given time frame. Regarding the main focus of the study, it does not seem reasonable to implement this model.

A further step will be the detailed examination of the airports' economic impact. The often used input-output-approaches have to be critically reviewed. Especially the discussion about multipliers for employment and monetary effects is controversial [11]. Critical points are that not all effects, positive and negative, are included in the studies. Further, the range of multipliers varies with the assumptions made in the studies. For example, a study about Cologne Bonn Airport from 1995 concluded an employment multiplier of 1.5 whereas another study resulted in a multiplier of 3.04 [12].

Primary analysis tool will be a Geographic Information System (GIS). Last but not least, it has to be decided which data implementation is useful and beneficial. So far, the following aspects will be integrated:

Figure 12: Planned Content of the GIS Analysis Tool (Own design)

i. Legally binding land use plans	iv. Noise footprints
ii. Regional planning	v. Night protection zones
iii. Airport master planning	vi. Sound insulation areas
	vii. Flight routes
	viii. Distribution of take-offs and landings on runways
	ix. Other sound sources
x. Employment	
xi. Welfare recipients	
xii. Income	
xiii. Population density	
xiv. Population development (time series)	xvi. Tax revenue
xv. Standard land values and rents	xvii. Air transport affine companies

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