



International Institute for
Applied Systems Analysis
www.iiasa.ac.at

Historical Development of Soil Protection and Land Use in the Rhur Area

Wink, R.

IIASA Working Paper

WP-96-035

April 1996



Wink, R. (1996) Historical Development of Soil Protection and Land Use in the Rhur Area. IIASA Working Paper. WP-96-035 Copyright © 1996 by the author(s). <http://pure.iiasa.ac.at/4991/>

Working Papers on work of the International Institute for Applied Systems Analysis receive only limited review. Views or opinions expressed herein do not necessarily represent those of the Institute, its National Member Organizations, or other organizations supporting the work. All rights reserved. Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage. All copies must bear this notice and the full citation on the first page. For other purposes, to republish, to post on servers or to redistribute to lists, permission must be sought by contacting repository@iiasa.ac.at

Working Paper

Historical Development of Soil Protection and Land Use in the Ruhr Area

Rüdiger Wink

WP-96-35
April 1996



IIASA

International Institute for Applied Systems Analysis • A-2361 Laxenburg • Austria

Telephone: +43 2236 807 • Telefax: +43 2236 71313 • E-Mail: info@iiasa.ac.at

Historical Development of Soil Protection and Land Use in the Ruhr Area

Rüdiger Wink

WP-96-35
April 1996

Working Papers are interim reports on work of the International Institute for Applied Systems Analysis and have received only limited review. Views or opinions expressed herein do not necessarily represent those of the Institute, its National Member Organizations, or other organizations supporting the work.



International Institute for Applied Systems Analysis • A-2361 Laxenburg • Austria
Telephone: +43 2236 807 • Telefax: +43 2236 71313 • E-Mail: info@iiasa.ac.at

ABSTRACT

The following paper aims at the provision of background information for an intended identification of key elements of soil protection and land use policies in the Ruhr Area referring in particular to the use of soils contaminated by heavy metal emissions. This information serves as a contribution to the Rhine/Black Triangle Policy Comparison which is part of the IIASA project on „Regional Material Balance Approaches to Long-Term Environmental Policy Planning“. This project takes a systems view concentrating on the impact of four heavy metals (arsenic, cadmium, lead and zinc) especially on agricultural soils in the Black Triangle and Upper Silesia Region.

The Rhine/Black Triangle Policy Comparison focuses on the analysis of policy options for reducing the negative consequences of soil contaminations in the Black Triangle. As regions with a high intensity of soil contaminations by anthropogenic heavy metal pollution and many common features concerning the economic development, the Ruhr Area and Katowice Voivodship and their specific natural, socio-economic and political conditions are the main topic of the comparison. A historical investigation of past policies in the Ruhr Area to reduce heavy metal pollution shall lead to the recognition and evaluation of their key elements from an economic point of view. Finally, considering specific socio-economic conditions in the Katowice Area, conclusions with regard to possible options for a transfer of policy elements from the Ruhr Area which seem economically beneficial shall be drawn. In this context, the information of the following paper serves as a basis for the intended economic evaluation of soil protection policies in the Ruhr Area.

Contents

1.	Introduction	1
2.	Starting Point: The situation in 1949	2
2.1.	Natural availability of soil functions in the Ruhr Area	2
2.2.	The demand for soil functions in the Ruhr Area	3
2.3.	The need for institutional action in the Ruhr Area after 1949	14
3.	Soil Protection and Land Use Policies 1949-95	16
3.1.	The 1950ies: Following on from institutions before World War II	16
3.2.	The 1960ies and 1970ies - The beginning of a conceptional environmental policy	19
3.3.	The 1980ies: The realization of the consequences of excessive soil contamination	25
3.4.	Outlook over the 1990ies: A new era of soil protection policy ?	32
4.	Conclusions and outlook onto future research	35

List of Diagrams:

Diagram I: Land Use Patterns in the Ruhr Area 1820-1956	5
Diagram II a-d: Land Use for Settlement and Traffic in % of total area in the Ruhr Area, Essen, Dortmund and Bochum	6

I. Introduction

The following historical summary deals with key elements of soil protection and land use policies in the Ruhr area after World War II from an economic perspective. Therefore, it is not a complete historical reappraisal, but an economic description and evaluation of important political guidelines. The main topic of this study is the investigation of political measures concerning soils contaminated by heavy metals in particularly large areas, such as agricultural land and private gardens. These measures, however, can only be analyzed by taking land use and soil policies in the Ruhr area as a whole into account. In this context, the Ruhr area can be regarded as a typical example of a so-called "old industrial area".¹ These regions are especially characterized by

- a high intensity of anthropogeneous use of environmental resources,
- a dominant and lasting influence by certain industrial interests on political decision-procedures, and
- therefore, a remarkable inflexibility of institutional structures with regard to socio-economic changes.²

The consequences of these characteristics for soil protection will be investigated in the following. First, a survey will be made on the starting points of soil protection policies after World War II with regard to the natural availability of soil functions, the different parties demanding these environmental resources and former political measures. The description of the starting point serves to show the need for institutional action. The following political measures will be evaluated in accordance with the implementation of this need. The survey on land use and soil protection policies after 1949 will be divided into four periods of time. For each period, the political objectives and measures related to soil protection in the Ruhr area, as well as the changes in the natural availability and human use of soil functions, will be analyzed. This investigation finally leads to an outlook into further research on efficiency-oriented, institutional reforms for soil policies in the Ruhr area.

¹ See for an explanation of the use of this term e.g. Klemmer (1992), pp. 35.

² See also Karl, Nienhaus (1989), pp. 194.

2. Starting point: the situation in 1949

2.1. Natural availability of soil functions in the Ruhr area

The aim of soil protection is to improve the supply of available soils for man and nature.³ The supply, however, does not refer to soils as natural resources in their own right; it means the possibilities for secondary activities which are linked to the use of soils. The supply, however, does not refer to soils as natural resources in their own right. It rather means the possibilities for secondary activities which are linked to the use of soils.⁴ Certain ecosystems, for instance, can only emerge when suitable soil structures exist in order to receive rain water and pass it on to ground water flows, and structures can only be built on stable soil layers.⁵ Protection hence addresses the availability of just these soil functions which can be classified as follows:

- *Regulation functions.* These functions include all the soil-inherent processes which lead to the stabilization of the circulation of substances within ecosystems.
- *Production functions.* These functions contribute towards soil fertility.
- *Carrying functions.* These soil properties make it suitable as a location for human activity.

In the Ruhr area, the availability of these soil functions varies, corresponding mainly to the natural conditions and land use patterns.⁶ The natural soil structures in the Ruhr area can be divided into three areas. The soils in the southern area along the Ruhr are characterized by a high content of clay and loam. The upper soil layers consist mainly of loess, which cause an average permeability for substances and water. In the northern area (Recklinghausen), soils are very sandy.⁷ Most of the soils in the Ruhr area are marlaceous and chalky. These characteristics improve the capacity to absorb hazardous substances. The soils in the central Ruhr area contain less clay and loam than the southern area, but also show a high fertility. In this area, the existence of layers of sand stone cause specific problems because the flow of water can be blocked.

³ See e.g. Hecht, Werbeck (1995), pp. 162.

⁴ See Werbeck, Wink (1994a), pp. 12; Hueting, Bosch (1994), pp. 44; SRU (1988), Tz. 548; Karl, Klemmer (1990), pp. 42.

⁵ See also Becker-Soest, Wink (1994), pp. 2.

⁶ See also Becker-Soest, Wink (1994), pp. 2.

⁷ See for the geological structures Bronny, Dege (1990), pp. 90.

These natural conditions lead to several consequences for the availability of soil functions:

- The regulation functions, with particular reference to the capacity of soils to protect ground water from being contaminated with hazardous substances, are restricted throughout the Ruhr area because of the high permeability of the upper soil layers. Therefore, there is a high potential danger of pollution for ground water above six meters under the ground surface.
- There is a high availability of production functions in the southern area. Along the Ruhr it is possible to use land for pasture. This land also historically serves as the Westphalian center of grain production.⁸ The soils in the central area are also characterized as favored by nature. In the northern area, agricultural use is restricted to relatively undemanding products, such as rye or potatoes.
- Originally there was a high potential for carrying functions in the Ruhr area. This potential has been reduced by intensive anthropogeneous use, in particular, by leveling down the upper soil layers, erecting buildings and motorways and depositing hazardous substances.⁹

Since industrialization began, conflicts between different demanders for soil functions have been increasing. Because of the strong interdependencies between the soil functions and the complex interrelationships between soils and the spatially mobile environmental media water and air, the use of one soil function, in particular, the carrying functions, leads to negative effects on the availability of the other functions in the region. The use of one function may directly affect a certain local site, e.g. to erect a building, but due to the ecological consequences from this one use, e.g. changes in local climate, there may be indirect effects on the potential of soil functions in a distant area. Therefore, competition between the different users of soil functions is not only restricted to local points, but also refers to larger areas; this aspect will be explained in the following.

2.2. The demand for soil functions in the Ruhr area

In this chapter, the different groups demanding available soil functions will be presented and, following this, the institutional guidelines for coordinating the

⁸ See e.g. Reif (1990), pp. 339.

⁹ See e.g. Brüggemeier, Rommelspacher (1990), pp. 526.

competing interests of different land users, as well as the effects of these guidelines on the availability of soil functions before World War II, will be analyzed. The conflict between different users of soil functions in the Ruhr area became more intense at the end of the last century. Before the expansion of the mining and steel industry, the agricultural use of soils was the dominant form of land use.¹⁰ Diagram I shows the development of land use structures between 1820 and 1956. While the area used for agriculture and forestry was continuously reduced, more and more land was used for industrial purposes and urban settlement or infrastructure. These changes could be identified in the entire Ruhr area, but there were remarkable differences concerning their intensity. Diagram II serves to present the increasing share of land used for traffic and urban settlement in the big cities along the historical "Hellweg" in relation to the total area between 1900 and 1956. Other cities (in particular, those along the rivers Emscher and Lippe in the northern Ruhr area) only contributed to these changes in land use after World War II. This development can be explained by looking at the changes in demand for soil functions, as well as the legal framework coordinating the competing interests in soil functions in the Ruhr area. The main demanders for soil functions in the Ruhr area before World War II were industrial companies, local authorities erecting urban infrastructure and agricultural users of land. Industrialization in the Ruhr area was favored by the natural deposits of coal, corresponding with a general technical progress in coal mining and steel production technology, and the link with European water and railways. Therefore, big mining and steel companies emerged in this area and determined social and economic developments. Their demand for soil functions was firstly dominated by interest in the soil layers which contained coal.

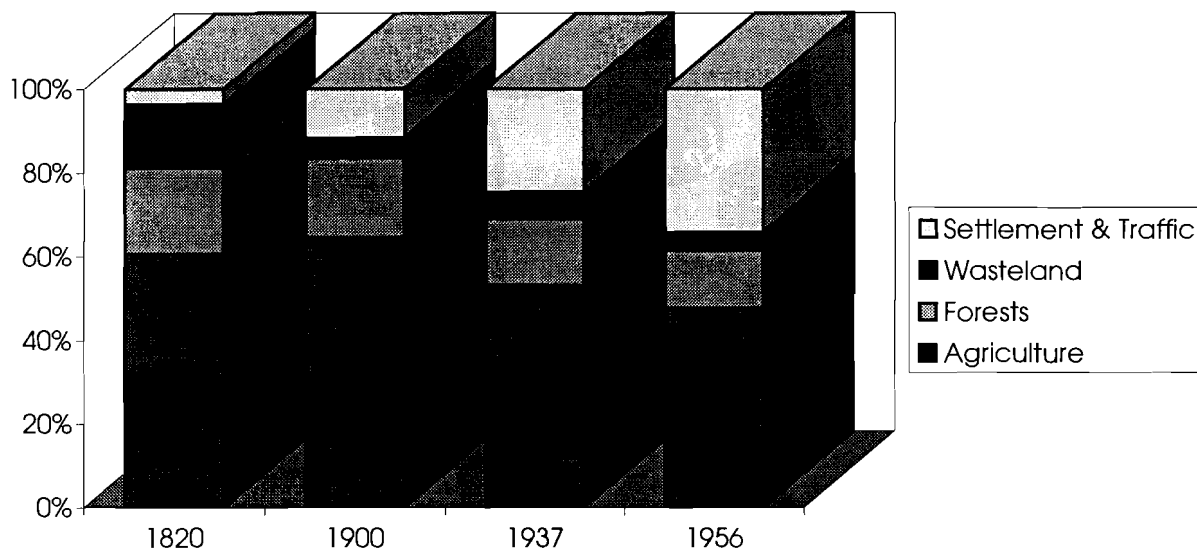
The mining activities caused a reduction in the upper soil layers as well as the ground water flows, and hence led to damage of the regulation supply and of the production and carrying soil functions over large areas.¹¹ To prevent high damage payments, especially for losses suffered by agricultural producers and landowners, the mining and steel companies purchased wide areas of land.¹²

¹⁰ See e.g. Reif (1990), p. 343.

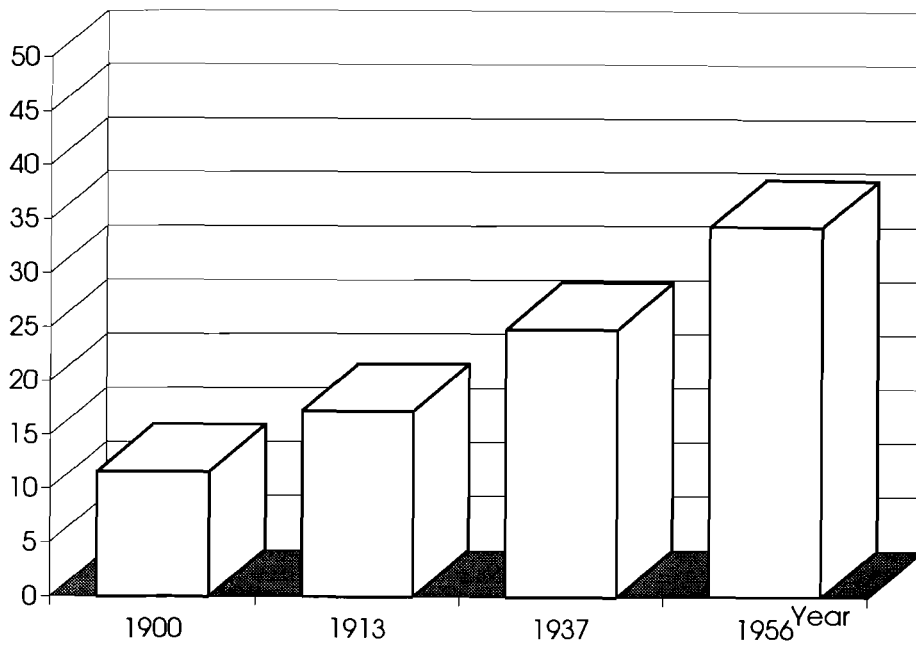
¹¹ See e.g. WBGU (1994), pp. 170.

¹² In 1910 industry owned e.g. more than the half of the total area in Hamborn and more than 30 per cent of total area in Oberhausen, Gelsenkirchen and Bottrop; see for more details Brüggemeier, Rommelspacher (1992), p. 79.

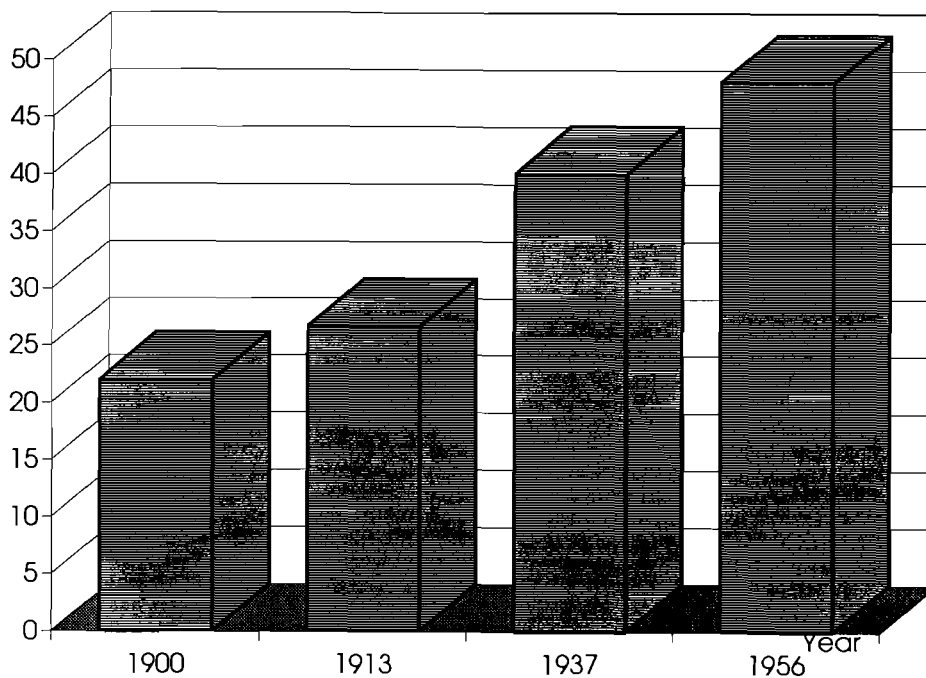
Diagram I: Land Use Patterns in the Ruhr Area 1820-1956



**Diagram IIa: Land Use for Settlement and Traffic in %
of total area in the Ruhr Area**



**Diagram IIb: Land Use for Settlement and Traffic in %
of total area in Essen**



source: F.J. Brüggemeier, T. Rommelspacher (1992), p. 76

Diagram IIc: Land Use for Settlement and Traffic in % of total area in Dortmund

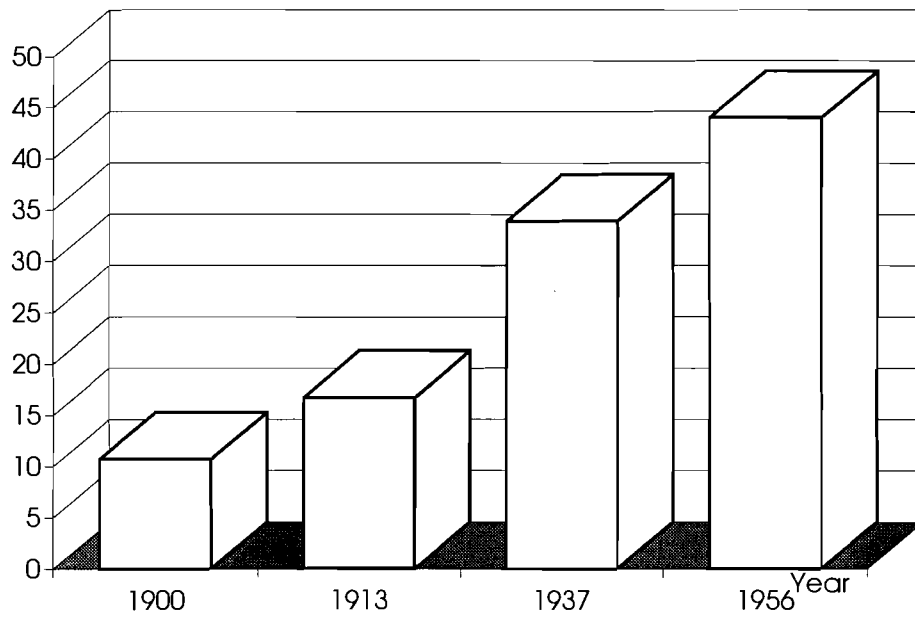
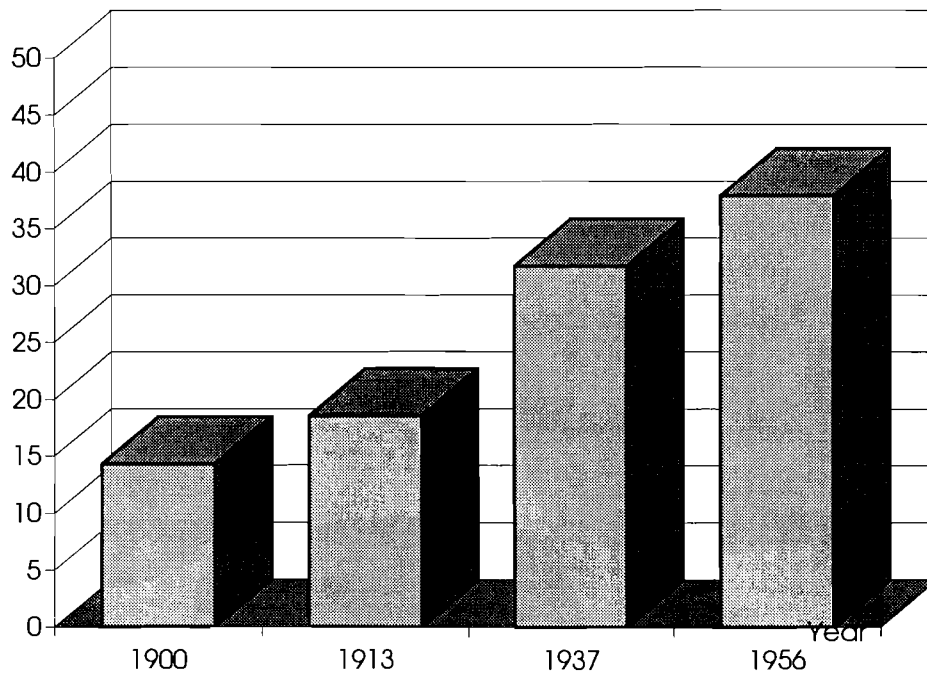


Diagram IIId: Land use for Settlement and Traffic in % of total area in Bochum



source: F.J. Brüggemeier, T. Rommelspacher (1992), p. 76

These areas, which were not needed for industrial buildings, were leased to tenant farmers, used for housing estates or left fallow. In the beginning of this century, damage caused by smoke containing soot and SO₂ was increasingly recognized. Public awareness of environmental problems was restricted to these air emissions.¹³ Because of the high share of industrial property and compensation for farmers, the consequences of emissions for the availability of soil functions were not taken into consideration in the public discussion.

After the first world war, it was not only the reduction of the upper soil layers which endangered the supply of soil functions, but moreover, the increasing emission of hazardous substances into the air, water and soils. The erection of processing industries, e.g. coking plants, and the development of the chemical industry in the Ruhr area led to the emission of substances which could not be comprehended as easily as coal dust, the removal of these substances seemed to overtax the economic and technical potential of the industries. As a consequence, high emissions of organic substances and heavy metals made their way into the soils via the air and water flows, specially by washing out of hazardous substances. Directly depositing coal sludge and hazardous waste into soils, without any public control and information, posed a high risk to human health and the resilience of ecosystems and was not noticed before World War II. Industrialization also induced a massive increase in the number of immigrants, in particular, from middle-east Europe, which, in turn, led to a shortage in housing. The erection of new housing estates by or with the financial support of the big mining and steel companies induced a further use of the available soil functions.¹⁴

The growth of cities in the Ruhr area also caused investors to build up basic urban infrastructure, e.g. railways, public transport, energy and the disposal of waste and effluents.¹⁵ One of the characteristics of institutional organization was the large degree of cooperation between local authorities and private companies, e.g. the associations for water provision and sewage purification. While the transport of sewage and sewerage installation, as well as the implementation of proper waste disposal sites, reduced the emission into soils, most of the infrastructure projects led to a further restriction of the availability of soil functions in the Ruhr area. These burdens refer

¹³ See e.g. Wey (1982), p. 106, and Klöpfer (1994), pp. 50.

¹⁴ See e.g. Schmitz (1987). The population density (residents per km²) in Bochum rose between 1852 and 1913 from 960 to 5145, see Reinirkens (1991), p. 89.

¹⁵ See e.g. Korte (1990), pp. 573.

mainly to the compression of the pores in the upper soil layers in order to achieve the necessary stability for the erection of buildings which, in particular, led to a considerable reduction in the regulation functions, e.g. with regard to rain-water flows.

Before the demand by industrial companies and suppliers of urban infrastructure increasingly determined the use of soil functions, farmers were the predominant group of demanders. At first, industrialization led to economic advantages for agricultural landowners because of increasing land prices and additional sales potential due to the immigrants coming from middle-east Europe. The previous option of wasteland in the Northern Ruhr area made it easier to sell the lucrative land, especially along the "Hellweg" (Essen, Dortmund). Therefore, conflicts with other demanders for soil functions were only few in number. Besides, the industry offered some of its waste materials for the production of fertilizer, e.g. the "Thomas-powder" from steel production and nitrogen from cokery plants,¹⁶ which led to an increase in the soil productivity. The relatively rash use of waste materials from industrial production and private households may cause the additional emission of heavy metals into the soils.¹⁷ In this context, it is important to remember that farmers in the Ruhr area can be characterized by a high degree of entrepreneurial flair. This refers to their flexibility concerning the selection of products as well as the organization of production processes. The relevant parameters for them were especially:

- the natural conditions,
- restrictions to productivity by emissions,
- demand preferences for agricultural products,
- transport costs, and
- the supply of forage means and fertilizers.

Consequently, farmers concentrated their supply on improved products. Production was organized in an extremely disintegrated manner and was adapted permanently to changing natural or market conditions.¹⁸ The growing intensity of emissions from industry and the resulting loss of soil productivity, however, induced the farmers to

¹⁶ See Reif (1990), p. 355.

¹⁷ See Schramm (1989), pp. 95.

¹⁸ A typical example refers to the specialization on dairy farming without pastoral agriculture in many plants in the central Ruhr area; see Reif (1990), pp. 358.

revert to legal action against industrial companies and to join together.¹⁹ As early as the last century, the "Association of farmers against damages by industrial plants" was founded in Wanne. Local associations representing agricultural interests joined together in 1926 to establish the "Industrial Damages Protection Commission" in order to support scientific and technical research, as well as to offer legal advice and political representation. These measures were aimed towards protecting the production functions in the Ruhr area, in particular, against air and water emissions.

Not only farmers, but also another group of demanders for production functions of soils, the private gardeners, appeared with increasing industrialization. Erecting housing estates with private gardens and creating attractive living conditions aimed at recruiting workers from rural areas in middle-east Europe.²⁰ It also served to provide workers with food. The economic dependency of workers on their employers and the increasing identification with mining and steel production in the Ruhr area, reduced the conflict potential between soil users because many private gardeners feared the loss of their jobs if the industry was faced with additional demand to prevent emission.

This brief survey of the different demanders for soil functions serves to show how the appearance of additional demanders, in particular, the mining and steel industry, led to an intensification of the competition for the available soil functions. The spatial expansion of industry and infrastructure projects drove agricultural users of soil functions out to the Northern Ruhr area. Industrial emission also induced negative effects on production and regulation functions in wide areas. The demanders of production functions reacted remarkably flexible and adapted their use of soil functions to the changing conditions. Interest groups, referring directly to the availability of regulation functions of soils, played only a minor role in decision-making procedures on land use, because these functions mainly affected ecological stability and posed only an indirect risk to human welfare.²¹

By taking a look at the institutional rules to coordinate the competing interests of different demanders in using soil functions before World War II, it can be recognized that coordination was primarily implemented on a private level. Local authorities were not responsible for asserting plans for land utilization. Therefore, industrial plants

¹⁹ See e.g. Klöpfer (1994), pp. 54.

²⁰ See Milchert (1982), p. 586.

²¹ See for an overview to the foundation of movements aiming generally at the protection of nature Wey (1982), pp. 129.

were built up in areas where land prices and transport connections indicated attractive location conditions. Housing estates with private gardens were built up within near distance to the industrial plants, and agricultural areas - where products depended strongly on transport - also remained in the near vicinity of the growing cities. This caused an intensification of the negative effects of industrial emissions. In order to restrict these emissions, a license requirement was introduced for industrial plants in the "industrial code" (Gewerbeordnung) ; these standards were formulated in "Technical Instructions" for Air Pollution Control. These standards, however, were only restricted to a few hazardous air emissions, e.g. SO₃, and the continuous existence of a once-granted approval was widely protected.²² The main technical measures to prevent emissions were related to the dilution of hazardous substances emitted and the use of higher chimneys.²³ Considering the increasing use of substances with a potential danger to man and nature, this development led to a spatial expansion of the negative effects without reducing their intensity. In a few cases in which the living conditions could not be tolerated by the residents, first initiatives were founded, e.g. the citizens' association in Duisburg-Hochfeld from 1928 against emission by the copper industry.²⁴

The increasing recognition of economic losses, resulting from industrial emission, induced more and more farmers to take legal action. The civil neighborhood law served as a legal basis for compensation claims. In many cases, however, it was not possible to prove that the emission by a certain industrial plant had caused the damage. The claims for compensation only referred to "locally unusual" burdens. As the Ruhr area was seen as a "special zone for industrial activities", most of the emissions were "usual" and therefore, no compensation was paid. In this context, the asymmetric potential for different demanders for soil functions to assert their interests in political and legal procedures has to be considered. Due to the financial means and the close connection between local/national authorities and the representatives of the mining and steel industry, many potential victims refused to claim for compensation because of the low probability of success and the high cost of legal action. Institutes, such as the "Industrial Damages Protection Commission" and the "Prussian Institute for Water and Air Hygiene (1921; since 1942 Institute of the German "Reich"),

²² See e.g. Klöpfer (1994), pp. 54.

²³ Effective processes were widely restricted to the elimination of industrial dusts in iron and steel works because of its relevance for the realization of production procedures and its contribution to the provision with raw materials, see e.g. Wey (1982), p. 108.

²⁴ See Wey (1982), p. 116.

supported the victims with scientific reports and information about technical measures to reduce the emissions, but their political influence was only limited when compared to the economic relevance of the industrial representatives.

The protection of the regulation functions of soils was one of the main topics for one institute which was founded in 1922 in order to implement a coordinated planning for the entire Ruhr area: the Ruhr District Planning Authority (Siedlungsverband Ruhrkohlebezirk; SVR) and was intended as a means of interlocal cooperation. The SVR was the first regional association with responsibility for spatial development planning. The assignment of responsibility to the SVR made it possible to save and preserve open green spaces. The members of the SVR were representatives from local authorities. According to the economic relevance of the industry for the development in the cities, the preservation of open spaces was limited, i.e. to the extent that it was not to hinder industrial activities. Therefore, measures oriented towards coping with existing environmental damage were implemented, e.g. the cultivation of deciduous trees instead of conifers because they can cope better with acids.²⁵ Besides, the implementation of a connected network of areas, which were not directly used by man, was doomed to failure due to the problems of coordinating the different interests of individual local and specific authorities. The SVR was dependent on financial grants from local authorities and there were many competing spheres of interest for water and mining authorities. Furthermore, the SVR was an institute equipped with specific responsibilities for certain aspects, whilst according to the general administrative organization, the cities in the Ruhr area belonged (and still belong) to three different regional authorities (government districts).

Summarizing the situation before World War II, there were only a few first steps towards a consistent policy on land use and soil protection in the Ruhr area. The use of civil law to solve conflicts between different demanders for soil functions, in particular, with regard to large areas (industry <-> farmers), could not lead to a complete understanding of negative effects of hazardous emissions due to problems to verify the underlying causes by measures of certain industrial plants and asymmetrical financial and political potentials to assert their interests. The implementation of a license requirement, together with technical standards for the prevention of air emissions, was not sufficient to reduce the damage to people and nature in the areas surrounding industrial plants. Quite the opposite in fact; higher

²⁵ See Brüggemeier, Rommelspacher (1992), pp. 52.

chimneys induced spatial expansion of emissions. The establishment of a special institute for interlocal planning, in particular, for the preservation of open spaces, led to local improvements with regard to the availability of the regulation functions of soils. The continuing loads by industrial plants, however, counteracted this development.

Supported by institutional guidelines, the Ruhr area strengthened its reputation as one of the major economic centers before World War II. The use of soil functions had to be adapted to the industrial development. Other users of carrying functions had to cope with the damage caused by the reduction of upper soil layers; a result of mining processes. The demanders of production functions, farmers and private gardeners, mainly adapted to the negative effects of emissions by the selection of plants. The main criteria for their decisions were productivity and market prices, possible risks to human health, resulting from an accumulation of hazardous substances, were not taken into account. Fruit and most of the vegetables were impossible to cultivate because they did not grow.²⁶ Private gardeners focused their activities on those vegetables which grew under any conditions, e.g. potatoes and cabbage. Most of the agricultural land was used for the cultivation of root crop as forage materials, in particular, for cattle breeding.²⁷ But these adaptation measures were only reactions to the obviously recognizable restrictions of the production functions. The actual burdens of soil functions and possible resultant effects, e.g. concerning the food chain, could not be understood completely and were not seen as an high-priority, environmental problem.

The presentation of the historical development before World War II serves to show the starting-point of policy-making after 1949 with regard to negative effects of land use to the availability of soil functions as well as to political measures and institutional guidelines. Before looking at the land use and soil protection policy after World War II, the need for institutional action after 1949 will be briefly investigated in the following in order to attain a precondition for the evaluation of institutional decisions from an economic point of view.

²⁶ Only a few gardeners with greenhouses using technical knowledge from the Netherlands offered fruits and vegetables.

²⁷ See Reif (1990), pp. 371.

2.3. The need for institutional action in the Ruhr area after 1949

Generally, the need for institutional action, in relation to land use and soil protection policies in the Ruhr area after 1949, did not differ from the aim of any soil protection policy: to implement a coordination of the available soil functions between different demanders in order to achieve basic social goals. From an economic point of view, this means that land use and soil protection policy strives at the maximum surplus of benefits beyond the costs for man and nature.²⁸ According to the different interests of individual demanders for soil functions, it is not possible to determine an optimal volume and form of soil function uses. Farmers demand different forms of qualities of soil functions to those demanded by industrial companies or private households. The relevant information for evaluating soil functions can therefore only be investigated on the individual level. Efficiency-oriented decisions concerning the intensity of using soil functions therefore can only be based upon individual evaluations. To assess soil protection policies in general, it is hence necessary to analyze whether the individual information concerning the evaluation of soil functions and the costs of protection measures were considered in the decision-making procedures. The more this information is used, and the more incentives are given to individual demanders for soil functions to research for more efficient techniques of land use and soil protection, the higher the probability that political measures will be advantageous for all individuals.²⁹ The necessity for political decision differs according to the variety of soil functions. In the following, the need for institutional action for each group of soil functions will be explained, first of all, in principle, and then in the specific context of the Ruhr area.

The regulation functions of soils are integrated into ecosystems. Human interests are hence only indirectly affected, e.g. higher risk of illness due to contaminated food. Because of the spatial mobility of air and water particles, it is impossible to define exclusive property rights for regulation functions of soils as this performance can only be realized within ecological cycles.³⁰ For these functions, it is hence necessary to collectively decide how they are to be used or preserved. Because of the different spatial interdependencies between the environmental media, the size of areas and the extent of restrictions for human land use has to be adapted to the prevailing environmental problem, e.g. preventing the reduction of upper soil layers above

²⁸ See Hayek (1990), p. 460; Hecht, Werbeck (1995), pp. 162; Becker-Soest, Wink (1994), pp. 7.

²⁹ See for more details Werbeck, Wink (1994c), pp. 405.

³⁰ Individual decisions to protect regulation functions of a certain area can be e.g. counteracted by emissions through other environmental media (water, air).

important ground water flows or the connecting open spaces to preserve biological diversity. In the Ruhr area before World War II, these collective decisions had been implemented, especially by the SVR. Due to political and administrative dependencies, it was not able to prevent a further degradation of the potential of regulation functions. After 1949, political decisions were needed concerning the question as to whether the regulation functions of soils in the Ruhr area should be preserved more effectively or be subordinated under the interest on other functions.

In contrast to the regulation functions, which can only be defined in the context of complex ecological systems and which are hence integrated into spatially mobile processes, the carrying and production functions of soils can be assigned to single areas. Therefore, it is possible to transfer property rights for these functions by selling and acquiring the corresponding areas. In the Ruhr area, however, the use of property rights had been restricted in two ways. First, the emission of hazardous substances and the extensive reduction of upper soil layers by industry led to burdens for soil functions in areas which did not belong to the emitting industries. Standards and compensation rules in the civil neighborhood law induced only an insufficient internalization of the negative effects into the private calculation of the emitting industries. It was hence necessary to implement institutional guidelines, which led the emitting industries to implement measures in order to prevent further damage.

Furthermore, the permanent emission of hazardous substances into the soils since the last century had already caused considerable restrictions to the availability of soil functions. As a result of

- insufficient control of industrial emissions,
- lack of scientific research concerning possible effects of emission, and
- a public awareness which focused its interest on environmental problems to directly recognizable effects,

knowledge related to the actual - and not directly recognizable - loads of soils was limited. Therefore, land users did not really know which forms of land utilization were generally possible, which negative effects might be expected, and which measures could improve the availability of soil functions on their land. An efficiency-oriented land use and soil protection policy would require that rules were implemented which would reduce these uncertainties. Information concerning former emissions had to be investigated, scientific research related to cause-effect-relationships had to be

supported, and the development of techniques oriented towards reducing or coping with existing burdens to soil functions had to be introduced.

Therefore, the need for institutional action in the Ruhr area after World War II referred to three main topics:

- collective decisions to preserve the ecologically relevant regulation functions of soils which have only indirectly affect human interests;
- measures to induce those emitting hazardous substances to take the possible negative effects on the availability of soil functions into consideration in their private calculations;
- instruments to improve knowledge related to existing burdens for soil functions and measures to cope with these them.

In the following, a survey of the land use and soil protection policies related to the Ruhr area, divided into four phases, will serve to prove whether these needs were satisfied. The description of the development in each phase starts with a summary of the changes to objectives concerning land use and soil protection, as well as to soil protection policies on the federal level, followed by a presentation of specific developments in the Ruhr area. At the end of each description, the effects on land use and the availability of soil functions in the Ruhr area will be investigated, and an evaluation of possible progress towards a satisfaction of the institutional need will be finally given.

3. Soil Protection and Land Use Policies in 1949-1995

3.1. The 1950s: following in the footsteps of pre-war institutes

As consequences of World War II, massive social and economic necessities became apparent. The destruction of most of the residential buildings and the stock of physical assets, as well as the high number of displaced persons, made it necessary to establish priorities for the availability of basic prerequisites for everyone in order to build up a secure livelihood. The vital significance of social and economic development drove the existing and - due to economic recovery - still increasing environmental damage widely out of public awareness. As economic recovery could not be realized without a secure provision of energy and basic materials, the industries in the Ruhr area, which mainly focused on the production of these goods,

were extremely important for the development of the entire nation. Therefore, the federal government selectively supported the building up of these industries. One of the most prominent examples of selective federal support is the law of investment aid to the industry (1952), this meant a diversion of capital from processing to primary industries.³¹ While 34.1 per cent of the capital came from NRW (North Rhine Westphalia), nearly 70 per cent of the capital was channelled to NRW.³² Besides financial support, the vital significance of the primary industries, in particular, in the Ruhr area, for economic reconstruction after World War II formed an emotional relationship - identification of the Ruhr area, gratitude from the whole nation - towards the coal and steel industry. Consequently, the economic structures in the Ruhr area were still increasingly dominated by the primary industries.

The structure of environmental policies and administrations before World War II were mainly taken up in the Federal Republic of Germany. This particularly refers to the orientation of emission reduction to license requirements by the industrial code for new industrial plants, the realization of emission control by different administrations, and the refusal of a stringent concept of environmental policy.³³ Environmental goals attracted less public attention than economic reconstruction and this generally restricted possibilities to assert claims for stronger emission standards. The consideration of already existing emission standards was hindered by conflicts between different administrative bodies, due to unclear assignments of competencies. There were only a few initiatives for improvements by environmental institutes. In 1952, an "inter-parliamentary working group for a natural economy" ("Interparlamentarische Arbeitsgruppe für eine naturgemäße Wirtschaftsweise", IPA) was founded which formulated general aims, based on principles for a lasting use of natural resources whilst considering future generations, but did not induce direct legal reforms.³⁴ In the Ruhr area, there were proposals for the implementation of cooperatives for clean air based on the associations for purification of sewage.³⁵ The implementation of these initiatives on a national and regional level was rejected, referring to possible additional costs for the emitting (primary) industries. The burden of these costs would affect exactly these industries, which were seen as an

³¹ See e.g. Kokalj (1992), pp. 220.

³² See Abelshausen (1984), p. 357.

³³ See e.g. Wey (1982), pp. 153.

³⁴ See Brüggemeier, Rommelspacher (1992), pp. 64. Klöpfer (1994), pp. 84.

³⁵ Especially the director of the SVR in the 1950ies attracted public awareness for this proposal, see Wey (1982), p. 182.

indispensable basis for further economic development. Therefore, the burdens of increasing air emissions were widely accepted by the public and politicians.

In view of this one-sided policy orientation in the 1950s, land use and soil protection in the Ruhr area was seen to be less important than the support of the primary industries. Consequently, the degree of emission exceeded that before World War II, both generally and in relation to soils.³⁶ This caused further restrictions for land use by farmers and private gardeners. Besides burdens caused by emissions, the use of land for industry and settlement affected former agricultural areas and wasteland. Between 1951 and 1959, 70 km² of land, which had formerly been used for agriculture, was changed into settlement areas.³⁷ These changes were made easier by expropriation potentials, resulting from laws supporting housing programs. The development of former wasteland particularly served to prevent the emergence of recreation areas.³⁸ Therefore, it can be said that the use of carrying functions of the soils in the Ruhr area was intensified by the building up of primary industries and housing estates. Land which was formerly used in order to the demand for regulation and production functions was changed into areas for industry and settlement and hence lost most of its natural potential for production and regulation functions. These direct effects were accompanied by indirect burdens of production and regulation functions because of the increasing industrial emission.

The loss of soil productivity was widely accepted due to the general interest in building up an industrial basis and - especially referring to private gardeners - the individual economic dependence on employment in emitting industries. The existing loads of soil functions, particularly in agricultural areas and private gardens, were not investigated, as there was no awareness of the necessity for research programs to analyze the substances already absorbed in the soils and to develop adaptation techniques for contaminated soils.

All in all, the institutional need for soil protection in the Ruhr area was taken into consideration during the 1950s. The further changes to former open space, into land used for industry and settlement, led to reductions in the available regulation functions of soils. There were no institutional reforms to improve the integration of the

³⁶ See Brüggemeier, Rommelspacher (1992), pp. 62.

³⁷ See Brüggemeier, Rommelspacher (1992), p. 87.

³⁸ This referred in particular to the cities of the Northern Ruhr Area, in which there were still a lot of agricultural areas, see Reif (1990), p. 348.

ecological relevance and significance of these functions for human health and welfare into land use planning. Following on from the industrial code law before World War II and considering the vital significance of building up primary industries, implied that no additional measures were implemented to internalize the negative effects of emissions for other demanders for soil functions. As a consequence, further burdens of production and carrying functions were created. The acquisition and distribution of information concerning substances which were already in the soils, and measures to cope with these burdens, were not supported by institutional reforms. Therefore, at the end of the 1950s, further restrictions to the availability of soil functions had to be implemented.

3.2. The 1960s and 1970s - The beginning of a conceptional environmental policy

The end of economic reconstruction showed the necessity of a new orientation with regard to the economic and social development, as well as the use of natural resources. While primary industries in the 1950s formed the basis for building up housing estates and industrial physical assets, the competitiveness of the processing industries determined the potential of economic development in the 1960s and 1970s. In the Ruhr area, there were only a few processing industries. Industrialists from middle-east Europe, who had been displaced after World War II and who had developed numerous innovations for the processing industries, built up new processing plants in the southern regions of Germany (Bavaria, Baden-Württemberg).³⁹ Therefore, there was a strong need for new investments in the Ruhr area in order to substitute the increasing loss of economic power and employment in mining and steel companies. At the same time, the general tolerance concerning environmental damage, which could be directly comprehended by the public, decreased. These damages, primarily air and water emissions, led to serious dangers for human health in industrial centers. The Ruhr area, as a conurbation with extreme pollution of the environment, became one of the first regions where environmental protection was used by politicians as an incentive for voters.⁴⁰

³⁹ See e.g. Abelshauser (1984), p. 350.

⁴⁰ The most prominent example refers to the slogan "blue sky above the Ruhr" of the SPD used in the election campaign for the federal parliament 1961, see Wey (1982), pp. 154.

First legal reforms related to the industrial code and civil law were already introduced in 1959.⁴¹ This specifically referred to the implementation of ways for authorities to adapt standards for single plants to changes due to technical progress and restrictions of the obligations of neighbors to tolerate burdens generated by industrial plants which implied a higher probability of the assertion of claims for compensations. In 1964, the implementation of technical guidelines for Air Pollution Control (TA Luft) led to higher standards for emission control.⁴² NRW set an example for other regions by passing the first State Air Quality Protection Law (ImSchG) in 1962.⁴³ This was combined with reinforcement by the control authorities.⁴⁴ The implementation of a Federal Air Quality Protection Law (BImSchG) in 1974 aimed at combining the pollution control of individual industrial plants with the environmental planning for entire regions.⁴⁵

After looking at the damages caused by extensive air pollution, the federal government expanded its legal initiatives, coping with other environmental problems. These initiatives were integrated into a general concept for a federal environmental policy.⁴⁶ Besides emission of hazardous substances into the air, the availability of soil functions had been endangered, especially by emissions resulting from uncontrolled waste disposal.⁴⁷ In 1972, the first federal law concerning the removal of waste was passed.⁴⁸ These legal rules reduced the risks resulting from the use of soils as a medium for uncontrolled waste disposal, and prevented the emergence of later damages caused by the absorption of hazardous substances in the soils.⁴⁹ Furthermore, specific standards for sources of soil contamination with hazardous substances, such as heavy metals, were implemented, e.g. for fertilizer and sewage sludge.

⁴¹ See Klöpfer (1994), p. 84.

⁴² Some of the former standards had been remained unchanged since 1895, see Wey (1982), pp. 112.

⁴³ See e.g. Klöpfer (1995), pp. 97.

⁴⁴ NRW became the only region with specific authorities for air pollution control, see Wey (1982), p. 216.

⁴⁵ See for an evaluation of these measures e.g. Feldhaus (1994), pp. 9.

⁴⁶ See for a survey Klöpfer (1994), pp. 96.

⁴⁷ See for a description of the need for political action Hösel (1969), p. 131.

⁴⁸ See for further details Lersner (1982), pp. 258; Hecht (1991), pp. 98.

⁴⁹ See for first statements concerning the dangers from old deposits SRU (1974), Tz. 349; SRU (1978), Tz. 595.

The natural, economic and institutional conditions in the Ruhr area caused specific needs for institutional action. The intensity of air pollution, which exceeded that of most of the other regions in the Federal Republic of Germany, at first led to quick legal action, e.g. the NRW-air pollution control law in 1962. The increasing federal harmonization of environmental standards (e.g. TA Luft), however, restricted the scope of regional authorities to adapt pollution control to the specific conditions in the Ruhr area. This led to a loss of flexibility where the attraction of new investments was concerned. Due to special authorizations for older plants in the primary industries, and the fear of additional loads by new industrial plants, the Ruhr area became a less attractive location for industrial investments.⁵⁰ Old industries obtained competitive advantages by special authorizations, while new industrial investors, who may have used state-of-the-art technology hence reducing emissions, did not get the opportunity to carry out these investments because of the existing burdens to the environment by the old industries. There were flexibilities for the local authorities to use bargaining processes with single firms of the old industries for an implementation of federal standards which considered the necessary time for adaption. But these flexibilities had been primarily used to prevent a necessary change of the economic structure. The orientation towards emission standards for every single plant and the renunciation of flexible instruments, which would permit the trading of emission rights between emitting industrial companies, reinforced the already existing structure of industries and sources for emissions.⁵¹ It cannot be said with certainty whether the habituation to less environmental quality and economic identification with primary industries, together with uncertainties concerning the economic and social consequences of structural changes, might have influenced public awareness.⁵² But it is unlikely that preferences in the Ruhr area corresponded to those in other German regions with regard to specific environmental, social and economic preconditions. Therefore, uniform standards in all regions led to divergence from the specific preferences in single regions, and especially in the Ruhr area, resulted in higher costs of adaptation to national standards when compared standards which might have corresponded to the regional preferences for environmental quality.

⁵⁰ See e.g. Klemmer (1988), pp. 526; Klemmer (1986), pp. 63.

⁵¹ See for this problem e.g. Klemmer (1990), pp. 262. See also Kilper, Latniak, Rehfeld, Simonis (1994), pp. 54 for the close connections between local authorities and industrial representatives in the Ruhr Area.

⁵² See e.g. for the assumption of less demands for environmental quality in economic and population centres Brüggemeier (1995), p. 12.

The problem of a growing lack of available land intensified this development. As many areas were owned by mining and steel companies, the representatives of these companies were able to prevent a possible use of land already used anthropogeneously, simply by refusing to sell property rights.⁵³ The refusal to sell gave the mining and steel companies an advantage in two ways:

- on the one hand, the prevention of new industrial investments might deter possible competitors, e.g. attractive human capital and the connection to local authorities;⁵⁴
- on the other hand, the transfer of property rights might lead to an analysis of the land in with a view to hazardous substances which had been absorbed in the soils and which might lead to liabilities for compensation.

As a result of this restricted supply of used land, new industrial investments were often carried out on soils which previously served as open spaces. As a rule, local authorities tolerated or even supported this development of open spaces in order to weaken the economic consequences of the decline of the mining and steel industries.⁵⁵ At the same time, land which was owned by mining and steel companies, where fertility and ecological potential was heavily restricted due to already absorbed hazardous substances, was left fallow.

On the other hand, the increasing significance of regional and inter-regional planning instruments made it possible to prevent the creation of new spaces with mixed demands for soil functions, e.g. the juxtaposition of industries, housing estates with private gardens and agriculturally used areas, and to preserve open spaces.⁵⁶ In the Ruhr area, the implementation of regional development plans was confronted with the specific problems of coordination between the diverging interests of the different authorities. Due to the affiliation to three different district governments and local authorities' fear of disadvantages - compared to other cities -, planning procedures were prolonged and often counteracted by local activities. Until 1976, the SVR was responsible for regional development planning. Then these responsibilities were allocated to the district governments. The successor institute of the SVR, the "Local

⁵³ See for more details Rommelspacher (1984), pp. 116.

⁵⁴ Stronger competition for attractive human capital might lead to higher wages. Connections to local authorities especially referred to the time for getting permissions, e.g. concerning buildings.

⁵⁵ See e.g. Mick (1994), pp. 80.

⁵⁶ See e.g. Großmann (1989), pp. 145.

Association for the Ruhr Area (Kommunalverband Ruhr; KVR)", was founded in 1979, but did not receive any formal responsibility for authoritative planning. The lack of coordination between the different local authorities led to restrictions in the availability of soil functions in the entire Ruhr area because the uncoordinated juxtaposition of different, mutually exclusive land uses along local borders, e.g. open spaces on the one side, emitting industries on the other, particularly incriminated the preservation of regulation functions of soils. On the whole, at the beginning of legal initiatives for environmental policy in the 1960s, the Ruhr area was one of the first regions where environmental strategies were implemented. Over the years, this position as a forerunner was gradually lost, especially due to

- inflexibility of federal environmental standards combined with incentives for the decision-makers on the local level to use their remaining potential for flexibilities only in favour of the already established industries,
- vital interest of primary industries to use environmental policy for their own goals, and
- unclear allocations of institutional responsibility which widely prevented interlocal coordination.

Besides institutional measures, changes in socio-economic structures in the Ruhr area influenced the demand for soil functions. The decline of mining and steel companies caused a reduction in emissions, as well as the building up of processing industries which offered new technologies for the prevention of emissions. On the other hand, additional emissions of hazardous substances into the air, water and soils had to be recognized because of the increase in traffic and services trades, this also caused further compression of the upper soil layers. Farmers were confronted with technological progress for production processes and a stronger integration into the international division of labor. Instead of producing forage materials, agricultural activities in the Ruhr area were increasingly characterized by big "factories" for poultry farming and pig breeding in the northern Ruhr area.⁵⁷ More and more highly fertile land in the southern Ruhr area was sold, particularly to build recreation areas or for housing estates.

The demand for production functions by private gardeners was influenced by a general increase in income and incentives to reduce the intensity of individual

⁵⁷ See e.g. Reif (1990), pp. 372.

gardening. While vegetable gardens had previously been the dominant form of private gardening, in the 1960s and 1970s, the number of ornamental gardens began to rise.⁵⁸ These gardens neither served as a basis for the individual provision of food nor did they create new potentials for the availability of regulation functions because the poverty of biological diversity and the high intensity of fertilizing, together with the use of pesticides these gardens from gaining significance for ecological development.⁵⁹ The drop in recognizable air emissions led to a general weakening of possible conflicts between different demanders for environmental functions. At first, farmers and private gardeners got better conditions for their activities. Possible burdens due to already absorbed hazardous substances in the soils were not obvious, so that there was no public awareness in order to analyze them. Quite the contrary, the use of fertilizer caused additional direct inputs of heavy metals into the soils.⁶⁰

Summarizing the developments in the 1960s and 1970s, there were a few first steps towards the implementation of a soil protection policy. These steps were mainly created as side-effects of other legal initiatives for environmental protection. In the Ruhr area, however, specific socio-economic and institutional conditions further hindered soil protection measures. The implementation of standards for air pollution caused a remarkable reduction in industrial emissions and diminished the danger of additional loads for soils. Special authorizations for old industrial plants, as well as the nation-wide harmonization of pollution standards and inflexible implementation, particularly affected the Ruhr area, where the existing dominance of primary industries was prolonged and the attraction of new investments with improved technologies for the prevention of emissions was hindered. Therefore, the use of carrying functions of soils could have been reduced or allocated to demanders who would have created a higher regional welfare. Furthermore, the possibility for the primary industries to use environmental standards and the refusal to sell land in order to hinder potential competitors, led to the development of previously open spaces, while soils with possible burdens, due to hazardous substances, could not be analyzed and were left fallow. The lack of coordination between local authorities, in particular, led to a reduction in the availability of regulation functions because of the implementation of land uses which were mutually exclusive. Institutional measures to support research on soils already contaminated was not implemented, mainly due to

⁵⁸ See Milchert (1982), p. 690.

⁵⁹ See e.g. Deutscher Rat für Landespflege (1992), pp. 16.

⁶⁰ See e.g. SRU (1985), Tz. 703; Plate (1985), pp. 319.

the non-recognizable effects of these loads. Thus, at the end of the 1970s, most of the institutional need for soil protection policy in the Ruhr area still existed.

3.3. The 1980s - recognizing the consequences of excessive soil contamination

It was only at the beginning of the 1970s, that impending damage caused by soil contamination from old deposits was first recognized. During the 1970s, the contamination of soils at former industrial sites had been recognized. As these realizations only referred to single cases, a local institutional need for direct protection against dangers became apparent.⁶¹ In the 1980s, the number of these single cases rose dramatically.⁶² At the same time, scientific research related to the analysis of cause-affectation-relationships issued more statements referring to the possible danger of soil contamination for man and nature. The increasing comprehension of the significance and vulnerability of soils led to first conceptional measures on a federal level. In 1985, the concept of soil protection by the German federal government mainly served to emphasize the need for a better consideration of soils as an environmental resource, and an improved coordination of legal rules which were dispersed to different laws.⁶³ Apart from this, there were only a few concrete institutional measures for federal soil protection, especially where the tightening up legal standards for the use of sewage sludge and pesticides was concerned.⁶⁴ Most of the institutional actions concerning land use and soil protection policy took place on a regional level.

The predominant topic for institutional action in the Ruhr area was characterized by an increasing decrease in employment, deficits concerning the development of economic structures and solutions for social problems.⁶⁵ As a reaction to these problems, numerous initiatives were taken up which referred only indirectly to the

⁶¹ See e.g. SRU (1990), Tz. 23.

⁶² See for an overview to the problems on the local level Fiebig, Ohligschläger (1989), passim.

⁶³ See for the general deficits of federal soil protection policy from an economic point of view Micheel (1994), pp. 17.

⁶⁴ See for an overview SRU (1994), Tz. 469.

⁶⁵ See e.g. Klemmer (1992), pp. 37. See Aring, Butzin, Danielczyk, Helbrecht (1989), pp. 234 for an analysis of individual reactions towards the economic crisis.

availability of soil functions.⁶⁶ The soil protection measures in the Ruhr area were primarily oriented towards two problems:

- the assessment of soil contamination on former industrial sites and deposits and
- the availability of land (carrying functions of soils) as a bottleneck for the implementation of the necessary structural changes.

A crucial obstacle on the way to solve these problems was caused by the interests of the primary industries, who owned most of the land and feared that they would have to pay compensation for the contamination of soils. New investors, who acquired land previously used by industries, could be confronted with claims for compensation due to the negative effects of soil contamination for neighbors, especially because most of the former emitting companies could no longer be identified or no longer existed. To reactivate areas previously used by mining and industrial companies, a specific fund was set up in 1980.⁶⁷ This fund served to buy previously used areas, to prepare them for other uses and to sell them mainly to local authorities or new industrial investors.⁶⁸ In 1984, a corresponding fund was founded for NRW, and a development institute, owned by NRW, was engaged to implement the acquisition, preparation and sales.⁶⁹ The financial means for buying and preparing the areas was derived from the license fees paid suppliers of hazardous waste disposal.⁷⁰

Problems soon arose, especially due to uncertainties concerning the standards of soil quality.⁷¹ The only legally binding standards concerning heavy metal contaminations of soils refer to the Federal Sewage Sludge decree, which was firstly implemented in 1982. In the beginning of the 1980ies a publication of reference values for heavy metals to evaluate soil contaminations by Kloke serves as a widely accepted basis to determine tolerable incriminations.⁷² At the end of the 1980ies, this predominated used values were substituted by dutch guidance values which have been replaced by new standard- and intervention-values in the 1990ies.⁷³ Furthermore, recommendations for the evaluation of heavy metals have been

⁶⁶ See e.g. Waniek (1990), pp. 9 and Werbeck, Wink (1994b), pp. 67.

⁶⁷ See for a description of the legal situation Thimet (1993), pp. 116.

⁶⁸ See for a description and critical evaluation Rau (1982), pp. 97; Wiegandt (1991).

⁶⁹ See Holzapfel (1992), p. 14.

⁷⁰ See e.g. Kühl (1990), p. 426; Karl (1987), pp. 66.

⁷¹ See e.g. Werbeck, Wink (1994b), pp. 70; Holzapfel (1992), pp. 31.

⁷² See Kloke (1980). The Federal Sewage Sludge Decree also refers to values of this list.

⁷³ See Viereck-Götte (1995), p. 74 with reference to Netherlands (1994).

published by the responsible State Ministry for Environmental Policy (Minister für Umweltschutz, Raumordnung und Landwirtschaft) and the State Agency (Landesanstalt für Ökologie, Landschaftsentwicklung und Forstplanung in NRW, LÖLF). The application of these recommendations, however, depended upon local authorities which are free to choose their relevant values.

As a rule, local authorities define the standards for tolerable soil contamination. Therefore, potential investors could not work with the generally accepted methods of assessing the necessary preparation measures. Furthermore, the evaluation of the potential, negative effect of contamination was highly dependent on the intended use by the new owner. Incentives for new owners to achieve a soil quality, which imply a surplus of the benefits over all relevant costs, including potential damage due to the geographical propagation of hazardous substances, might be introduced in order to induce users to contribute to a suitable preparation of soils.⁷⁴ However, the indirect financing by funds led to the loss of these incentives. Furthermore, the strong influence of local authorities and the development institute in NRW curbed the freedom of individual land users to develop originally innovative preparation techniques.

Referring to the difficulties facing land previously industrially used, open spaces and agricultural areas were still being developed. Planning instruments by the NRW government, which tried to fix an obliging minimum share of local open spaces, could not be asserted because the local authorities did not agree.⁷⁵ On the other hand, due to economic, social and generation changes, higher individual preferences for recreation areas and stronger demands for the preservation of environmental resources were expressed. Therefore, an increasing number of recreation areas, especially in the southern Ruhr area along the river Ruhr, were created. In economic and densely populated centers, only a small number of projects to support the availability of production and regulation functions were implemented. One local project which tried to combine the protection of production and regulation functions was the common gardens project in Gladbeck, where individual private gardens were connected with forests and marshlands, and where principles of natural gardening were generally accepted.⁷⁶ Such local initiatives caused a higher diversity of land use

⁷⁴ See for more details Karl (1987), pp. 45.

⁷⁵ See Brüggemeier, Rommelspacher (1992), p. 87.

⁷⁶ See Schulz, Strauch (1990), pp. 19.

and improved the availability of regulation functions, which were normally only insufficiently considered.

The support of production and regulation functions was accompanied by an increasing realization, that burdens of soils also affected large areas, which primarily served as potentials of production and regulation functions and which were mainly within the near vicinity of economic and densely populated areas. In NRW, first investigations of soils especially concerning contaminations caused by dust related immissions of the heavy metals lead, cadmium and zinc had been carried out at the end of the 1970ies. These investigations led to the recognition of heavy metal contaminations in twofold elevated concentrations above background values in areas with high dust precipitation.⁷⁷ In the 1980ies further studies had been carried through by the responsible State Center (LÖLF) in individual cities.⁷⁸ At certain sites strong restrictions on the availability of soil functions had to be implemented which varied locally due to natural soil structures and possible sources for emissions nearby.⁷⁹ Correspondingly, the high contamination of soils could be noticed in the southern Ruhr area which showed a higher permeability for substances, and which was confronted with high emissions of heavy metals through the air and the river Ruhr by non-ferrous metal industries.⁸⁰ Most of the contaminated areas were primarily affected by dust precipitation.⁸¹ Besides industrial emissions, loads of heavy metals from traffic were of predominant significance.⁸²

Faced with potential loads of hazardous substances in large areas, the need for action was primarily seen in cases where human health might be endangered. Therefore, research into the consequences of soil contamination was intensified. Additional standards for orientation were introduced to ascertain the event of risks to human health. But the implementation of the necessary measures was not combined with obliging stipulations for those affected.

⁷⁷ See Krämer (1976), König, Krämer (1985), pp. 32.

⁷⁸ See for an overview Viereck-Götte (1995), pp. 46.

⁷⁹ Those relatively small areas were mainly realized in Bottrop, Dortmund, Datteln, and Witten. In Duisburg large areas of the central and southern city was affected, see König, Krämer (1985), pp. 30.

⁸⁰ See as an example the contaminations of the Ruhr meadows in Bochum-Brockhausen with heavy metals in: Reinirkens (1991), p. 66.

⁸¹ There had been a doubling of soil contaminations in areas with high dust precipitation, see König, Krämer (1985), pp. 32.

⁸² See e.g. Münch (1991), Kreis Unna (Ed.; 1984), pp. 20.

As gardens and agricultural areas were private property, the investigations of loads in the soils could not be carried out without the consent of the owners. Obliging stipulations referred only to the general use of sewage sludge, fertilizers and pesticides, but there were no legal possibilities for vigorous action concerning restrictions for the cultivation of plants and other land uses on contaminated soils.⁸³ Thus, action focused mainly on the supply of information. In 1987, recommendations for the cultivation and consumption were published by the NRW government, presenting information with regard to the ascertainment of burdens of soils - primarily agricultural areas and gardens - and possible measures to reduce the risks generated by contaminated soils. While there were permanent technological improvements of measures to protect and decontaminate soils at incriminated sites,⁸⁴ corresponding techniques were not suitable for extensive contamination. The application of lime showed only a temporary effectiveness - due to the loss of lime under the influence of rain.⁸⁵ Therefore, recommendations for cultivation should serve to implement adaptation measures. These recommendations mainly referred to the different capacities of plants to absorb substances. Due to their ability to absorb cadmium, the renunciation of the cultivation of celeriac and spinach on contaminated soils was recommended, as well as the renunciation of the cultivation of salad and kale because of their susceptibility to lead and cadmium.⁸⁶ The evaluation of potential risks was mainly related to the protection of human health. Other factors, e. g. ecological effects or productivity loss, were not taken into consideration.⁸⁷

The observance of these recommendations depended upon the individual preferences by gardeners and farmers, i.e. there was no sovereign enforcement. Due to reallocation measures for agricultural land, the shifting of the regional agricultural center to the northern Ruhr area and the long experience of farmers, particularly with air pollution, no further intensive restrictions on land use were introduced with the comprehension of soil contamination. For this group, standards for the application of sewage sludge and fertilizer were more decisive. The private gardens, however, were often located in areas which were heavily affected by heavy metal contamination. The

⁸³ See e.g. Plate (1985), pp. 319.

⁸⁴ See for an overview to the available techniques e.g. Wille (1993), pp. 98; Holzapfel (1992), pp. 31.

⁸⁵ See Hinzen, Ohligschläger (1987), pp. 109.

⁸⁶ See e.g. Landwirtschaftskammer Rheinland (1983).

⁸⁷ See e.g. to the problems of the definition of standards for tolerated soil incriminations Kloke (1982), pp. 302.

consequences of the realization of soil contamination can be differentiated according to three groups of gardeners:⁸⁸

- Those who mainly had ornamental gardens with an intensive use of pesticides and fertilizers and who were not directly affected by the concentration of recommendations for protection against health risks. For these gardens, however, recommendations for reducing the risks of hazardous inputs into the soils and to support regulation functions were given.
- Those who had vegetable gardens and used the recommendations to change their cultivation patterns and who were mainly moved by the fear of damaging their own health. The costs of adaptation measures, mainly costs resulting from the change in cultivation patterns were relatively low because there was no vital dependency on the food provided by gardening, as was the case at the beginning of this century.
- Those who had vegetable gardens and did not change possibly harmful cultivation patterns and who were, on the one hand, only insufficiently informed, as specific analysis and recommendations were restricted to single cases and general information did not reach every individual gardener. On the other hand, it should be noted that people in the Ruhr area had been confronted with extreme environmental damage for a long time and hence for many gardeners, the threshold is somewhat higher before serious danger is taken into consideration. This might lead to the question whether it is necessary to protect people from the underestimation of environmental risks for the individual.

The effectiveness of the recommendations was hence restricted. Besides measures to cope with existing burdens, local and regional planning was oriented towards the prevention of new conflicts between land use and soil contamination. For certain, already contaminated or endangered areas, land uses which were connected with private gardening, were excluded.⁸⁹ On the other hand, potential burdens for private gardens had to be considered when planning and building permission was granted.⁹⁰

These institutional actions partially led to improvements concerning the availability of soil functions. Burdens caused by industrial emissions, waste disposals as well as by

⁸⁸ See e.g. Schulz, Strauch (1990), pp. 10; Piel, Hölter (1986), pp. 15; Schmid (1986), pp. 97.

⁸⁹ See e.g. Stuck (1992), pp. 77.

⁹⁰ See for these rules in the BauGB Schulz, Strauch (1990), p. 10 and Hinzen, Ohligschläger (1987), pp. 172.

farmers and private gardeners decreased. This enabled soils to regenerate their function potential. Furthermore, the recognition of soil contamination on former industrial sites and deposits, induced measures to reactivate the potential of carrying functions; this made it possible to refrain from developing open spaces. The recommendations to change cultivation patterns and fertilizing techniques might lead to more efficient use of the soil fertility. All in all, institutional measures connected with a general change in public awareness concerning land use and soil protection facilitated at least a weakening of anthropogeneous demands on soil functions.

Comparing the measures implemented to the institutional need from an economic perspective, only a few steps towards efficiency-oriented soil protection can be recognized. The reduction of air and direct soil emissions was achieved by using standards, e.g. technical instructions referring to tolerated air emissions (TA Luft), and legal decrees concerning the use of sewage sludge (KlärschlammVO). These instruments only insufficiently reflected the necessary differentiation, according to the varying prevention costs on the part of polluters and the specific natural conditions of the place. Therefore, measures may be possible which would, for example, bring about a corresponding environmental quality with lower costs. Furthermore, the assertion of standards required high costs for control and sanctions.

The analysis, acquisition and preparation, as well as the decision about the future use of contaminated soils on former industrial sites and deposits, were mainly carried out by public institute. Thus, only a few incentives for individual new investors to develop original techniques which would fulfill the conditions of certain individual cases were created. Insufficient transparency of decision-making processes for the public, and rivalry between different authorities on a regional and local level further hindered a quick and efficiency-oriented reactivation.

These deficits also affected the possibilities for creating and preserving of open spaces, especially where the conflict increasingly erupted between a stronger demand for recreation and - at least as a starting-point - ecological functions, on the one hand, and, on the other hand, the need for available land to implement the necessary economic developments.

The effectiveness of measures to ascertain and adapt to extensive soil contamination was primarily restricted to providing farmers and gardeners with information and recommendations - without obliging stipulations. Problems concerning this topic mainly referred to the conveyance of information and the prior orientation of the

measures towards the protection of human health, thus neglecting all other criteria. At the end of the 1980s, there was a broad awareness concerning institutional needs for the protection against soil contamination,⁹¹ but burdens of extensive areas due to long term absorption of hazardous substances were not seen as a main topic for the soil protection policy.

3.4. An outlook on the 1990s - a new era of soil protection policy

A reflection on the present decade does not necessarily belong to a presentation of the historical development. The political decisions and objectives of the soil protection policy in the 1990s, however, can be seen as a direct continuation of the measures after World War II. Therefore, an outline of these years serves to comprehend the general guidelines of soil protection policy after World War II, and makes it possible to contemplate the results of these political developments in relation to the availability of soil functions in the Ruhr area.

In the 1990s, soil protection policy on a federal level was, on the one hand, characterized by the implementation of legal rules which led to a reduction of emissions into soils, e.g. technical instructions for hazardous and domestic waste disposal and the integration of the protection of soils as one aspect which had to be taken into consideration in license-granting procedures according to the air pollution control law.⁹² On the other hand, there was and still is an animated discussion concerning the introduction of a specific federal soil protection law, which should harmonize the procedures for formulating standards of tolerated soil burdens and the necessary measures to cope with contaminated soils.⁹³ In some of the Lands in the Federal Republic of Germany, corresponding laws have already been passed.⁹⁴ Therefore, it can be expected that the way in which to protect soils, by implementing standards, will be continued and intensified. In the long run, these actions might also

⁹¹ See SRU (1990), Tz. 908. See also for a general investigation of the need for soil protection policy Klemmer et al. (1994), pp. 128.

⁹² These measures to protect soils, however, were partially counteracted by legal reforms which facilitate the development of former open spaces to build up industrial plants and housing estates, see SRU (1994), Tz. 464.

⁹³ See for this discussion e.g. Erbguth (1986), pp. 137; Interdisziplinäre Forschungsgemeinschaft für Gesellschaft, Umwelt und Sicherheit (1993), pp. 69; Kauch (1993); Werbeck, Wink (1994c), pp. 408; Peine (1994), pp. B 87; Schink (1995), pp. 227.

⁹⁴ See Heiermann (1992), pp. 317.

affect the contamination of large areas, as scientific research, which previously focused on contaminated sites and deposits, has now been extended to investigating dangerous contamination from the past in these areas.⁹⁵

In NRW, legal initiatives have been deferred until the federal government finally decides on the federal soil protection law. According to the agreement between the governing coalition parties, priorities for soil protection shall be established in order to restrict the emissions of agricultural land uses. Furthermore, a publication of renewed recommendations for the analysis of extensive soil contamination, as well as for cultivation and consumption of food affected by soil contamination, is planned by the responsible agency (Environmental Agency of NRW - Landesumweltamt). To improve the availability of regulation functions, the NRW government attempted to implement obliging aims for the necessary area of local open spaces in regional development plans.⁹⁶ These initiatives, however, were rejected by local authorities who feared restrictions for attracting new investors. These conflicts are particularly relevant for the Ruhr area, where available land is restricted due to the existing soil contamination from the past.

In the Ruhr area, the conflict between the demand for land to build up industrial plants, office buildings and housing estates on the one hand, and especially the demand for recreation areas and the availability of ecological stability on the other hand, still continues. In a large regional project oriented towards combining these diverging interests, the International Building Exposition (IBA) will be carried out until the end of this century.⁹⁷ This serves to supply carrying functions of soils to new investors, as well as reactivating the regulation functions, especially in the northern Ruhr area which was developed later and which has not yet achieved the necessary change in economic and social structures. Generally speaking, a growing number of former industrial sites, which had been contaminated in the past, have been prepared for new use.⁹⁸ But public awareness is now increasingly directed towards the risk of soil contamination and preparation techniques.⁹⁹ The resulting conflict causes

⁹⁵ See SRU (1995), Tz. 7.

⁹⁶ See for a presentation of the discussion Mick (1994), pp. 81.

⁹⁷ See e.g. Brüggemeier, Rommelspacher (1992), pp. 210.

⁹⁸ See for single case studies Gossow, Dahlmann (1994), pp. 129; Ebel (1994), pp. 137.

⁹⁹ See e.g. Kraus, Discher (1993), pp. 164 and Kirbach (1995), p. 19, where the conflicts concerning the realization of a plant to "clean" contaminated soils in Bochum are presented. See Beckmann (1993), pp. 306, for an overview to the legal situation.

additional costs and time in the licensing procedures for the implementation of decontamination measures which impede the allocation of previously used land to new demanders, and induce incentives to develop open spaces. The growing awareness with regard to soil contamination has also led to a higher demand for information concerning the possible dangers of private land use. According to this development, private gardeners showed a higher willingness to acquire information about soil quality and possible necessary restrictions on cultivation. It is, however, remarkable that until now there is no blanket coverage of information concerning contaminations of soils, although many data are already available.¹⁰⁰ For example, the State Center of Air Quality (Landesbehörde für Immissionsschutz NRW) collected data of soil contaminations by lead and cadmium in the Ruhr District paralleling the air quality surveillance program (Erhebung zum Wirkungskataster für den Luftreinhalteplan) in 1977 to 1983.¹⁰¹ A first statistical preparation of the data concerning garden soils, i.e. a first study on the contamination of soils in the whole Ruhr District for an individual soil use pattern in general, was carried through in 1995. In general, this study shows that lead contaminations decline from the west of the Ruhr District to its east. Locally, this pattern may be superimposed by individual contaminated industrial sites and dumps. It can also be seen that there are higher rates of soil contaminations in the Southern Ruhr Area than in the northern region. The highest values, however, can be realized in the middle of the Ruhr District along the river Emscher. Here most of the industries with high rates of dust had been located, in particular after World War II. This statistical data offers the opportunity to analyze the effects of certain sources of heavy metal pollutions on the soils and to evaluate the different need for cleaning and adaption strategies in individual parts of the Ruhr Area. Due to these developments, additional knowledge now exists about the intensity of contamination in private gardens. There is, however, a growing uncertainty concerning the evaluation of risks caused by heavy metal contaminated soils. Risk assessment studies in the 1990ies led to the conclusion that the direct oral ingestion of contaminated soils only causes only marginal incriminations of human health, e.g. carcinogenic effects.¹⁰² In particular a complete understanding of the reaction of the human body towards contact with heavy metal contaminations is still missing. This scientific uncertainties, which question the guidance values used until now, might induce an adaption of the evaluation with regard to necessary measures for soil protection and prevention of human dangers. Considering that these

¹⁰⁰ See for this statement SRU (1994), Tz. 474. See for first steps Zieschank (1986), LÖLF (1988).

¹⁰¹ See for more details Viereck-Götte (1995), pp. 35.

¹⁰² See Ewers, Viereck-Götte (1995).

developments mainly focus on oral ingestion of contaminated soils, there is still need for certainty concerning the effects of the cultivation of contaminated soils and the evaluation of tolerable heavy metal contents of plants.

After nearly fifty years of land use and soil protection policy in the Federal Republic of Germany, there are less burdens with regard to the availability of soil functions in the Ruhr area. Contamination by industrial air emissions and deposits decreased, measures to reactivate soils contaminated by emissions from the past have been taken up, and more knowledge to cope with extensive soil contamination has been gained. On the other hand, the development of open spaces continues,¹⁰³ anthropogeneous use of soils with important potentials for regulation functions for recreation is still increasing, and reductions in disperse emissions, especially by traffic and agriculture remain slow. The increasing public awareness of the vital significance of soils particularly resulted in local initiatives, e.g. the common gardens in Gladbeck or single projects by the IBA, which induced new forms of land use with a potential for growing efficiency. One of the decisive questions, the answer to which determines future economic development and the quality of life in the Ruhr area, refers to the implementation of institutional rules which support this local growth of individual knowledge in order to search for an efficient use of available soil functions.

4. Conclusions and outlook on future research

Analyzing the situation in 1949, three main topics of institutional need for land use and soil protection policy in the Ruhr area were ascertained:¹⁰⁴

- an improved consideration of regulation functions - their availability has only an indirect effect on human welfare - which are characterized as common goods, so that only collective decisions can lead to preservation;
- measures to internalize the negative effects of - primarily industrial - emissions on the availability of soil functions into the private calculation of the causing party;
- instruments to induce incentives for research and development, as well as the dispersal and application of knowledge concerning burdens of soil functions by contamination from the past and techniques to cope with those them.

¹⁰³ See e.g. Schmidt-Bleek (1993), p. 153.

¹⁰⁴ See Chapter 2.3.

Contemplating these needs, a look at the measures implemented in the Ruhr area reveals little success. The effects of planning instruments - striving for the protection of regulation functions - were weakened by the interests of local authorities who placed their priorities on the attraction of new industrial investors. From an economic point of view, one has to ask, whether instruments which could be adapted more flexibly to specific local preferences of individuals, without creating uncontrolled discretionary powers to local politicians, might achieve a more efficient result.

The decrease of emissions, particularly by industries and deposits, was reached through the implementation of standards. For the Ruhr area, this implied a prolonged and economical - as well as ecologically harmful - adaptation process due to special authorizations for old industries and the discretionary powers of local authorities. Hazardous substances, which were emitted by disperse sources, e.g. traffic and agriculture, were not given sufficient consideration. More flexible instruments which induce changes in behavior, by using economic incentives and grant the addressees more possibilities to find adaptation techniques on their own to achieve a collectively defined goal of environmental protection, might cost less for all involved and just might make these adaptation processes easier and faster.

The assessment and evaluation of soil contamination from the past, including decisions about measures to protect and cope with contaminated areas, were mainly brought about by the direct actions of public authorities or standards. Individual adaptation techniques, especially concerning contaminated sites, were often impeded by public action. The analysis of extensive soil contamination took a relatively long time and led to recommendations which could not be individually considered because of shortcomings where the conveyance of information was concerned. Still, there is a need for institutional measures which will show private gardeners and farmers, in particular, the necessity and individual advantages of adaptation techniques for soil contamination from the past, without neglecting the potential for developing original ideas of adaptation.

The specific situation of the Ruhr area mainly refers to the long experience with environmental damage, together with a long-term economic dependence on emitting industries, and include the extremely unclear - as well as mutually impeding - structure of institutional decision-making bodies. Surely, these preconditions might explain why it has taken so long for the first steps to be taken towards improving environmental quality, along with the permanent decrepitude which hinders the

progress of adaptation processes. The economic task for future research, however, can be seen in the development of institutional structures and rules which overcome exactly this inflexibility and which support individual changes in knowledge and behavior without determining them.

Chronology of relevant events:

- 1952 Federal Law concerning the investment aid by the industry was passed.
- 1952 Interparliamentary working group for a natural of economy was founded
- 1953 Federal Laws for the acquisition of land for buildings and the management of housing space with improved possibilities to expropriate were passed. Agricultural land users were increasingly driven towards the Northern Ruhr Area.
- 1959 Amendment of Federal Industrial Code and Civil Law
- 1961 "Blue Sky above the Ruhr" as a slogan for the election campaign to federal parliament
- 1962 First State Air Quality Protection Law in Germany was passed in NRW.
- 1964 Federal Technical Instructions for Air Pollution Control (TA Luft) with stronger emission standards was implemented
- 1968 Medium-term action plan of the NRW-Government with specific aims for the development of the Ruhr Area
- 1971 Environmental Programme of the Federal Government was passed.
- 1972 Federal Law concerning waste disposal was passed.
- 1974 Federal Air Quality Protection Law was passed.
- 1975 Second medium-term action plan of the NRW-Government with specific aims concerning open spaces in the Ruhr Area
- 1976 First regional plans for clean air in NRW; first investigations of extensive areas concerning heavy metal contaminations from the past, especially in Duisburg
- 1976 Allocation of decision competences for district planning from the SVR to the district governments
- 1979 Foundation of KVR as successor organisation of SVR
- 1980 Grundstücksfonds Ruhr to select, acquire, prepare and sell contaminated sites was founded.
- 1980 First decree of the NRW-Government for the registration of industrial sites and deposits with contaminations from the past was issued.
- 1985 Concept for soil protection of the Federal Government was passed.

- 1987 Public recommendations for the assessment of extensive soil contaminations as well as for the adaption of cultivation and consumption to these contaminations in NRW were published. Furthermore, recommendations to the ascertainment of contaminations from the past on industrial sites and deposits were issued by the NRW-Government.
- 1988 "Guiding lines and measures for soil protection" of the Federal Government were decreed; tightening up of standards for the application of pesticides in the federal law concerning the protection of plants from 1986.
- 1988 NRW-Law for hazardous waste disposal was passed, where the raising of licence fees for suppliers of hazardous waste disposal was dedicated to the management of industrial sites and deposits with contaminations from the past.
- 1989 Special Report of the SRU concerning contaminations from the past was finished.
- 1992 Federal Legal Decree concerning the application of sewage sludge was passed with higher standards for soil protection.
- 1993 Proposal of the Federal Government for a federal soil protection law was published.

Bibliography:

- Abelshauer, W., Historische Ursachen der gegenwärtigen Strukturkrise in der nordrhein-westfälischen Industrie, in: Düwell, H., Köllmann, W. (Hrsg.), Rheinland-Westfalen im Industriezeitalter. Beiträge zur Landesgeschichte des 19. und 20. Jahrhunderts. Bd. 3: Vom Ende der Weimarer Republik bis zum Land Nordrhein-Westfalen, Wuppertal 1984, pp. 343-361.
- Aring, J., Butzin, B., Danielczyk, R., Helbrecht, I., Krisenregion Ruhrgebiet ? Alltag, Strukturwandel und Planung (= Wahrnehmungsgeographische Studien zur Regionalentwicklung, H. 8), Oldenburg 1989.
- Becker-Soest, D.; Wink, R., Vision und Wirklichkeit globalen Bodenschutzes. Effizienzorientierte institutionelle Ansätze auf marktwirtschaftskonformem Boden, (= Ruhr-Universität Bochum, Diskussionsbeiträge des Seminars für Wirtschafts- und Finanzpolitik, Nr. 25), Bochum 1994.
- Beckmann, M., Rechtsfragen der Genehmigung mobiler Bodenreinigungsanlagen, in: Neue Zeitschrift für Verwaltungsrecht, Jg. 12 (1993), H. 4, pp. 305-311.
- Begründung des Gesetzes zum Schutz vor schädlichen Bodenveränderungen und zur Sanierung von Altlasten (Bundes-Bodenschutzgesetz), Referenten-Entwurf in der mit den Ressorts abgestimmten Fassung vom 7.2.1994, in: Ständige Deputation des Deutschen Juristentages (Hrsg.), Diskussionsgrundlage der Abteilung Umweltrecht des 60. Deutschen Juristentages, München 1994, pp. B 23 - B 86.
- Bodenschutzkonzeption der Bundesregierung, Unterrichtung des Deutschen Bundestages durch die Bundesregierung, (= Deutscher Bundestag, Drucksache 10/2977 vom 7.3.1985).
- Bronny, H.M.; Dege, W., Raumpotential und Raumstrukturen an der Schwelle zur Industrialisierung, in: Köllmann, W.; Petzina, D.; Weber, W. (Hrsg.), Das Ruhrgebiet im Industriezeitalter, Geschichte und Entwicklung. Bd. 1, Düsseldorf 1990, pp. 81-109.
- Brüggemeier, F.-J., Natur, Gesundheit, Eigentum. Zur Entstehung des Umweltbewußtseins in Deutschland im 19. und 20. Jahrhundert, in: Klöpfer, M. (Hrsg.), Schübe des Umweltbewußtseins und der Umweltrechtsentwicklung, Bonn 1995, pp. 1-17.
- Brüggemeier, F.J.; Rommelspacher, T. (Hrsg.), Blauer Himmel über der Ruhr; Geschichte der Umwelt im Ruhrgebiet 1840-1990, Essen 1992.
- Brüggemeier, F.J.; Rommelspacher, T., Umwelt, in: Köllmann, W.; Petzina, D.; Weber, W. (Hrsg.), Das Ruhrgebiet im Industriezeitalter. Geschichte und Entwicklung, Bd. 2, Düsseldorf 1990, pp. 509-559.
- Deutscher Rat für Landespflge, Natur in der Stadt - der Beitrag der Landespflge zur Stadtentwicklung. Gutachterliche Stellungnahme und Ergebnisse eines Kolloquiums des Deutschen Rates für Landespflge, (= Schriftenreihe des DLR, H. 61), Meckenheim 1992.
- Ebel, W., Altlastensanierung zur Errichtung eines Dienst-, Gewerbe- und Landschaftsparks auf dem ehemaligen Zechen- und Kokereigelände Erin in Castrop-Rauxel, in: Verein Deutscher Ingenieure (Hrsg.), Wege zur sicheren Beherrschung von Altlasten, (= VDI-Berichte, Nr. 1119), Düsseldorf 1994, pp. 137-149.
- Eikmann, T., Kloke, A., Nutzungs- und schutzgutbezogene Orientierungsdaten für (Schad-)Stoffe in Böden, in: Rosenkranz, D. et al. (Hrsg.), Bodenschutz. Ergänzbare Handbuch der

- Maßnahmen und Empfehlungen für Schutz, Pflege und Sanierung von Böden, Landschaft und Grundwasser, Kennziffer 9305, Berlin, 14. Erg.-Lfg. X/93.
- Erbguth, W., Weiterentwicklungsbedarf im Bodenschutzrecht, in: *Natur + Recht*, Jg. 8 (1986), pp. 137-141.
- Feldhaus, G., Von der Gewerbeordnung zum Bundes-Immissionsschutzgesetz: Die Erwartungen des Gesetzgebers - Versuch einer Bilanz, in: Koch-H.-J., Lechelt, R. (Hrsg.), *Zwanzig Jahre Bundes-Immissionsschutzgesetz*, (= Forum Umweltrecht, Bd. 9), Baden-Baden 1994, pp. 9-20.
- Fiebig, K.H., Ohligschläger, G., *Altlasten in der Kommunalpraxis - Ergebnisse einer bundesweiten Umfrage*, Berlin 1989.
- Gossow, V.; Dahlmann, K., Umlagerung von kontaminierten Böden zwecks Revitalisierung von Industriebrachen am Beispiel des Mönninghofgeländes, in: *Verein Deutscher Ingenieure (Hrsg.), Wege zur sicheren Beherrschung von Altlasten*, (= VDI-Berichte, Nr. 1119), Düsseldorf 1994, pp. 129-136.
- Großmann, K., Übergemeindliche Freiraumkonzeptionen als integrierter Bestandteil einer zukunftsorientierten Raum- und Siedlungsstrukturentwicklung im Rhein-Ruhr-Gebiet, in: *Kommunalverband Ruhrgebiet (Hrsg.), Freizeit und Naherholung im Verdichtungsraum*, Essen 1979, pp. 141-153.
- Hecht, D., Möglichkeiten und Grenzen der Steuerung von Rückstandsmaterialströmen über den Abfallbeseitigungspreis, (= *Schriftenreihe des Rheinisch-Westfälischen Instituts für Wirtschaftsforschung*, H. 51), Berlin 1991.
- Hecht, D.; Werbeck, N., Ökonomie des Bodenschutzes, in: Junkernheinrich, M.; Klemmer, P.; Wagner, G.R. (Hrsg.), *Handbuch zur Umweltökonomie*, (= *Handbücher zur angewandten Umweltforschung*, Bd. 2), Berlin 1995, pp. 162-167.
- Heiermann, R., Schutz des Bodens vor Schadstoffeintrag: die Instrumente der direkten Verhaltensbeeinflussung des öffentlichen Rechts, (= *Schriften zum Umweltrecht*, Bd. 26), Berlin 1992.
- Hinzen, A., Ohligschläger, G., *Stadtplanung und Bodenkontaminationen - Zum Umgang der Stadtplanung mit belasteten Böden*, (= *Forschungsbericht*, Nr. 101 02074; UBA-FB 87-021), Berlin 1987.
- Holzapfel, A.M., *Flächenrecycling bei Altlasten. Sanierung und Wiederverwendung brachliegender Industrie- und Gewerbeflächen am Beispiel des Ruhrgebiets*, (= *Abfallwirtschaft in Forschung und Praxis*, Bd. 53), Berlin 1992.
- Hösel, G., Über die Notwendigkeit einer umfassenden Neuordnung der Abfallbeseitigung, in: *Städtehygiene*, Vol. 20 (1969), No. 6, pp. 129-135.
- Hueting, R.; Bosch, P.R., Sustainable National Income in the Netherlands: the calculation of environmental losses in money terms, in: *Modeles de developpement soutenable. Des approches exclusives ou complementaires de la soutenabilite?*, Paris 1994, pp. 43-56.
- Hügen, L., Das Gesetz "für die Wolfsschlucht". Bodenreformpolitik in Nordrhein-Westfalen 1945-1949, (= *Düsseldorfer Schriften zur neueren Landesgeschichte und zur Geschichte Nordrhein-Westfalens*, Bd. 28), Essen 1991.
- Interdisziplinäre Forschungsgemeinschaft für Gesellschaft, Umwelt und Sicherheit (Hrsg.), *Beiträge zum Bodenschutz. Rechtsvergleichende Betrachtungen und Entwicklung eines integrierten Steuerungssystems*, (= *TU Berlin, FAGUS-Schriften*, Bd. 3), Berlin 1993.

- Karl, H., Altlastenfinanzierung - Ansätze zur Deckung des Finanzbedarfs, (= Ruhr-Forschungsinstitut für Innovations- und Strukturpolitik, Bd. 1/87), Bochum 1987.
- Karl, H., Klemmer, P., Einbeziehung von Umweltindikatoren in die Regionalpolitik, (= Schriftenreihe des Rheinisch-Westfälischen Instituts für Wirtschaftsforschung, N.F., H. 50), Berlin 1990.
- Karl, H., Nienhaus, V., Kommunale Wirtschaftspolitik zwischen ökonomischer und politischer Rationalität: Anpassungsprobleme alter Industrieregionen, in: Jahrbuch für Neue Politische Ökonomie, Bd. 8 (1989), pp. 188-204.
- Kauch, P., Bodenschutz aus bundesrechtlicher Sicht: Bestandsaufnahme, Defizitanalyse und Weiterentwicklungsmöglichkeiten, (= Beiträge zum Siedlungs- und Wohnungswesen und zur Raumordnung, Bd. 152), Münster 1993.
- Kilper, H., Latniak, E., Rehfeld, D., Simonis, G., Das Ruhrgebiet im Umbruch. Strategien regionaler Verflechtung, (= Schriften des Instituts für Arbeit und Technik, Bd. 8), Opladen 1994.
- Kirbach, R., Wie kommt das Gift wieder aus dem Boden ?, in: Die Zeit, Nr. 41, 6.10.1995, p. 19.
- Klemmer, P. et al., Grundlagen eines mittelfristigen Aktionsplans der Umweltpolitik in der Bundesrepublik, (= Untersuchungen des Rheinisch-Westfälischen Instituts für Wirtschaftsforschung, H. 10), Essen 1994.
- Klemmer, P., Adaptive Problems of Old Industrial Areas: The Ruhr Area as an Example, in: Hesse, J.J. (Ed.), Regional Structural Change in International Perspective: United States, Great Britain, France, Federal Republic of Germany, Baden-Baden 1988, pp. 511-528.
- Klemmer, P., Gesamtwirtschaftliche Effekte ökonomischer Instrumente im Umweltschutz, in: Wagner, G.R. (Hrsg.), Unternehmung und ökologische Umwelt, München 1990, pp. 262-282.
- Klemmer, P., Regionalpolitik auf dem Prüfstand, Köln 1986.
- Klemmer, P., Risiken und Chancen des strukturellen Wandels in alten Industrie-Regionen, in: Gesellschaft für Sicherheitswissenschaft (Hrsg.), Der Mensch und seine Risiken in Gesellschaft, Technik und Umwelt, Wuppertal 1992, pp. 33-50.
- Kloke, A., Erläuterungen zur Klärschlammverordnung, in: Landwirtschaftliche Forschung, Sonderheft 39 (1982), pp. 302-308.
- Kloke, A., Orientierungsdaten für tolerierbare Gesamtgehalte einiger Elemente in Kulturböden. Richtwerte '80, in: Rosenkranz, D. et al. (Hrsg.), Bodenschutz. Ergänzbare Handbuch der Maßnahmen und Empfehlungen für Schutz, Pflege und Sanierung von Böden, Landschaft und Grundwasser, Kennziffer 9300, Berlin, 14. Erg.-Lfg. X/93.
- Klöpfer, M., Umweltrechtsentwicklungen in Deutschland nach 1945, in: Klöpfer, M. (Hrsg.), Schübe des Umweltbewußtseins und der Umweltrechtsentwicklung, Bonn 1995, pp. 91-131.
- Klöpfer, M., Zur Geschichte des deutschen Umweltrechts; unter Mitarbeit von C. Franzius und S. Reinert, (= Schriften zum Umweltrecht, Bd. 50), Berlin 1994.
- Kokalj, L., Industrie- und Wettbewerbspolitik - Konzeptionen und Ergebnisse im internationalen Vergleich, Dissertation, Bonn 1992.

- König, W., Krämer, F., Schwermetallbelastung von Böden und Kulturpflanzen in NRW, (= Schriftenreihe der Landesanstalt für Ökologie, Landschaftsentwicklung und Forstplanung NRW, Bd. 10), Münster 1985.
- Korte, H., Die Entfaltung der Infrastruktur, in: Köllmann, W.; Petzina, D.; Weber, W. (Hrsg.), Das Ruhrgebiet im Industriezeitalter, Geschichte und Entwicklung. Bd. 1, Düsseldorf 1990, pp. 569-599.
- Kraus, S., Discher, H., Sanierung bewohnter Altlasten, in: Pfaff-Schley, H. (Hrsg.), Altlasten als Planungshindernis. Planungsprobleme, Handlungsdefizite, Lösungsstrategien, (= Abfallwirtschaft in Forschung und Praxis, Bd. 58), Berlin 1993, pp. 169-177.
- Kreis Unna (Hrsg.), Schwermetalle in Böden verschiedener Nutzungsformen im Kreis Unna - Eine Bestandsaufnahme-, Bodenbelastungskarte, Teil I, Unna 1986.
- Kühl, C., Kooperationsmodelle zur Finanzierung der Altlastensanierung - eine kritische Analyse, in: Zeitschrift für angewandte Umweltforschung, Jg. 3 (1990), H. 4, pp. 418-427.
- Landesanstalt für Ökologie, Landschaftsentwicklung und Forstplanung (LÖLF) NRW (Hrsg.), Mindestuntersuchungsprogramm Kulturboden zur Gefährdungsabschätzung von Ablagerungen und Altstandorten im Hinblick auf eine landwirtschaftliche oder gärtnerische Nutzung, Recklinghausen 1988.
- Landwirtschaftskammer Rheinland (Hrsg.), Vorbeugende Maßnahmen zur Futtergewinnung und Fütterung in schwermetallbelasteten Gebieten, (= Informationen zum Umweltschutz, Nr. 23), Köln 1983.
- Lersner, H. Frhr. v., 10 Jahre Abfallbeseitigungsgesetz, in: Müll und Abfall, Vol. 14 (1982), No. 10, pp. 258-260.
- Meier, F., Die Änderung der Bodennutzung und des Grundeigentums im Ruhrgebiet von 1820 bis 1955, Bad Godesberg 1961.
- Micheel, B., Bodennutzung als umweltökonomisches Problem. Anknüpfungspunkte zur Verbesserung der Bodenordnung als Zielbeitrag zum Boden- und Landschaftsschutz, Bochum 1994.
- Mick, T., "Regelungsdickicht" als Investitionshemmnis. Eine kritische Bestandsaufnahme, (= Ruhr-Forschungsinstitut für Innovations- und Strukturpolitik, Bd. 4/94), Bochum 1994.
- Milchert, J., Freiraumstruktur in Arbeitersiedlungen des Ruhrgebietes, Teil 1 und 2, in: Garten und Landschaft, Jg. 92 (1982), H. 8, pp. 585-590 bzw. H. 9, pp. 687-694.
- Münch, D., Naturschutzgebiete in der Großstadt und ihre Bodenbelastung, Dortmund 1991.
- MURL (1987), Schadstoffarmes Gemüse und Obst aus Haus- und Kleingärten. Anbau- und Verzehrsempfehlungen. Blei-Cadmium-Zink, Düsseldorf.
- Netherlands (1994), Niederländische Liste 1994. Interventions(I-Werte)- und Referenz(S-Werte) für Böden und Grundwasser, in: Rosenkranz, D. et al. (Hrsg.), Bodenschutz. Ergänzbare Handbuch der Maßnahmen und Empfehlungen für Schutz, Pflege und Sanierung von Böden, Landschaft und Grundwasser, Kennziffer 8936, Berlin, 15. Erg.-Lfg. I/94.
- Peine, F.-J., Teilgebiet "Bodenschutz" im Rahmen des Endberichts zum FuE-Vorhaben "Umweltgesetzbuch - Besonderer Teil" im Auftrag des Umweltbundesamtes, in: Ständige Deputation des Deutschen Juristentages (Hrsg.), Diskussionsgrundlage der Abteilung Umweltrecht des 60. Deutschen Juristentages, München 1994, pp. B 87 - B 141.

- Piel, H.-D.; Hölter, S., Erfassung und Bewertung des ökologischen Potentials in Hausgärten sowie anschließenden Freiflächen - an Beispielen aus Bochumer, Herner und Essener Stadtteilen, (= Ruhr-Forschungsinstitut für Innovations- und Strukturpolitik, Bd. 3/86), Bochum 1986.
- Plate, H.-P., Bemerkungen zur Düngung und Schwermetallbelastung in Klein- und Hausgärten, in: Das Gartenamt, Jg. 34 (1985), H. 4, pp. 319-321.
- Rat von Sachverständigen für Umweltfragen (SRU), Altlasten II, Sondergutachten, Stuttgart 1995.
- Rat von Sachverständigen für Umweltfragen (SRU), Altlasten, Sondergutachten, Stuttgart, Mainz 1990.
- Rat von Sachverständigen für Umweltfragen (SRU), Für eine dauerhaft-umweltgerechte Entwicklung, Umweltgutachten 1994, Wiesbaden 1994.
- Rat von Sachverständigen für Umweltfragen (SRU), Umweltgutachten 1987, Stuttgart, Mainz 1988.
- Rat von Sachverständigen für Umweltfragen (SRU), Umweltprobleme der Landwirtschaft, Sondergutachten, Stuttgart, Mainz 1985.
- Rau, T., Bodenallokation und Bodenpolitik im Ruhrgebiet - Eine alloktionstheoretische Untersuchung des "Grundstücksfonds Ruhr", (= Beiträge zur Struktur- und Konjunkturforschung, Bd. XIX), Bochum 1982.
- Reif, H., Landwirtschaft im industriellen Ballungsraum, in: Köllmann, W.; Petzina, D.; Weber, W. (Hrsg.), Das Ruhrgebiet im Industriezeitalter. Geschichte und Entwicklung, Bd. 1, Düsseldorf 1990, pp. 337-393.
- Reinirkens, P., Siedlungsböden im Ruhrgebiet. Bedeutung und Klassifikation im urban-industriellen Ökosystems Bochums, Paderborn 1991.
- Rommelpacher, T., Großgrundbesitz in der regionalen Krise. 25 Jahre montanindustrielle Bodenpolitik im Ruhrgebiet, in: Über Planung 1984. Eine Sammlung planungspolitischer Aufsätze (= Schriftenreihe des Fachbereichs Stadtplanung und Landschaftsplanung, H. 8), Kassel 1984, pp. 114-124.
- Schink, A., Die Entwicklung des Umweltrechts im Jahre 1994 - Zweiter Teil -, in: Zeitschrift für angewandte Umweltforschung, Jg. 8 (1995), H. 2, pp. 227-239.
- Schmid, R., Bodenbelastung in Kleingärten - mögliche Ursachen und Gefahren, in: Hochheimer Arbeiten, Stuttgart 1986, pp. 97-106.
- Schmidt-Bleek, F., Wieviel Umwelt braucht der Mensch ? - MIPS-das Maß für ökologisches Wirtschaften, Berlin u.a.O. 1993.
- Schmitz, C., Bergbau und Verstädterung im Ruhrgebiet. Die Rolle der Bergwerksunternehmen in der Industrialisierung am Beispiel Gelsenkirchen, Bochum 1987.
- Schramm, E., Zu einer Umweltgeschichte des Bodens, in: Brüggemeier, F.J., Rommelpacher, T. (Hrsg.), Besiegte Natur. Geschichte der Umwelt und Natur im 19. und 20. Jahrhundert, München 1989, pp. 86-105.
- Schulz, D., Strauch, V., Bodenschutz im Kleingartenwesen, in: Rosenkranz, D.; Bachmann, G.; Einsele, G.; Harreß, H.-M. (Hrsg.), Bodenschutz. Ergänzbare Handbuch der Maßnahmen und Empfehlungen für Schutz, Pflege und Sanierung von Böden, Landschaft und Grundwasser, Kennziffer 5340, 4. Ergänzungslieferung, Berlin 1990.

- Stuck, B., Altlasten, in: Du Bois, W., Zimmermann, K. (Hrsg.), Umweltdaten in der kommunalen Praxis. Datenbeschaffung und Datenverarbeitung für Umweltplanung, Überwachung und Umweltverträglichkeitsprüfung. Kommunale Umweltinformationssysteme, Taunusstein 1992, pp. 71-79.
- Thimet, J., Die Sanierung von Altlasten: Rechtliche Instrumente und Vollzug. Eine rechtsvergleichende Untersuchung des Rechts der Vereinigten Staaten und der Bundesrepublik Deutschland, (= Europäische Hochschulschriften, Reihe 2: Rechtswissenschaften, Bd. 1450), Frankfurt u.a.O. 1993.
- Umweltgutachten 1974, (= Deutscher Bundestag, Drucksache 7/2802 vom 14.11.1974).
- Umweltgutachten 1978, (= Deutscher Bundestag, Drucksache 8/1938 vom 19.4.1978).
- Viereck-Götte, L., German-Polish exchange of experiences on standards of soil contaminations and deposition of contaminants in garden allotments, Enclosure 1: German experiences in industrial centers of North-Rhine-Westphalia, (= Study by Büro für konzeptionellen Umweltschutz für Medizinische Einrichtungen der Rheinischen Friedrich-Wilhelms-Universität in Bonn by order of the Umweltbundesamt), Bochum 1995.
- Waniek, R.W., Die Zukunftsinitiative für die Regionen Nordrhein-Westfalens, (= Ruhr-Forschungsinstitut für Innovations- und Strukturpolitik, Bd. 5/90), Bochum 1990.
- Werbeck, N., Wink, R., Bodenschutz und Marktwirtschaft. Anwendungsfall Ruhrgebiet, (= Ruhr-Forschungsinstitut für Innovations- und Strukturpolitik, Nr. 5/94), Bochum 1994b.
- Werbeck, N.; Wink, R., Bodenfunktionen und Bodennutzung - Institutionelle Alternativen zur Allokation des dritten Umweltmediums, in: List-Forum, Bd. 20 (1994a), H. 3, pp. 262-282.
- Werbeck, N.; Wink, R., Der Entwurf der Bundesregierung für ein Bundesbodenschutzgesetz - Wegbereiter oder zusätzliche Hürde zu einem effizienzorientierten Bodenschutz ?, in: Zeitschrift für angewandte Umweltforschung, Jg. 7 (1994c), H. 3, pp. 403-414.
- Wey, K.G., Umweltpolitik in Deutschland. Kurze Geschichte des Umweltschutzes in Deutschland seit 1900, Opladen 1982.
- Wiegandt, C.-C., Reaktivierung von Gewerbe- und Industriebrachen: Das Modell einer Fondslösung am Beispiel des Grundstücksfonds in Nordrhein-Westfalen, in: Rosenkranz, D.; Bachmann, G.; Einsele, G.; Harreß, H.-M. (Hrsg.), Bodenschutz. Ergänzbare Handbuch der Maßnahmen und Empfehlungen für Schutz, Pflege und Sanierung von Böden, Landschaft und Grundwasser, Kennziffer 6730, 6. Ergänzungslieferung, Berlin 1991.
- Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (WBGU), Welt im Wandel: Die Gefährdung der Böden, Jahrgutachten, Bonn 1994.
- Zieschank, R.; Schott, P., Umweltinformationssysteme im Bodenschutz - konzeptionelle Überlegungen zu einem Erfassungs- und Bewertungsansatz der Umweltbeurteilung, Berlin 1986.
- Herget, J., Zur räumlichen Variabilität der Gehalte ausgewählter Schadstoffe in Stadtböden, in: Zeitschrift für Pflanzenernährung und Bodenkunde, Vol. 157 (1994), pp. 309.

Viereck-Götte, L., Ewers, U., Schadstoffe in urbanen Böden, (= bislang unveröff. Vortrag für ein Seminar für arbeitsmedizinische Weiterbildung der Ärztekammer Westfalen-Lippe, Kursreihe X, Umweltmedizin), Bochum 1995.