Examining the Social Context of Land Regeneration
A Social Constructionist Approach

by

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Declaration of authorship

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Abstract

This thesis is concerned with the social context of land regeneration projects. Land regeneration projects aim at finding new uses for degraded or derelict land. The social and cultural dimensions of land regeneration projects are often overlooked. Thus, this thesis aims at examining the social dimensions of a land regeneration project. As a case study, this thesis examines the project RECOAL (Re-integration of coal ash disposal sites in the western Balkans). The aim of RECOAL was to develop sustainable and low-cost solutions for the regeneration of coal ash disposal sites in the western Balkans. The project ran from January 2005 to December 2007 and was largely funded by the 6th Framework Programme for Research and Technological Development of the European Union. The research team included research organisations in Bosnia and Herzegovina, Croatia, Austria, Germany and the UK.

This thesis adopts a social constructionist perspective to understand the problem of coal ash pollution ‘as the actors see it’. Hence, the aim of this thesis is to explore how RECOAL stakeholders construct the environmental problems to be addressed by the project and how these perspectives influence, and in turn are influenced by the project development. This thesis also examines the tensions that occur between competing ‘definitions of the situation’ and evaluates the implications of this analysis for land use regeneration projects. Qualitative methodologies were used to examine the perspectives of researchers, local residents affected by pollution and institutional representatives.

This thesis argues that, in environmentally degraded areas, there may be multiple social constructions of the environmental problem and thus, tensions may emerge between competing definitions of the situation. These tensions are part of the social context in which land regeneration projects are developed and they influence their results. Moreover, the results of the research suggest that land regeneration projects adapt to accommodate these contesting definitions of the situation using different mechanisms that include ‘expectations management’ and ‘knowledge management’ procedures. ‘Knowledge management’ procedures, for example, include formal and informal rules to deal with the uncertainty of the results in risk assessment. ‘Expectations management’ procedures require the project members to liaise with stakeholders at different levels. While both expectations and knowledge management procedures are embedded in the scientific practice they are rarely stated explicitly. Finally, this research argues that examining the social context may help land regeneration projects to improve their expectations and knowledge management procedures. In particular, adopting a social constructionist perspective may help exploring the social context of land regeneration projects by revealing the multiplicity of perspectives that intervene in the definition of environmental problems. The research recommends including local actors’ perspectives earlier on in the framing stage of land regeneration projects.
Executive Summary

Background

Land regeneration projects aim at finding new uses for degraded and derelict land. Land regeneration differs from land reclamation in that it does not require restoring the land to its natural state in order to find an appropriate use for that land. Studies on land regeneration have pointed out the difficulties of dealing with contaminated land because the impacts on land are permanent and land may be subject to many uses and numerous ownerships or interests. However, the social and cultural dimensions of land are often overlooked. Researchers and practitioners working in land regeneration projects find themselves looking for solutions that need to address simultaneously ecological and social requirements because land regeneration is influenced by social processes.

The research discussed in this thesis began with a general question: what happens when a land regeneration project is considered within the social context in which it is developed? The sub-discipline of environmental sociology aims at developing "distinctive understandings of the relationship between society and the environment" (Hannigan, 1995; p. 5). Thus, this field can contribute to study the social context of land regeneration projects. The research explored the views of citizens and scientists involved and/or affected by land regeneration projects, and how different actors are able to influence the environmental and social impacts of those projects. Within environmental sociology, the research adopted a social constructionist perspective to understand the problem of coal ash pollution 'as the actors see it' without passing a judgement on whether their views are accurate or not.

The Engineering Doctorate was based at Forest Research, where I had the opportunity to work in the project RECOAL (Re-integration of coal ash disposal sites in the western Balkans). The aim of RECOAL was to develop sustainable and low-cost solutions for the regeneration of coal ash disposal sites in different locations of Bosnia and Herzegovina, Kosovo and neighbouring countries. The main case studied by the consortium was the disposal of coal ash from a thermal power plant in Tuzla, Bosnia and Herzegovina. The project ran from January 2005 to December 2007 and was largely funded by the 6th Framework Programme for Research and Technological Development of the European Union. A consortium of research organisations in Bosnia and Herzegovina, Croatia, Austria, Germany and the UK participated in the project. RECOAL was chosen as a case study for two reasons: 1) the social and technical interest of the issue of coal ash in the western Balkans; and 2) the possibility of studying RECOAL within the timeframe of the EngD at Forest Research.

Research objective

The aim of this thesis is to explore how RECOAL stakeholders construct the environmental problems to be addressed by the project, and how these perspectives influence and in turn are influenced by the project development. The thesis also examines the tensions that occur between competing 'definitions of the situation' and evaluates the implications of this analysis for land regeneration projects.

Summary of methodology

The research presented in this thesis explored the perspectives on coal ash disposal of the stakeholders involved in RECOAL, including the researchers, local residents and institutional representatives. Targeted qualitative research was carried out in three phases. First, an initial exploration of local perspectives in Tuzla was carried out in the spring of 2006. Second, RECOAL researchers' perspectives were studied in a set of interviews carried out between December 2006 and July 2007. Third, in August 2008, the research explored the local actors' evaluation of RECOAL's solutions for coal ash disposal sites in Tuzla. This provided an opportunity to examine the context of RECOAL and its local
impact while being involved in the development of the project. Due to the conditions of the research, the fieldwork required a certain amount of opportunism and ad hoc solutions for unexpected difficulties. In addition, the research used diverse material compiled in RECOAL meetings and project work, including participant observation annotations, e-mails and reports of RECOAL’s work.

Statement of theses

The first thesis is that, in environmentally degraded areas, there may be multiple social constructions of the environmental problem and thus, tensions may emerge between competing definitions of the situation. These tensions are part of the context in which land regeneration projects are developed and thus, they influence their results in different ways.

The second thesis is that land regeneration projects may adapt to accommodate these contesting definitions of the situation using different mechanisms that allow the project to maintain a ‘common front’, or working consensus, when the project is presented to external audiences. This requires procedures for ‘knowledge management’ and ‘expectations management’. ‘Knowledge management’ procedures, for example, include formal and informal rules to deal with the uncertainty of the results in risk assessment. ‘Expectations management’ procedures require the project members to liaise with stakeholders at different levels. While both ‘knowledge management’ and ‘expectations management’ procedures are embedded within research practices they are rarely stated explicitly. Indeed, the thesis gives some examples in which the lack of awareness of these practices appears to have separated some RECOAL researchers from the core project team.

The third thesis is that the examination of the social and political context may help applied research projects studying land regeneration, such as RECOAL, improving their ‘knowledge management’ and ‘expectations management’ procedures. The social and political context can be evaluated by exploring competing definitions of the situation in the construction of the environmental problem. The literature suggests that this analysis may help to incorporate into the project contextual knowledge that ultimately may be valuable to understand what the project impact is likely to be. The experience in RECOAL suggests that, in addition, analysing the social construction of the environmental problem facilitates ‘knowledge management’, because it helps the project team to understand its impacts in terms of how the project results are likely to be used and interpreted by different local actors. In addition, understanding the social construction of the problem may help the project team to state explicitly ‘expectations management’ procedures that help in the development of the project.

Structure of the argument

The thesis consists of nine chapters. Chapter 1 offers an introduction to the topic of study and the project RECOAL. Chapter 2 critically examines social constructionist theory and argues that environmental problems can be understood as claims-making activities to assert the presence of an alleged condition in society, in this case, environmental pollution. The chapter also explains social constructionist views on science and society. Chapter 3 reviews the technical, economic and political context of coal ash pollution in Bosnia and Herzegovina. Chapter 4 reviews the methodology applied during the research, including the research methods and the ethical problems faced by the researcher in exploring a ‘real-life problem’. The results are presented in Chapters 5, 6, 7 and 8.

Chapter 5 analyses the local identities associated with a polluted place to expose latent and expressed social concerns which can be incorporated into land regeneration projects. The chapter argues that land degradation does not necessarily rupture ties between identity and place, but rather, it may pose threats for the continuity of residents’ identities. The chapter proposes a model for understanding performed identities in the context of environmental change based on the concepts of sense of place and stigma associated with the place. The emergence of stigma is not always linked with the presence of risks as they are defined in
the risk assessment. Yet, the social construction of stigma may help explain the relationship between people and an environment under change, without needing considering whether that place is actually polluted or not.

Chapter 6 explores the symbolic structures that support the construction of the problem of environmental pollution. Local narratives of pollution were compiled and analysed using the theoretical framework of pollution rituals developed by Mary Douglas. The analysis showed that local residents perceived the pollution as a transgression of the industry in their lives. These pollution beliefs served local residents to allocate blame to industrial actors. The same analysis was applied to commonly used definitions of pollution in environmental sciences, to demonstrate that within environmental sciences pollution is not perceived as a transgression of symbolic systems. Rather, potential pollutants are regarded as natural elements and risks are associated with their concentrations. This explains some of the differences in thinking about pollution between researchers and local residents.

Chapter 7 reviews critically the research procedures used to characterise pollution; in particular, the chapter explains the development of the risk assessment within RECOAL. The research also shows how local residents perform their own assessment of risks associated with the coal ash disposals. The research suggests that the results of the risk assessment of RECOAL did not provide sufficient information to explain away local concerns about pollution. Moreover, the interviews with RECOAL researchers suggested that they felt unable to talk about how their results fitted the economic and social context of the project because this was regarded as being out of their realm of expertise.

Following standard technical guidance, RECOAL researchers established a difference between risk assessment (the characterisation of the potential adverse health effects of human exposures to environmental hazards) and risk management (the evaluation of alternative regulatory actions to address previously identified issues). Chapter 7 argues that, in practice, both risk management and risk assessment remain confused with respect to goals, kinds of expertise and operating principles. Furthermore, this work adds to a body of literature arguing that in high uncertainty conditions, such as those pertaining to most environmental problems, determining who is an expert and what counts as valid knowledge is a highly political issue and the construction of expertise therefore needs to be open to political debate.

The first part of Chapter 8 explains the expectations of different actors in Tuzla according to their definitions of the situation. The research suggests that different stakeholders regard research as a tool to establish the evidence to support their particular definition of the situation and that stakeholders’ expectations of the project are unrealistic. Although RECOAL results did not clearly support any of the views of local actors, the way the results are presented appeared to support the definition of the situation put forward by the local industry.

The second part of Chapter 8 argued that scientists have a limited influence on the long-term impacts of a land regeneration project. In RECOAL, the research scientists performed their research according to pre-established roles. In conforming to these roles scientists feared to express their value-judgements explicitly and focused only on generating factual results, leaving the benefits of the project to be decided within the social and political context of the project. In some cases scientists with a declared commitment brought it into the project in the form of a ‘disguised engagement’. In other cases, some researchers focused on the process of research, trying to bring into it different perspectives, but it is not clear whether there is added value in this approach.

Final Summary

This research has explored multiple perspectives that influence a land regeneration project, RECOAL. First, the research revealed that various points of view exist within local communities. Second, the research found fundamental differences in the understanding of
coal ash pollution between local residents and researchers, originating in the systems of representation in which the pollution is framed. Third, the research found that current risk assessment methodologies do not provide the tools to assure people of the presence or absence of dangers associated with pollution. Professional judgements on measures for managing risk did not dissipate local concerns about potential health and environmental hazards associated with the coal ash disposal sites. Fourth, the research brought to light the expectations that different local actors held towards the project. These expectations were great and ultimately could not be fully met: projects like RECOAL cannot solve everyday problems for disadvantaged communities, particularly when the research problem is formulated too narrowly. Some actors were found to be able to use the discourse of the project to their own advantage, while others were unable to do so. Moreover, researchers adopted a range of attitudes regarding the local impact of the project and in doing so they favoured the interests of particular local actors over others. This suggests that the impact of land regeneration projects for local residents and institutions depends on how different actors interact and use the narratives and outputs produced within the project. The research recommends including local actors’ perspectives earlier on in the framing stage of land regeneration projects.
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<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>BEN</td>
<td>Balkan Endemic Nephropathy</td>
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<td>BAT</td>
<td>Best Available Technology</td>
</tr>
<tr>
<td>BiH:</td>
<td>Bosnia and Herzegovina</td>
</tr>
<tr>
<td>BOKU</td>
<td>University of Natural Resources and Applied Life Sciences of Vienna, Austria</td>
</tr>
<tr>
<td>BTUC</td>
<td>Brandenburg University of Technology at Cottbus, Germany</td>
</tr>
<tr>
<td>CCRs</td>
<td>Coal Combustion Residues</td>
</tr>
<tr>
<td>EIA</td>
<td>Energy Information Administration (US)</td>
</tr>
<tr>
<td>EP</td>
<td>Elektroprivreda, Public Utility Company in Bosnia and Herzegovina</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FAZ</td>
<td>University of Zagreb, Croatia</td>
</tr>
<tr>
<td>FBA</td>
<td>Furnace Bottom Ash (or Bottom Ash)</td>
</tr>
<tr>
<td>FBiH</td>
<td>Federation of Bosnia and Herzegovina</td>
</tr>
<tr>
<td>FC</td>
<td>Forestry Commission</td>
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<tr>
<td>FGD</td>
<td>Flue Gas Desulphurisation Waste</td>
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<td>FR</td>
<td>Forest Research</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>CEE</td>
<td>Central and Eastern Europe</td>
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<tr>
<td>gW</td>
<td>Gigawatts</td>
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<tr>
<td>Ha</td>
<td>Hectare[s]</td>
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<tr>
<td>HEIS</td>
<td>Hydro-Engineering Institute, University of Sarajevo, Bosnia and Herzegovina</td>
</tr>
<tr>
<td>HDZ</td>
<td>Croatian Democratic Party for Bosnia and Herzegovina</td>
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<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
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<tr>
<td>LEAP</td>
<td>Local Environmental Action Plan</td>
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<tr>
<td>m</td>
<td>Metre[s]</td>
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<tr>
<td>mW</td>
<td>Megawatt</td>
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<tr>
<td>mWh</td>
<td>Megawatt-hour</td>
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<tr>
<td>NEAP</td>
<td>National Environmental Action Plan</td>
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<tr>
<td>NGOs</td>
<td>Non Governmental Organisations</td>
</tr>
<tr>
<td>OHR</td>
<td>Office of the High Representative in Bosnia and Herzegovina</td>
</tr>
<tr>
<td>OSCE</td>
<td>Organization for Security and Co-operation in Europe</td>
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<tr>
<td>PAHs</td>
<td>Polycyclic Aromatic Hydrocarbons</td>
</tr>
<tr>
<td>PCBs</td>
<td>Polychlorinated biphenyls</td>
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<tr>
<td>PFA</td>
<td>Pulverised Fly Ash</td>
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<tr>
<td>POPs</td>
<td>Persistent Organic Pollutants</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>RECOAL</td>
<td>EU 6th Framework Programme Project on the Re-integration of Coal Ash Disposal Sites in the western Balkans</td>
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<tr>
<td>RS</td>
<td>Republika Srpska</td>
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<td>RCEP</td>
<td>Royal Commission on Environmental Pollution, UK</td>
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<td>s</td>
<td>Second[s]</td>
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<tr>
<td>SDA</td>
<td>Party for Democratic Action, Bosnia and Herzegovina</td>
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<tr>
<td>SDP</td>
<td>Social Democratic Party for Bosnia and Herzegovina</td>
</tr>
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<td>SDS</td>
<td>Serbian Democratic Party for Bosnia and Herzegovina</td>
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<tr>
<td>SI</td>
<td>Symbolic Interactionism</td>
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<tr>
<td>SSK</td>
<td>Sociology of Scientific Knowledge</td>
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<tr>
<td>STS</td>
<td>Science and Technology Studies</td>
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<tr>
<td>TEP</td>
<td>Termo-elektrana Tuzla</td>
</tr>
<tr>
<td>UBAL</td>
<td>University of Banja Luka, Bosnia and Herzegovina</td>
</tr>
<tr>
<td>UKCEED</td>
<td>UK Centre for Economic and Environmental Development</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
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<tr>
<td>USEPA</td>
<td>United States Environmental Protection Agency</td>
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<tr>
<td>WHC</td>
<td>Water Holding Capacity</td>
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1. Introduction

This thesis is concerned with the development and impact of land regeneration projects. Leopold (1949 [1989]) declared emotively that "land is not merely soil; it is a fountain of energy flowing through a circuit of soils, plants and animals" (p. 216). Moreover, land is regarded as the base upon which human societies are built (Caldwell and Shrad- Frechette, 1993). Yet, land is often described just as a source of sustenance, resources and wealth. Scholars have pointed out that land includes social and cultural meanings:

"...land is much more than material base: it is imbued with diverse, sometimes contradictory, social and cultural meanings..." (Owens and Cowel, 2002; p. 4)

Land regeneration projects aim at finding new uses for degraded and derelict land (e.g. Hilton, 1967; Sellers et al., 2006). Land regeneration differs from land reclamation in that it does not require restoring the land to its natural state in order to find an appropriate use for that land (although land reclamation methods may be used to bring the land to a state compatible with its designated use). In recent years, remediation and reuse of contaminated land has been identified as a way forward in advancing the sustainability of urban areas (Owens and Cowel, 2002).

Studies on land regeneration have pointed out the difficulties of dealing with contaminated land because the impacts on land are permanent and land may be subject to many uses and numerous ownerships or interests (Tromans and Turrall-Clarke, 2000). Often, the 'diverse and contradictory social and cultural meanings' of land are overlooked. However, researchers and practitioners working in land regeneration projects find themselves looking for solutions that need to address simultaneously ecological and social requirements because land regeneration is influenced by social processes.

The research discussed in this thesis began with a general question: what happens when a land regeneration project is considered within the social context in which it is developed? It addresses the interrelated conditions of society and the environment in which such a project occurs. The sub-discipline of environmental sociology aims at developing “distinctive understandings of the relationship between society and the environment” (Hannigan, 1995; p. 5). Thus, this field can contribute to study the social context of land regeneration projects. The research explored the views of citizens and scientists involved and/or affected by land regeneration projects, and whether or not different actors are able to influence the environmental and social impacts of those projects. Within environmental sociology, the research adopted a social constructionist perspective to understand the problem of coal ash pollution ‘as the actors see it’, without passing a judgement on whether their views are accurate or not.

This thesis, in particular, focuses on the role of researchers in land regeneration projects and the associated social expectations from those projects. Often, citizens and scientists are portrayed as having different understandings of ‘the land’:

"The ordinary citizen today assumes that science knows what makes the community [of society and its land] clock tic; the scientist is equally sure that he does not. He knows that the biotic mechanism is so complex that its workings may never be fully understood.” (Leopold, 1949 [reprinted 1989]; p. 205)

Recent work in environmental sociology has questioned whether this distinction is tenable considering that science is also a social activity and that the ‘ordinary citizen’ may be knowledgeable of environmental science (Irwin, 1995). The research presented in this thesis explores different types of knowledge that emerge around a land regeneration project and how they are dealt with by the project team.
The EngD was based at Forest Research, where I had the opportunity to work in the project RECOAL (Re-integration of coal ash disposal sites in the western Balkans). The aim of RECOAL was to develop sustainable and low-cost solutions for the regeneration of coal ash disposal sites in different locations of Bosnia and Herzegovina, Kosovo and neighbouring countries. The project ran from January 2005 to December 2007 and was largely funded by the 6th Framework Programme for Research and Technological Development of the European Union. The research team included research organisations in Bosnia and Herzegovina, Croatia, Austria, Germany and the UK.

The project focused on the geographical region of the western Balkans. The fall of Marxist-inspired governments in Central and Eastern Europe (sometimes referred to as ‘velvet’ or ‘gentle’ revolutions) had associated economical, political and social processes without precedent in modern history. Increasingly, commentators have noted the importance of health and environmental concerns as factors of change in post-socialist societies:

“If the velvet revolutions that swept across CEE in 1989 were, in the first instance, struggles for democracy, they were also at root cries of desperation from people fearful for the deterioration of the environment and their children's and their own health.” (Pavlinek and Pickles, 2000; p. 127)

The western Balkans had seen the transition to democracy hindered by the civil wars of the 1990s and a difficult process of political transition. Conflicts over land have an important role on this transition. RECOAL was chosen as a case study for two reasons: 1) the social and technical interest of a land regeneration issue such as the management of coal ash disposal sites in the western Balkans; and 2) the possibility of studying RECOAL within the timeframe of the EngD at Forest Research.

The research presented in this thesis proceeded by studying the perspectives on coal ash disposal of the stakeholders involved in RECOAL, including the researchers, local residents and institutional representatives. Table 1-1 presents the meta-research question and how it was interpreted in the form of a concrete research question and sub-questions. Table 1-1 also specifies how the research questions are related with the structure of the thesis. Targeted qualitative research was carried out in three phases. First, an initial exploration of local perspectives was carried out in the spring of 2006. Second, RECOAL researchers’ perspectives were studied in a set of interviews carried out between December 2006 and July 2007. Third, in August 2008, the research explored the local actors' evaluation of RECOAL’s solutions for coal ash disposal sites. The research provided an opportunity to examine the social context of RECOAL and its local impact while being involved in its development.

The research unveiled multiple perspectives that influence the project in different ways. First, the research revealed that various points of view exist within local communities. Second, the research found fundamental differences in the understanding of coal ash pollution between local residents and researchers, originating in the systems of representation in which the pollution is framed. Third, the research found that current risk assessment methodologies do not provide the tools to assure people of the presence or absence of dangers associated with pollution. Professional judgements on measures for managing risk did not dissipate local concerns about potential health and environmental hazards associated with the coal ash disposal sites. Fourth, the research brought to light the expectations different local actors held towards the project. These expectations were great and ultimately could not be fully met: projects like RECOAL cannot solve everyday problems for disadvantaged communities, particularly when the research problem is formulated too narrowly. Some actors were found to be able to use the discourse of the project to their own advantage, while others were unable to do so. Moreover, researchers

1 At the time of writing, March 2009, the country’s political system seems as fragile as ever (e.g. ICG, 2009).
adopted a range of attitudes regarding the local impact of the project and in doing so they favoured the interests of particular local actors over others.

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Where in the thesis this is addressed</th>
</tr>
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<tbody>
<tr>
<td><strong>Meta-question</strong>: What happens when a land regeneration project is considered within the social context in which it is developed?</td>
<td>Introduction/conclusions</td>
</tr>
<tr>
<td><strong>Project specific question</strong>: How do RECOAL stakeholders construct the environmental problems to be addressed by the project, and how these perspectives influence, and in turn are influenced by its development?</td>
<td>Chapters 5, 6, 7 and 8</td>
</tr>
<tr>
<td>• Sub-question 1: What are the different perspectives on coal ash pollution of local residents in Tuzla and how are they related to their perceptions of the place?</td>
<td>Chapter 5</td>
</tr>
<tr>
<td>• Sub-question 2: What are the different conceptualisations of pollution that influence the views of scientists and local residents in Tuzla?</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>• Sub-question 3: How is knowledge about the risks associated to the coal ash disposal sites developed within RECOAL and within the local communities?</td>
<td>Chapter 7</td>
</tr>
<tr>
<td>• Sub-question 4: What are the local expectations about the benefits that RECOAL should deliver, and how do RECOAL members deal with them?</td>
<td>Chapter 8</td>
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Table 1-1: Summary of research questions and roadmap to find the answers.

The impact of the research on local residents and institutions depended on how different actors interacted and used the narratives and outputs produced within the project. Representatives of local institutions and residents interpreted the results according to their own expectations. However, residents were unable to use RECOAL results to advance their own objectives because they held different perspectives on the pollution from coal ash. What the impacts of the project will be in the long term has not been evaluated because of the time scale of the research. However, the results so far suggest that including local actors’ perspectives earlier on in the framing stage of the project could be advantageous.

The following section describes the development of RECOAL, and explains the reasons why it was selected as a case study. Section 1.2 provides an overview of the structure of the thesis.

1.1. A brief history of RECOAL

RECOAL emerged as a result of different EU programmes to facilitate the interaction of scientists across the European Union and neighbouring countries. In 2001 a group of Bosnian researchers visited Vienna with funds from the EU programme TEMPUS².

² Tempus (The Trans-European mobility scheme for university studies) is an EU funded program that "supports the modernisation of higher education and creates an area of co-operation in countries surrounding the EU". The program covers 27 countries in the Western Balkans, Eastern Europe and Central Asia, North Africa and the Middle East.
Among these researchers was Dr. Hamid Custovic, a professor of Agricultural Sciences at Sarajevo University.

In 1991, Dr. Custovic had been commissioned to run several experiments to determine whether it was safe to plant crops on coal ash disposal sites capped with a layer of soil. These experiments were prepared at Drežnik, a disposal site that belonged to Thermoelekrtrana Tuzla (TEP Tuzla) in the city of Tuzla, in the Northeast of Bosnia and Herzegovina. At that time, TEP Tuzla was one of the pillars of the Bosnian economy, with a significant share of electricity production in the country (see Chapter 3 for more details). Local protests regarding the dispersion of coal ash into local communities had prompted the establishment of a soil cover to cap older coal ash disposal sites, and the industry was interested in knowing whether and how those sites could be re-cultivated. However, the civil war in Bosnia and Herzegovina (1992-1995) interrupted the experiments, the research establishment and the normal functioning of the energy industry sector.

Dr Custovic explained this story to Professor Walter Wenzel, from the Department of Soil Sciences at BOKU (University of Natural Resources and Applied Life Sciences of Vienna). This prompted Prof. Wenzel’s visit to Bosnia and Herzegovina, giving the Bosnian researchers an opportunity to explain to him the problem of coal ash pollution and also their own problems as researchers with limited resources and infrastructure. These visits resulted in the development of a research proposal with the objective of bringing together a consortium that could help the Bosnian partners to strengthen their research capacity. The problem of the remediation of coal ash disposal sites appeared to be ideally suited to bringing the consortium together. A proposal was submitted to the EU 5th Framework Programme, but it was not accepted. A new team was assembled together and a second proposal was submitted with the remit of developing solutions for the reintegration of coal ash disposal sites in the western Balkans. Researchers were brought together by a genuine concern about environmental degradation in Bosnia and Herzegovina, and the western Balkans more generally, and the aim of solving a ‘real life problem’, coal ash pollution, by testing environmental technologies at a field scale. One of the innovations included in the second proposal was an element of social research. Prof. Wenzel invited Paul Tabbush from Forest Research to develop the social research component in the proposal after meeting him at an unrelated meeting for another land use project.

The initial meeting in February 2005 brought all the partners to the coal ash disposal sites in Tuzla, the proposed experimental site (See Table 1-2). In April 2005 the partners met again in Tuzla to carry out the first experiments and soil sampling. From then on, the consortium met twice a year until the final project meeting in November 2007, the date of the final meeting of the project. Some partners sharing responsibilities for deliverables met independently to complete shared tasks.

In the first year, the consortium developed a preliminary risk assessment for the disposal sites. During the second and third year, different potential low-cost solutions for re-generation were tested including: the addition of a soil cap; the addition of organic amendments; the cultivation of different varieties of crops on the disposal sites; the establishment of alternative crop rotation systems; the design of wind barriers; the optimum design for a station for the mechanical filtration of water; and the development of a phyto-remediation system. In parallel, Forest Research delivered the following outputs: a stakeholder analysis; a compilation of urgent problems; an evaluation of the local demands on the management of the disposal sites; a economic appraisal of the solutions proposed; a socio-economic evaluation of the suitability, feasibility and acceptability of the solutions; and tools to help decision-makers select different re-generation solutions. In July 2007, Forest Research organised a stakeholder workshop in Tuzla, during which RECOAL researchers presented the available results to different actors, including municipal and
regional institutions, the University, local residents and environmental NGOs. On the same day, HEIS organised a press conference to publicise the project.

<table>
<thead>
<tr>
<th>Partner</th>
<th>Country</th>
<th>RECOAL Main responsibilities</th>
</tr>
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<tbody>
<tr>
<td>University of Natural Resources and Applied Life Sciences of Vienna (BOKU)</td>
<td>Austria</td>
<td>Coordinating of the project. Testing biological water filtration methods.</td>
</tr>
<tr>
<td>Hydro-Engineering Institute of the University of Sarajevo (HEIS)</td>
<td>Bosnia and Herzegovina (Sarajevo)</td>
<td>Carrying out water analysis and mechanical filtration experiments.</td>
</tr>
<tr>
<td>University of Banja Luka (UBAL)</td>
<td>Bosnia and Herzegovina (Banja Luka)</td>
<td>Developing agricultural experimental fields on the sites.</td>
</tr>
<tr>
<td>University of Zagreb (FAZ)</td>
<td>Croatia</td>
<td>Developing greenhouse experiments. Providing expertise on crop rotations and wind barriers solutions.</td>
</tr>
<tr>
<td>Brandenburg University of Technology at Cottbus (BTUC)</td>
<td>Germany</td>
<td>Completing the risk assessment. Carrying out experiments to test soil and amendments.</td>
</tr>
<tr>
<td>Forest Research (FR)</td>
<td>United Kingdom</td>
<td>Carrying out social research to establish social and economic demands on the sites.</td>
</tr>
</tbody>
</table>

Table 1-2: List of RECOAL partners

The final output of RECOAL was called the ‘Handbook of Re-generation Solutions for Coal Ash Disposal Sites in the western Balkans’. This handbook was conceived as a public output that could be read by an audience including policy-makers and industry managers but also NGOs, local organisations and local residents interested in this particular issue. The handbook included procedures that could be followed across the western Balkans but focused on the case-study of TEP’s coal ash disposal sites in Tuzla. At the time of writing (January 2009), the ‘handbook’ is being translated into Bosnian for its dissemination among local stakeholders. The legacy of RECOAL, in Tuzla and elsewhere, is expected to be heavily influenced by how the handbook is received among local actors.

1.2. Structure of the thesis

This thesis does not offer a complete account of what happened in RECOAL, that is, the development of the project, the evolution of its arguments, or the power struggles between different members of the project. On the other hand, this thesis is not exclusively concerned with the perspectives of local actors and how their lives are affected by coal ash pollution. Instead, this thesis explores the grey area where the concerns of RECOAL researchers and the concerns of local actors intersect. Rather than defending any position from a moralistic point of view – trying to impose a view of what RECOAL researchers or local residents should do – I attempt to describe how different perspectives interact.
These perspectives are explored from a social constructionist perspective. This approach is elaborated upon in Chapter 2. In particular, Chapter 2 explains social constructionism within the sociology of environmental problems were environmental problems can be understood as claims-making activities to assert the presence of an alleged condition in society, in this case, the pollution. The chapter traces some of the roots of this perspective in the Symbolic Interactionism literature, and moves onto explaining how it has been applied in some studies of environmental problems. The second part of Chapter 2 explores social constructionist views on science and society, which inform the rest of the thesis.

The case-study is explored in detail in Chapter 3. I begin by reviewing the technical, economic and political context of coal ash pollution in Bosnia and Herzegovina in general and then focus specifically in Tuzla. In particular, Chapter 3 outlines the perception of coal energy as the economic engine of Bosnia and Herzegovina; the technologies available to the coal industry in Bosnia and Herzegovina; and the contradictions of a political system in transition, that seems to have moved little forward from the Dayton Agreement that ended the Bosnian armed conflicts in 1995. Chapter 4 reviews the methodology applied during this research, including the research methods and the ethical problems faced by the researcher in exploring a 'real-life problem'.

Research results are presented and discussed in Chapters 5, 6, 7 and 8. Chapter 5 focuses on the emergence of different ‘performed identities’ among local residents around the coal ash disposal sites in Tuzla. The analysis reviews different reactions to the coal ash pollution among local residents in Tuzla. Chapter 6 explores the emergence of pollution beliefs among local residents, and how they compare with the tacit understanding of pollution shared by researchers within RECOAL. Chapter 7 moves from symbolic differences into the practice of risk assessment, explaining how RECOAL researchers have developed such assessment and how this compares with the ways in which local residents identify and manage risks they identify associated with the coal ash disposal sites. Finally, Chapter 8 reviews the expectations of different actors within the project, and the way in which these expectations were dealt with within RECOAL.

The concluding chapter, Chapter 9, brings together the argument and reviews some potential implications for the development of land regeneration projects.
2. Contributions of Social Constructionism to the Understanding of Environmental Problems

2.1. Introduction

Social constructionism assumes that the natural environment is subject to multiple interpretations. Sometimes these interpretations differ, causing conflicts among the actors that hold them. This approach has been developed separately within the fields of sociology of scientific knowledge and sociology of social problems, reaching slightly different positions. This thesis adopts the perspective of social problems, because it is considered to be a more pragmatic standpoint (Burningham, 1996). However, the approach adopted within the sociology of scientific knowledge has also influenced this thesis, because of its discussions about the nature of knowledge and expertise and its relationship with the use of knowledge in policy and decision-making processes, and thus, it will be developed further in Section 2.3.

The sociology of social problems builds largely on the sociological tradition of Symbolic Interactionism (SI) and the studies of social psychology by George Herbert Mead. Although within this thesis there is no room for a full account of the diverse SI literature, some of its principles need to be outlined before going on to describe the fundamental tenets of the sociology of social problems.

According to Blumer (1998 [1969]) symbolic interactionist scholars share three premises: (1) human beings act toward things on the basis of the meanings ascribed to these things; (2) things' meaning is derived from social interaction between individuals; and (3) these meanings are modified through an ongoing, changeable, interpretative process. Sociology handbooks often summarise this approach in W.I. Thomas' phrase: "If men [sic] define situations as real, they are real in their consequences" (cited in Janowitz, 1966). However, according to SI analysis, this is not a relativist approach; rather, Blumer describes SI as a 'down-to-earth' approach to the study of human group life and human conduct. Accordingly, SI:

"...lodges its problems in this natural world, conducts its studies in it, and derives its interpretations from such naturalistic studies." (Blumer, 1998 [1969], p. 47)

According to Blumer, to study how individuals ascribe meaning to objects, SI aims at understanding such objects as the actors see them. Thus, the approach avoids engaging with claims about objectivity of the research or building the research upon a single theory as sufficient equipment to study an unfamiliar topic. The understanding of meaning and social interaction is derived from the observation of social actions. In this context, organisations are regarded as arrangements of people interlinked by their respective actions, that is, SI avoids representing organisations as single entities operating with their own dynamics.

The objective of this chapter is to review the theory of social constructionism and explore some of the contributions of this theory to an understanding of environmental problems and the generation of environmental knowledge. Section 2.2 reviews the application of social constructionism in the environmental sciences explaining the origins of social constructionism within the sociology of social problems and exploring its application to the study of environmental issues. Section 2.3 outlines some of the principles of social constructionism within the Sociology of Scientific Knowledge (SSK) and Science and Technology Studies (STS). In particular, the section looks at the relationship between science and policy and explores contemporary theories of the role of the expert in environmental decision-making. Section 2.4 discusses co-constructionism, a theory that aims to integrate constructionist and critical realist approaches to understand environmental problems. Section 2.5 summarises the main ideas presented in this chapter.
2.2. Social constructionism and the environment

Constructionism (or constructivism) is a confusing term; there is little consensus or rationale about the terminology used (Burningham, 1998); some social scientists avoid these terms focusing on 'social constructions', adding new terminology. This thesis adopts the term 'constructionism', although 'constructivism' may be mentioned in quotes from other authors. The following section explains the beginnings of social constructionist theory and reviews critically some of its applications to the study of environmental problems.

2.2.1. The social construction of social problems

The term "social construction" emerged as a response to some problems found in the sociology of social problems. Following functionalist approaches to sociology, social problems were regarded as 'identifiable objective conditions' of society that pre-existed sociological analysis. Blumer (1971) challenged this definition of social problems in three areas:

- the inability of sociological theory to precede society in the identification of social problems;
- the lack of consensus about what were or which were identifiable objective conditions in society; and
- the ineffectiveness of sociologists in solving social problems which they attempted to solve by "removing themselves from the society itself", imagining themselves as observers of objective conditions without realising that they also participate in the collective process of social problem definition (Blumer, 1971; p. 301).

Instead, social problems are unpredictable and they refer to issues which are culturally and temporally 'relative' (Mauss, 1975). The process by which social problems are defined is entirely social (Spector and Kitsuse, 1977). To find objective conditions, sociologists (in particular the functionalist school) needed to define an 'ideal' status quo in which social problems existed (Spector and Kitsuse, 1977). Spector and Kitsuse concluded that conditions were identified only within a "moral definite universe" that was itself the product of social definition (Spector and Kitsuse, 1977; p. 43). Hence, social problems could be better regarded as "products of a process of collective definition" (Blumer, 1971; p 298).

Another important influence in constructionism was "Labelling theory", which characterised deviance as a reaction to social controls. Constructionism adopted some of the fundamental insights of labelling theory, namely the independence of meaning from the objects to which it is attached within a cultural group (Schneider, 1985) and the recognition of the sociologist as another member of society who participates in the definition of social problems, instead of being an independent observer (Spector and Kitsuse, 1977). Constructionists differentiated themselves from labelling theory by focusing on the political and historical quality of collective definitional processes; and by rejecting the image of deviants as "helpless, hapless" victims (Schneider, 1985; p 226).

Spector and Kitsuse define social problems as "the activities of individuals or groups making assertions of grievances and claims with respect to some putative conditions" (1977; p. 75). This definition has two main implications:

- Social problems are activities of the members of the society, rather than 'objective conditions' in a static form to be discovered by the sociologist; and
- Social problems are built by claiming a condition that may or may not exist in the society.
Therefore, sociological questions should focus on the origin of the definition of social problems instead of trying to identify the 'objective conditions' in society that presumably define a social problem. The sociological environment is the product of the society "with the totality of its socio-cultural and psychological formations" (Berger and Luckmann, 1966: p. 51). If activities are claims-making, i.e. complaints and demands for the relief of an activity perceived as offensive (Spector and Kitsuse, 1977), a sociologist may ask questions such as:

- Who makes the claim? How is the claim constructed?
- What is the relationship between those who 'make' a claim and those who 'receive' it?

Spector and Kitsuse regarded value explanations to social problems as insufficient. Explaining claims-making activities in terms of values and culture is compromised by the tautology between the values and the activities that they are meant to explain, and avoids solving the empirical issues posed by questions like those above (Spector and Kitsuse, 1977). Note that social constructionism assumes both that (a) a condition may exist without being claimed; and (b) a claim can be made without the condition being present. In any case, the sociology of social problems aims at developing a theory of claims-making activities, rather than a theory of existing conditions within society.

What then is the role of values in the definition of social problems? Spector and Kitsuse used the concept of 'vocabularies of motive' (Mills, 1940) to answer this question. Mills (1940) stated that motives are responses given to questions about conduct in anticipation of the consequences to this conduct. They are words that stand for justifications of 'present, future or past' actions or programs of action. They do not originate within individuals, but from the context in which they develop their actions. In the light of this theory, values are regarded as motives. Motives explain and support claims, complaints or demands of individuals or social groups (Spector and Kitsuse, 1977). While values serve individuals to explain their claims-making activities in terms of the anticipated social responses to their claims, they do not explain how social problems come to be defined as such.

Instead, claims-making activities are best defined by studying the 'natural history of social problems', that is, their origins, their evolution and their interrelationships with other social problems (Spector and Kitsuse, 1977). Blumer (1971) also proposes a similar way to study social problems and Berger and Luckman (1966) refer to the history of human institutions and habits. The concept is heuristic and directs attention to loose similarities across cases (Schneider, 1985).

Constructionism was claimed not just as another view in the sociology of social problems but rather as a new approach for sociology (Schneider, 1985). Schneider classified empirical problems under a constructionist view in five main categories: containing trouble and avoiding problems; the creation, ownership and processing of problems; public regulatory bureaucracies and legal institutions; problems and troubles in a medical environment; and social problems and the media (Schneider, 1985). Thus, social constructionism came to be understood as the main theory explaining the emergence of social concerns. However, this thesis is concerned not only with how claims are made, but also how some particular claims become dominant in a particular context and how this affects different groups of individuals.

The work of W.I. Thomas can be used as a stepping stone to explore this question. Thomas is widely considered to be within the S.I. tradition, but the scope of his work extends beyond S.I. to other fields such as ethnography and institutional theory. His concept of 'definition of the situation' (Thomas, 1923) was developed to explain why individuals or groups of individuals may be 'unadjusted' to the 'normal' context in which they live. He was particularly concerned about the ability of individuals to make decisions 'from within'
rather than having them imposed by a set of social circumstances. According to Thomas, a ‘definition of the situation’ precedes any action. This is not restricted to concrete acts, but rather, it may develop in a series of ‘habits’ that determine behaviour. He argued that some individuals fail to adjust to social conventions because of the rivalry between individual definitions of the situation and collective, or normal, definitions of the situation. He explained that:

"Morality is thus the generally accepted definition of the situation, whether expressed in public opinion and the unwritten law, in a formal legal code, or in religious commandments or prohibitions." (Thomas, 1923; p. 43)

Thus, unadjusted individuals deviate from this collective morality. Although Thomas adopted a social psychological approach by grounding his study in individual cases, this thesis adopts a broader approach by considering whether alternative definitions of the situation may emerge among a social group, thus challenging the generally accepted definition of the situation. Conflicts may arise between competing definitions of the situation, although not all definitions are able to establish a collective morality.

Thomas’ theory anticipated social constructionism by recognising a plurality of perspectives to explain social phenomena. While social constructionism looks at how such perspectives are constructed, the definition of the situation offers an explanation of why some perspectives acquire more prominence in society than others and establish collective meanings in the form of formal and informal institutions that regulate the behaviour of individuals.

2.2.2. Social constructionism and environmental sociology

Newby (1991) argued that sociology had not had a prominent role in the debate about the environment because of the existence of “two cultures”. He argued that on the one hand the environment has been perceived “as a matter on which only natural scientists can form authoritative judgements” (p. 1) and on the other, sociology has failed in making significant contributions to the debates due to the barriers imposed by their own discipline (Newby, 1991). These perceived shortcomings led some sociologist in the early 1980s to claim that sociology was excessively anthropocentric and needed to recognise the limits to growth imposed by nature (e.g. Catton and Dunlap, 1980). The sub-discipline of environmental sociology has grown since, partly as a response to these concerns.

However, more recent work has shown that the inclusion of ecological considerations into sociology does not necessarily involve moving away from the foundations of the discipline. Some social constructionist thinkers have challenged our understanding of the relationship between humans and the environment. Pollution, degradation and loss of resources or health risks are common environmental issues. Environmentalists and other social groups allege that environmental issues are undesirable or unresolved situations in society to which solutions must be provided. Environmental issues (problems) can be considered social problems: the claims-making actions of social groups and individuals with respect to a putative condition, the degradation of the environment. The following issues indicate that environmental problems may be considered as socially constructed:

- In the first place, the putative conditions to which environmental problems occur are induced by human societies; when similar problems occur in nature, independently of human action, they are not called environmental problems but natural catastrophes, and they are likely to receive different responses from human societies.
- Second, environmental problems are described using terms which are not clearly defined due to their complexity or the lack of consensus about their meaning. For instance, biodiversity loss has different meanings: it can mean the loss of gene pool
material, loss of species, or loss of ecosystems. The relationship between biodiversity and ecosystems is also unclear (Ghilarov, 2000).

- Third, scientists' perspectives vary within and across different disciplines (e.g. Hart and Victor, 1993). A divergence in theories to explain environmental issues are common, for instance in both social sciences and environmental policy (Burningham and O'Brien, 1994). This typically results in different accounts of environmental problems.

- Fourth, environmental problems need solutions, mainly from the policy sphere of society. The term "environmental problems" has normative implications in itself (Bird, 1987).

- Fifth, claimants of an environmental problem tend to have different opinions on what the origins of environmental problems are and which solutions are the most appropriate. The politics involved in its management are multi-faceted (Taylor and Buttel, 1992). Claimants select the concrete characteristics of the environment that support their claims (Burningham and O'Brien, 1994).

- Finally, putative conditions need to be defined. Returning to the concept of biodiversity, this word was first used in 1986 by E.O. Wilson. Before his work, few people were interested in the diversity of forms of life. Therefore, it needed the definition [or construction] of a concept to identify an environmental problem: the preservation of that biodiversity.

The concept of 'natural history' has been borrowed from the natural sciences to establish methodologies for the study of social problems. Blumer's (1971) model of the 'natural history' of social problems has five stages: the emergence or definition of social problems, the legitimization of social problems, the mobilization of action, the formulation of an official plan of action and the implementation of the official plan. Spector and Kitsuse (1977) enlarged upon this natural history model. The five stages of Blumer are combined in two stages: an initial one, when the claim is made and public debate arises, and a second stage, when the claim is recognised by the authorities and some responses are drawn.

Spector and Kitsuse add two further stages. Stage three accounts for the moment in which the claim re-emerges, and is readopted by its claimants (Spector and Kitsuse, 1977). Instead of directing their actions against the initial putative conditions (like in Stage one), in Stage three claimants focus their criticisms on the inadequacy of the response. Stage four entails the moment in which the responses to the problem are diversified. Claimants perceive that it is no longer possible to work within the system and take proactive action to solve their own claims. In doing so they challenge the legitimacy of existing institutions (Spector and Kitsuse, 1977). This stage involves the creation of new institutions either to influence existing ones or to create alternative solutions for its members. In the terrain of environmental problems, an example of the former are most environmental NGOs that lobby for governmental action; an example of the latter are conservation activities taken by these NGOs or the creation of cooperatives of consumers that control the safety of the agricultural products they consume.

Natural history models give us an insight into how environmental problems have developed, or how they have been socially constructed. However, two main criticisms have been raised against this model (Hilgartner and Bosk, 1988; p. 54). First, the model is criticised for not acknowledging that social problems do not necessarily develop in a linear succession of stages. Second, the model studies social problems in isolation, which does not reflect the importance of the interactions between the processes of definition of several social problems in the same space and time frame. Hilgartner and Bosk explain that public attention is scarce and hence, 'social problems compete for societal attention' (p. 55).
Thus, social problems should be studied in relation to other social problems, taking into account the institutionalized system of collective definition of social problems.

To overcome these issues Hilgartner and Bosk propose a different model which they call ‘the public arenas’ model of social problems definition. Social problems are defined in arenas of public discourse where the problem must be claimed. Each arena has a carrying capacity. For instance, some argue that environmental problems are not at the top of the agenda of public institutions when they are dealing with an economic crisis. Or in a newspaper, environmental problems may compete with other stories that are thought to be more pressing or more popular. Hilgartner and Bosk explain that competition between the definitions of problems occurs at two levels:

- Between different types of problems due to the limitations of the arenas (for instance environmental problems may compete with other problems such as crime or public health).
- Between the different interpretations of a social problem (for instance climate change may be regarded as a product of human consumption of fuel or alternatively as the product of natural climate dynamics).

According to Hilgarner and Bosk, few problems succeed in maintaining a high level of public attention. They highlight that the ‘drama’ of the problem helps maintaining the public interest in these problems.

Both models give us an idea of the dynamics of environmental problems. Whereas the Natural History Model puts emphasis on the contextualisation of the problem, the Public Arenas Model presents a more institutionalised framework, focusing on the interaction between problems. Both these models can be used to illuminate the construction of environmental problems. Hannigan identifies three main tasks in this construction: assembling, presenting and contesting environmental claims (Hannigan, 1995):

- Assembling: the initial stage in the construction of the environmental problem concerns the initial elaboration of the incipient problem, in which this must be named, delimited and contextualised in terms of the scientific, technical, legal and moral basis for the claim.
- Presenting: Environmental claims must be well presented in the corresponding arenas, in order for their successful competition with other problems or with other interpretations of the data that enable the definition of an environmental problem. To set political and media attention, the environmental problem needs to be presented in a dramatic fashion; legitimisation of the environmental problem will depend on its presentation, influenced by cultural and political factors. For instance, some NGOs have been successful in developing a high profile for environmental issues occurring in remote areas by campaigning (Yearley, 1991).
- Contesting: If the environmental claim achieves legitimacy, institutional answers to the problem may be produced. In some cases, the environmental claim may be transformed into a less threatening political issue, for instance, by dissociating the environmental problem from other issues such as poverty or inequality. Thus, claim-makers may feel compelled to engage in political or legal actions to contest institutionalised definitions of the problem.

Although these models of environmental problems have had considerable influence, alternative social constructionist methods have been developed to study environmental problems within the social context focusing on the particular issues emerging within their case study. The following section reviews the evidence of empirical studies about social responses to pollution.
2.2.3. Individual and collective responses to environmental pollution

How environmental problems are defined has important practical consequences. For instance, conferring different meanings to nature and landscapes implies that there will be different strategies used by humans to relate to these elements. An environmental change may be perceived as an improvement by one cultural group and as a threat by another. Furthermore, how the environmental problem is constructed will depend on the categorisation used to analyse both the landscape and nature. Landscape or nature modifications may challenge the very basic set of interpretations that defines one person’s interaction with their environment, and therefore their self definition (Greider and Garkovich, 1994; Relph, 1976).

In her study about lead pollution in Broken Hill, McGee (1999) found that, after identifying an environmental problem and the hazards associated with it, local residents took little proactive action. Most of the responses were taken privately and activism was reduced to collaborations in exposure management (McGee, 1999). McGee found some factors underlying these responses such as disagreements over the nature and the extent of the pollution and the stigmatisation of individuals by their own community. One important factor determining the local responses to pollution in that case study was the relationship between the industry producing the pollution and the community suffering it. In Broken Hill the mine causing pollution provided jobs to the community, which limited collective action. These findings are related to what has been labelled ‘chronic syndrome’, a feature found in communities that suffer the pollution caused by a polluter while depending economically on it (Wynne, 1996). Another factor in the Broken Hill study was the isolation of the community from social institutions were their concerns could be heard and acted upon (McGee, 1999). Individuals affected by residential pollution frequently report isolation (Aronoff and Gunter, 1992), especially when both corporations and authorities share the responsibility for the pollution (Capek, 1993). In Broken Hill isolation fostered independence among local residents who adopted private methods of coping with the pollution (McGee, 1999). These findings support the observation that residents of communities facing chronic disasters are likely to exhibit a ‘frontier individualism’ that works against collective action (Kroll-Smith and Couch, 1985 cited in McGee, 1999; p 76).

However, other studies in resident pollution show that victims of pollution may form a social movement after being ignored or stigmatised by external actors (Capek, 1993). Antitoxic activists ask responses from governments and corporations such as to have accurate information about the situation, demand the possibility of presenting their case to the society in a respectful and unbiased hearing, and claim their right to participate in the decision-making process about the future of the community (Capek, 1993). Edelstein, for instance, found that residents may begin with a simple (and dismissed) Not In My Back Yard (NIMBY) claim, a simple form of local opposition that could evolve into large networks with other concerned groups of the public. Social learning and consensus transform the claim to a “not in anybody’s backyard” (Edelstein, 2004; p. 275), which in turn may result in a claim to change a whole society that has stigmatised a community through pollution. Collective action is an important tool in defining and solving the pollution problem.

Defining a situation as unjust is a vocabulary of motive: it defines a plan for action. For example, environmental justice is frequently claimed in the aftermath of an environmental problem (Bullard and Johnson, 2000; Roberts and Toffolon-Weiss, 2001; Shrader-Frechette, 2002). While studying a toxic contamination incident, environmental justice is founded on the notion that powerful social actors have appropriated the rights of the victims of toxic contamination and “justice resides in the return of these rights” (Capek, 1993; p. 8). Victims feel their rights violated by the level of pollution itself, the lack of reaction to the incident and the perception of themselves as second class citizens (Capek, 1993). Victims gain ‘environmental justice’ when their problem is recognised by the wider
society and when they acquire the right to democratically influence decisions about their future (Capek, 1992).

Environmental protests are, therefore, not only about the putative conditions that the claimants refer to (the environmental pollution) but also about other social factors that interact with the conditions as such. Environmental problems are not only associated with issues in the natural world, but also with other struggles of our current societies, such as economic crises, political processes, social inequality and injustice (Yearley, 1991). Environmental problems may have the legitimacy that other claims lack; therefore claiming environmental problems may advance solutions to problems drawn by other agendas (Capek, 1992). Environmental protests may thus become forces for social change, or "eco-social change" (Edelstein, 2004; p. 279).

Gaining recognition is a difficult step for a pollution problem. A pollution problem requires the social identification of a condition, the pollution. This identification is not a trivial thing. The literature exposes some of the factors that prevent communities from identifying the condition of residential pollution, such as the amorphous and invisible nature of chemical exposure; the difficulties, even for so-called experts, in diagnosing its presence and consequences; the reassurances (if present) by industry or local authorities about the safety of the area affected; or personal circumstances, such as the pride of ownership of a contaminated land parcel (Capek, 1993). There are several types of local 'knowledges' that may contribute to the construction of an environmental pollution claim such as direct observation of working practices, observations of health and environmental disorders, comparison with other sites, testimonies of local workers and systematic data collection (Irwin, 1995). People use their own contextual knowledge to assess the credibility of experts' claims (Yearley, 2005).

Social constructionist studies have shown the importance of discourses in assembling and presenting an environmental problem. For example, in her study of the noise pollution problem from new roads in the South of England, Burningham (1996) showed how local residents employed rhetorical tools to assert the social impacts of noise pollution. According to her analysis, local residents presented themselves as victims of the development, which was portrayed as having a strong moral component of unfairness. Interviewees represented their powerlessness by showing how the development had affected multiple aspects of their everyday life. In this way, she argued, residents were not merely submissive and frustrated victims: they were active participants in the dispute. Simultaneously residents establish a divide between 'them' (those who cause the impacts) and 'us' (those who suffer them). While technicians and planners construct the developing problems as merely technical issues, the public would frame them in moral and political terms. The work of Burningham also explores local residents' accounts of health risks following the literature on 'lay epidemiology'.

The concept of 'lay epidemiology' refers to the observation that 'epidemiology' has "identifiable counterparts in the thoughts and activities outside the formal medical community" (Davison et al., 1991; p. 6). Indeed, 'lay epidemiology' research has shown that non-expert accounts of health and the environment can be coherent and logical while providing a narrative of the relationship between illness and the individual's perception of her or his place in the world (Williams and Popay, 1994). According to Williams and Popay, lay epidemiology poses a direct threat to health experts because what is commonly perceived as a private problem (e.g. the health of the individual) is transformed into a public problem (e.g. the health of the community). Lay epidemiology offers the tools to develop a critique of the manner in which health risks are conceptualised and measured (Ibid.). The role of science in society is questioned:
"Popular epidemiology is not anti-scientific. Rather, it has a different concept of what science is, whom should it serve, and who should control it." (Brown, 1987; p. 83)

Social constructionism has provided numerous empirical and theoretical evidence of the need to re-examine the relationship between science and society, which will be explored further in Section 2.3. Yet, thinkers adopting a realist position have provided strong criticisms of constructionism, particularly towards constructionist critiques of science and knowledge. In the last years, this debate has lost echo and relevance. However, to understand the development of the social constructionist perspective in environmental sociology since the 1990s this debate needs to be explained.

### 2.2.4. The realist-constructionist debate

Critical realism offers a perspective on environmental problems as the result of intense and complex interactions between humans and nature. Critical realism relates the causes of environmental degradation to the same factors that cause social problems and inequalities. Some important critical realist perspectives are:

- **Social ecology and eco-socialism**: these different perspectives conceptualise environmental problems as the result of differences in power between humans that result in the oppression and exploitation of both, the environment and less powerful groups in society (e.g. Dickens, 1997).

- **Eco-feminism**: eco-feminists combine feminism and environmental sociology and conclude that humans are separated from nature due to the patriarchal organisation of society (e.g. Gaard, 2001).

These critical realist perspectives are not mutually exclusive. For instance, both eco-feminism and eco-socialism draw on Marxist thinking and recognise the importance of constructionism in understanding meanings and knowledge. The starting point of eco-socialism is the combination of questions of social and environmental justice. Dickens, for example, contends not only that environmental degradation disproportionately affects those suffering social injustices (or those who have fewer resources) but also that social injustice is the very cause of environmental degradation (Dickens, 1997).

Some realists warn against the dangers of the 'constructivist myopia' (Murphy, 1994). Environmental realists criticised social constructionism for two reasons: (1) the failure of social constructionism to accept the fundamental reality of environmental problems and (2) the 'lack of morality' of social constructionism, because by denying the reality of environmental problems it prevents political action and social change (see description in Burningham and Cooper, 1999). However, criticism has been often directed at simplified or caricatured versions of social constructionism. Critics tend to ignore that constructionism is a perspective which may take very different approaches (Burningham and Cooper, 1999). The existence of different approaches has been labelled as the 'constructivist strategy of ambiguity' (Murphy, 1994; p. 967), but this argument seems to imply that all constructionist scientists hold a common strategy, while it is more likely that scientists hold different theories and arguments that stimulate scientific evolution.

Constructionist approaches can be classified into mild and radical constructionism (Sismondo, 1993) or into contextual and strict constructionism (Best, 1989). Here, they are examined as helpful orientations of different approaches rather than strict classifications into which every social constructionist sociologist should fit. Mild constructionist approaches focus on the social processes involved in the development of institutions and knowledge (Sismondo, 1993). At the other extreme of the spectrum is radical constructionism, doubting any reality beyond that of social constructions. For instance, Bird (1987) claims that there are multiple realities or cultural representations of encounters
in which meaning is negotiated and translated. The division between mild and radical constructionism is similar to the distinction between contextual and strict constructionism employed in the sociology of social problems.

The criticism that constructionism denies reality does not apply to those authors who defend any form of mild or contextual constructionism, which constitute the 'backbone of constructivist science studies' (Sismondo, 1993). The dominance of mild approaches in the social constructionism empirical work is commonly overlooked by its critics (Burningham and Cooper, 1999). Instead critics freely equate constructionism and relativism (e.g. Murphy, 1994). Mild approaches interact with other sociological stances, commonly resulting in a variety of pseudo-realist approaches. For instance, Aronoff and Gunter (1992) aim to integrate constructionist and structural elements of the problem of a community recovering from a chemical pollution disaster. Seale (1998) proposes the use of 'subtle realism': he considers that language constructs new worlds while referring to a reality 'outside the text' (Seale, 1999; p. 470). Some of these views have been translated into co-constructionism, which recognizes both the social construction of nature and the natural construction of society; i.e. society and nature construct each other (see Section 2.4).

Burningham and Cooper argue that even when an author does not account for reality, this does not mean that reality is denied. They argue that the strict constructionist perspective is not an ontological claim about the non-existence of reality but rather a radical scepticism about any ontological claim (Burningham and Cooper, 1999). This echoes the approach of Spector and Kitsuse (1978) who emphasised that the study of social problems should focus on claims-making activities about a condition, and not about whether such conditions exist or not in society.

By distinguishing between existence and meaning, constructionists are able to formulate and answer different questions (Burningham and Cooper, 1999). Some social constructionists assert the primacy of the meaning over the material (e.g. Greider and Garkovich, 1994) but they rarely go further in making ontological claims. Instead social constructionists remain ontologically agnostic. In terms of ethics and politics, constructionism gives room to different accounts of reality which can be useful, for instance, in cases in which scientific evidence is vague and uncertain (Burningham and Cooper, 1999).

Sismondo (1993) analyses the work of Steve Woolgar and concludes that Woolgar is a radical constructionist. Since objects are inaccessible without representation, Woolgar assumes that the natural world is constructed by scientific knowledge, rather than scientific facts being built as reflections of the natural world (Sismondo, 1993). Woolgar says that since this radical constructionist interpretation is heuristic, it is more plausible than an ontological realist one. This position approaches relativism. Realists warn against its risks: “If relativism is accepted, then the logical requirements of sociology can not be satisfied, and sociology itself is impossible” (Murphy, 1994; p. 691).

Valuable lessons can be learned from realist critics. Realists rightly point out that under constructionism, constructionist accounts become social constructions (Murphy, 1994). This, far from questioning the validity of social constructionism [as some critics may imply], reinforces it. The authors of a provocative book about environmental discourses write:

“To take an interest in how pistons, cylinders, connecting rods and wheels sustain and make possible travel by train is not to mount an attack on trains” (Harré et al., 1999; p. 3).

To analyse the history and context of a particular scientific account does not necessarily question it; it explains it. For instance, accounts of environmental problems traditionally
disregarded by some institutions, such as radical environmental perspectives, may be taken into account under a constructionist perspective.

Reflecting on scientific practice may go beyond sociology, since (as discussed in the works of Latour and Woolgar and Knorr-Cetina) science depends on scientists' interpretations of facts. These interpretations occur in a given socio-historical situation. This opinion, rather than undermining the validity of science, questions a common conception of knowledge based in absolute and static foundations— a conception labelled as naïve realism (Irwin, 2001b; Hammersley and Atkinson, 1995).

It is important to note that some criticisms of constructionism are directed not towards the approach of constructionism and its empirical applications but rather focus on philosophical approaches which may only indirectly relate to the sociological work. For instance, it is generally assumed that postmodernism has inspired constructionism and constructionism has also been linked to relativism. As Burningham and Cooper explain, constructionism is not aimed at developing a theory of reality but rather it attempts to give new responses to the field of sociological inquiry.

It has even been argued that scholars should go beyond social constructionism by taking apart the debate between realism and relativism (Woodgate and Redclift, 1998). For instance, co-constructionists (see Section 2.4) contend that both realist and constructionist are closer than they are willing to admit, since both approaches share the acceptance of the dichotomy between the social and the natural (Macnaghten and Urry, 1998). Debates like this contribute to a critical appraisal of the adequacy of social constructionism to explain environmental issues (Sutton, 2004). Ultimately, the empirical applications of social constructionism have shown that this perspective has the potential to contribute to a better understanding of social problems in their political, historical and sociological context.

Realist perspectives approach the environment as a given entity separated from society to which cultural groups adapt their practices. Social constructionists, on the other hand, affirm that meanings are not inherent but conferred by humans to things. Landscapes and nature are, therefore, meaningful for human societies as long as they are "grounded in cultural symbols" (Greider and Garkovich, 1994; p. 4). Since those cultural symbols are variable, the interpretations of nature and landscapes will vary accordingly. For instance, humans create landscapes by defining them within a particular set of values and beliefs, making landscapes that reflect cultural identities (Rackham, 1990).

Environmental constructionists identify a close interrelation between social and environmental problems. Because narratives are built in a determined context, all the factors involved in that context influence their construction. The environment and society cannot be dissociated since they belong to the same context. To advance social change, claimants may use environmental arguments; to advance environmental change, claimants may use social equality arguments. Narratives do not have one but several layers of interpretation, and each one may serve different objectives. Thus, environmental problems are inextricably linked to social conflicts (e.g. Martinez-Alier, 2001).

Sociology has helped to realise the importance of understanding and appreciating different cultures and social structures, while questioning taken-for-granted assumptions (Best, 2003). Constructionism may act as a corrective for ignorance and misinformation in the make-up of social problems or other narratives of truth (Blumer, 1971). Constructionism is another possible mode of critique (Burningham and Cooper, 1999), a potential route for improvement, in both empirical and theoretical matters. Burningham and Cooper (1999) show that constructionism may be a positive approach in a variety of situations such as: conflicts in which all the views deserve a fair hearing; when disempowered groups are to be given a voice of their own; or when there is no consensus or conclusive solutions on the objective knowledge about a particular issue.
2.3. Social constructionism, science and policy

The constructionist perspective, in which different narratives of social life compete in the constitution of what we understand as knowledge, has posed important questions about how different understandings of environmental problems emerge. This section reviews relevant theories that explore this topic.

2.3.1. Social constructionism and the laboratory

Some realists suggest that science should be studied as 'craftwork', as an activity that requires practical skill and experience (Ravetz, 1973). Constructionists present science as a negotiation process (Bird, 1987). Scholars such as Latour and Woolgar or Bird regard scientific knowledge not as the discovery of facts about nature, but rather as consensus in the scientific world, achieved only when refuting the current theory is too costly for the researcher (Latour and Woolgar, 1986).

Sociologists of science, such as Knorr-Cetina, Woolgar or Latour, adopted constructionist perspectives to explore the process of knowledge production. They posed the question: is scientific knowledge a social construction? They were inspired by the idea that institutions, epistemologies and knowledge are heavily influenced by social forces (Sismondo, 1993). Sismondo developed a useful comparison of the work of these theorists in terms of how they regard scientific practices (Table 2-1).

<table>
<thead>
<tr>
<th></th>
<th>Knorr-Cetina, 1983</th>
<th>Latour and Woolgar, 1986</th>
</tr>
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<tbody>
<tr>
<td>Objects of Study</td>
<td>Mundane and progressive selection of the scientist’s object of study</td>
<td>Scientists’ preferences shape the operations involved in the construction of knowledge</td>
</tr>
<tr>
<td>Theory development</td>
<td>Construction of models that fit the facts associated with the phenomena:</td>
<td>Construction of patterns and conceptual order.</td>
</tr>
<tr>
<td></td>
<td>involves four phases: genesis, transformation, negotiation and transaction</td>
<td>Together with theories, specific languages and inscription devices are also constructed.</td>
</tr>
<tr>
<td>Origin of “facts”</td>
<td>“Facts” that represent the phenomena are constructed in an artificial laboratory separated from nature</td>
<td>The phenomena is entirely constructed in the laboratory - it does not exist independently</td>
</tr>
</tbody>
</table>

Table 2-1: Comparison between two works in sociology of science (adapted from Sismondo, 1993).

This line of thinking may even question the capacity of humans to access reality via knowledge (or science). For instance Bird asserts that not only scientific facts but also reality are constructed through representations (Bird, 1987); therefore our knowledge does not directly refer to the external reality to the self but only to our representation of it.

While the statement that institutions and knowledge are products of human interactions heavily influenced by social forces is relatively uncontroversial (Sismondo, 1993), some authors suggest that constructionism brings sociologists to the ‘dead end of relativism’
Constructionism accepts that our understanding of the world depends on our own disruptive actions (Bird, 1987). Knowledge is the product of the actions that we do to know the world. The role of the scientist as a knowledge producer may also be questioned. If we understand the discovery of 'knowledge' as an interaction between the researcher and the researched (Bailey, 1997), scientists become competitors to gain the 'power to name the world'. They build their knowledge on a web of socio-political interests, cultural themes and metaphors, personal interactions and professional negotiations (Bird, 1987).

Gieryn has contributed to this debate with his study of the boundaries of science (Gieryn, 1995; Gieryn, 1999). Science boundaries indicate where science finishes and society begins the boundary between science and non-science. Claiming this border also identifies scientists and scientists' practices. According to Gieryn, essentialist views on science regard science boundaries as unique, necessary and invariant, thus differentiating science from any other cultural products. He produces three examples of essentialist views on scientific boundaries: (1) Popper's understanding of science as composed of 'falsifiable' theories, that is theories that can be logically refuted; (2) Merton's demarcating science by using four ethical principles (communalism, universalism, disinterestedness, organised scepticism); and (3) Kuhn's characterisation of science limits as established by scientific consensus (susceptible to challenge by paradigm changes leading to scientific revolutions). Gieryn criticises these approaches from a social constructionist point of view: what theories are falsifiable and which are not is ultimately determined by scientists themselves, as are the experiments designed for that aim. Equally, the application of ethical norms is determined by everyday experience. Finally consensus is limited by the terms in which it is defined: rather than being understood as a collective phenomenon, consensus is better understood as a contextually contingent phenomenon.

Gieryn approaches the problem of boundaries from a constructionist perspective, thus assuming that the production of knowledge is contextually contingent and interest-driven, drawing selectively on inconsistent and ambiguous attributes. In his work, Gieryn uses cartographic metaphors: he describes himself as drawing topological metaphors in a cultural space (Gieryn, 1999). He investigates different examples of scientists' boundary-making activities (e.g. monopolisation, expansion, expulsion, protection).

Gieryn draws heavily on the Symbolic Interactionist writing of Everett Hughes on work and workplaces (Hughes, 1958). In particular, by examining 'how work is done', Hughes showed that doing the work requires the worker to adopt a meaningful representation of what the work is; thus, the work itself is a collective representational activity. This explains the emergence of 'social worlds' within groups with shared commitments to the pursuit of a common task. According to Gieryn, scientists can be regarded as sharing a 'social world', as a function of the researchers' interests and tasks. However, he also criticises the idea of 'social world' for emphasising that the negotiation of boundaries is tied to occupational interests or particular resources. Indeed, he advocates the need for social constructionism to 'move out of the lab':

"Getting constructivism out of the lab assumes that the actual practices of scientists in laboratories - and their "professional" inscriptions of nature - are surrounded by an interpretative flexibility that allows for multiple and variable accountings. Getting constructivism out of the laboratory moves science closer to places where matters of power, control and authority are settled. Constructivism is not just a stick for beating up old-fashioned epistemologies; it is as well a theoretical challenge to just-as-old sociologists - Marxism, functionalism, rational choice theory - seeking explanations at the top of that discipline agenda: uneven distributions of authority, power, control and material resources." (Gieryn, 1995; pp. 440-441)
The following section therefore looks at some constructionist analyses that do ‘move out of the lab’ by examining the relationship between science and policy.

2.3.2. The relationship between science and policy

Most of the work examining the relationship between science and policy criticises the idea that science can provide knowledge to resolve political disputes. A nuclear scientist, Weinberg (1972) stirred this debate in his essay Science and Trans-Science. Weinberg was concerned about epistemological problems in the relationship between science and society:

"Many of the issues which arise in the course of the interaction between science or technology and society — e.g., the deleterious side effects of technology, or the attempts to deal with social problems through the procedures of science — hang on the answers to questions which can be asked of science and yet which cannot be answered by science. I propose the term trans-scientific for these questions since, though they are, epistemologically speaking, questions of fact and can be stated in the language of science, they are unanswerable by science; they transcend science." (Weinberg, 1972; p. 209)

The problem identified by Weinberg is that science cannot provide an answer to Trans-Science questions because they go beyond science: they need to be answered within policy processes, either in political forums or following adversarial procedures, in court and elsewhere. The differentiation between scientific questions and trans-scientific questions (akin to Hume’s fact-value distinction) opens the door for public participation in Trans-scientific questions, but leaves untouched a core of issues with are “unambiguously in the realm of science” (Ibid.; p. 222).

Jasanoff responded to this essay by showing that establishing the boundaries between science and trans-science is not a straightforward task:

"The lines between science, policy, and the areas where the two are mixed are difficult to draw not merely because science is indeterminate, but because the effort to make such distinctions is politically charged." (Jasanoff, 1987; p. 224)

Jasanoff explains that boundary disputes between science and policy are played out in the realm of language. Knowledge claims are continually ‘constructed’ and ‘deconstructed’, as her examples of the role of scientists as expert witnesses show. Distinguishing what is purely scientific, she argues, may help protect the institutional interests of science but avoids addressing the issues of concern in policy-making. Thus, the Weinberg solution leaves the problem of the relationship between science and society unsolved. Jasanoff is concerned about the de-construction of science in the policy-making process. While this de-construction may help to open public debate about the validity of science, highlighting the indeterminacy of science weakens the ability of policy-makers to incorporate scientific claims in their decisions. Drawing on her observations about the chemical industry in the US she writes:

"The chemical industry has been aggressive in pursuing this line of attack. Its insistence on ‘good science’ and its complaints about the technical competence of the federal agencies are consistent with the broader objective of removing as much discretionary power as possible from regulators, who are viewed as captive to environmental interests. Administrators, such as Ruckelshaus’, have vacillated between these two positions, hoping, on the one hand, that scientific deliberations will lead to clean, credible resolutions of policy dilemmas, but recognizing, on the other, that such solutions are seldom within the reach of science." (Ibid.; p. 226)

3 The seminal work of Ruckelshaus in the administration of risk will be reviewed in Section 7.2.
Indeed, the uncritical inclusion of science in decision-making, characteristic of some technocratic approaches to government has been regarded as deeply undemocratic. Fischer (1990) argues that the way expert knowledge is used sustains undemocratic forms of government. Because those who held the appropriate knowledge define the constraints of the system and the solutions “little room is left for meaningful debate, let alone the free play of political interests” (Fischer, 1990; p. 15). The technocratic perspective is apolitical: it regards political processes with scepticism and thus, prescribes its replacement with knowledge-informed decisions. Technocrats regard politics as a problem, rather than as providing solutions. This view, Fischer argues, is unsympathetic to openness and equality. Instead, Fischer advocates opening up the scientific process to the incorporation of more political debate.

Fiorino (1989) argues that the prioritisation of scientific and experts’ judgements in policy-making may lead to the removal of political debate from decision-making. Instead, he argues, the increasing involvement of technical and scientific experts has led to the politicisation of expertise. This has led to a participatory dilemma, because institutions are unable to respond to greater demands for participation on decisions. Fiorino is not merely asking for more participation: he challenges current participatory models for placing emphasis on struggle and conflict. Instead, a new participation ideal can be proposed, in which power is truly shared and the public is recognised as citizens, rather than as subjects (Fiorino, 1989).

These types of arguments have led to the proposal of new models for the relationship between science and policy. The concept of ‘post-normal science’ has been highly influential particularly among scientists and engineers. ‘Post-normal science’ is proposed as a method of inquiry to be developed in situations of high uncertainty and high political stakes (Funtowicz and Ravetz, 1993). ‘Normal science’ was the term used by Kuhn to refer to ‘puzzle-solving science’ that precedes and continues after a scientific revolution, or change of paradigm (Kuhn, 1996 [1962]). Funtowicz and Ravetz document the emergence of a new type of inquiry that incorporates the contribution of an ‘extended peer community’ which, beyond actors with institutional accreditation, includes all people with an interest and a desire to participate. The role of citizens in science is described as contributing to the quality assurance process of science (Funtowicz and Strand, 2007).

Another proposal has been called ‘Mode 2’ science. Mode 2 emerges not as a normative model but rather as a response to the increasing blurring of boundaries between science and policy, between pure and applied science and the turn towards problem-solving and trans-disciplinary science (Nowotny et al., 2001). The claim is towards a shift from ‘reliable knowledge’ (as advocated by traditional science) towards ‘socially robust knowledge’ (Gibbons, 1999). This ‘socially robust knowledge’ is validated outside the laboratory by involving ‘lay experts’ (Nowotny et al., 2001). But the main feature of Mode 2 science is the situation of science in its context:

“The old image of science working autonomously will no longer suffice. Rather, a reciprocity is required in which not only the public understands how science works but, equally, science understands how its publics work.” (Gibbons, 1999; p.15)

Building upon the Mode 2 framework, Sheila Jasanoff remarks that there is a need for a change of the culture of governance, beyond increasing participation. She has proposed the implementation of ‘technologies of humility’ as habits of thought for citizen participation in governing science (Jasanoff, 2003), articulated along four focal points: framing (what is the purpose?), vulnerability (who will be hurt?), distribution (who benefits?); and learning (what do we need to know and how can we find about it?).

The need to widen the debate on science underpins all these proposals. Science does not belong to scientists alone. This is the compelling argument that Wynne and Mayer make in
their essay "How science fails the environment". Exploring how scientific uncertainty should be interpreted in government policy making, they say:

"The most important point to emerge may be that the interpretation of uncertainties in and around such scientific models has been seen as a scientific matter, for scientists alone to resolve, when actually it is a process riddled with social and political implications, and requires a wider debate." (Wynne and Mayer, 1993; p. 33)

They argue that policy can be scientifically precise by demarcating the problem in very specific terms and excluding the possibility of unforeseen events. Moreover, policy culture gives credibility to opinion when it is defined in scientific language, rather than aiming to describe human and social experiences (Ibid.).

A number of institutions have reflected on the potential for participatory methods to bridge the gap between science and policy-making. A study among scientists showed that scientists are open, able and willing to engage with the public discussion of science (Waterton et al., 2001). In the UK, the Royal Commission on Environmental Pollution (RCEP) published an influential report on Setting Environmental Standards, placing greater emphasis on transparency and openness in defining standards for environmental pollution. The report advocated the articulation of people’s values within the policy process, at the earliest stage possible in setting standards and developing policies (RCEP, 1998). They described methods such as focus groups, citizens’ jury, and deliberative polls, urging the Government to incorporate these procedures into environmental policy-making (in 2000, the Cabinet Office responded that they had already published guidance on best practice in consultation, including the methods reviewed by the report). The RCEP is a highly significant initiative, but is not unique. Indeed, the RCEP report followed the adoption of the Århus Convention in 1998, to guarantee rights to public participation in decision-making in environmental matters. The Convention guarantees three types of rights: the access to environmental information; public participation in environmental decision-making; and access to justice. The Convention has 42 parties (including Bosnia and Herzegovina since the 1st of October 2008) and is implemented in the European Union in a Council Directive.

Thus, institutional initiatives such as those described above have resulted in different participatory exercises within the European Union. For example, in 1999 the UK Centre for Economic and Environmental Development (UK CEED) organised a consensus conference on the management of radioactive waste, involving a panel of 15 citizens who considered the key issues of radioactive waste disposal over a period of several months (UKCEED, 1999). The results were disseminated in a public hearing and a ministerial report. Irwin has examined some ‘social experiments’ of scientific citizenship such as the Public Consultation Developments in the Biosciences (Irwin, 2001a) and the UK public debate on genetically modified crops ‘GM Nation’ (Irwin, 2006). He raises some practical issues about the development of engagement exercises, including: the importance of the location of the exercise; the balance of information and consultation; the influence of pre-framing the agenda on the discussions; the extent to which citizen groups can be active within the process; and the social and technical assumptions embedded in the definition of the problem. Irwin observes that citizens played an important role in the consultation “but their contribution was ultimately refracted though the research process” (Irwin, 2001a; p. 15).

Irwin has noted that public opinion itself is a social construction, emerging in a particular social context (Irwin, 2006). Thus, participatory exercises are embedded in a struggle over what counts as legitimate talk, or participation. For example, he notes that consultation exercises often pursue public consensus, and seek to involve ‘innocent’ citizens rather than activists, thus trying to move away from adversarial political debate. The aims of
participatory exercises have also been criticised. For example, Jasanoff has raised questions about the extent to which openness and transparency should be absolute goals in science, goals that, according to her, should be context specific (Jasanoff, 2006).

Irwin proposes that rather than looking for universal solutions or institutional fixes to deal with the relationship between science and society, the efforts should be directed towards developing and opening the discussion between researchers, policy-makers and citizens (Irwin, 2001a). Jasanoff explains that the rise of the information society has distributed and de-centralised knowledge: governments now need to acknowledge public knowledge. However, power institutions such as governments and corporations are struggling to establish the terms of this debate. Two key issues are relevant: the construction of boundaries of inclusion and exclusion and the terms in which the debate is framed (Jasanoff, 2004). Who is the expert, and how that expertise is constructed, becomes a central issue of discussion. The following section discusses the role of the expert in environmental decision-making.

2.3.3. The role of the expert in environmental decision-making

When taking policy actions, experts hold a privileged position. Non-experts are often regarded as lacking specialist knowledge necessary to articulate policy recommendations (Renn et al., 1993). The ordinary view is that the public hold values but not scientific knowledge, while experts use ‘systematic knowledge’, preventing the interference of values in the decision process (Renn, 2001). As a consequence, experts are key players in policy-making decisions. In contrast to the ‘expert’ knowledge of scientists, citizens hold ‘lay’ contextual knowledge.

However the relationship between experts, science and citizens may not be as straightforward as described above. Irwin (1995) identifies three issues in the application of science to environmental threats:

- there are ‘structural uncertainties’ when we confront problems which are at the very limit of our understanding and therefore simple and unambiguous responses may not be available;
- scientists operate with “underlying social assumptions and social models” (p. 106); that is, scientists’ responses are also constructed within a set of social practices; and
- scientific inquiries often treat the environment as a closed system, whereas nature and society behave as open systems.

Irwin concludes that scientific knowledge is not in opposition to contextual knowledge for, at least, two reasons: first, because contextual knowledge may be constructed in scientific terms; second, because scientific knowledge is a type of contextual knowledge in itself because scientists develop their practices within a social context (Irwin, 1995).

The relationship between expert and lay knowledge is explored in Wynne’s (1996) study of the different ways in which scientists and farmers deal with an environmental problem (here the radioactivity caused by the accident in Chernobyl in North Cumbria pastures). Wynne explains the conflict that the issue raised between farmers and scientists: while scientists relied on their culture of prediction and control, farmers “assumed predictability to be intrinsically unreliable” (p. 67). Instead of adopting the threshold levels and control measures proposed by scientists, farmers valued their adaptability and flexibility in the new context of action. In addition, scientists ignored the multidimensional complexity of the problem. The problem of radiation from radio caesium and its migration patterns within the soil and plants interacted with a multitude of socio-economic and cultural factors influencing the attitudes of farmers and local villagers (Wynne, 1996). Local control of an environmental problem is based on day-to-day observations and experiences, and characterised by its flexibility and adaptation to observed contextual variations. Wynne
cites a study of the potato farmers in Peru (van der Ploeg, 1993) to explain how scientific solutions may become “mythical” solutions in local contexts, i.e. while local solutions are grounded in every-day experience, scientific solutions are based on laboratory experiments and theories that may look esoteric (or at least confusing) in the eyes of the local population (Wynne, 1996).

The literature offers several additional examples of the difficulties experts face when viewing environmental problems in their social context. For instance, Harrison et al. (1998) explain how experts may expect to find a solution by transforming regional problems into technical or scientific problems. However, solving the technical problem does not necessarily ‘solve’ the views of the people who claim that situation as problematic (Ibid.). Moreover, expert advice is not always accepted as correct by local people (Harrison et al., 1998; Burgess et al., 2000). Instead, local knowledge can be more efficient in local contexts because it is place-specific and historically embedded (Harrison et al., 1998).

Expert knowledge can also “misread” the environmental problems and their causes. Leach and Fairhead provide an example debating a conflict between lay and expert knowledge about human-ecological interactions in the Guinean savannah. They showed that the small patches of forest were created and maintained by the agricultural practices of local villagers, instead of being relict forest remnants threatened by the locals, as scientists and policy-makers regarded them (Fairhead and Leach, 1996).

The above examples illustrate the importance of developing a self-critical attitude as an essential step in recognising the limits of knowledge and its applicability. Ravetz explains that researchers need to accept other alternative criteria:

‘…the research scientist’s criteria of quality are not the only legitimate ones in this process. However different or conflicting may be other criteria of quality, they must be taken into account, not only in the reporting of the research but even in its planning and execution.’ (Ravetz, 1973; p. 108)

Ravetz explains here the need to develop a self-critical perspective on the scientific practice acknowledging the limits of one’s individual knowledge and the ways problems are framed. This self-critical perspective is crucial to help create a science able to respond to multi-faceted environmental challenges, in which multiple quality criteria must be included for the development of sustainable policy applications.

Outside the field of sociology of scientific knowledge and social constructionism, other research suggests that scientific and lay knowledge may not be completely different. For instance, psychological studies have shown that while facing risks, both experts and lay people make similar types of errors with similar sets of information (Renn, 1998). Theories of rational decision-making have shown that expert judgements are embedded in values, but, rather than being detrimental, these values may play an important role in the evaluation of the options available for action (Renn, 2001).

Jasanoff has engaged in discussions about the role of the expert in science and policy. She unveils two dominant paradigms: either all expertise is considered to be biased or expertise is perceived as a form of superior knowledge. By focusing on US examples, she shows that governments use these views to advance particular interests. The experts are used instrumentally, without acknowledging the complex process through which expertise is generated. Expertise is contextually generated, and thus, it does not pre-exist the disputes that it is summoned to settle. But while the governments may turn to a technocratic society, popular discourses frequently caricature experts as lacking political commitment and even moral integrity (Jasanoff, 2003). Jasanoff advocates that experts should be given a form of delegated power, recognising both scientists’ ability to provide meaningful representations of reality, and the contingent, negotiated nature of knowledge, thus, opening the door for political discussion, as discussed in Section 2.3.2.
However, the issue of delegated power becomes more complicated when talking about applied knowledge. For instance, Weinberg (1972) discusses the difficulties faced by the engineering profession:

“The engineer works against rigid time schedules and with a well-defined budget. He cannot afford the luxury of examining every question to the degree which scientific rigour would demand. Indeed, ‘engineering judgement’ connotes this ability, as well as necessity, to come to good decisions with whatever scientific data are at hand.” (Weinberg, 1972; p.211)

New models have emerged about the role of the professional engineer and scientist in sustainable development. For example, building on the framework of ‘post-normal’ science, technical experts have been described as ‘honest brokers’ (Mitchell et al., 2004). According to this model, technical experts should take a long-term perspective on the problem of study expanding the boundaries of their practice in three ways: moving away from singular, prescribed technology; engaging with problem framing and formulation; and situating the problem in context. This model shifts the emphasis from demarcating boundaries for scientific and technical model (and who has legitimacy to enforce them) to a consultative, bargaining decision-making process.

Yet, how is it possible to account for the expert judgement? One possible solution has been given by Bent Flyvbjerg (2001, 2002) who, following Aristotelian theorisation of knowledge, argues that experience leads to a type of knowledge that is neither concerned with universals invariable in time and space (episteme) nor the concrete activity that leads to the instrumental application of knowledge (techne). Instead, there is another type of practical wisdom, called phronesis, concerned with the ethics, values and also the action of the situation (Flyvbjerg, 2001). Phronesis involves including subjective considerations in decision-making, true reasoning that is only achieved by experience (Flyvbjerg, 2002).

In discussing the role of the expert, Flyvbjerg (2001) uses the example of the virtuoso soccer player in which experience brings together understanding and performance in the single moment in which the soccer player get the virtuoso kick: “Experts do not see problems as one thing and solutions as something else; they do not get anxious about the future while they act; they do not make plans. Their skills have become so much a part of themselves that they are no more aware of them than they are of their own bodies” (p. 19). This is not irrationality, but rather an intuitive understanding that allows the expert to find the right decisions.

‘Public delegates’, ‘honest brokers’ or ‘intuitive virtuosos’, the issue here is to what extent the expert role can be recognised in its complexity within the changing context of science and policy. There is no single formula to define expertise because the role of the ‘expert’ is continuously renegotiated in social interactions (Yearley, 2005). The same boundaries intended to protect the institutions of science pose a question on the role of the expert and have denied the possibility of experts bringing their own virtuoso understandings into the policy processes (e.g. Jasanoff, 2003). Participation not only requires opening up the debate of science to the public, but also requires experts and scientists to express their own values and to engage with the political debate. This interface, between the experts and the publics is a central concern of this thesis and will be discussed in Chapter 7, analysing the process involved in the production of knowledge about pollution risks, and in Chapter 8, reviewing how experts manage stakeholders’ expectations of the project.

2.4. Beyond social constructionism: co-constructionism

Section 2.2.4 explored how the realist-constructionist debate contributed to the development of social constructionism within environmental sociology. This debate also spawned a new response that attempts to move beyond the realist and constructionist positions, called co-constructionism. For co-constructionists nature and society are
simultaneously constructed by each other. Natural and social elements interact together, shaping each other’s features and future actions. Co-constructionism is not far from constructionism itself. Early constructionist work such as Bird’s (1987) already suggested the importance of nature’s agency. Co-constructionism can be understood as an attempt to transcend the debate between realists and constructionists (Irwin, 2001b; Macnaghten and Urry, 1998; Sutton, 2004). However, some authors contend that co-constructionism has gone beyond the constructionist perspective (Sutton, 2004). Some writers bring co-constructionism together with Actor-Network Theory (ANT). ANT originates within the Sociology of Scientific Knowledge (e.g. Callon, 1986; Latour, 1993) while co-constructionism is a denomination widely used in Environmental Sociology (Cudworth, 2003).

The point of departure for co-constructionism is the rejection of the dualisms created by modernity such as nature/society; local/global; science/culture; expert/lay knowledge; and human/non-human, among others. Co-constructionism affirms that these dualisms confuse our view of the world because it is inhabited by “hybrids” (Latour, 1993). Irwin provides an example of those “hybrids” interpreting the Bovine Spongiform Encephalopathy (BSE) case in UK:

“...the simple characterization of this case as representing the “scientific” analysis of a “natural” problem is flawed in numerous ways, since no easy line can be drawn between what is “scientific”, what is “natural” and, indeed, what is “social” in a case like this. [...] The modern cow is the product of generations of human-controlled cattle-breeding, feeding and housing. Looked at in this way, it is difficult to see where the social element of a factory farming ends and the natural begins. Instead, both are part of the same web of human and animal interaction.”

(Irwin, 2001b; pp 79-80)

The BSE case as described by Irwin is neither entirely social nor natural. Instead, it is a hybrid that integrates multiple social and natural building blocks. Socio-natural hybrids are the components of the reality described in the world of co-constructionists.

To overcome the nature-society dualism ANT proposes the representation of nature as another actor together with human beings and institutions. This implies that agency (i.e. capacity to influence their surroundings) is extended to both humans and non-humans (Murdoch, 2001). This does not imply the reification of nature, but recognition of the capacity of natural actors to cause change and generate responses.

Co-constructionism aims at understanding the relationships between the different entities (both human and non-human) that intervene in an environmental problem or situation (Irwin, 2001b). One of the ways of understanding these relationships is by researching the complexes of actors and networks. Callon (1986) describes the following objects of study in ANT:

- **Actor-worlds** are composed of both human and non-human elements with an assigned role and a context for action. Actors create actor-worlds by means of translation;
- **Translation** is used by actors to assign a role to every entity in their actor-worlds; and
- **Actor-networks** describe the internal structure of actor-worlds, by displaying the sets of relationships and ties between their different elements (Callon, 1986).

To study actor-networks Latour (1993) finds inspiration in anthropology. Anthropologists study the ‘others’, those who are considered to be ‘non-modern’, and accordingly, still see the world as a network whose elements remain unclassified into social and natural
categories. In this ‘non-modern’ world described by Latour human and non-human objects coexist simultaneously.

Burgess et al (2000) identify three main elements in co-constructionist social research:

- the analyst must follow all the actors involved in the process, whether human or non-human, in order to achieve impartiality;
- the natural and the social need to be explained together following the ‘principle of generalized-symmetry’; and
- actors can join together across categories, conceptual divisions or dichotomies, as it is stated in the ‘principle of free-association’.

Co-constructionists propose the full renovation of science, abandoning the natural-social dualism in order to understand the complex reality of hybrids. Some authors claim that modern dualisms compromise our views about nature and society (Burgess et al., 2000; Murdoch, 2001). In his renovation project for science, Latour claims the identification of quasi objects, related by networks, which are “real as Nature, narrated as Discourse, collective as Society and existential as Being” (Latour, 1993; p. 89). Latour’s non-modern project contains directions for a whole renovation of both society and science.

The theoretical development of co-constructionism in Environmental Sociology has been significant in recent years. Co-constructionism is one of the main attempts to progress beyond the realist-constructionist debate. Its empirical applications, however, remain obscure. One example of ANT application is the paper “Knowledges in action: an actor network analysis of a wetland agri-environment scheme”, by Burgess, Clark and Harrison (2000). The paper successfully shows how human actors build ‘actor-worlds’, but it is not clear how natural actors do so. Moreover, the distinction between social and natural actors (farmers, environmental activists, ecosystems and crops) remains implicit within the text. Co-constructionism needs to develop further empirical work to demonstrate its utility beyond the contributions of social constructionism. This thesis has been developed from a social constructionist point of view, but its thinking has also been influenced by co-constructionist approaches. In particular, the main tenet of co-constructionism, the abandonment of the social-natural dualism, will be revisited in Chapter 3.

2.5. Conclusion

This chapter explored the role of social constructionism in the study of environmental problems. The main lesson from this review is that environmental sociology offers multiple perspectives to study environmental problems. Social constructionism does not give any absolute recipe; instead, it proposes to build an understanding of the meanings and relationships that make a problem relevant for human societies. The research question can now be narrowed down adopting a social constructionist perspective.

Thus, the aim of this thesis is to explore how RECOAL stakeholders construct the environmental problems to be addressed by the project, and how these perspectives influence, and in turn are influenced by its development. The experience of RECOAL may contribute to develop a better understanding of the interactions between different stakeholders in land regeneration projects.

Building on the sociology of social problems, the thesis will focus on claims-making activities, aiming to adopt the 'actor's point of view'. The thesis will explore the tensions that occur between competing definitions of the situation. The central stakeholders are those who participated directly in RECOAL, the researchers and those who are likely to benefit from it. Thus, this thesis adopts a social constructionist perspective to examine science 'outside the laboratory' and the relationship between knowledge production and decision-making. The focus of the thesis is neither the construction of science, nor the
construction of demands on science; rather, the thesis looks at the interaction of different perspectives (from science and outside science) to interpret a particular environmental problem within the development of a technical project, RECOAL.
3. Coal Ash Disposal in Tuzla: A Case Study

3.1. Introduction

The research followed a case study approach, because case-study methodologies are particularly suited to study a phenomenon in its real-life context (following Yin, 2003). In this case, taking RECOAL as the unit of analysis of the case study, the research explored not only the project itself, but also those elements, normally considered external to the project, that may influence or be influenced by its development. Case-study methodologies are poorly codified and they are often taken for granted. Often the research is tailored to the case of the study and the details of the approach need to be spelled out. Thus, while this chapter reviews the case study of coal ash disposal in Tuzla as the problem for analysis within RECOAL, Chapter 4 will review in detail the data collection and analysis methods (such as document reviews, site visits, active participant observation, non-participant observation, field diaries, interviews, discussions with key individuals and feedback from stakeholders) that have been employed within this analysis.

The selection of the case study (RECOAL) preceded the writing of this thesis, and was motivated by the need to engage with the work in RECOAL at FR. Initially, the unit of analysis was the project RECOAL, studied as a whole. However, as the research developed this had to be adjusted focusing on the different interrelated aspects of the project and its context including the coal ash disposal sites and their environmental relationship, the relationship of local residents in Tuzla with their surroundings and even my own relationship with the project. This chapter provides a background to the case-study by explaining some aspects of its scientific and social context. This is, necessarily, a descriptive and partial account of coal ash disposal in Tuzla, as understood by an external observer.

Co-constructionists have criticised the enduring conceptual distinction between what is natural and what is social embedded in the scientific tradition (see Section 2.4). However, actors' constructions of the environmental problem were embedded in arguments belonging to both natural and social sciences. Bruno Latour (1993) argues that the social and the natural are so interrelated that our world is not composed of entities which can be separated into either natural or social: rather, our world is composed of socio-natural hybrids. The separation of the content into social and natural components has proven to be unhelpful to understand how RECOAL stakeholders construct the problem of coal ash pollution. Developing regeneration solutions may require an understanding of the context in which such solutions could be implemented and this brings together its 'social' and 'natural' aspects.

This chapter thus provides a context for the case study of RECOAL, including background information that helps understand subsequent chapters. The Chapter presents findings from environmental science regarding the production of energy from coal in Bosnia and Herzegovina (BiH), and more generally, the environmental impacts of coal ash disposal. The chapter explores how natural and social sciences interact in the description of current issues around coal ash disposal.

Section 3.2 focuses on the economic significance of coal-energy generation in Bosnia and Herzegovina and its limitations, including the disposal of coal ash. Section 3.3 provides an overview of coal ash disposal technologies and Section 3.4 reviews the main environmental and human health impacts associated with coal ash disposal. Section 3.5 describes different alternatives for remediation of coal ash disposal sites and finally, Section 3.6 explains some of the institutional barriers that prevent the implementation of solutions in BiH. The account of the context of RECOAL presented in this chapter is by no means exhaustive. Instead, this chapter compiles some of the issues that have emerged
during my involvement in RECOAL’s development, and provides one of the many possible accounts of the context of coal ash disposal in BiH.

3.2. Coal energy in Bosnia and Herzegovina

The history of energy production in BiH has been strongly influenced by its large coal reserves. Indeed, the electricity industry that developed during the 1950s and 1960s was linked to coal mining centres. The centre of the lignite industry in former Yugoslavia was the Tito Mines complex at Tuzla, in the Pannonian Basin. A 2.7 mW plant close to the coal mine Kreka, in the outskirts of Tuzla started operating in 1906 and closed in 1956. In 1959 TEP was established in Tuzla; the final phase of construction, with the plant already in operation, concluded in 1978. This plant is currently the largest energy production unit in BiH with a net production of 2,806 gWh in 2006, which accounts for 58% of the thermal energy production and 44% of the total energy production in the country (RECOAL, 2009).

The Bosnian wars during 1992-1995 had a considerable impact on the production of electricity in the country. Energy plants were strategic objectives and often targeted by shelling and bombings. The conflict was followed by a considerable effort to reconstruct the facilities and infrastructure in the energy sector. Another major impact of the war was the sudden change in the institutional and economic conditions for electricity production.

The Dayton agreement⁴, a political agreement to stop the armed confrontation in 1995, divided the country into two main entities, the Federation of Bosnia and Herzegovina (FBiH) and Republika Srpska (RS), and one independent district (Brčko). Each entity had developed a constitution during the war; the RS being conceived as a unitary state divided into municipalities and the FBiH as a federation of smaller territorial units, the Cantons, which in turn split into several municipalities (see Figure 3-1). In addition, the Dayton agreement established ethnic quotas of ‘constituent peoples’ (Croat, Bosniak and Serb)⁵ set to guarantee that each group has equal influence in decision-making⁶. The effect of the agreement is that government and economic organisations have also become divided along ethnic lines.

Since 1945 and until the break-up of Yugoslavia, the Electric Utility of Bosnia and Herzegovina (ElektroBiH), a state owned vertically integrated utility, had authority over the generation, transmission and distribution of electricity in Bosnia and Herzegovina. After 1992 three ethnically led electricity utilities replaced ElektroBiH: Elektroprivreda Bosnia and Herzegovina (EP BH); Elektroprivreda Hrvatske Zajednica Herceg-Bosne (EP HZHB) and Elektroprivreda Republika Srpska (EP RS). Until the early 2000s, the three EPs functioned as independent vertically integrated utilities, that is, they were in charge of the whole chain of power delivery. They were assigned a territory (according to ethnically determined borders) within which they controlled the electricity market. The organisation of the electricity utilities into three ethnically divided companies is perceived as having detrimental impacts upon the efficiency of the energy sector particularly regarding the coordination of activities between the three utilities (Jenko, 2007).

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⁴ Signed in Paris on 14 December 1995, the Dayton Agreement ended the Bosnian Civil War (1992-1995) and established its national Constitution. Bosnia and Herzegovina is the only country in the world whose constitution was written in a language other than the official language of the country (English).

⁵ The three groups of ‘constituent peoples’ are virtually indistinguishable; they also speak mutually intelligible languages. The only feature that allows for their differentiation is their religion (Croats are characterised as being Catholic, Serbs as Orthodox and Bosniaks as Muslim).

⁶ BiH is commonly referred as an example of ‘consociationalism’.
During the last years, the energy sector in BiH, under the guidance of international organisations, has followed the trend towards deregulation of the power industry. New laws on electricity in each entity followed the publication of a law on transmission, regulation and system operation of electricity in BiH\(^7\).

According to energy sector analysts, deregulation requires the segmentation of the responsibilities of generation, distribution and supply between different actors, thus moving away from the regional model in which one vertically integrated utility would oversee the entire chain of power delivery (Mazer, 2007). Thus, at the beginning of 2006 two new companies started operation: (1) the Electricity Transmission Company (Transco)\(^8\), responsible for the maintenance and construction of the transmission infrastructure and (2) the Independent System Operator (ISO)\(^9\) responsible for the management and control of the transmission sector in coordination with Transco. This also followed the establishment of the State Electricity Regulatory Commission in Tuzla, responsible for regulating transmissions and international trade. The implementation of the new laws on electricity has also led to the reorganisation of the public utilities as limited liability utilities, whose capital is held 90% by the State and 10% by private shareholders, including international private investors.

These institutional changes have had a considerable impact on the functioning of the utility companies. For example TEP Tuzla has seen large investments in modernising its infrastructure such as the reconstruction of three of its seven generation blocks, the changes to automatic controls, and modernisation of the boilers. This work has improved its generation capacity (709 mW) and extended the lifetime of the plant. Now, the company plans to build new blocks to increase the plant generation capacity by 50%.

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\(^8\) Law on the establishment of a Transmission Company in BiH (Official Gazette of BiH 35/2004).

Some analysts argue that BiH’s potential for electricity production is underexploited and could emerge into a prosperous economic sector (Lekić, 2008). Thus, the energy sector is regarded as central to the country’s development strategy. The main reasons to be optimistic about the energy sector are BiH’s considerable coal reserves; they are estimated at 5464 million metric tonnes (34% brown coal and 66% lignite) (Lekić, 2008). Despite the growing importance of hydropower (there are 14 plants in the country) coal is likely to continue shaping the energy sector in the coming decades. The total installed capacity from thermal power plants is 1779 mW (709 TEP Tuzla; 514 TEP Kakanj; 276 TEP Gacko; and 279 TEP Ugljevik).

Furthermore, the country expects to get additional revenues from exporting electricity. Figure 3-2 shows a steady growth in both electricity consumption and generation since the signing of the Dayton agreement in 1995. The generation has grown much faster. Thus, in 2006, the industry produced an extra 3.6 billion Kwh largely exported to nearby countries.

![Figure 3-2: Annual net generation and net consumption of electricity in Bosnia and Herzegovina (data source: EIA, 2008)](image)

This trend is thought likely to continue. However, there are still unresolved questions about the capacity of BiH to turn into a major energy producer. Coal has significant environmental impacts that have already stirred the public animosity towards thermal power plants. The main concern regarding thermal power plants is air pollution. For example, in Tuzla, the thermal power plant emissions amount for circa 99% of the total emissions in the city (see Table 3-1).

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Total emissions (t/year)</th>
<th>TEP Tuzla emissions share (t/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>sulphur dioxide (SO₂)</td>
<td>74206</td>
<td>73590 (99 %)</td>
</tr>
<tr>
<td>nitrogen oxides (NOₓ)</td>
<td>13120</td>
<td>13000 (99 %)</td>
</tr>
<tr>
<td>small particles</td>
<td>19150</td>
<td>18390 (96 %)</td>
</tr>
</tbody>
</table>

Table 3-1: Air emissions in Tuzla according to data from the meteorological station of Tuzla (source: RECOAL, 2008).
In addition, thermal power plants produce significant amounts of solid residues from the combustion and handling of coal. These are commonly referred to as Coal Combustion Residues (CCR). The disposal of these residues occupies large areas of land and is likely to have large environmental impacts. In order to understand the environmental impacts of CCRs it is necessary to understand what they consist of and how they are handled by the industry.

3.3. Coal Combustion and its Residues

Heterogeneity is a characteristic of CCRs\(^{10}\). This section explains the main types of CCRs, their composition and the coal disposal technologies most commonly used. It also reviews how these findings are related to the case of TEP Tuzla.

3.3.1. Coal Combustion Residues

CCRs are wastes produced during the combustion process in coal-fired power stations. Fly ash, bottom ash and boiler slag are common to all types of coal combustion. Several technologies may be applied to reduce gaseous emissions such as sulphur oxides, resulting in flue gas desulphurisation waste or fluidised bed combustion waste.

- Fly Ash is the fine fraction of grained dust obtained by electrostatic or mechanical precipitation, sometimes referred as Pulverised Fly Ash (PFA). Fly ash particles are small enough (0.001 to 0.1 mm) to be carried from the boiler in the flue gas (Korcak, 1998).

- Furnace Bottom Ash (FBA), or just Bottom Ash, is the coarse ash fraction (0.1 to 10 mm). It has a sand-like texture and it is obtained from the dry bottom furnaces. Unburned carbon is mostly present in these fractions and, to a lesser extent, in fly ash (Mohapatra and Rao, 2001). Boiler slag is also found in the furnaces, but current technologies tend to decrease its amount.

- Cenospheres are hollow spheres where inorganic materials solidify around trapped gas bubbles. After its separation by flotation, cenospheres have many industrial applications like the manufacturing of light density construction materials (Mohapatra and Rao, 2001).

- Flue Gas Desulphurization Waste (FGD) is a wet product composed of lime/dolomite-scrubbing sulphur oxides produced by the process of desulphurisation\(^{11}\) of flue gas. When the lime/dolomite is applied the combustion forms a dry waste denominated Fluidised Bed Combustion (or Boiler) Waste.

In the TEP Tuzla Plant, there is no separation of the residues. All the CCRs are collected together, mixed with significant amounts of water and pumped through pipes to the disposal sites. CCRs are commonly mixed with coal tailings and discards before its disposal (Hansen et al., 2002) and TEP is not an exception. Such a heterogeneous mixture of CCRs is going to be referred in the text under the generic term coal ash.

TEP produces between 0.4 and 0.9 m\(^3\) of coal ash per mWh. The plant could produce 1.7 million m\(^3\) of coal ash per year at maximum production capacity, but the plant does not always maintain this capacity. In 2006-2007, about 0.9 million m\(^3\)/year of coal ash were produced (see Figure 3-3).

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\(^{10}\) The varied fields of study have led to a confusing terminology. While CCRs are referred to as such when they constitute a waste disposal problem (also Coal Combustion Waste), scholars who study their possible industrial applications describe them as ‘Coal Combustion By-Products’ (CCBs) or even ‘Coal Combustion Products’ (CCPs).

\(^{11}\) Desulphurisation avoids the emission of sulphur in gas form, one of the most harmful effects of coal combustion (Kleb et al., 1999). The result is an increase in the sulphur content of coal ash.
3.3.2. Coal Ash Composition

Understanding the composition of coal ash is important to help determine its environmental impacts. The literature discussing the composition of coal ashes shares one common conclusion: coal ash composition is highly variable. It depends on several factors such as: composition of the parent coal (i.e. anthracite, bituminous and lignite coals produce ashes of different compositions); particle size and age of the ash; conditions of the combustion process; degree of weathering; efficiency of emission control devices; and technologies used for storage and handling (see Adriano and Weber, 2001; Asokan et al., 2005).

Coal ash consists mainly of glassy spheres together with some crystalline matter and unburned carbon. Four main oxides account for most of its composition: silicon (SiO₂); aluminium (Al₂O₃); iron (Fe₂O₃); and calcium (CaO). The metallic oxide content of coal ash is often higher than those of the parent coal (Baba and Turkman, 2001). Over the years TEP Tuzla has taken advantage of the availability of coal in nearby villages, using lignite from open cast mines in Bukinje and Dubrave or from underground mines in Šikulje and Mramor; and dark coal from open cast mines in Banovici and Đurđevik. Currently, TEP Tuzla uses a mixture of 75% lignite and 25% black coal, mainly from Banovici and Dubrave, which have been found to be enriched in chromium, nickel and arsenic (RECOAL, 2008).

Elements found in the parent coal may suffer physical and chemical transformations during the combustion process, changing the solubility and the association patterns of elemental species (Popovic et al., 2001). Combustion increases the concentration of metal ions (the organic fraction is removed during the combustion) and causes the redistribution of elements (Seferingolu et al., 2003). Fly ashes are commonly enriched in heavy metals and metalloids during the combustion process, though it rarely happens in bottom ash and slag (Vassilev and Vassileva, 1997; Popovic et al., 2001).

Fly ash has a higher risk of containing potential pollutants than coarse ash. Trace elements are detected in non-magnetic, heavy and fine-grained fractions of fly ash (Vassilev and Vassileva, 1997), and concentrations increased with decreasing particle size (Adriano et al., 2002). Another study found that fly ashes contained toxic quantities of cadmium, chromium and lead, while only cadmium and lead concentrations were characterised as
toxic in bottom ash (Baba and Turkman, 2001). Thus, evidence found in the literature suggests that the separation of coal combustion residues could facilitate alternative and tailored treatments. Unfortunately, disposing all the CCRs together is considered standard practice and TEP is no exception.

CCRs can also contain arsenic, molybdenum, selenium and boron, which are all elements that may cause phytotoxicity (Adriano et al., 2002). From these elements, in the case study, all but selenium have been detected at elevated levels. Coal ashes may also contain enhanced levels of radioactive elements such as uranium, thorium and radon (Reijnders, 2005) and hazardous organic compounds such as Polycyclic Aromatic Hydrocarbons (PAHs) (El-Mogazi et al., 1988). FGD residues have gypsum-like composition, with higher calcium and boron concentrations (Ahn and Mitsch, 2001).

The state of the potential pollutants in the residues, and their toxicity, mobility and availability in the ecosystem will determine their environmental impact (Asokan et al., 2005). Mobility depends on the pH of the ashes, that can vary from 4.5 to 12.0 (Adriano, 2001 [1986]; Adriano and Weber, 2001; Carlson and Adriano, 1993) and the composition of the parent coal (Carlson and Adriano, 1993).

3.3.3. Coal Technologies

The technologies used during the coal combustion and the disposal technology influence the environmental impacts of coal ashes. Understanding these technologies is necessary to design an appropriate plan for restoration.

The combustion technology determines the composition of the resulting ash, being specific to the operation of every thermo-electric plant. Of particular importance are the technologies applied to reduce the emission of harmful gases, such as desulphurisation, which concentrate the pollutants in solid residues. For instance, hybrid fluid technology and electrostatic removal of dust reduce sulphur emissions to the atmosphere during the combustion and accumulate sulphur in the fly ash (Kleb et al., 1999). Similar technologies can reduce selenium in airborne emissions up to 99.5% resulting in seleniferous fly ash. (Lemly, 1999). Mercury emissions are also highly controlled although reduction technologies are less advanced (Yokoyama et al., 2000). Policies are likely to continue encouraging the reduction of gaseous emissions of sulphur, selenium and mercury to the air, which is likely to lead to an increase of these elements in the residual coal ashes.

Coal ash disposal technologies determine the composition of the final ash, and therefore influence the process of pollution, the spatial pattern and intensity of the pollution. Depending on the amount of water used for transport, the system of disposal may be denominated dry disposal or wet disposal.

- **Dry disposal**- Ashes are solidified, or encapsulated, allowing its physical transport by road to the disposal site. In some cases transport occurs through pipes, pumping to the landfill a muddy solid sludge.

- **Wet disposal**- Ashes are mixed with water and pumped through pipes into a wet lagoon. Once the residues are on the disposal site the water is drained and the ashes settle and slowly fill up the site.

The environmental impacts of wet disposal sites are generally more severe than those of dry disposal sites. In dry disposal, compaction and cementation reactions occur, and the pollutants appear in less labile forms (Hansen et al., 2002). The high liquid to solid ratios of wet disposal sites (10:1 to 20:1) favour leaching and the migration of potential pollutants in wet lagoons, increasing the area and intensity of the pollution and accelerating the process (Hansen et al., 2002).
TEP Tuzla disposal sites are wet lagoons. The transportation of coal ash from the furnaces to the disposal sites is by hydraulic suspension system mixing water with the solid material (see Figure 3-4). The water is filtered through the ash and soil, and is collected in channels that return the water to the factory. The plant reuses around 40% of the water, the rest being disposed in the polluted river Java, crossing the plant location and the city of Tuzla.

![Figure 3-4: Schematic representation of the disposal of bottom ash and fly ash in the Tuzla thermo electric plant TEP.](image)

The immediate effect of wet coal ash disposal is the use of large areas of land. To date, approximately 29,500,000 m$^3$ of coal ash have been disposed of in five disposal sites, occupying 157 ha of land (see Table 3-2). According to TEP, the current sites have capacity to dispose another 19,300,000 m$^3$, which at the current rate of production would allow TEP to continue disposing CCRs there for another 20 years. However, in this context, and considering the current plans to enlarge TEP’s production capacity, the siting of new disposal sites is one of the main challenges facing TEP. The capacity of TEP to find new sites was already questioned in 1998 when organised active protest and the intervention of local institutions managed to halt the construction of a new site at the popular lake ‘Kop’. Up to now, the sites have been constructed in areas surrounding human settlements (see Figure 3-5), a practice that increasingly faces opposition.
<table>
<thead>
<tr>
<th>Disposal Site</th>
<th>Opening-closure</th>
<th>Max height of ash (m)</th>
<th>Cubic capacity (m³)</th>
<th>Area (Ha)</th>
<th>Landscape and land use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dreznick</td>
<td>1981-1991</td>
<td>278</td>
<td>8.800.000</td>
<td>45</td>
<td>Diverse crops (alfalfa, red clover, maize, potatoes, and tomatoes) on a soil cover of 10-30 cm thickness.</td>
</tr>
<tr>
<td>2. Plane</td>
<td>1964-1990</td>
<td>260</td>
<td>4.300.000</td>
<td>18</td>
<td>Crops (mainly pasture and maize) on a soil cover (average 10-30 cm thickness) with a layer of humus added from the surroundings.</td>
</tr>
<tr>
<td>3. Divkovic I</td>
<td>1985-1995</td>
<td>281</td>
<td>13.900.000</td>
<td>45</td>
<td>10 ha covered with mine residues. Unsuccessful tree plantations (Robinia pseudoacacia; Picea sp; Salix sp).</td>
</tr>
<tr>
<td>4. Jezero I</td>
<td>1991-2003</td>
<td>280</td>
<td>2.500.000</td>
<td>24</td>
<td>No remediation; a new disposal project is to be built.</td>
</tr>
<tr>
<td>5. Divkovic II</td>
<td>1995- active</td>
<td>281</td>
<td>6.900.000 (remaining)</td>
<td>44 (final: 68)</td>
<td>Active (Estimated use still left 20-25 years)</td>
</tr>
<tr>
<td>6. Jezero II</td>
<td>To be opened</td>
<td>280</td>
<td>12.400.000 (remaining)</td>
<td>-</td>
<td>To be built on the existing site of Jezero I</td>
</tr>
<tr>
<td>7. Kop</td>
<td>Project rejected</td>
<td>-</td>
<td>25.000.000</td>
<td>-</td>
<td>Local residents protests and concerns about its sustainability have stopped its construction</td>
</tr>
</tbody>
</table>

Table 3-2: Disposal sites from TEP Tuzla, Bosnia and Herzegovina

Figure 3-5: Map of the disposal sites in Tuzla
In addition, large volumes of water are needed to transport the ash to the disposal sites. TEP uses about 0.5 m$^3$/s of water to transport the ash in the form of slag, later discharged into the Jala River as wastewater. The ash is mixed with water in a ratio of 1:11, so that 27216 m$^3$ of water and 2474 m$^3$ of slag are transported to the sites every day (903,076 m$^3$ of slag per year). Figure 3-6 shows the way the water is used.

Figure 3-6: Sankey diagram of TEP's water use balance (Source RECOAL, 2009).

The slag of ash and water is disposed at the big disposal sites contained by a dike. While submerged in water, coal ash is protected from wind dispersion. However, lagoons are slowly drained, leaving the ash to dry and exposed to the air. The water favours gravimetric separation, so that less dense particles accumulate near the surface and are then susceptible to wind erosion. This also increases the leaching of various elements (Popovic et al., 2001). For instance, in a study in Slovenia, the extreme alkalinity of the water due to ash leaching caused the death of most of the plant and animal life in the area (Popovic et al., 2001). The ashes in Tuzla also are extremely alkaline. Pipes transporting the ash to the site seep out relatively small amounts of sludge which may also cause further pollution. Leaks are difficult to predict, and there is a high uncertainty about their location. In the coal ash disposal sites in Tuzla there was evidence of leaks along the pipes.

TEP Tuzla envisages the use of dry disposal technologies in the future. Wet disposal utilises more water and energy than dry disposal. Since a high amount of water is involved, water pollution is more likely to occur in wet lagoons than on dry disposal sites. Moreover, recent developments in dry disposal technologies have made it more economically viable (Personal communication, 2005). The change to dry disposal might also help resolve the problem of disposal because the ash could be transported further by road, opening options for disposal further away from TEP.

3.4. Coal ash and the environment

Popovic et al (2001) identify two phases of environmental pollution related to coal ash deposits:

- the emission and deposition of enormous amounts of coal ash, polluting air, water and soil with ash particles (including the problem of huge ash dumps); and
• the leaching of microelements (including toxic heavy metals) from ash disposal sites.

Other paths include uptake by plants or wildlife, the disruption of habitats and the dispersion of the ashes by the wind. This last issue, not so much discussed in the literature, has proven to be the main cause of concern and social alarm in the case of TEP, because of its visibility. Figure 3-7 offers a summary of the main environmental impacts associated with coal ash disposal.

![Figure 3-7: Environmental impacts of coal ash disposal sites, before and after being capped with soil.](image)

### 3.4.1. Impacts on air quality

Air quality is affected by the emission of contaminants during the combustion process (mainly sulphur, selenium and mercury), and by the dispersion of deposited ashes by the wind particularly in uncovered sites. This dust is likely to be comprised of the lighter components of the ash. When the ash is deposited in the lagoon, lighter components settle out last and thus can get dispersed when the site becomes desiccated.

Dispersion of ashes by the wind occurs following a gradient, with highest concentrations close to the main source, and concentrations decreasing following geographical patterns, namely the prevailing wind direction (Klose and Makeschin, 2004). Atmospheric aerosol particles (diameter 5nm – 20 µm, most of them <10 µm) remain suspended in the atmosphere for varying lengths of time depending on the size of the particle; the height reached by the particle; the wind speed; and other climatic factors such as the relative humidity and precipitation (see Alloway and Ayres, 1993).

Air masses circulation may transport suspended particles thousands of kilometres. Particles are removed from the atmosphere by washout, settlement, impactation and deposition (Alloway and Ayres, 1993). In a case study in the Delhi region (India) the impact of fly ash dispersal enriched the alkalinity and heavy metal content of soils in the vicinity of thermal powers plants (Mehra et al., 1998).
In Tuzla, the dispersion of particulates is particularly severe during the summer, when there is little rainfall and winds are of a higher magnitude. Ash particulates thus affect the surrounding biosphere and life of local people in the settlements around the disposal sites. To date, there has been little research to evaluate the specific impacts of coal ash disposal around Tuzla. However, its negative impacts are reflected in the discourses of local people about how ash particles damage their properties, crops and home-gardens (this point will be elaborated in chapters 5, 6 and 7).

The air dispersion of coal ash mobilises some metal species such as Fe (Ball et al., 2000). Inhaled aerosol particles reach the bloodstream of humans and animals through alveoli in lungs. Plants absorb pollutants by the cuticle particles falling into the foliage. Absorption is influenced by moisture and pH and varies with plant species.

3.4.2. Impacts on water quality and resources

Ash composition, the time span of the leachate and the pathways of the leachate are some of the factors determining the leachate composition. In wet disposal sites groundwater pollution is likely to occur in two ways: gradual seepage of porewater from the base of the deposit or liner failure or soil breaking and flush-out of accumulated salt or other substances (Hansen et al., 2002).

Hansen et al (2002) describe three processes of migration in groundwater:

- Advection- movement caused by the flow of groundwater;
- Dispersion- movement caused by the irregular mixing of waters during the advection;
- Retardation- chemical or physical mechanisms, which occur during the advection and tend to slow down the rate of contaminant migration (e.g. absorption and precipitation).

Geohydrological and geochemical properties, pH and conductivity, leachate composition, and characteristics of the waste material and the deposit are some of the factors influencing chemical species mobility (Hansen et al., 2002). The amount of leachate depends on the water storage capacity and the moisture content of the ash (Mudd and Kodikara, 1998). Both factors are functions of the porosity of the ash. The high liquid to solid ratio found in wet disposal sites (10:1 to 20:1) increases the risk of groundwater pollution (Hansen et al., 2002).

In Tuzla, the ash has pozzolanic properties. This may cause the creation of an impermeable barrier and can retard or even stop the leachate (Kazonich and Kim, 1999). Although cementation processes are less frequent in wet storage systems (Hansen et al., 2002), wet storage systems, like the ones in Tuzla, normally dry up during the summer season. As a result pozzolanic layers can form on the top of the disposal site.

The large volumes of water used in Tuzla in the wet disposal process (usually between 0.4 m$^3$/s and 0.85 m$^3$/s) affect the whole local hydrological system (RECOAL, 2009). The disposal of slag creates an artificial outflow, which affects the flow and composition of both surface and underground waters. Also, the large settling ponds cause increased evaporation: according to RECOAL results 30% of the water inflow to the disposal site either infiltrates the ground or evaporates.

Water courses and lakes are polluted either by the direct contact with coal ash (pumped into them, dispersed by the wind, or acquired by direct surface runoff) or indirectly through

---

12 Modelling leaching associated with dry ash disposal includes liquid trickling, films, and gaseous forms interacting with solid particles. Static and dynamic regions may be found in the disposal site, covering a whole range of humidity from wet to dry, resulting in gradual seepage to groundwater (Hansen et al. 2002).

13 Defined as proportion of leachate water in relation to the total influent water.
seepage and groundwater contamination (Carlson and Adriano, 1993). Major impacts of coal ash on water are changes in water pH and elemental concentrations, increases of electric conductivity and turbidity and changes in water temperature (Ibid.). Consequently, coal ashes can reduce both species diversity and population size of aquatic plants, invertebrates and fish in the streams receiving these discharges (Ye et al., 2001).

RECOAL carried out analyses of the outflow water during the three years of the project. These analyses show that the water is highly alkaline, in some cases reaching pH values around 12. The water samples were rich in hydrocarbonates, sulphates, calcium and magnesium. Leachate acidity is inversely related to the leaching rate of inorganic constituents of coal ash, i.e., the lower the pH, the more metals are released in the leachate (Kazonic 1999; Baba and Turkman 1999; Karuppiah and Gupta 1997). Also, lower pH increases the toxicity of the elements released (Karuppiah and Gupta, 1997). Acid Mine Drainage (AMD) is unlikely to occur in our case study. However, given the high alkalinity of the sites, the measured concentrations of potential pollutants on the disposal site are conservative because further mobilisation of pollutants can occur when the pH is lowered (see also Section 7.3).

Scientists argue that if metal concentrations are at acceptable levels, risks associated with coal ash disposal are significantly reduced (Pathan et al., 2003). Leachate composition consists largely of sodium, sulphate and chloride ions, and its toxicity is determined by the concentrations of metals present in the ash (Karuppiah and Gupta, 1997). Although some hazardous compounds (lead, aluminium) may be adsorbed (and immobilised) into the ash, leachates frequently contain arsenic, boron, barium, molybdenum and selenium (Mudd and Kodikara, 1998). In the samples taken in Tuzla, some potential pollutants were found in elevated concentrations, particularly boron, chromium and nickel. Sulphates and arsenic were also found in elevated concentrations.

The research carried out in Tuzla suggests that the concentration of sulphates in the leachate is comparable with their concentration in the adjacent surface waters (e.g. river Jala). However, even if the content of heavy metals in the leachate is similar to the concentrations in the soil solution, the cumulative effect of its assimilation into the ecosystem should be considered. For instance, although mercury may remain stable in the ash, the annual accumulation of coal ash, and therefore mercury, could increase the significance of this release (Heebink and Hassett, 2002). In addition, the presence of a pollutant in relative stable forms poses a liability because its stability depends on variable factors such as pH.

Permanency and toxicity of pollutants in water depends on the solubility of ions. Influencing factors are: concentrations of anions and chelating ligands, pH and redox status of the water and presence of absorbent sediments (Alloway and Ayres, 1993).

The pollutant potential will also depend on the elementary species found in water. In the case of Tuzla, oxygen saturation in the transport water was 100%, whereas it was only 3% in the water discharged from the landfill. This had a strong impact on the potential of pollutants to have deleterious effects on health and the environment. In reduced oxygen conditions, arsenic V is reduced to more toxic and mobile arsenic III species. In contrast, chromium VI is reduced to the more benign form of chromium III (Dellantonio et al., 2008). Thus, the effect of substrate changes over time on the pollutant potential will depend on the particular elements affected (see also Section 7.3.3).

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14 Acid Mine Drainage (AMD) characteristics are low pH and high concentrations of Iron and Manganese. It is common in coal mining but it has also been associated with land disposal of coal combustion by-products (Ye et al 2001).

15 Chelating ligands are chemicals that form a soluble complex with certain metal ions, limiting their reactivity.
When heavy metals are released into water they react with the water and its constituents, precipitate into the sediments, and enter the trophic chain of plants and animals (Alloway and Ayres, 1993). For instance, seleniferous fly ash has been identified as a source of risk for fish (Lemly, 1999) and benthic fauna may be reduced due to the release of suspended solids (Carlson and Adriano, 1993). These effects result in habitat degradation, reductions of the environmental quality and risks of contamination of the food chain.

In contrast, some ecosystems have a strong resilience to the application of coal ashes. In some cases coal ashes could eventually improve the living conditions of particular ecosystems. For example, small amounts of coal ash may result in increases of the elemental concentrations of the aquatic biota (Carlson and Adriano, 1993). Such a beneficial impact, however, is unlikely to occur in the vicinity of TEP Tuzla landfills due to the very large amounts of coal ash and the high pH of water leaving the coal ash disposal sites.

### 3.4.3. Impacts on soil quality and resources

The distribution of pollution from the ashes on surrounding top soils is correlated with the prevailing wind direction (Praharaj et al., 2003). Soil pollution occurs in the disposal site and in surrounding areas influenced by air pollution or leaching processes. When soils are polluted by air dispersion coal ash will mainly impact on the topsoil and the organic matter (Klose and Makeschin, 2004). The impacts of fly ashes on soils have been widely studied, including extensive research about their potential as soil liners or amendments. Table 3-3 summarises some of the properties of the ashes that may have an impact on soil quality and resources.

Coal ash is known to be one of the major sources of heavy metal pollution found in soils of surrounding areas of the disposal sites. In coal-ash-polluted soils arsenic, molybdenum and selenium are frequently found in concentrations potentially toxic for grazing animals (El-Mogazi et al., 1988). Metals such as zinc and cadmium occur primarily in exchangeable (bioavailable) form, while metals such as lead are generally less bioavailable (and therefore less toxic) (Lasat, 2000). For instance, in Tuzla, the main pollutants of concern were arsenic, molybdenum, chromium and boron. Some of these aspects will be reviewed in more detail in Section 7.3.

<table>
<thead>
<tr>
<th>Favourable</th>
<th>Potentially unfavourable or detrimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium carbonate equivalency: increase in fertility</td>
<td>Presence of B and soluble salts especially in unweathered materials</td>
</tr>
<tr>
<td>Presence of pozzolanic or cementation reactions</td>
<td>Long-term availability of Mo, Se, and possibly As (among others)</td>
</tr>
<tr>
<td>Dominance of salt size particles</td>
<td>Too high calcium carbonate equivalency in certain products</td>
</tr>
<tr>
<td>Presence of calcium, potassium, phosphorous and other nutrients</td>
<td>Potential micronutrient deficiency and other nutrients imbalance</td>
</tr>
<tr>
<td>pH buffering capacity</td>
<td>Potential sodicity</td>
</tr>
<tr>
<td>Mitigation of aluminium toxicity (retention) especially in subsoils</td>
<td>Reduced infiltration and percolation in some cases</td>
</tr>
<tr>
<td></td>
<td>High erosivity</td>
</tr>
</tbody>
</table>

Table 3-3: *Properties and factors of fly ash that may influence soil quality* (adapted from Adriano and Weber, 2001)

In conventional processes most of the organic fraction of coal is burned during the combustion process. However, ashes may contain substantial amounts of hazardous
organic compounds, also called Persistent Organic Pollutants (POP), such as polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), methyl sulphates and chlorinated dioxins and benzofurans (Reijnders, 2005). Unfortunately, the scope of RECOAL did not allow for a full investigation of organic compounds, although a literature review carried out by John Boxhall suggested that the risk of organic compound contamination in the coal ashes at Tuzla was low (Boxhall, 2007a).

Of special concern is the case of boron, cited frequently as cause of phytotoxicity (El-Mogazi et al., 1988; Carlson and Adriano, 1993). Some authors regard its effects as temporary: boron is not easily incorporated into soil colloids and therefore, it migrates quickly through the leachate- potentially polluting waters (Adriano et al., 2002). There is also empirical evidence that boron phytotoxic effects decrease over time (El-Mogazi et al., 1988; Ahn and Mitsch, 2001).

Pollutants remain longer in soils when adsorbed onto humic and clay colloids depending on the properties of the pollutant, the pH and redox status and nature of the adsorbent, the concentrations and interactions with other metals present and the presence of soluble ligands in their proximity (see Alloway and Ayres, 1993).

Studies of the application of fly ash to enhance agricultural soils have shown that fly ash may improve the structural characteristics of soils by improving the water-holding capacity and plant available-water in coarse or fine textured soils (Adriano and Weber, 2001), and reducing the soil hydraulic conductivity (Pathan et al., 2003). Whether this is also true for soils consisting exclusively of coal ash remains unknown. Water-holding capacity (WHC) is enhanced by the contributions of spherical and amorphous ash particles, with a large surface, to the microporosity and aeration of the soil (Adriano and Weber, 2001). The WHC increases the amount of water available for plants while reducing potentially harmful leaching. On the downside, ashes may reduce water infiltration (Adriano and Weber, 2001), increasing water runoff, soil erosion and loss of topsoil.

3.4.4. Biodiversity, flora, fauna and landscapes

Wet disposal of coal ash has been associated with developmental abnormalities in animals and other negative impacts on phyto- and zooplankton in the water ecosystem (Reijnders, 2005). Some of these effects are discussed in more detail below. There is, however, little literature available regarding the cumulative effects on both wet and dry disposal.

Elevated concentrations of coal ashes in soil may result in phytotoxic levels of boron, and elevated levels of arsenic, molybdenum and selenium in plant tissue (Carlson and Adriano, 1993; Adriano et al., 2002). The incorporation of huge amounts of coal fly ash into soils appears to inhibit plant establishment and germination and to retard early growth stages (Singh et al., 1997). This could be due to high levels of soluble salts and an increase of pH that reduces the availability of essential nutrients (Adriano and Weber, 2001; Singh et al., 1997) such as phosphorus (Bi et al., 2003) and nitrogen16 (Carlson and Adriano, 1993). Inhibition of soil germination may be due to the elevated concentrations of potential pollutants such as heavy metals and other elements (Singh et al., 1997). The development of pozzolanic layers may also influence plant establishment (Carlson and Adriano, 1993). Table 3-4 summarises the effects of the application of fly ashes on Vicea faba L. crops, depending on the concentration of fly ashes.

The toxicity of heavy metals is strongly linked to the bioavailable fraction, that is, the fraction that can be absorbed by the plant. Essential elements such as copper, manganese, iron or zinc are necessary for plant growth, but may be toxic in high concentrations. Non-essential elements such as arsenic, cadmium, mercury or lead are not necessary for plant growth.

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16 Coal ashes contain little nitrogen because most of it is volatilised during the combustion. Phosphorus is not readily available for plants possibly for its interaction with aluminium and iron, and with calcium in high alkaline ash, such as the one found in the TEP TUZLA sites (Carlson and Adriano 1993).
growth and they can be toxic above critical concentrations. Excessive concentrations of heavy metals can induce biochemical processes such as changes in the permeability of cell membranes (cadmium, copper, lead), the inhibition of protein synthesis (mercury), inhibition of enzymes (tantalum, lead, cadmium), or the competition for sites with essential elements or groups (arsenic, selenium). Cadmium, lead and mercury can affect the respiration and photosynthesis process, while cadmium, chromium, mercury, manganese and selenium may result in chlorosis¹⁷ (Alloway and Ayres, 1993).

<table>
<thead>
<tr>
<th>Fly ash concentration in sandy soil</th>
<th>Germination</th>
<th>Plant growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (6-8%)</td>
<td>Enhanced</td>
<td>Stimulated</td>
</tr>
<tr>
<td>High (20%-35%)</td>
<td>Delayed/Inhibited</td>
<td>Retarded</td>
</tr>
</tbody>
</table>

Table 3-4: Effects of fly ashes on Vicea faba L. crops (adapted from Singh et al. 1997)

Some plants bioaccumulate metals in their plant tissues, without detrimental effect to plant growth. In Tuzla, part of the area affected by the coal ash pollution has been covered with a thin soil cover of 10-30 cm thickness. Local residents have cultivated various crops on this ash including leguminous pastures, corn, beans, potatoes and cereals. As a result metals could be transferred into the food-chain posing risks to livestock and ultimately humans (Adriano et al., 2002). Other plants may be affected in the long term by the accumulative effect of coal ash (Brake et al., 2004).

The most successful coal ash colonisers are N₂-fixers, or plants tolerant to high salinity and high boron concentrations, such as some members of the families Brassicaceae, Chenopodiaceae, Fabaceae and Poaceae (Carlson and Adriano, 1993). Some of these can be observed on the disposal sites at Tuzla. Trees have been planted at the edges of the sites (mainly willows and false acacia) but they do not seem to be as successful as agricultural crops. This may be because tree roots tend to reach deeper than conventional agricultural crops; thus, they are more susceptible to the pollutants contained in the coal ash below the thin soil cover.

Unless contamination is quite severe, lethal effects of coal pollution on animals is rarely observed. Instead, chronic exposure to contaminants results in sub-lethal impacts on physiology and morphology of organisms (Rowe, 1998). Thus, a diverse fauna in moderately polluted habitats is not an indicator of lack of toxicity (Rowe, 1998). Indeed, some adult amphibians (e.g. Bufo terrestris) bioaccumulate high levels of selenium which make them good indicators of polluted areas (Hopkins et al., 1998).

For instance Rowe (1998) found that freshwater shrimp (Palaemonetes paludosus) exposed to CCRs pollution accumulated arsenic, cadmium and selenium, while its survival rate was similar to that of the same shrimp living in a non-polluted area. Chronic coal ash exposure increased the energy needs of the shrimps living in the polluted sites. Since animals belonging to different taxons (here crustaceans, amphibians and reptiles) have shown similar responses this is likely to be an impact of coal ash disposal (Rowe, 1998). Banded water snakes (Nerodia Fasciata) exposed to coal ash pollution accumulated metals in liver, kidney and/or gonads, while exhibiting normal activity parameters (Hopkins et al., 2002). In another study, southern toads (Bufo terrestris) captured in coal-ash polluted sites showed elevated levels of arsenic, selenium and vanadium (Hopkins et al., 1998). Rowe (1998) suggests that other negative impacts could be found in “pollution-related elevations of maintenance costs for reproductive output, storage of lipids and growth rates” in

¹⁷ Chlorosis is the yellowing or whitening of normally green plant tissue because of a decreased amount of chlorophyll, often as a result of disease or nutrient deficiency. Chlorophyll deficiency results in a limited capacity to obtain energy from sunlight.
different animal species. Aquatic disposal of coal combustions wastes may also lead to the reproductive failure of many wildlife species, such as common grackles (Bryan et al., 2003).

Although the effect of coal ashes has been widely examined in wetlands, animal impacts are not limited to this environment. For instance, when applied to meadows, coal ashes may raise the rumen pH of grazing animals to the extent that fermentation may be markedly reduced (Reijnders, 2005). In Tuzla, grazing animals and game wildlife are the most likely bearers of risks into the food chain. Although there are no studies on the impacts of coal ash on the local wildlife in Tuzla, local residents notice serious effects particularly on fish.

The main change of land use occurs when the disposal site is established. The ashes create a significant disruption to the valleys, such as at the sites of Jezero and Drežnik, where the local landscape has been completely changed. If the site is located in an old mine (e.g. Plane and Divkovići I and II), it may entail the recuperation of land for agriculture or other uses after the disposal site is capped. However, this apparent enhancement may jeopardise the secondary benefits of the area, for example, increasing soil erosion and water pollution levels.

On the other hand adding coal ash to sandy soils improves the soil structural characteristics and in the short term can enhance crop production. Adriano reports from Jacobs et al. that banding of ash into a field at 45° angle to the surface produced increases in corn (Zea Mays, L.) yield (in Adriano and Weber, 2001). Therefore, the dispersion of coal ash may raise agricultural productivity, but also it may increase the long-term effect of heavy metal accumulation and spreading the risk through the food chain. Due to population pressure at Tuzla, agricultural fields have been established on some of the sites. RECOAL has put considerable effort into understanding the implications of these processes.

3.4.5. Public health and safety

RECOAL did not focus on the potential health impacts of coal ash disposal, but on the development of remediation solutions for the sites (see section below). Thus, existing knowledge about public health in Tuzla is sparse. The exposure pathways for humans are multiple and interconnected, depending on the composition of the ashes, the location of the disposal sites and the specific characteristics of the environment. Generally, the coal ash is likely to result in human exposure via four main pathways:

- Exposure to pollutants in water via ingestion and direct contact: pollutants may migrate into the watercourse polluting surface waters and groundwater. From there they can enter humans directly through the different uses of water (i.e. ingestion, direct skin contact for hygiene, washing, etc).

- Exposure to airborne pollutants via inhalation and direct contact: pollutants released into the air, mainly by the suspension of microparticles, are inhaled but may also cause problems by surface contact, such as eye or skin irritation. Although a soil cover in combination with tree barriers could theoretically break this pollutant pathway, soil covers on the disposal sites present high concentrations of heavy metals, which could still be released to the air. Injuries to the lung depend on the size of the particulates and their pH (Fernandez et al., 2003).

- Exposure to pollutants by ingesting contaminated soil: soil may be ingested suspended in water, as residues in food, or even by accident when developing activities on the polluted soil. Deliberate ingestion also occurs, for instance among children (this is commonly known as pica).

- Exposure to pollutants through the food chain: vegetables may accumulate heavy metals in their shoots, which are later consumed by humans. Also, vegetables may
contain pollutants from the air, soils and water. Cattle ingest pollutants by similar pathways as humans, and therefore, they constitute another route of exposure. Fish, amphibian, and other animals living in waterways and consumed by humans can be a potential source of risk, since they may be directly exposed to the pollutants. In this case study, the analysis of different crops at the disposal sites has shown that plant uptake of heavy metals such as chromium and nickel exceeds the recommended concentrations for similar agricultural crops.

Workers at the combustion plants, local residents and visitors are the main human receptors of this pollution. Health impacts caused by coal extraction and its use are characterised as severe, widespread, and complex (Finkelman et al., 2002). Some of the main health risks from coal ashes arise from the presence of metals and metalloids in its composition. Gupta (1999), for instance, summarises some of the diseases linked with metals frequently found in coal ashes (see Table 3-5).

<table>
<thead>
<tr>
<th>Element</th>
<th>Potential Health Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>Dysfunction in the cardiovascular system, gastrointestinal tract, kidney, nervous system, skin, blood and liver. Common effects are: hepatocellular injury, anaemia, developmental disabilities, embryotoxicity, heart disease, hyperpigmentation and peripheral neuropathies. Chronic ingestion: muscle weakness and aching, skin pigmentation, hyperkeratosis, edema and peripheral arteriosclerosis (blackfoot disease), and myocardial damage.</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Polycythemia, intercellular hypoxia</td>
</tr>
<tr>
<td>Copper</td>
<td>Gastrointestinal disorders, irritation of the respiratory track when inhaled. Excessive intake results in haemolysis, heptotoxic and nephrotoxic effects (e.g. anaemia, hemochromatosis, cirrhosis, atrophy of the liver, tuberculosis, carcinoma). Chronic poisoning results in Wilson’s disease of heptolenticular degeneration.</td>
</tr>
<tr>
<td>Chromium</td>
<td>Allergic skin irritations, dermatitis, irritation to mucous membranes and conjunctiva and gastrointestinal ulcers, chrome holes (i.e. penetrating ulcer around fingernails, eyelids and forearms). Correlated with incidence of lung cancer; carcinogenic, teratogenic and mutagenic.</td>
</tr>
<tr>
<td>Manganese</td>
<td>Accumulates in kidney, liver and bones. Causes cirrhosis, influenza, bronchitis. Chronic exposure results in “manganese psychosis”, an irreversible brain disease whose effects are uncontrollable laughter, euphoria, impulsiveness, sexual excitement followed by impotence and speech disability. Inhalation produces manganese pneumonia.</td>
</tr>
<tr>
<td>Nickel</td>
<td>Asthma, gastrointestinal disorders, headache, neoplasia of lung and respiratory tract. Nickel carbonyl causes nausea, dizziness, headache, chest pain, pulmonary symptoms, tachycardia and extreme weakness, and eventually may be lethal.</td>
</tr>
<tr>
<td>Lead</td>
<td>Overdose causes shock syndrome, haemolytic crisis, anaemia, haemoglobinuria, kidney damage and acute central nervous system symptoms such as paresthesias, pain and muscle weakness. Chronic exposure causes anorexia, muscle discomfort, malaise and headache, gastrointestinal effects, clumsiness, vertigo, ataxia, headache, insomnia, restlessness and irritability. Encephalopathy may result in coma.</td>
</tr>
</tbody>
</table>

Table 3-5: Potential Health Impacts of Pollutants that Could be Released to Water from Coal Combustion Residues (Adapted from Gupta, 1999)
Another set of pollutants of special interest are polycyclic aromatic hydrocarbons (PAHs, such as benzopyrene, benzathracene, benzofluoranthene), known or suspected carcinogens, and aromatic amines that have been linked to urinary tract cancer and tubulointerstitial nephropathies (Tatu et al., 1998). PAHs enter easily into the foodchain and may be linked with the geographical disease Balkan Endemic Nephropathy. These organic compounds were not researched within RECOAL because they were outside the project’s remit.

Balkan Endemic Nephropathy (BEN) is an irreversible kidney disease geographically confined to several rural regions of Bosnia, Bulgaria, Croatia, Romania and Serbia. Its origin is uncertain, however:

"...there is a growing body of evidence suggesting the involvement of toxic organic compounds present in the drinking water of endemic areas (...) leaching by groundwater from low rank Pliocene lignite deposits, and transported into shallow household wells or village springs" (Finkelman et al., 2002)

In this theory, BEN is the result of long-term exposure to PAHs leached in the alluvial valley below the lignite deposits (Tatu et al., 1998). Symptoms seem to be aggravated after a prolonged rainy period, which would link the disease to the transportation of PAHs through the watercourses (Tatu et al., 1998). CCRs disposal sites could also be sources of PAHs, since they may be present in the residues and subsequently leach into the environment. However, the high pH observed in the disposal sites is likely to immobilise these compounds, rather than release them. BEN is identified as a major disease in BiH, and this is an issue of public concern.

Coal has been traditionally linked with a number of diseases. For instance home burned coal may cause chronic arsenic poisoning (including carcinogenic lesions on the skin) or skeletal fluorosis (Finkelman et al., 2002). The ‘black lung disease’ (Coal Workers Pneumoconiosis) is associated with employment in coal mines but its links to coal ash disposal are still unproven.

3.5. Pollution control and reclamation

Given the nature and impact of coal ash disposal, remediation solutions are needed. The development of low-cost and sustainable solutions for coal ash disposal in the western Balkans was RECOAL’s main objective. This section presents an overview of techniques used in land remediation that could be applied in coal ash disposal, to put into context and discuss the selection of remediation options proposed by the RECOAL team.

The remediation of coal ash disposal sites follows pioneer guidance developed for a variety of brownfield sites. The methods of remediation may be used across different situations. EPA (2000: p. 10) classifies remediation and cleanup options for contaminated land into two main groups18: conventional technologies, which are already widely used in mine site management; and innovative or emerging technologies, not widely available and still in a development stage.

In addition to the methods reviewed in this section, EPA considers institutional controls, such as restricted access, deed restrictions, zoning, limited future development, regulatory requirements, and procedures for soil disposal, health and education programs, to be highly necessary and effective in preventing risks. Despite the differentiation, most of the methods are applied in combination. This is due to the variety of effects of coal ashes and the need for targeting different effects simultaneously.

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18 Another classification (Wood, 1997) divides land reclamation methods into engineering approaches (as traditional methods of excavation and disposal) and process-based techniques (including physical, biological and chemical process). In this review I have chosen the EPA classifications for three main reasons: First clarity and structure. Second, it allows a differentiation of innovative methods; and third, the terminology of ‘engineering approaches’ overlooks the fact that what the author calls process-based techniques could also be classified as engineering approaches.
3.5.1. Conventional techniques

Conventional techniques are those that have been widely applied in a diverse range of mineral polluted sites and waste landfills, and hence are considered 'standards'. Some problems related to the application of these technologies are the production of new residues that need to be managed, the high costs associated and their limited effectiveness. Conventional techniques include treatment technologies, collection, diversion and containment technologies, and reuse, recycling and reclaiming technologies (USEPA, 2000: 10-3).

Treatment technologies change the composition of the waste by either removing or destroying harmful components of the waste or transforming the pollutant into a less toxic, mobile or reactive form. Examples of widely available treatments are:

- **Chemical treatment.** Organic and inorganic contaminants are chemically transformed into less environmentally aggressive states. Some of the most common types of chemical treatment include oxidation/reduction treatments, dechlorination, hydrolysis and pH adjustment (Wood, 1997). The cost of these treatments varies, depending on the location of the landfill, and the components that need to be neutralised.

- **Stabilisation.** Contaminants can be transformed into less mobile (or less soluble) forms, minimising their potential environmental damage. The costs of these treatments can be significant, depending on the binder or stabilisation agent. Some agents commonly used are Portland cement, pozzolanic materials\(^{19}\), lime, silicates, clays or polymers (Wood, 1997).

- **Solidification.** This process consists of a physical treatment to encapsulate waste in a monolithic solid of high structural integrity, such as in containers or by cementation. Though some methods of solidification can be inexpensive and seem to be very efficient, they pose significant risks because the matrix can break down releasing the harmful constituents.

- **Mechanical separation.** Pollutants can be separated from the matrix applying differential physical characteristics such as density or magnetic separation (Mulligan *et al.*, 2001). Gravimetric separation is spontaneously happening in the wet disposal sites of TEP Tuzla, although the final separation is not carried out.

- **Thermal desorption and destruction.** This refers to the use of heat to separate a contaminant from the containing waste or destroying the contaminant. When metals are volatilised and recovered through pyrometallurgical processes it is referred as pyrometallurgical separation (Mulligan *et al.*, 2001). Although these techniques are very efficient (it can result in the total elimination of the compound) they are restricted to a limited number of metals at a high cost.

- **Solvent extraction.** This method uses chemical equilibrium separation techniques to separate contaminants in situ, through the application of a non-aqueous liquid reagent. For instance leaching (i.e. acid leaching that mobilises the inorganic compounds) is used to extract pollutants, and it can also be used to estimate the mobility of the pollutants (Mulligan *et al.*, 2001).

- **Electrokinetics extraction.** The separation of materials occurs using a low intensity current between cathode and anode embedded in the contaminated soil (Mulligan *et al.*, 2001). The availability of this technique is limited, determined by the site characteristics and requires time and maintenance of the electrodes.

\(^{19}\) Fly Ash is a stabilisation agent itself. CCRs are sometimes combined in modern cover systems (Nathanail and Bardos, 2004).
• **Soil washing and soil flushing.** Both processes consist of chemical and physical extraction techniques commonly applied to excavated soils. Costs, including the cost of removing and returning the soil, may be very high. Soil flushing employs water, with or without additives, to solubilise contaminants, while soil washing employs chemical agents (e.g. sulphuric and hydrochloric acids, chelating agents), to remove both organic and inorganic components (Mulligan et al., 2001).

The main type of chemical treatment is the inducement of redox reactions, which detoxify, precipitate, or solubilise metals and/or metalloids. Oxidation reactions may include the addition of oxidising agents (i.e. potassium permanganate, hydrogen peroxide, hypochlorite or chlorine gas while reduction reactions use alkali metals such as sodium, sulphur dioxide, sulphite salts or ferrous sulphate) (Mulligan et al., 2001). Chemical treatments and stabilisation are promising treatment options for the Tuzla sites. Other chemical treatments aim to isolate metals. For instance lead, cadmium and zinc can be isolated in insoluble minerals such as phosphates (Lambert et al., 1997).

The adjustment of pH is commonly achieved by neutralisation reactions. On the sites in Tuzla, the addition of humus could help to reduce the high pH observed. In addition, this would serve as a pre-treatment, prior to the establishment of a vegetation cover. As a result, heavy metals will be more labile, increasing their migration and spreading pollution: if a pH treatment is required on site, its consequences should be evaluated in advance.

Solidification and stabilisation techniques may be used in-situ or ex-situ. In-situ protocols have lower costs but physical problems make it only suitable for shallow pollution sites (Mulligan et al., 2001). In the Tuzla case, ex-situ solidification is to be used for future disposal sites. TEP is considering solidification of ashes, prior to its disposal; solidification would reduce the spread of the ashes by wind erosion. Extraction of metals for commercial use is theoretically possible through pyrometallurgical separation (Mulligan et al, 2001) or solvent extraction (Reijnders, 2005). However, unless analytic results show very high concentration of metals in the ashes, this is unlikely to be feasible for the Tuzla sites.

Collection, diversion and containment techniques consist of the isolation of the contaminant by preventing any possible pathways of exposure. All control, diversion and containment technologies reduce the risk, but do not eliminate the pollutant.

• **Landfills** are conditioned sites in which wastes can be relocated or concentrated, in a location that minimises the risks. They can also incorporate containment systems such as cover systems (e.g. capping), in-ground barriers (e.g. cut-off walls) or liners (Wood, 1997).

• **Cut-off walls** are structures designed to prevent the flow of groundwater and water runoff. They may also prevent water entering the contaminated area and divert it. Slurry walls and cement walls are common types of structures, with cement being more expensive than slurry. When these methods are unaffordable, sheet piling (piling up different materials) can also be used for a short period of time.

• **Capping** includes the establishment of a layer of topsoil, frequently clay. Enhancement with chemical sealers, revegetation or concrete and synthetic covers are some of the options that complement the establishment of the topsoil.

• **Pumping groundwater** is a method to extract the water and decontaminate it ex situ. It is frequently combined with the establishment of slurry walls (Mulligan et al., 2001).

• **Detention/sedimentation controls** are used to control erosion and runoff, normally allowing settling of suspended particles at the natural rate. They can also consist of settling basins or wetlands.
Interceptor trenches are ditches filled with permeable material (frequently gravel) that collect and redirect the water. The costs of interceptor trenches are moderate depending on the availability of materials. Sometimes permeable barriers are combined with a chemical treatment through the addition of a reactive agent, treating the pollutants in addition to controlling the water flow (Mulligan et al., 2001).

Erosion controls are common engineering measures to avoid erosion and include covers, wind breaks, runoff detention structures or diversions. In particular diversions are engineering works that divert ground or surface water from infiltrating contaminated areas, avoiding the posterior leaching or migration of pollutants. Stream channel erosion controls can also be used.

Being relatively inexpensive and straightforward, capping has been used by TEP Tuzla on two of the disposal sites (Plane and Drežnik) with further revegetation. This has reduced wind erosion, reducing infiltration (and therefore leaching) and improving the landscape. Furthermore, the establishment of a soil cover reduces the amount of oxygen reaching the waste, resulting in less oxidising reactions that would increase metals solubility (Lindgren and Rasmuson, 1994). The main risk is posed by the development of cracks over time which allow water to infiltrate and may cause leaching of potential pollutants (mainly selenium) (Lemly, 1999). The risk of water pollution at the Tuzla sites is high, since the capping layers are far from stable, and they are ploughed regularly for agricultural use. Interceptor trenches have been established at some sites, but only part of the collected water is reused, while most of it (up to 60%) is returned to the main river in the area.

While wetlands can certainly improve the quality of the down-gradient receiving waters, benefits are likely to be jeopardised by the sedimentation and bioaccumulation of potential pollutants in the wetlands. Furthermore, if it is considered that wetlands constitute an attractive habitat for fish, birds and other species, the likelihood of exposure of the fauna to pollutants increases. In his study of selenium pollution from coal ashes Lemly (1999) concludes that these wetlands constitute a net loss of benefits and creation of an ecological liability that did not previously exist.

The variety of alternative uses for coal ashes, widely developed by the industry, reduces the need for landfill, costs and environmental impacts. In Tuzla ashes have been used to refill abandoned coal mining sites. They could also be used as clinker in the cement industry and as isolating material in highway construction. However there are constraints to the reuse of CCRs, in particular, CCRs based industries are capital-intensive and need considerable investment and interested parties may not always be aware or willing to reuse CCRs (Asokan et al., 2005).

CCRs are widely used in the construction industry as components of cement and asbestos, as constituents of CCRs-based bricks, as a binder in Portland cement, as a substitute for timber products and as base course in embankments and roads construction (Asokan et al., 2005). Some advantages of fly-ash-based cement, in comparison with ordinary Portland cement, are increased resistance to lime leaching, alkali aggregate reactions and carbonation, smoother surface, lower water permeability and penetration of chloride and sulphate ions (Ibid.). Until 2006, TEP provided 200,000 t/year of coal ash to the nearby cement plant of Lukavac (reducing the disposal of coal ash by more than 20%). However, a dispute about the price of the ash has ended up in the tribunals.

One of the study sites is a former coalmine, while new mines are in use close to TEP. The use of coal ashes to refill mines is a controversial issue since its long-term effects are uncertain. For instance, it has been said that coal ash filings may react with naturally occurring fluids such as rainwater, organic-contaminated runoff, and acid mine drainage and pose significant pollution risks (see Kazonich and Kim, 1999). Alkaline ashes are
potentially remediation additives to acidic coal residues and acidic mine spoils, but the acidic leaching on the ash induces the release of pollutants to the environment.

The enhancements derived from the addition of coal ashes to soils have been already explained in Section 3.4.3: increasing the soil water-holding capacity, reducing hydraulic conductivity, providing a source of extractable P, and therefore increasing crop production (Pathan et al., 2003; Carlson and Adriano, 1993). Physical and chemical characterisation of the ashes is necessary, prior to its soil application. Factors such as texture, pH, moisture content, reactivity of ash and soil, ion exchange capacity, method of application and percentage of addition determine the final results (Asokan et al., 2005). The uptake of trace elements from ash is also dependent on plant maturity and crop type (Brake et al., 2004). The extreme alkalinity of the CCRs in TEP Tuzla makes them applicable only on extremely acidic sites.

3.5.2. Innovative and emerging technologies

The innovative technologies explained here are still under development. They are not widely available due to unknown costs and performance data. At the moment some of these techniques are quite promising, offering feasible and environmentally-responsible technologies for land reclamation. They have been developed as a response to the shortcomings of conventional technologies for remediation of metal/metalloid polluted soils, commonly regarded as expensive, time consuming, only partially effective and producing new wastes that are difficult to handle (Fitz and Wenzel, 2002).

Bioremediation is a particular type of treatment applied in situ or ex situ, which includes the use of microbiota as a catalytic agent that can degrade a large number of contaminants (Wood, 1997). Naturally occurring aerobic or anaerobic processes are cheap and easily combined with other treatments. More elaborated bioremediation techniques include bioleaching, biosorption, biologically induced redox reactions and biomethylation.

Two common examples of the use of bioleaching are the oxidation reaction with the bacteria Thiobacillus sp, used to extract copper, zinc and uranium, and the production of citric and gluconic acids with the fungus Aspergillus niger (Mulligan et al., 2001). Biosorption is a promising and inexpensive technique in which metals may be absorbed into biomass such as algal or bacterial cells, dead or alive (Ibid.). Sulphate reducing bacteria and other bacteria such as Bacillus subtilis can perform redox reactions. By the addition of a methyl group to a metal, biomethylation increases the volatility of the compound. Biomethylation has been applied to selenium, but currently it is not commercially available (Ibid.).

However there are a few disadvantages associated with these methods (e.g. Wood, 1997):

- some of the microbiological processes require long process times;
- some processes may form hazardous intermediate products;
- they are only applicable to selected contaminants (most inorganic contaminants are not treatable); and
- some contaminants may inhibit the degradation (for instance pesticides or heavy metals).

There are many examples of the combination of bioremediation approaches with other land remediation methods. For instance, fixation of nitrogen can be achieved by planting forage legumes. This system, depending upon the nodulation of clover roots by nitrogen-fixing bacteria, was found to be effective one year after soil replacement in an abandoned coalmine (Rimmer and Younger, 1997). Ex-situ bioremediation may be carried out in treatment beds, biopiles vented and irrigated bioreactors or simply by mixing the contaminated soil with organic materials (Nathanail and Bardos, 2004). In the Tuzla case
study microbiota were examined in the soils to evaluate their activity, but this did not result in any potential bioremediation treatment.

Phytoremediation involves the use of plants to extract, stabilise or detoxify contaminants in soil and water. Three main phytoremediation techniques may be applied:

- **Phytoextraction** uses plants that accumulate pollutants in their shoot and leaves, to harvest and dispose them afterwards.

- **Rhizofiltration** is a similar process in which pollutants are accumulated in the rhizosphere, by the roots of the plants, commonly in the form of bulbs.

- **Phytodegradation** is the degradation of organic pollutants due to plant exudations, decreasing the pH and forming metal complexes (Mulligan et al., 2001) or volatilising its components, either removing or stabilising hazardous metals and metalloids.

Phytoremediation can be complemented by traditional agricultural practices such as fertilisation (for instance reducing the pH and increasing metal bioavailability), the addition of synthetic chelators, crop rotation, pest control and irrigation (Lasat, 2000).

The main problem of phytoremediation is that, while it decontaminates the polluted site, it leaves the problem of disposing heavy-metal contaminated plant material (Lambert, et al, 1997; p. 98). Most authors recommend its use only in shallow soils with lower levels of contamination, using fast-growing plants (Mulligan et al., 2001).

Phytoremediation has been already tested on the Tuzla sites, although unsuccessfully, by the establishment of a *Salix* sp. Also, RECOAL tested a soil-vegetation system to retain dissolved and particle-bound potential pollutants and to buffer the pH from the effluent in the disposal site Drežnik. This system appeared to be more effective when the pollution is moderate, being able to reduce average arsenic concentrations by 75% (RECOAL, 2008). However, this system is likely to pose problems like those discussed above for wetlands, such as increasing the long-term contamination risks to animal and plant species that interact with the soil-vegetation system.

### 3.6. The implementation of solutions: governance challenges

The previous section explored different alternatives to manage coal ash disposal. However, only some solutions are suitable for the case study in Tuzla. Indeed, a pre-selection of relevant solutions informed the proposal of RECOAL. The research in RECOAL was motivated by a perceived need for cultivation land in the communities around the disposal sites; thus, it was deemed that stabilisation methods using amendments or soil, which could support crops, would be the most appropriate solution in this case. For water remediation bioremediation methods and mechanical filters were regarded as the most suitable alternatives. Although the perceived agricultural demands on the sites were presented as the main justification for the selection of potential solutions, the selection was also informed by the background of the members of the project. The project was initiated by soil and agricultural scientists: hence the preference for agricultural methods rather than chemical or civil engineering solutions.

Another issue considered in the design of the RECOAL technical annex was the concern that the responsibility of the project did not extend beyond the design of solutions and the provision of recommendations to local organisations capable of taking action on the remediation of coal ash disposal sites in the western Balkans and, in particular, Tuzla. For this reason solutions needed to respond to local demands (i.e. so that their adoption would not need additional incentives) and needed to be low cost because of the limited resources available in BiH. The institutional structure governing environmental policies, distinct in interest and operation from those governing energy resources and the social actors...
lobbying it (local communities, NGOs, and other actors) will also influence the development of RECOAL.

As in the case of the energy sector, the environmental sector in BiH is highly conditioned by the consequences of the Dayton agreement. Interviews with local NGOs in Tuzla confirmed that after the war, given the more immediate needs for reconstruction and reconciliation, environmental issues were left aside. Because of the scarcity of available resources in the country, most environmental actions have been developed by local organisations with the support of international organisations. The war also left other legacies in BiH: (1) a chaotic and unmanageable institutional system which costs the country over 60% of its GDP; (2) the maintenance of an inaccessible centralised system of governance in which local institutions lack capacity for action; and (3) a generalised distrust in any institution among citizens who do not see themselves represented in the nationalistic parties or in the bureaucratic structures of decision-making. This has left citizens with a sense of powerlessness which hinders negotiations about any social problems, let alone those addressing environmental concerns.

Within the government, most of the responsibilities for environmental policy fall within the municipalities in RS and the municipalities and the Cantons in FBiH. Municipalities are responsible for local matters including managing the provision of communal services, maintaining roads and pavements and regulating sectors such as waste management and water pricing systems. This gives municipalities an important role in regulating planning and environmental impact assessment. In the FBiH municipal activities are under the guidance of the Cantons. Cantons are regional entities that in some cases reflect the subdivision of the FBiH along Catholic and Muslim lines. Cantons are composed of government-like institutions, including several ministries, institutes and associated organisations. Thus the policy process is further hindered by the complexity in the distribution of responsibilities between municipalities and Cantons (Miović, 2007). Cantons and municipalities dispute with each other the right to govern former national assets such as public utilities (Jokay, 2007), but the control of them by the entities (FbiH and RS) seems at the moment unquestioned.

Municipalities are further divided into ‘local communities’ whose main remit is to communicate local concerns to the Municipality. Local communities are led by an elected ‘secretary’ (‘povjerenik’, meaning ‘commissioner’ or ‘trustee’), who develops political action to bring the interests of the local community to the Municipality. Although the local communities lack resources, they organise frequent local meetings to discuss concerns that affect everybody in the community, such as electricity supply, district heating or the perceived state of the environment. More recently, the local communities have emerged as institutions facilitating the participation of every resident in decision-making. For example, TEP Tuzla has frequent meetings with the local communities of Husino, Sicki Brod, Bukinje and Solana, the communities geographically closest to the plant. TEP Tuzla uses these meetings, to which public attendance is open, to communicate with local residents. For example, TEP recently held local community meetings to obtain the local residents’ support for their application for a loan from the International Monetary Fund (IMF). Also local community consultations have been held regarding the concession of a permit for the enlargement of a disposal site, Jezero II.

The local communities also participate in consultations led by the Municipality. In Tuzla municipal officials are particularly proud of the Local Environmental Action Plan (LEAP). The LEAP was an initiative of publicly held consultations in every local community of the Municipality of Tuzla. The results of these meetings were compiled into a report summarising the most urgent environmental problems identified by the local communities (Bektašagić and Žabić, 2007). The Plan has served as a basis for further environmental projects beyond the Municipality. For example, several local NGOs have used the plan to apply for external funding and carry out additional bottom-up initiatives in Tuzla.
Non-governmental initiatives become extremely important in a context in which the rule of Law on environmental issues is questionable. Regarding physical planning, the legislative framework is partially built on former Yugoslavian policies (Jancar-Webster, 1993). For instance, until 2002, the Law on Physical Planning was kept in force. This regulated land uses including dispositions for environmental protection. Although new regulations on Physical Planning and Construction were published in 2002, the former procedures continue to serve as a reference for the implementation of the new laws.

In BiH, the government is monitored by an international 'protectorate' whose remit is to implement a governance plan for BiH in accordance with democratically-inspired values (Pugh, 2002). The 'protectorate' includes several institutions such as the Office of the High Representative (OHR) of the Peace Implementation Council, the United Nations (UN), the missions of the Organization for Security and Cooperation in Europe (OSCE) and the European Union (EU), the International Management Group (an EU-funded body that undertakes reconstruction evaluations), aid agencies and international financial institutions. Although there is no doubt that this protectorate has been able to maintain the truce that ended the conflict in the 1990s, critics say that the very presence of these organisations (with authority over elected politicians) prevents the Bosnian society from developing in a truly democratic way (e.g. Belloni, 2001; Chandler, 2000).

Most environmental policies have been promoted by international organisations (see REC, 2000; NEAP, 2003; Agriconsulting, 2005). Democratisation and sustainable development are priorities on the environmental governance agenda of the international protectorate (e.g. UN, 2004). More recently, greater emphasis has been given to government decentralisation and increasing participation in local decision-making (e.g. OSCE, 2007). Environmental policies have been supported by the development of several strategic papers such as the National Environmental Action Plan supported by the World Bank (NEAP, 2003) or the Poverty Reduction Strategy Paper (Mid-Term Development Strategy of BiH 2004-2007) developed in conjunction with the International Monetary Fund (IMF, 2004). More recently, on 1st of October of 2008, BiH adopted the Aarhus Convention on access to environmental information, public participation in decision-making and access to justice in environmental matters.

The support of the international community, in particular the European Union (EU), led to the development of breakthrough legislation on environmental matters. A set of environmental legislation was developed under the PHARE EU programme. This consisted of six new regulations on (a) environmental protection, (b) air protection, (c) water protection, (d) waste management, (e) nature protection, and (f) the creation of an environmental protection fund. The legislation was partially based on the principles and standards of the European Union (for example, it contains detailed provisions for the introduction of Environmental Impact Assessment methodologies originating from EU procedures) but also contained original contributions, in particular the creation of an Environmental Protection Fund as a means of implementing the polluter's pays principle. The laws at the national level were transposed into new regulations in the FBiH in 2003 (equivalent laws were published in RS). In the FBiH, the laws needed to be transposed for each Canton which has delayed the process of implementation. At least in Tuzla, the

20 Official Gazette SR BiH 9/87
21 Official Gazette of the Federation of Bosnia and Herzegovina 52/2002
22 Official Gazette of the Federation of Bosnia and Herzegovina 55/2002
23 PHARE is an EU programme that provides funds to accession countries to prepare them for membership of the EU. Also, integration measures and the development of harmonising regulations are supported by the CARDS Project (EC Support to the BiH Government in the European Integration Process).
24 Environmental protection (Official Gazette of F B&H, No. 33/03); Air protection (Official Gazette of F B&H, No. 33/03); Water protection (Official Gazette of F B&H, No. 33/03); Waste management (Official Gazette of F B&H, No. 33/03); Protection of nature (Official Gazette of F B&H, No. 33/03); and Establishment of an 'Environmental Fund' (Official Gazette of F B&H, No. 33/03).
environmental governance structures appear to have little impact on the implementation and enforcement of these regulations.

The energy sector in BiH is facing environmental and economic challenges. In the FBiH, most decisions lie with the National Public Utility Company, Elektroprivreda (EP). EP currently faces an external challenge on two economic fronts: on the one hand the urgent need for modernisation, after having reconstructed the infrastructure damaged during the war in order to be able to compete in international markets; on the other hand, EP is challenged by the international community to reform the institution towards a private supply of electricity (which indeed has resulted in the opening up of the company to international investors, as explained in Section 3.2). Thus, the request to comply with environmental regulations and the implementation of best available technologies (BATs) is hindered by the need to respond to the most pressing challenges explained above (although current efforts towards modernisation include the implementation of end-of-pipe remediation technologies, such as air pollution filters in thermal-power plants).

The question of the control of EP is further complicated by the division of the company along ethnic lines, in parallel to the government institutions as explained in Section 3.2. Thus, nationalistic conflicts are also manifest in the management of EP. The decision-making is concentrated in three urban centres (Sarajevo, Mostar and Banja Luka, each with its distinct ethnic identity), while the production of electricity concentrates in areas that do not have easy access to these decision-making centres, such as Tuzla and Kakanj. In the case of Tuzla, the nationalistic question has added consequences. Tuzla has been traditionally considered a tolerant, non-nationalistic, centre. Indeed, nationalistic parties get a strikingly small representation in the Canton of Tuzla, particularly when compared with the other nationalistic strongholds. In terms of energy, Tuzla depends on the decisions taken in Sarajevo, a Bosniac stronghold. Thus, according to local officials, political decisions tend to disregard Tuzla as an important player, because local residents tend to vote for non-nationalistic parties, and thus, Tuzla counts little for nationalistic votes.

The conflict with TEP in Tuzla resonates with this question. Decisions regarding the functioning of TEP in Tuzla are taken in Sarajevo. Thus, Sarajevo-based managers have few incentives to engage with the additional demands posed by Tuzla’s authorities and citizens. In Tuzla, the lack of action regarding the environmental degradation caused by TEP Tuzla is regarded as the product of this political situation. As one municipal representative said jokingly during an interview “local managers in TEP cannot buy toilet paper without asking permission from Sarajevo”. Thus, the state of environmental pollution can be regarded as an example of the regional discrimination that non-nationalistic areas suffer in BiH, a situation that is created and maintained by the deficiencies of the Dayton agreement.

The implementation of regulations in Tuzla takes place within a highly complex institutional structure, with limited finances. A good example of the mismatch between intended transposition of law and actual implementation is the case of the ‘Environmental

25 The Social Democratic Party of Bosnia and Herzegovina - Socialdemocrats (Socijaldemokratska Partija BiH - Socijaldemokrati / Социјалдемократска Партија БиХ - Социјалдемократи) confirmed its stronghold in Tuzla in the October 2008 elections, against the backdrop of rising nationalism in most areas. SDP is a centre-left political party successor of the Communist league of Bosnia and Herzegovina, the regional branch of the League of Communists of Yugoslavia, led by Tito until 1980.

26 There is now considerable discussion about the need for reforming the Dayton agreement and the possibilities to create a new constitution. In a recent talk at the London School of Economics and Politics (03.11.2008) the current Official High Representative in Bosnia and Herzegovina, Miroslav Lačaj, explained that the only way forward he saw required the agreement of the nationalistic parties on the need of reform of the agreement. However, because the Dayton agreement reinforces the power of nationalistic parties in BiH, is unlikely that they will reach an agreement. Mr. Lačaj resigned in February 2009, being substituted by Valentin Inzko, an Austrian diplomat.
Fund’, one of the regulations mentioned above. The Law follows widespread practice in Central and Eastern Europe (Francis et al., 1999) using the ‘polluter pays principle’ by establishing a tax on those practices considered as polluting and using these revenues to ameliorate impacts. In 2006, a municipal worker explained in an interview that the implementation of the Fund had failed:

Municipal worker: It’s been more than three years [since the adoption of the mentioned legislation] but the Federal Fund for environmental protection has not been established yet. (...) Only one part is functioning – that is, the collection of the pollution levy from car owners. (...) [T]he Government of Tuzla Canton had that environmental fund, too, but it eventually abolished it.

Interviewer: Does it mean that the businesses do not pay their legal obligations?

Municipal worker: (...) [W]e got a change of government and the new government is not happy to ask 'their' companies for that sort of contribution because this new government needs money for some other things.

Further research on this topic showed that the Municipality had tried to charge TEP Tuzla following the requirements of this law. This Law would have effectively re-distributed funds from the central areas were decisions are made (e.g. Sarajevo) to areas that suffer the environmental impacts of pollution (e.g. Tuzla). According to a Municipal Official, the government in Sarajevo halted the implementation of the law to avoid the redistribution of financial resources following the environmental impacts of companies such as TEP.

The complexities of the transition system and decision-making are further complicated by the confusion between rules and institutions. Perhaps the most notable conflict is that over property rights. For instance, the issue of who is the legal owner of the coal ash disposal sites is contentious. According to municipal officials, the land was lent to TEP on the condition that after the disposal was finished, the land would be returned to the Municipality. This transfer of ownership and any associated conditions are currently being negotiated between TEP and the Municipality. The issue is further complicated through the use of the land by some local residents and farmers/entrepreneurs for agriculture and grazing while the sites have been without any effective control. Currently, the use of the sites continues to operate informally, and the establishment of clear and effective property rights is likely to create a conflict of interests and claims with those who are currently using the sites. However, it is clear that the resolution of this issue is paramount to implement any regeneration programme on the sites. The Municipality is pressed by the lack of land for development and the construction of infrastructures. Thus, they find themselves ‘bargaining’ with TEP for the land of the disposal sites, in exchange for what is considered a ‘historical debt’ (the tax that, according to the Municipality of Tuzla, TEP should pay on account of air pollution) with the city of Tuzla. TEP has the opportunity of benefiting from the negotiations by shifting to the Municipality a long-term liability (the disposal sites). On top of that, TEP argues that returning the sites back to the Municipality should be considered a payment for the ‘historical debt’.

3.7. Conclusion

This chapter reviewed some of the difficulties in establishing the boundaries of the RECOAL case study (the disposal of coal ash in the western Balkans, and particularly in Tuzla). The establishment of the boundaries of the case study is conditioned by the availability of resources and information as well as the capacity of the researcher to synthesise the relevant aspects that can help to understand the problem. Yin (1994) explains that, in case studies, the boundaries between the phenomenon and the context may not be clearly evident. Moreover, coal ash disposal is a multi-faceted issue influenced by multiple social, natural and technological factors.
In addition, this chapter argued that RECOAL stakeholders regard the disposal of coal ash in Tuzla as an urgent issue. Local institutions, industry and even scientists seem to agree on the need to find a solution for the disposal of large amounts of coal ash, even though they may have different ideas about what is the best way to do so. The absent actor in this discussion has been local residents, who are those most affected by the disposal of coal ash. Local residents views have not been discussed in this chapter: they will be reviewed in detail in Chapters 5, 6, 7 and 8. The analysis presented in the following chapters is mediated by the researcher's understanding of what are the key aspects of the problem (i.e. the economy of the energy sector, the technologies of coal energy generation and coal ash disposal, the environmental impacts of coal ash disposal, and the political structures that enable environmental actions). These ideas will inform the content of subsequent chapters.
4. Methodology and Methods

4.1. Introduction

This chapter provides an overview of the methodology used to answer the research question posed in previous chapters, about how different actors participating in RECOAL or affected by the project construct the problem of coal ash disposal. The previous chapters explained why this question was worthy of research. Chapter 2 explained the significance of social constructionism in understanding environmental issues while Chapter 3 presented some social, political, economic and technical aspects of the issue of coal ash disposal in Tuzla, BiH. This chapter explains the methods used to generate and analyse the data for the inquiry.

The research question sought to highlight the subjective experience and meanings of coal ash disposal sites among different RECOAL actors. This, in turn, would explain how the coal ash disposal sites come to be understood as posing an environmental problem. The interpretivist paradigm is useful to reconstruct the subjective experiences of the actors (Hughes and Sharrock, 1997). In parallel to symbolic interactionist approaches, the interpretive paradigm views social phenomena as the result of interactions between different social actors. A central assumption emerging from this paradigm is that understanding social phenomena requires looking at the interpretations of the actors themselves. From a social constructionist perspective this means looking at the claims-making activities aimed at attracting society’s attention to a putative condition in society. Bringing the views of the actors themselves to the fore is a complicated task; particularly when there are large and heterogeneous groups of relevant actors and few opportunities to approach them, such as in the case of RECOAL.

The methodology presented here has been developed towards building empathy with the actors participating in RECOAL, to build an understanding of their perspectives through the sensitive collection of qualitative data. Table 4-1 brings back the research questions presented in the Introduction, and summarises the information and data collection methods used to answer these questions in this thesis. The following sections explain how these methods were developed and the difficulties encountered in applying this approach. Section 4.2 focuses on the role of the researcher and how this was shaped by my previous experience and the researcher’s position in RECOAL. Both sections 4.3 and 4.4 focus on the methods for data collection and the development of fieldwork. Section 4.5 explains the procedures used for data analysis and reporting. Finally, Section 4.6 focuses on the ethical issues that affected the research.
<table>
<thead>
<tr>
<th>Research Question</th>
<th>Information required</th>
<th>Data collection methods</th>
</tr>
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<tbody>
<tr>
<td><strong>Meta-question:</strong> What happens when a land regeneration project is considered within the social context in which it is developed?</td>
<td>Understanding the social context of a land regeneration project, how the project is developed and which factors of that context appear to influence it.</td>
<td>Development of a case-study taken the whole land regeneration project (RECOAL) as the unit of analysis.</td>
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<tr>
<td><strong>Project specific question:</strong> How do RECOAL stakeholders construct the environmental problems to be addressed by the project, and how these perspectives influence, and in turn are influenced by its development?</td>
<td>Understanding the views of different actors on the project’s object of research and how these views develop as the project unfolds.</td>
<td>Different aspects of the question addressed in the sub-questions below.</td>
</tr>
<tr>
<td><strong>Sub-question 1:</strong> What are the different perspectives on coal ash pollution of local residents in Tuzla and how are they related to their perceptions of the place?</td>
<td>An analysis of the claims about coal ash pollution, and environmental pollution more generally, made by local residents.</td>
<td>Interviews with local residents, field diary and observations.</td>
</tr>
<tr>
<td><strong>Sub-question 2:</strong> What are the different conceptualisations of pollution that influence the views of scientists and local residents in Tuzla?</td>
<td>An analysis of how the concept of pollution is employed in the talk of environmental scientists and local residents in Tuzla.</td>
<td>Review and analysis of scientific literature on environmental pollution. Interviews with local residents, field diary and observations.</td>
</tr>
<tr>
<td><strong>Sub-question 3:</strong> How is knowledge about the risks associated to the coal ash disposal sites developed within RECOAL and within the local communities?</td>
<td>An analysis of how RECOAL researchers and local residents in Tuzla construct and present knowledge about the risks associated to coal ash disposal sites.</td>
<td>Interviews with RECOAL researchers and participant observation within the project. Interviews with local residents at different stages of the project.</td>
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<tr>
<td><strong>Sub-question 4:</strong> What are the local expectations about the benefits that RECOAL should deliver, and how do RECOAL members deal with them?</td>
<td>An analysis of the expectations expressed by stakeholders, and how RECOAL members adjust their practices according to these expectations.</td>
<td>Interviews with all RECOAL stakeholders. Participant observation within the communication events developed by RECOAL.</td>
</tr>
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Table 4-1: Research questions, information requirements and collection methods.
4.2. The researcher's role and reflexivity

One of the findings presented in Chapter 2 is that scientists operate within a set of assumptions emerging from their experience, thus, scientific practice is necessarily socially situated. The research discussed in this thesis is influenced by biases emerging from previous experiences. Gadamer (1977) argued that prejudices, also referred to as *prejudgements*, are inescapable conditions of being and knowing; they are part of the process of knowing, both enabling and obstructing the enterprise of building knowledge (Gadamer, 1977). Therefore, biases and prejudices need to be identified as part of the methodology in which a researcher operates.

Prejudices do not only come from the researcher as an individual: they are also developed in a context. Indeed, according to ethnomethodological writings, all uses of language and action are *indexed*, that is, they are contingent on the context in which they emerge (Garfinkel, 1984 (2002)). A researcher's account of her research is not an exception to this condition. Another concept borrowed from ethnomethodology is *reflexivity*, that is, the idea that all accounts simultaneously *say something* and *do something* (Garfinkel, 1984 (2002)). Pierre Bourdieu (2004) developed this concept at his final lecture at the Collège of France, in which he positioned himself in his 'social space'. He aimed at taking a point of view of the author "to break with the illusion of an absolute point of view, which is characteristic of every point of view" (Bourdieu, 2004; p. 95). He then proceeded to provide an account of his own point of view as a sociologist, presenting what he calls a 'sketch for a self-analysis'.

This thesis follows Bourdieu in recognising that the account presented here is as much a social construction as the accounts which the thesis investigates. Yet, its findings are relevant to our social life, in the same way that the perspectives and accounts of the social actors presented here are relevant to understand the problem of coal ash disposal. Two things differentiate the following account: 1) it is a systematic process of collecting and arranging knowledge; and 2) it aims at being *reflexive*, by looking at the conditions that shape it and make it possible. What follows is a personal account of my research experience, provided in the first person. With this account I want to demonstrate that my research was *indexed*, that is, situated in a particular context, and reflexive, it provides an account that 'does' something beyond presenting an argument.

The research has been chiefly shaped by its development within RECOAL (sometimes the development has been actually 'in parallel'). It is important to explain here that my previous education primarily focused on technology and engineering. Although I had been introduced to some aspects of social research during my postgraduate studies in environmental sciences and during work experience in environmental policy, when I started the EngD I had a somewhat naïve understanding of social research. On arrival I was given the opportunity to work on two different projects in Forest Research. One of them was RECOAL. The other one was SENSOR, a project to develop sustainability appraisal tools within a large consortium of twenty partners across Europe. During the first meeting my academic supervisors suggested that I should, at least initially, focus on RECOAL and its technical components, to make sure that I cover the engineering requirements of this Engineering Doctorate. I adopted this argument gladly, mainly because I was intrigued about the Balkans and I was looking forward to travel there, without questioning whether SENSOR was strategically a better project, in terms of getting more data (SENSOR consisted of several case-studies around Europe, rather than a single one) or in terms of assuring my professional future (because in some sense, SENSOR can be regarded as a more prestigious project and participating in it could open the door for jobs in policy-making at the European Union or elsewhere).

The RECOAL project has been influenced by the tension between sociology and engineering. I needed to understand simultaneously the principles of social constructionism...
and the chemistry and agricultural basis of land remediation. Thus, I struggled to define a clear role for myself as a researcher. This tension was partially relieved during my 2nd year Viva when I found myself welcoming strong criticisms about my lack of engagement with some key figures of social constructionism and symbolic interactionism. This comment shaped the rest of my research project: I felt that I needed to prioritise the sociological side of the project and that this did not need to be detrimental to my capacity to make a contribution to environmental engineering. Yet, during the project I felt that I was neither an engineer nor a sociologist, and I found myself defending the project on these two fronts, depending on the audience that I was addressing (e.g. some social scientists have criticised me for not developing the theoretical aspects of the project, while some engineers have criticised me for diverting the attention from the real problem in Tuzla, the environmental pollution).

I have not yet resolved whether my research is situated within a problem-solving frame or whether or not it should be better considered as a piece of critical work. However, I am not sure whether I need to resolve this dilemma. Indeed, problem-solving and critical writing could be regarded as two sides of the same coin, as problems cannot be effectively solved without previous identification, and the identification of problems tends to present the need for critical analysis and an implicit solution (and in some cases, the lack of an obvious solution). Still, when the role of the researcher stands in between the line of problem-solving and critical work, defining the purpose of the project becomes a hard task.

Thus, although the research question has remained unchallenged since the first reports of the project, the way the question is answered has evolved according to my own research experience. Initially, I became closely attached to RECOAL, developing a sense of responsibility for the project. I understood that the success of my project depended on the success of RECOAL in developing solutions that could be adopted in Tuzla, for the benefit of those that appeared to suffer most from the pollution. As the project unfolded, I felt that regardless of what happened in RECOAL, I would be able to develop a strong critique of the project. Thus, my attachment to RECOAL has slowly loosened, particularly as I have progressively become disenchanted [and re-enchanted on occasions] of its capacity to bring about positive change. Whether this change is about to come or not is still to be seen.

Although my detachment from the objectives of RECOAL happened progressively, I can trace it to my first fieldwork period in Tuzla, during March-April 2006. Researchers often become involved with their research subjects during fieldwork periods. For the researcher, the fieldwork is an intense experience, which requires the cultivation of empathy with the interviewee and an attachment to the people being studied, in the attempt to see the world from their perspective. In addition, the fieldwork may remove the researcher from their everyday environment and the researcher may need to develop stronger links with the subjects studied in order to sustain the active effort needed to complete the fieldwork. In my case, during the six weeks of fieldwork I became completely submerged and enchanted by Bosnian society, even though I hardly comprehended it.

My attachment to Tuzla developed through numerous experiences, both negative and positive. However, I can offer some examples which may illustrate how this attachment was produced and re-produced in my interactions with different actors. Very early, I perceived the Bosnian society to be a very dynamic one, looking forward to a brighter future and forgetting the differences that led to an armed conflict during the 1990s. This created a conundrum for me, because I was trying to explain the past: the socialist regime, the nationalistic divisions, and the power tensions that had shaped the coal ash disposal sites. During my interviews people talked about these problems, but in ways that disconcerted me. I was shocked by the nostalgia for socialism, and by the omnipresence of Tito's portraits in almost every home, and their idealisation of the socialist doctrines of the state. Furthermore, I increasingly perceived the ethnic divisions to be a rhetorical tool that
some people would use in a particular context, rather than as a central divisive force within society.

My experiences of Tuzla were mediated by Jasmina, my first translator. She introduced me to Bosnian culture and manners. Her opposition to nationalism, made me sceptical of the interests of self-proclaimed interest groups. Her political views influenced my understanding of a society seemingly worse of by the newly launched capitalism. For me she embodied the values of Bosnian society: strength, determination, self-belief and optimism. Reports of corruption, ethnic violence, intolerance or chauvinism simply passed over my head; instead I came to believe that the attitude of the international community towards Bosnia was detrimental for the development of the nation. This had immediate consequences with regard to my actions within RECOAL as I found myself understanding the Bosnian partners better than Austrian and German counterparts. I think this optimism of the good natured Bosnians seemed to get transmitted through my reports to all the other members of the Forest Research team. However, in the last stages of research, I became disillusioned with the lack of action in BiH to deter nationalism and the lack of political action to address citizens’ problems (see ICG, 2009).

More concretely I became committed to finding solutions on hearing the views of local residents regarding the pollution of the sites. The interviews motivated me to do something useful for these communities to help improve their living conditions. However, as the project developed, I became disenchanted with the actual opportunities RECOAL presented to do so. Instead, some RECOAL partners adhered to clichés that appeared not to be relevant to the case (such as the idea that the cultivation of the sites was needed for the survival of refugees), and appeared to emphasise the results that favoured the industry’s point of view.

In this sense, the incorporation of Claudia Carter into the project (and as industrial supervisor in 2006) was very beneficial for me because she shared my concerns about the local residents, who appeared to be suffering the worst of the pollution. Under her auspices I presented my information on the local residents' problems to the RECOAL team. My association with Claudia added a critical note to RECOAL’s reports. In November 2006, Claudia and I made two presentations on local and institutional views on coal ash to the whole team of RECOAL, but they were received with irritation by our partners in Tuzla (TEP) and Sarajevo (HEIS) and got scant reactions from the other partners. During the rest of the project, Claudia and I strove to enrol the rest of RECOAL partners in our project of focusing RECOAL’s work more on local concerns. However, even though we managed to recruit most of the project partners’ sympathy (in my last visit to Tuzla I was warmly welcomed by TEP), our impact (beyond the contents of our own deliverables) was restricted by the inherent limitations of the project.

After my final period of fieldwork in July/August 2008 my feelings towards RECOAL were largely of disappointment. The disappointment extended to my own inability to bring about real change within or outside the project. Upon further reflection, however, I have understood that RECOAL could not catalyse a change outside its remit. From a problem-solving perspective, RECOAL was supposed to provide feasible solutions for the disposal sites, and RECOAL has done so (although their feasibility is still under question). I believed that RECOAL had missed an opportunity to challenge the political system. In particular, I believed that RECOAL could have challenged the operational principle of the ethnically controlled Elektroprivreda, of prioritising profit over the human and ecological health of Tuzla. However, my criticism of RECOAL ignores the development needs of the area, the economic and social constraints in which the industry operates and its local significance. Indeed, few local residents challenged the operation of TEP: they only wanted it to function more responsibly, abiding by EU regulations. In that sense, RECOAL’s work programme and approach was itself a product of the context in which it was developed.
Thus, I am now battling between optimism and disappointment. Indeed, my role within RECOAL has been considerable. I was accepted as a full project member. I contributed the drafts of the several deliverables and dissemination outputs. I have had a definitive impact on the development of the handbook for remediation methods, since the initial definition of its contents. I was simultaneously an insider (full participating researcher) and an outsider (detached observer) within RECOAL. From a doctorate point of view, the question is whether I can make a meaningful contribution to knowledge on my own, without the support of a project like RECOAL. During the Engineering Doctorate I have taken special care to separate two streams of work: activities intended to contribute to RECOAL and activities intended to contribute to my thesis. But the two worlds have frequently merged into each other. First, I found that my ‘thesis’ findings could be useful to RECOAL; then I found that some findings from RECOAL would influence my thesis. This heralded the end of my double life as some sort of ‘sociological spy’ in RECOAL. Thus, I realised, I had never been anything else than a RECOAL researcher, for I was bound to its objective — finding a way to deal with the coal ash disposal issues in Tuzla.

I have tried to ensure a rather mechanical separation of RECOAL’s work and my own work by providing an entirely new account in my thesis. Indeed, my work in RECOAL is quoted here (and can be read in the progress reports I submitted every six months to the University of Surrey as part of the requirements of this Engineering Doctorate), but the materials presented in this thesis constitute a different body of knowledge from that presented in RECOAL, even if concerned with the same problem. Three main features of the EngD project establish this difference:

1. The object of study is different. RECOAL aims to improve our knowledge about coal ash management in Tuzla or elsewhere: however, the research presented here explores how different types of knowledge about the disposal sites emerge and what impact this has on the construction of solutions for the problem identified.

2. The research presented here incorporates the theoretical frame of reference (social constructionism) explicitly. Although the knowledge generated for RECOAL by Claudia Carter and myself operated under similar assumptions (particularly the suspension of any preconceived beliefs about the nature of the project) these were not always brought to the fore. In RECOAL we focused instead on making a good case for advancing local interests within the project (although the extent to which we were successful in doing so can be questioned).

3. The research presented here has clear methodologies and boundaries independent of the work carried out within RECOAL. Indeed, Forest Research provided independent funds for travel and subsistence for those activities (i.e. fieldwork) which were considered not immediately relevant for the development of RECOAL. Thus, this formal differentiation has provided the grounds to separate the materials that belong to RECOAL and to the EngD thesis. Reference to the work in RECOAL is signposted thorough the thesis.

The aim of this section was to provide an overview of the main factors influencing my research. Indeed, the research has been developed around three inter-related tensions: (1) the tension between the requirements of a sociological investigation and the resolution of an engineering problem; (2) the parallel tensions of trying to provide solutions to practical problems and providing criticisms to advance social change; and (3) my contrasting role as a member of RECOAL and as independent (and critical) observer of the project. These tensions remain largely unresolved: instead, they constitute the core of the work presented in this thesis.
4.3. Data collection methods

Following the research question, semi-structured interviews were the main method of data collection. However, other data collection methods were used to cross-check issues not fully revealed during the interviews. This is a common feature in qualitative research methods which often are referred to as 'bricolage', that is, as a process requiring multiple methodologies and tasks (Denzin and Lincoln, 1994; p.2). In this case, the interviews were supplemented with participant observation and analysis of key texts used within the RECOAL project.

Semi-structured interviews aim at discovering the respondent's point of view and feelings. This form of interview is open enough to allow the respondent to choose the issues of relevance. With this aim, the interviewer poses open ended questions, without taking any definitions or agendas for granted wherever possible. The interviews used an interview guide of topics to lead the conversation. The method allowed the collection of a relevant and in-depth data set in a relatively short period of time, thus optimising the time constraints of the EngD. The interview worked as a very flexible method of study allowing respondents to bring into the interview opinions not anticipated by the researcher. Because the interview was confined to a limited period of time (in this case to one and a half hour maximum) it could be recorded enabling a systematic collection of records that could be validated in further stages of the research.

The main disadvantages of semi-structured interviews emerge because interviews are circumscribed to the situation in which they occur and are necessarily mediated by the interviewer (and when translation is needed, by the translator). The interview should be regarded as an 'active' process (historically, politically and contextually bound), and thus, it cannot be regarded as a neutral tool (Fontana and Frey, 2008). Furthermore, the interview relies on the respondent as a source of data.

The interviews revolved around an interview guide which was designed in advance by the interviewer. However, in practice, the interviews were developed as unstructured, just giving some cues to the respondents, using the interview guide mainly as a checklist to avoid missing relevant topics. The interviews needed to maintain a balance between being open but guided to maintain the focus on the topics that were relevant for both the respondent and the interviewer.

The data collected during the interviews was complemented with additional data obtained while working within RECOAL, including numerous observations and note-taking at RECOAL events, correspondence and reports, that constituted a 'field journal'. The observations within RECOAL rendered a large amount of data which was not forced or manipulated: rather they recorded events that occurred regardless of my intervention. However, not all observations were relevant to the topic of the thesis; the selection of observation data may well be regarded as opportunistic. This method could be referred to as participant observation within RECOAL, but with the caveat that I did not aim to have the role of detached observer; rather I tried to influence RECOAL as much as I could to achieve solutions which I perceived to be relevant for local residents. This form of participant observation developed during my stays in Tuzla, and during the different meetings and events related with RECOAL was recorded by taking notes and keeping a field diary which included my own interpretation of events and feelings. This method is critical in order to ground the interpretative ('verstehen') approach adopted in this thesis and to develop an empathic relationship with context and subjects of study.

Finally, a substantial part of the research was done by analysis of texts produced within RECOAL, particularly the technical annex of RECOAL’s proposal, and the deliverables submitted annually. This was needed for two reasons. First, this analysis helped to interpret some of the interviews. Second, the documents contained particular pieces of material that help to explain researchers’ perspectives of the problem of coal ash, i.e. how RECOAL
members construct the problem of pollution can be elicited within the RECOAL deliverables.

4.4. Fieldwork stages

The collection of data from interviews was done in three fieldwork periods. Each period had a preparation time (for quality assurance purposes a research plan was submitted to Forest Research each time) and a data collection period in Tuzla (for the first and third period) and in Austria, Bosnia and the UK (for the second period).

4.4.1. Stage 1: Local perspectives on coal ash pollution

The objective of the first fieldwork period was to focus on the perspectives of local residents around the coal ash disposal sites in Tuzla. Unstructured interviews had been carried out by David Edwards (FR) and a local contractor (the Centre for Urban Ideas) as part of RECOAL in the first half of 2005. The preparation period involved analysis of these data. The analysis explored the potential alternative interpretations of the relationship between the landscape and the local communities in the context of environmental pollution. This analysis was subsequently published as a journal article in Landscape Research (Castan Broto et al., 2007).

These findings helped to shape an interview guide (see Appendix I). The guide was structured along a few open topics to reveal local residents’ experiences of the environment. However, issues such as pollution or radioactivity were not raised by the interviewer unless the interviewee made explicit mention of them. The opening section of the guide focused on presenting the research, explaining why interviewees’ opinions were relevant and asking the respondent whether they consented to the interview. This stage also provided assurances about anonymity requirements. The closing part of the guide provided an opportunity to recap the main topics of the interview and ask interviewees if they had any questions about or comments on the project. The opening and closing sections of the interview were kept fixed in almost all the interviews.

The data collection period was March-April 2006. The sampling started by establishing the population of study as residents living in the communities around the coal ash disposal sites in Tuzla including: Šići, Mihatovići, Plane and Šički Brod (MZ Šićki Brod); Bukinje, Divkovići, Šikara and Hudeč (MZ Bukinje); and Drežnik and Moluhe (MZ Solana). Eight thousand people are believed to live in these communities but the figure is uncertain due to the continued movements of population in the area and the lack of accurate census records. The sample was drawn initially by using previous contacts made in the early stages of the project RECOAL; however, these contacts were limited. Moreover, most of the contacts selected by snowball sampling were confined to a close circle of individuals with similar opinions and thus, did not represent the whole spectrum of views within those communities. After two weeks of fieldwork the sampling strategy was changed to approaching individuals in their residences agreeing with them in situ to do the interview. In the end, the main criteria employed for sampling was geographical.

Initially, the interviews were expected to be one-to-one interviews. However, sometimes interviewees requested to have the interview in small groups. In group interviews, the attention was often taken away from the interviewer, and a conversation among the interviewees developed. In total 36 interviews were carried out among 51 local residents. Table 4.2 provides a summary of this data.

The interviews were carried out with the aid of a translator. This established an additional mediator in the interview, and in some situations it created misunderstandings and interrupted the flow of the interview. Generally, however, the presence of the translator facilitated the development of the interview in two main ways: first, by contributing to build rapport with interviewees by observing the cultural conventions and interpreting
other cultural cues unknown to myself; and second, by dealing sensitively with some difficult situations. Being accompanied by a translator was also a way to ensure safety while working in unknown communities.

Rapport was built by ensuring that the respondents understood that there was a sense of purpose associated with the interview. Thus, at the beginning of the interview the translator and I would make clear that I would contribute their opinions to RECOAL. Particular care was taken to avoid the creation of false expectations among local residents. This created some conflicts when the respondents perceived that they were being 'used' as informants and they thought that I was not prepared to give back anything in return (see also section 4.6). I tried to establish with them what I could give back: (1) all the information known to me about RECOAL; and (2) the guarantee that their perspectives would contribute in some way to the project results. It is on this basis that 51 respondents agreed to grant an interview. However, an equivalent number of people declined to participate in the research.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age distribution</th>
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</thead>
<tbody>
<tr>
<td>Male</td>
<td>27</td>
</tr>
<tr>
<td>Female</td>
<td>24</td>
</tr>
<tr>
<td>Total respondents</td>
<td>51</td>
</tr>
<tr>
<td>&lt;40</td>
<td>9</td>
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<tr>
<td>41-60</td>
<td>36</td>
</tr>
<tr>
<td>&gt;60</td>
<td>6</td>
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<table>
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<th>Local community</th>
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</thead>
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<tr>
<td>Catholic/Croat</td>
<td>MZ Bukinje</td>
</tr>
<tr>
<td>Muslim/ Bosniak</td>
<td>MZ Drežnik</td>
</tr>
<tr>
<td>Unspecified</td>
<td>Other</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>21</td>
<td>17</td>
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<tr>
<td>21</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 4.2: Main descriptors of interviewed sample during the first fieldwork period.

Whenever possible, the interviews were taped. This was a sensitive issue for some women who would only consent to be interviewed if the conversation was not recorded. According to my translator this was motivated by a sense of shame about their own opinions rather than by fear of being listened to beyond their household. Some women said that their opinions were not worthy enough to be listened to, and thus they should not be recorded. In one case I decided to conduct an interview without a recorder, by writing everything by hand, only to guarantee that the opinions of people who felt they had nothing important to add would also be incorporated into the research.

Each interview was transcribed word by word and then translated into English by the same translator who accompanied me during the fieldwork. I worked closely with the translator to minimise the emergence of misinterpretations. The interviews were compared with the field journal to make sure we had kept an appropriate record of everything that happened during those two months (the translator, in addition, kept her own field book).

4.4.2. Stage 2: Researchers perspectives on coal ash pollution

The second fieldwork period was of a very different nature. The objective of this fieldwork was to explore the perspectives of RECOAL researchers on the problem of coal ash disposal and the development of the project. Due to reasons of convenience and time management, the fieldwork was carried out during three different RECOAL meetings in November 2006, March 2007 and July 2007.

The interview guide was developed taking into consideration the interviewer’s relationship with the respondents. After one year of working in RECOAL, my views on the problem of
coal ash disposal and the nature of my research were well known to RECOAL researchers. Thus, the interview guide was designed to stimulate a meaningful conversation with the researchers. Originally, I planned to compare researcher's views directly with the views in local communities. Thus, I developed an interview guide very similar to the one used among local communities. However, when I piloted the draft interview guide among colleagues I did not have satisfactory results. I realised that asking scientists about how the problem was perceived did not make a lot of sense, as they merely repeated what was already stated in RECOAL reports. Thus, I shifted the emphasis in the interviews from the state of the environment in Tuzla to the benefits that RECOAL is expected to deliver to society; the risks within RECOAL; and the relationships between RECOAL members. The final version of the researchers' interview guide can be found in Appendix I. Questions 2 and 3 of the interview guide were flawed but I did not discover this until I analysed the final data. Question 2 assumed that the researchers would use the concepts of risk and uncertainty to refer to their own research. The data showed, however, that this was not always the case. The mistake was to include an implicit assumption within the question. Question 3, which a priori intended to reflect on the dynamics within RECOAL rendered plenty of information about internal disputes within RECOAL which were not relevant to this research. Most of the interviews were centred on Question 1, which produced the insights that informed chapters 6, 7 and 8 of this thesis.

The population of study was the researchers and technicians participating in RECOAL. The objective was to interview everybody who had participated in RECOAL. However, only the researchers who attended at least one of the three meetings mentioned above could be interviewed. Claudia Carter and I were excluded as potential interviewees. The final sample included 16 researchers and technicians, 10 of whom could be described as senior researchers and 6 as junior researchers (in accordance with their age distribution and position). The sample was not gender balanced reflecting the predominance of male researchers in the project as a whole, and only one female respondent can be classed in the senior group. All the interviews were one-to-one and only two of them needed translation. Table 4-3 summarises the main descriptors of the interviewed sample.

<table>
<thead>
<tr>
<th>Gender</th>
<th>n</th>
<th>Age distribution</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>13</td>
<td>21-40</td>
<td>6</td>
</tr>
<tr>
<td>Female</td>
<td>3</td>
<td>41-60</td>
<td>10</td>
</tr>
<tr>
<td>Total respondents</td>
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<td></td>
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<table>
<thead>
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<tbody>
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<td></td>
</tr>
<tr>
<td>Austrian</td>
<td>3</td>
<td>Bosnian 6</td>
</tr>
<tr>
<td>Polish</td>
<td>1</td>
<td>British 1</td>
</tr>
<tr>
<td>Italian</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Table 4-3: Main descriptors of interviewed sample during the second fieldwork period.

With most RECOAL researchers rapport had been already established by working in RECOAL. The interviews were recorded in all but one case, in which the researcher requested not to be taped. There is heterogeneity among the interviews because they occurred in different situations and settings and at different stages of the project. All the recordings were fully transcribed for their analysis.
4.4.3. **Stage 3: Evaluation of RECOAL's local impact**

The third fieldwork period was carried out in August 2008, six months after the official conclusion of the project. The fieldwork was carried out after the conclusion of RECOAL to show some trends about the impact of the project in Tuzla. The main objectives for this period were: (1) to verify and complement results previously obtained; and (2) to bring back to local actors in Tuzla some information in the form of RECOAL's reports.

The preparation for this fieldwork period was more intensive than for the other periods. It required preparation in three areas: writing the fieldwork plan; analysis of RECOAL findings; language training. The preparation included elaborating two interview guides, one employed with representatives of local institutions and another employed with local residents (See Appendix I). In addition, the fieldwork required summarising the main findings of RECOAL in a way that could be communicated to diverse audiences, in order to meet the goal of bringing the findings from RECOAL back to the local residents. Finally, it was thought that the fieldwork would benefit if I could improve my command of the Bosnian language enough to have basic conversations with my interviewees. Thus, I followed a 45 hour of one-to-one tuition in the Bosnian language.

The interviews with local institutional representatives focused on their ability to catalyse change. They assumed that the interviewees had some capacity to induce changes regarding the disposal sites. In practice, however, this assumption was not really practical, so the interview guide was not always useful. In contrast, the interviews with local residents focused on identifying whether they had noticed improvements in the environmental situation, and whether those improvements could be linked to RECOAL. The interview guide was more useful among local residents (particularly among local residents who knew little about RECOAL) than among institutional representatives. Those who had interacted with RECOAL on several occasions were keen to document their own expectations and reservations about RECOAL.

The population targeted included those actors who could potentially have been influenced by or influenced RECOAL. This included both local residents and institutions based in Tuzla (the Municipality, the Canton, the University, the Industry and NGOs). A list of stakeholders was compiled by RECOAL partners for a project stakeholder workshop in Tuzla in July 2007. This list was used to draw a sample for the interviews. The final sample included 33 respondents who participated in 29 interviews. All the interviews were one-to-one, except four of the interviews with local residents which were in pairs. Table 4-4 summarises the main characteristics of the interviewed sample.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age distribution</th>
<th>n</th>
<th>n</th>
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</thead>
<tbody>
<tr>
<td>Male</td>
<td>21-40</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>41-60</td>
<td>17</td>
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</tr>
<tr>
<td>Total respondents</td>
<td>&gt;60</td>
<td>10</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Local institutions</th>
<th>n</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipality</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Canton</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>NGOs</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Local residents</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Table 4-4: **Main descriptors of interviewed sample during the third fieldwork period.**
Building rapport was an easier task in this fieldwork period than in previous ones. Although I had to be accompanied by a translator, I could speak a few common sentences in Bosnian, which earned me the interest and attention of local people. In addition, many of the interviewees remembered me (or in some cases remembered somebody from RECOAL), and they were pleased by my return to Tuzla, because, they said, it showed that I was genuinely interested in the resolution of their environmental problems.

The fieldwork was planned around the ‘Handbook of remediation methods’ that was expected to be ready by the summer for its dissemination in Tuzla. Thus, I intended to bring with me some copies of the handbook and hand them to the respondents. However, the European Commission took additional time in providing feedback on the scientific content of the deliverables which delayed the production of the handbook. Thus, I prepared an alternative outline of RECOAL results, using early drafts of the handbook. With the help of the translator we produced a short summary of RECOAL’s main results. We read and explained these results to the interviewees at the end of each interview. Some of the local residents were very pleased by this because, according to them, it was the first time that they had been given results about the pollution of the coal ash disposal sites. However, several respondents argued that they could do nothing with verbal results and that some sort of official report was needed urgently.

Interviews were recorded and stored following the conventions of the two previous research stages. However, since this data was not to be analysed systematically, the interviews were translated directly from the recording thus optimising the work of the translator (who did not need to transcribe them into Bosnian first) and allowing the completion of the interviews before the end of August 2008.

4.5. Data analysis

Coding is an initial step that precedes the analysis per se. It is a procedure that disaggregates the data into manageable segments which are grouped and labelled according to pre-identified categories. Coding is a tool to both describe the structure of the data (according to predefined categories) and establishing explanations for the problem studied. The use of analytic software such as QSR NVivo facilitates the coding by providing tools to display the text and the coding labels (called ‘nodes’) simultaneously. Other tools to establish links between the texts are also provided.

However, coding cannot be solely regarded as a mechanical process consisting only of the selection of pieces of text according to predefined categories. Rather there is a need to establish the coding process within the theoretical framework in which it is developed. Furthermore, the coding labels (or ‘nodes’) should not be understood as fixed and immutable labels. They are established at the start of the analysis process, but the data do not necessarily conform to these categories. Sometimes categories have to be changed to fit the data. Other times, the pre-determined categories may become an obstacle if they prevent the researcher from adopting a new theoretical point of view that may be more appropriate to describe the data. Two strategies are needed to deal with these problems: (1) re-coding; and (2) theory-oriented coding.

Only the data sets from the fieldwork stages 1 and 2 were coded systematically. Both sets of data were coded in successive re-coding steps. For example stage 1 data was coded fully three times. The first coding concluded with the preparation of a thematic report that summarised qualitatively the content of the interviews. This report was used to bring some evidence into RECOAL deliverables, and as a basis to continue the analysis that informs this thesis. The final structure of the thematic report built directly on the original coding categories, following the interview guide (see Appendix I, Coding Guide I).

The main difference between both outlines is the presence of emergent categories that were not included in the thematic report because at that time I did not know how to interpret this
data. These three categories ('Reference to foreigners', 'Metaphors of pollution' and 'Comments on communism') were later analysed in more detail and they have directly informed the argument in this thesis. Thus, after examining the category 'metaphors of pollution' the interviews were re-coded following a new node scheme (see Appendix I, Coding Guide II).

These two coding guides reveal the extent to which the analyst is responsible for the content of the analysis. Coding Guide I shows a logical connection from the development of the interview guide, to the coding of the data. In the report, categories such as general information about the area, employment, or water supply are presented side by side with more controversial categories such as 'pollution fear'. Coding Guide II, however, consists exclusively of controversial categories. If all the categories of coding emphasise the negative aspects of pollution, the results of the coding are likely to present a negative view of pollution among the local population. It could be argued that Coding Guide II has been developed as a result of the analysis developed in Coding Guide I, and therefore, presupposes the information obtained during the original analysis. However, the results of Coding Guide I were first influenced by the design of the interview guide, informed itself by a sense that the experiences and perceptions of pollution may have not been significant among local residents. Had I decided to focus my interviews on pollution only the results of both coding guides could be different. Further re-coding was carried out focusing on the construction of discourses of pollution, explaining how pollution and its dangers are explained, and how those discourses have associated plans for action.

The researchers' interviews were treated differently. They were coded using a very simple coding sequence, presented in Coding Guide III (Appendix I). This coding process was complemented with queries. Queries allow for the search of a keyword or a piece of text and the associated paragraph in which it is embedded. This allows looking for sections in the interview that are concerned with similar topics and then comparing them. Once the coding process has been completed (i.e. the interviews have been read, analysed, fragmented and grouped), this type of theoretically (keyword) guided search may be more effective to find relevant examples.

The researchers' interviews were not re-coded and thus, they were not examined in the same depth as the residents' interviews. This was largely due to the need to refer back to other texts and observations from RECOAL as the main source of data to understand how scientists construct the problem of environmental pollution in Tuzla. However, the interviews with the researchers explained how researchers justify their role in providing sustainable solutions to the disposal sites, and their declared intentions about what they expect to contribute to the project.

The following chapters of the thesis present a selection of results from the analysis of Stages 1 and 2 interviews. Such selection is informed by the concepts that are presented in each chapter. However, all the analyses refer back to the initial systematic coding that was carried out on the two sets of interviews. The data compiled during the third fieldwork period has been used in a very different way. Firstly, it was used as a means of in situ validation of the data. Thus, some examples of the third fieldwork period have been provided when they support findings from previous analysis. On the other hand, validation also occurred during the fieldwork, when the results were presented directly to local residents.

Before reviewing the ethical aspects of the project in the following section, some aspects regarding the validity of the analysis need to be considered. Some authors distinguish between internal and external validity of qualitative research. Internal validity requires checking the coherence and credibility of the research argument (see Bryman, 2004; Seale, 1999). This requires reading the full account of the research in this thesis. Within the ethnographical tradition Clifford Geertz famously pointed out the importance of
elaborating a comprehensive account at a level of detail that can only be achieved in qualitative research and that is commonly referred to as 'thick description' (Geertz, 1973). However, it is important to remember that this project has not been grounded in ethnographic methods. During the project, I did not have the time or resources to investigate every detail of the situation. Instead, I have aimed at developing situated accounts of my observations about the pollution in Tuzla. In addition, the quality of research is often described as the capacity of the researcher to understand how her subjectivity might influence the research results (Peshkin, 1991). The emphasis on reflexivity of Section 4.2 shows my commitment to engage in self-criticism about the bias of my research and its overt political intentions, which will be further described in the ethics discussion (Section 4.6).

External validity is related to the usability of the research in generalisations. Generalisations are difficult in qualitative research because the depth required in data reduces the size of the population that can be managed within the study, and therefore excludes the possibility of making inductive generalisations based on probabilistic reasoning. Alternatively, Payne and Williams (2005) have explained that in qualitative research, 'moderatum generalisations' are applicable. These are characterised by moderation in the scale of what is claimed and their hypothetical and testable character (Payne and Williams, 2005). Thus, generalisations can be applied as long as they are situated (within the context of Tuzla or within the context of the development a land regeneration project, RECOAL). Moreover, comparative generalisations with other case studies are also possible.

4.6. Ethical considerations

Some scholars suggested that ethical reviews are not necessary in qualitative studies because social research methods do not harm their subjects physically or emotionally and because social scientists do not have the means to impose themselves on other people (Dingwall, 2006). In contrast, the experience during this research suggests that qualitative research involves serious sensitive issues regarding the treatment of respondents. Indeed, the research has had intended and unintended consequences both for the respondents and the researchers intervening in the study. The study of the perspectives of local residents and researchers raised several ethical issues.

4.6.1. Ethical issues in interviewing local residents in Tuzla

The relationship between the researched and the researcher is the main ethical concern when doing qualitative research (Aldred, 2008). Qualitative researchers have to take steps to ensure that this relationship is as balanced as possible. Aldred (2008) compiles the following six principles that inform commonly accepted practice on research ethics such as the ESRC Framework for Ethical Review:

1. Integrity and quality.
2. Full disclosure about the research to research staff and subjects.
3. Confidentiality and anonymity.
4. Voluntary participation by participants.
5. Avoidance of harm to participants.
6. Avoiding or disclosing conflicts of interest.

The application of these principles is not straightforward and needs careful consideration of what each one requires. However, research should establish procedures that cover, as best as possible, the issues outlined above. Principles (2), (3), (4) and (6) are related to the setting of the interview. The first step in the fieldwork was to explain the theme of the
research and the role of the interviews to the translators and to every respondent. However, this disclosure had to be necessarily limited by the available time and circumstances in which it occurred. In order to avoid misinforming the respondents, translators were provided with a statement about the purpose of the research. This statement included an explanation of my relationship with TEP and RECOAL, to make sure any conflict of interest was disclosed. Confidentiality and anonymity has been guaranteed by restricting the access to the data. Original names were replaced by pseudonyms to be presented to the general public. The interviews started with a full disclosure of the research to the respondents. Only when the research was explained, and anonymity stated, respondents would be asked whether they wished to participate in the interview. The recorder would be switched on in front of them and this would signal informed consent at the start of the interview (interviewees could stop the device at any moment). Regarding point (5), although no obvious injury could have been caused by my research to interviewees, is it possible that another type of 'social damage' could be caused by the research and gone unnoticed.

In one remarkable occasion after an interview a respondent questioned my legitimacy as a researcher. She explained that it was absurd to have me doing research in Bosnia because I was not Bosnian and I could not understand the language. According to this lady, hiring a local person to do this research, instead of a researcher and a translator, would have been more efficient and appropriate. She was not attacking me as a researcher, but rather, she voiced her concern over outsiders employed to do a job that local researchers could do better. Although I think that the lady misunderstood the nature of my work, I also think that she was right in pointing out that my legitimacy as a researcher could not be taken for granted. My translator explained this further in a letter of impressions that she sent me after completion of the fieldwork:

Translator (letter extract): “I rather enjoyed our interviews, although there were several rather unpleasant ones, which only gave me the impression that many people were fed up with numerous researchers, who offered nothing in return, not even the feedback from the research. I would advise you not to follow their suit, and to send information to all the people you promised. Pointing out that the research was initiated by the 2 Bosnian researchers was a very good idea, as well as the fact that TEP co-financed the project. That made people believe that this research was more personalised than the others before it, and they felt more ready to cooperate.”

For the interviewees it was important to relate the research back to their country and priorities. Thus, my interpreter pointed out that explaining the Bosnian representation in RECOAL (the researchers from Sarajevo and Banja Luka and the local industry TEP) added legitimacy to my research, rather than compromising it.

Research fatigue emerges when individuals or groups become tired of participating in research and express this either by showing reluctance to engage with the project or refusing to take part in it (Clark, 2008). Research fatigue is common in groups that after being researched receive little feedback or observe little change as the result of their engagement (ibid.). In Tuzla, local residents have participated in several public engagement exercises organised by the local government institutions, NGOs or industry, but they seem to get little in return. Thus, my translator advised me not to behave in the same way. The demand to give something back was clearly stated in some interviews. For example, the following excerpt of an interview with two local residents in Bukinje shows how they were disappointed when they found out that I was only a PhD student. I thought I had explained this at the beginning of the interview, but obviously they had not understood this. Thus, the interviewees felt cheated when I restated it:
Petar: She’s writing her doctoral thesis.

Elvir: So that’s it! No use of all this, it’s all the same. You should have told us right away, little girl [to the translator]. There was a professor who also did interviews and also recorded them... Her husband did a doctoral thesis. She did interviews for her husband. So what did we get from it? Nothing...We wasted our time for nothing...You should have told us right away so that we wouldn’t waste time.

Thus, local residents felt their time was wasted if it only served as an input into a doctoral thesis. I explained to them that, within the means available to me I would feedback the results to everybody else in the project, and they would have to hear these results. The interview continued for 40 minutes more but the interviewees were worried about the instrumental use I was making of them; I was worried about exactly the same thing.

This example shows that people who engage with research do not experience it passively; if they perceive that it may not be useful to them, and that it only contributes to the career of the researcher, this increases their fatigue (Clark, 2008). Yet, triggering change is not always within the reach of the researcher. One year later I presented the results of the fieldwork in TEP, but TEP representatives dismissed it because the opinions of local residents were not considered trustworthy. Having taken the opportunity on every occasion to bring the local perspectives to the ears of whoever wanted to listen to me, I am aware that I have indeed done relatively little to improve the lives of those residents.

The cases presented in this section, however, were exceptions to the generally welcoming character of my interviewees: most interviews were quite enjoyable, particularly when interviewees felt rewarded by the visit of a stranger interested in their life and situation. The set-up of these interviews (particularly how I presented my research, putting effort into avoiding creating unrealistic expectation) was key in developing rapport with local interviewees.

Moreover, bringing back the results of RECOAL (even though I could not show them the Handbook) provided the greatest source of legitimacy to my research role. A local interviewee that I had encountered before explained that I was the first researcher to ever return, and that proved my trustworthiness. On my second encounter with Elvir (quoted above) he explained that, after my return, he thought that I really cared about them and took myself and my translator on a tour to visit places affected by the disposal of coal ash.

Indeed, many researchers find motivation for their research in the idea of finding a ‘voice’ for the ‘voiceless’, and so did I. In doing this, I followed a common trend in qualitative research in which the researcher takes a political stance in favour of the group being studied (Fontana and Frey, 2008). This begs the question to what extent I am an appropriate translator for local residents’ views. My interventions are necessarily detached. However the alternative is to leave these communities without even trying to approach them or understand them. My solution is that trying to listen is better than no interest or abandoning hope.

I was emotionally involved with these communities, feeling responsible for their future, with a clear sense of desperation at my own incapacity to provide effective solutions for improving their livelihoods. I understood this to be my duty. The second visit showed some signs of progress associated with the modernisation of the country, but there was little advance regarding improved management practices at the disposal sites. During the research, I have tried as much as possible to be of use to local residents by providing them with information and acting as a channel of communication with TEP and other institutions. However, I am still concerned about whether this is enough payment for their time and dedication.

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27 All names have been changed to protect the identity of interviewees.
Recently I found an article that exposed the exact problems I was having in my research. The article explores the potential harm that an empathic relationship with subjects of research could cause (Sampson et al., 2008). According to the authors, the success of qualitative research depends on the researcher's "capacity to imagine and empathise with the experience of the 'other'" and this is likely to cause emotional harm in the researcher, particularly when the research results do not seem to benefit the wider society (Sampson et al., 2008; p. 930). This, they argue, is an assumed cost of the qualitative inquiry. I hope that my reflections here illustrate these 'costs'. The 'costs' have been shared by two translators, who accompanied me through the interviews and trusted my capacity, as a researcher, to create something that could really benefit the people who they perceived to be suffering.

4.6.2. Ethical issues in doing interviews with RECOAL researchers

The ethical issues related to interviewing RECOAL researchers are of a different nature. Although the power relationship established between the researched and the researcher still exists, it is of a different nature. The researchers knew me well and understood the purposes of my research. It was on these grounds that they accepted to engage in the interview. The interviews followed the same procedures explained above regarding informed consent, disclosure of conflicts of interest and anonymity although interviewees were told that given the structure of the sample, total anonymity could not be guaranteed.

The main issue emerging during the analysis of the researchers' accounts was my capacity to do harm to the other researchers as research subjects. Some researchers chose to tell me controversial or very personal opinions about their colleagues and the general quality of work in the project. Indeed, some pieces of data are likely to upset or worry some of the participants of the project, should they ever read them. Obviously, to what extent some of the materials could be considered to be offensive will depend on how they are presented. For example, I used the data in individual conversations during RECOAL meetings trying to help some people in RECOAL to see the points of view of other participants, and this was never offensive because it was done at a personal level. This is however not the type of work that goes into a research thesis.

My perception is that some of the expositions presented in this thesis will not necessarily be welcomed by the members of RECOAL, who may see it as an unfair critique of commonly accepted methods of analysis. However, I feel compelled to tell some parts of the story as I see them, because critically assessing the science and its methods is needed alongside putting those methods in practice. I am aware that some of the critiques presented here were well-known to RECOAL members and they accepted them as tacit knowledge or as compromise solutions.

This research takes a social constructionist view on science and thus, it explains how different views of a problem are constructed by different actors without necessarily emphasising the primacy of any perspective. However, given the status of science in our society, not being ready to accept its principles as universal may be perceived by some scientists as an attack (as indeed happened during the so-called 'science wars' during the 1990s, see Gieryn, 1999). This research can be perceived as leaning towards the interests of local residents. TEP has also argued that my carrying out interviews among local communities could undermine their credibility. Thus, my research could be harming TEP technicians and RECOAL researchers. The researcher is confronted with a dilemma well known in the literature:

"Should researchers investigating an oil company's corporate governance be primarily concerned about potential harms or benefits to people affected by oil exploration, or harms or benefits of the research to the oil company?" (Aldred, 2008; p 890)
Aldred (2008) argues that the researcher’s involvement with individuals and organisations requires the acceptance of responsibilities towards those who are being researched and those who are affected by those being researched. Thus, the researcher has also a responsibility towards those who benefit from or suffer damage by the research but do not directly intervene. In the case of Tuzla, my responsibility involved responding to local residents about whether RECOAL was able to provide plausible answers to their concerns about the environment. Thus, information of benefit to local residents in Tuzla should be brought to the fore. Additional information about RECOAL’s internal conflicts and project management, however, are not directly relevant for the questions that I am aiming to respond to in this research. Aldred (2008) warns that the study of powerful organisations may lead researchers to self-censorship. My conclusions are shaped by a sense of respect towards my colleagues in RECOAL and I may have silenced some controversial data following my own understanding of their relevance. However, I do not think this is necessarily a negative issue: indeed, the normal process of selection and re-interpretation required to write a thesis needs to have always a certain dose of self-censorship if it is to be concluded in a reasonable time.

4.7. Conclusions

This chapter presented the methodology used in this project including salient and controversial issues. The methodology was designed according to an interpretative paradigm, thus adopting data collection methods such as semi-structured interviews. Three fieldwork periods followed substantial preparation about the topics and the procedures for interviewing. The data analysis followed well-established methods of data coding.

The chapter also illustrates that the research required a certain amount of opportunism and _ad hoc_ solutions for unexpected difficulties. For example, the sampling method had to be changed during the first fieldwork period; additional data sources such as text and observations had to be included because of their relevance to help explain the findings; and the final stages of data analysis are hard to explain as they were operated on a great amount of intuition. The research project balanced pre-planning with variety and improvisation.

The chapter also revealed major research difficulties associated with ethical dilemmas that have emerged during the development of the research. Ethical guidelines from the British Sociological Association and other organisations were studied prior to the fieldwork, and taken into consideration in the research proposals. However, interviewing procedures and considerations were not enough to solve the specific issues such as the emotional involvement in the research and associated needs (giving something back to the local residents and avoid offending RECOAL colleagues with my analysis). Some of these issues remain unsolved today. Yet, on the whole, the idea of giving a ‘voice’ to those ‘voiceless’, the local residents, was a powerful and lasting reason for this research.
5. Pollution and Identity among Local Residents

5.1. Introduction

Within RECOAL, identifying the local demands on the environment and land use was considered a necessary step to develop remediation solutions which can benefit local citizens and institutions. The subsequent question is who has the legitimacy to determine what such demands are? The report of the stakeholder analysis (FR, 2006) identified the following groups: RECOAL partners, local communities, municipal authorities, Canton authorities, governmental institutions, wider public, NGOs, Tuzla University, other industrial sectors, and international organisations. This report suggested that social research should focus on understanding the needs of 'local communities' because the project affected them directly while they appeared to have little capacity to influence it. The interest of 'local communities' in the future of the disposal sites is accompanied by great expectations about the possibilities of a project, such as RECOAL, to improve the state of their environment and their welfare.

During the project, the term 'local community' was retained because it seemed appropriate to translate the term that the local residents use to refer to themselves as a group. Local residents are organised in settlements that share a secretary and a local council. Each settlement is referred to as 'Mjesna Zajednica' (MZ), where 'mjesna' is an adjective signifying 'local' and 'zajednica' is a derivative noun from the adjective 'zajedno', meaning 'together'.

This chapter explores the different identities emerging within the apparently homogeneous local communities. In particular, it is concerned with identities that emerge associated with the place in the context of environmental degradation. Two aspects of the relationship between identity and place are presented: the preservation of the ties to a place despite its ongoing degradation and the emergence of new identities associated with that place. The chapter argues that the diversity of perspectives encountered in Tuzla can be understood by examining two aspects of the relationship between identity and place: the ties to the place and the identification of a stigma associated with the place. The simultaneous consideration of these two factors helped identify four types of performed identities in response to the pollution.

Although the relationship between place and identity has received considerable attention within the literature, this relationship has rarely been examined in the context of environmental degradation. Hence, how research on place and identity can contribute to current thinking in land regeneration remains largely unexplored. The argument is developed in the following manner: Section 5.2 offers a review of literature about the relationship between identity and place. Section 5.3 examines the emergence of stigma and the preservation of the ties to the place in environmentally polluted places. Section 5.4 introduces a tentative typology of performed identities in the Tuzla case. The discussion compares the findings of the case study with those found in the literature and the conclusion reflects on the relevance of this analysis for land regeneration projects.

5.2. Research perspectives on identity and place

Place and its influence on the formation of identity is a topic that has received considerable attention from different disciplines. Focusing on individual identities, environmental psychologists have defined place identity as one of the basic components of self-identity. Place identity refers to the aspects of identity defined in relation to the physical environment, and the conceptual understanding which enables the individual to interact in a particular setting (Proshansky, 1978; Bonaiuto et al., 1996; Hopkins and Dixon, 2006; Manzo and Perkins, 2006). The concept of place identity has been further developed by identifying other characteristics of the bond between identity and place such as 'sense of
place’, ‘place attachment’ or ‘place dependence’, triggering explorations of the differences and connections between these terms (Low and Altman, 1993; Hummon, 1993; Manzo, 2003; Stedman, 2003; Smaldone et al., 2005).

The attachment of meaning to places has received considerable attention through exploring their attribution (Gustafson, 2001), their contribution to the formation of social identities (Rubinstein and Parmelee, 1993; Harner, 2001) and how they are contested in natural resource struggles (Cheng et al., 2003). However, two other components of place, the physical setting and the activities performed in it, are also relevant (Relph, 1976). Hence studies of place should not overlook the influence of the physical components of a place on the sense of place (Stedman, 2003) or the experiential, interactive and relational components of places (Relph, 1985; Gieryn, 2000).

Landscape studies have paid considerable attention to the action component of places emphasising people’s engagement with landscapes through daily practices (Thomas, 1993; Macnaghten and Urry, 1998; Ingold, 2000; Castan Broto et al., 2007). Doreen Massey describes places as the sites where social relations and ‘activity spaces’ intersect (Massey, 1995). These places or ‘meeting points’ of interactions are necessarily multiple, dynamic, fragmented and changing (see Massey, 1994; May, 1996; Casey, 1998; Manzo, 2003; Davenport and Anderson, 2005; Smaldone et al., 2005). The sense of place has been shown to predispose action (Stedman, 2002).

Moreover, certain expressive components of identities are ‘performed’ in relation to places (Hetherington, 1998). Both identity and place are reflected in the interactions occurring in those places: for each interaction a particular conception of self and of the place is called into being to help explain the actions taken (Anderson, 2004). Examining identities as ‘actions’ addresses the experiential nature of the social process by which identity and place are produced and re-enacted.

Empirical studies concerned with identity-place relationships have recurrently focused on recreational or scenic settings (e.g. Bricker and Kerstetter, 2000; Vitterso et al., 2000; Wickham and Kerstetter, 2000; Vorkinn and Riese, 2001; Kyle et al., 2004; Stedman and Hammer, 2006). These type of studies seems to assume that the nature of the bond with places is necessarily positive (Manzo, 2005). Relatively little work has been done in eliciting the relationship people have with polluted or hazardous places. Environmental degradation may have discernible impacts on social understandings of the degraded place and in the formation of identities (Davenport and Anderson, 2005). Such environmental transformations can pose a threat to existing social identities and may generate adaptive responses (Brown and Perkins, 1993; Bonaiuto et al., 1996; Twigger-Ross and Uzzell, 1996; Hopkins and Dixon, 2006). In these circumstances sense of place can be an important mediator for the social experiences of the place (Simmons and Walker, 2005).

Goffman (1990) uses the term stigma to refer to a particular deeply discrediting attribute, which makes an individual less desirable than others in the same category. He emphasises that stigma emerges within relationships: it requires a set of social anticipations or expectations about what is ‘normal’ prior to the identification of potential deviations from that ‘normality’ (Goffman, 1990). For the stigma to be recognised, visible symbols need to be identified that can be attributed, communicated and acted upon (Goffman, 1990). In relation to place, stigma can be used to explain how the perception of a negative environmental change in a place can result in profound transformations of local identities (e.g. McGee, 1999; Bush et al., 2001; Edelstein, 2004; Simmons and Walker, 2005). We focus here not on how stigma is attributed to the people but on the place where the physical changes occur. Those physical changes provide visible symbols through which the place is stigmatised.

The concept of ‘insideness/outsideness’ (Relph, 1976) is useful to conceptualise the relationship between identity and the ties to a place. Insideness represents a commitment to
the place not only from an individual but also from a collective perspective; outsideness signifies the separation of the individual who is transformed into an observer of that place. Individuals exhibiting strong ties with the place (insideness) characterise the place as a unique component of their existence. In contrast, individuals exhibiting weak ties with a place (outsideness) behave in space as if the place was something accidental and with limited influence over their personal decisions, and appear to lack interest in collective action (see Relph, 1976).

Some authors contend that environmental degradation results in erosion, if not rupture, of the bond between people and places, a 'placelessness' (Relph, 1976). Because an existing perception of place is questioned when spatial observations no longer correspond with expectations, those physical changes may trigger the re-negotiation of the human relationship with that place (Relph, 1976). If this re-negotiation is unsuccessful, place changes may catalyse the estrangement of people from that place (Hummon, 1993) and turn them into 'outsiders'.

A range of literature supports the idea that environmental degradation weakens the bonds with a place. In particular, place attachment, the element that emphasises the emotional bond to a place, is regarded as necessarily connected to a positive emotional relationship with a place (Guiliani and Feldman, 1993). This suggests that the emergence of negative emotions about a place would necessarily lead to the rupture of the emotional bonds between identity and place. However, some authors maintain that these bonds are influenced by a range of experiences, both positive and negative (Manzo, 2005). For example, empirical studies of pollution in residential areas have shown ambivalence within the accounts of those living with environmental pollution risks (Bumingham and Thrush, 2004; Phillimore and Moffatt, 2004). Studying the relationship between identity and place in a polluted place may contribute to this debate by showing the variety of reactions that may emerge in such a setting.

Following the literature, both places and identities can be regarded as processes in continuous evolution (Massey, 1994; Davenport and Anderson, 2005). This poses some epistemological problems for their study. As Doreen Massey highlights 'if places can be conceptualised in terms of the social interactions which they tie together, then it is also the case that these interactions themselves are not motionless things, frozen in time' (1994; p.155). The study of both place and identity is confronted with the fragmented nature of these processes (Hall, 2000) and their variability (Casey, 1998). However, if place and identity occur within a network of social interactions (Massey, 1994), then place can be understood by studying those interactions. For each interaction, a particular conception of self and the place is called into being, that help to explain the actions taken (Anderson, 2004).

How are place and identity performed within a particular network of social interactions? Casey borrows Bourdieu's notion of 'habitus' (Bourdieu, 2005) as a tool to explain how nature and culture come together into a disposition for action in a given setting (Casey, 2001). 'Habitus' constitutes the basis for the continuity of identity, while accommodating the existence of infinite variations within that continuum (Casey, 2001). This concept resonates with the idea that individuals and social groups develop relatively stable images of places and self-identities with the effect of ordering and balancing their observations, expectations and experiences (Relph, 1976). Although they are subject to erratic processes, 'habitus' such as identity (as a conception of the self) and place (as a conception of the environment where the self interacts) present relative stabilities that may be communicated through language and other cultural devices.

The importance of language as a nexus between place and identity has already been described by Dixon and Durrheim who propose a discursive approach to understanding the construction of identity and its place-related components (Dixon and Durrheim, 2000).
They propose that place-related aspects of identity can be analysed as a set of discursive practices attached to that place. Dixon and Durrheim argue that "place and autobiography are effortlessly united through language" (Dixon and Durrheim, 2000; p 31).

The interviews carried among local residents in March/April 2006 were analysed to explore the construction of an environmental problem associated with the coal ash disposal sites in Tuzla. The initial analysis put emphasis on what aspects of the local environment were brought in when claiming a problem and how this was related to local residents' life experiences. Further analysis considered the relationship between how residents referred to the place in which they live, and how they presented themselves accordingly.

Following the literature, two concepts were employed to articulate the analysis: habitus and the pair insideness/outsideness. The idea of 'habitus' helps to explain the idea of identity as actions performed in a given setting. The analysis focused upon identifying each citizen's discourses about their immediate environment, the pollution and the activities associated with these discourses to detect patterns and regularities in the relationship between identity and place using Relph's (1976) concept of 'insideness/outsideness'. Further analysis focused on examining the reactions to the place using this dialectical concept.

5.3. Stigma and place in degraded environments

5.3.1. Symbols of stigma

Research on places associated with environmental pollution has drawn on the idea of stigma to explain how an environmental change in a place results in profound transformations of local life (e.g. Bush et al., 2001; Edelstein, 2004; McGee, 1999). Goffman (1990) emphasises that stigma emerges within relationships: a set of social anticipations or expectations about what is 'normal' is required prior to the identification of potential deviations from that 'normality' (Goffman, 1990).

The presence of pollution may result in the construction of a place as stigmatised, and hence creating a potential stigma within the local communities (Bush et al., 2001; Simmons and Walker, 2005). This process will require the definition of other places considered as 'normal' and stigma symbols demonstrating how the current situation deviates from defined normality. In the polluted communities of Tuzla, the laundry was consistently referred to as one of the 'proofs' of pollution. As the following examples show:

Elma: "When you hang out white laundry, it cannot be out for more than an hour. You can see soot all over it. And so that laundry.... You have to try better to observe it on coloured laundry... [pause]. On white laundry, after an hour, that laundry is no longer white. All over it, it's like someone burned it..."

Sila: "I just want to tell you that the laundry becomes black."

Hanna: "Really, last summer there was this rain a couple of times, it was impossible! The laundry, the white laundry which was outside... you later had to boil it a couple of times in order to make it presentable and..."

Edin: "And you can observe the pollution for example when it snows, the snow is white normally, but here it's actually black from soot, products of the burning from TEP. That's one of the aspects of pollution. When you hang out the laundry... You see, almost nobody hangs out the laundry, but always they hang it somewhere inside their houses, in the attics etc."

The new observations are tested against a 'normal' background situation: if you have white laundry, the pollution is clearly observable. However, if you have coloured laundry, the
pollution changes may be disguised by the colour of the laundry. The ‘normal’ laundry (white) becomes disrupted by a sudden change of the expectations (it becomes black). Emphasis is added because of the nature of the status quo defined as ‘normal’ by the dissimilarity between white and black, clean and dirty. Hanna adds that they had to boil the laundry ‘a couple of times in order to make it presentable’. This last observation expresses the concern of these women not only about the disruption caused by the pollution, but also about their responsibility and efforts to ensure that they can get rid of its effects.

Stigma symbols allow for the stigma to be attributed, communicated and acted upon (Goffman, 1990). The association of the stigma of pollution to a place requires the establishment of physical symbols belonging to that place. For instance, in Tuzla, pollution evidence is found, for example, in the black snow; calcareous residues on water sources; waste residues on communal land; and the degraded public infrastructure. The laundry is a symbol of distinct character; it is not only attached to the public space but also to the private space of the family that exhibits that symbol. The symbol of dirty laundry may transform the community stigma into a private one. As something shared, the community can act upon the stigma in order to improve the situation. However, when attached to individuals, the stigma may also become a means of separation from the rest of the community. References of normality may be found in experiences of the people in other settings. For the stigma to be identified, the community needs to be geographically differentiated from other ‘non-contaminated’ communities. For example, one of the interviewees above compared her experiences in her community with those in other villages:

Sila: “I was at my sister’s the other day in Srebrenik28. That isn’t such a big distance, but still... [pause] and I felt that it’s easier to breathe there, and then that the laundry is clean when it’s hung out, cleaner laundry.”

The pause in the middle of the quote was extremely evocative, as if she was looking for the words to express how nice is Srebrenik in comparison with the local communities around Tuzla (although environmental problems in Tuzla can be compared with those in Srebrenik). Simmons and Walker (2005) note that identity and sense of place are constructed by drawing contrast with other places and identities to which the individual or the community belong, such as, in this case, the experiences visiting locations outside their place of residence. At the same time, these comparisons help to identify the symbols of the stigma associated with the place.

Halid: “... in Stuttgart when I got drunk, drunk, (...) I consumed a quite large quantity of alcohol and slept little afterwards but still I got up fresh. Here even if I haven’t drunk any alcohol, I sleep normally but I get up feeling horrible anyway.”

Halid emphasises how bad he feels in Tuzla, and compares it with his experience in Stuttgart where he feels better even when having a hangover. This comparison suggests two implications:

- pollution is something inherent to the place where he lives, and it does not occur in other ‘normal’ places; and
- the effects of pollution cannot be compared with those caused by his own actions; the consequences of pollution go beyond what a single individual could do to cope with it.

Although the stigma symbols belong to the place, it permeates the whole community because everyday life becomes significantly affected. Defining the stigma of contamination as a mere ‘geographic stigma’ fails to acknowledge that it also produces a spoiled place identity and a ‘social stigma’ in addition to the geographical or technological

28 An industrial city north of Tuzla.
one (Bush et al., 2001). Bush et al. (2001) explain that the stigmatising attributes that characterise a contaminated place may be transferred to those living in that place. In terms of the capacity of the community to undertake actions, whether this attribution occurs or not is not as relevant as whether the members of that community believe that they bear a social stigma. This social stigma is communicated and acted upon using the symbols that allow its identification:

Antonija: "It’s in all of us: you wash your hair and it’s in your hair... And if I go to the garden, I have to wash it immediately, so imagine the extent of that. Not to mention that certain plants cannot even grow. It can happen that certain vegetables get spots, get burned from the outside. Now it’s less than it used to be, but it isn’t good at all, it’s impossible that in this 21st century we live in such a way, that we poison ourselves. (...)When you talk to someone, you go somewhere and you tell them where you live, in Šćiki Brod near the power plant or in Tuzla near the power plant, and oooooooh, they all know it’s polluted; that it’s an industrial area.”

Ramiz: “We are famous, this area around TEP and this industry; we are famous for the black snow, for example. We are famous for thick fogs coming from Solana, if you’re from Tuzla, and want to go towards Šćiki Brod, eternal fog, and eternal humidity. We are famous for wide-spread malignant and carcinogenic diseases, as well as respiratory diseases of people. Because when you say that you come from Šćiki Brod, the doctors are not surprised that you have health problems.”

Edin: "We are recognisable in ex-Yugoslavia for this pollution. (...) So whatever is dirty, bad, it can be disposed of here...Let the trees and everything blossom in the another place, while we are treated as second-rate citizens.”

The stigma spreads from the contaminated sites into the community, and transforms its residents into second-rate citizens. Interviewees explain that they feel that the competent authorities ignore their complaints and that society at large has forgotten them. Thus, they feel alone in trying to improve their lives and attempts to eradicate the symbols of stigma. The interaction of environmental and economic factors further reinforces the reproduction of stigma symbols.

5.3.2. Preservation of the ties to a place

The analysis presented above suggests that physical changes have a strong effect on citizens’ experiences of a place, their practices and feelings. Pollution is thought to trigger a progressive detachment of people from the places where they live until a complete alienation occurs. If the old meanings cannot be upheld and residents are unable to renegotiate the sense of place, the place becomes undesirable or meaningless and therefore marginalised or separated from human experience.

However, the deterioration of environmental conditions does not necessarily destroy the bond with the place. People continue to live and plan their lives in their place of residence. During one particular interview a couple of retirees, Maja and Antun, explained how the ashes had come to dominate their lives and how the economic situation was deteriorating rapidly. However, they were convincing about their desire to live there for the rest of their lives, and wanted to create opportunities for their children to stay with them (although two of them had already migrated to other countries):

Antun: "... this slag is still being discharged. They are going to continue doing it and nobody is addressing us to see how we are living and how we are managing.”

Maja: "(...) you have to see it, when you pass this house… [she points to the North] (...) We will show you, it is coming so close to us, and soon we will have no place to go.”
The ashes were then starting to spread into their garden. Even though the situation of degradation was described as unbearable they explained that they wished to remain in what had always been their home. Coal ash had made their life difficult by disrupting their spatial practices, from cultivating their home-garden to appreciating the landscape. However, their bond with the place seemed to be intact. Instead, environmental degradation was perceived as threatening their way of life. The deterioration of the environment and the landscape is perceived as a great loss. Later in the interview Maja explains:

Maja: "Well it can't get nicer than when everything was nature; but everything is now gone. You know, when you have something beautiful and you lose it and it's no longer there."

In other cases interviewees went further, completely embodying the harm to the place as harm to the self. The most expressive example of this was given by a retiree, Marianna, being interviewed with a friend from a younger generation, Ivana. Explaining how the pollution affects a variety of resources, she resorted to explaining how the pollution affects her personally.

Marianna: "My land is ruined. My water is ruined."

Ivana: "That's how it is for all of us my, yes..."

Marianna: "They are suffocating me with electricity..."

The transmutation of changes in the place as changes in the body also represents the worries that the pollution inflicts on Marianna. From her health to her subsistence activities the changes to the place affect her conception of the self. Despite this, the link of the interviewee here with the place is not broken but reinforced. The degradation of land and water results in her 'suffocation', as if she embodies the environmental degradation. This idea is reinforced by her use of the possessive pronoun in 'my land' and 'my water'.

In some cases the maintenance of the ties with the place was expressed explicitly. For instance, Halid, a middle aged man, explained:

Halid: "Tuzla has always been sacrificed. Always. Always. Salt water, Tuzla was wrecked. Coal mines, the exploitation of coal, electricity production, the dirt, the slag site. But I was born here in Tuzla and I have never thought about leaving Tuzla because of the ecology. And as far as the breathing goes, we breathe in all sorts of things without any problem. The organism gets used to it so you just keep quiet, you are born and you die in Tuzla."

The above extracts illustrate how the environmental degradation did not necessarily cause the link with a place to break. Instead, some residents have internalised features of pollution through redefining their relationship with the place. Hence, the emergence of a stigma associated with industrial pollution is not necessarily correlated with deteriorating ties to a place. This suggests that the sense of place draws on a place’s positive and negative physical components, since both strongly influence the social experiences of that place.

5.4. Performed identities in the context of environmental pollution

The analysis presented in the previous section suggests that the emergence of stigma associated with industrial pollution does not necessarily break the ties to a place. Additional experiences of the place may create stable bonds between the individual and that place. This suggests that local residents around the coal ash disposal sites in Tuzla may present different performed identities depending on their perception of stigma associated with the place and their strength of ties with the place. The qualitative data from the interviews was analysed to evaluate whether interviewees who presented a similar
conception of the place constructed the problem of pollution in a similar way and thus, performed a particular type of identity.

5.4.1. Perceptions of stigma associated with a place

Section 5.3.1 explains the emergence of stigma symbols associated with the pollution from the energy sector and the coal ash disposal sites. However, not everybody within the communities attaches the same meaning to those symbols. Some disregard them as unimportant. The interviews did not compile specific data to determine the presence of the stigma, because they aimed to be as open as possible, without assuming that local residents were concerned about the environment prior to the interview. Thus, each interview had to be analysed independently to determine the attitudes of the interviewee towards the place and their perception of stigma. The subjective perception of the analyst has played a strong role in this process. Sometimes, the attribution of the stigma to the place was encapsulated in one statement. In most cases, however, the interviews contained numerous observations about the environment, which were further taken as symbols of the suffering experienced within that particular community. The following quotes illustrate that local residents feel forgotten, threatened, poisoned. Furthermore, they expressed, in different ways, their perception of the impacts that the pollution has on their lives:

Joka: “For 20 years we have suffered because of the dirt, soot, this waste (...). We have no water, we should at least have water and heating, but it’s destroying us, TEP, and no one, no one even knows about us that we exist at all in Šički Brod. Šički Brod has been forgotten long and long ago.”

Joka emphasised that the destruction of the environment resulted in the destruction of the people ('it’s destroying us'). She referred both to the pollution and to the lack of services such as water and heating. This suggests that she perceives both issues as interconnected. Furthermore, she feelt that not only TEP, but also everybody else has ‘forgotten’ their community. In the following example the interviewee compared his life with that of the man who lives in a clean environment to convey his sense of loss as a result of the pollution:

Dubravko: “Our slag sites, TEP.... They have to employ people, have to work, it had to be, but let us feel in a way that these people aren’t totally... For example, I’ll compare myself with a man who lives in nature and nothing can touch him. He has water running, he can drink. The waters that were here before the disposal started were marvellous. You could... we didn’t have any problems. Now we have nothing.”

Dubravko said: “a man who lives in nature and nothing can touch him”, implying that he has to confront problems resulting from the degradation of the environment. He ended his description of this ‘ideal life’ by stating that before the disposal sites the waters “were marvellous”. In this way he related the degradation of the environment with the emergence of ‘problems’ that they did not suffer before the disposal of coal ash started in the area. He concluded dramatically: “Now we have nothing”. In another example, an interviewee compared the pollution with a ‘poison’:

Ivo: “About the environment...concerning the environment...what people sow before...now that TEP exists it doesn’t grow well, the land is poisoned, the land is poisoned because of TEP...in the same way in which old people and children are poisoned, thus the land is poisoned, so it doesn’t yield...”

This description brings together the land, the old people and the children: they are all ‘poisoned’, he argued. Ivo used the adjective poisoned to refer to both the land and the people, implying that they are suffering in the same way and for the same reasons. Similar ideas emerged in other interviews:
Elvir: “On that location, right there, Divkovići, all the people there are Divkovičes, and the name of the place is Divkovići and... there’s more... and 80-90% of people there didn’t live until 49, they are Divkovičes. And the slag site is there. A slag site in Divkovići and a slag site there on the other side in Hudeč. It all happens right there in Divkovići. (...) Maybe when you see me next time I won’t be alive.”

Elvir explained that the name of the place is the same as the family name of most people living there. This is not presented as a coincidence, but as a symbol of the interconnectedness of people and land.

The analysis also showed that a considerable number of interviewees perceived no stigma in relation to the disposal sites. These interviewees did not mention the stigma symbols referred to above. Most of the interviewees who perceived no stigma associated with the disposal sites were living closer to the sites that are already covered with soil. The following statements were made by interviewees who did not express concerns regarding the presence of stigma associated with the disposal sites. The all emphasise the need to find a use for the sites:

Alija: “As far as we know, the people who sow here, wheat and maize grow here amazingly.”

Mersiha: “I heard that there is a large, empty, unused space there. People use it for sowing. It’s their only benefit from that space. But it’s a small benefit from a space that could, for example, be used for something more charitable. So that more people would benefit from it.”

Khrista: “It would be good if somebody would do something, for something there to be useful... There is 300 dulums of state land down there, and it’s going to waste. We sow, I have a garden down there and I sow, too.”

Zlatko: “Nothing came out of those plans for the moment. Nothing. At least, when they finish filling the slag site, they should do something, because the space is wide and stable and it could be used for anything.”

5.4.2. Maintenance of the ties to the place

Following the discussion presented in Section 5.3.2 the analysis examined whether the ties to the place were maintained regardless of the perception of a stigma associated with the place. Initially, the analysis examined individual statements that established a connection between the individual and the place. However, in order to determine whether a significant attachment was present or not, the whole interview had to be examined. For example, some indicators that were used to determine the presence of ties with the place were: plans for the future in that place (or in another place, indicating detachment); presentation of the place and the self as united; claiming improvements in the place as improvements for oneself; or accounts of the place as having particular significance for the life history of the individual. The following examples were considered to denote the maintenance of ties to the place:

Dubravko: “I’ve been here, my grandfather and great-grandfather and all have lived close to the slag site. I’ve already said this. I’m a resident here. My father had so much land, but I won’t take that into account because some other people had even more. (...) If a man knows that his grandfather and his great-grandfather had property and land and real estate here and now is being threatened by such a strong company as TEP...”

Elma: “Because I lived here, I mean, I was born here. My parents were born here. My father, my mother, they are all from this place. My grandfathers, great-grandfathers, from generation to generation.”
Both Dubravko and Elma related their ties to the place with the fact that their families had lived there several generations. Other interviewees explained how their ties to the place have been created during the course of their lives:

Mesa: “I was born there and I have spent my whole life there, and I intend to stay there for the rest of my life.”

Finally, there were interviewees that expressed their ties to the place in terms of their lack of capacity to restart their lives in another place:

Maja: “Am I fit for any other place? I’m fit for no place. I can only look to somebody to bring me something here. But there will be nothing here if I do not bring it myself. It’s a hard life. I wish that you are happy when you grow old. That nothing hurts you. I wish that for you just like I wish that for my own children.”

During the analysis statements stating a wish or intention to leave the place were taken as denoting a rupture of the ties with the place, and those who declared that their presence in that particular location was accidental, as is shown in the following examples:

Ante: “No one sees any good here. Watching TV, knowing... Having in mind that I, me and my son travelled a lot, we have family in the West... We see how it’s going there, this here is all...I don’t see any opportunities. Only those who have nowhere to go, live here.”

Mersiha: “Well, I don’t know. I cannot tell you a lot about the disposal sites because I am not a resident of this town, you know?”

Mersiha declared that she is not a resident on the town even though we interviewed her in the house she bought a few years ago. In her quote she differentiated between being a resident and simply living in that location. Mersiha appeared to consider herself as living there accidentally and did not feel entitled to an opinion concerning community issues. Several people approached during the fieldwork expressed a similar position. In some cases, these voices corresponded to people displaced by the war that after living there for more than a decade still felt that they belonged to the place.

On some occasions a difficulty appeared in determining whether the ties with the place were eroded or not, particularly in some cases in which the perception of the place had worsened following the deterioration of the environment. Two interviewees appeared to have clear links to the place because they wanted to see improvements, but acknowledged that relocating the community was a solution to deal with the pollution:

Edin: “And if this continues I think we will all die. Because we suggested to the Municipal and Canton authorities that, if this dirty black industry continues to develop here, we should simply be moved collectively to somewhere else. And we will demonstrate our civil disobedience by protests in front of the biggest polluters in this area. (...) And of course, we ‘localists’ all fight for our interests, for the interests of our local community.”

Petar: “If they want people to live a bit longer they have to move us all from here. And then they can deposit as much slag as they want. That’s the only solution.”

5.4.3. Four performed identities

In each instance, the analysis showed that for each combination of perceived stigma and ties with the place, interviewees expressed their intention to perform a particular type of action according to the perceived situation. Each type of action was accompanied with a

29 Indeed, many local residents who declined to give an interview explained that they did not know much about the place because they did not belong to it. Thus, the sample is likely to be biased towards people that declare to have ties to the place.
particular presentation of the self and of the individual capacity to act in this particular setting. Thus, the analysis identified four performed identities that could emerge in a degraded setting, 'activism', 'opportunism', 'escapism' and 'conformism'; these identities are shown in Figure 5-1 below.

![Figure 5-1: Performed identities in the context of environmental pollution](image)

The analysis showed 27 interviewees presenting themselves as 'Activists', 4 as 'Opportunists', 5 as 'Conformists' and 9 as 'Escapists'. Additionally, 4 interviewees did not fit this classification, because their interviews did not contain information to determine whether their ties to the place were strong or not (three interviewees could be classified as escapists/activists and one as opportunist/conformist). In the case of two interviewees it was decided that the interview did not provide enough information to include them in the analysis. These numbers, however, should not be taken as representing the distribution of these performed identities among the local residents. They are only indicative of the variety of examples in each category. The analysis was influenced by the subjective judgement of the researcher regarding whether each interviewee belonged to a particular category. Furthermore, some of the interviews were carried out in groups. The analysis has been extended to all participants, including those in the group interviews, but this has added a layer of complexity to the analysis.

What the analysis showed clearly is that at least four different performed identities can be found in the communities studied, according to their perception of stigma and their ties with the place. When performing each type of identity, individuals present a particular construction of the environmental problem of coal ash. Moreover, each characterisation serves to justify their actions to cope with the problem.

a) Activism

If the ties with a place remain strong in an environmentally degraded place, then social action will be directed to establishing means for the continuation of personal and collective
welfare and identity into the future. However, the character of such actions will be closely linked to the perception of a stigma attached to the environmental pollution. Activism is the most common response to the perception of a strong stigma associated with pollution. When adopting an 'activist' identity, local interviewees take or demand actions which will 'restore' those aspects of the place that are perceived as symbols of the stigma. For instance, a middle-aged woman explained which actions she would like to be taken:

Antonija: “What would we like to be done? First of all we would be satisfied to hear that they install proper filters, which are appropriate, which don't pollute the environment. And then, when this situation improves, that they start planting greenery, all kinds of greenery, fields, these public areas, renovate some buildings, so that it looks like something.”

People with strong ties to a place and stigma associated with it tend to lobby for actions to improve the state of the environment within their community. A manifestation of this identity is reflected in the local emergence of highly active groups such as the local NGO ‘Eco-Zeleni’ (Eco-Green), whose members defined themselves as ‘environmental activists’, the women’s group, and the local community. The following quotes give examples of the ‘actions’ taken, including filing complaints, actions to control TEP’s activities, making demands to TEP, organising meetings and signing petitions for the closure of disposal sites:

Joka: “I always participate whenever there’s a citizens’ meeting... (...) We talk and we tell each other that we should go there and block TEP, until they give us what we request: heating and a reduction in the cost of electricity.”

Edin: “I checked that myself, with others: we opened those containers which are located around TEP and where medicinal products are stored at a temperature even under -30 degrees. We informed the public about [the illegal burning of medicines and dumping on the sites] through the electronic media, but nothing changed radically. But I knew that piece of information as well. Because we went and organised round tables, we pointed out these flaws.”

Elma: “We signed a petition in the local community: a petition was made where every resident signed.”

Elvir: “Whatever topic ordinary people start, these people from TEP never acknowledge it because of their company, and they wouldn’t initiate it. And me and Petar [pseudonym]... Who else is here? We are new, Petar and me, but we have initiated our complaints now and we’re working on it and we will persist.”

Mesa: “Occasionally, we hold some meetings... we had a big meeting in Šćiki Brod a couple of years ago with the representatives of all 7 local communities. And we discussed exactly the topic of ecology and environmental protection. (...) And we started an initiative, the Eco-Green, with the residents themselves. We started an initiative to save the lake, not to let them put slag here. Because that would be a shame.”

When performing activism individuals often emphasise that they are forced to act for the well-being of the community:

Ismet: “I live in Bukinje, I’m 50 years old. And at the moment I’m working for the interest of citizens, in the local community.”

Mehmed: “I have been active in social activities for some 20 years, and I think I was the first to come to this local community. We formed the local community exactly because of these problems evident today. (...) We are talking here about our lives and the lives of our families, and surely no one will come here from the outside and solve our problems.”
According to Burningham (1996) expressions gather the support of other potential speakers to bolster the argument, while it puts the speaker in a good light by showing that the claimant is interested in other local residents beyond his/her own personal interest. This practice was common during the interviews in Tuzla associated to individuals that presented strong ties with the place.

b) Opportunism

There are some who do not consider the environmental pollution as stigmatising; for them the environmental change is a source of new opportunities. For example Zlatko, a young student living below the dike of one of the disposal sites explained the many uses the ash could have such as mixing them into asphalt ('because it is sturdier and more compact') or even to locate an airplane runway (because 'when it hardens the slag is very stable'). Zlatko says:

Zlatko: “I would use this because I know that in the West they make use of all natural resources. But we don’t make use of it. Simply, we don’t have that vision, you know. And you could make here whatever you wanted. It’s really stable. During the summer, when it dries out, people can cross it with horse-drawn carts, transporting wood.”

Perhaps the most striking action is the cultivation of the disposal sites by some of the local residents. Cultivation was made possible by the establishment of a thin soil cover (10-50 cm) over about 73 ha of the sites. Some residents argue that the food shortage during the recent war forced them to start cultivating the sites. After the war the practice continued and, since 2005, a farmers’ association is operating to promote farming on the sites. They perceive that cultivation is necessary to take maximum advantage of the presence of the sites. For instance, the president of the farmers’ association, who pioneered the cultivation of the disposal sites against the criticism of a wide sector of the community, was keen to explain his motivation to start growing crops and fodder on the disused disposal site. He remembers himself walking around the site when a local elder pointed his attention to the flat extension of derelict land saying: ‘look at that land. It should be used…’. Another resident explained that cultivation started during the war, but it also made them proud:

Alija: “They didn’t actually cover it for us to sow but to stop the dust. However, when we saw the land on the sites… the war did this thing: ‘let’s try to sow that’, and we started to sow… but you cannot imagine the yield we got! Posavina, Semberija aren’t up to their knees! Our production would put to shame both Posavina and Semberija. Considering the fact that when you plant three times 3 kg of seed, then a little fertiliser you get amazing beans! And the people more or less survived during the war thanks to the dam.”

Although among the interviewed sample there were only four individuals identified as opportunists, they have considerable influence in policy-making, and policy-makers themselves are looking for alternatives to turn a putative problem- the disposal sites- into a source of opportunities. However, opportunists may find themselves in a difficult position because those perceiving a stigma associated with the sites declare that opportunistic activities on the sites endanger the rest of the community members. The cultivation of the sites has been accompanied by growing concerns about the potential detrimental effects of such practices on local health. The interviews show that other local residents denounce the cultivation of the sites as a way to introduce additional dangers into the community, via local markets. Opportunistic activities on the sites are justified as a desperate option: unemployment, lack of income and hunger appear to be good reasons why people would cultivate potentially dangerous land.

Interviews among those local residents who cultivate the sites, however, show a different perspective on the pollution. Those who grow crops there argue that this is the best way to
take advantage of the new situation. Their previous experience of producing food there suggests that the land is suitable for cultivation. According to them, nobody has observed any abnormal effect on the health of people since 1991 (when they started cultivating the land). They present this option as a good management option, rather than as a desperate alternative. One local resident openly dismissed claims of other residents about the pollution of the sites: he argued during an informal meeting (not recorded) that those who would not use the site to grow crops were not worried about the pollution; rather, they were just ‘lazy’. This was his sole explanation to refer to local residents who refused to approach the sites, considering that mere contact with the coal ash could have irreversible consequences for their health.

However, this case of disregard of other local residents’ opinions was an exception. Most opportunists, albeit presenting the option of cultivation as a feasible option, also ponder the possibility that those sites could pose a threat to themselves and other local residents. In doing so, they develop arguments to justify their actions. Alija, a retired man (over 60) with a strong influence on the political life of the community Solana, had some plots on the disposal sites. Without being prompted by the interviewer, he addressed the local concerns about the radioactivity of the sites:

Alija: “There is slag there on the sites... and we thought that because of the ash there could be some radioactivity. Although we aren’t experts, but we weren’t scared because nobody forbade it. (...) When someone gets poisoned from mushrooms, you say you should ban it so nobody picks them, but we ploughed freely because nobody banned it, nobody informed us.”

In the quote, Alija used the pronoun ‘we’ to refer to a wider group of people involved in ploughing and sowing the disposal sites (again using a rhetorical instrument to build up legitimacy to his argument). He explained that they are aware that cultivation could be causing a problem. Later in the interview he explained that they talk about radioactivity 'over coffee', that is, this is an issue that they talk about informally very often, in the routine context of having a coffee together. Thus, the risk of radioactivity is part of their everyday life. In contrast to the activist perspective, their interviews suggest that the potential presence of the risk is not enough reason to stigmatise the sites as inherently dangerous places.

Yet opportunists like Alija need to find arguments to disregard the importance of risks and continue with their daily activities. Moreover, they have to deal with the claim that they may be endangering other members of the community. He argued that local residents are not competent to determine the presence of risk; rather, experts should demonstrate the presence of a risk at the disposal sites.

Alija’s argument presents both epistemological and political difficulties. From an epistemological point of view, this argument appears to construct the problem of pollution as a relatively simple problem, that ‘experts’ should be able to characterise simply in order to assess the environmental risks. However, coal ash pollution is a complex issue, which affects all the components of the ecosystem and is subject to great uncertainties regarding its evolution over time (see additional elaboration of this point in Chapter 7). Thus, the assumption that a ready answer exists takes no notice of the difficulties in estimating the presence of risks associated with the disposal sites. Indeed, it overestimates the capacity of experts to determine and communicate risks. Moreover, Alija’s argument assumes that, to constitute a threat, risks have to be proven to exist. The experience shows, however, that the absence of evidence of a risk is not the same as the absence of the risk itself, particularly when little has been done to determine the potential risks on the sites.

Alija implicitly assumed that there are competent authorities capable of providing an appropriate assessment of risks associated with the disposal sites. His account also assumed that these authorities are able to inform local residents of whether the cultivation
on the sites is safe. But the very existence of competent institutions which could produce an authoritative opinion about the disposal sites was eroded with the transition to a democratic system. Bosnia and Herzegovina now has a complex and confusing governance structure, with numerous gaps in the legislation and ambiguities as to who are the competent governance bodies in any policy area, let alone environmental policy (see Section 3.6 and additional references such as Agriconsulting, 2005 or NEAP, 2003).

Even if such an authority existed, there are serious doubts about whether it would be able to communicate efficiently with those who cultivate the sites. Alija highlighted that there has not been any communication about farming on the disposal sites and whether it is dangerous or not. However, he appeared to ignore the fact that farmers do not have property rights over the disposal sites. They are effectively cultivating an area considered to be wasteland and they do not have a legitimate right to cultivate it.

c) Escapism

If the ties with a place are broken, then performed identities will tend to de-emphasize those aspects linked to the specific environment. Responses will tend to emphasize private actions to cope with pollution, and not engage in or create opportunities to redefine the collective identity. If the perceived stigma is high and the ties with the place are broken, the individual may find no reason to remain within the local community. Perhaps the most extreme manifestation of this is the abandonment of the place. Many people expressed their wish to leave:

Evad: “If we could... I have a son here and another son in Belgium and a daughter in Italy (...). If we could, we would leave too.”

Interviewees referred to the current migration process as ‘exodus’; however, it is difficult to quantify the scale of out-migration since the area received a large number of refugees during the war and census statistics are still unreliable. The desire to leave emerges even among people who lack the means to move away. For instance, Muhamed, a retiree explained:

Muhamed: “You see if the youth had anywhere to go, not a single young person would stay here.”

Escapists direct their efforts at redefining alternative identities not linked to the stigmatised place allowing them to redefine their identity in different settings. Should the policy process be concerned with the actions of those who abandon the place? Since land management decisions aim to influence the development of that particular place including escapists in the process seems redundant or even counter productive. However, this argument ignores the possibility that escapists’ responses may have emerged in response to the transformation of the place.

For example, an interviewee in Bukinje explained that his worries about the environment were coupled with an incapacity for action due to his economic situation and lack of future prospects. He had been compiling evidence, he argued, of the pollution in the area by visiting the local cemetery. He insisted in providing us with this evidence two days later, but when my translator and I tried to contact him, he had emigrated to Croatia. On the phone, his wife said he was desperate. In the context of his previous interview, it appears that both environmental and economic factors moved him to break the ties with the place. Thus, there is a moral argument to include escapists within the policy process; environmental regeneration should ideally enable the restoration of the ties with the place. However, the practical problem of involving those who are not present emerges. Their representation may be possible by using another social group as a proxy. For example, activists claim to represent those who have already migrated: this may be the only possible way to bring them in. Within the current policy process, physical absence equals political absence.
d) Conformism

Finally, another discourse emerges among those who appear disengaged from the ongoing changes, and play down the place stigma, considering it as an inevitable fact of life or as a minor problem compared with other aspects of their life. In some cases residents explained that they do not do anything, because they do not have the means, or time, or because they feel powerless.

Janko: "You could say a lot about it, but there is nothing I can do. Nothing. Even though, lots of things should be done."

This reaction appeared to be common among those residents who refused to participate in this research. For instance, a couple living in front of the disposal site in Dreznik declined to engage in an interview on the grounds that 'they cannot speak up for the community because they are not from there' even though they were happy to show us around their house and invited us for coffee. Another couple of retirees sunbathing in front of their house from where TEP's chimneys were clearly visible declined the interview because 'they were not interested in any environmental issues'. This does not necessarily mean that they are really disinterested; rather, they may not want to discuss intimate experiences with an unknown foreigner or they may not want to risk offending others. Behind these discourses there may be a profound sense of isolation, resignation or despair, which is difficult to capture in a single interview. However, those who seem disentangled from the place are likely to be perceived as uncaring and selfish by other members of the community, especially those with a strong perception of stigma. Take the example of Antonija:

Antonija: "I care about the environment (...), some people care about it, but there are some who don't (...) If people organised something, I would be the first to go out tomorrow and urge people to do something, to clean outside of my yard, and outside of my building (...) we could organise an action to do something, but believe me that in 5-6 days it would be the same again. But this is not worth your writing, that's just the mentality of our people here, us particularly, the locals..."

Antonija associated the lack of action on environmental problems with the lack of interest in environmental issues. In her view this is one of the obstacles that prevent locals from taking effective collective action to improve their lives. This example also illustrates the significance of attributed identities in the social reactions to environmental pollution.

Conformists may be perceived as not wanting to participate in the policy process. Should those who do not want to be included in the policy process be represented at all? In policy processes already compromised by the lack of resources, making extra efforts to include those who seem 'not to care' may be regarded as useless.

However, there are several reasons to advocate the inclusion of those who may not want to participate. Firstly, we may be unaware of the reasons that motivate conformist attitudes. Some interviewees in Tuzla argued that the lack of action among some residents is motivated by their dependence on the industry. Secondly, conformist attitudes may emerge due to the difficulties that individuals have in bringing their opinions to a debate. This is common when conformists’ arguments are not provided within a frame of reference shared with those involved in the decision-making process. Who defines the frame will eventually determine the outcome. A conformist attitude may emerge from the belief that nothing can be done to improve the policy process. Individuals may feel alienated and eventually retreat to a conformist-like type of attitude. For instance, an interviewee explained her frustration in trying to bring her concerns to her representatives:

Sofie: "I'm a nobody in this... whatever I said, people would laugh at me. That's how it is. I would be laughed at, and the person who I would tell my opinion to,
who would be able to do something about it, would find me hilarious. You know, that's our mentality, because I am not the authority."

She feared being laughed at, and implied that such a thing will occur not on the grounds of the value of her own arguments but rather because of who she is: they would find her 'hilarious', or 'laughable'. Her opinion on the ontology of the problem seems to her irrelevant within the context of power relations in which the decision-making process is embedded.

Thus, conformist attitudes may be motivated by perceived structural barriers to the expression of their concerns, even though their concerns may be equally valid and useful within the policy process. Research among local residents may help to bring these concerns to the fore, by providing a means in which people who consider themselves to be 'laughable', or who are afraid of being singled out, can communicate their message without fear or ridicule. However, this requires a trusting relationship between the researcher and the researched, which may take longer than a few interviews to develop.

5.4.4. Justification of the analysis

The analysis presented here could be accused of essentialism because it describes performed identities as universal responses to pollution. The division of local communities into four performed identities emphasises generalities observed by an external researcher and depend on her subjective judgement. Although they offer a detailed description of the social context among local residents in Tuzla, the categories presented in this chapter are cultural constructions, rather than categories easily applicable in a wide variety of case studies. For that reason, this Chapter describes these identities within the context in which they occur.

The analysis helps to characterise different types of performed identities that emerge associated with a degraded area, to identify alternative arguments and to explain the potential conflicts that may emerge among actors supporting those arguments. Furthermore, the research identifies groups of people that may easily escape the eye of the analyst (escapists and conformists) but argues for the need to involve them more fully in the decision-making process.

Each performed identity is defined by the kinds of actions that individuals exhibit, characterising divergent ways of reacting to the environmental change. Because performed identities are inherently dynamic and evolving, the identity types proposed and discussed in this section are derived from individuals and group behaviour in a particular place and situation, a snapshot image of what was observed at the time the interviews took place. One single individual may present more than one performed identity, depending on the situation in which the identity is performed. Still, two aspects reinforce the general interest in the above classification and analysis:

- First, identities are self-reinforcing. For instance, an individual performing an activist-like identity is likely to defend the links between residents and places, and therefore these actions reinforce the ties with that place every time the activist-like identity is performed. This is likely to result in a more or less stable perception of the self-identity, an 'habitus', and the belief that other members of the local community may share it.

- Second, these are public identities performed, in this case with a foreigner. They may not correspond to the identities that the individuals perform in private or to a different audience.

The major strength of this analysis goes beyond the description of particular types of performed identities in the context of environmental pollution. First, the analysis demonstrates the dangers of generalisations about the homogeneity of 'local communities'.
Within local resident communities multiple identities emerge with alternative accounts of the same problem. Overlooking these differences may lead to the reinforcement of local conflicts caused by the diversity of opinions among local residents. The analysis also shows that stigma and ties with the place are two important concepts that help to understand how local residents relate to the pollution and develop particular types of performed identities.

5.5. Discussion

The empirical evidence obtained from the interviews and summarised in this chapter shows that environmental pollution does not necessarily rupture the bond between identity and place. This implies that emotional bonds to a place emerge from both positive and negative experiences of that place which contribute to the process of self and collective identification. However, even though the linkage with the place is maintained, the environmental degradation may be perceived as a hazard threatening their own existence and life world, and community life as they understand it. This supports evidence observed in other studies where for a community 'the sense of loss that they express is not only a loss of place but also, more profoundly, a loss of self' (Dixon and Durrheim, 2000, p. 36). Hence, efforts to reverse degradation processes need to be aware of the threats that the pollution (and potentially the regeneration) may pose for the self-perception of local residents.

From this point of view, understanding the potential reactions that are likely to emerge in the context of environmental pollution requires policy-makers to consider a wider spectrum of environmental reactions. Characterising the residents as a single group with a homogeneous reaction may also obscure those opinions of residents who do not choose to express their concerns.

When environmental change occurs, opportunism emerges as the capacity to adopt new identities and actions associated with the transformation of a place; its positive impacts will be proclaimed while its negative outcomes or potential threats will be rationalised. For instance, in Tuzla, interviewees who cultivated the disposal sites argued that it could not be dangerous, because if it were, the responsible institutions would have advised them not to cultivate there. The transformation of a place creates momentum for the redefinition of locals' identities and the identification of opportunities for social action (Petrzelka, 2004). However, less negative perceptions of environmental pollution may require several exercises of rationalisation and denial of the symbols that constitute a pollution stigma (see also e.g. Zonabend, 1993).

Activism emerges associated with stigma; activist individuals would strengthen their identity by redirecting action towards the restoration of a place. Negative aspects of the environmental transformation are highlighted and its stigmatisation symbols taken as a platform for collective action. Individuals do that by including in their collective sense of self the environmental components of the place where they live (Dixon and Durrheim, 2000). In Tuzla, interviewees showing activist identities were concerned about neglected sectors of the community and dared to question technocratic arguments that overlooked the uncontrollable nature, extent and range of hazards of the existing environmental pollution.

Research on contaminated communities has focused on the formation of grassroots organisations within contaminated areas (see e.g. Edelstein, 2004). Edelstein argues that these organisations emerge after the failure of individuals and groups to cope with the pollution and contribute to the formation of a 'sense of community' which may enable their development, mutual support and capacity to initiate political action for mitigating or stopping pollution. In that sense, the creation of action groups to contest the pollution is a key for the development of a new community identity, and for its survival.
Kevin Hetherington points out that the formation of activist groups is intrinsically linked to how individual identities are developed through protest (Hetherington, 1998). Members see themselves as progressive members of their community with the capacity to represent the ‘moral self’ of that particular group – and, more generally, of society (Hetherington, 1998). However, in establishing a moral baseline, they may demean other forms of identity. For instance, in Tuzla, activists strongly criticise those who cultivate the derelict ash disposal sites; those who leave the local community; and those who they perceive as not seeing the bigger problems beyond their own self-declared insignificant lives. They redefine what ‘normality’ is in the new context and by doing so they create an additional stigma on those whose identities do not support collective action.

If ties break, individualist identities are likely to manifest themselves in escapism and/or conformism. Some individuals may be able to reinvent themselves in a different setting after the rupture of their linkages to that place. Migration, although widely understood as the only alternative left for unemployed youngsters, is perceived as a symptom of the annihilation of the local communities. In contrast, ‘conformists’ renegotiate their identity as their fate. They may think that they lack the capacity to improve the situation. In this context, accepting the environmental degradation as an inherent characteristic of the place may be the only way to deal with the pollution. Conformist and individualistic attitudes are pointed out by other residents as uncaring and selfish; individualists are seen as having little interest in the place and as impeding collective action to adapt to or ameliorate the environmental change. They can be easily ignored by a policy process that demands active participation from its citizens.

However, it is important to bring to the fore the opinions of the individuals exhibiting these identities. Firstly, we may not be aware of the reasons that motivate conformism. For instance, research has shown the difficulties of identifying residential pollution in one’s own neighbourhood, when identifying the pollution poses more problems than it resolves (Burningham and Thrush, 2004). Secondly, conformism may emerge due to the difficulties individuals face bringing their arguments to a debate that has been framed by other actors in terms that do not allow local residents to explain their arguments. Land regeneration projects thus need to pay explicit attention to the emergence of conformist-like attitudes, in order to avoid overlooking relevant, but often unvoiced, aspects which may have a negative impact on the lives of local residents.

5.6. Conclusion

This chapter suggested that land degradation does not necessarily break the ties between identity and place, but rather, it may pose threats for the continuity of residents’ identities. Because returning a place to its original pre-industrial state is not always possible (or even desirable), land regeneration needs to take account of the dangers posed for local residents and address their concerns about regeneration plans and what happens thereafter. Hence, projects researching land regeneration solutions, such as RECOAL, need to address threats to identity in addition to the physio-chemical remediation as both critically affect individual and collective well-being. Understanding the local identities associated with a polluted place exposes latent and expressed social concerns which can be incorporated into land regeneration projects, alongside measures to mitigate the physical impacts of pollution.

Measures should be taken to examine the evolution of local identities, their disruptions and means of continuity and the reasons why conflicts arise. In particular, two different types of measures may be included in institutional projects to improve the lives of people affected by pollution. First, measures to eliminate the symbols of stigma associated with a place, either physically (e.g. removing dirt, rubbish) or symbolically (finding new safe uses for the polluted place); and second, the identification of ways to facilitate identity change and counteract stigma. Such measures need to be tailored for every context. In the case of
Tuzla, based on the interviews, the self-esteem of the local communities living around the ash disposal sites could be improved by:

- creating new sources of reliable employment;
- establishing green-spaces and improving the infrastructure to help the local landscapes 'look beautiful'; and
- providing benefits that could make life in the area more desirable (e.g. co-generation of electricity and heating for local residents).

This chapter proposed a model for understanding performed identities in the context of environmental change based on the concepts of sense of place and stigma. While the model is effective for explaining the emergence of alternative perspectives on pollution in Tuzla, further empirical research is needed to test the model for other case studies which aim to identify and explain local reactions to a range of social and environmental transformations. Any application of this model will need to take into account the extent to which identity is socially constructed (Somers, 1994).

The following chapter takes up the task of investigating the process by which pollution is identified and characterised by local communities. This chapter looks at how scientists themselves define pollution and how their discourse separates them from the perspectives held locally. In particular, the chapter reviews the dangers that local residents associate with the coal ash in the case of Tuzla, and how this unlocks mechanisms of blame.
6. Pollution Definitions in Context

6.1. Introduction

The environmental problem of coal ash disposal in Tuzla has been referred to repeatedly as a problem of 'environmental pollution'. Understanding what is meant by 'environmental pollution' is critical to characterise the causal links between the pollutants and the environmental and health hazards. However, defining pollution is problematic. A scan through different definitions of pollution in the environmental sciences literature shows variations in terms of how pollution is defined and acknowledged in a particular context, the dynamic character of pollution, and the means of identification of hazards associated with the pollution.

Forty years ago anthropologist Mary Douglas proposed an intriguing theory about the nature of pollution and dirt. She argued that what dirt and pollution are can be determined only within the cultural system in which they are claimed (Douglas, 1966). Dirt is something that disrupts the symbolic system in which it is defined. Mary Douglas developed this theory to explain pollution rituals of non-western cultures, but the theory has proven to be applicable to explain contemporary relationships with waste. The theory could be potentially applied to explain people's relationship with pollution and the emergence of pollution beliefs among different human groups. Thus, this chapter examines how local residents around the communities in Tuzla interact with the coal ash waste and how pollution beliefs emerge as a result of that. The analysis suggests that the way local residents construct beliefs about pollution within local communities is different from how researchers approach the issue of environmental pollution on the sites. Local residents have developed completely opposite understandings of pollution to those of the scientific community because they are grounded in different understandings of what pollution is and how it relates to the symbolic system within which the pollution is defined.

Section 6.2 presents a review of contemporary definitions of pollution within different scientific disciplines, in particular environmental sciences, soil sciences and environmental law. This is followed by an analysis of Mary Douglas' ideas of pollution. Section 6.3 presents an analysis of different accounts of pollution emerging from the interviews with local residents in Tuzla. Section 6.4 brings together different understandings of environmental pollution showing the fundamental differences between researchers' and local residents' accounts of environmental pollution.

6.2. Ideas of pollution and contamination

6.2.1. Definitions of pollution in environmental sciences

There is no single definition of what pollution is. The examination of commonly accepted definitions of pollution shows that these definitions are far from consensual, particularly when applied across different academic disciplines such as environmental management, soil science or environmental law. This section reviews some definitions of pollution extracted from textbooks, with the intention of exploring contemporary understandings of pollution shared by scientists and technicians.

Rachel Carson, in her book _Silent Spring_, gave the following compelling description of environmental pollution:

"The most alarming of all men's assaults upon the environment is the contamination of air, earth and rivers, and the sea with dangerous and even lethal materials. This pollution is for the most part irreversible. In this now universal contamination of the environment chemicals are the sinister and little recognized
According to Carson, the pollution is created by defilement of the environment and the introduction of foreign substances into it. She identifies an agent, the human, who is assaulting the environment. Carson's book presents a combination of both moral and scientific arguments to prevent humans from destroying the environment.

Even before the publication of *Silent Spring* it was possible to find the argument, in both scientific and legalistic terms, that pollution was not merely the entry of anthropogenic substances into the environment. The damage caused by potential pollutants on natural resources would depend on how valuable those resources were for humans. Pollution was characterised as an intrusion detrimental to human values upon the environment. Take for instance this example of research on water pollution in which the authors express their concerns about the definition of pollution in a litany that begins as follows:

"Should the mere change (physical, chemical, or biological) of some aquatic environment resulting from waste disposal be regarded as pollution even when ordinary humans use it and enjoyment of the water and of associated natural resources have not been affected adversely? When there is evidence of environmental change, is this always reliable evidence of damage to valuable natural resource? (etc...)" (Doudoroff and Warren, 1957; p. 145)

The latter ideas about pollution have endured as concepts within the imagination of environmental scientists, i.e. that diverse substances are present in the environment but they only become pollutants when the proportions in which they occur are regarded as abnormal. For instance, the following definition was found in a textbook on "Environmental Chemistry":

"Chemical pollution is understood to mean a high level of some chemical substances that adversely affects the natural environment. Pollution can be thought of as being the presence of too high concentration of a resource in the wrong place at the wrong time." (O'Neill, 1998; p. 181)

This idea goes back to Paracelsus' (1493-1541) principle widespread in toxicology and associated environmental sciences: "Solely the dose determines that a thing is not a poison" (quoted in Borzelleca, 2000; p. 3). Paracelsus' definition breaks the symbolic boundaries between poison and other elements of the environment. The poisoning characteristics of an object are not to be found in the object itself, and our conceptual understanding of such an object, but rather in the quantities of the object provided (and, associated with this, on how these quantities reach the individual). This principle is essential in environmental health science, in particular in exposure analysis and risk assessment (Binswanger and Smith, 2000).

Paracelsus' principle has been tested in several fields. For example, a review of evidence examining the misconceptions regarding the environmental causes of cancer explains that "[a]t low levels of synthetic chemicals to which humans are usually exposed, such increased cell division [shown in dose-response experiments with rodents] does not occur" (Ames and Gold, 2000; p. 3). They further elaborate this principle by explaining that "[e]ven Rachel Carson was made of chemicals", and that indeed, about 99.9% of the chemicals ingested by humans are 'natural' (Ames and Gold, 2000; p. 5). Abnormality is not located in the nature or presence of the pollutant, but rather, in its concentration. Potential pollutants, apart from some rare exceptions, are elements naturally found in the environment.

Definitions of pollution in terms of the abnormal concentration of 'natural' substances have spread throughout the environmental sciences literature (Porteous, 2000; Collin, 2004; Kabata-Pendias, 2001; Adriano, 2001 [1986]; RCEP, 1998). Such definitions have
been reinforced by making a distinction between contamination and pollution. Contamination is related to the presence of 'abnormal' concentrations of substances in the environment, with no detrimental effect to either human or the environment: in contrast, pollution requires the definition of a harm, a danger, associated with such concentration (e.g. RCEP, 1998; Kabata-Pendias, 2001; Adriano, 2001 [1986]). This differentiation emphasises the natural character of the pollutant which can be present in the environment without detrimental effects. In essence, the difference between contamination and pollution seems to be that the latter adds an element of danger to the situation.

Because many pollutants occur naturally, they do not have to be avoided or eliminated. Instead, they need to be controlled. In order to control them a definition of normality is established in the form of thresholds (e.g. Kroes et al., 2005). Thresholds determine the minimum concentrations above which the pollutant is likely to cause harm either to humans or the environment (or the maximal concentration of pollutant that is likely to cause no harm).

This understanding of pollution also addresses the issue of 'natural contamination' cases, in which a potentially hazardous substance has been found to exceed normal concentrations due to natural causes. Examples of natural contamination include the pollution of groundwater in the Argentinean Pampean Plain with arsenic and other trace metals (Farias et al., 2003) and the pollution caused by the Kawah Ijen crater lake in East Java (Indonesia) (Löhr et al., 2005). The presence of 'natural contamination' has an important impact on management. For example, a team of scientists studying a brownfield site on former steelworks in Naples (Italy) found evidence that confirmed that in addition to contamination from anthropogenic activities, there was a 'strong natural component' (Tarzia et al., 2002; p. 45). Their abstract, recommends stopping any remediation effort:

"The natural contribution of hydrothermal fluids to soil pollution, in addition to the non-bio-availability of metal pollutants from industrial materials, indicate that heavy metal remediation of soils in this area would be of little use. Continuous discharge from mineralized hydrothermal solutions would cancel out any remediation effort." (Ibid.; p. 45).

A debate emerges from this definition about the origin of such pollution. In order to be able to establish precisely the consequences of pollution some definitions specify that pollution is of anthropogenic origin (e.g. Grant and Hawkins, 1995; Allaby, 2006; RCEP, 1998). In contrast, some authors specify that although pollution is often the result of human activities, it can also occur naturally (e.g. Collin, 2004; Novotny, 1999). Because most definitions of pollution consider pollutants to be present 'naturally' in the environment, it does not resolve the issue of whether contamination is necessarily of anthropogenic origin. For example, an article entitled Is pure groundwater safe to drink?: natural 'contamination' of groundwater in Norway contained the following disclaimer, noting the importance of natural 'contamination':

"The title of this article is designed to provoke. Naturally occurring parameters are, by definition, not contamination. Nevertheless, nature is not necessarily nice, and naturally occurring trace toxins can be every bit as undesirable as their counterparts derived from human pollution." (Banks et al., 1998; p. 104)

For a legal point of view, however, it is important to identify precisely the anthropogenic character of pollution. For example, the following definition of pollution appears in a legal text from the European Union:

"'pollution' shall mean the direct or indirect introduction as a result of human activity, of substances, vibrations, heat or noise into the air, water or land which

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30 Environmental practitioners favour the use of the term 'contamination' precisely because it does not have the same implications as the term pollution.
may be harmful to human health or the quality of the environment, result in
damage to material property, or impair or interfere with amenities and other
legitimate uses of the environment." (CEC, 1996; Art 2.2)

In addition, pollution is identified in relation to the damage it causes to those things that
humans regard as important. According to the definition above, pollution only occurs as long as its effects are shown to be harmful to human activities or reduce environmental
quality according to human-set environmental standards. Environmental scientists
frequently feel the need to clarify the relativity of pollution claims:

"Whether a particular discharge into the environment causes pollution depends on
the circumstances in which it occurs, the capacity of the receiving environment to
dilute and disperse, the nature and the quality of the substance, assessment of risks,
public attitudes and value judgements." (Grant and Hawkins, 1995; p. 85)

This suggests that public attitudes and value judgements are important in determining
whether a particular discharge into the environment causes pollution. The relativity of
pollution requires naming not only the hazards that it may cause but also the receptors of
such hazards and the pathways through which those hazards affect them. This process
requires a series of subjective choices to deal with the ambiguities of pollution while
simultaneously maintaining the belief of being led by a systematic attitude towards it.

In summary, this section explored some principles that underlie the tacit knowledge about
pollution shared by most environmental scientists, by exploring definitions of pollution in
textbooks and manuals of environmental sciences. Three main points emerge from these
definitions: 1) the 'natural' character of the majority of potential polluting substances
because they can occur on the environment 'naturally'; 2) the difference between
contamination, as an abnormality, and pollution, as an abnormality that poses a hazard to
humans and the environment; and 3) the need to relate the occurrence of pollution with the
aspects of the environment that humans regard as valuable. The following section looks at
the idea of pollution from a completely different perspective, by examining the theory of
pollution developed by Mary Douglas.

6.2.2. An anthropological theory of pollution

The work of Mary Douglas has strongly influenced the literature of environmental studies.
For instance, her collaborations on studies of risk (Douglas and Wildavsky, 1983) have
influenced risk theory (Giddens, 1991; Beck, 1992; Adams, 1995) and her cultural theory
has been used to explain different styles of natural resource management (e.g. Milton,
1996; Steg and Sievers, 2000; Hoekstra, 2000).

However, Mary Douglas' ideas about pollution and waste have had less influence in
understanding how societies deal with pollution. Her book Purity and Danger: an analysis
of the concepts of pollution and taboo was first published in 1966, only three years after
Rachel Carson's Silent Spring (1963), in the wake of an environmental consciousness tide
which supported the growth of environmental movements. However, Mary Douglas' book
was not directly concerned with environmental pollution. Although the book famously
defines 'dirt' as 'matter out of place' (quoting William James) it largely overlooks any
material concerns and focuses instead on the relationships between pollution and different
ideas about the sacred, religious and sexual beliefs.

Douglas' theory argues that ideas of dirt and pollution express some aspects of social
symbolic systems. She suggests that pollution myths are organised around beliefs that link
the individual with the cosmos, and they are expressed in body-related practices and
taboo. Pollution-related behaviour exhibits some regularity so that cultural differences
associated with pollution are 'only a matter of detail'. However, her definition of dirt also
rests on its material components and their being 'out of place'. She emphasises the relative
character of dirt using examples:
“Shoes are not dirty in themselves, but it is dirty to place them on the dining table; food is not dirty in itself, but it is dirty to leave cooking utensils in the bedroom, or food bespattered on clothing…” (Douglas, 1966; p. 35-36)

That is, dirt occurs within a symbolic system. Dirt is only identified within a set of pre-ordered relations and the breaches to such order. She characterises the recognition of dirt as a positive effort to organise the environment. The ordering and classification of matter requires the rejection of inappropriate elements that do not adjust to such order, the dirt. The anomalies, however, may be persistent, in which case individuals are forced to deal with them, either negatively, ignoring or eliminating them, or positively, by redefining the symbolic order to adjust to anomalies. The theory is developed into five cultural provisions to deal with anomaly:

1- establishing rules to settle the interpretation of the anomaly into other pre-defined categories;
2- controlling the anomaly physically, either eliminating it or disguising it;
3- establishing rules to avoid anomalies or their emergence which affirms the categories that helped to identify the anomaly;
4- labelling anomalous events as dangerous which develops social anxieties around them; or
5- using anomalous events to open doors towards other symbolic systems, in religious rituals or elsewhere.

The fourth strategy is closely linked with the development of pollution beliefs. In particular Mary Douglas is interested in the ambiguous character of dirt anomalies, particularly in relation to the two potential reactions that may emerge against dirt, either avoidance/rejection or the full embracing of anomaly to create a new symbolic order. She explains:

“Granted that disorder spoils pattern; it also provides the materials of pattern. Order implies restriction; from all possible materials a limited selection has been made and from all possible relations a limited set has been used. So disorder, by implication is unlimited, no pattern has been realised in it, but its potential for patterning is indefinite. That is why, though we seek to create order we do not simply condemn disorder. We recognise that it is destructive to existing patterns; also that it has potentiality. It symbolises both danger and power.” (Douglas, 1966; p. 94)

Mary Douglas argues that pollution beliefs have the potential to stir the symbolic structures that organise life at a particular time in a particular society, and this may provide the opportunity for powers and dangers to emerge. Pollution beliefs question the symbolic structure on which the society rests because their powers 'inhere the structure of the ideas itself' (Ibid.; p. 113). In order to describe how pollution is related to power she attempts to map the areas where danger and power coexist. She uses three dialectical concepts:

- Internal/external power refers to the difference between the power inherent to the psyche of the agent and the power which can only be invoked by the agent's conscious actions.
- Controlled/uncontrolled power refers to the power that can or cannot be unleashed at will by the agent.
- Endangering/endangered differentiates the social position between those who produce the danger and those who suffer its consequences, whether or not powers are exerted to defend the social structure.
These concepts serve to differentiate legitimate, controlled powers from uncontrolled powers that may endanger the individual. The aim is to relate the disruption of the symbolic structure with individual actions, and how these actions are [or not] legitimated. These three concepts are combined in the following correlation:

"Where the social system explicitly recognises positions of authority, those holding such positions are endowed with explicit spiritual power, controlled, conscious, external and approved- powers to bless or curse. Where the social system requires people to hold dangerously ambiguous roles, these persons are credited with uncontrolled, unconscious, dangerous, disapproved powers- such as witchcraft and evil eye." (Douglas, 1966; p. 99)

Well defined social positions render situations in which there is little ambiguity possible, powers are external and controlled, and this is supported and encouraged by the members of such cultural systems. Alternatively, when this is not the case, powers become internal and uncontrolled, and the danger potential increases. The society is then divided between 'malefactors' and 'victims' and protections against those powers needs to be developed. The characterisation of an individual as 'malefactor' or 'victim' is linked back to the emergence of pollution beliefs, and the symbols that provoke them.

Using the above conclusions she proceeds to relate her ideas about dirt and pollution to the establishment of moral codes of conduct. Pollution rules and moral rules are not necessarily related for they refer to different issues. That is, the pollution code refers to what the world should be, according to the set of pre-defined rules about the material world within which pollution is recognised. Moral rules, instead, are about what should be done according to rules about what is good or bad human behaviour. In other words, pollution rules relate to social expectations about the material, whereas moral rules sanction human behaviour. She explains that applying moral rules is complicated because:

"...there can often be more than one view on what action is right, because of disagreement about what is relevant to the moral judgement and about the estimated consequence of an act. (...) Pollution rules, by contrast with moral rules, are unequivocal. They do not depend on intention or nice balancing of rights and duties. The only material question is whether a forbidden contact has taken place or not."(Ibid.; p. 130)

Pollution beliefs avoid ambiguity by focusing on material issues and observations for which evidence can be gathered. Pollution rules may substitute moral rules when the latter are ambiguous. Although pollution beliefs should not be confused with the moral code because pollution and moral beliefs are frequently unrelated both codes operate in parallel and ultimately refer back to the same cultural system. Thus, when moral rules are obscure or contradictory, pollution beliefs 'can distract from the social and moral aspects of a situation by focusing on a simple material matter' (Ibid.; p. 138)

Mary Douglas makes a strong point in explaining that the significance of pollution beliefs is sustained on contradictions. While there are strategies for the social system to deal with dangers (whether they are externally imposed or emerging from within), she finds them self-defeating. Pollution beliefs flourish whenever social organisation categories are ill defined. By contrast, when the symbolic categories are rigidly defined, so that they suppress the emergence of anomaly, pollution beliefs vanish. An exception to this rule is that in some special cases a highly developed but subtle system of institutions may prevent the emergence of pollution beliefs even though the social categories remain ill defined.

The book Purity and Danger focuses on sexual behaviour and beliefs because, she argues, they are the most 'explosive' social pressures. However, other examples of pollution beliefs can be found when examining the relationship between people and their environment. Social pressures to regulate our interactions with the environment are
certainly ‘explosive’. Conflict emerges in a variety of settings degraded by environmental pollution from the classic examples of Love Canal (e.g. Edelstein, 2004) to more recent conflicts related to extractive practices (Martinez-Alier, 2001) or bad management of disasters (e.g. Brinkley, 2006). Reviewing her work on *Purity and Danger* Mary Douglas explains:

“At the Massachusetts Institute of Technology in 1968 I talked to a friend in political science who, on looking up the word ‘pollution’ in the new Encyclopaedia of Social Sciences had been surprised to find my article on ritual defilement. A careful comment on *The Golden Bough* and other misunderstandings of magic and taboo was of little help to him because, at that time, concern for rivers and the survival of water-life had become a major political issue in the United States and he wanted to know what river pollution entailed. I felt he would have liked to have complained to the editors of the encyclopaedia about their selection of writers.” (Douglas, 1992; p.4)

Yet, this chapter departs from the assumption that Mary Douglas’ theory of pollution and taboo has great potential explanatory power to explain the emergence of pollution beliefs in our society, and how these relate to how we identify or define pollution. Some authors have applied this theory to understand, for example, social attitudes to pollution in urban settings such as the city of Lagos in Nigeria (Jarvela and Rinne-Koistinen, 2005) or the global environmental crisis (Saurin, 2001). These authors focus on the understanding of dirt as ‘matter out of place’ to emphasise that what counts as pollution is context dependent. However, these works do not explore further the implications of defining pollution in this particular way, and what implications this has for the development of moral codes related to pollution beliefs. The following sections analyse the construction of pollution beliefs in Tuzla, the emergence of dangers associated with those beliefs, and the identification of malefactors and victims in the context of coal ash pollution.

### 6.3. The construction of pollution beliefs in Tuzla

#### 6.3.1. Local descriptions of pollution

The qualitative research in Tuzla indicated that local residents refer to pollution in multiple ways. Direct references to environmental pollution are made mainly by those residents identified in Chapter 5 as performing an ‘activist’ type of identity. Their references employ subtle descriptions that help explain their own perceptions of pollution and how it affects them. Analysing these descriptions can help the external observer to understand how pollution is comprehended and experienced among local residents in Tuzla. Table 6-1 offers a summary of the main descriptions employed to refer to the perceived pollution and its effects, providing some representative examples about how such beliefs are communicated in the local discourses in Tuzla.

Table 6-1 divides these descriptions into two groups, according to the way in which the association with the pollution is drawn. The first group contains a series of descriptions that refer to the experience of pollution in Tuzla. In these, the pollution phenomenon is defined by referring to the instances of observed anomaly putatively caused by the pollution. These quotes refer to local observations of pollution as ‘dust’, ‘dirt’, ‘meteorological phenomena’, or an ‘invader of space’. The second group refers to descriptions in which the association is built upon the perceived consequences of pollution and the fears emerging around them. Thus pollution is referred to as ‘something that we do not see’, ‘an agent of disease’, ‘a poison’ or as ‘radioactivity’, all of which are related to

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31 This section focuses on the discourses of the ‘activist’ actors. Some of the concerns expressed by this group were also present in the discourses of the other groups, mostly implicitly, but the focus remains with those who explicitly claimed the existence of a pollution problem in Tuzla.

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the putative causal relationships between pollution and the deteriorated health of residents within the local communities around the disposal sites in Tuzla.

<table>
<thead>
<tr>
<th>Pollution is:</th>
<th>Quote examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dust</td>
<td>“Because that dust is horrible, it’s something black, it’s sharp. You know how it is? It is like when you grind iron, something like that.”</td>
</tr>
<tr>
<td></td>
<td>“[W]hen it goes into your eye, that tiny speck of dust, that sharp dust, you have to go to the doctor to get it out for you.”</td>
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<td></td>
<td>“[T]he water is very black, very dirty. (...) Since it’s black, dirty, muddy, it means… it’s unclean.”</td>
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<tr>
<td></td>
<td>“...in the morning when I sweep this porch outside... I sweep it every morning and there is still dust on the porch and the fence.”</td>
</tr>
<tr>
<td>Dirt</td>
<td>“For example, it can happen that the weather is grey and dark without wind, and you feel that...I don’t know how to call it; we call it ‘dense air’ ”</td>
</tr>
<tr>
<td></td>
<td>“Rains are usually very dirty. Rain leaves those traces, how can I explain it, they are like yellow, like...some unhealthy colour...”</td>
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<td></td>
<td>“Everyone has white snow, but we have black snow in the winter.”</td>
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<td></td>
<td>“[W]hen the wind blows... (...) you can’t see anything, you can’t see buildings, you can’t see houses, you can’t see trees, anything. It’s black all around.”</td>
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<tr>
<td></td>
<td>“this climate [...] has appeared here and automatically there is a consequence...”</td>
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<tr>
<td>Meteorological phenomena</td>
<td>“I don’t know what we don’t see in that smoke and that dust. I don’t know what we don’t see from the chemical industry (...) [I] don’t accept that only when we see smoke from TEP (...) we consider it the only problem. The problem also consists of those other things, those that we don’t see.”</td>
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<td></td>
<td>“The basic thing that worries us the most...never mind the yellow dust and everything we see here at the moment, that black soot and all kinds of particles which can be seen from burning coal...we are mostly concerned by the ‘sulphurisation’, so, something we cannot see.”</td>
</tr>
<tr>
<td>Invader</td>
<td>“[A]t day you would get used to it, it comes in through the window; the dust comes through the glass. It all comes in and all white clean becomes black. It sneaks into the house.”</td>
</tr>
<tr>
<td></td>
<td>“Ash, soot, it all enters the house through double window panes, through the glass of the windows, and [even] through the roof tiles...”</td>
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<tr>
<td>Invisible danger</td>
<td>“I don’t know what we don’t see in that smoke and that dust. I don’t know what we don’t see from the chemical industry (...) [I] don’t accept that only when we see smoke from TEP (...) we consider it the only problem. The problem also consists of those other things, those that we don’t see.”</td>
</tr>
<tr>
<td></td>
<td>“The basic thing that worries us the most...never mind the yellow dust and everything we see here at the moment, that black soot and all kinds of particles which can be seen from burning coal...we are mostly concerned by the ‘sulphurisation’, so, something we cannot see.”</td>
</tr>
<tr>
<td>Agent of disease</td>
<td>“More or less, we all feel a change in the respiratory tract. If, for example, someone is a bit sick, has problems with bronchi, I don’t know, they certainly fell it. Then what we feel...it happens many times that you feel the dust.”</td>
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<tr>
<td></td>
<td>“[T]hey said that that slag is full of cancer.”</td>
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<td></td>
<td>“It’s something like humidity, and then the children inhale it. Our children are really sick. It’s a big problem.”</td>
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<tr>
<td>Poison</td>
<td>“[W]hen you see here that a rabbit died, that cows which graze grass are sick... (...) All kinds of herbicides and pesticides are used so our air is poisoned. Because the land here is so contaminated. Various poisons are let into our rivers. (...) The fields where people cultivate, those same fields. And then they sow and they contaminate themselves. ”</td>
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<td></td>
<td>“He brought fish and put them there. (...) I saw that all those fish died. It was up there if you’ve been where the pumps are where that... As soon as the water from the slag site started to flow in the rivers, the fish died.”</td>
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<tr>
<td>Radioactivity</td>
<td>“[A]lmost nothing grows here. And what does grow is dangerous to consume. You know? That’s dangerous. Because people are forced to cultivate these slag sites which are also radioactive, so they cover the slag sites with a thin layer of soil and then grow potatoes, grains and other crops. In that way, they get radiated themselves.”</td>
</tr>
<tr>
<td></td>
<td>“[It] is surely radioactive, and no one wants to tell us in which percentage, but it surely causes cancer.”</td>
</tr>
</tbody>
</table>

Table 6-1: Descriptions of pollution in Tuzla

To explain the experience of pollution most local residents refer to it as ‘dust’. Using the word ‘dust’ emphasises that it affects them in the form of fine particles of matter that
surround them continuously. Other words employed to refer to pollution include ‘lye’ (a term normally used to refer to a strongly alkaline solution), ‘soot’ (a black powder formed by combustion of coal), ‘slag’ (waste material associated with coal extraction or by mixing chemicals with a liquid metal) or ‘smoke’ (gaseous suspension of burned materials containing fine particles of carbon). These terms relate the nature of the local pollution with its origin, the coal combustion, except ‘lye’ which refers to the alkaline nature of the residue. Nonetheless, ‘dust’ was the most common word used to refer to the pollution emphasising the nature of interviewees’ experience of the pollution, rather than their ideas about its origin or composition.

The word ‘dust’ is also related to ‘dirt’ or ‘dirtiness’, making reference to a layer of particles that covers surfaces and buildings. Several quotes refer to this ‘dirt’ on benches, tables, coming through the windows, etc. Other quotes refer to other types of ‘dirt’, such as ‘dirt’ in the laundry, or the general idea of ‘dirt’ per se, and the general ugliness of the infrastructure in the community. Occasionally, in reference to the origins of the coal ashes as a by-product from the thermo-electric plant, the pollution is referred to as ‘waste’.

Pollution is also described as a meteorological phenomenon. This reference emphasises the ‘atmospheric’ nature of pollution among the local communities in Tuzla, in contrast to the idea of ‘dust’ that emphasises the minuscule size of the particles. Referring to meteorological phenomena allows local residents to establish a link between the particles of coal ash and the way they perceive their impact, affecting simultaneously the entire environment. Thus, the pollution comes in the form of harsh winds, ‘yellow’ rains, ‘black’ snow or loss of visibility.

The last category of description, built upon local experiences of pollution, refers to the pollution as an invader. An invader is an agent that enters an area of activity in an unwanted and forceful way; in an invasion, the invader takes possession of the space. Referring to pollution as an ‘invader’ explains how people interact with this ‘invader’ trying to keep the pollution separated from their lives by a set of spatial practices (in particular cleaning). The idea of the ‘invader’ is implicit in the more descriptive references to ‘dust’, ‘dirt’ and ‘meteorological phenomena’ all emphasise the all-pervading nature of the pollution in the communities around Tuzla.

The second group of descriptive statements are built upon the fears associated with pollution. The first category in this group characterises pollution as ‘something that we can not see’. This refers to the idea that the visible impacts of the coal ash (such as the ‘dirtiness’) are a mere indication of the potential unknown impacts that the pollution could have in their lives. When describing the pollution a common sentiment among interviewees would be “this is what we see... and God knows what we do not see”, emphasising the idea that individuals may be unaware of the most destructive consequences of pollution.

Although this group of statements are built upon constructed perceptions or expectations and not necessarily individual observations of what is deemed to be pollution, they may refer to other observations that are locally considered consequences of the pollution. This is the case in the many instances in which interviewees referred to the pollution as an agent of disease. They would characterise the pollution as the direct agent for their own afflictions. In some cases, such afflictions are individualised and given autonomy (for instance when an interviewee says “that slag is full of cancer”).

The category agent of disease is related to regarding pollution as a poison. However, while the first refers to the pollution as something ‘inside the body’ that triggers the disease, the latter idea refers to the pollution as something introduced in the body (ingested or inhaled). In other words, referring to the pollution as a poison highlights its materiality. Both concepts however, are not only applied to humans but also to the environment (e.g. animals, plants, landscapes are referred to as either poisoned or unhealthy).
Finally, a very common way to refer to the pollution in Tuzla is to explain it as 'radioactivity'. Because radiation is not perceived to be localizable or reducible to individual parts, the concept of radiation may resonate with local understandings of pollution within the landscape as a whole. Some authors have noted that characterising pollution as radioactivity highlights the lack of control local people feel that they have over these risks (Davis, 2005). In this case, pollution is presented by TEP and the local authorities as a very complex phenomenon, whose causes and consequences go beyond what they can anticipate. Referring to it as radioactivity links the pollution directly to a cause (the coal ash disposal sites are considered to be 'radiated') and to a consequence (cancer). The notion of radioactivity not only helps local residents to relate the industrial activities with their own experience of pollution, but also serves as a stepping stone for the development of a political programme with clear guilty parties and unlawful activities that need to stop.

This non-exhaustive compilation of descriptive statements presents a rich picture of the complexity of the concept of pollution among local residents in Tuzla. The numerous observations gathered in the daily experience of pollution is synthesised in multiple and conceptually rich descriptions which not only allow local residents to communicate their concerns around pollution but moreover provide them with instruments (part of their cultural repertoires) to build programmes of action. For the purposes of the argument, these statements help the analyst to explore at the ways local people interact with pollution and their beliefs about it, and hence allow for an interpretation of Mary Douglas' theory of pollution in this case. The following section explores the formulation of dangers associated with these pollution beliefs.

6.3.2. Dangers of pollution: victims and malefactors

Douglas' theory suggests that pollution beliefs always have a material component. As the first group of descriptive statements in Section 6.3.1 reveals, pollution beliefs in Tuzla are closely linked to the material experience of the place: the dirt, the dust and the changes in meteorological phenomena all symbolise the pollution. And because of the experience of it, local residents find these phenomena 'dangerous':

Alija: "The dust was so terrible that the area all the way to Irac, Miladije and our community and this part down all the way to Bukinje was almost completely in the darkness. Was this dust dangerous? We don't know now. We found it dangerous. It was one hell of dust... You basically could not leave the house, because the air was full of dust..."

Declaring the industry to be 'dirty' is an active effort to organise their environment and situate the industry in an appropriate place within their symbolic framework. Local residents demand a clear separation between industry and its effects and life in the local communities. However the effects of industry on the environment and their life persist: the experiences described in their talk about pollution presented above constitute a catalogue of environmental anomalies, which are labelled as 'dangerous'. Thus, the characterisation of the industry as 'dirty' is followed by the catalogue of dangers associated with it.

Edin: "Once, when the times were good, when industry wasn't so developed, especially the 'dirty' industry. (...) Everything used to grow here. Watermelons, fruit, vegetables... However, for the last 10 or 15 years, almost nothing grow here. And if anything grows, it is dangerous to consume. You know? That's dangerous."

This suggests that the identification of the pollution in symbolic terms could be explained as a transgression of the technological system into the socio-natural system. The industrial development is perceived as having disrupted the harmonious (normal) course of life in the local communities around Tuzla. Several interviewees provided accounts similar to the one that follows:
Hamid: “[B]efore the advent of industry this area had clean rivers, open-air swimming pools, parks where people could meet, etc. However, with the advent of industry and its development everything was taken away from us. It was taken away because of the coalmine which, due to coal exploitation from pits, damaged certain plots, and also due to coal exploitation in opencast mines. And all this was done for the needs of electrical power production, more concretely TEP.”

Other people referred to how the place was before the advent of the industry: they referred to the clean waters, the dense forest where they collected wood fuel and the recreation areas where they celebrated Labour Day. These references establish a marked contrast between the memories of the place before the pollution (described as beautiful and pristine) and the place now, deteriorated and dangerous.

Health dangers, the loss of dear elements of space, or the disruption of spatial practices are all different social anxieties developed around the identification of anomalous events. Pollution beliefs emerge together with the association of dangers with the anomaly: the dirtiness. The second set of descriptive statements associated with different fears developed about the disposal sites reveal the concepts used to characterise and manage those fears within their everyday lives. However, together with the dangers about the potential health impacts and the loss of resources, local residents fear as well being abandoned and forgotten.

Branka: “It has been 20 years since we starting suffering because of the dirt, soot, this waste. I think pollution here is so terrible because they illegally burn medications in TEP. It isn’t soot any more, but some white dust. (...) It’s destroying us, TEP, and no one, no one even knows about us; no one knows that we exist at all in Sıkı Brod. Sıkı Brod has been forgotten long and long ago."

Antonija: “Nobody cares anything about us. (...) That’s the way it goes, the coal mines, the power plant... I think something can be done, I think they can fix some things, only they’re expensive, for example, the filters... As far as I’m informed, the industry gets great amounts of money, from the Federation, from the government, for ecology... those factories which produce gases and all kinds of harmful things! But regarding the institutions that can help us... I think that no one invests in them now... and that’s that, we have been totally forgotten.”

This is associated with a sense that the local communities are sacrificed for the sake of electricity production and economic growth of the country. TEP is assigned a clear responsibility for the dangers associated with the pollution:

Mehmed: “Today, when we observe the concrete situation in the country as it is, none of the people could be against TEP’s work or the production of electricity, but you shouldn’t sacrifice the area around TEP because of it. So, you should compensate these people for what was taken from them. Apart from the buildings used for TEP’s infrastructure and the accompanying buildings, they have also taken their clean air, the clean spring water, and their fruits from the garden... Their agricultural land was destroyed, and what is worse, their health has been destroyed.”

Because TEP is the endangering agent, TEP is responsible for providing something back to the community to protect or compensate it from those dangers. Some of the actions may be directed to the physical elimination of the anomalies themselves. However, the demands

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32 Note that interviewees identify other endangering agents; particularly some members of the community whose practices are perceived as dangerous (those who cultivate the sites are the chief example of this, but also fly tippers and those who burn charcoal). Most interviewees, however, describe them as ‘victims’ forced to do these practices themselves. For example, people who cultivate the sites were said to do so because they did not have any other alternative sources of income.
from the local communities go beyond the mere regeneration of the environmental state: something else has to be brought back to compensate for them being put in danger.

Muhamed: "Let me just point out, TEP has been working for 45 years and the whole town of Tuzla has been provided with heating, only our communities don't have it. Don't we deserve to get at least heating? There are people who are sick, threatened: let them have it! Most of them are mining families, poor families. Or at least give them some kind of compensation... (...) We can't do anything about it, we're powerless. We try with all our might to get better water, or, I don't know, new asphalt or something, to at least improve our situation a bit... but it's all useless. They turn a deaf ear to us, the just promise lies, false promises all the time."

Up to August 2008 TEP did not recognise these claims from the local communities. Lack of trust in for TEP and local institutions has developed because local residents perceive that TEP is not interested in their problems and is willing to let their communities suffer (or even disappear) to produce electricity. The beliefs about the pollution and its dangers and the lack of recognition from TEP provide the grounds to describe the industry as an endangering agent and malefactor. On the one hand, TEP is seen as carrying out dirty and unsuitable activities. This is why local residents claim that the technologies in TEP are outdated, and that modernisation is needed (in particular installing new filters). On the other hand TEP's governance system is regarded as tainted by numerous corruption practices. For example, local residents frequently referred to the issue of TEP illegally burning medicines. The following is the most complete account of this issue:

Muhamed: "Since the beginning of the war until the present day all the countries, pretending to be very charitable, sent to us their medicines... Most of these medicines were past their expiration date, so when the time came to perform a revision of all the medicines, there were huge disposal sites of expired medicines and the question was where to put them or what to do with them. (...) And then, a neighbour of mine who lives across TEP calls me and tells me: 'There are some trucks coming, six trucks, they are going to TEP, right there to the gate where SIDMIL have their waste, and they are unloading medicines.' (...) [This] is why we started to suspect that TEP was burning those medicines. And then our doubts were justified 100% when we saw its effects... It is normal here to see black snow from the pollution from TEP, you can see now. But then the snow was... and even when there was no snow, some kind of yellow ash, or reddish, used to fall on the ground, and when it'd fall on your car, or your shoes, it couldn't be removed, it was some greasy sticky residue. No one dares to admit and say that they burn medicines here, TEP takes the money, they keep silent, we have no proof, and we have reasonable doubts."

TEP is perceived to have power enough to spread the corruption beyond its boundaries. For example, some local residents are embittered after a Parliamentary resolution that declared that they should be compensated ended up being 'a joke'. They accuse TEP for not having acted justly with respect to that resolution:

Petar: "In one of the sessions of the Council of the Canton 4 years ago a law was passed that TEP should pay a certain amount a month as a polluter. (...) However they paid the first instalment and stopped paying after that. (...) A couple of months ago, we raised this question again: (...) why didn't they pay up? Then it turned out that the one who passed the law formulated it in a wrong way. Instead of mWh (megawatt hour) they put mW (megawatt). mWh is the consumption and mW is the installed power and the difference is drastic between these two terms, so it turned out that, with that first instalment, they paid 30 years in advance. The amount they should pay. But we don't believe that such a mistake could be accidental. Because
that law was not devised by amateurs. We believe, simply, that someone was bribed and that, even now, people are being bribed. Everywhere. People are paid to keep silent and to deceive.”

This suggests that residents not only accuse TEP’s of polluting practices that are endangering the community, but also, they are passing a moral judgement on TEP as a careless organisation, and in the worst cases, corrupt. Traditionally, industries have established a link with the communities surrounding them by providing safe and reliable jobs to support the community. At the moment, some local residents claim that TEP avoids employing people from the local community. Although these claims have not been proven, they show that TEP is no longer perceived as one of the major sources of employment in the area. The claims of local residents suggest that the social contract between TEP and local residents has been broken. The proposals put forward by local residents attempt to set the basis for a new social contract in which TEP provides clear benefits for the residents. The following section explores these issues.

6.3.3. Old and new codes: a country in transition

Mary Douglas’ theory of pollution analyses the interaction between the pollution and the moral code. Sections 6.3.1 and 6.3.2 examine how pollution is recognised in Tuzla. This section turns to explore some aspects of the moral code and its relevance to understand the local descriptions of pollution.

During the interviews some local residents expressed nostalgia for the socialist regime of former Yugoslavia, explaining that their quality of life had worsened. They explain that services provided by the former socialist system, such as pensions, health services or employment security, have disappeared while the privatisation process has resulted in a sharp rise in unemployment and the concentration of resources in a few hands. Work was defined as a fundamental part of life by most interviewees who see unemployment jeopardising the future of their local communities:

Sead: “…there are fewer and fewer jobs, less industry and all the other things which are necessary for a normal life, for having a normal job, for simply communicating…”

Hasane: “Before the war (…) I had my store, my shop. And we [my husband and I] lived a normal life, worked. Everything was more normal than now. Salaries were more regular and people worked more.”

In these instances, interviewees emphasise the ‘normality’ of life before the war. Their life went on as, more or less, they expected. This compares with the current situation in which they do not know what to expect. More than a decade after the end of the war, the country is still undergoing continuous adjustments without a normalisation of either the political or social situation. This has direct consequences for the acceptability of pollution. For example, talking about the pollution a local resident explains:

Hamid: “Well you have to imagine that everything which was made and which brought us some harm brought us so much good that we were a local community which had no unemployed people, we made money.”

Hamid is not arguing that if they were ‘paid’ they would not care about the environment. Rather, he is seeking to establish that the harm they suffered was acceptable in the context of the benefits which ensured the continuity of their local community. He highlights that there was employment for everyone, and therefore, people were able to develop alternative strategies to cope with pollution. In contrast, today, their demands have been extended from the maintenance of a quality of life to the preservation of their environment. Like other transition countries, understandings of what a ‘good life’ is has changed in parallel with material changes to their quality of life since 1989 (see also Illner, 1998).
The demand for employment goes hand in hand with a demand for people's participation in decision-making within TEP and other industries. These demands are built on their past experiences: One of the characteristics of the self-management system of the former Yugoslavia was that workers had a greater share of influence within the 'socially owned companies'. Following Edvard Kardelj's theory of associated labour, workers were given the right to decision-making within their companies, then 'organisations of associated labour' (Damachi and Seibel, 1982). Thus, working in the industry may have given local communities access to decision-making about some aspects of environmental management. This could explain why the environment and unemployment seemed to be closely linked during the interviews. Alongside its limitations (notably economic ones), the 'self-management' system may also have had significant perceived social benefits, mainly contributing to a sense of ownership of TEP by the local communities.

Interviewees discussed the apparently recent emergence of the environmental discourse. For instance, Faruk, a middle-aged male local resident, explained that during the former regime expressing their discontent about environmental problems was against the general dogmas of industrialisation and development that preoccupied the country, and therefore was considered reactionary or 'anti-revolutionary'. This implies that the reason why local people did not take action to defend the environment was that they were afraid that this would have compromised their life within a totalitarian state. However, alongside individuals who felt coerced by the state, some interviewees pointed out that environmental awareness did exist in former Yugoslavia. Research on the environment and civil society in Bosnia and Herzegovina also suggests that the environmental movement received intellectual and scientific support from several sectors within the socialist society (see also Fagan, 2006). This resonates with the opinions expressed by some local residents:

Mehmed: "This notion of ecology didn't appear from this government and multi-party elections. We were aware of the environmental problem much earlier."

By 'notion of ecology' Mehmed refers to the awareness of the problem of pollution and the actions of the community to protect their environment. Mehmed contests the idea that the 'notion of ecology' is a product of the transition to a multi-party system. Instead, those who live in the local community were aware of environmental problems much earlier. He uses the word 'notion' to refer to an understanding about ecology which is not necessarily well articulated in coherent discourses. Instead, environmental issues were intrinsically linked with their everyday lives and articulated in a more casual fashion. For instance, citizens' demands put forward in workers' assemblies during the 1980s moved TEP to establish a soil cover on abandoned coal ash disposal sites. Many citizens' actions today build upon pre-war experiences with environmental and civil rights struggles.

Some interviewees use environmental claims to criticise the multi-party system, and in general, the confusion that exists regarding decision-making and governance. The example of Hamid is illustrative:

Hamid: "...it was better in the system before the war. Because you didn't have to... at least you didn't have to agree on everything. These days it's enough that one political party of a hundred of them isn't satisfied and everything gets complicated."

According to Hamid, having to agree is an obstacle, rather than an asset, for decision-making. This may seem counterintuitive at first but it fits within the political context of Bosnia and Herzegovina. Several interviewees indicated that any policy issue is transformed into an ethnic, and therefore nationalist, issue upon which nationalist parties, representing Bosniaks, Serbs or Croats, disagree to trade off and advance their own nationalist objectives. Those who do not identify with nationalism are effectively sidelined from political life. This understanding of the current political situation, which interviewees generally touched upon but did not develop fully, was shared by some municipal officials.
They argue that the Municipality of Tuzla is being effectively sidelined by the national government because its citizens consistently vote non-nationalistic parties (this point is further developed in Chapter 3.6). Local residents connect this problem with environmental governance at the local level. To continue with the example of Hamid:

Hamid: "... this system now is complete chaos: If certain parties that have no idea of what ecology is have to agree upon the issue of ecology, God help us. (...) I respect all things, but air pollution is not a matter of elections or pre-election activities. And now, someone [from a political Party] shouldn't state in their pre-election activities, "We will clean the air." No, that should be done by the industry or other services for ecology, without asking any Party their opinion of it."

Hamid expresses concern about the negotiation of environmental issues among parties whose comparative disinterest in the environment prevents competent bodies from taking effective action. Hamid’s example suggests that local residents assume that ‘air pollution’ is a ‘fact’ that affects their lives deeply. Hence, the debate should not be about whether or not environmental issues should be on any political agenda but, given the urgency of the issue at stake, what kind of actions should be taken to improve the situation. In parallel, municipal officials insist on the dissociation of environmental problems from the interest of nationalist groups. In the context of a country divided along the lines of ‘constituent peoples’ some interviewees voiced scepticism about any scope in such a political system to achieve environment improvements.

Local residents have taken numerous actions to mobilise authorities to do something about their situation. In 2000 their concerns were brought before the federal parliament and a resolution for the protection of the environment in the local communities around TEP was adopted (see Table 6-2). The resolution adopted the language used among local residents about communities being ‘endangered’ because of the ecological situation and, although TEP is not explicitly mentioned, there is a reference to stop the construction of additional disposal sites around these communities. Indeed, the resolution stopped the development of a new disposal site in the lake ‘Kop’. However, the resolution has not had any other effect; local residents explain that a change of government resulted in the resolution being dismissed.

Thus, local residents turn to the industry to protect them from the environment and propose measures for compensation. However, compensation is not a straightforward matter: meaningfully valuing cleanliness, habits or health is impossible. Also, putting a price on it poses serious ethical considerations. Local people accept TEP’s presence, but the perceived unfairness of the situation cannot be reversed by money, only by ‘internalising’ TEP within the community. In order to do that, TEP is compelled to share its benefits. For example, local residents ask TEP to allocate free electricity supply to the local people or the establishment of a tax which could be reinvested in the environment, the ‘eco-dinar’ to be paid to the community (Section 3.6 explains in detail the political process by which the ‘eco-dinar’ was enacted and dismissed before its implementation). For example a local resident explained:

Mahira: "...we would be satisfied if they at least started to give us this ‘eco-dinar’, and we could be able to put certain pressure on the Municipality of Tuzla, on the Cantonal government to carry out some of our plans for the protection of the environment in cooperation with the Service for spatial planning, with the ecological associations and citizens’ assemblies.”

Most interviewees argued that TEP should offer local residents free heating. This proposal was summarised during one interview:

Muhamed: "We are fighting to get heating from the Electroplant, because TEP has such an excess of thermal energy... This steam goes into the air; the Electroplant
requires minimum resources just to provide heating for this most threatened community. It could supply us with heating only from the excess steam going up in the air. (...) In addition, we pollute ourselves because we are poor, we burn plastic, rubber; we don't have money to buy real wood so that we could heat ourselves on real wood and real coal. The people burn all kinds of things, we add to the pollution."

The resolution about the ecological protection of the local communities of Šćiki Brod, Bukinje and Husino adopted at the 13th meeting of the Federation of BiH, held June 12th, 2000.

1. The Parliament of the FBiH emphasises the extremely difficult ecological situation and wants the public to pay attention to the endangerment of the environment in this area within the endangerment of the FBiH in general. Because of that, the Parliament calls for all social and political forces, organs and institutions of the government, from the Municipality to the Federation, to join and start solving the ecological problems of this area.

2. The Parliament of the FBiH, specially emphasises that the endangerment of nature, and therefore of the health of people, is a serious question and it can not be to the individuals to make decisions which could have legal consequences for the future of the new generations. That is why the Parliament wants all the activities which would contribute to the further endangerment of the ecological state to be stopped and forbidden. That specially refers to the location for the new disposal site of slag and ash in the area of the former Kop, Šćiki Brod. The current disposal sites of the slag and the industry have already jeopardised the health and the lives of people who live in this area. Therefore, this new disposal site concerning its location would jeopardise the life and the survival in this area.

3. The government of the FBiH demand that on the level of the Tuzla Canton and the FBiH the process of making legal laws regarding the protection of residents, nature, and the environment should be fastened.

4. We also want the government of the Tuzla Canton, besides the government of the FBiH, to organise activities for a study about the influence of the industrial environment and the ecological pollution on the health of the residents of endangered local communities, as well as for the Ministries, to create annual plans for the revitalisation and sanitation of the current state and development regarding the ecological problems and the improvement of life in the industrial environment.

5. The Parliament of the FBiH demands that in the shortest possible period of time the solutions should be provided, as well as the measuring stations in endangered local communities in order for them to measure the pollution of water, soil and air and to keep the public informed about the results each week.

6. The Parliament of the FBiH thinks that the Municipality Council, the Canton and the Federation, should ensure that the money resulting from ecologically taxing economic activities and other subjects returns to the area which is the most endangered and the money will be used for the sanitation and the re-vitalisation of the consequences of the ecological damage. The Parliament of the FBiH starts the initiative to form the Eco-fund as soon as possible.

7. The Parliament of the FBiH thinks that the projects of the re-vitalisation and sanitation of the current state of the local communities should be done since those local communities have been almost destroyed by the development of the industry and by the ecological situation.

Table 6-2: Text of the resolution adopted by the Parliament of BiH, translated from Bosnian by an interpreter from Tuzla.

What local people are proposing, by trying to obtain free heating from TEP, is using the thermal pollution of TEP to reduce their own pollution caused by burning high polluting substances to keep warm. Local people are also concerned about the pollution caused by individuals who burn plastic and brown coal. Moreover, burnt coal and plastic are commonly dumped in rubbish containers, causing additional pollution. Even if this
pollution is not comparable with that from TEP’s chimneys, local people believe that eliminating it would improve the state of the environment. In conclusion, by giving free heating, TEP would contribute towards the overall wellbeing of the community. Claiming free heating has three sources of legitimisation: social, addressing the claimed need of internalising (if only partially) TEP within the local community; economic, taking advantage of a by-product of TEP (the excess of heating); and environmental, by reducing the air pollution caused by household heating. Although free heating will not solve local environmental problems altogether, it could be a way for TEP to come closer to the local communities, and to work for the mutual benefit and improvement of the living conditions in the area.

6.4. Revisiting Mary Douglas’ theory of pollution in Tuzla

This section examines the data presented here in relation to Mary Douglas’ theory of dirt and pollution. The evidence from the interviews in Tuzla confirms some of the aspects of the theory in relation to the construction of the problem of pollution. In particular:

- Pollution beliefs emerging among local residents are grounded in experiential observations of anomalies in their environment. Pollution beliefs are related to perceptions about the presence of danger and the allocation of blame.

- The division of the society into victims and malefactors according to pollution beliefs allows for the application of a moral code to those who are believed to cause the pollution.

- Tacit knowledge and beliefs about pollution that feature in environmental sciences do not recognise the close relationship between pollution and moral codes. Therefore, researchers’ knowledge about pollution may not include the local understandings of what pollution is, how it affects local residents and what should be done about it.

The following section explores these implications.

6.4.1. Pollution beliefs: anomaly, danger, blame

The analysis of descriptions of pollution among the local communities near the coal ash disposal sites in Tuzla has unveiled a range of concerns. Interviewees relate pollution with a range of activities, from mundane experiences (e.g. the dirtiness in the laundry) to bizarre events (e.g. the black snow). The material component of pollution, highlighted by Mary Douglas, is an essential component of its experience. Pollution beliefs are related to the association of danger and anomaly.

One particular way to refer to the pollution in Tuzla is as ‘an invader’. Although this reference was not always specific, a majority of interviewees referred to the pollution as being something ubiquitous that invaded all the space of their experience.

George Lakoff and Mark Johnson’s book ‘Metaphors We Live By’ argues that everyday speech includes a multitude of ‘conceptual metaphors’ that help to explain an abstract of less structured ideas in terms of a more concrete and clearly organised one. As Lakoff and Johnson say:

“The essence of the metaphor is understanding and experiencing one kind of thing in terms of another.” (Lakoff and Johnson, 1980; p. 5)

Metaphors are part of the conceptual framework that “structure what we perceive, how we get around in the world, and how we relate to other people” (Ibid.; p. 5). Metaphors help societies to define their ‘everyday realities’. According to Lakoff and Johnson, cognitive metaphors help make coherent certain aspects of human experience. But, they argue, ‘conceptual metaphors’ also explain how we construct the reality around us. As they
explain "the acceptance of the metaphor, which forces us to focus only on those aspects of our experience that it highlights, leads us to view the entailments of the metaphor as being true" (Ibid.; p. 5). Hence, our definition of what is true will also depend on the cognitive metaphors that we employ to explain such reality.

'Invader' could be characterised as a cognitive metaphor used by local residents to understand their relationship with the pollution. The metaphor makes explicit the idea of the pollution as an active agent. As an invader, the pollution is uncontrolled: local residents lack the capacity to keep it within limits. The metaphor describes how local residents relate to the pollution and how they construct it. Resonating with Mary Douglas' ideas of uncontrolled powers, the metaphor of pollution as an invader emphasises that attempts to control the anomaly physically or to re-interpret the symbolic world to integrate the anomaly have failed. Hence, as Mary Douglas predicts, these anomalies have been labelled as dangerous and social anxieties have been developed around them.

Mary Douglas explains how the emergence of danger is associated with the labelling of social actors as endangering or endangered. The interviews suggest that this is precisely what is happening in the communities around Tuzla, where local residents feel that the industry is responsible for the dangers posed by the pollution. Thus, we can conclude that the observation of anomalies in the Tuzla landscape is one factor leading to the characterisation of different actors as 'endangering' and 'endangered'.

6.4.2. Morality and pollution: victims and malefactors

According to Mary Douglas, the identification of endangering and endangered agents is part of the process of confronting the dangers associated with the emergence of pollution beliefs. This process consists of the establishment of social positions, a social divide, between those who produce the danger ('malefactors') and those who suffer the consequences ('victims'). Those who characterise themselves as 'victims' demand protection against the pollution dangers.

Malefactors are portrayed as both materially dirty and morally corrupt which signals an interaction between the moral and the pollution codes. Mary Douglas explains that pollution related rules may reach where the moral code cannot be applied. She is particularly concerned about the difficulties of applying the moral code in a setting where there are multiple views on what action is right. This is clearly the situation in Tuzla, not only with respect to the pollution, but also with respect to the political transition from a socialist to a multi-party system. Local residents have seen a huge transformation of the socio-economic system, from a self-regulated system, in which workers had a share of participation in decisions regarding the companies, to a capitalist system in which not only have workers lost their influence on management and politics, but moreover, they have lost their jobs (for example, TEP has halved its workforce since the end of the war and many other local industries, including the mine, have closed).

Local residents do not see their concerns reflected in the new multi-party system. An observer may think that one of the potential solutions to improve the environmental situation is to dismantle a somewhat obsolete industry; yet, such an option is completely ruled out within the local communities around Tuzla. This is not only an economic question: the industry in Tuzla is regarded as an inseparable part of the local life. Rather, TEP, as well as the other industries, appears to be another member of the community to be preserved. Activists demand from TEP the implementation of appropriate and environmentally sensitive technologies and the provision of more and better jobs for the local communities. However, the moral argument for the provision of jobs, that could have been effective during the socialist system, appears now to be outdated. Certainly, such moral argument is at odds with the relatively new objectives of an industry struggling to compete in the international market of energy. This can be explained as a 'failure' of the moral code to provide a course of action for the community.
For example, some residents' accounts highlight work as the central value of life. They perceive that the re-valorisation of work was recognised in the system of the Socialist Federal Republic of Yugoslavia\(^3\), but not so much in the new period, when they perceive the industry has lost the interest in maintaining the communities. In Tuzla, this is reinforced by the political situation, because the non-nationalistic local government does not feel backed by the nationalist federal and national governments (see also Section 3.6). Indeed, in some cases, the critique was extended to the current political system as a whole. The implication is that the transition process in Bosnia and Herzegovina is yet to develop appropriate values and associated institutions capable to address the local needs of residents suffering problems such as the one in Tuzla. At the moment, the moral code seems to be ineffective in addressing the problems of local residents.

Mary Douglas argues that pollution rules may help to provide an answer where the moral code is ambiguous. The moral aspects of a situation may be obscured by focusing the issue around a material problem, the technological transgression of the socio-natural system. The 'pollution code' identifies clearly the danger, but also the endangering and the endangered members of the community. In Tuzla, claiming pollution equates to claiming the transgression of the technological system into the life system of the local residents and their landscape. This identifies TEP as an endangering agent. Where the moral code is limited to identifying TEP's responsibility in the deterioration of the living conditions in the community the pollution code is unequivocal. In contrast, it appears that in former Yugoslavia there was a moral code that regulated the relationship between endangering and endangered agents. The system, for example, may have allowed the workers (mostly local residents) to have a share in the decision-making. Local residents perceived that competent institutions were able to take care of these problems and that the behaviour of the industry was regulated. Thus, this may have prevented local residents from constructing the problem of pollution as something intrinsically dangerous. The presence of TEP was accepted because TEP compensated the community through employment and local projects\(^4\).

Here, Mary Douglas' theory helps to explain the development of pollution beliefs around the coal ash disposal sites in Tuzla, within the social-symbolic system of the local communities in Tuzla. Moreover, the interaction between the moral code and the pollution code has led to an increase in demands from the local residents. For example, interviewees who recounted their experiences before the war explained that there were complaints about the dust and dirtiness of the sites, but the establishment of a layer of soil to isolate the ashes sufficed to satisfy such beliefs. In that case the visual removal of the symptoms of pollution, with a soil cover, was enough to deal with pollution beliefs. Now, however, local residents campaign about the construction of any new disposal sites, because the local fears about them go beyond ideas of dirt. These fears are associated with pollution beliefs, establishing rules to substitute the absent moral rule. Establishing a layer of soil will not suffice now to calm the anxiety created by the dangers of pollution. Instead, some local residents demand that TEP assumes responsibility for the pollution and pays something back to the community in compensation. The pollution beliefs, identifying TEP as an endangering agent, are instrumental in determining causal relationships and political responsibilities. The example suggests that pollution beliefs are an instrument of political power among local communities dealing with environmental degradation.

\(^3\) For example, Tito, president of the SFR of Yugoslavia during 35 years, used to photograph himself with industrial workers and emphasise his origins as a worker in the metal industry as propaganda for the regime.

\(^4\) In former Yugoslavia it was common that industries would execute development projects in the communities affected by its activity, including roads, infrastructure, parks, sports installations etc. Thus, the Municipality is now asking TEP to include this type of measures in its 'Programme for a friendly environment' (see also section 3.6)
6.4.3. Identifying pollution

After reviewing the application of Mary Douglas' theory of pollution in the case of Tuzla it is useful to reflect on how the theory, and the example, relate to the scientific definitions of pollution presented in Section 6.2.1. These definitions express scientists' beliefs about pollution and are indeed part of the tacit knowledge that informed the work of RECOAL.

Section 6.2.1 started with a reference to Silent Spring, the classic work by Rachel Carson. Carson is forceful in expressing that the pollution is created by defilement of the environment and the introduction of foreign substances into it: matter out of place. Clearly, Carson identifies an agent, the human, who is endangering the 'community', the Earth. Carson's definition, and indeed her whole book, is a combination of both moral and pollution codes regulating the relationship between humans and the environment. This definition fits with an understanding of pollution as a transgression of an anthropogenic technological or industrial system into the socio-natural system that humans need for their survival, an understanding that resonates with the local views of pollution in Tuzla.

None of the other understandings of pollution resonate with Mary Douglas' theory as presented here. The review of definitions showed that a fundamental idea implicit in the definitions of pollution in environmental sciences textbooks highlight the 'natural' character of the majority of potential pollution substances that can 'naturally' occur in the environment. Explaining pollutants as natural components of nature whose concentrations exceed background values removes any need for pollution beliefs. Potential pollutants (e.g., heavy metals and other compounds) are part of the environment themselves. They occur naturally in the environment. Hence, there is no transgression of the socio-natural system by pollutants, as pollutants are already embedded in it. The pollution is a matter of location and concentration. The symbolic system implemented here explains the observed anomalies (the dust, the dirt, the meteorological phenomena) as logical consequences given the characteristics of the system.

Paracelsus' principle of the dose may appear to resonate with Mary Douglas' example of the shoes over the table, a resource "in the wrong place at the wrong time". However, this analogy would not be adequate. There is a fundamental difference between the environmental sciences' definitions of pollution and Mary Douglas' shoes example. The shoe on the table is an alien element, belonging to another category (i.e. it is a thing we use to walk, not a thing we use to eat). However, the pollutant is not an alien element; it belongs to the environment where it is found. Rather, what is abnormal is its concentration. Hence, the study of this definition suggests that the recognition of pollution is not associated with a material transgression and the challenge to the symbolic system is absent. As a consequence, there is not an automatic identification of dangers associated with the environmental change: such dangers have to be identified and characterised independently from the material transgression.

The absence of anomaly prevents the emergence of beliefs of dangers associated with the pollution. Instead, the impacts of pollution are identified by referring to the relationship source-pathway-receptor which established a dynamic relationship between the potential pollutant (the substance) and the potential hazard. The issue of danger is further addressed by differentiating contamination and pollution, by establishing that the mere presence of the potential pollutant in elevated concentrations (abnormality) is not sufficient to confirm the potential dangerous effects of such substance.

Another aspect highlighted in the analysis has been the need to characterise pollution as causing a type of damage to something that humans deem valuable. In Tuzla, the dangers of pollution introduce dangers to the system in which individuals operate, posing a threat not only to their health and the environment, but also to the course of life as they understand it. Mary Douglas emphasises that pollution beliefs do not emerge if a system of rules and conventions is in place to deal with potential anomalies. Section 6.2.1 introduced
technical and legalistic definitions of pollution that specified that pollution is anthropogenic. This provision attempts to link the origin of pollution with an actor that can respond to it. This clarification is necessary because some definitions of pollution leave the door open to include the introduction of potential pollution substances by natural forces (so-called 'natural pollution'), which could not be addressed in a legal context.

Mary Douglas regards pollution beliefs as tools to keep the different elements of society in their allocated roles when an anomaly questions the cultural system. In the case of scientists, the cultural system is sophisticated enough to accommodate some observations that local residents regard as anomalies. Moreover, the scientific establishment, and the procedures to identify and manage pollution, are backed up by a sophisticated and subtle legal system full of prescriptions about methodologies and ways to deal with them, which appears to manage any environmental pollution anomalies not addressed previously. Thus, their understanding of pollution is de-polluted, because pollution beliefs are absent.

However, researchers often appear reluctant to link pollution concerns with political initiatives (see also Section 2.3.2). Mary Douglas argues that "experts on risk do not want to talk politics lest they become defiled with political dirt" (Douglas, 1992; p. 38). The definitions of pollution analysed in Section 6.2.1 regard pollution as a matter of physical characterisation only, at a different scale of measurement than that used by local residents. Rather than looking into the physical effects perceived by local residents using their senses, researchers prioritise the measurement of concentrations of elements and chemical compounds. At this level there is no differentiation between the origins of the different elements: they all are natural, because they all are part of our reality. Hence, the moral character of the pollution becomes irrelevant. The analysis above shows that the environmental sciences definitions of pollution result in the separation of pollution beliefs from moral issues, and effectively de-politicises pollution phenomena.

Definitions of pollution are effective in establishing rules to settle their interpretation and hence, creating a symbolic system that can explain the anomalies without attaching dangers to them. The dirt, however, does not disappear. It is only displaced. The 'dirt' is now found within the political and socio-economic systems whose criteria are used to take decisions about the pollution. Pollution observations may be confined to the realm of chemical analysis, and thus, they may not be enough to establish causal links, impacts and responsibilities. Instead, the demands for science to respond to societal demands are interpreted by scientists as an attempt to bring their opinions into the muddy domain of policy-making. This may be interpreted as a failure of the scientific symbolic system to explain the occurrence of environmental pollution in a socio-natural context. Hence, the interactions within this domain are perceived as a transgression of their own symbolic system. Pollution beliefs may then emerge about the dangers of politics, should they interfere with knowledge systems. In other words: societal demands to resolve pollution are perceived as a threat to the symbolic system within which researchers operate.

6.5. Conclusions

This chapter suggests that although how pollution was described in Tuzla was very specific to this case – in particular considering that local residents associated it with the material manifestations of pollution – the process by which pollution beliefs are formed may be reproduced in other similar situations. The identification of material anomalies, the ascription of dangers to those anomalies and the emergence of the endangering/endangered divide are likely to be common steps in the construction of an environmental pollution problem. The generality of this process is reinforced by some definitions of pollution referred to in the literature, such as Rachel Carson’s Silent Spring, a book with enduring appeal.
With respect to the analysis of definitions of pollution within the environmental sciences, this is likely to be applied to disciplines related to environmental management. Hence, the following observations may be reasonably expected in similar contexts where pollution is interpreted differently by local residents and researchers:

- emergence of different interpretations of pollution among local residents (for whom the dangers of pollution are self-evident) and environmental managers (for whom the dangers need to be identified separately);

- in the case of local residents, or other actors directly affected by the pollution, pollution rules may be used to substitute moral rules where a clear and defined moral code is absent;

- the separation of the material observations of pollution from their socio-political context in scientific discussions of environmental pollution; and

- the reluctance of some scientists to engage with the political debate around pollution.

Scientific knowledge is influenced by the concepts upon which science is constructed. Depending on the concepts a particular form of knowledge is mobilised. These concepts develop into particular analytic frameworks which eventually result in programmes of action. Eventually scientists establish distance between their own knowledge and the knowledge built upon different conceptual understandings of the world. This process brings about contrasting discourses and ultimately, distinct conceptual understandings of pollution that establish a divide between researchers and local residents affected by pollution. The following chapter explains how scientific definitions of pollution are implemented in research procedures to characterise pollution; in particular, the chapter will explain the development of the risk assessment within RECOAL. The analysis will suggest that researchers not only distance themselves from the context of study but also find arguments to distance themselves from political processes.
7. Evaluating and Managing Risks

7.1. Introduction

Risk assessment and risk management are two necessary steps in the process of identifying risks and finding solutions to manage them. This chapter examines their significance for land regeneration. In particular, the chapter focuses on the practices that constitute risk assessment and risk management, and how scientists, planners and other social groups enact them. Risk assessment was considered a key stage in the RECOAL project. It was one of the first stages of the project followed by developing remediation technologies; testing the proposed solutions; and designing decision tools. However, the project did not allocate resources for risk management. Thus, the management of risks was not included in the project and this had implications for the practical benefits of RECOAL in Tuzla.

RECOAL researchers involved in risk assessment asserted that the practices followed 'standard methodologies'. Following the initial characterisation of the project, methodologies were employed with the objective of identifying and quantifying the risks associated with soil pollution, dust generation and water pollution caused by the disposal sites. Deliverables were identified accordingly. The main conclusion from the risk assessment was that the problem of pollution associated with the disposal sites was 'less bad than originally anticipated' (Wenzel, 2007). The industrial partners involved in the project welcomed this result.

Qualitative research among members of local communities presented a different story. The risk of pollution from the disposal sites is described by them as embedded in their everyday practices. They find evidence of pollution in different aspects of their daily life and they are able to draw on alternative forms of expertise such as scientists from the community or local health workers. The pollution risks are a reality that they live with.

This chapter focuses on the construction of the environmental problem by two different groups: RECOAL water, soil and agricultural experts on one hand and 'activist' local residents on the other. The chapter explains how two competing narratives of pollution risk are constructed around the coal ash disposal sites in Tuzla. This analysis illustrates the dichotomy between risk assessment and risk management and examines the role of the expert in the process of assessing and managing pollution risks. This is an important contribution to knowledge because the role of the risk assessment within its socio-political context is commonly overlooked within the literature (Eduljee, 2000). The chapter starts with a review of literature on risk assessment and risk management. This contributes to an understanding of the implementation of the theory in RECOAL in Section 7.3. Section 7.4 considers how risks are understood and managed in the local communities. A discussion of the main points raised in the case study concludes this chapter.

7.2. The practice of risk assessment and risk management

7.2.1. Differentiating assessment and management

In environmental sciences risk is commonly defined as a compound measure of the magnitude of a hazard and its likelihood of occurrence (e.g. Rodricks, 2006). Yet, there is mounting evidence that the emergence of environmental risks is culturally determined (Douglas and Wildavsky, 1983). Some risk practitioners have responded by drawing a distinction between 'objective' and 'perceived' risk and between the 'scientific basis' and the 'policy basis' of decisions about risk (see discussion in Adams, 1995).

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35 Dust and pollution were not evaluated in the RECOAL project, which had implications for the assessment of risks.
Following this, risk assessment and risk management have been established as two separate steps in the process of determining the risks associated with an environmental problem and defining an appropriate plan of action. Rodricks traces this separation back to 1983, in a study by a Committee of the U.S. National Research Council of the National Academy of Sciences (NRC, 1983). The report concluded that risk assessment and risk management were two closely related but differentiated processes because they respond to different objectives. Risk assessment was described as the characterisation of the potential adverse health effects of human exposures to environmental hazards, while risk management was thought to refer to the evaluation of alternative regulatory actions to address previously identified issues. Following this, the first recommendation of the report was that:

“If regulatory agencies should take steps to establish and maintain clear conceptual distinction between assessment of risks and the consideration of risk management alternatives; that is, the scientific findings and policy judgements embodied in risk assessments should be explicitly distinguished from the political, economic and technical considerations that influence the design and choice of regulatory strategies.” (NRC, 1983: p. 151)

The main reason to maintain this separation was the belief that the confusion between assessment and risk management affected the credibility of the risk assessment. Risk assessment alone, they argued, cannot respond to the range of social, political and economic issues surrounding a risk management decision. The Committee was also concerned about the potential misuse of risk assessments tailored to the political process. Thus, risk management became a separate process during which risk assessment results are integrated with other policy considerations (e.g. technical feasibility, costs, and offsetting benefits) to decide what is to be done about assessed risks (NRC, 1994).

According to the NRC reports, this separation reflects the actual process of evaluating and managing risks, first identifying the risks that are worthy of attention, and only then determining the appropriate actions to manage them. The NRC reports on risk assessment are important because they have set the basis for the development of risk assessment methodologies in Europe and the US.

The separation between risk assessment and risk management follows cultural notions of the distinction between facts and values. Separating risk assessment from risk management replicates the modern model of science-policy relationship (Functowicz and Strand, 2008). Such a model prescribes that appropriate decisions can be taken upon reliable facts. Science is in charge of producing such facts feeding them into the value-laden policy processes. Thus, a separation between the facts about risks (compiled and assembled during the risk assessment), and the proposals for its management (the risk management) mirror the differentiation between facts and values.

The separation between risk management and risk assessment is today one of the pillars of existing guidance regarding the management of risks in the US and Europe. This separation is enforced by characterising risk assessors and risk managers as different actors. According to the EPA's guidelines for ecological risk assessment (USEPA, 1998):

“Risk managers are individuals and organizations who have the responsibility, or have the authority to take action or require action, to mitigate an identified risk. The expression “risk manager” is often used to represent a decision maker in agencies such as EPA or State environmental offices who has legal authority to protect or manage a resource. However, risk managers may include a diverse group of interested parties who also have the ability to take action to reduce or mitigate risk.” (USEPA, 1998; p. 10)

On the other hand, regarding the risk assessment process:
"Risk assessors are a diverse group of professionals who bring a needed expertise to a risk assessment team. (...) Every risk assessment team should include at least one professional who is knowledgeable and experienced in using the risk assessment process." (USEPA, 1998; p. 11)

While the heterogeneous group of risk managers includes individuals with either power or interest in the issue at stake (i.e. stakeholders, although, according to the guidance the involvement of all stakeholders is not always needed or appropriate), the risk assessors group includes those who have the expertise to assess whether a particular risk exists. This establishes a split between risk managers (holding power and values over a particular decision) and the risk assessors (holding the knowledge that makes it possible to reach a decision). According to the guidance the risk assessment results are provided to the risk management team in the form of a report which will inform the risk management decisions in conjunction with other factors (USEPA, 1998). While the EPA risk assessment guidance continues to reinforce the distinction between risk assessment and risk management (NRC, 1983; NRC, 1994; USEPA, 1998; USEPA, 2007), little guidance is offered on the risk management process.

Several critiques followed the NRC reports. The most widespread critique is that the involvement of risk managers at earlier stages of the project may help to develop a site-targeted risk assessment. In response, most recent guidance incorporated a 'problem formulation' stage in which the risk management team is involved to define end uses and relevant contextual issues that may help guide the risk assessment (see USEPA, 1998; Ferguson et al., 1998; USEPA, 2007). Moreover, rather than merely following the risk assessment, risk management is now used to define what is considered a 'whole process', into which the risk assessment is integrated (e.g. Figure 7-1).

In the European Union, a concerted action from 1996 to 1998 brought together experts and policy makers to elicit the combined knowledge on risk assessment of contaminated land (Ferguson et al., 1998). Their report was more critical of the differentiation between risk assessment and risk management, and explained why such separation may be problematic. The report highlighted the following issues in maintaining the separation between risk assessment and risk management:

- the uncertainty that characterises the risk assessment process;
- the issue that a risk assessment decision may reduce the autonomy of risk managers;
- the need to incorporate values to assert the acceptability of a particular risk;
- the impossibility of obtaining scientific proofs for low levels of risk;
- the uncertainties around risk assessment.

EU risk assessment practices appear to be much more open to the blending of risk management and risk assessment practices. A European Environment Agency (EEA) report argued that risk assessment and risk management are 'intimately linked', and that the separation of the risk assessment process from its policy applications is impossible in practice (Fairman et al., 1998). Yet, when describing the methodologies for both risk assessment and risk management, both procedures remain distinct.
The debate on the separation between risk assessment and risk management is causing much controversy. In 2006, the White House Office of Management and Budget (OMB) published a Risk Assessment Bulletin intended to move forward the reform of risk assessment procedures set up by the NRC reports. The draft OMB Risk Assessment was reviewed by the National Academy of Science. The results of the review were shocking: the Scientific Review found the bulletin "fundamentally flawed" and recommended that it should be withdrawn (NRC, 2007). One of the major criticisms concerned the definition of risk assessment and its confusion with what were considered to be either components of risk assessment or steps belonging to the risk management process.

One contentious issue in the bulletin was the redefinition of risk assessment to include risk mitigation aspects (e.g. risk reduction measures). The Scientific Review Committee said that this was a "sharp departure from the long-established conceptual distinction between risk assessment and risk management" (NRC, 2007; p. 29). The report clarified that good communication between risk managers and risk assessors was 'imperative' for an appropriate risk characterisation, maintaining a clear differentiation between risk assessment and risk management:

"a 'conceptual distinction' does not mean establishing a wall between risk assessors and risk managers. Indeed, they should have constant interaction. However, the dialogue should not bias or otherwise colour the risk assessment conducted, and the activities should remain distinct; that is, risk assessors should not be performing risk management activities." (NRC, 2007; p. 30)

The separation, they argue, allows the risk assessors to remain objective avoiding participation in management tasks and decisions that the risk manager is responsible for. While the debates have helped to elicit some of the difficulties inherent in the risk assessment and risk management processes, the debate about its distinction is still open. Moreover, while the guidance and methodologies for risk assessment seem to be relatively
established, how risk management is to be conducted remains obscure and recommendations appear to be mostly context specific.

7.2.2. Scientific knowledge and risk assessment

As a conclusion to his book Calculated Risks Rodricks provides the following definition:

"Risk assessment is the analytical framework used to organize, evaluate, and characterize available knowledge and its associated uncertainties regarding the nature and magnitude of threats to human health arising from the environment, including both the natural world and every type of human influence on it. The results of the risk assessments are used to guide policy decisions regarding the need to take actions to control or eliminate these threats so that human health is adequately protected. They are also used to identify the research needed to reduce uncertainties and, thereby, to improve understanding of these threats. Risk assessment is thus the instrument used to measure progress in understanding and managing every type of threat to human health." (Rodricks, 2006; p. 319)

According to Rodricks, the risk assessment is understood as an 'analytical framework' to organise and present knowledge: it is a set of systematic approaches to analyse existing scientific knowledge and information regarding activities that could pose a risk to humans (and the environment).

According to Rodricks, the risk assessment recognises a) the limitations of scientific knowledge (it deals only with 'available knowledge') and b) the uncertainties associated with scientific knowledge, which receive special attention below. The risk assessment methods are needed, precisely, because scientific knowledge is incomplete. The results of the risk assessment are dual: on the one hand, they should serve to provide a factual basis for the risk management process, the decision-making. On the other hand these results should guide further research to reduce uncertainties and improve the understanding of those risks. This last point is important, as risk assessment becomes an instrument for evaluating the quality of human knowledge and the science used to produce it. All in all, risk assessment is hold up as the single instrument to understand and manage every threat to human health. These claims, for risk assessment, may sound, as the author himself recognises, somewhat grand. Yet, risk assessment is used profusely in industry, in planning and in the development of new policies, just to mention a few examples.

The limitations of the framework are acknowledged. Together with his enthusiasm for an all-too-powerful risk assessment framework, Rodricks offers the following remark:

"Winston Churchill said that "democracy was the worst form of government, except for all the others." I paraphrase: "Risk assessment is the worst basis for public health decision making, except all the others." (Ibid.; p. 318)

Here, Rodricks is addressing critics of the risk assessment process. In particular he is concerned with two types of criticism: 1) that the risk assessment is a burdensome process compared with the more simple approach of identifying metals and then eliminating them; and 2) that risk assessment does not offer appropriate data for decision-making and is subject to numerous uncertainties.

The first criticism is addressed by explaining that it does not address "the elementary principle that all chemicals will exhibit toxicity at some dose" (p. 316). This again involves a particular definition of poison and pollution, already reviewed in Chapter 6 of this thesis. It is worth noting that Rodricks himself explains that the approach of reducing any potentially toxic pollutants, without attending to their doses, could be useful in cases where

36 Note that Rodricks refers only to 'human health' not considering ecological risk assessment.
37 Note that there is a wider range of substances apart from metals that could also pose a risk.
these pollutants exhibit high toxicity, are very persistent or accumulate in the environment. As explained in Chapter 6, the toxicology principle is not universal, particularly if local residents perceive great dangers associated with the presence of the pollutant. Ultimately, Rodricks argues, containable risks should not deter our societies from using ‘beneficial chemicals’.

The second criticism relates to the impossibility of eliminating uncertainties associated with scientific knowledge. The NRC (1994) defines uncertainty as the lack of precise knowledge about what is the truth. The report argues that uncertainty creates an intellectual problem (not knowing what the ‘truth’ is) and a practical problem (how to assess risk under uncertainty conditions). According to the NRC report, ignoring these uncertainties may lead to both the manipulation of the results and a false sense of certainty associated with risk estimations. The report identifies two obstacles for the acknowledgement and quantification of such uncertainties: the reluctance of the research community to quantify uncertainties in the belief that this could lead to reduce confidence in the risk assessment and the lack of methodologies to assess risk uncertainties.

Beyond procedural and methodological limitations, quantifying every uncertainty may be impossible. Wynne (1972) provides a taxonomy of knowledge limitations. He calls them risk, when the system behaviour is basically known, and outcomes can be assigned probabilistic values; uncertainty, when the system parameters are known, but not the probability distributions; ignorance, when there are parts of the system unknown, but those gaps of knowledge are identified; and indeterminacy, when there are parts of the system that remain unknown and the gap in knowledge has not been identified (Wynne, 1972).

Other models refer to knowledge, data and modelling uncertainties. Knowledge uncertainties arise from researchers’ limitations of knowledge and uncertainties related to the difficulties of predicting complex behaviour of living systems, also referred to as framing uncertainties. Data uncertainties are introduced through inaccuracies and errors that may occur during data gathering and analysis. Finally, modelling uncertainties arise from the limited validity of scientific models in a world in dynamic change (Floyd, 2006). Shrader-Frechette (1996) also identifies decision-related uncertainties, i.e. those uncertainties that relate to the criteria for final risk decisions (Shrader-Frechette, 1996).

Whereas Floyd’s taxonomy refers to the processes by which researchers build up knowledge about the world (data, models, theories, knowledge), Wynne's classification addresses epistemological problems of research. Ignorance and indeterminacy remind us of the limitations of human’s knowledge to fully understand the world, and the idea that complete knowledge will always be confronted with the paradox that there will always be gaps in knowledge that we have not identified as such.

The analysis presented in the following section focuses on the latter classification of knowledge, data and modelling uncertainties. Although Wynne's classification is more general and describes the philosophical dilemmas surrounding the practice of risk assessment, the classification of knowledge, data and modelling uncertainties is a more useful approach to evaluate the practice of the risk assessment in a project like RECOAL.

Rodricks (2006) addresses the issue of uncertainty by emphasising that the risk assessment is merely a process of organising available information in order to make inferences about relevant risks. He argues that “risk assessment should not be blamed for society's failures to acquire adequate scientific data and knowledge” (p. 318). Indeed, uncertainty is a component of risk assessment (Ferguson et al., 1998). The following section reviews the development of the risk assessment in RECOAL focusing on knowledge, data and modelling uncertainties that emerge within RECOAL's practices.
7.3. **RECOAL risk assessment**

RECOAL followed standard methodologies for the assessment of the risks associated with coal ash disposal. The distinction between hazard and risk informs the risk analysis methodology. According to Tromans and Turrall-Clarke (2000) *hazard* is a property or situation that may lead to harm and *risk* is a combination of the likelihood of occurrence of a hazard and its magnitude.

Toxicity is the capacity of a substance to cause damage to a receptor, such as humans and other parts of the environment. According to the standard toxicological framework a substance alone does not cause any damage: it needs to reach the receptor through a 'pathway' in an amount, 'dose', susceptible of causing damage. Thus, the model source-pathway-receptor characterises 'pollutant linkages' to draw conclusions about the potential risks (Rudland et al., 2001). Accordingly, the risk assessment paradigm, established in the 1983 NRC Red Book, consists of four steps:

- **Hazard identification** involves the identification of linkages (source-pathway-receptor) between a potential pollutant and adverse health or ecological effects;

- **Hazard characterisation** (also referred to as 'dose-response assessment') is the description of the relationship between the amount of pollutant that reaches the recipient (dose) and the incidence and severity of the adverse health effects;

- **Exposure assessment** is the determination of the intensity, frequency, and duration of actual or hypothetical exposures of humans or the environment to the potential pollutant, requiring the estimation of the concentration of a substance within different environmental compartments;

- **Risk characterization** combines the assessments of exposure and response to determine the probability of occurrence of the risk and its severity.

The main steps of the risk assessment are summarised in Figure 7-2.
7.3.1. Hazard identification

In RECOAL, the stage of hazard identification integrated the results of a literature review with the preliminary data generated during the first year of RECOAL (additional detail about the methods, sampling and data can be found in Appendix II). RECOAL researchers participated in a brainstorming session during a project meeting in Vienna, in November 2005. Led by the project leader, Walter Wenzel, the project team identified three main pathways for exposure to risks associated with the coal ash disposal sites (see also BOKU, 2008a). A schematic representation of RECOAL’s model is provided in Figure 7-3.

- The deposition of large amounts of coal ash and the consequent dispersal of ash particles by wind and water, polluting air, water and soil;
- The food chain pollution due to trace elements uptake into crop and fodder plants; and
- The leaching of microelements, such as metals and trace elements, from ash disposal sites, and their subsequent arrival in potable water supplies and other important ecosystems.
According to some RECOAL members, this analysis follows a 'static approach' because it gives an account of a snapshot in time of the pollutant linkages on the site. However, the dust dispersion and leaching processes are highly influenced by the age of the ash because of the physical-chemical conditions in the disposal sites in Tuzla, in particular the elevated pH (around 10-11), and thus, a 'dynamic approach' is needed (BOKU, 2008a).

The ash composition varies at different depths due to weathering processes. The distribution of pollutants within the disposal sites will be a function of the flow of water through the ash. Water is expected to dissolve soluble salts which will be discharged in the outflow. The salts precipitate in the discharge canalisations that bring the water from the disposal sites to the canals. Thus, salts are extracted from the ashes, and this is likely to lower the pH. Greater acidity will facilitate the mobilisation of potential pollutants immobilised at higher pH such as cadmium and nickel, which will migrate from the upper to the lower layers of the disposal site, following the flow of water to the discharge waters (BOKU, 2008a). The consequences of this process are threefold:

- reduction of pollutant concentration in the upper layers of the disposal sites due to migration downwards, mitigating the problems of dust evolvement and direct contact with the sites;
- reduction of the concentration of soluble salts washed away by water and thus reduction of the pH in the effluent water; and
- increase of the concentrations of metals, and thus the toxicity, of the effluent water.

Consequently, RECOAL identified the following issues to be tackled by the project:

- reduction and treatment of the effluent;
- evaluation of the effluent's impacts on other water resources such as surface waters, local wells and underground reservoirs;
- reduction of dust dispersion;
- evaluation of the environmental, social and public health impacts of dust dispersion;
• evaluation of the uptake of elements by the vegetation on disposal sites and the opportunities for agricultural cultivation and livestock grazing; and

• evaluation of the exposure pathways associated with the ash disposal sites for humans, the entrance of potential pollutants into the food chain and the possible impacts on public health.

7.3.2. Hazard characterisation

The hazard characterisation consisted of selecting thresholds to evaluate the experimental results. The major limitation to drawing standards in this case is that, by the end of the project in December 2007, the information available suggested that standards for contaminated land in Bosnia and Herzegovina needed to be developed. Thus, RECOAL researchers established guideline values for food and animal fodder; wastewater and soil conservation. For food and animal fodder and waste water, the researchers consulted existing European Union regulations but found that guideline values existed for only a limited number parameters and substances (BOKU, 2008b). For soil, the researchers employed the guidance values of the German Federal Soil Protection and Site Ordinance, because regulations on soil protection are not available at the European level (Ibid.).

Because of the limitations of existing regulation, the researchers explained that they needed to refer to scientific literature in order to establish relevant guidance values (Ibid.).

The first risk assessment results were submitted before the selection of standards was completed (BTUC, 2006). Thus, thresholds were defined identifying ‘normal’ values in accordance with the literature (see Appendix II). For example, the researchers defined ‘normal’ values of chemical properties for plants and soils (Scheffer/Schachtschabel, 1992); tolerable elemental content for agricultural soils (Bergmann, 1988); normal properties of water according to drinking water standards (TVO, 2001); normal properties of waters in the rivers Rhein and Elbe (Streit, 1994) and classification of materials according to the German classification of solid wastes (LAGA, 1997). RECOAL researchers used these values in the absence of knowledge on toxic thresholds for the context of Tuzla. The selection of these values followed previous experience of the researchers in evaluating risks. Because the German and Austrian partners of RECOAL led the risk assessment deliverables, the hazard characterisation relied heavily on Germanic literature standards and experiences of risk. However, at a later stage, RECOAL defined new standards based on the bioavailable metal fraction (BOKU, 2008b).

The definition of standards requires an inherent element of professional judgement. For instance, the range of elemental concentration in water has been compared with ‘normal’ concentrations found in the rivers Rhine in the years 1988 and 1990 and Elbe in 1991 (Streit, 1994). If we consider that the river Rhine spans 1320 km, from the mountains of Grison in Switzerland, to the very industrial area of Hoek van Holland in the Netherlands, it follows that the definition of normal standards will depend on where the sample was taken, and the samples will be affected by several other factors such as topography, geology and human activities (in fact, some would argue that pollution in some parts of the Rhine is also not acceptable, e.g. Bernauer and Moser, 1996). Particular care needs to be taken in risk assessment to guarantee that the results and the standards are really comparable (RCEP, 1998).

Additionally, water samples from wells have been compared with the guideline values for drinking water given by the World Health Organisation (WHO) (see Appendix II). However, different chemicals have different effects in humans, and while some may be of concern for their acute effects in the short term, others need to be monitored for the likely chronic effects that long-term exposure may cause (WHO, 2006). The WHO report on drinking water guidelines highlights that “a series of analytical results may fail to fully
identify and describe the public health risk" (p. 30). Thus attention must be given to the causal factors that may allow the identification of additional unanticipated hazards (Ibid.).

7.3.3. Exposure assessment

The major experimental input of RECOAL was done at the exposure assessment stage. This required evaluating which potential pollutants present in the coal ash could reach receptors (humans and the environment). RECOAL members argued that they followed 'commonly accepted methodologies' for the assessment of contaminated land, although disagreements arose in some meetings about what these methodologies were. The methodologies and the literature presented in RECOAL reports are summarised in Appendix II.

In RECOAL, the initial analysis focused on the source of potential pollutants, the ash, and the soils covering them. The research first focused on evaluating and quantifying the total quantities of individual elements in environmental media (i.e. water, soil or air). This is normally done by performing an acid extraction which degrades the silicates and gives 'true total concentration' of the element. For simplicity 'pseudo-total' concentrations with aqua regia are commonly used (aqua regia is composed of one part nitric acid and three to four parts hydrochloric acid). RECOAL used the 'aqua regia' method to determine the element content in the ashes and in the soils covering the ashes (see Appendix II).

These total (or pseudo-total) concentrations of metals are used in land contamination assessment. Total concentration values found in site sampling can be compared with generic hazard characterisation values. For example, in the UK, Defra has produced Soil Guideline Values (SGV) based upon total elemental concentrations as indicators of potentially unacceptable risks. SGVs are given in mg of element per kg of soil for elements such as lead, selenium, mercury, chromium, cadmium and arsenic, for different given uses (e.g. residential with plant uptake, residential without plant uptake, allotments and industrial). SGVs reflect the idea that different pathways will be established depending on the use made of that land. However, these SGVs are only given as an indicator of potential risk. The main problem regarding the use of total elemental concentrations is that they are not directly related to toxicity or exposure, the main principles in evaluating risk. They only indicate whether further assessment is required, but they do not substitute the judgement that an expert could make taken into consideration the type of soil, the geomorphology and other experiences regarding particular types of potential pollutant. Yet, systems of 'trigger values' such as the SGVs of the UK exist in several countries although there is great variability in the methods by which the values are determined and used (Ferguson et al., 1998).

In RECOAL, total concentrations of arsenic, boron, copper, nickel, zinc and chromium in ash and soil samples were found to be exceeding the tolerable thresholds for agricultural soils (see Appendix II). From the total elemental content in soil only a fraction is available, that is, only a fraction can be dissolved in water, available to plants or transferred to other media. Furthermore, of the total elemental concentration available, only a fraction will be available for absorption by plants. The researchers can determine the pathways of exposure of the receptors only by knowing the fractions available and bioavailable. This is further complicated by the complexity of soil-plant interactions. For example, a metal apparently not available in leaching experiments may be present in the plant in greater concentrations because some plants can accumulate relatively large amounts of metals by foliar absorption of atmospheric deposits on plant leaves (Alloway and Ayres, 1993).

The available fraction is usually determined through leaching experiments. These extractions are commonly made with water, although there are alternative methods such as those simulating the properties of rainfall water (using calcium chloride) and those simulating the conditions that would make the water available to plants (using ammonium acetate) (see for example van Herwijnen et al., 2007). RECOAL provided results showing...
that from the list of elements of concerns presented above, only arsenic, boron and nickel were present in the leachate (see Appendix II). Researchers argued that this could change as the ash ages and the pH decreases. Leachate concentrations were compared to drinking water standards after local residents were found to be using local wells that could have been contaminated by the leachates from the sites. These standards were much more stringent than the thresholds used for total concentrations ('normal' background values).

The bioavailable fraction is more difficult to evaluate, because it depends on the receptor. RECOAL approached this problem from three different perspectives: a) taking samples in the field of cultivated and wild plants and digesting these samples to evaluate their metal content; b) conducting greenhouse experiments by growing plants in controlled conditions with different mixtures of soil and ashes and evaluating the metal uptake of those samples; and c) doing controlled microbe respiration experiments to evaluate the toxicity of the ash to microbes. The results were varied depending on the experiment and the species treated, from not showing any effect at all (such as in the microbes experiments) to showing high element uptake of nickel and boron (see Appendix II).

The risk assessment was followed by the development of a scientific article assessing the environmental risks in the disposal sites in Tuzla (Dellantonio et al., 2008). The results stated that the ashes were 'enriched' with arsenic, boron, chromium, nickel and vanadium and to a lesser extent cobalt and copper; and soils presented 'moderate contamination' with chromium and nickel and to a lesser extent with arsenic, copper and zinc. The paper differentiated between disturbed and undisturbed soils, i.e. disturbed soils are those where ploughing has broken up the soil cap, thus bringing the ashes to the surface. Because both disturbed and undisturbed soils were found to be polluted, the paper argued that the contamination regarding chromium and nickel is "obviously from geogenic origin" (Ibid.; p. 680). However, this ignores alternative hypotheses which may also explain the pollution of undisturbed soils. One hypothesis discussed during a project meeting (Vienna, 2006) was a 'hydraulic lift' of elements, i.e. the uplifting of chemical compounds by the elevation of the water level above the ash level. The ash presents pozzolanic properties, which facilitates the creation of impermeable layers at different heights within the mass of ash and may disturb the flows of water through the ash. Thus, the alteration of the water flow resulting in a hydraulic lift of elements offers an alternative explanation which was not further considered in the latest RECOAL reports.

Data variability poses problems regarding the estimation of total concentrations of elements in soils. The choice made in presentation affects the results in terms of the information provided and how it is interpreted. For example, Table 7-1 shows a table of data regarding the total concentration of elements in soil and ash samples from the different sites. The table is presented to an academic audience and therefore, it requires some expertise for its interpretation. Table 7-2 presents a data table presented at one RECOAL project meeting in 2006. In this case, the colour code helps to compare the results with the standards provided at the bottom of the table, to facilitate its interpretation in a meeting with a wider audience.

In terms of the results, the comparison of both tables shows that initial estimations of elemental concentrations were more elevated than those published in the journal article. Averages are given in the article with a figure denoting standard deviation, a measure of the dispersion of the data. Yet, it appears that the initial measures in Table 7-2 represent largely extreme values, particularly regarding the concentrations of arsenic, boron and copper. The difference of concentrations is plausible considering that additional samples were compiled and analysed within the time span between the two tables (the number of samples in Table 7-1 is given in the row labelled 'n'). Thus, the concentration estimations presented in the table in Table 7-1 were considered valid estimations for average elemental concentrations in soil and ash samples.
Table 7-1: Mean total element concentrations in ash and cover soils of coal ash landfills in Tuzla (mg kg⁻¹, standard deviation in brackets) (source Dellantonio et al, 2008).

<table>
<thead>
<tr>
<th>Element</th>
<th>Plane</th>
<th>Dreznik</th>
<th>Divkovic I</th>
<th>Jezero</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cover</td>
<td>Ash</td>
<td>Cover</td>
<td>Ash</td>
</tr>
<tr>
<td></td>
<td>Varying</td>
<td>0-20 (cm)</td>
<td>Varying</td>
<td>0-20 (cm)</td>
</tr>
<tr>
<td>n</td>
<td>18</td>
<td>19</td>
<td>37</td>
<td>36</td>
</tr>
<tr>
<td>As</td>
<td>24 (9.2)</td>
<td>61 (21)</td>
<td>23 (10)</td>
<td>69 (20)</td>
</tr>
<tr>
<td>B</td>
<td>67 (29)</td>
<td>187 (9.2)</td>
<td>66 (31)</td>
<td>116 (25)</td>
</tr>
<tr>
<td>Cd</td>
<td>0.2 (0.1)</td>
<td>0.3 (0.1)</td>
<td>0.3 (0.1)</td>
<td>0.3 (0.1)</td>
</tr>
<tr>
<td>Co</td>
<td>33 (8.4)</td>
<td>41 (5)</td>
<td>35 (9.8)</td>
<td>38 (6.5)</td>
</tr>
<tr>
<td>Cr</td>
<td>228 (87)</td>
<td>352 (59)</td>
<td>323 (131)</td>
<td>354 (44)</td>
</tr>
<tr>
<td>Cs</td>
<td>5.2 (1.5)</td>
<td>9 (1.7)</td>
<td>5.4 (1.2)</td>
<td>9.1 (1.4)</td>
</tr>
<tr>
<td>Cu</td>
<td>49 (16)</td>
<td>100 (12)</td>
<td>46 (16)</td>
<td>81 (9.5)</td>
</tr>
<tr>
<td>Mo</td>
<td>0.4 (0.2)</td>
<td>0.9 (0.16)</td>
<td>0.5 (0.26)</td>
<td>0.7 (0.3)</td>
</tr>
<tr>
<td>Ni</td>
<td>368 (158)</td>
<td>682 (128)</td>
<td>418 (170)</td>
<td>597 (107)</td>
</tr>
<tr>
<td>Pb</td>
<td>22 (5)</td>
<td>17.4 (4)</td>
<td>18 (2.7)</td>
<td>16 (2.8)</td>
</tr>
<tr>
<td>Se</td>
<td>1.3 (0.6)</td>
<td>2.3 (0.3)</td>
<td>1.4 (1.3)</td>
<td>1.8 (1.5)</td>
</tr>
<tr>
<td>U</td>
<td>1.3 (0.3)</td>
<td>2.5 (0.6)</td>
<td>1 (0.3)</td>
<td>2.6 (0.4)</td>
</tr>
<tr>
<td>V</td>
<td>64 (26)</td>
<td>120 (40)</td>
<td>82 (29)</td>
<td>148 (37)</td>
</tr>
<tr>
<td>Zn</td>
<td>82 (29)</td>
<td>85 (12)</td>
<td>80 (17)</td>
<td>90 (10.6)</td>
</tr>
</tbody>
</table>

n.a., Not analysed

Even with these qualifications, the results presented in Table 7-2 should not be disregarded when assessing the risks on the sites. Even if estimations of average elemental concentrations fall below acceptable levels, it is unlikely that those average values will apply in the disposal sites where a range of heterogeneous materials are deposited. The results have shown high variability in samples from different areas of the disposal site and this is displayed not only between sites but also within a single site. This variability corresponds to changes in the management of the combustion process, the use of coals from different sources, changes in the combustion and disposal technologies and interaction with other activities on the land (i.e. illegal dumping of waste on the sites). The challenge is to determine whether this has resulted in particular areas where pollutants concentrate, or ‘hotspots’. The results presented in Table 7-2 point to this problem: while the estimations of average values of elements may be within an acceptable range, data in Table 7-2 suggest that some samples present disproportionately high concentrations of those elements. Unfortunately, the exact sampling strategy conducting to the results in Table 7-1 and 7-2 has not been fully explained (in particular, how that sampling strategy related to the site history), and thus, it is not possible to evaluate whether steps were taken to ensure the detection of hotspots on the site or this was outside the scope of the RECOAL project.
Table 7-2: Metal contents in soil and ash samples from field sites Dreznik, Plane and Jezero\(^3\) (source BTUC 2006).

There are also interpretative difficulties when analysing the elemental concentrations in plants, denoting the bioavailable fraction to plants. For example the report on the risk assessment from BTUC estimated elemental concentrations in plants sampled at the disposal sites and resulting from greenhouse experiments growing cereals (wheat and triticale) on ash from the sites. The report concluded that “[f]rom the findings of the plant analyses it can be assumed that there is a potential risk that nickel will enter the food chain via the fodder plants” (BTUC, 2006; p. 22).

Further research found elements such as boron and molybdenum were also bioavailable to the plants. Boron is given less importance in the risk assessment process because its compounds are normally non-toxic to humans. However, boron compounds may be highly toxic to plants. The high concentrations of boron are also considered detrimental for the environment. However, the implicit prioritisation of human health shifted the attention from boron to elements such as nickel, cadmium and mercury, which are of more concern from a human health perspective. During later stages of the project, when the research shifted its focus to the development of suitable crops, boron was considered one of the main elements of concern.

Similarly, molybdenum was not included in the initial list of elements tested (see Table 7-2). However, this element turned out to be important in the formulation of a hypothesis about the potential consequences on cattle grazing on the sites. According to Dellantonio et al. (2008) high molybdenum concentrations cause hypocuprosis in ruminants grazing on

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\(^3\)The upper row presents exposure values of different sites for ash or soil, and the row below presents different thresholds for the characterisation of risk according to German classifications for soils, agricultural soils and waste materials. Only values highlighted in green are within 'tolerable levels'.
the sites, a disease in which the uptake of molybdenum induces a deficiency of copper, an essential element for these animals.

To evaluate the contamination of water resources, samples were taken in the inlet and outlet points of each disposal site. This comprises three inlet and three outlet points only, because Divkovići I and II and Plane share the same inlet and outlet points (see chapter 3 for further explanation of the physical characteristics of the sites). In addition, samples were taken from three different points in the river Jala. Initial results from RECOAL conclude that "[d]rainage from disposal sites did not significantly contribute to the chemical condition of the river Jala" although they recognised that the effluent increased the sulphate concentration (BTUC 2006; p. 24). The implication underlying this statement is that the coal ash disposal sites appear to be a minor problem compared with the general state of pollution in the area.

An important issue is the speciation of elements from the ash-transport water (measured in the inlet of the disposal sites) and the discharge water from the outlets and boreholes. Indeed, the speciation of the metal will determine both its behaviour in the sediment and its toxicity to humans and the environment. Chromium and arsenic are two well-known cases: chromium may occur on a hexavalent form (chromate) or in a trivalent form (chromite), called Cr(VI) and Cr(III) depending on the redox conditions and the organic matter present. In reducing conditions, the predominant form of chromium is Cr(III), which is considered less toxic to humans, plants and animals (Alloway and Ayres, 1993). There are two predominant species of inorganic arsenic: As(V), that predominates under aerobic conditions, and As (III) that predominates in reducing conditions. In this case, the species under reducing conditions, As(III) is considered to be more toxic that the As(V) form (Bunce, 1994).

Discharge waters were found to have elevated concentrations of arsenic when compared with the ash-transport water, while larger concentrations of chromium were observed in the ash-transport water than in the discharge water. According to Dellantonio et al (2008) arsenic V is reduced into the most labile and damaging form of arsenic III, while chromium is reduced from chromium IV to the more benign form of chromium III. Other metals are likely to follow behaviour similar to chromium, leaving arsenic as the main pollutant of concern in the water from the disposal sites (see also RECOAL, 2008).

Early reports from the social research emphasised the importance of private wells in the local communities, because the municipal supply of water was intermittent, low quality and unreliable. This convinced RECOAL researchers to include samples from two local wells in the analysis. Because RECOAL was not able to sample the groundwater, these samples provided an estimation of the extent to which such waters were polluted. The wells were found to be contaminated by sulphates and by compounds of nickel, arsenic and boron originated in the disposal sites (BTUC, 2006).

The issue of water was a contentious one in the project. HEIS, in Sarajevo, held the main responsibility for the physical and chemical analysis of water, as well as the determination of the hydrodynamic relationships in the coal ash disposal sites. They provided results covering these issues and reported in RECOAL deliverables (e.g. HEIS, 2006). However, there was not a good integration of the results of HEIS in the rest of the team. Thus, the results presented in the initial risk assessment provided only chemical analysis of water done by BOKU, as specified in the report. Managing partners’ work proved to be the main challenge to BOKU in coordinating the project, and this resulted in the omission of HEIS inputs to significant outputs.

7.3.4. Risk characterisation

Risk characterisation requires determining the magnitude of the hazard and a probability of occurrence of a risk. In practice, however, the information available cannot be presented in
this form. The extensive research programme managed by RECOAL was not designed to provide a single answer about the presence or absence of risks. Instead, RECOAL provides a series of statements which are inconclusive about the risks of the disposal sites. For example, the following results were published on the website of RECOAL (http://www.rhizo.at/default.asp?id=1304&lid=2; last accessed 12/09/08):

- **Coal ashes taken from disposals in Tuzla were found to be highly alkaline.**
- **Analysis of trace element concentrations showed that the disposed ash was rich in As, B, Cr, Ni, V, and, to a lesser extent also in Co and Cu whereas Cd, Pb, and Zn showed normal concentrations as reported for soils.**
  - Total concentrations in cover soils (originally taken from nearby locations at Jezero) indicate moderate contamination with Cr, Ni, and, to a lesser extent, with As, Cu and Zn.
  - Contamination of the soil cover was also found for undisturbed cover soil samples which were not mixed with ash due to tilling practises and for additional soil samples taken from the surroundings of Plane and Dreznik.
  - Elevated concentrations, particularly of Cr and Ni, are obviously from geogenic origin.
- **Activities of radionuclides (40-K, 210-Pb, 226-Ra, 228-Ra, 228-Th, 238-U) in ash and cover soils did not exceed the background load known from naturally derived soils.**
- **Reduction of AsV to the more mobile and toxic AsIII species cause the increase in the landfill leachate.**
- **Our studies along a gradient of differential time lapsed since abandonment of coal ash disposal sites in the Tuzia area showed that pH, electrical conductivity (indicative for the salt content) and concentrations of B, Ca, Cr, Mo, SO4²⁻ decreased with time. This provides evidence for notable natural attenuation of the ash bodies for a range of pollutants.**

These statements indicate that RECOAL results do not provide a complete assessment of the magnitude of the hazard or of its probability. Instead, RECOAL identified multiple hazards, some of which can be characterised as negligible (i.e. radioactivity), and other which are shown to be problematic (multi-elemental concentrations in soils; alkalinity; reduction of arsenic species in the water).

One of the classical preoccupations of the risk assessment methods has been the avoidance of false positive conclusions, that is, the potential identification of a non-existent risk (see for example Ferguson et al., 1998). In statistics, this is commonly referred to as Type I error, to assert the presence of a pollution risk, when this risk is not present. Less attention is put to the other type of statistical error, Type II error or false negative. This error occurs when the test fails to identify a condition which is actually present. Indeed, the numerous uncertainties surrounding the risk assessment suggest that this type of error could also be possible. Furthermore, the concept of risk already includes a probability of occurrence of the hazard, and thus, Type I errors are already contemplated in the very identification of risk, making the identification of Type II errors a priority (these errors are not contemplated within the risk definition). Both types of errors should be ideally described statistically, relating them to a standard, but often, within the risk assessment process, this step is overlooked (see also Shrader-Frechette, 1996).

For example, there are numerous theories which have not been tested by RECOAL and that could have a definitive impact on the results. Rather than providing a quantification of the risk, the risk characterisation points out the main potential pollutants that are likely to
pose a problem, in order to support the development of remediation technologies targeted at particular elements. Individual elements, however, may have different behaviour depending on the environmental conditions and, crucially, the presence of other potential pollutants. However, most thresholds, such as those provided by RECOAL, are still calculated according to the exposure to single elements.

Initially, the risk assessment contained a balanced interpretation of the presence of potential pollutants in the soil, with reference to alternative hypotheses: the first one is the capillary hydraulic lift of elements from the ashes; the second one is the deposition of pollutants from other sources such as air pollution or pollution of the original soil before ash disposal (BTUC, 2006). Presenting alternative hypotheses is a good way to acknowledge the assumptions and uncertainties inherent in the risk assessment process (RCEP, 1998). However, the hypothesis of hydraulic lift was later withdrawn. The paper published by Dellantonio et al (2008) argues that the pollution of chromium and nickel on the sites is of "geogenic origin", but unfortunately, the evidence supporting this is not explicit.

Moreover, some of the assumptions used to study the disposal sites are problematic. For instance, the exposure assessment relies on the assumption that the bottom layer of the Dreznik site is impermeable (see HEIS, 2006). This is essential to determine the points where water pollution is likely to arise and it has been used uncritically to sample the sites. However, evidence such as the water leakages to local wells suggests that this assumption does not fully explain the hydrological process on the sites. If such a hypothesis is wrong, it could render the suggested water treatment options ineffective. Indeed, the concentration of potential pollutants in wells suggests that coal ash leachates contaminate underground water resources.

Yet, without discounting the evidence, RECOAL presents the results with what appears to be optimism, a practice which is common in risk assessment since the beginning of the profession (see Whittemore, 1983). Assumptions and professional judgement are used to deal with uncertainties. In other cases, uncertainties are disregarded as being outside the remit of RECOAL. Therefore, how the project is framed determines how the researchers are likely to deal with uncertainties regarding the results.

The literature suggests that in order to avoid both false positives and false negative conclusions, the results should be articulated using a three-valued frame: (i) negligible risk; (ii) risk cannot be proved to be absent or present; (iii) risk is present beyond reasonable doubt (Shrader-Frechette, 1996). However, RECOAL results cannot provide an overall assessment of the disposal sites using this frame. At best, RECOAL can say that some risks are negligible (i.e. radioactivity), while others are present beyond reasonable doubt (i.e. sulphate pollution in wastewaters and wells). Instead, RECOAL results show that there are still considerable "gaps in our knowledge about the disposal sites. The question is whether a project like RECOAL can present the results in terms of absence or presence of risk, or whether there are other ways to present the evidence of pollution linkages to policy-makers and the public.

The results are further complicated by their evolution in time. In the hazard identification stage, RECOAL pointed out the importance of understanding how the disposal sites are likely to evolve; for instance, high pHs are related to limited mobility of heavy metals within the disposal sites. However, it is difficult to predict what will be their behaviour if pH values drop. The RECOAL team recognised the need for continuing to investigate these issues, but the effectiveness of the researchers in doing so was limited by its duration (three years). The time problem was deemed outside the remit of RECOAL, and consequently it was not addressed fully by the project.

The use of a precautionary approach to assess and manage risks has already been discussed in Chapter 2. Such approach would require a shift from the avoidance of Type I errors to
the avoidance of Type II errors. This is why the precautionary principle is also described as a shift of the burden of proof from those who suffer the risk to those who cause it (see COMEST, 2005). In the case of Tuzla, because of the concerns of local residents and the evidence of environmental and health impacts, TEP should prove that the coal ash disposal sites are safe instead of the local residents having to prove the presence of risks. It can be argued that the consequences of Type I error are economic (in a worse-case scenario, the closing of TEP) while the consequences of Type II error are social and environmental (the destruction of the human and ecological health around the sites). However, the distinction between the consequences of Type I and Type II errors may be more complex than this analysis suggests. For example, in Tuzla, the precarious situation of the economy (locally and nationally) and the dependence on energy resources suggests that closing the industry would also have catastrophic social and environmental consequences, beyond the economic dismissal of TEP. Above all, proving that the sites are completely ‘safe’ is out of the reach of researchers, technicians and scientists.

RECOAL researchers have focused their research on those hazards that can be tackled with solutions available. Filtering solutions are available to reduce arsenic III and sulphates in the discharge water. Amendments or soil covers can be added to the surface of the sites to prevent dust evolvement, whereas limiting farming practices on the site will reduce the risk of migration of pollutants into the food chain. Problems such as the leaching of polluted water into the groundwater; the long-term risks of synergistic effects between multiple pollutants; or the potential for contaminating wild plants disappear from the RECOAL reports. Thus, solutions become gradually mixed with the risk assessment suggesting that the separation of risk management and risk assessment in practice is neither possible nor useful.

However, the focus on solutions has consequences related to how the project is framed. Only those solutions already contained within the original project proposal have been developed by RECOAL. These solutions are mostly related to the background of the researchers and their perception that they are under-researched or innovative. One such case is the development of a phytoremediation bed for filtering the discharge water, a pioneering solution in coal ash management but whose effectiveness has not yet been demonstrated. The most appropriate solutions in Tuzla may be well-established and effective technologies or policy solutions not included in RECOAL (i.e. civil engineering works for water management; implementation of new waste disposal technologies; relocation or compensation of local residents).

For example, RECOAL focused on developing safe agricultural practices on top of the disposal sites. Studies exploring the possibility of using coal ash as an amendment for agricultural land exist, but the idea of cultivating the disposal sites on a thin layer of soil, or with the addition of an amendment, is an innovative one. The original idea did not emerge from RECOAL but from some local residents that started to cultivate the sites during the early 1990s to deal with the problem of food scarcity during the war. Social research among local residents has shown that these practices are dividing the community and that alternative safe uses should be found for the sites (a detailed account is provided in Section 5.4.3). However, the idea captured the imagination of the scientists that initiated RECOAL, who regarded the cultivation of the disposal sites as an ideal solution to both contain the environmental hazards and provide economic opportunities for the local residents.

Yet, technically speaking, this ‘ideal’ solution may be more complicated to implement than originally anticipated. RECOAL developed multiple recommendations to develop safer agricultural practices on the disposal sites, including the avoidance of some crops (such as potatoes or Lucerne), avoiding ruminants grazing on the sites and avoiding ploughing and tilling the soil caps in the sites Dreznik and Plane. Some statements in RECOAL’s outputs appear to suggest that the local residents (and not the ashes) cause the main risks
associated with the sites because of their tilling practices. For example, the paper concludes that:

"Tilling, as part of uncontrolled farming on some sites, caused mixing of mineral soil and ashes thus exposing ashes once more to wind erosion and potentially contaminating food and fodder crops." (Dellantonio et al., 2008; p. 685)

Ploughing is one example of, according to the argument of the paper, how local residents 'cause' risks through inappropriate practices on the disposal sites. In other words, local residents appear to have the minimisation of pollution risks within their power by avoiding tillage, planting selected species of crops and grazing cattle on the disposal sites. The responsibility of minimising risks exposure is thus shifted from TEP to the local residents.

The solutions provided require local residents to conform to a series of rules about cultivation practices on the disposal sites, in other words, local residents need to be 'disciplined' to live close to the disposal sites. Such rules fail to address both the local needs for food and fodder and the economic system in which cultivating polluted land makes sense for some individuals. These ideas contrast with those expressed by local residents and discussed in Chapter 5. Some RECOAL members explained that those who complained loudly about the pollution of the sites (referred to in Chapter 5 as 'activists') were 'ecological opportunists' who only wanted compensation. On the other hand, 'opportunists', those who cultivate the sites, are regarded as irresponsible because their agricultural practices create additional risks by breaking the soil cover and uncovering the ashes.

These views, however, ignore that the issue at hand is the disposal of ash itself: the performed identities described in Chapter 5 are motivated by this issue. The disposal of ash has, in the first place, disrupted the spatial practices of local residents, who have developed different mechanisms to interact with the new areas (i.e. farming, avoidance of the area). Moreover, the disposal of ash poses a risk to the whole community, regardless of the farming practices of the sites, and affects the three environmental compartments (water, soil, air). The focus on the cultivation of the sites downplays the importance of depositing large amounts of ash on the sites, as a consequence of electricity generation.

7.3.5. Uncertainty and values

The review of risk practices confirms ideas about the risk assessment which have been around (if often ignored) since the publication of the 1984 EPA Red Book. As Whitemore (1983) argued, the risk assessment process is populated by uncertainties and value judgements. Ruckelshaus famously argued that no amount of data can substitute for professional or experienced judgement (Ruckelshaus, 1983).

Some of the indeterminacies that RECOAL has faced during the process of risk assessment are summarised in Figure 7-4. The existence of these uncertainties moved scientists to make certain choices regarding the methods of study, the interpretation and the presentation of results. These choices are necessary for the analysis and are informed by the experience and expertise of the project team. Judgement can be a suitable approach where complete knowledge is out of reach. However, when presenting the final results some RECOAL scientists felt that the use of their own professional judgement was limited, because it could be interpreted as a political position. This topic will be further elaborated in Chapter 8. Before that, it is useful to examine how local residents assess and manage risks.
7.4. Local residents’ assessment of risk

The importance of public participation in the management of risk was identified early in the development of risk analysis methodologies (e.g. Ruckelshaus, 1983). However, often participation only occurs when delegated risk assessors and managers consider that the inclusion of other interested parties may benefit the process. For example the EPA Guidelines for Ecological Risk Assessment specifies that “where they have the ability to increase or mitigate risk to ecological values of concern that are identified, interested parties may become part of the risk management team. However, involvement by interested parties is not always needed or appropriate” (USEPA, 1998; p. 13). This effectively means that the concerns of interested parties will only be considered when they can be incorporated within the framing of the problem already enforced by those directing the risk assessment process. The European Union Health and Consumer Protection Directorate specifies that stakeholder interaction will be encouraged in Scientific Committees on issues that are relevant to several Member States, of high importance for human health and/or environmental protection; and not closely related to a particular product of company. They argue that stakeholder participation contributes to greater transparency and openness.
However, the work of the Scientific Committees “is, and must remain, independent” (Directorate-C, 2007; p. 1).

Including local residents in the risk assessment may help to create a social contract between those whose practices create the risk and those who bear its impacts (Fischhoff, 1995). An additional powerful reason to include the public in the risk assessment process is that the perception of risks is very subjective. Research suggests that risks are constructed in social processes which are more important in risk perception than either empirical evidence or psychological perceptions (Rogers, 1997). Historical perspectives on risk management show that increased concerns about risk in the industrial age are closely linked to the idea that we have control over our own destiny and therefore, we can minimise and even eliminate the risks (Covello and Mumpower, 1985). This observation could explain that in Tuzla the perception of risk is linked to the lack of trust in the local industries and government institutions, which are believed to care little about the fate of the local communities. Risks become unacceptable when a local population believes that they can be avoided, or that they have been managed more efficiently in other situations (Fischhoff, 1995). For instance, in Tuzla, interviewees frequently refer to existing European environmental policies as a point of reference to reduce risks in their own communities. Hence, a sustainable project needs to establish an ongoing process of risk communication, able to listen to the public and be sensitive to the context where the project is applied (Walker et al., 1999).

Social research among local residents around the coal ash disposal sites in Tuzla aimed at bringing local residents’ views into the risk assessment on the grounds that local residents’ views should be considered in the evaluation of coal ash pollution because they are directly affected by it. The research was conducted keeping an open mind about what was relevant with regard to the environmental pollution in the local communities around the sites in Tuzla.

The analysis has been structured in terms of hazard identification, hazard characterisation, exposure assessment, and risk characterisation for analytical purposes only. The interviews with local residents did not follow this structure. However, it is useful to show that their discourses are comparable with those of the researchers involved in RECOAL, and that beyond their instrumental value in terms of providing alternative results and solutions for the sites, they demonstrate that involving local residents in the process of assessing and managing risks is needed before establishing what the problem is.

### 7.4.1. Hazard identification

The problem of coal ash disposal belongs, in local residents’ accounts, to a wider context with multiple dysfunctional aspects. Pollution, lack of infrastructure, unemployment, massive migration, poor health, and political abandonment are some of the most prominent difficulties that local residents experience in this particular context. In particular, pollution and unemployment are two facets of the same problem: industrial decline. In Tuzla, the industry (and TEP is the rule, not the exception) struggles to compete in a globalised economy, let alone protect the environment. Industrial representatives argue that, at the moment, they are unable to provide the funds for pollution abatement. Local residents point out that these are not separate problems. Rather, they consider health and ecological risks together with the economic situation. The economic difficulties of local residents affect their capacity to deal with the risks of pollution and protect their environment. This has moved some local residents to develop economically productive activities on the coal ash disposal sites. Lack of resources, whether at the individual or at the municipal level, has prevented actions to protect the local communities and ecosystems from the spread of dust (e.g. wind barriers, erosion protection works), from the pollution of underground waters (e.g. the establishment of filtering stations), or even from any interaction with the disposal sites (e.g. adequate signalling and fencing of the sites and associated water).
For example the following quote shows an account of the interaction of a wide range of social and economic factors with the environmental ones:

Hamid: "Before the advent of industry, this area had clean rivers, open-air swimming pools, and parks where people could meet. However, with the advent and development of industry, everything was taken away from us. It was taken away thanks to the coalmine which, due to coal exploitation from pits and opencast mines damaged the land. This was all done for the needs of electrical power production in TEP. That's why I closely link the economic situation to responsibilities of air pollution. Because those people [in the industry] mutually acknowledge each other. Who takes which piece of cake it's well-known... It's well-known by higher positions but not by ordinary citizens and residents... So, because of that, they should now pay us back: developing the sewage system; making roads; supplying these local communities with drinkable water; stopping the water reductions, so we can tackle this problem of cleaning and maintaining; not further expanding the disposal sites, etc, etc. That would compensate for what was taken from us."

Thus, it appears that local residents' accounts of the environmental risks are embedded in parallel accounts of the economic and political situation. This differs from RECOAL's accounts of the coal ash disposal sites that present them as isolated systems in which the input is the slag coming from the sites and the output is the water, dust and food chain transfers (Figure 7-3).

Local residents' accounts of the sites start by identifying TEP as the cause of the pollution situating TEP within a socio-economic map. Figure 7-5 offers a schematic representation of such accounts. The figure does not aim to be exhaustive or exact: instead it contains an accumulative interpretation of multiple accounts that coexist simultaneously within the local communities in Tuzla (this is different from RECOAL whose problem definition appears to be consensual and has been presented in project reports and meetings). Figure 7-5 aims to exemplify how the problematic focus is shifted from the coal ash disposal sites in the accounts of scientists to the overall socio-environmental situation in the accounts of local residents. Local residents present a holistic understanding of the environmental problem including simultaneously environmental, social and political factors. The conclusion is that solving the problem of pollution requires both environmental remediation solutions and political economic actions targeted at the root causes that create the conditions of pollution and prevent local communities from taking appropriate measures to deal with the problem.

The characterisation by RECOAL limits the problem to the disposal sites. In contrast, local residents' accounts include additional environmental aspects regarding the disposal sites, in particular, the environmental consequences of the dust and the pollution of water resources. This shows that constructing the environmental problem does not necessarily require turning a blind eye to the socio-economic aspects of the problem.

This problem definition allows local residents to extend the causal chain indicating both causes and consequences of the environmental pollution. For example the lack of political will, the lack of standards and corruption are all considered causes of the environmental pollution in the area. On the other hand, unemployment, lack of care and the general deterioration of local life are considered consequences of the same processes that result in environmental pollution. This raises more hypotheses than the model proposed by RECOAL. Also, this model allows for the identification of feedback loops (e.g. the lack of political influence of the local people fails to stir the political will to do something in the sites, perpetuating pollution and continuing the deterioration of local life that reduces the local residents' capacity to exert political influence). Both the energy needs and the health and environmental impacts of energy production are implicit in this causal chain.

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Figure 7-5: Schematic representation of local residents' delimitation of the problem

The local models of problem definition, of which one possible one is exemplified in Figure 7-5, are situated in a particular period in time, referring to dynamic relationships between different actors and agents (the current political system, the decline of the industry, the lack of political action). In contrast, the RECOAL model is atemporal; it describes an issue out of its particular temporal and spatial context. This is highlighted in the results of RECOAL which limit the project to take into account the evolution of the disposal sites when developing solutions to remediate the coal ash pollution. For instance, the project focuses on farming on the disposal sites but this is an activity locally in decline which has become marginal during the life of the project, and that is likely to be substituted by commercial or recreation facilities on the sites. Thus, a simplified model of the disposal sites -although it allows RECOAL to describe pollutant relationships in detail- has limited capacity to describe the complex network of relationships of which the pollution created by the disposal sites is but one consequence.

7.4.2. Hazard characterisation

The description of the relationship between a potential pollutant and its health impacts occurs within the model described above: it extends beyond the measurement of potential pollutants on the disposal sites. During the interviews, however, the methodology based on thresholds was explained to local residents and they demonstrated being aware of it. However, they were not ready to accept that such methodology was correct. During their interviews, in different ways, they posed the question of who determines what is acceptable.

Science has long recognised its inability to detect low level risks that occur during a long period of time. Chapter 6 explains how current understandings of pollution and pollutants regard those as ‘natural’, thus, assuming them to be an intrinsic part of life on the Earth.
This is followed by the ‘de minimis’ principle for exposure to low levels of potential pollutants, which dictates that additional man-made chemical exposure should be considered tolerable as long as it is small compared to natural exposures (Weinberg, 1986). Indeed, the ‘de minimis’ principle needs to be well specified. What is a normal background concentration of arsenic in, let us say, arsenopyrite mines in China may be disastrous in central London. Lately, the idea of a ‘de minimis’ risk has been refined into referring to ‘de minimis’ risk as the risk that is ‘virtually safe’, returning to the original scientific problem: that science cannot always determine what is virtually safe.

Local residents emphasise that they should have a say in establishing what limits are acceptable. Increasing concentrations of potential pollutants, they argue, should not be tolerated even if those concentrations are maintained within a ‘de minimis’ level. They point out that fixing thresholds is a political decision in which they want to take part.

Local residents are reluctant to accept a hazard characterisation that does not explain their observations about the deterioration of health among local residents. References to the poor health of the communities are common among interviews. Those health impacts are worsened by their lack of resources and their deficient access to health care, as emphasised in the local descriptions of the problem. Local residents emphasise the contextual nature of the damage caused by the pollution:

**Muhamed:** "They have performed some kind of an analysis, but the data says (it is worrying) that the pollution effects are at a 'slight rise': but it isn't a slight rise. And more: according to official data, cancer diseases, pulmonary diseases, diseases of the respiratory tract are at a 'slight rise', but what is a 'slight rise' to them [those who produce the data] is a catastrophe to us."

During the interviews, the most common complaint mentioned was respiratory problems. Interviewees also mentioned that there is a high incidence of cancer in the area and some people pointed out that this is especially frequent among the young. The local doctor confirmed the high incidence of respiratory and cancer conditions. She had treated in the last three years around 100 cases of serious respiratory conditions and 30 cases of cancer. The most common types of cancer were, in decreasing order of importance, lung, stomach and urinary tract cancer.

She also argued that having discussed her [limited] data with colleagues, she found these results alarming. Considering pollution as one of the risk factors of respiratory conditions, she found it plausible that the high incidence of these diseases could be related to environmental degradation.

**Local doctor (interviewed in March 2006):** "[W]hat I observed was that the number of respiratory conditions, and the complications that occur to my patients, are far stronger and far more frequent than those occurring in other surgeries attended by my colleagues. However, these are not representative data."

She also confirmed that there was a high percentage of mental problems - especially post-war depression - but she did not think that this was related to the environment; rather, she argued, this was a consequence of the general socio-economic situation. However, other interviewees regarded mental problems as linked with the environmental problems, because they established multiple linkages among all the factors within the complex socio-natural system in which the disposal of coal ash occurs (Figure 7-5).

Apart from respiratory conditions and cancer, local residents identified numerous other health problems within their community. For example, several interviewees mentioned that the environmental situation caused tiredness. An interviewee reported that when he was going to visit his family in Germany he felt more vital and less tired than when he was in Tuzla. Some interviewees reported allergies and asthma associated with bronchitis as well as other disturbances, such as heavy snoring, frequently sneezing, coughs and eyes...
irritation. In some occasions they linked the pollution with a higher risk of suffering heart conditions and strokes. All these observations constituted a body of evidence that can not be simply ignored. This resonates with Beck’s observations about the ‘side effects’ of modernisation risks. He writes:

“What scientists call ‘latent side effects’ and ‘unproven connections’ are for them their ‘coughing children’ who turn blue in foggy weather and gasp for air, with a rattle in their throat. On their side of the fence, ‘side effects’ have voices, faces, eyes and tears.” (Beck, 1992; p.61)

Thus, local residents suffering these problems, which could be linked to the disposal sites, regard with scepticism comparisons with thresholds, that appear to be arbitrary, and that seem to disregard the health conditions emerging among local residents. It appears that a dose-response experiment is being conducted in Tuzla, where a whole population is already suffering the impacts of the pollution but where pollution linkages cannot be demonstrated to exist. Beck (1992; p.61) explains: “people themselves become small, private alternative experts in risks of modernisation”. In consonance with the lay epidemiology literature referred to in Section 2.2.3 (see also Brown, 1992), local residents in Tuzla gathered information in order to understand the epidemiology of health impacts of the pollution.

7.4.3. Exposure assessment

The exposure assessment requires the identification of potential pollutants in the environment. However, local residents do not use formal methods of assessment. Instead, they find evidence of these pollutants in awkward phenomena which disrupt their everyday lives, relating the phenomenon to their ordinary experiences. This is an example of the use of ‘members measurement systems’ (Sacks, 1992), already noted in other constructionist analysis of environmental problems (e.g. Burningham, 1998).

Local residents refer to the “black snow”: after the fall, the snow is immediately covered in dust that makes it look black. Dirtiness is present in most of the interviews. It is normally associated with problems in the laundry, such as the presence of yellow specs or the dirt that spreads on the clothes when they dry them outside the house. Other evidence is found in the presence of yellow rains, the precipitation of purple-reddish flakes, fogs and gases, dust clouds, foul smells and other perceived abnormalities such as irritation in the eyes and sore throat, spotty surfaces in plants and vegetables etc. Some residents characterise their environmental problems as a problem of “air pollution”. They talk about black soot that leaves “sticky residues” and affects their breathing.

Some interviewees explain that living in the area makes people used to pollution; some of them refer to the reports of visitors from other towns pointing out the evidence of pollution. For instance an interviewee said that she did not smell anything but her friends from another town felt that the area was insalubrious because the whole air “stinks”.

People link pollution with the presence of the disposal sites. The main issue is the dust. Some people affirm that they are not worried “when the weather is calm”, that is, when there are no winds. However, the strong winds (also called “storms”) which happen normally during the summer spread the dust around the local communities directly causing dirtiness, skin and eye irritations, respiratory problems, lack of visibility and deposition of soot over plants. People explain that the dust “sneaks into the houses” and worsens the effects of the air pollution. This seems to be aggravated by the potency of the windstorms, which may reach 80/90 km/hr having blown off roofs and knocked down trees in the past. Local residents also observe the water that comes out from the disposal site. Some people explain that the water is “kind of green” or that “everything is dead” on those waters. Many people assert that the water contains high quantities of lime.
The ash is taken as a foreign element in the environment. For local residents the evidence of the danger of pollution is reflected in the unnatural character of the ashes. For example, being aware that the ashes are recycled in the cement plant in Lukavac, an interviewee says:

Evad: “That slag is taken away and used for cement, cement! You know what cement is like... If it is used as a material for cement, naturally it is not healthy. If we were eating a spoon of cement, here and now, what would we be like? Cemented. It is used especially for that!”

Other environmental problems mentioned refer to the interaction between humans and the disposal sites. For instance, the presence of the disposal sites poses a question because children play in the immediate environs and there have been one or more cases of accidents where children were drowned at the sites. Some people suggest that growing crops in the sites may spread the pollution (radiation or otherwise). A problematic issue is people and animals eating the produce from the disposal site. A family whose main business is butchering explained that they have observed abnormalities in the entrails of slaughtered animals, particularly in the liver.

Some interviewees talk about health and environmental impacts and how they are related to the current state of the industry. They back-up their assertions invoking different kinds of expertise. Some local residents are engineers and many were formerly workers in TEP, the coal mines and other industries. Other local residents have contacts with NGOs and experts from the university in Tuzla which provide them with opinions and observations about the pollution on the sites.

Interviews referred to widespread suspicion about the use of environmental problems to advance particular or nationalist interests in BiH. One issue of contention is the measurements of environmental pollution from a monitoring station installed by the Canton. Local frustration became evident after the readings allowed the Canton authorities to suggest that air pollution was worse in Tuzla than in the communities around TEP and the disposal sites. Local residents concerned with the issue explained that there are several pitfalls about the measurements. For example they contended the measuring station was in a location protected from pollution by a small forest; that only selected pollutants that are more common from vehicle emissions are monitored; and the lack of systematic procedures to gather readings from the station. For instance, a young man whose house is near the measuring station explained:

Dubravko: “Do you know why they [the Canton authorities] don’t give the correct results? If they were to give the correct results, they would have to close TEP. (...) Having in mind that we lived in a socialist system where orders were given and (...) [had to be carried out]. Now we have entered the multi-party system and everything that is done is supposed to be transparent. However, if they were to tell us in a transparent fashion how many of those emissions, pollutants in air, particles, wind blowing and other nasty things were here, then TEP would have to be closed”

Dubravko suggests that the authorities have already established that TEP cannot be closed, and therefore, that air pollution measurements have to be ‘adjusted’ to meet those pre-fixed objectives. Dubravko assumes the existence of an environmental problem as given, known by experts, and the fabrication of evidence, such as the readings of carefully placed measuring stations need to disguise it. Beyond the difficulties inherent in the scientific assessment of environmental risk, Dubravko identifies a deliberate attempt to cover up the results of pollution to advance the interests of the economically powerful actors.
7.4.4. Risk characterisation

Local residents emphasise in their interviews the pervasiveness of pollution impacts in their life. They refer to their own experiences of everyday phenomena, such as dirtiness; meteorological changes, such as ‘sticky rain’ or ‘black snow’; or awkward environmental spaces, including ‘dead water’ or ‘moonscapes’. This brings attention to the certain presence of pollution that according to local residents is ‘self-evident’; it is something that ‘anybody can see’.

Although these day-to-day observations were considered in RECOAL, the solutions did not specifically address them. Some RECOAL participants argued that those effects were not caused by the disposal sites only but rather they were the product of years of uncontrolled industrial pollution difficult to quantify or study. For example, in the risk assessment, the pollution of the sites’ waste water was considered almost negligible when compared with the pollution in the river Jala. This is however, clearly contested by local residents. TEP is considered part of a bigger industry conglomerate that pollutes the environment, although TEP is clearly identified as ‘the biggest polluter’:

Muhamed: “Apart from TEP we have 28 bigger polluters; we haven’t even counted the smaller ones. I’ll just give you a list: there is that chemical plant, the asphalt base, TEP – to tell the truth, this is the biggest polluter, so it goes to the first place. So TEP, and then HAK, then the asphalt base, then four petrol stations in this local community... this situation doesn’t happen anywhere else in the country.”

Thus, clear responsibilities can be attributed to the polluters regarding the improvement of the environmental situation. Furthermore, TEP is perceived as having the resources to push forward appropriate actions to remediate the situation.

This is connected with how the problem is constructed among local residents. The environmental problems caused by TEP, the coal ash disposal sites and the air pollution, are situated within a web of social, political and economic factors. These environmental problems are thus the consequence of inappropriate political and economic action. Solutions to resolve the environmental problem require examining the initiating causes (namely lack of political will; lack of resources; inappropriate standards; and corruption) of industrial decay. Hence, environmental and technical solutions should be accompanied by appropriate legislative and economic instruments to tackle the overall problem of industrial decay and environmental degradation. People in communities around Tuzla want local industry to recognise their role as polluters and act responsibly. The most immediate demands are the sanitation of the disposal sites and the installation of proper filters in TEP’s chimneys. The enforcement of appropriate regulations according to standards enforced in the European Union is also a chief priority of local residents:

Ramiz: “There has been devastation, a hundred of years of devastation of the area of this local community, which wasn’t followed by legal acts. When I say legal acts I mean laws, which were passed in the area of ecology to determine the domain and degree of pollution in acceptable limits, at least close to the European standards, which would regulate the environmental pollution in these areas.”

The immediacy of the pollution effects is at the heart of local residents’ characterisations of the problem. However, the risk assessment in RECOAL overlooks some of the most immediate issues for the local population such as the dirt caused by the dust, foul smells or minor medical symptoms, because they do not fit easily within the experimental analysis. Literature shows the importance of immediate locality or ‘front-door’ issues (sometimes referred to as ‘doorstep issues’), such as this, particularly among disadvantaged groups (Bumingham and Thrush, 2001; Burningham and Thrush, 2004; Lucas et al., 2004). The case of Tuzla adds evidence to show that these ‘front-door issues’ explain how environmental pollution affects the quality of life of the local population. Moreover, these
'front-door issues' constitute, within the local residents' discourses, the incontestable evidence of the presence of pollution risks in their communities.

The question of 'invisibility of risk' is recurrent within local residents' accounts of pollution. They argue that if they are able to detect all the other symptoms (from the landscape disruption to the health impacts), then 'what they do not see' may be even more worrying. Indeed, risk assessors describe themselves often as those characterising 'what it can not be seen' (e.g. Weinberg, 1986). Yet, it appears that the study of the 'invisible' and its impacts has displaced the study of the 'visible': even though the 'visible' is more immediate and can be experienced and investigated even by those who are not designated as 'risk assessors'.

Local residents are open to discussing the magnitude of the hazard, but they remind the interviewer that the negative impacts of it are already discernible in the poor health of the local community. This is sometimes obscured by the common appeals to emotion of local discourse, particularly within the common references to diseases among children. However, the argument remains valid: even if the coal ash disposal sites are only adding to an overall polluted environment, they contribute to the deterioration of the environment. The presence of pollution in an area does not justify in itself the addition of more pollution. In contrast, TEP (or the local institutions) could argue that given that they need to dispose of coal ash, disposing it in an area already polluted may be more beneficial to the overall society than polluting additional areas that have not suffered before. Such an argument is implicit in the statements from TEP representatives.

The local residents contest this argument in two ways: denying the need to dispose of coal ash, and claiming that no area should be sacrificed in the name of industrial activity. Regarding the need to dispose of coal ash, local residents claim that TEP technology is outdated, and that it should be updated. The most commonly mentioned issue is the need for the installation of new filters on the chimneys. Regarding the disposal of coal ash, local residents have joined forces with municipal representatives to press TEP to adopt systems of coal ash disposal that has less impact on the environment. The traditional wet disposal method is considered to be outdated given a) the potential for dry disposal methods to reduce the area needed for the disposal; and b) the opportunities for recycling the ashes in a nearby cement power plant. Both options are currently being discussed at TEP, which is keen to explain the improvements made in coal ash disposal technologies in meetings with the local communities. However, the narrow frame of RECOAL (and the limited resources available to the team) prevented researchers from including these considerations in the course of the project.

In addition, local residents insist that their area should not be 'sacrificed' in the name of economic growth or industrial production. For instance, a political activist in Šicki Brod explained that such sacrifice could be avoided by providing adequate compensation to local residents:

Edin: '...none of the people here are against TEP's work or against the production of electricity, but the area around TEP should not be sacrificed because of it. Thus, these people should be compensated for what was taken from them. [TEP] has taken these people's clean air, their clean spring water, their fruit from the garden, their agricultural land, and what is worse, even their health was destroyed. They have to give something back and compensate them.'

Compensation is not a straightforward matter: meaningfully valuing cleanliness, habits or health is impossible. Also, putting a price on it poses serious ethical considerations. Local people accept TEP's presence. This should be the subject of political debate. However, the uncertainty regarding the environmental impacts has delayed the implementation of measures to abate not only the environmental but also the social impacts of the pollution in
Tuzla. This risk uncertainty has also delayed measures targeting the root causes of industrial decay in the area, and their relationship to the pollution.

7.4.5. A contentious issue: radioactivity

Early social research work among stakeholders in Tuzla showed that radioactivity was one of the main concerns of local residents. Indeed, this issue had sparked numerous controversies between local residents and TEP, with TEP arguing that this was not an issue of concern and local residents claiming that TEP was trying to deceive them regarding the radioactivity levels on the sites.

The issue of radioactivity was not identified as a concern within the proposal for RECOAL although the possibility of the ashes being radioactive is referred to in the literature about coal ash (e.g. Alper, 2002; Francis, 1990). However, RECOAL’s original proposal only focused on metals and metalloids. The reasons for this were not clearly specified in the text; however, it is likely that the choice of topic was motivated by the considerable larger body of literature studying metals and metalloids (rather than radioactive elements) in coal ash and the previous experience of RECOAL researchers.

FR commissioned the local Centre for Urban Ideas (CUI) to do a preliminary stakeholder assessment. In a footnote in their report they state that “[a]ccording to the statements of heads of local community Sički Brod and the citizens, certain number of people are becoming ill with cancer, particularly lung cancer, and the number seems to be higher every year. The citizens claim that the animals are getting sick as well; they are giving an example of local hunters bringing 50 pheasants to disposal sites Divkovici. After few days all pheasants died” (CUI, 2005; p. 3). In contrast they remarked in the body of the report that the measurements of radioactivity by ‘the authorised institute’ (unspecified) were at least ten times less than allowed.

The research on local perspectives showed that despite institutional and industrial reassurances the belief that the sites were radioactive was widespread among local residents. Some interviewees explained that they have heard this belief elsewhere and others asserted its presence on the grounds of their own expertise. The following are a few examples from the interviews about the beliefs regarding radioactivity on the coal ash disposal sites:

Alija: “we thought that when the lye was mixed with the soil this could bring some radioactivity.”

Edin: “people are forced to cultivate these slag sites which are also radioactive, so they cover the slag sites with a thin layer of soil and then grow potatoes, grains and other crops. In that way, they get radiated themselves.”

Elma: “How healthy is it? I believe it’s not healthy, I think it’s radioactive.”

Evad: “Fruit didn’t grow on the sites. I think this is because the sites are radioactive. We call it radioactive.”

Halid: “[T]hat slag from the incineration, which has some kind of radiation. (...) And now, does it really radiate or it doesn’t radiate, and in which proportions, and in which units of measurement? (...) I’ve heard... the slag emits radiation, and then it causes cancer, and then... this is what somebody said. I have heard that slag sites cause some radiations.”

Halid’s wife: “I’ve heard on television that there is a slag site somewhere and that it causes radiation.”
Hamid: “We have certain problems because an opinion circulates that it’s radioactive, and it is partly, I know as a civil engineer that that slag is partly radioactive.”

Muhamed: “You see, apart from that soot which is surely radioactive, and no one wants to tell us in which percentage, but it surely causes cancer. (...) No expert raised the question of the quality of a crop that grows on radioactive ashes, how much radioactivity it absorbs from the land, how healthy it is, even for cattle to eat...”

Alana: “Because my sister works in a mine. And she says to me: ‘don’t sow there.’ She says: ‘it’s radioactive, ‘ you know? ‘It can harm you in 5 years from now, those vegetables, you know,’- she says. She works as the secretary in the mine. She says: ‘don’t you sow there.’ She says it’s dangerous to eat that. That’s a slag, you know?”

The issue is clearly contentious, as many interviewees avoided mentioning it during the interview and waited until the interviewer turned off the recorder to ask about the radioactivity on the sites. However, local representatives and environmental activists are keen to highlight the issue of radioactivity as the main concern regarding the disposal sites. One member of the local ecological group (Eko-zeleni) explained:

Ramiz: “We found out, unofficially, without any firm proof, that a degree of radiation existed and that it was dangerous for the people. And through the Ecological movement ECO-Green Tuzla, through eminent experts they established that there is radiation present in that slag. But in what quantity and if it was over the limit or within the limits, we never found out from competent people. But there is radiation, it exists.”

Local residents refer to TV reports and word of mouth as the main sources of the information about the radioactivity on the sites. They believe firmly that radioactivity exists but they do not have the evidence to prove it. TEP has organised several meetings to explain that the levels of radioactivity are ‘within acceptable levels’, but local residents remain firm in their belief that radioactivity exist. TEP uses the ‘de minimis’ principle, arguing that the radioactivity levels on the disposal sites are comparable with naturally occurring levels of radioactivity. Local residents contest that:

Muhamed: “when I mention the radioactivity to the director of TEP, that is, the director of the Electricity supply company of Bosnia and Herzegovina, he says: “Well an ordinary wood is radioactive, it’s normal, the sites are radioactive but this is not worrying.” What does he care when he lives in Sarajevo.”

The argument of local residents against TEP is that the mere presence of radioactivity, regardless of the measured level, is dangerous and susceptible to cause damage to the community. Moreover, they argue, those who characterise low radioactivity levels as negligible avoid living in those communities. In other words, experts and industrial managers regard the radioactivity levels as negligible because they are not exposed to them. Thus, the question is not whether the radioactivity level is low enough to be safe, but rather, who cares enough about the community to determine which level is low enough.

On the other hand, local residents highlight that the radioactivity on the sites is a problem insofar as it has detrimental health consequences for the community. As a local resident explained:

Mehira: “For so many years now, there has been a hypothesis about the possibility of radioactivity. (...) But all these stories derive from the fact that we have a large number of people here who have or had cancer.”
Thus, saying that the radioactivity levels are normal is only acceptable as long as there are alternative explanations for the high local incidence of cancer (and other diseases and environmental impacts attributed to the radioactivity). Recent discussions with local residents suggested that a focus on epidemiology as a way to link the environmental situation with the health impacts in the community could be more reliable than studying independent chemicals. Indeed, this sort of methodology is included in recent guidelines on cumulative risk assessment (USEPA, 2007). Thus, lay epidemiology is not only a tool to be considered in health education (as argued in Davison et al., 1991). Rather, lay epidemiology accounts reveal the limitations of scientific accounts to help local residents to make sense of what is going on while provides the tools to relate the illness and its causes with factors not contemplated in the scientific accounts of illness, from the individual beliefs to the relationship of people and the place (see also Williams and Popay, 1994).

Within RECOAL, the social researchers communicated to the other partners the local concerns about radioactivity. The issue was tentatively raised at RECOAL meetings. TEP representatives mentioned their efforts to measure radioactivity and explained that they have always found measures of concentrations of radioactive elements within normal thresholds. However, other RECOAL members took on the challenge posed by this issue and investigated further evidence of radioactive pollution.

RECOAL partners at the University of Life Sciences in Vienna (BOKU) initiated tests (by an ‘independent laboratory’) to measure and evaluate radioactivity levels. This research concluded the following:

“For all sites under study activities of $^7$Be, $^{134}$Cs and $^{137}$Cs were below detection limits. Activities of other radionuclides ($^{40}$K, $^{210}$Pb, $^{226}$Ra, $^{228}$Ra, $^{228}$Th, $^{238}$U) in ash and cover soils did not exceed the background load known from naturally derived soils (Ivanovich, 1982). In contrast, total concentrations of up to 11,700 Bq kg$^{-1}$ were reported for coal ashes in other regions of the West Balkans (IAEA, 2003). The low activities measured in Tuzla are very important to dissipate the existing distrust of the local population regarding the possible radioactive contamination of ash disposals [sic].” (Dellantonio et al., 2008; p. 680)

Thus, the conclusion from RECOAL was that radioactivity was not an issue of concern in the coal ash disposal sites in Tuzla. In addition, Forest Research hosted an MSc student, Jon Boxhall to help investigate the potential radioactivity risks from the sites that remained unexplored by the analysis reported above. He conducted a literature review on the potential human health risks associated with the radioactivity of ashes, concluding also that based on the (limited) evidence available the radioactivity levels on the sites appear comparable with normal background levels in the area (Boxhall, 2007b).

These results were presented during a local workshop held in Tuzla on the 11th of July 2007. A presentation in Bosnian, by a local member of RECOAL (Dr Hamid Custovic) focussed on the health impacts of disposal sites on humans and animals, in particular regarding alleged higher radioactivity levels and heavy metal concentrations. Most members of the RECOAL team expected that the evidence gathered, particularly the results from an ‘independent laboratory’, would add legitimacy to the results among local stakeholders. Indeed, at the workshop, stakeholders appeared confident about the results of RECOAL, regarding the contamination of water and the potential solutions for remediation of the coal ash disposals.

Questions were raised regarding health concerns related to the alleged radioactivity of the coal ash. The RECOAL Workshop report explains that:

“Despite reassurances from the RECOAL team that measurements and analyses of the samples taken from the sites were totally independent, some scepticism was
expressed about the results that showed the level of radioactivity to be within legal limits. This scepticism reflects widespread belief, as expressed frequently by informants in the interviews and informal meetings with the locals conducted for RECOAL, that radioactivity of the coal ash deposits presents a serious health risk to the local population, particularly a concern over perceived high rates of cancer. This belief was reiterated by some participants during the group sessions."

This example shows that the ‘factual’ evidence about the absence of radioactivity on the disposal sites may not convince the local population of the safety of the sites; the construction of the environmental problem as a radioactivity problem remains within the imagination of the local population. According to local residents’ views, the theory of the radioactive nature of the coal ash is the most plausible hypothesis to explain the association between the pollution and the high incidence of cancer among the local population.

Further interviews in the local communities around the disposal sites in Tuzla during July and August 2008 show that the belief about the sites being radioactive is still widespread among local residents. Thus, RECOAL results have not been enough to “dissipate the existing distrust of the local population regarding the possible radioactive contamination of ash disposals [sic]”. The following dialogue occurred when presenting the results from RECOAL to two local residents, Nusret and Jusuf, in Bukinje in July 2008 (translation excerpts between the translator and the interviewer have been omitted to facilitate the reading):

Nusret: I don’t know whether you [RECOAL] did some research about radioactivity?

Vanesa: [after showing the above quote from Dellantonio et al, 2008] I don’t have the numbers here, we were looking at them with Tomo [another resident], the only thing that they say here is that it doesn’t exceed the normal concentrations in natural soils.

Jusuf: Yes, [it does not exceed] the maximum level that is allowed.

Nusret: Look at this. [He shows the interviewer photocopies of the official results of radioactivity on the sites provided by the regional office.] Here we have the analysis of the radioactivity in 2002, 2003, and 2005, and this shows that certain pollutants appear in increased amounts every year.

(…)

Jusuf: When it comes to Tuzla, that is Bukinje, or Šićki Brod [local communities] it is always about the maximum level of pollutant allowed, they would say that the maximum of allowed particles is 95 per mg and that’s what we have.

Nusret: Look at this. [He reads from the radioactivity results:] “within maximum limits of radioactive contamination of the environment, the determined level of natural and artificial radioactive nuclei’s in the samples of slag and ash doesn’t exceed the maximum determined level.” And what’s the minimum? At one public discussion, when I met with the lady in charge of this department, she said that she didn’t know anything about it because there were some people at the round table who would be disturbed by her statement. Tell me what is the minimum limit?

(…)

Jusuf: And we would like to get away from the standard methodology, at least the one of Bosnia and Herzegovina. When it comes to Bukinje, the maximum limit is valid. When it comes to Sarajevo, they apply the minimal: It is 10, 9, 5 times worse here, and they put everything there in order, so the methodology that is being applied in Sarajevo isn’t for us.
Nusret: It's a political issue.

Jusuf: I wanted to say this: here, 50 meters away, there is the man who owns the store, and he produced 4 tons of onion, half a tone of beans, and I don't know how many tons of tomatoes and similar things on the place that used to be Jezero, the disposal site, and he sells the vegetables in his store. No one can tell him that he cannot sell, who is the person who could forbid him to see [the danger], since we are talking about radioactivity. Whether that's healthy or not, no one can prove it to us, no one wants to, and I am supposed to advise my neighbour against going to that shop and the man who owns it is also my neighbour. It looks like he's slowly killing his neighbours.

Nusret and Jusuf contested the results of radioactivity as being 'within normal levels'. They argue that there is a steady rise in radioactivity levels according to the measures taken in 2002, 2003 and 2005. The increase alone, they say, is a concern regardless of whether this increase is within tolerable levels or not. Secondly, they contest the idea that radioactivity has to be measured according to tolerable levels. Instead, they propose to use minimum possible levels, that is, the minimum level of radioactivity that could be achieved in the sites.

Nusret provided an example of how even asking for minimum radioactive levels can be received negatively by experts. His statement encapsulates one of the paradoxes of environmental expertise, in which experts are asked to determine the maximum amounts that the industry can pollute without damaging human health and the environment, instead of calculating what is the minimum pollution that those industries can cause. This is often considered a naïve statement particularly by those risk assessment defendants who argue that the pollution caused by some industries is necessary to bring about many benefits that our societies enjoy, from chemical products to cheap electricity (e.g. Rodricks, 2006). However, the primacy of human interests over nature and the need for continuous industrial development to achieve human needs are not universal assumptions. Thus, asking what the minimum level of radioactivity on the sites is questions the political and economic system within which environmental degradation occurs.

Nusret and Jusuf situated the problem of radioactivity in a socio-political context. For example, they put forward that the pollution was a 'political issue'. Indeed, the claims of pollution are accompanied by a sense of abandonment by the political authorities, particularly those in Sarajevo who benefit from the industrial development without suffering its environmental consequences. This issue will be explored more deeply in Chapter 8. In addition, Jusuf and Nusret emphasised the social consequences of the pollution, not only how it affected their health but also how it affected the relationships between local residents living together, as in the example of the man selling potentially hazardous beans to his neighbours.

Another issue discussed with Jusuf, Nusret and other interviewees was RECOAL's presentation of the results. The actual radioactivity measurements made by RECOAL have not been made available so far, aside from the indications provided above. Sample locations are also unspecified. Thus, local residents did not consider these results believable, particularly those local residents who, being interested in the issue of pollution, considered themselves capable of interpreting the results. RECOAL researchers did not provide the full results because they assumed that local residents would be satisfied with the interpretation of them.

Several lessons can be extracted from the example of radioactivity in Tuzla. Firstly, the example shows that local residents are capable of interpreting and challenging scientific results based upon their own experiences. Local residents challenged the methodology, the
establishment of thresholds and the presentation of results. Secondly, local residents locate the radioactivity issue within a wider socio-economic context, thus linking the methodologies applied in environmental research with wider methodological issues. In particular, local residents are concerned about who has the legitimacy to determine what level of radioactivity is safe. They challenge the conventional methodology (proposing a maximum tolerable concentration of radioactivity) by asserting that they should aim to achieve the minimum possible level of radioactivity. They also challenge TEP's presentation of the data. They believe that political and industrial actors should do everything possible to avoid any increase in radioactivity levels, no matter how small or comparable with natural background concentrations they are.

Finally, local interviewees do not find evidence of radioactivity in their observations of the environment: instead, radioactivity is associated with the high local incidence of cancer. The health problems call attention to radioactivity. Thus, local residents would be prepared to accept ruling out the radioactivity problems if they were offered alternative explanations for the health problems in their community. RECOAL, however, does not attempt to provide such an explanation in its account of risk assessment. Thus, local residents are unlikely to accept this assessment as valid regardless of whether radioactivity is present or not.

7.5. Discussion

Risk assessment, like risk management, is a politicised process. Traditional views on risk assessment argue that if the assessment is to be objective, it needs to be separated from the political process; they separate risk assessment (purely based on expertise) from risk management (subject to subjective political decisions). The NRC Red Book (1983) argues that this separation is useful to ensure that dissatisfaction with regulatory outcomes does not lead to criticism of risk assessment methodologies. The report argued that risk assessment and risk management involved different goals, kinds of expertise, and operating principles (NRC, 1983). In practice, both risk management and risk assessment remain confused with respect to goals, kinds of expertise and operating principles. Furthermore this work adds to a body of literature arguing that in high uncertainty conditions, such as those pertaining to most environmental problems, determining who is an expert and what counts as valid knowledge is a highly political issue and the construction of expertise therefore needs to be open to political debate.

The criticism of the distinction of risk management and risk assessment goes back to the publication of the NRC Red Book. In 1983, Whittimore published an article in the journal Risk Analysis arguing that the separation of the toxic regulation procedure in two stages, the first concerned with the facts (risk assessment) and the second with the values (risk management), was both unrealistic and unattainable. She showed in her article that risk assessment procedures involved value-laden assumptions, and that those assumptions influenced the quality and quantity of information and the interpretation of results (Whittimore, 1983).

Risk assessment scholars have already recognised that the choice of risk assessment methods cannot be isolated from risk management goals (NRC, 1994). The relationship between risk management and risk assessment has therefore been redefined to include risk assessment as a component of the risk management, giving space for stakeholders to make a contribution to the risk assessment process at the outset of the project. However, risk assessment and risk management are still presented in official documents and scientists discourses as two separate processes: assessment is understood as the stage where objective knowledge about the risk is collated and risk management is a process where stakeholders’ values and risk assessment’s factual accounts of risk assessment are put together to reach a decision.
This resonates with the theory of the modern model of science and policy (Funtowicz and Strand, 2007). Funtowicz and Strand explain that the current paradigm of the relationship between science and policy dictates that science can be fed as raw facts into the policy process. Indeed, risk assessment is understood as a process, purely scientific, that feeds facts into the value-embedded risk management process. The implementation of this model in real life situations has generated criticism regarding the legitimacy of experts to have a privileged role in the decision-making process. Participation exercises have been developed to respond to these criticisms, but without disruption of the original paradigm. As Funtowicz and Strand argue, the traditional model of the relationship between science and policy needs to be challenged. The evidence presented about the risk assessment practices of RECOAL researchers suggest that scientists do not necessarily provide incontestable facts relevant to the policy process.

This chapter provided several examples about how risk assessment is carried out in practice by a team of scientists genuinely concerned about the project questions, the social impact of the project and the legitimacy of the results. The examples show:

a. that the modern model of science and policy (manifested in the separation of risk assessment and risk management) is inappropriate because it does not reflect the way that these processes are carried out in practice. Instead, the examples in this chapter show that values and facts coexist during the process. Insisting on the isolation of scientific facts may render scientific findings irrelevant; and

b. that local residents (as an example of actors whose views are often disregarded as 'unscientific') can make meaningful contributions to the process of building knowledge about the existence of a problem and in particular to the risk assessment, not only by establishing the local demands on the sites but moreover, by making meaningful contributions to the assessment of risks.

In this respect the chapter presents a non-exhaustive catalogue of value assumptions that scientists need to accept to complete a risk assessment. The examples here refer to assumptions regarding framing the problem, defining valid thresholds, establishing valid methodologies, applying theories, and disregarding alternative plausible hypothesis. Some of the assumptions, even when they are known to be inexact, allow scientists to provide a best estimate, that is, the best possible assessment of the situation with the resources available. Assumptions and judgements facilitate the emergence of a plausible explanation and most probable estimates. The difficulties inherent in the scientific enterprise of completing a risk assessment should not be used to discredit it. However, scientists also need to use self-reflective practices to continuously test their knowledge.

The literature contains other examples that suggest similar conclusions. For example, Brian Wynne described the case of shepherds coping with radioactivity in North Cumbria. After the Chernobyl accident in 1986, scientists assumed that the observations of radioactive caesium in clay soils, in which it is chemically immobilised, were unconditionally applicable in the upper hills of North Cumbria. The application of the theory led scientists to give projections on sheep restrictions, which caused farmers considerable hardship when applied, only to find later that in the acid peaty soils in which these sheep grazed, radioactive caesium remained mobile (Wynne, 1996). In North Cumbria, policy-makers misunderstood the multidimensional complexity of the problem and ignored socio-economic considerations (Wynne, 1996). This example suggests that scientific analysis needs to examine its own assumptions and use critical analysis to foresee possible gaps in understanding not dealt with by the scientific analysis and engage with local knowledge of environmental practices.

The research in RECOAL shows that scientists are normally aware of value-laden assumptions underscoring their analysis, although they may not explicitly recognise or label them as such. Some are camouflaged as methodological postulations, such as the
hypothesis of the lack of permeability of the disposal sites, or simple accidents of research, such as the chromium contamination of samples. Scientists are also willing to revise their own assumptions in light of new facts.

The second conclusion of the analysis is that science would benefit from opening up to other types of knowledge traditionally disregarded for being considered 'value-laden'. Beck (1992) explains: "people themselves become small, private alternative experts in risks of modernisation" (p. 61). Adams (1995: p.1) argues that 'everyone is a true risk expert' because we all have developed risk expertise in our lives but, he says, 'this is one skill we never master completely'. No type of knowledge should be disregarded from the outset on the grounds of its lack of objectivity (although they may be disregarded because of their consistence, coherence or relevance). This chapter has shown many examples of how local residents seek to assess risks and provide potential solutions to reduce these risks.

The research presented here suggests that local residents frame the pollution problem more openly than RECOAL researchers, situating the coal ash disposal sites in a wider social, political and economic context (instead of describing them as an isolated system). Using this frame they are able to trace multiple connections pertaining to the socio-natural system in which the problem emerges. Local residents are able to identify potential causal links of environmental pollution rooted in the economic and social drivers that result in industrial decay and that ultimately cause or worsen the problem of coal ash disposal. Such an approach may bring about a wider range of solutions than the RECOAL model was able to provide.

In addition, local residents hold knowledge about how the pollution affects them. This knowledge helps them to construct problems and solutions of direct relevance in their situation. Locally identified problems and solutions are likely to have greater relevance for the decision-making process than those identified by a team of non-resident observers. In spite of this, projects like RECOAL are unable to work outside their frame of reference to adapt the project objectives to the local context. The initial research proposal is likely to constrain the delivery of the project, unless it is designed to accommodate new concerns as they emerge.

RECOAL researchers, in particular the social research team in the project, tried to address the real problems of the local people, i.e. exploring how the findings and proposed solutions from the project may be relevant to and influence everyday life practices in those communities. This work brought some results. For instance, research was carried out to determine the local demands on the disposal sites. Qualitative research highlighted the reliance of local people on wells due to the unreliable municipal supply of water. The issue of the wells was consequently put on RECOAL's agenda showing that the sites were polluting some of those resources. The radioactivity issue was also considered by RECOAL, but the results did not convince local residents of the relative low risk of radioactivity on the sites because the study did not address the conditions behind the construction of the radioactivity problem, i.e. the spread of cancer cases within the community. This is related to the way in which the risk assessment is conducted. For example, Floyd (2006) argues that in doing risk assessments, problems with unknown or incomplete data are frequently avoided.

7.6. Conclusion

The interviews with RECOAL researchers suggested that they felt unable to talk about how their results fitted the economic and social context of the project because this was regarded as being out of their realm of expertise. However, RECOAL may have gone too far in preventing and avoiding actions that were seen as having the potential to influence political decisions about the coal ash disposal sites. For example, most researchers would
refer only to those findings which were not contentious, either because they were already well known before the project started (e.g. the high pH values of the outflow water in the sites) or because they did not raise concerns during the project development (e.g. the microbial activity on the ashes and respiration). These statements did not have any political repercussion but they also had little explanatory power regarding what could be done about the risks caused by the disposal sites.

This process seemed to put forward a false negative conclusion, indicating that, based on the evidence collected during the RECOAL project, the risks caused by the coal ash disposal sites were tolerable. Such a conclusion will clearly benefit the industry TEP, but it has not solved the problems constructed by local residents. Chapter 8 discusses how this is likely to benefit TEP rather than other stakeholders. This conclusion suggests that in keeping the separation between facts and values scientists may unknowingly be taking a political stance favouring those who are able to put forward a plausible and practical interpretation of the results. A more critical view on the outcomes of RECOAL may question why there has been an emphasis on the positive results instead of emphasising the potential hazards associated to the disposal sites.

Some lessons can be extracted from this case-study to inform the development of any future projects similar to RECOAL. Firstly, the local relevance of scientific results will be determined by scientists' capacity to provide arguments that resonate with the concerns of stakeholders. If the view of one single powerful stakeholder is benefited by the results this is likely to be interpreted as biased research, regardless of the reputation of the researchers that conduct the risk assessment and the rigour of the scientific practice. The separation between risk assessment and risk management may not be practicable.

In Tuzla, the problem of coal ash will remain unsolved until the local concerns (from front-door issues to health conditions) are addressed in some way. RECOAL found solutions for the remediation of the sites, but these may not be relevant if they are not supported by local residents and/or authorities. The focus on agricultural cultivation will benefit a minority of residents, but will not satisfy those who perceive a stigma associated with the place and see their lives impeded by the disposal of coal ash.
8. The deployment of expertise in the context of environmental pollution

8.1. Introduction

Previous chapters have adopted a social constructionist approach to describe different identities, definitions of pollution and understandings of risk constructed around the issue of coal ash disposal. This chapter turns the attention to the applicability of RECOAL results, and its capacity to develop feasible and useful solutions that can improve the quality of life around the disposal sites. In doing so, this chapter maintains that the processes of knowledge generation are influenced by their social context. Chapter 2 presented the work of some scientists who argue that scientific facts are socially constructed (Knorr-Cetina, 1983; Latour and Woolgar, 1986). However, this chapter, following Burningham and Cooper (1999), adopts a social constructionist approach only regarding the generation of knowledge, without questioning the ontological reality of the phenomena studied.

This chapter aims to demonstrate that a social constructionist approach may help to improve the processes of environmental governance by acknowledging the multiple perspectives on an environmental problem and recognising their importance in generating environmental remediation solutions. Chapter 7 suggests that, in the context of environmental risk, scientific facts alone may not be able to provide an adequate response to the demands posed by social actors. Moreover, this chapter argues, when environmental facts are regarded as absolutely certain (as in the case of the measurement results of radioactivity) the sample evidence alone often fails to convince actors who may feel manipulated and/or abandoned by the selective, if scientifically valid, approach.

Environmental research and associated processes of knowledge generation about environmental problems is subject to high expectations about the capacity of that research to provide feasible solutions. Different actors' expectations may not be compatible, particularly when they originate from competing definitions of the environmental problem at hand. Thus, from the outset, the scientific project is immersed in a web of expectations where competing interests may try to capitalise on the results of the project.

This has important consequences for the development of research. Previous chapters have referred to Jasanoff’s work on the relationship between science and policy (Jasanoff, 1987; Jasanoff, 2003; Jasanoff, 2004; Jasanoff, 2006). Jasanoff (2004) explains a dilemma that affects many researchers regarding the practical application of their research: on the one hand they are asked to provide factual accounts to support policy-decisions; on the other hand, politicians may appropriate, manipulate or ignore scientists’ knowledge at their convenience. Researchers are thus placed in a difficult position having either a disproportionately large amount of power, able to rule out any other consideration if they provide the right kind of arguments, or a marginal position when their arguments are seen to be irrelevant (or, as Jasanoff suggests, when vested interest are able to appropriate scientists’ discourses). The researchers’ position depends on whether they are able to present their information in a format suitable for the current definition of the situation: their capacity to influence policy will not only depend on the results that they obtain, but also on their capacity to present their results to relevant social actors.

The predominant response of scientists to this dilemma (intimately related to the fact/value distinction and the debate between science and trans-science) has been to establish a clear distinction between what is considered ‘real science’ and what is regarded as management, or technological applications of science. The discussion between risk assessment and risk management, revisited in Chapter 7, is an example of scientists’ responses. Thomas Gieryn has called this a process of ‘drawing boundaries’ (Gieryn, 1995; Gieryn, 1999). The process of drawing boundaries is an activity embedded in the construction of environmental knowledge. Chapter 2 argues that although science boundaries are effective
in protecting science and guaranteeing its continuity, these boundaries do not solve the dilemma that characterises the relationship between science and policy.

Chapter 2 provides some examples of scholars that have advocated opening up the processes of knowledge generation to the participation of citizens. They focus on the need to adapt science to the new requirements of democracy and create, in different ways, a socially robust science (e.g. Funtowicz and Ravetz, 1993; Gibbons, 1999; Jasanoff, 2003). Moreover, some scholars argue, deeper involvement of communities in decision-making may lead to better solutions (e.g. Chambers, 1997).

The issue emerging is whether this puts an additional strain on the researchers' role in environmental knowledge generation. Many researchers appear to feel threatened by the call for citizens' participation in science. This is an understandable response given the complicated relationship between science and policy and the need for science to draw clear boundaries in order to maintain its significance in our society (a more elaborated discussion of this problem is presented in Section 2.3). Participation is often presented as an add-on to be included in the process of generating knowledge. Alternatively these calls for participation (embedded in proposals such as 'post-normal science', 'mode 2 science' or 'sustainability science') could be interpreted as a call for the redefinition of the role of the researcher and the expert in the policy process. Ideally, removing the need for boundaries in science should naturally lead to a more open and democratic process of knowledge generation and the re-imagination of the role of expert-scientist as producer of suitable constructions to understand reality instead of being a detached observer providing value-free knowledge to the policy process. However, evidence is needed to demonstrate that this proposal can be applied beyond being an utopia.

RECOAL provides a case study to show how expectations are created around a project and the process by which researchers draw boundaries around what they consider to be 'good science'. In studying the case of RECOAL we gain insights into the role played by scientists; how solutions for environmental problems are provided; and whether alternative methods can be devised to improve this process. In this way, this chapter intends to fuel the debate about the role of the expert-scientist in environmental policy-making and management, rather than attempting to solve it completely.

The chapter is structured into four sections. The first section describes the web of expectations created around RECOAL. The second part examines proposed solutions for the remediation of the disposal sites and their implementation. The third section describes the construction of a 'common front' within RECOAL and the dissensions from this common front. The concluding discussion reflects on the role played by the researchers and the extent to which the research project can address local actors' expectations.

8.2. A web of expectations

This section aims to describe the web of expectations that have emerged around RECOAL. Expectations were not only created around what the project was thought to be doing, but also include its requirements and duties as a project funded under the EU 6th Framework Programme. Individuals or groups of people build up these expectations according to their construction of the environmental problem addressed by RECOAL. Thus, it is useful to revisit here the concept of 'definition of the situation' by W.I. Thomas (1923). Thomas explained that individuals and groups of individuals may develop definitions of the situation that diverge from the 'accepted definition of the situation' expressed formally and informally in laws, cultural prohibitions, religious commandments, public opinion, etc.

Thomas used this concept to analyse why some individuals were unadjusted to a particular social situation. In this section, the concept is used differently. Rather than considering individuals struggling against a commonly accepted perspective, this analysis presents different groups of people with competing definitions of what the problem of coal ash disposal consists of. Each definition of the situation exposes a particular representation of the issue of environmental pollution in Tuzla which assigns duties and responsibilities
towards different actors. The analysis will reveal some points of commonality between these discourses, but it will also show distinct groups of opinion raising competing expectations about the results and the outcomes of RECOAL. The groups that have naturally emerged are local residents, local institutions and TEP.

8.2.1. Local residents' expectations

Chapter 5 reviewed the relationship between place and identity in the context of environmental pollution. In doing so it identified four different performed identities among local residents (activism, individualism, conformism, escapism). Each identity unveiled a different understanding of the environmental problems considered. However, these performed identities become more blurred when we shift attention from the relationship with the place to the expectations from the RECOAL project. Although individuals differed in what was to be done with the disposal sites, in some aspects they exposed similar positions about what RECOAL was expected to do regarding the coal ash disposal sites.

Firstly, the majority of local residents present the problem of coal ash as an issue externally imposed on them. For some interviewees (mainly conformists and individualists), this is part of the status quo, an issue they have to live with. For others (mainly activists and escapists), it is a source of consternation and protest. For all, however, it is the result of TEP's activities. Most interviewees assert that TEP has behaved irresponsibly in the selection of the location of the disposal sites and has failed to apply appropriate land regeneration methods. This is understood as embedded in the nature of TEP as an industry. For example:

Hajro: [talking about TEP] “Economic organisations do things only in their own interest: they see environmental actions as additional expenses. In Tuzla, like in other places, they come and build a factory and they do not give anything back because they see that as their own expense. That is the reason why we are not satisfied. I am objective about it, the industry must exist, whether it is mining, chemistry, energy, but something has to be given to the environment.”

Hajro’s quote reflects a widely held sentiment that companies should take into account whether the production of economic benefits is detrimental for life in local communities. Yet, interviewees suggest that TEP does not pay attention to their needs. TEP is perceived as a powerful and distant actor, protected by politicians because it is considered a matter of national interest. In contrast, local residents present themselves as victimised and powerless:

Selmira: “We will submit a request but I doubt that TEP will do anything. Maybe we would get something if we were to sue TEP but we do not have the money.”

Dika: “The citizens rebel against this situation. The citizens are asking for something to be changed but they are powerless, they can not do anything.”

Elvir: “We can not do anything because there is no State, no one asks citizens about anything.”

The first quote shows that local residents feel that nobody hears their complaints; if they have serious complaints, they cannot access the courts because they cannot cover the costs. The second quote shows that despite citizens’ efforts to rebel against this situation, they cannot do anything. The third quote explains that citizens do not have a State that can defend them because ‘there is no State’ (or else, the State is completely ineffective). The respondent also adds that nobody asks the citizens’ opinions, thus, they are not listened to. TEP is also accused of not keeping its promises:

Munira: “TEP were supposed to fix our road but now they are in court with the factory of cement and they get their coal from Uglevik... they no longer transport anything from here. So they did not fix our road as they had promised even though it was said in a contract, that they were supposed to fix it.”
This interviewee explains that TEP were not interested in fixing the road because there was no benefit attached to it, even though they had contractual obligations. The road was an added cost, and they eventually dropped their commitment to build it. In this context, government institutions are regarded as a crucial actor that could take action to mitigate the environmental damage. They could assist the citizens’ demands, because citizens alone cannot achieve their objectives:

Mehmed: “If that is dangerous, and we already know that radioactivity is dangerous, then society, the State, the governmental institutions should stop people from using it: it is better to protect as much as we can because there is no cure for it.”

Fejzo: “Here, those who decide about this, they should know about this problem, they should solve it. We, the little people, the citizens, we can only be subjects of examination, we can not do anything until the people responsible take things into their own hands: the Municipality, TEP, the Mayor of Tuzla, the president... Otherwise we alone will not achieve anything.”

However, citizens do not feel supported by their local institutions. They feel that local institutions do not listen to them and give them little feedback about what is going on with respect to the disposal sites. Some describe their country as governed by erratic political processes:

Jasir: “In 2001, as a request from Eko-zeleni Tuzla and Sički Brod, we wrote a resolution and two members of the SDP39 presented our problem. The resolution is about the total ecological protection of our communities. But we got nothing from that resolution because the government changed in the following year. Hadžiapašić [former BiH president, from the Bosniak Party of Democratic Action] came and they forgot about the resolution.”

What Jasir argues is that their resolution was ‘forgotten’ because the new president was from a different party than the one who presented the resolution (SDP). Some local residents go further by suggesting that local institutions protect vested interests.

Vladan: “The Minister [from the Canton Tuzla] came to the local community (...). I told her that they are lying to us. I asked her whether we could get the analysis every week, every day, whenever possible. She said that there was no need for it and showed me something thinking that I would believe her after seeing that. But we have our suspicions: we think that the findings are ‘bad’ but they present them as if they were ‘good’ (...). I asked her to give us the findings, but she would not, they protect others: Elektroprivreda is... [powerful].”

Thus, local residents feel that both TEP and local institutions fail to address their demands. Some explain the individual approaches they have adopted to cope with pollution. Civil society has supported many local initiatives (most notably co-ordinating local citizens’ opposition to the siting of a new disposal site in the lake known as ‘Kop’ and the aforementioned resolution). However, NGOs are limited in what they can provide. Also, the literature has been critical about the activities of some NGOs in BiH (e.g. Fagan, 2006). In that sense, later interviews (2008) among local residents show a certain fatigue about the activities of local NGOs (in particular Eko-Zeleni) and their lack of results, particularly because they focus only on planting trees as a means of environmental protection:

Izet: “We no longer trust the ecological association of the Canton [Eko-zeleni], we do not need more saplings here: we want to protect the citizens. We need direct help. (...) Saplings yes, but where they are needed. You can not save a life by

39 The Social Democratic Party of Bosnia and Herzegovina - Socialdemocrats (Socijaldemokratska Partija BiH - Socijaldemokrati, Социјалдемократска Партија БиХ - Социјалдемократи) is a centre-left political party in Bosnia and Herzegovina, successor of the League of Communists of Bosnia and Herzegovina, the Bosnian branch of the ruling party in former Yugoslavia.
planting a sapling. (...) Don’t get me wrong when I speak about saplings. Saplings yes, but on the disposal site, for it to be covered with soil and then plant them, that is OK, but we do not want saplings to be planted here in the local community. The funds are not used properly.”

The quote above summarises a long conversation about the appropriateness of NGO actions. While local residents acknowledge that NGOs are well-meaning, they seem wary about whether their interests match the local needs. According to the accounts of these interviewees, NGOs that have taken an interest in TEP’s environmental pollution seem to do little else than divert funds for projects that, although laudable, do not solve the immediate problems of local residents. NGO representatives portray themselves as lacking resources to respond to these challenges (Eko-zeleni argues that they need funds to plant more trees and to support their court action against TEP).

In summary, local residents’ define the situation bleakly: they portray TEP as an irresponsible industry; local institutions are inefficient at best and corrupt at worse; and non-governmental organisations seem unable to respond to local residents’ needs. In this context, local residents present themselves as victims of an inconsiderate industry and a corrupt political system.

Thus, citizens pose expectations on any actor who, according to their perceptions, would support their definition of the situation. RECOAL falls into this category because, according to local accounts, international projects can help them to turn things to their benefit and improve their quality of life:

Izet: “[talking about RECOAL] they are the only ones who can help us, to give us facts. People are aware of the fact that they cannot close TEP, because it is in the interest of the State, but those people also have to be aware of the fact that I care about my life, my health and that our children are leaving.”

International projects like RECOAL are regarded as able to provide the ‘facts’ about the situation. In the extract above Izet accounts for two types of ‘facts’: 1) that TEP cannot be closed (because it is in the interest of the State, that is, for the common good); and 2) that their lives are negatively affected by pollution. His concern is that most people emphasise only the first type of argument: he counts on international projects to bring about ‘facts’ to support the concerns of local residents. However, what Izet describes as ‘facts’ has a strong value component. The definition of the interest of the State is necessarily a value judgement. Likewise, what he cares about as an individual will necessarily depend on value judgements.

A critique of interviewees’ discourses for not distinguishing ‘facts’ from ‘values’ would be misplaced. The ‘fact’ and ‘value’ distinction is by no means intuitive. The question is whether it can be applied to explain our experiences of life, as facts and values are embedded together in the arguments that constitute a problem; this is an issue already explored in Section 7.4.1. Yet, local residents feel that having the ‘facts’ is crucial for the defence of their arguments:

Mehmed: “Some people did a study, I think it was in the local community, and there were good things in it but no facts, no background, and no science. Politics is politics. I can talk as much as I want, but without science... (…) We can talk as much as we can around here, but without that knowledge, and argument, and proofs, there is nothing. It is certain that there is a risk: it is certain that we are afraid of it.”

Again, the interviewee suggests that science (not ‘talk’ or ‘politics’) need to be brought into the discussion. He expresses his convictions: ‘that there is a risk’ and ‘that they are afraid of it’. Thus, science, or facts, should help to confirm these statements that for him are certain: the existence of a risk and the impacts that it has on the local population. Expectations from RECOAL (and similar international projects) are built upon the need to
demonstrate their own observations and experiences of the pollution, and document its impacts on their daily life.

The international community, in particular the European Union, is regarded as a reference for quality of life standards. Local residents frequently explain that they would be satisfied if everything was done according to what they describe as ‘European standards’:

Antonija: “Of course, we all want it to be better, cleaner. (...) What would I like? Of course I would like everything to be at the European level.”

Thus, international projects are well regarded because they are perceived to be able to introduce international standards for the protection of health and the environment. Another valuable aspect of international projects mentioned during the interviews is their ‘independence’. The international community is regarded as a potential ally that could counter-act the power of Elektroprivreda and TEP, while by-passing local and ineffective bureaucracies. Experts in international projects have the expertise and the independence to make a conclusive case about the disposal sites:

Izet: “We know that the government and those who work on problems related to ecology will always say that it is not radioactive; they have been telling us that it is not radioactive; but the people who come from abroad have information about whether it is dangerous or not. (...) I know how much they lie, those experts who come here and claim that the dust is not radioactive when we have proofs that it is. We would be glad if someone from abroad would come, someone autonomous, an NGO perhaps, to check the measuring station and even to check radioactivity. The experts from Sarajevo come and they say that this is not as much radioactive as it is in Kakanj and they lie to the people in Kakanj saying that it is not as much radioactive there as it is in Tuzla. That’s how those experts are trying to deceive us; maybe only to get a small amount of pocket money. We want an organisation from the EU, which knows about those things, to come and tell us whether the level of radioactivity here is permitted or not. I have to tell you, recently, if you would take the death certificates of the people here, almost every person died from lung cancer.”

Note that Izet says that local people ‘have proofs that it is radioactive’. For example, by the end of the quote he refers to the high rates of people dying of lung cancer. Chapter 7 has shown other examples in which local residents develop a ‘lay expertise’ on radioactivity and pollution on the disposal sites. Most interviewees were either convinced about the presence of radioactivity or had doubts that led to great anxiety. Thus, there are great expectations about the capacity of RECOAL to assert conclusively whether the sites are radioactive or not. They believe RECOAL would provide the final proof of the injustices committed against them and disseminate the results among actors capable to take action upon it:

Vladan: “[To the translator] Thank her, [to the interviewer] thank you for pressuring them to do something in the interest of the people, maybe there will be some changes if people who have influence come, but our generation do not have a chance to see any improvement. My biggest wish, and I told this to the two directors of TEP, is to wake up in the morning, look through the window and see that someone demolished the chimneys. The director wasn’t happy to hear this.”

Ismet: “I would like to ask her [the interviewer] if she could send feedback directly to our local community. We want the report to be sent to us directly because we do not trust the Municipality (...) I think they are hiding some things in co-operation with some individuals in Elektroprivreda (...). It is very difficult to get information from them. They pretend that they do not have it.”

Branka: “Tuzlanska Televizija and Tuzlanski List [main local television station and main local newspaper]. You can always contact them. That was why I asked what the goal of her project was: if she contacts the media her bosses will see that she
did her job. I hope that we will have at least a minimal benefit out of it, because if one keeps repeating that they pollute, then they will find a way out, a solution.

In summary, the expectations of RECOAL held by local residents are related to their identifications of themselves as victims of an irresponsible industry and a powerless or corrupt government. They expect international projects to play the role of arbiters between them and the industry. Because they perceive the situation as unjust, they expect those ‘arbiters’ to recognise that injustice and move other parties to do something about it.

8.2.2. TEP’s expectations from RECOAL

In every interview TEP representatives appeared to behave defensively although this behaviour tended to wane during the interview as interviewees seemed to feel more comfortable with the interviewer. For example, some representatives expressed disdain regarding the use of those interviews. They draw boundaries with the interviewer by using body language, interrupting the interview for no obvious reason, commenting on the inappropriateness of questions or completely ignoring the questions posed by the interviewer (the list of questions can be found in Appendix I, Interview Guide II). Sometimes they expressed verbally that they felt judged and blamed as individuals for an environmental problem beyond their responsibility. This appears to be a response to TEP being portrayed by public opinion as irresponsible and outdated. TEP’s assessments of environmental risks are not trusted even though in recent years they have increased their engagement with the public (partially motivated by new Environmental Impact Assessment legislation).

TEP also portray themselves as ‘victims’, but of a different kind. They present themselves as an industry consisting of experts implementing the best technologies available and taking care of the environment according to known ‘facts’. However, they see their work hindered by the political context and the opposition of local residents which they depict as unjustified at best and irrational at worst. For example, one of the workers at TEP explained how they were making all possible efforts to help local residents:

Dzanan: “When we assessed the environmental impacts for the construction of Jezero, first we had the assessment evaluated by the Federal Ministry, and after that assessment there was a public discussion. All local communities were included, NGOs, governmental organisations from the field of ecology. A study of the influence of the disposal sites on the environment was done on the basis of that discussion. (...) After the public discussion, all justified and unjustified arguments from the local community were taken into consideration, and they were included in the study of the influence of the disposal sites on the environment. That study was revised by the Ministry and another public discussion was held for the local actors to see that their suggestions were included in the study. (...) [W]e are forced by the law to protect the environment to have that type of communication, that type of cooperation: the legal procedure for getting the environmental permit includes the requirement of having public discussions. (...) Justified arguments are taken into account and we try to address them, but there are unjustified suggestions such as that of TEP to stop working. (...) In the last 10 years, we have spent 60, 70 million for projects related to the ecology. That’s one of the signs that TEP cares. Look, I’m one of the citizens of this town; I happen to work in TEP but it is not in my interest for my child to be poisoned by something if there are negative impacts on the environment. Not just me, but practically all the other workers in TEP are residents of the local communities here. We have a common goal, we shouldn’t be divided. (...) [After a question about the new filters in TEP] The limit for the old filters according to the European Union [legislation] is 100 mg per cubic metre in the air that goes through the chimney. The effects of the filters show that the emissions are between 30 and 50, below the limit stated by the EU for energy
production. Before those filters, the emissions were 1000, 1200. Those are huge positive effects for the local community."

This TEP employee presents himself as concerned and caring about the local communities; moreover he portrays himself as a member of the local communities, and thus, caring about the environment as much as any other local resident. The investments in ecology-related projects, the new chimney filters, the public meetings are all presented as signs that ‘TEP cares’. TEP workers present themselves as limited by technology, resources and politics. However, they present visions of a better TEP and a better environmental future:

Nermin: "We have big plans now; we are planning to open a new disposal site called Jezero 2. (...) Before doing that we have to solve the issue of wastewater. We are working on it; we are working on a project to establish a closed system for wastewaters. The reports from the RECOAL project will be useful for that. That will be a temporary solution. We visited TEP in Kosovo and Hungary in order to see their system of disposing the slag, the half-dry system. We are trying to apply it here; it’s our vision, if we can do it."

Thus, RECOAL’s results are seen as only part of a temporary solution; their ‘vision’ is to move into a half-dry system of disposal, that is, using less water and transport the slag on trucks to other, more remote, areas. The dry-disposal solution appears to be motivated also by a desire to appease the Municipality and the local communities.

The expectation of RECOAL is that it will help them to find temporary solutions for the wet disposal system. In addition, TEP employees see RECOAL’s big role to be demonstrating limited environmental impacts of the coal ash disposal sites on the local population, thereby aiding them to regain the trust of the communities:

Nermin: “Bosnia Herzegovina is an EU oriented country, so when we heard that the EU wanted to fund such a project we wanted to get involved (...). The other reason why we wanted to join the project is even more important. It is because of its human aspect; we wanted to know if the disposal sites posed a problem for the local population.”

Dzanan: “That’s why it is very important to have an official report from an international institution: because people trust international institutions more than they trust us.”

However, the expectation is that RECOAL will provide positive results about TEP’s environmental performance.

Interviewer: Are there any risks that may prevent RECOAL from achieving its objectives?

Nermin: No, actually the results of RECOAL are very positive so there won’t be any problem to finish it and they will give recommendations that we will put in practice. Had the results not been positive for TEP I don’t know what would have happened... that would have been a political question.

Interviewer: But the scientific results are not clear cut, in fact it is not clear whether the results for water on Dreznik could be applied to other disposal sites?

Nermin: Yes, that is true, for instance we know that there are leakages in the west side of Jezero to the underground, and also on the right side of Dreznik; I mean we have put together the water balance and there is some water that is not reflected on it, so there must surely be a leakage somewhere.

RECOAL is expected to provide ‘positive results’ that confirm TEP’s arguments that the impacts of the disposal sites on the environment and the local communities are minimal. Nermin asserts that if the results had shown a significant environmental risk, the issue of the coal ash disposal sites would have been transformed into a ‘political question’. Positive results are regarded as scientific and negative results as political, even though both positive and negative results have scientific and political relevance. Thus, only if the results support

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TEP's position will they be regarded as non-political. However, the results are not as positive as Nermin suggests at first. On the one hand, there are numerous uncertainties regarding the results of RECOAL, like the one exposed in this interview. On the other hand, the results of RECOAL show that there are serious risks associated with the disposal sites.

TEP acknowledges that 'people are endangered', but they claim that there has to be a limit to what TEP can do to address this issue, that is, they argue that TEP's responsibility is limited because they are already doing as much as is possible to improve the situation.

Interviewer: What results would you like to have and how would you use them?

Dzanan: First, we expect 'real' results of the research, that's always one of our goals: to get real results, and then we apply those results depending on the needs. It is probable that we would use them to explain to the local people that the damage is not as big as it is thought in unofficial circles, by laymen and ordinary citizens. If there were any negative impacts (...) we would try to eliminate them.

The expectations of some employees of TEP are similar to those of local residents: they hope that RECOAL will provide 'real' results about the risks of the disposal sites. The difference is that local communities believe that risks are serious and that something must be done about them, while TEP employees suggest that the risks are not serious enough to justify a forceful response from TEP. Thus, TEP is planning to use RECOAL results not only to inform local communities, but also to counteract their arguments:

Nermin: "We would like to receive RECOAL's reports; they would be very useful, very useful, because the results are very affirmative. Now, we are having this problem...someone is suing us because the grass on his land won't grow; the leaves are yellow... they have to be yellow because of the weather... he must be crazy. This project will say that something like that isn't possible."

He argues that RECOAL will provide information to demonstrate that there is no linkage between the operation of TEP and the environmental impacts observed by local residents in their home gardens. Such information would release TEP from further responsibilities towards local residents. However, in order to be effective, such information has to be provided in a format that can be used by TEP. During interviews in August 2008, TEP technicians expressed their disappointment because RECOAL had not yet provided them with the 'official' results they wanted in a format that they could use to advance their objectives.

Nermin: "We haven't received any reports from the RECOAL project, the final ones. (...) My directors are constantly accusing me that I deceived them, so to speak, because I promised that they would get all the reports, that everything would be settled, but nothing. I called the faculty for hydrotechnology in Sarajevo and I insisted that they should send those reports, they intervened, and they said that it wasn't finished, that nothing was finished. We haven't received any report, we should have received some sort of manual, but we have received nothing. We need those reports, we would like to use them, the results were affirmative, we could use them in future projects, but we haven't received anything officially."

Dzanan: "I don't know what happened because we don't know the final results. We have never received the final report. That's why our management criticised us because we participated in that project from the beginning and we have never received any final report from the consortium even though this is their obligation and it was planned from the beginning. (...) We gave our support for the making of the experimental fields, and you should ask the experts about the results, and we haven't received final results so we cannot comment on that. That's one of the big flaws of this project."

In summary, TEP employees involved in the project expect that RECOAL will provide independent evidence of TEP's efforts to operate the plant in the best possible way. These
expectations are related to their perception that they are being unfairly blamed for environmental problems beyond their responsibility. Likewise local residents, TEP employees expect RECOAL to play the role of arbiters that will help others recognise their efforts to reduce the power plant's impact on the environment.

8.2.3. **Local institutions' expectations**

Local institutions have a clear political outlook on the problem of coal ash disposal. Most institutional representatives link the problem of coal ash with the Tuzla-Sarajevo relationship. Tuzla is a stronghold of the non-nationalistic party (successor to the former Yugoslavia league of communists) SDP. However, it depends on the government of the Federation in Sarajevo, which is in the hands of nationalistic parties (given the power structure in Bosnia and Herzegovina, only nationalistic parties have access to the presidency). This has an impact on the capacity of local authorities to build up resources:

Emin: "There is one additional level of problems that are typical of Tuzla. The local authority and the higher levels of authority, the Canton, the Federation and the State, have opposite political preferences. In Tuzla, ever since the communist regime ended in 1989, no nationalistic party has ever won. (...) There is a constant antagonism between the local community and the higher levels of authority. The local community does not have any power except cleaning the streets and collecting litter. (...) The problem is not the people who work in TEP, but those who are in Elektroprivreda, which owns TEP, and hence decisions are made in Sarajevo. (...) Because parties in power, it does not matter whether they are nationalistic or not, put their own people in charge of the companies that they own. And those people control the companies, and they are doing things according to their political party. (...) This situation is not beneficial for TEP... so many levels of authority, it would be difficult even without this double authority; there are places where nationalistic parties have the power and it is not easy for them either. But also Sarajevo does not care about other provinces and is taking all the money for itself. I am talking about Sarajevo as a capital, not the political option... They also don't care about the pollution in Kakanj, for example."

This problem is particularly acute with Elektroprivreda, a public utility company considered of national interest, and with nationalistic strongholds in Sarajevo, Banja Luka and Mostar, but whose production centres are scattered around the country. Another municipal official explains this situation:

Husref: "The important thing is that Elektroprivreda is always in the hands of one party in power which is always a different party from the party in Tuzla. Because we are social-democrats they don't want to help us. (...) And that's the core of the problem. They don't want to be partners with us."

The local institutions present themselves as lacking the resources and political support to take effective action. They are left to negotiate with TEP over administrative issues:

Emin: "Now we have a problem because TEP wants more disposal sites but we have not included them in our spatial plan. And this department does not plan to give them a permit for new disposal sites, except for those that are already planned. So now we can negotiate these permits; that's our only card to make them do something about it, to give the land back to us after re-cultivation."

Municipal officials are hoping to establish the impacts of TEP's practices:

Zdravko: "I can not say how I will use the results of RECOAL because we don't have the project report on our desk; we are still waiting to see it and to read it. Only then we will be able to say whether it is of any use. Now, I can only say what
we expect from this project. We expect an answer to the question whether the current way of disposing slag and ash allows the possibility to use the disposal sites when they are no longer active. That would be very important in a decision-making process regarding the future disposal sites. We are especially interested in that because Elektroprivreda of Bosnia and Herzegovina intends to build new capacities at TEP, with more power than now. And every project that can provide answers for the current ways of disposing of waste materials is useful because we have our doubts regarding the current way of disposal. If it turns out that we are right and that those surfaces are lost, and they are not small at all, they influence the health of people and the health of the whole system, then we would ask for a change in current practices of disposing of waste materials and we won't allow the current treatment. That's the reason why we supported this project, because it was in our interest to get answers to some questions."

However, the Municipality operates an alternative strategy of bargaining with TEP. From the interviews it emerged that Municipal officials hope to achieve three goals: 1) recuperate the disposal sites for further use to ameliorate the pressing problem of land scarcity (particularly levelled land); 2) find out appropriate methods and locations for TEP’s waste disposal; and 3) get TEP to fund different initiatives to guarantee health protection and re-establish the trust with local communities. These objectives cannot be met should TEP disappear; rather, it is in the interest of the Municipality to keep TEP open but force it to co-operate with the Municipality:

Husref: “They need one new [production] block. There are six blocks now and they should be closed in 2012, this one in 2015, this one in 2018, this one in 2020, this one in 2025 and this one in 2025 approximately. They are supposed to be closed so they have to build a new block to replace these three. (...) In order to do that, they have to get the building permit from the local community. (...) They have told us that the next phase will be the programme of the ‘friendly environment’ which is our main interest. In this programme there are several points regarding the coal ash disposal sites: a.) find a purpose for the degraded land; b.) contribute to solving the infrastructure problems of the settlements near the TEP; c.) install district heating and greenhouses for the production of vegetables because you cannot grow vegetables in the open; d.) construct closed playgrounds for children... If they want a ‘friendly environment’ they have to create it in the local communities around TEP because people have to like them.”

In an earlier interview in 2006, Zdravko was more receptive to the idea of negotiating with TEP transferring the ownership of the disposal sites to help the Municipality deal with current land scarcity problems:

Zdravko: “We have had several meetings with the people from TEP (...). I think there's the good will to transfer the ownership of this land to the Municipality. I think that Elektroprivreda... they are aware that one filled-up dump site is not something they should cling onto, is it? Well, we play exactly on that card, to trade with... to have the land returned to us for free so we can put it to some use. (...) There's no doubt that the project [RECOAL] could be useful to the Municipality.”

The flat areas of the disposal sites could help the Municipality solve problems of land scarcity (proposals include a small airport, a hippodrome, a sports centre, a cemetery, small production units, or a trailer park). However, the transfer of ownership would also require the Municipality to deal with any liabilities for environmental pollution on the sites. Thus, RECOAL is expected to provide some answers regarding the safe uses of the disposal sites. In the meantime, negotiations between TEP and the Municipality are hindered by several factors such as the different priorities and cultural modus operandi of the two institutions and the uncertainties regarding pollution. Furthermore, the issue of the disposal sites is negotiated together with other issues such as the concession of new permits for TEP. The lack of power of the Municipality to enforce environmental and planning
regulations to control TEP and their own lack of resources is in the background of these negotiations.

The issue is further complicated by the need for Municipality officials to show leadership regarding development projects in the Municipality and environmental protection. For example, Husref elaborates on the need for a programme 'of the friendly environment', that TEP could use to regain the trust of local citizens and to demonstrate that they are not trying to manipulate public opinion.

Husref: "We need to change the opinion of the citizens about the need to have a new thermo-electric power plant block. People are not convinced now. If you would ask them, they would say: 'We don't want it. Why would we want that when it has only caused us bad things?' (...) Thus the programme of a 'friendly environment' is a precondition. We need to trade with TEP: that's important now. The Mayor must not accept something that is not in the interest of the citizens. Citizens, NGOs, experts, who are not in Elektroprivreda, should be included in the decisions. In the former system, Elektroprivreda paid its experts and formed its lobby in order to persuade the citizens, and to lie to the citizens... Maybe TEP would find that better. Even though they did not change anything for the citizens."

In contrast to the Municipality the Canton representatives give different reasons for their interest in RECOAL. They do not need to negotiate with TEP in the same way. Instead, the Canton is focused on developing spatial plans and requires arguments to justify Canton decisions. As they argue, planning requires both 'politics and science':

Samija: "This is politics and science. The disposal sites are already there, some are still being exploited, if you want to do something you get the answer that TEP can not work without the disposal sites and that without TEP there is no electricity and so on. In our plan we did not plan any new locations for the disposal sites. Our suggestion was to use the current disposal sites as much as possible. It is also possible to return ash and slag to the mines, where it came from. Scientifically it is possible, a bit more expensive but possible. Since there is no more space in Tuzla Canton we said in our plan that there will not be any more disposal sites and that existing ones should be re-cultivated when they cease to be active. And slag and ash can be returned to the place where they came from. That's what science can say something about."

The dilemma faced by the Canton is only half spelled out. The problem of land scarcity emerging from a legacy of industrial decay requires the Canton to find space for pressing competing uses. However, citizens are mobilised against some land uses. Having a weak authority and limited resources, the Canton authorities are struggling to deal with public opposition. For example, during the interviews in August 2008, Canton officials were extremely worried about the waste management and disposal in Tuzla. At the moment, small waste landfills are scattered around the Municipality, causing numerous complaints. The Canton proposed to concentrate waste disposal in a single giant landfill site in a town called Lukavac (that already hosts TEP water supply facilities and a cement plant), but the public response against it was unanimous and forced the Canton to withdraw the proposal. Municipal officials believe that appropriate evidence would help to justify their land use plans. Regarding the disposal sites, during an interview in April 2006 a Canton official explained that evidence about appropriate land use would be very beneficial for the completion of the Tuzla Spatial Plan:

Samija: "I ask about your research because we have started developing the Municipal Spatial Plan. We have just started, so your research would be very useful and it could be incorporated into this process because its findings may influence the future use of the coal ash disposal sites. I assume that in April next year you will have some results on the soil pollution, on possible use of the land, whether it's suitable for agriculture or some other purposes, or whether planting trees or grassland are the exclusive options etc. I believe that your research will
indicate what sort of future use will be possible. This would be very useful for us, really, if we have something specific to say about the sites, to find common ground with TEP and with all others regarding the future use of that land. So instead of just saying: ‘re-cultivation’ we could have some specific elements to incorporate in the plan.”

The Canton official expects that RECOAL will explain what can be done and what not with the disposal sites: having specific details would help the Canton to give particular directions about what should be done with the sites. She expects that this may help in finding a ‘common ground’ between different stakeholders about future land-use. Thus, Canton authorities expect RECOAL to produce findings that everybody can agree with. Again, we revisit the idea that science is expected to bring ‘true facts’. These interviewees suggest that dissension and discussion create tensions that are detrimental for the policy process. Instead, science should bring specific solutions that everybody could agree with. This resonates with David Fiorino’s (1989) critique of the removal of political debate from policy-making discussed in Section 2.3.2.

However findings of RECOAL alone have not been enough to draw a middle ground between the parties involved. One of the concerns of the Canton officials is that the project could end without any ‘useful’ application for Tuzla. Samija remarked that the project should send them their ‘results’:

Samija: “For the outcome not to be a document which would end up in the European Union in someone’s drawer, like many others before... The purpose of this project is not to be someone’s scientific experiment but the purpose of this project, as a European Union project, is for us to use it.”

Samija criticises the danger of a project’s lack of usefulness if the only outcome are reports that end up with EC bureaucrats but do not get disseminated to potential end-users and those affected by the topic of research. According to her, other projects ‘end up in European Union drawers’, that is, they do not have a practical benefit. Furthermore, she adds, this project should not be ‘someone’s scientific experiment’. That is, the objectives of the project should go beyond individuals’ own agenda. She thinks that European Union projects should leave something useful behind. Section 8.3 will review in more depth what the project has left behind.

Considerable effort was put into disseminating the findings of RECOAL among a variety of audiences. The most notable effort was the organisation of a public workshop in Tuzla in July 2007. During the workshop, some RECOAL members presented the findings of RECOAL orally. In addition, each partner organisation prepared posters for display and some of them had handouts. An unusually high number of translators were available to facilitate communication between local actors and RECOAL’s researchers.

However, the interviews carried out in August 2008 showed that most stakeholders, most of whom attended the workshop, still felt uninformed about RECOAL. The efforts of RECOAL to disseminate the results in a variety of formats were not recognised. Canton officials acknowledged their participation in the workshop and the previous visits of RECOAL researchers. However, they regarded these events as efforts on their part, not as occasions for information gathering. They expected RECOAL results to be provided to them in a formal format:

Samija: “I think that the project should be sent as a brochure, or as a recommendation to the Ministry of Planning.”

Cedo: “With signatures.”

Samija: “It needs to make it obvious that it is an official document. Like other studies that we do and use. A research article is an article, I can read an article in any magazine or from the Internet, but it has to be an official study in order to be used, so that we could endorse it. (...) RECOAL’s final report should be sent to all
the people who will use it in further planning. That is what I expected from this project, that it would have a final report or any document that we can use."

This request is completely justified, and indeed, at the moment of writing (February 2009) RECOAL’s handbook of remediation methods is still being translated into Bosnian for its dissemination among local actors. However, additional inferences can be made from this request. Why was the information provided during the workshop not enough to assist the Ministry of Planning in the Canton? Why does it need to be provided in a formal format, as an ‘official study’ and ‘with signatures’? The signature indicates responsibility: that is, RECOAL researchers (in particular the co-ordinating team at BOKU, Vienna) should take full responsibility for the project’s results. The formal format ultimately certifies that the results are correct, and that they are ‘the truth’. In that format the results can be used as evidence, in the institutional meetings, in negotiations between actors, by the press and in courts. This suggests that the formal style of presentation is what confers ‘truth’ status upon the results (i.e. if they are not presented in a formal document, with signatures, the results are not considered definitive or valid and can not be ‘used’ by the Ministry of Spatial Planning).

In summary, the Canton and the Municipality are struggling to balance finding the objective of safe solutions for the disposal sites and the objective of ensuring that TEP pays a fair price for the environmental damage caused. Whereas the Municipality is engaged in adversarial negotiations with TEP, bargaining for the ownership of the sites, the Canton favours a consensual approach relying on the capacity of science to reconcile different perspectives.

8.2.4. Definitions and expectations

The evidence and analysis presented in this section discuss the expectations of different actors in Tuzla according to their definitions of the situation. The extracts and context given in the above sections show that the different actors expected to use the results of RECOAL to advance their own interests. The Canton authorities emphasised the need for consensus between different actors, and expected RECOAL to provide evidence that all the actors could adhere to. Confrontation was the favoured option of all the other actors (Municipality, TEP, local residents, and NGOs whose definition of the situation is not presented here because it overlaps with the opinions of the other actors). They all emphasised their participation in adversarial procedures: tough negotiations, court proceedings, confrontations in the media. They all expected RECOAL to provide evidence supporting their position in these procedures in the form of ‘true facts’. Although the positions adopted were different, the manner in which they stated their position was essentially similar (see Table 8-1).

Most accounts show unrealistic expectations about the benefits that RECOAL is able to provide. Chapter 7 demonstrates that, given the nature of the risk inquiry, proving the complete absence or presence of risk is not feasible. Thus, the risk assessment is embedded in a political process in which a negotiated decision about what is accepted as being safe needs to be taken. This process is needed to bring all parties to the realisation that only an agreement will determine what level of risk is acceptable in Tuzla. Given the history of distrust between TEP, local communities and local institutions, the level of risk acceptability in Tuzla could be lower than in other industrial areas (additional examples in Renn, 2009)

The analysis suggests that actors pose unrealistic demands from a relatively small project, with a limited remit of purely research objectives, such as RECOAL. Local residents expect that RECOAL will play the role of arbiters recognising their situation as unjust and compelling other actors (especially TEP), to remediate that injustice. TEP’s expectations of what RECOAL can deliver are also unrealistic, for it is unlikely that the results presented by the project are going to fully dissipate the concerns of the local residents. Canton and municipal authorities expect RECOAL to provide a formal assessment of the safety and
use of the disposal sites. According to the accounts of the officials, such formal assessment should give a decision about the safety of the sites and a recipe about how to re-generate them. In effect, this demand would require RECOAL to make a political decision, which also falls outside the remit of the project.

<table>
<thead>
<tr>
<th>Actor</th>
<th>Priority</th>
<th>Adversarial</th>
<th>Against...</th>
<th>Perceived role of the project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local communities</td>
<td>Demonstrate they are suffering from environmental and health hazards</td>
<td>Yes</td>
<td>TEP and Government Institutions</td>
<td>Provide evidence about the risks posed by the sites</td>
</tr>
<tr>
<td>TEP</td>
<td>Demonstrate the pollution risk they are causing does not justify excessive intervention</td>
<td>Yes</td>
<td>Local Communities</td>
<td>Provide evidence about the safety of the sites</td>
</tr>
<tr>
<td>Municipality</td>
<td>Find out potential uses for the disposal sites to deal with local land scarcity</td>
<td>Yes</td>
<td>TEP</td>
<td>Provide a land use solution for the disposal sites</td>
</tr>
<tr>
<td>Canton</td>
<td>To find a location for controversial land uses and harmonise the different land uses across the Canton</td>
<td>No</td>
<td>None</td>
<td>Provide evidence about the suitability of different land uses</td>
</tr>
</tbody>
</table>

Table 8-1: Summary of stakeholders' positions and expectations of RECOAL.

Each set of actors were confident that RECOAL would bear out their existing beliefs. They all believed that their beliefs of pollution reflected the reality of the situation and thus scientific research would confirm their observations. The expectations were unrealistic both because they overestimated the capacity of the RECOAL project but also because they assumed the accounts of pollution and risk generated by the RECOAL project would match their own beliefs of pollution. The expectations followed narrowed understandings of what was the truth of the situation that did not acknowledge the complex and multi-layered nature of the problem of coal ash disposal in Tuzla.

The analysis shows the importance of the choice of format in which results are communicated. The emphasis on formal presentation of results (notably among Canton authorities, but also demanded by local residents and by TEP) suggests that the results of RECOAL may not be considered relevant if they are not accompanied by a formal 'approval' which enables further action. For example, TEP wanted to use the results of RECOAL in a court case against local residents. Canton officials hoped for written recommendations to back up certain developments. However, getting involved in planning decisions and court procedures is clearly beyond the remit of RECOAL, an EC-funded research project.

The limitations inherent to the Bosnian political system and the lack of resources have prevented local institutions from taking action to tackle the potential hazards associated with environmental pollution in Tuzla. In this situation, a project like RECOAL could have considerable impact, providing additional support to institutions and palliating the lack of available knowledge about potential solutions for the coal ash disposal sites. Thus, arguably, RECOAL has an additional moral requirement to improve the local quality of life: both local residents and RECOAL researchers highlight this. RECOAL researchers
assume that completing its objectives would automatically benefit local residents. This is explored in the next section, examining who RECOAL did benefit and how.

8.3. Contributions of RECOAL to governance and quality of life

This section distinguishes between the results and benefits of a project. Results are the information obtained from the research and experiments. Benefits refer to the advantages or profits gained from them. The results are presented in RECOAL reports. However, understanding RECOAL's benefits requires considering who benefits from the results and in which way. Thus, to explore the benefits of RECOAL, the results exposed in the reports need to be compared with the expectations of different actors presented above.

8.3.1. The 'results' of RECOAL

Chapter 7 has reviewed some of the results of RECOAL regarding the associated risks at the disposal sites. RECOAL was unable to establish a comprehensive risk characterisation of the type presence/absence of risk. Instead, what RECOAL provided were values for the concentrations of chemical elements. Accordingly, RECOAL concluded that there are some elements that do not pose a risk (e.g. lead), some elements that pose a risk for humans and the environment (e.g. sulphates, arsenic, boron), and some elements that may be causing a potentially serious problem (e.g. molybdenum, chromium, nickel). The acceptability of these risks was evaluated with reference to the background concentrations of pollutants in the environment of Tuzla and European standards. For example, RECOAL found that the concentrations of pollutants in the river Jala were significantly higher than in discharged waters from the disposal sites. Soils in the immediate areas of the disposal sites had high concentrations of nickel, as did soil covers at the disposal sites. Finally, RECOAL included an analysis of radioactive elements, although there was not a systematic sampling of all the areas that could potentially be contaminated. RECOAL's analysis suggested that the concentration of radioactive elements on the disposal sites were below regulatory levels. These results have been used in a preliminary assessment of the risks associated with the coal ash disposal sites.

RECOAL results show that local residents of local communities around the disposal sites are probably exposed to significant environmental risks; however, it is not clear whether these risks are all directly related to the disposal sites or may also come from other pollution sources. Moreover, the additional risk posed by the disposal sites appears to be minor in comparison with other risks emerging in the surrounding landscape, such as the chemical contamination of the river Jala, the low air quality or landslides causing by salt and coal mining. The tacit assumption by RECOAL members underlying this conclusion is that the acceptability of risks in an already polluted area may be higher than in pristine areas; thus, local residents are regarded as being able to continue their lives enduring a higher level of transformation of the environment and living conditions. Local residents counteract this argument saying that they have already suffered considerable environmental damage. Interviews with local residents show that they believe they should be protected from additional pollution because they are already threatened.

RECOAL provided a range of potential solutions that could be applied to reduce the risks associated with the disposal sites. Solutions are tailored to each particular environmental compartment. Soil covers and amendment additions are thought to stabilise the disposal sites and prevent dust dispersion. Crop covers are introduced to prevent erosion and provide a source of income to local residents. Mechanical and biological filters are expected to improve the quality of the discharged waters before being returned to the river Jala. The test and the analysis have refined the solutions but the solutions proposed have remained in essence the same as those described in the research proposal, i.e. not taking into account local citizens' demands and institutions' plans for the sites.

Another issue is the design of the experiments to test the solutions. The experimental results are dependent on the resources that were available to the researchers at the time the
experiment was done. For example, soil covers and amendments were established using locally available materials. The experiments demonstrated that the addition of amendments was a ‘competitive option’ with respect to the establishment of a soil cover (Reppman, 2007). However, researchers cannot anticipate how solutions will be implemented and the practical constraints that will be faced by managers or policy-makers (e.g. availability of necessary information, quality and condition of the materials, local supply of materials needed, qualified personnel to implement the solutions).

8.3.2. Social research contributions to RECOAL

RECOAL’s social research team developed a qualitative based method to evaluate the remediation options for the disposal sites. The appraisal of remediation options is the middle stage in the management of contaminated land following the risk assessment and preceding the implementation of the remediation strategy, which was not included in research (Figure 8-1). This was, therefore, the final stage of analysis within RECOAL. The analysis built on three key sources of information compiled by RECOAL:

- the risk assessment of Tuzla’s coal ash disposal sites;
- the results of the laboratory and field experiments that tested various low-cost remediation techniques using locally available materials; and
- the interests and views expressed by stakeholders during interviews held during 2005 and 2006 and a stakeholder workshop held in July 2007.

The options appraisal aims at presenting a shortlist of feasible and acceptable options and integrating them in a coherent remediation strategy which incorporates wider contextual concerns about the future of the contaminated land. The next stage of implementation was considered beyond RECOAL’s remit and the responsibility of either TEP or the local authorities, depending on the outcomes of their current negotiations about the management of the sites. RECOAL’s contribution thus concluded with the proposal for a suitable remediation strategy for Tuzla’s coal ash disposal sites and the production of a Handbook on coal ash remediation which included decision tools to guide any potential user through a series of steps involved in reintegrating sites.

The methodology was originally inspired by the report “Model Procedures for the Management of Land Contamination” published by the Environment Agency41. The procedure reflects the policy application of state of the art knowledge on land contamination. Although it was developed for England and Wales, the publication provides a framework for general application in other contexts. However, when this methodology was applied in the context of Tuzla some difficulties emerged: the methodology assumed the availability of data and resources which was beyond RECOAL’s scope and reach. In particular, the methodology required the development of individual criteria for each pollutant linkage in order to compare options for single individual pollutants. Instead, in RECOAL, we had relatively little information about several pollutants acting together and a few low-cost solutions that needed to solve all problems simultaneously. Furthermore, several local social and economic concerns were not reflected in the EA methodology and the results obtained appeared to be inappropriate.

41 The Environment Agency is the public body for protecting and improving the environment in England and Wales.
The social research team found, thus, that an alternative approach was needed. The team had previously developed a report about the local demands of the population. The insights of this report, together with the insights of the members of the social research team where used to develop a flowchart to facilitate and simplify the evaluation of the remediation options (Figure 8-2). The flowchart was intended to indicate the kind of information needed as a minimum to assess a particular option’s suitability for a specific remediation problem/context. It was proposed for use as an open-ended iterative process (to ensure long-term effectiveness and suitability of a remediation strategy) rather than a one-off linear process.
OPTION UNDER EVALUATION

DOES IT RESPOND TO LOCAL AND REMEDIATION DEMANDS?

YES

Is it safe?

NO/Unknown

YES

Is it feasible?

NO

Can future development facilitate its implementation?

NO

INCORPORATION IN FUTURE EVALUATION PROGRAMS

YES

Can the option be modified as to improve its acceptability?

NO

EVALUATE IT AS A DIFFERENT OPTION

YES

Are there other reasons why the option should be considered regardless of its cost?

NO

INCLUDE IN SHORTLIST

YES

Do we have sustainable alternatives

NO

Will be sustainable in the long term?

NO

Is it cost-effective?

YES

Is it acceptable?

NO

Is there research available or feasible that can provide further information about the safety of the option?

NO

EXCLUDE FROM SHORTLIST

Figure 8-2: Solutions evaluation flowchart (FR, 2008)
Originally, the team tried to develop criteria appropriate to evaluate each principle and continue with the evaluation of options. Some examples of such criteria are provided in Table 8-2. However, when the flowchart was applied to each option independently it immediately showed that trying to synthesise all the information in a few indicators added complexity to the analysis without helping to make meaningful comparisons.

As a result, the project team decided to adopt a more generalist view to describe qualitatively their evaluation of each option with regard to five selected aspects (safety, feasibility, acceptability, cost-effectiveness and sustainability). The social researchers argued that such analysis helps evaluate the grounds on which suggestions are based and infer to which degree the subjectivity of the researcher has influenced the final recommendations. In addition, researchers argued that the approach helped to:

- Simplify the analysis;
- Offer a realistic appraisal about the validity of the data;
- Offer a holistic view on the main environmental problems which addresses the uncertainties associated with them;
- Respond to local demands on remediation of the sites;
- Favour a sustainable approach to the solutions integrating simultaneously technical, social and environmental aspects of land contamination.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Example Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is it safe?</td>
<td>Emergence of new pollutant linkages</td>
</tr>
<tr>
<td>Is it feasible?</td>
<td>Local availability of materials</td>
</tr>
<tr>
<td>Is it acceptable?</td>
<td>Local opposition to the measure</td>
</tr>
<tr>
<td>Is it cost-effective?</td>
<td>Reduction of pollutant X relative to the cost of the measure</td>
</tr>
<tr>
<td>Will be sustainable in the long-term?</td>
<td>Maintenance needs</td>
</tr>
</tbody>
</table>

- Table 8-2: Criteria for the evaluation of remediation options

The following section explains how each solution developed by RECOAL was evaluated, attending to the five criteria presented in the flowchart (safety, feasibility, acceptability, cost-effectiveness, sustainability).

8.3.3. Review of remediation options

The options discussed in this section are those investigated by RECOAL. They are the range of solutions that were deemed to be low-cost and sustainable at the outset of the project (see Table 8-3). Each of the options was reviewed independently to investigate its applicability in the context of Tuzla. The evaluation followed the diagram in Figure 8-2. However, each option presented difficulties for its evaluation. The evaluation procedure required experiences and skills which can not always be synthesised in a series of rules. The main limitation of this analysis is that it does not reflect the potential to use some options in combination. For example the establishment of vegetation requires a soil cover or the addition of appropriate amendments to the coal ash depending on the requirements of the plants to be established. The water treatment options discussed here may improve their efficacy by adding more conventional civil engineering methods such as cut-off drenches or reactive walls.
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Establishment of a soil cover</strong></td>
<td>The establishment of a soil cover is a measure to cap the ashes and facilitate the establishment of vegetation. The main issues regarding the soil cover are its safety, the thickness of the cover and the availability of local materials. More information about the soil cover can be found in RECOAL Deliverables D13, D17, D23, D24 and D25.</td>
</tr>
<tr>
<td><strong>Ash amendment</strong></td>
<td>The development of ash amendments, additions to the ash to improve their physical or chemical variables, is intended to serve as an alternative to the establishment of a soil cover as described above. The amendments may improve the ash conditions, stabilise target pollutants and facilitate the establishment of vegetation such as grass. The main issues regarding the addition of amendments are their safety, their effectiveness and the logistic difficulties for its development. Additional information about the soil amendments can be found in RECOAL Deliverables D14, D17, D23 and D24.</td>
</tr>
<tr>
<td><strong>Cultivar alternatives</strong></td>
<td>Crops such as Corn, Potato, Wheat, Barley, Alfalfa and Red Clover have been tested to establish whether they can be safely cultivated on the disposal sites. The main issue regarding the cultivation of crops on the disposal sites is the potential migration of pollutants into the food chain. More detail on the test performed can be found in RECOAL Deliverables D18, D19, D21 and D22.</td>
</tr>
<tr>
<td><strong>Wind barriers and landscape measures</strong></td>
<td>Wind barriers are an effective method to prevent the dispersion of dust from the disposal sites. Wind barriers consist normally of the establishment of several rows of trees. Trees can also be considered as an alternative to crops, although they require the establishment of an appropriate soil cover. Additional information can be found in RECOAL Deliverables D27 and D28.</td>
</tr>
<tr>
<td><strong>Effluent treatment system (including sorbent materials)</strong></td>
<td>The drainage may be filtered using a column system in which different sorbents may facilitate the retention of pollutants. In this case, the positive environmental impacts of the treatment plant depend on the quality of the sorbents, their ability to stabilise the potential pollutants and their active life (i.e. at what intervals does the material need changing/refreshing because their performance reduces). Further details of water treatment systems can be found in RECOAL Deliverable D10 and D11.</td>
</tr>
<tr>
<td><strong>Phyto-extraction system</strong></td>
<td>The main objective of the phyto-extraction system consists of establishing a plant-soil treatment to extract or stabilise the pollutants. Such system should be established as part of a sequential treatment system (also referred to as 'cascade system'). Pollutants would be stabilised by an appropriate soil cover and the establishment of tree species able to retain pollutants. More information available in RECOAL Deliverables D12 and D26.</td>
</tr>
</tbody>
</table>

Table 8-3: Options considered by RECOAL
Soil cover

The establishment of a soil cover is an option already considered and implemented in the sites in Tuzla. According to the RECOAL researchers, it is an effective means to prevent dust dispersion and isolate the contaminants under the soil cover. However, some questions have emerged about its safety. Samples from the soil cover in Dreznik and Plane suggested that some of the contaminants from the ashes were also present in the soil cover. As explained in section 7.3.5, it is still unclear whether these contaminants proceed from the ashes directly (migrating into the soil due to a hydraulic lift) or were already present in the soil materials used to cover the site (the materials of the soil cover were obtained from nearby areas which could have been previously polluted with the ashes through dust dispersion). Additional risks are posed by the agricultural practices carried on the sites (tilling and ploughing), which bring the ashes to the surface mixing them up with the soil material and spreading the pollution.

Since the soil cover was already established in two of the disposal sites, the development of additional soil covers is feasible. However, a question remains about the quality of such a soil cover. For instance, RECOAL’s estimations suggested that a soil cover of 20 centimetres would cost around 16,900 €/ha, a very high cost particularly when considering that a this cover is still quite thin and does not guarantee the isolation of the ashes.

With respect to its acceptability, a good quality soil cover would be welcomed by the local residents and authorities, who consider it as an indispensable part of the sanitation of the disposal sites. The effectiveness of adding a soil cover is immediately noticeable, particularly in preventing dust dispersion and facilitating re-vegetation and thus has significant landscape effects. This is very attractive to local residents, who may start developing new uses for the derelict land on top of the soil cover. However, the research by RECOAL suggested that with respect to the immobilisation of pollutants, the soil cover may be less cost-effective than alternatives such as the addition of amendments to the ash. The soil also constitutes the basis for additional remediation methods such as the establishment of vegetation.

Theoretically the cover would not need much maintenance. Since the soil would be added to a flat area, water erosion was not be expected to be significant. The establishment of a dense vegetation cover, not to be harvested during the summer, could help protect the area from wind erosion during the drier summer months. However, in the past, major disruptions of the vegetation and soil cover have been caused by tillage and ploughing practices which have broken up the cover and mixed it with the ashes. Cultivation is not the only practice that could compromise the long-term preservation of the cover. Excavation required by other users - e.g. to establish the foundations of buildings or a graveyard - may also compromise the sustainability of the soil cover. Table 8-4 summarises the main issues.

After the evaluation, the soil cover still stood as a potential remediation option for the disposal site. The implementation of this measure, however, should address the concerns about its safety. For example, the implementation of the soil cover needs to be accompanied by appropriate plans for re-vegetation and guidance for local residents on suitable practices that avoid additional risks for the sites. Particular attention has to be paid to avoid creating a false sense of security once the soil cover is established, given that RECOAL scientists did not rule out the safety risks associated with this measure.
Is it safe?  Risk of diffuse pollution and potential transfer of pollutants to the food chain.

Is it feasible?  High costs associated to its establishment.
Materials locally available.

Is it acceptable?  Likely to be welcomed among local residents.

Is it cost effective?  With respect to the immobilisation of pollutants it is less cost effective that alternatives such as ash amendments.

Will be sustainable in the long-term?  Dependent on the establishment of vegetation and the interactions with local residents.

<table>
<thead>
<tr>
<th>Table 8-4: Soil cover evaluation summary</th>
</tr>
</thead>
</table>

**Ash amendments**

As an alternative to the establishment of a soil cover, ash amendments have also the potential to reduce dust dispersion and stabilise pollutants. However, the amendments are limited regarding the isolation of the ash and the potential establishment of vegetation, because they are unlikely to provide an adequate substrate for most plant species. According to RECOAL scientists, the ash amendments could effectively support vegetation with superficial roots, such as grass.

Appropriate materials such as sawdust and sewage sludge are available within 35 km of the sites (though a closer source would be preferable) and the amendments have a lower cost than the soil cover.

A question remains about the acceptability of the measure. The amendments could fail in convincing local residents that the sites are safe after its application (especially depending on the quality and content of pollutants in the sewage sludge). In addition, the ashes would not be restored to their 'original state' for further uses, which would disappoint some policy-makers looking for solutions to the local land shortage.

With respect to the immobilisation of pollutants ash amendments appear to be more cost-effective than alternatives such as the establishment of a soil cover. However, the amendments would not have the additional landscape benefits that a soil cover provides, and may limit the potential for re-integrating the sites into local ecosystems.

A priori, the amendment is designed to require the lowest level of maintenance and monitoring. However, long-term tests are necessary to evaluate the remediation power of the amendments, as the chemical processes on site can vary with changing environmental conditions. Table 8-5 summarises the main points of the evaluation.

Ash amendment is a valuable alternative and less costly than a soil cover. However, the evaluation suggests that the ash amendments may not always be suitable. According to this analysis, this option should be regarded either as a short-term alternative when there are limited resources but urgent action required or confined to derelict and unused areas where the access for local residents to the sites is limited.
Table 8-5: Ash amendments evaluation summary

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is it safe?</td>
<td>Yes in the short term; further tests needed in the long term.</td>
</tr>
<tr>
<td>Is it feasible?</td>
<td>Lower costs than alternatives. Materials locally available.</td>
</tr>
<tr>
<td>Is it acceptable?</td>
<td>Acceptance problems among local residents.</td>
</tr>
<tr>
<td>Is it cost effective?</td>
<td>With respect to the immobilisation of pollutants it is very cost-effective although it lacks additional benefits such as landscaping measures.</td>
</tr>
<tr>
<td>Will be sustainable in the long-term?</td>
<td>Concerns about chemical reactions in changing environmental conditions.</td>
</tr>
</tbody>
</table>

Cultivar alternatives

The issue of safety is closely linked to the species and varieties of cultivar and the technologies used in its cultivation. RECOAL analysed different crops already being cultivated on the sites. Research results suggested that potatoes or beans are not safe to grow on the sites because most pollutants accumulate in the edible part. Instead grass species such as winter wheat, barley, alfalfa, red clover and oat could provide a safer alternative if the sites continue to be used for agricultural production. Maize is also discouraged.

Feasibility is not an issue for the cultivation of these crops, as the cultivation is ongoing on both Dreznik and Plane. However, this cultivation has been carried out with significant personal costs – in the post-war context and the difficulties of finding employment (income) and a hesitant economy. In addition, local residents claim that cultivation, particularly of cash crops, entails a significant risk. The ashes retain a lot of water, which facilitates the rapid growth of species. However, during the dry summer the physiological drought may be worsened by the absorption capacity of the dark ashes, and this may reduce the fraction of water available to plants.

Acceptability of cultivation on the sites is a significant issue that has divided public opinion, as it was explained in section 5.4.3. On the one hand those who cultivate the sites are developing institutions (such as the recently formed Farmers’ Union) to lobby the Municipality and TEP for allocating land rights to provide assurance for their investment. On the other hand a growing number of people oppose the cultivation on the grounds that it possesses too great a risk for the community (contamination of the food chain; exposure to the ashes) and justify it only on the grounds of subsistence needs of the local population. If the local and regional economies continue the slow path of recuperation in which they have been embarked during the last half decade it is likely that the cultivation of the sites will be uneconomical. In addition, RECOAL could have contributed to the debate by specifying clearly which options are safe and which should be avoided, but there is no evidence of this happening.

The economic analysis suggested that, at current prices, only Alfalfa and Red Clover provided an annual net benefit that made them profitable crops. Winter Wheat, Barley and Oat were being cultivated at the expense of the labour costs of local residents. Another alternative considered the establishment of permanent pastures (e.g Alfalfa and Red Clover) on the disposal sites. The cost of this option was found to be relatively low compared with the landscape benefits which could be obtained (the protection of the potential soil cover and the stabilisation of pollutants according to the research results).
With respect to its effectiveness, seasonal crops do not provide adequate protection during the whole year. In particular winter crops (e.g. Winter Wheat) will not provide protection during the summer, when the winds are stronger and erosion more problematic. To overcome this problem RECOAL proposed two crop rotation systems in which crops with different seasonal growth patterns alternated to provide coverage during the whole year. Alternatively, permanent pasture would require less maintenance and provide protection throughout the year, being the more cost-effective alternative.

<table>
<thead>
<tr>
<th>Is it safe?</th>
<th>Beans, Potatoes, Maize: Unsafe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cereals (Winter wheat, Barley, Oat): Relative safe, but</td>
</tr>
<tr>
<td></td>
<td>Fodder crops (Alfalfa, Red Clover): Relative safe</td>
</tr>
<tr>
<td>Is it feasible?</td>
<td>All the crops tested have been already cultivated on site,</td>
</tr>
<tr>
<td></td>
<td>however, cultivation has been possible until now due to</td>
</tr>
<tr>
<td></td>
<td>the economical situation.</td>
</tr>
<tr>
<td>Is it acceptable?</td>
<td>Important local conflicts associated to the cultivation of</td>
</tr>
<tr>
<td></td>
<td>the sites.</td>
</tr>
<tr>
<td>Is it cost effective?</td>
<td>Permanent pasture appears to be cost-effective; seasonal</td>
</tr>
<tr>
<td></td>
<td>crops are discouraged.</td>
</tr>
<tr>
<td>Will be sustainable in the long-term?</td>
<td>Annual crops require numerous inputs which make it very unsustainable in the long term. Permanent pasture is likely to be more sustainable.</td>
</tr>
</tbody>
</table>

Table 8-6: Cultivar alternatives evaluation summary

Cultivation of the disposal sites would require the annual inputs such as seedlings, fertiliser, pesticides and labour. The clear limitations specified above – environmental, social and economic – suggests that the sustainability of annual crops could be clearly compromised on the disposal site. The cultivation of crops could be justified in terms of the annual income derived from the selling of produce, but it appears that such income is not enough to cover labour costs for cereals. Permanent pastures, on the other hand, would require less maintenance and little annual inputs, while providing a permanent coverage of the site, thus preventing wind erosion and also avoiding damaging tillage and ploughing practices.

The evaluation of the different cultivar alternatives suggests that the seasonal cultivation of the sites is not an appropriate solution for the remediation of the disposal sites. Its application is discouraged mainly by its low cost-effectiveness and the difficulties to meet any sustainability requirements. In addition, the cultivation of the sites is likely to cause significant social disruptions and pose environmental risks unjustifiable by the low magnitude of the attached economic benefits.

On the other hand, the establishment of permanent pasture is a potential alternative, which appears to meet four out of five criteria of safety, feasibility, cost-effectiveness and sustainability. The establishment of landscaping measures in combination with permanent pasture may make this proposal more attractive and help convey the message that many crops are currently unsafe to grow.

**Landscaping measures**

There are few reservations about the establishment of landscape measures. RECOAL has proposed the establishment of wind barriers with local tree species such as Poplar (Populus Alba) and Hazel (Corylus Avellana). Despite some risks associated with such measure (i.e. if they are locally used as firewood they may release captured contaminants into the
atmosphere), tree barriers appear to be the best method for preventing dust dispersion, wind erosion and to improve the landscape and general appearance of the area. The advantages of this measure appear to outweigh the potential risks.

Although the cost per hectare appears to be high, particularly compared with the costs of establishing crops, the tree belt does not need to be extended to the whole site but only around it. The team found some problems with respect to the availability of tree seedlings, particularly Hazel, but the forestry industry is quickly developing in the area, which suggests that these initial difficulties may be easily overcome.

The tree belt appears to enjoy great acceptability among local residents, many of which are already being organised in tree-planting activities. Accordingly to TEP, the establishment of tree belts was the main condition from local residents to give consent for the enlargement of existing disposal sites.

The cost-effectiveness of the measure is very difficult to evaluate, as the tree-belt will not directly affect the immobilisation of pollutants. However the tangible benefits (reduced erosion and improving the landscape state), added to additional intangible benefits mentioned by many local residents (having a recreational space, improving their perception of their place of residence and their confidence in its safety) make this measure highly attractive.

The trees are likely to have a positive effect on the long-term sustainability of the area. Without further maintenance requirements and clearly marked positive social impacts, the establishment of a tree belt is likely to have a fundamental impact on the economic revival of the area and the recuperation of local confidence.

<table>
<thead>
<tr>
<th>Is it safe?</th>
<th>No substantial concerns about its safety.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is it feasible?</td>
<td>Minor concerns about obtaining the seedlings; likely to be resolved in the near future.</td>
</tr>
<tr>
<td>Is it acceptable?</td>
<td>Enjoys great acceptability among local residents.</td>
</tr>
<tr>
<td>Is it cost effective?</td>
<td>Clear tangible and intangible benefits.</td>
</tr>
<tr>
<td>Will be sustainable in the long-term?</td>
<td>Long-term operation which requires little or no maintenance.</td>
</tr>
</tbody>
</table>

Table 8-7: Tree belt evaluation summary

The establishment of a tree belt appears to us not only a potential but an essential measure for the restoration of the sites – this has been made clear by local residents in individual interviews and public meetings. Unfortunately, research about the potential for reforestation of the whole disposal areas was not addressed by RECOAL. Reforestation appears to be out of the category of ‘low costs solutions’ due to the depth of soil cover required for its establishment. However, beyond the doubts about its feasibility, such option is likely to meet safety requirements and enjoys great acceptability among the local population in Tuzla.

Effluent treatment system

RECOAL tested solutions for improving the quality of the effluent from the disposal sites. The safety of any effluent treatment system will depend on the efficacy of the sorbents used and the implementation of appropriate maintenance practices. RECOAL has tested several sorbents most of which can be said to improve the characteristics of the effluent water considerably. A cheap option tested was to use a local available material (‘brunt’) as sorbent in combination with gravel and Beech sawdust. However, after the elementary analysis of filter water it appears that the ‘brunt’ may contribute its own pollutants (a
distinct rise in Chromium levels was observed). Bauxite, though more expensive, was found to have superior capacity in filtering out pollutants without adding new risks.

Although the system was tested in a system of columns, it appears that the feasible option in Tuzla would be the establishment of a filtering bed along which the materials have to be deposited. In its simplest form, the bed would have very little establishment costs, given that materials and expertise can be found locally. However, to ensure the efficacy of the system, appropriate excavation and maintenance works may increase the cost considerably. Additional costs may be incurred depending on the materials used to substitute the ‘brunt’ (e.g. Anthracite).

The system would have great local acceptability, as it will contribute to the local perception about somebody doing something to improve their safety. It will be powerful to improve the characteristics of the water, in particular reducing its pH and conductivity and retaining some of the suspended solids. The efficacy in reducing the concentrations of pollutants on the water will vary according with the sorbent used.

Any effluent treatment will require considerable monitoring and attention. Firstly, the sorbent need to be replaced periodically, as their effectiveness diminishes with time. This will result in additional difficulties not only due to the costs of the replacement but also due to the difficulties to dispose of the potentially polluted sorbent. In the pilot experiment in Tuzla materials needed to be replaced every six months. However, given the tangible benefits of the system (in particular the improvement of quality of water which could be potentially reused) the system could sustain itself.

<table>
<thead>
<tr>
<th>Is it safe?</th>
<th>It reduces pollution, but additional risks could be posed if using unsuitable materials.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is it feasible?</td>
<td>All materials tested are cheap and available locally.</td>
</tr>
<tr>
<td>Is it acceptable?</td>
<td>Any system to improve the quality of water will enjoy great acceptability.</td>
</tr>
<tr>
<td>Is it cost effective?</td>
<td>The improvement of the water quality has to be balance with its long-term costs.</td>
</tr>
<tr>
<td>Will be sustainable in the long-term?</td>
<td>It requires intensive maintenance but the overall benefits are undeniable.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 8-8: Effluent treatment system evaluation summary</th>
</tr>
</thead>
</table>

Its main downside is the required maintenance, which may reproduce the establishment costs periodically. However, the benefits associated to the measure are likely to outweigh this concern. The treatment durability could be improved by combining it with civil engineering works such as cut-off drenches.

**Phyto-extraction system**

The phyto-extraction system is the most innovative solution considered in RECOAL. It overcomes the maintenance difficulties by using vegetation to stabilise pollutants, as a dynamic filter. However, due to the limited duration of the project, the evidence about the effectiveness and safety of this measure was not proven.

Feasibility questions emerge when considering that the system will require a great extension of land. Land in Tuzla is, at the moment, on shortage. The phyto-remediation solution is likely to enjoy local acceptability (none of the interviewees expressed concerns about this option). However, if the establishment of the phyto-remediation bed is seen to be in conflict with other local demands on the land, its acceptability could be compromised.
Is it safe? Current results indicate that it is safe.

Is it feasible? High costs of establishment and land may hinder its implementation.

Is it acceptable? A filtering system with trees is likely to be welcomed by local residents.

Is it cost effective? More results are needed to understand its cost-effectiveness.

Will be sustainable in the long-term? Requiring low maintenance.

Table 8-9: Phyto-extraction system evaluation summary

The system appears to be a suitable alternative for filtering water although significant concerns remain about its cost-effectiveness and feasibility. The phyto-extraction system feasibility could be improved by establishing the bed on top of the disposal sites, using a feedback loop cycle, and using it also as a landscape feature could give added value (such as erosion protection and increase of the aesthetic value of the area).

Options comparison

Ideally, a land remediation manager would like to have a wide range of options to choose from. In such a case the difficulty would be posed by the selection of the most optimal option. Options could be ranked according to one or more criteria, in order to select the most advantageous. However, in practice the options available to the manager are likely to be reduced by the different environmental, social and economic constraints of that particular context. In Tuzla, for instance, the options were very limited. A summary of the evaluation is presented in Table 8-10, giving a qualitative valuation for each criterion according to the explanation above.

The evaluation allowed the exclusion of some options such as the cultivation of vegetable crops and cereals. The remainder are not necessarily mutually exclusive, but it was deemed that to be effective they would need to be tailored according with a regeneration plan for each of the sites. For example, a soil cover was recommended for the disposal sites where the ashes threaten the residences of local inhabitants, such as in Divkovići I and Divkovići II. In areas where the sites are isolated the addition of ash amendments could be a cheaper alternative to soil covers. Similarly, both water treatment solutions could be combined, using the mineral sorbents as a short-term solution which can be integrated in a more sustainable phyto-extraction system, once this technology is established in Tuzla.

The evaluation tool put great emphasis on establishing a transparent procedure which allowed multiple stakeholders to engage critically with the process. Transparency is required in acknowledging the limitations of the analysis. Firstly, the criteria were general enough that can be applied across different types of solutions responding to different objectives. This reduced the precision of the procedure but opened it up to a wider audience. The loss in precision is compensated by the fact that the options available are limited, and enough detail to discriminate among them is given.

The proposed criteria should be open for discussion. Researchers may help to determine the limits of what is realistically achievable (e.g. how safe the disposal sites can be). This information should also help to open the discussion about which resources are needed, who is going to provide them, how this is going to affect local residents and whether compensation for the risks is justifiable.
<table>
<thead>
<tr>
<th>Option</th>
<th>Safe</th>
<th>Feasible</th>
<th>Acceptable</th>
<th>Cost-effective</th>
<th>Sustainable</th>
<th>Recommended?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil cover</td>
<td>**</td>
<td>**</td>
<td>***</td>
<td>***</td>
<td>**</td>
<td>YES</td>
</tr>
<tr>
<td>Ash amendment</td>
<td>***</td>
<td>***</td>
<td>*</td>
<td>***</td>
<td>*</td>
<td>YES</td>
</tr>
<tr>
<td>Vegetable crops</td>
<td>-</td>
<td>***</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>NO</td>
</tr>
<tr>
<td>Cereals</td>
<td>-</td>
<td>***</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>NO</td>
</tr>
<tr>
<td>Fodder crops</td>
<td>*</td>
<td>***</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>YES</td>
</tr>
<tr>
<td>Permanent Pasture</td>
<td>**</td>
<td>***</td>
<td>*</td>
<td>*</td>
<td>**</td>
<td>YES</td>
</tr>
<tr>
<td>Wind belts</td>
<td>***</td>
<td>**</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>YES</td>
</tr>
<tr>
<td>Filtering bed</td>
<td>**</td>
<td>***</td>
<td>***</td>
<td>**</td>
<td>*</td>
<td>YES</td>
</tr>
<tr>
<td>Phyto-extraction</td>
<td>**</td>
<td>*</td>
<td>***</td>
<td>**</td>
<td>**</td>
<td>YES/NO</td>
</tr>
</tbody>
</table>

Note: Number of starts (*, **, ***)) according to the valuation for each criteria. A minus (-) for negative values.

Table 8-10: Evaluation of re-generation solutions for Tuzla (FR, 2008)
Although researchers were able to provide quantitative information regarding the safety and cost-effectiveness of the solutions, these figures should not be taken as definitive because there are significant limitations to their application. For example, regarding safety, Chapter 7 concludes that, although risk assessment methods are helpful in evaluating the potential risks in a particular site, the acceptability of those risks will be always a matter of social acceptance. The previous section in this chapter suggests that due to the current socio-political conditions (especially the lack of trust on industry and institutions), to evaluate the risk acceptability among local communities in Tuzla requires reaching an agreement with local residents. Even if health hazards have not been unequivocally linked to the disposal sites, the industry and local institutions need to acknowledge the dangers associated with the disposal of coal ash and compensate for it. Moreover, health hazards should not be evaluated too narrowly, as the health of the community may be compromised by the transformation of the landscape, regardless of whether it causes proven health or environmental hazard (see also Section 6.3.2). Cost-effectiveness was evaluated based on researchers’ experiences while carrying out their experiments, but their cost estimations may not correspond with the costs that TEP would incur, should it decide to implement the solution in the future, because of the availability of materials, inflation, use of in-house knowledge and experience, etc.

Furthermore the report should be read as a rationalisation of the decision made, that is, a justification of why the options recommended were deemed the most appropriate to the case in question. This means that this is not a recipe of how to make a decision, but rather, of how to explain it. In other words, the methodology explained here cannot substitute the expert judgement gained through field visits, experimentation and social research in situ, understanding the demands of both the environment and society in a particular context.

At the time in which this research was done (2005-2008), the discussion focused around the allocation of blame. The evaluation tool was designed to help move the discussion on to determine who is affected and how, what can be done and whether compensation is appropriate. At the moment, however, these questions are displaced from the centre of the discussion because all the actors focus on the question of who is to blame. The adversarial processes have paralysed dialogue about land restoration and compensation. The immediate consequence is that the sites pose a considerable burden for all the actors involved, particularly when scarce resources are used on adversarial procedures such as court procedures or lengthy negotiations between the Municipality and TEP.

8.3.4. Benefits of the project

The definition of benefit as somebody’s ‘advantage’ or ‘profit’ requires examining what positive outcomes can be related to RECOAL’s work and results. What is positive will necessarily depend on the interpretation of those results.

RECOAL benefited the researchers who participated in the project. RECOAL provided part of the salaries of these researchers. It gave the opportunity to young scientists to develop their career; a third of researchers interviewed were researchers in an early stage of their career. RECOAL also benefited researchers in established positions by improving their reputation and providing opportunities to develop publications. Part of the RECOAL proposal included the training of researchers and equipping laboratory facilities in the Balkans (in Zagreb and Banja Luka). Indeed the project proposal explained that “[t]he project will help to re-establish research infrastructure (field, lab) in the participating west Balkan countries and initiating dialogue / collaboration among researchers / research institutions across political and ethnic boundaries in the region”. The efforts of RECOAL in this respect are likely to help develop a scientific community in Bosnia and Herzegovina, whose development was hindered by the breakup of former Yugoslavia and the civil wars in the 1990s and appeared to have a positive effect on young researchers, who seemed hopeful about their scientific prospects after RECOAL was finished.
TEP, the industrial partner of the project, appears to have benefited from the results of RECOAL, too. RECOAL carried out experiments that TEP alone could not do because of the lack of resources (or interest). At the time of writing, the Municipality, local residents and TEP are fighting a 'battle of evidence', that is, they are bringing into the fore different pieces of evidence to support their case regarding the existence of risks associated with the disposal sites. So far, it appears that RECOAL has not made a strong case about the presence of a health risk associated with the disposal sites. As explained in Chapter 7, there is evidence of 'some risks', but overall, the results are 'better than expected'. During project meetings some RECOAL members tried to avoid the alienation of TEP's representatives by emphasising the supposedly positive results about the risks caused by the disposal site. In summary, the results suggest that the health risks posed by the sites may be acceptable in comparison with those already existing in the environment. Thus, RECOAL recommendations may be used by TEP to argue that a low cost re-cultivation programme may be sufficient to regenerate the sites and return their ownership to the Municipality. TEP could use the project results to demonstrate that they are doing as much as possible to deal with the pollution on the sites. The legitimacy conferred by RECOAL's international status may further reinforce TEP's position.

Many members of local communities have emphasised radioactivity as their main concern regarding the disposal sites. They have put forward their concerns about radioactivity citing their own sources of expertise such as environmental NGO scientists. RECOAL's radioactivity results support TEP's argument that the measured radioactive levels on the sites were too low to pose any health hazard for local residents. However, some local citizens insist on their concerns about radioactivity. Local residents' claims can be summarised in the quote from one interview: "and it isn't healthy, we see it with our own eyes, people die young here". The observations of awkward phenomena and the deterioration of health are sufficient evidence, in local accounts, of the presence of radioactivity.

Presented in this way, local claims about radioactivity help TEP to put their case in a positive light. Local residents argue that radioactivity is the main cause of deterioration of the quality of life. TEP argues that radioactivity is not a cause of concern, and thus, local claims are unjustifiable. The simultaneous consideration of the two statements leads to a misleading conclusion, namely, that local residents may need to consider alternative causes for the deterioration of their quality of life, other than radioactivity. Nevertheless, radioactivity is not the only potential cause to fit their observations about the communities' poor health. The relatively low concentrations of radioactive elements found on the sites do not disprove the potential health risks caused by non-radioactive elements found on the site (sulphates, arsenic and heavy metals) or the effect of the combination of several pollutants present in the air, water and soil (the latter has never been properly assessed or analysed). The fears of local residents about the health risks posed by the disposal sites may thus be entirely justified. However, the 'battle of evidence' focuses on radioactivity only. Rather than enquiring about different causes of health deterioration, citizens argue that the results for radioactivity are low because TEP is not trustworthy. Framing the issue in this particular way has resulted in TEP benefiting from the 'unbiased' results of RECOAL's radioactivity assessment. It follows that local citizens need to revise their own framing of the problem if they want to be able to use the results of RECOAL to their own advantage, revisiting alternative causes that could be behind the health deterioration of individuals in the local communities.

RECOAL's proposal specifies that:

"The interdisciplinary collaboration between scientists from different countries in the West Balkan region and in the EU, and the participation of local authorities and power plant operators will combine scientific knowledge and local knowledge to ensure the effective local implementation of the developed solutions." (p. 8)
However, the responsibility of RECOAL ends in designing potential low-cost solutions and establishing experimental sites. The results, compiled in a handbook, will be disseminated among local authorities and other stakeholders, but given the lack of resources available and the weak governance structure their impact is likely to be limited.

RECOAL was relatively successful in achieving research results as stated in the project objectives and developing a research network in the western Balkans. However, the impact of the project on improving local livelihoods and wellbeing will depend on whether the solutions developed are relevant for the context of Tuzla, and whether there are institutions capable of implementing the solutions proposed. The experience of RECOAL can be used to explore whether research projects should be committed to the objective of improving local livelihoods and wellbeing, when such goals fall outside the remit of the project.

The success of research projects is usually evaluated in respect of delivery against research objectives, rather than being evaluated in terms of the benefits they deliver to certain sectors of society. Knowledge generation is not necessarily linked to social benefits. Sometimes this depends on the type of knowledge generated and whether such knowledge is implemented; other times knowledge is simply not relevant. A utilitarian view of knowledge is limiting, because knowledge is not always useful and not only useful knowledge is valuable for our societies. Yet, when considering the topics researched in RECOAL, there is something compelling about the idea of being able to develop a risk assessment and technological solutions to improve the local quality of life. This is because the type of knowledge generated by RECOAL has the potential to change the course of history in Tuzla and move the government and industry to take action to remediate the disposal sites. The impact of RECOAL may be higher in the years to come. However, the evidence presented here suggests that RECOAL’s results will be used to justify the status quo, merely applying some basic low-cost mitigation measures to deal with the most obvious pollution risks.

RECOAL members were independent but operated within the constraints of the project proposal and the accepted processes of knowledge generation. Moreover, additional constraints were posed by the relationships within the project, and the desire of most project members to keep good relations with TEP, which was perceived as a key player in the project. The ‘performance’ of expertise shaped the results and the benefits of the project. In other words, how expertise was deployed influenced the impact of RECOAL. Thus, the following section explores how expertise was deployed in RECOAL and the consequences of these actions.

8.4. The deployment of expertise in RECOAL

RECOAL researchers have their own expectations about the results and impact of RECOAL. Given the heterogeneity of the research team, these expectations vary greatly: different disciplines, cultural background and interests led to different definitions of the situation. Indeed, according to researchers’ accounts of the project, communication between partners has been one of the main challenges they face. The premise of this section is that individual expectations of RECOAL influence researchers’ interpretations and actions to deliver RECOAL’s objectives and the deployment of expertise in public life.

The concept of ‘performance’ is useful to understand how expertise is delivered in the research team. Using a symbolic interactionist perspective, Goffman describes social interactions as ‘performances’ in which individuals ‘act’ according to their perceived expectations from the ‘audience’ providing ‘impressions’ - a front - consistent with to the ‘reasons’ of the actor (Goffman, 1997). This conceptualisation is particularly relevant for exploring the work of individuals within teams. The goal of the team is to maintain a coherent ‘definition of the situation’ as ‘front’ of the team. Each individual or group of individuals may adopt a role within the team but the focus on the front performance of the team reduces the possibility of dissent.
8.4.1. Team exclusions: the case of TEP

In RECOAL, the refusal of TEP to follow the conventions of RECOAL (its front) brought TEP 'out of the team'. TEP had little input to RECOAL outputs other than allowing RECOAL members to access the disposal sites and hold meetings on TEP's premises. TEP's project members were dissatisfied if researchers would visit the sites unaccompanied, or would take any other initiative without consulting them. For example, one of the RECOAL meetings was marked by a brief intervention from TEP's Director:

Director... "Welcome... good to see more young than old people - the project will definitely be a success! [...] I must say if I'm dissatisfied with something. We are also part of the team and as partners we should be allowed equal participation in the project. But this should not be a limiting factor... just a good suggestion so we work together. We are very interested in your results..."

TEP representatives' complaints about not being treated as a full member of the team were often interpreted as a threat to RECOAL, because researchers believed that TEP personnel could prevent RECOAL from completing the experimental work on the disposal sites:

Researcher 1: "The risk was at the beginning, the question whether TEP would be co-operative enough... and well, you know the situation, and if it would have been denied to use the sites, it would have been difficult."

TEP's actions suggested that they wanted to control the research carried out in RECOAL. For example, regarding FR researchers' intentions of carrying out interviews among local actors, TEP representatives argued that while interviewing representatives of governmental institutions was useful for the project, researchers should avoid any interaction with local communities because they only tried to benefit economically from the claims about the ecological deterioration of the environment. Indeed, some local residents did claim that they should be compensated for the ecological damage. Furthermore, local residents had a lot more to say about the disposal sites than was anticipated by TEP representatives (as demonstrated in Chapters 5, 6 and 7).

However, through these expressions of wariness about the interview methodologies, TEP was very effective in reducing the impact of the social research. First, the social research was delayed. Second, a proposal of research was agreed with TEP and any issues that could cause confrontation were avoided. Finally, research results were presented back to the project team taking TEP's opposition into consideration and trying to convince TEP that they should not fear the results. For example, the social research team made two presentations at a project meeting held at TEP in November 2006. These presentations were carefully prepared and phrased to deliver results that would be of interest to TEP and that TEP could act upon, avoided mentioning the most controversial issues (such as the burning of medical waste by TEP). Despite this, the presentations were very badly received by TEP project members, with aggressive body language and continuous interruptions. It seemed that even acknowledging that local residents and institutions could have an opinion was a step too far for the representatives of TEP. This attitude was not confined to the research on local perspectives on coal ashes; during the interviews other RECOAL members explained that TEP posed a potential obstacle to the completion of their research although they did not specify exactly how.

Initially, TEP's project members were very effective in shaping how researchers conducted research in Tuzla, as the researchers were very sensitive to the company's fears that the results could lead to operational difficulties for their business. However, their actions within the project eventually sidelined them from the research by the rest of the project team: they stopped attending meetings, did not follow the procedures to claim their allocated payment and had little input towards the final results of the project. Aside from the controversies with the social research team, TEP remained an 'inactive' project member. RECOAL representatives presented themselves as depositories of project results

42 Notes taken by David Edwards in the kick off meeting of RECOAL.
but did not have any other further input into the project (indeed, TEP never claimed any money for its participation in RECOAL). Yet, other RECOAL members perceived that TEP worked 'against' RECOAL.

For example, a confrontation between TEP and other RECOAL partners occurred when Forest Research organised the stakeholder workshop in Tuzla in July 2007. According to RECOAL's proposal, the workshop should have been organised by HEIS, the partner that supported TEP closely. However, during the project meetings it became obvious that researchers at Forest Research had greater motivation to organise it, and HEIS was happy to pass on this responsibility to them. The terms of the workshop had been discussed in previous meetings and correspondence. No action had been taken without previous consultation with RECOAL members, but TEP representatives did not respond to these e-mails (indeed, before this event they never responded to any e-mail). Thus, Forest Research partners were surprised to receive a strong complaint from TEP suggesting that they had not been informed of this workshop and they threatened to boycott it. TEP asked FR to call the whole event off.

TEP was less successful on this occasion than in the interventions at the beginning of the project because their action was perceived as a threat not only to the social research team within RECOAL, but to the whole project. The co-ordinating team from BOKU intervened to make it clear that having a workshop in Tuzla was one of the conditions of the completion of RECOAL. During the workshop, TEP sat apart from RECOAL and behaved as if they were not members of the project. The workshop in Tuzla marked a tendency that would become even more acute towards the end of the project. For example, at the last meeting of RECOAL the expressed perception was that it was one of the most successful project meetings. One of the participants remarked that the project had been so successful because the attendants were only "those who were really interested in the results of the project", and therefore, nobody in the meeting was hindering RECOAL's advancement. TEP representatives were notable by their absence at this meeting. Thus, by the end of the project TEP representatives were regarded as having little real interest in RECOAL and they had virtually no input to the final outputs of the project.

Some could argue that TEP missed the opportunity to promote themselves as members of a consortium researching the safety of the disposal sites. Perhaps TEP took this attitude because they were afraid of the consequences that RECOAL could have, should it find conclusively that the disposal sites posed an unacceptable risk to local residents. For example, a RECOAL employee and project member responded like this during an interview in 2008:

Interviewer: How will you use the RECOAL results?
Dzanan: Depends on the results, maybe we'll have to hide the report.

Later in the interview he explained that he meant this as a 'joke'. This follows other occasions in which TEP representatives have showed themselves to be wary about the potential damage that the company could suffer from RECOAL's results. However, in hindsight, the attitude of TEP towards the rest of the members of the research team can be regarded as successful because eventually, TEP was the major beneficiary of the project. In the social and political context of coal ash pollution TEP have been able to use RECOAL by distancing themselves from the rest of the project team, emphasising the independence of the project team from TEP's interests.

8.4.2. RECOAL's common front

The exclusion of TEP from the team was only possible by the performance of a common front within RECOAL. RECOAL's common front emerged regardless of the cultural and disciplinary differences between RECOAL members. Understanding how a common front has emerged requires looking at the heterogeneity within the project, and how different positions were dealt with.
Firstly, there was a divide between ‘locals’ and ‘non-locals’. This divide operated at two levels:

- non-Bosnian partners perceived themselves to be different from Bosnian partners; and
- Bosnian partners perceived themselves to be different from the ‘locals’ from Tuzla (including local contractors, TEP workers and any other actors involved in the project).

Some non-Bosnian partners suggested that Bosnian partners lacked appropriate expertise and commitment to the project. This was claimed by reference to a lack of performance in conducting experiments and submitting reports. Some Bosnian partners reacted to this by explaining that they lacked resources and experience to conduct the research, and emphasised their interest in learning from the non-Bosnian partners (indeed, RECOAL provided the opportunity for some of these researchers to be trained in Vienna). Other Bosnian partners felt patronised by this perception and complained that the other partners failed to recognise their skills and the practical limitations they had to deal with (such as the intrusion or lack of collaboration from TEP). The Croatian team was somewhere in the middle: they were able to understand the local language and culture, but non-Bosnian partners had a higher opinion of their commitment and expertise. The local/non-local divide operated also at the local level. For example, some Bosnian partners did not feel welcome in Tuzla and lacked local contacts, which would have facilitated the experiments. In some cases, ethnic differences were thought to impede the research.

The other divide in the project was created by the differing definitions of geographical scale at which the objective of the project was established. Some researchers emphasised that the objective of the project was to develop remedial treatments for coal ash disposal sites in the western Balkans; thus, the project should look at methods that could be replicated in other sites. They emphasised generalisation of scientific methods over the resolutions of the problem of coal ash disposal in Tuzla. The alternative position was to focus on RECOAL as a means to develop specific solutions for the sites in Tuzla. These researchers regarded the re-generation of coal ash disposal sites in Tuzla as an example of what could be done with disposal sites, but emphasised the practical detail of how solutions are going to be put forward.

Unlike the local/non-local tension, this divide was not obvious during project meetings but the position adopted (generalisation versus localisation) influenced the researcher’s framing of the problem. This was manifest during the interviews with researchers. Applying a particular framing helped the scientists to reduce the uncertainty of the research problem. Researchers adopting a ‘generalising’ position delimited the research problem focusing only on the use of methods that could be replicated in other contexts. These researchers shared an interest in sampling and laboratory experiments and compared the situation in Tuzla with that in other countries or locations. Researchers adopting a

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43 The project integrated a team of Serbian ethnic origin, from Banja Luka and another team of Bosniac ethnic origin, from Sarajevo; local residents in the areas near the experiments, such as Divkovici, were mainly of Croat ethnic origin. Thus, the Croatian team from Zagreb may have felt more welcomed among the local communities. TEP management depended on the Bosniac branch of Elektroprivreda; thus, the team of HEIS in Sarajevo could have felt close in terms of ethnic origin. However, this analysis denies the importance of personal relationships building bridges between different social groups regardless of their ethnic origin. It also overlooks the fact that ethnic groups in Bosnia and Herzegovina are not always distinguishable and they have been reinforced largely as a product of the war and the Dayton agreement (for a discussion of this topic see section 3.2). This is particularly true for Tuzla, where most interviewees pride themselves in their disregard of nationalism and this is manifest in Tuzla politics, were the anti-nationalistic socialist party has won all the elections since the late 1990s.

44 Note that the two divides are clearly different; the first is related to the cultural background of the researchers while the second one is related to the definition of RECOAL’s objectives. Approximately half of the Bosnian researchers adopted a ‘generalising’ position, while a third of non-Bosnian researchers put emphasis on the importance of ‘localising’ the research results (proportions are for descriptive purposes only because this is a small sample, n=16).
'localising' position delimited the research problem by focusing on the particular characteristics of the case study in Tuzla. Researchers adopting this position perceived the problem as having an added layer of complexity; during their interviews they expressed their frustration that the straight application of the scientific method did not bring straight answers for the resolution of the problem of coal ash in Tuzla.

A debate between these two positions emerged only during the last meeting motivated by the need to present both positions in the handbook for remediation methods. The debate was resolved by dividing the handbook into different sections. The sections 'Minimum checklist for regeneration of coal ash disposal sites'; 'Decision-support tools'; and 'Risk assessment approach' were written from a generalist perspective while the last section presented the case of Tuzla as a separate case-study. In addition, a list of 'restrictions' was included in the introduction to specify the conditions of the sites studied by RECOAL, thus, narrowing down the realm of application of the methods. In the end, the handbook represents a symbolic triumph for the 'localising' position because the solutions are extremely specific.

However, these positions converge in explaining the expectations of RECOAL, and the extent to which its results could be used to benefit specific actors. Such a united front was clearly visible during the last project meeting where consensus was evident after the debate between the 'localising' and 'generalising' positions. This common front was established according to how the environmental problem was constructed. Thus, researchers established two main dimensions of the environmental problem: the dust issue and the contamination of water (for an extended explanation of the problem definition see section 7.3.1 and 7.4.1). In addition, the common front included an emphasis on re-vegetation methods for re-generation and the methodological and resource limitations to determine the presence or absence of risk:

Researcher 2: "We do not have the money in this programme to do the practical work. We can just give ideas."

The separation of research from its applications is a prominent feature of this common front. Yet, within this front individual researchers performed different roles, combining both their positions with respect to the scale of applicability of the results (i.e. local/non-local; generalising/localising). This separation of research results and contextual applications constituted the basis for a position of 'withdrawal' regarding RECOAL impacts. In other words, RECOAL researchers shared a common belief that their approach to the project was non-partisan; ideally, RECOAL was intended to benefit every actor by unravelling the 'truth' of the situation. The tacit assumption here is that there is an absolute truth about the environmental problem of coal ash which can be unravelled by RECOAL for the benefit of every actor affected by the project.

Because the results of RECOAL are believed to be non-partisan, they are provided without further interpretation about who should apply them and how. Firstly, science is presented as 'apolitical', which resonates with the arguments by F. Fischer (1990) explained in Chapter 2:

Researcher 3: "Science is not supposed and never should dare to interfere with political life. We should not interpret results for political purposes. This is the point where science would go too far. So we have to deliver options, we have to deliver state of the art knowledge: but the choice made out of it is the task of politicians."

Some researchers believed at the outset that RECOAL would be able to give recommendations about what exactly is to be done with the disposal sites. However, after conducting the experiments they felt increasingly frustrated because the increase in knowledge did not reduce the uncertainties regarding the sites. Thus, they argued that RECOAL cannot give recommendations. Some researchers explained that before they could make a definitive judgement, they needed to do more research to determine whether the sites are safe or not and what solutions are appropriate for them:
Researcher 4: "I thought at the beginning of the project or when I joined the project, I thought "there are some basic experiments we can find out what really is the thing we are looking at" and now the project is nearly done so it's not even a year now left and we are still not really sure about some things and it's somehow, how do you say, it's funny. (...) I learned that it is more complex obviously so...and we have data but I think it's not enough. We need to have more: maybe for some aspects, maybe the metal contents of plants... so I think we have a lot of plant samples from the dredging experiment and I really would like to know what is really in and making my mind up and comparing to some personal levels and see if it's contaminated or not. We have some idea now but I'm not really sure about it. I think there is some data missing. (...) I am not really sure what the research reveals. I still think, even if someone would say: 'Okay we don't have so many problems with plants'; I'm still not really convinced because I've seen in the data that we have a lot of metal uptake and I would really like to compare this what we've found in the laboratory to the field situation."

The common front of RECOAL refers continuously to the research proposal and the tacit assumption that some quantitative data are not enough to provide a conclusive interpretation of whether there is a risk or not in the disposal sites. Thus, RECOAL members can join this common front regardless of whether they believe that there is a risk associated with the site or not. In the end, as explained in the previous section, TEP benefited most from this position because of the perceived absence of evidence of risk is interpreted as the absence of the risk of the hazard.

The precautionary principle was implicit within RECOAL discourses of contamination and pollution. Most researchers acknowledged that the contamination of Tuzla was worrying and that local communities could be seriously affected. Thus, the presentation of results alone within the project was automatically interpreted from a precautionary perspective. The presence of risk was justified only on the grounds of its acceptability considering the levels of background contamination (e.g. the quality of the water in the river Jala was worse than the quality of the discharged water from the disposal sites). However, this was not put forward in the RECOAL reports. Researchers often assumed that this view would be readily understood by the industry but this proved to be incorrect. Indeed, the experience of RECOAL suggests that the precautionary principle should be spelled out more explicitly alongside the results of the project.

8.4.3. Dissension from the common front of RECOAL

According to Goffman (1996) the functioning mechanisms of the team prevent the emergence of dissent from the common front. In RECOAL, some researchers adopted individual strategies to deal with this situation.

'Disguised engagement' was a position held by some Bosnian researchers, who adopted a localising frame of the project. They emphasised the importance of applying the results of RECOAL (either favouring TEP or the local communities) while maintaining the dominant discourse of RECOAL's front that distanced RECOAL researchers from local interests. Locally engaged members of RECOAL were successful in putting their positions forward without disclosing their interests.

For example, some researchers emphasised that the research should have positive benefits for TEP (beyond their monetary assignation as partners). During an interview with Dr David Edwards in 2005 a researcher explained her position:

David Edwards' notes: "She [researcher 5] said that all sides can have a benefit from RECOAL—people who will finally be influenced, and not just those on any one side. It's not just about scientific results, but about making recommendations (to improve things for local people and TEP etc). TEP will be in a position to say that now they are moving into the world of environmental protection (to find out) how it can be improved."
In accordance with RECOAL’s front, this researcher emphasises that the project has to benefit every actor affected by coal ash disposal. Improving actors’ trust in TEP should automatically benefit all the other actors. Later in this interview she added that the project should help TEP to “improve their PR [public relations]”. In a later interview in November 2007 she had changed her position slightly. Then, she argued that RECOAL should provide TEP with “simple and clever solutions”. Once again she emphasised that facilitating TEP’s work would automatically benefit all the other actors regardless of their perceptions of TEP:

Researcher 5: “I also talked to people from TEP while we were... in the RECOAL meeting. What is also important for them is that we have managed to get a clearer picture of what is happening on their disposal site and also help them to find the easiest and best applicable solution for them. And on the other side the local community, the Canton, the Municipality, will also, in a certain moment, how to say, accept and welcome efforts done within this project in order to... Everyone will have benefit. I mean... (...) First of all I think that the local community will insist on what TEP is somehow promising within our project. And also what’s important for, on other side, for TEP is that they will finally see that they are not that complex but rather very simple and clever solutions what will help them in future work.”

The position of this researcher, arguing that RECOAL should mainly benefit TEP, dissents from the common front of RECOAL. However, her position goes unnoticed because she argues that ensuring TEP’s gain will benefit all the other actors. This is a naive assumption, particularly when considering the struggles between the different actors described above. As the project unfolded this researcher came to be perceived as disruptive by other members of the research team.

Other researchers dissented from RECOAL’s common front because of their engagement with the local communities. For example, some researchers emphasised during the meetings that Tuzla was ‘the most endangered area in Bosnia and Herzegovina’. An example of how support for the local communities was brought about occurred during the stakeholder workshop in Tuzla, in July 2007.

The example refers to the construction of a graveyard on the disposal sites. The municipal authorities pressed by the lack of land for burying people promoted the option of the graveyard. A municipal employee explained during an interview:

Zdravko: “[T]he Municipality is in a great need of ‘quality’ land for development. We have very little quality land available for development. Any Municipality needs between 16 and 18 percent of land suitable for development. We have about 6.5 percent, so we do need any suitable land that we can ‘extract’ for communal development, for example to build a new cemetery. I don’t need to explain why we need a new cemetery, do I? That’s where that idea of the cemetery comes from.”

A Canton representative also supported building the graveyard:

Samija: “Yes, the cemetery was one of the options. However, a survey showed that, for some reason, people didn’t like it; they had a problem with “being buried in ash”. I don’t understand what the problem was – isn’t it “ashes to ashes”? Anyway, the cemetery option was eventually dropped – and what remained in the plan was the idea of small business units.”

The graveyard proposal had strong opposition from the local communities, although the reasons for this opposition were not entirely clear. Some local residents explained that

45 During her interview this researcher expressed her dissatisfaction with the management within RECOAL. She argued that she should have been given management responsibilities within the project. This was however never intended and thus not considered within the project. This evolved into a conflict with the management team of RECOAL, coupled with her complaints that the interests of TEP should be prioritised over the interests of other members of the research team.
building a graveyard would not benefit them because only one person would get employment from such use, and it would prevent the construction of other facilities that they could benefit from more (such as a sport centre). It appears that some local residents argue that there are moral reasons why people should not be buried in the ashes. I did not gather this in any of my interviews, but a representative of Eko-Zeleni, claiming to represent the local communities, explained that:

Zlatko: "The people from all our three religions think that a man was made out of soil and that he should go back to it, and not to slag."

Chapter 5 discusses that the ashes are perceived as being dangerous because they are dirty, polluted, and unholy. This idea resonates with the culture in Bosnia and Herzegovina and the strong significance of burial rituals. The respondent also highlights that this is important for people 'from all our three religions', emphasising that the graveyard issue is an important component of the three nationalist positions. For some local residents building a graveyard on the disposal sites may be culturally unacceptable. However, local residents did not often express this sentiment.

The situation is very different in the Municipality and the Canton. Most officials belong to the SDP party, the most important anti-nationalistic party in Bosnia and Herzegovina. Religion is the main factor differentiating the three ethnic groups, and thus, an essential component of nationalist positions, whether Serbian, Croatian or Bosniac. For members of the SDP cultural factors are among the issues that cause conflict in the society of Tuzla, and thus government officials downplay them. The idea of the graveyard has not been dropped: municipal and Canton officials tried to put it forward on several occasions after this interview. But then something happened: a member of RECOAL exposed an opinion about the graveyard.

The option of the graveyard was not considered by RECOAL. Indeed, RECOAL had only researched solutions already included in its research proposal: (1) a top-soil cover; (2) adding compost to the ash; (3) cultivation of local crop varieties most resistant to the pollution; (4) a permanent pasture; (5) crop rotation systems that minimize environmental hazards; (6) tree belts; (7) an outlet filtering station with inert materials; and (8) a wetland system for the filtration of water pollutants.

During the stakeholder workshop in Tuzla there were two scientific presentations. The first one, by Walter Fitz, offered a factual account of RECOAL objectives and results. The presentation, in English, had to be stopped every few seconds to allow for its translation, which made it difficult to follow. One of the Bosnian researchers, Hamid, took responsibility for the second presentation, which focused on the solutions recommended. In this case, the presentation was in Bosnian; RECOAL researchers approached translators individually to follow the presentation. During this presentation, the researcher stated that local residents were exposed to important risks (aside from radioactivity claims) and asserted that the option of the graveyard was not feasible. After the presentation I talked with another representative of Eko-Zeleni, claiming to represent the needs of the local communities. He was pleased with the results of the meeting because RECOAL results were clear in discouraging the option of building a cemetery on the site.

 Actually, RECOAL had not even considered such an option. The very mention of the graveyard had always been accompanied by jokes: it had not been taken seriously. Yet, during the presentation, Hamid brought together the results of RECOAL and his beliefs about what such results implied for the establishment of a cemetery on the site. This was not refuted by other RECOAL members probably because disrupting the presentation would have broken the common front presented to the audience of local stakeholders in Tuzla (and probably language barriers also prevented Hamid from being interrupted).

46 Translators had not been scientifically trained and in a public context they felt overcome by succession of chemistry and agricultural terms they simply did not understand, as they explained to me later.
47 This was a public presentation; thus, a pseudonym has not been used here.
Hence, the front presented within the workshop was slightly different from the one explained above, as it led assistants to believe that the RECOAL results supported the position against the establishment of a graveyard on the disposal sites. Hamid’s intervention convinced some government officials:

Samija: “In the meantime, the Mayor had an idea to turn that disposal site into a graveyard. It was very interesting to me and I wanted to ask the question during the workshop whether it was possible, and there was one very convincing reply from the professor about what is happening with the ash after the disposal. That it becomes cement and that it has no purpose. Those conclusions are important to us, what can be done with the disposal sites, since we are doing the plan. Either to eliminate it, or not. That’s why we saw the value of the official reports from RECOAL, because it was based on some scientific research.”

Samija believed that RECOAL had conclusive results that demonstrated that the graveyard was an unfeasible option and expected to receive an official confirmation of these recommendations to definitely rule out the option of the graveyard. Hamid’s performance of ‘disguised engagement’ had a great impact on the future of the sites.

However, after Hamid’s intervention, other members of RECOAL commented privately on the option of the graveyard. They explained that nothing in the RECOAL project could serve as evidence to support or disprove the option as feasible. RECOAL had focused on health and environmental impacts, and these were considered largely irrelevant for people already dead.

Given the results, opposition to the graveyard option appears to be grounded in moral values: dead people should not be buried in contaminated land. Indeed, the moral issue is linked to a material issue, the dirtiness of the disposal sites, to make a case against the option (see Chapter 5 for an extended discussion of the interaction between pollution and moral codes). However, bringing together these two codes in the way Hamid did during the workshop challenged the common front of RECOAL. Hamid’s position resonated with the discourses found among the local NGO Eko-zeleni (note that although this NGO claims to represent local communities, interviews with local residents did not identify such a ferocious opposition to the graveyard option as the one presented by Eko-zeleni representatives).

Hamid’s intervention had a further consequence: bringing the ethnicity factor into the discussion of environmental pollution associated with the disposal sites. The Municipality, the Canton, and most of the local residents interviewed in the local communities appeared to be more interested in the safety of the disposal sites and the need to find ways to compensate local residents for the pollution. For example, the Municipality proposal for TEP’s programme of the ‘friendly environment’ includes the safe re-cultivation of the disposal sites, the construction of new facilities on the disposal sites (such as ‘production units’ and a sport centre, or a park) and the development of new infrastructure (district heating). All these proposals were supported by most local residents. Moreover, all these proposals lack an ethnic component, as they are thought to benefit all residents equally regardless of what ethnic origin. The option of the cemetery, however, introduces a religious element into the discussion, because the reasons to oppose it are mainly associated with religious codes. Rather than dividing the people along the three ethnic lines, it divides those who prioritise religious reasons (against the graveyard) from those who do not. In his intervention in the workshop, Hamid legitimated the religious position. This could be seen as further contributing to the dominant role of ‘Sarajevo’ nationalism in non-nationalist ‘Tuzla’ politics (see Chapter 3 for an extended discussion of this issue).

This section explored the position of ‘disguised engagement’ of researchers that dissented from RECOAL’s common front, but did not directly confront it. The first example is a

48 He engaged with local concerns but appeared to maintain his opinion within the boundaries of RECOAL’s common front.
researcher who fiercely supported TEP and had a strong impact at the beginning of the
project by limiting the research that could be carried out according to the wishes of TEP's
representatives. Confrontational positions against TEP were silenced. On the other hand,
Hamid's position seemed at first aligned with the sensitivities of the local residents.
However, his intervention in the RECOAL workshop, in particular regarding the option of
constructing a graveyard on the disposal site, served to align RECOAL with nationalistic
interest, against non-nationalistic positions that put religious sensitivities, regarding the
burial of the dead, in a secondary position. The success of Eko-zeleni in portraying itself as
representatives of local communities, and their alignment with researchers in RECOAL
such as Hamid has led to their ultimate success in delaying [and probably ruling out] the
construction of a graveyard on the disposal sites.

8.5. Lessons from RECOAL

The analysis shows that there are multiple competing expectations of RECOAL. The
analysis argues that people's understanding of science occurs within a context of interests
and other background expectations (see also Yearley, 2005). In Tuzla, the Municipality,
industry and local residents are involved in adversarial procedures to define the situation
regarding the disposal of coal ash. The expectation was that the RECOAL project would
provide the facts to support the definitions of the situation defended by each group of
actors about the safety of the coal ash disposal activities and the potential solutions that
could be implemented to remediate the disposal sites. Local residents want RECOAL to
provide facts to confirm their observations of changes in their immediate environment to
move TEP to take action to improve their livelihoods. TEP expects RECOAL to provide
facts that will prove the local residents wrong, and will clear TEP from responsibilities.
The Municipality expects RECOAL to provide information that they can use to negotiate
with TEP both the transfer of ownership of the disposal sites and the environmental taxes
for air pollution emissions. Finally, the Canton adopts a technocratic perspective, expecting
RECOAL to produce facts that will help to conciliate the different clashing positions.

The research suggests that different stakeholders often regard research as a tool to establish
the evidence to support their particular definition of the situation and that stakeholders’
expectations of a project are often unrealistic. For example, RECOAL results do not
clearly support any of the views of local actors. The way the results are presented appears
to incline the balance slightly towards TEP. This has not been the result of the project itself
but of the need to include TEP within the project to present a coherent common front to
RECOAL's audience. Some authors have argued that there is a reciprocal relationship
between what is accepted as 'truth' and the trust between different actors involved in
environmental debates (Carolan and Bell, 2003). Both 'trust' and 'truth' appear to be the
product of social interactions between different actors (Yearley, 2005). Carolan and Bell
(2003) argue that while trust facilitates consensus about what is 'true', providing 'truths' to
social actors (i.e. scientific expertise and tests) may also contribute to develop trust
between the different social actors, although the extent to which this occur is
unpredictable. The case of Tuzla illustrates that providing some 'truths', in this case the
results from RECOAL, it is not necessarily enough to improve deteriorated relationship
between industry and residents.

Further reflection is needed to evaluate to what extent research projects can meet the
expectations that society has of them. Projects like RECOAL have objectives stated at the
outset which specified what the project should do. RECOAL built a good case to
demonstrate that it has met these objectives. However, the social expectations of the local
actors are about the consequences of RECOAL's results, rather than the results themselves.
RECOAL has little influence over these consequences. This is a common feature of
research projects: resources and time constraints often limit researchers from following the
objectives to their full consequences and they may not be interested or qualified to do this
anyway. If this is true for the physical aspects, it is even more relevant for a project's social and political consequences.

However, asking researchers to determine what the project consequences will be is an unrealistic demand. Experience gained from the research suggests that, although researchers are relatively free to compile, construct and present their results, who benefits from those results and in what ways is beyond the influence of the researchers. In other words, local actors will try to appropriate the results of RECOAL to advance their interests, and their success in enforcing a particular definition of the situation will be determined by the political and social context in which those actors operate. The analysis of expectations resonates with previous experience of participatory exercises in environmental decision-making (e.g. Carter, 2006).

For example, TEP seems to be the major beneficiary of RECOAL. TEP is using some of the results, particularly the low values for the concentrations of radioactive elements, to show that their own analyses are credible and that the risks posed by the coal ash disposal sites are within acceptable levels. However, some of the results show that there are considerable risks attached to the disposal sites for the environment and the health of local residents. Rather, the social and political context has favoured TEP. Some of these factors are structural, such as:

1) the lack of resources prevents regulatory institutions from taking actions against TEP;
2) TEP is aligned with powerful nationalistic interest, being under the control of Elektroprivreda in Sarajevo, a company considered of national interest; and
3) Electricity from coal is one of the great hopes for the development of Bosnia and Herzegovina.

Other factors are related to the way the problem is presented by different actors. For example, local residents focused on the issue of radioactivity as one of the main dangers posed by the coal ash disposal sites, paying relatively less attention to other factors that could also be posing a risk. Thus, TEP only needed to pay attention to the results for radioactivity to contest their claims.

Another factor is the high levels of pollution from other industries besides TEP. The mines, the chemical industry and the cement plant are among industries that are also known to be contaminating the environment in Tuzla. Research alone is not able to separate the responsibilities of each industry in polluting soils, water and air, and thus, a TEP representative explained that "they are not the only polluters around there". This is an example of 'disorganised irresponsibility' (Beck, 1992; Giddens, 1999). The case of the coal ash disposal is somewhat different in that it can be isolated from the rest of the environment to be analysed. Thus RECOAL researchers have evaluated, for example, the pollution in the discharge water from the disposal sites, or in the plant tissue samples collected around the disposal sites. However, when these results are compared with the background concentrations of pollutants on the environment, the coal ash disposal sites appear to be 'clean' in comparison. For example, the contribution of the discharge water from the disposal sites to the contamination of the river Jala appeared to be comparatively small.

Researchers have a limited influence on who benefits from the project. Moreover, the effects of the researchers' actions may have unintended consequences. For example, the way in which RECOAL results were presented has mostly favoured TEP partly because of the reporting structure adopted by RECOAL. The results were presented in scientific reports given to other actors to interpret. TEP can capitalise on this better than local residents and local authorities because the reports follow the technical and scientific conventions that they use to report routine information. It follows that an alternative way of reporting the results could have favoured other actors.
Researchers are divided between their moral responsibilities and the need to present the results devoid of subjective interpretation or value judgements. Indeed, many RECOAL researchers openly expressed their commitment to the improvement of local communities in Tuzla beyond the responsibilities of RECOAL. However, this commitment caused a dilemma in most scientists because they thought it could prevent them from being impartial in the presentation of the results. For example, researchers often expressed this saying that they sympathise with the needs of local residents but 'as scientists' they could not support their claims.

Constructionist studies of science have argued that “scientific agreement typically emerges from people consenting to stop disagreeing rather than from the compellingness of the scientific evidence itself” (Yearley, 2005; p. 183). Section 8.4 argued that RECOAL scientists constructed a common front to present its results, but disagreements within this common front existed.

Commitment to local actors’ positions separated some scientists from the common front of the team. Section 8.4 discusses two examples. In the first one, the insistence on RECOAL as an instrument for TEP’s benefit ultimately separated a researcher from the rest of the team because she challenged the most important value of researchers: their independence. She thought it legitimate to openly align the project with the interests of TEP (obviously she did not anticipate that in the current socio-political context an independent project would benefit TEP more than a public relations operation). In the second case, a RECOAL researcher put forward a case against the construction of the graveyard on the disposal sites. Although this was not supported by other members of RECOAL, it did not drive the researcher out of the project because it did not conflict with any values established in RECOAL’s common front. The experience of RECOAL shows that disguised engagement may be allowed in a research team as long as it is not seen as a threat to their core values (in this case, independence and methodological integrity).

The only RECOAL researchers who openly supported TEP over other actors were eventually sidelined. The general agreement (in line with the views of the Canton) was that RECOAL results would automatically benefit all the stakeholders within the project. However, the resistance of researchers to establish the presence of risks (due to insufficient evidence) led TEP to assert the absence of them. Although this is clearly a partial misinterpretation of the information provided by RECOAL, it has been accepted by other stakeholders (even though they may demand official evidence, to believe it). By failing to articulate local fears, scientists sidelined themselves, reluctantly, with TEP, even though their commitments may lie with local residents perceived as the real victims of the pollution.

The social research group from Forest Research took a considerably different perspective from other RECOAL researchers. Concerns about the unfair distribution of RECOAL’s benefits moved the social research group to try to situate the project within its social and political context to gain a perspective of the long-term consequences of research. In order to do so, research among local communities’ perspectives were gathered alongside literature reviews of the governance structure in Bosnia and Herzegovina and the social impacts of land pollution.

At the outset of the project, the emphasis on local perspectives moved other RECOAL researchers to include in their research programme activities to respond to local concerns. Thus, water samples were taken in local wells to evaluate their quality after it emerged that local communities relied on these wells to cover the inadequate and erratic water supply from the Municipality (during the last two years it has emerged that this supply is now continuous). Several samples were also taken to assess levels of radioactivity following the revelation that radioactivity was the major concern among local communities.

However, the extent to which this type of research could contribute to RECOAL was limited. Firstly, the social research was not adequately timed: research on local demands was carried after RECOAL’s analysis and experiments had already started. Thus, revealing
that the interest of local communities was geared towards reforestation and security, rather than cultivation, did not stop RECOAL from continuing to develop their experimental fieldwork which focused on planting crop varieties on the disposal sites. To a certain extent, this is justifiable because: a) it was stated in the project proposal, which, in effect, is a research contract that needs to be delivered; and b) it makes sense to follow a pre-established contract to ensure that the results generated by the RECOAL project can be applied beyond the case-study in Tuzla. It follows that the social research could have had a bigger impact if it had begun before the other components of the project. In that way it could have been used to help frame a research proposal that could simultaneously respond to local communities and develop research replicable in other contexts. This resonates with well-established calls to recognise the potential of social sciences to contribute to the study of the environment (e.g. Newby, 1991).

However, once the research proposal was completed, making substantial modifications to it could have hindered the research rather than improve it. Minor modifications (such as additional tests, mini-literature reviews) could be included as added-value activities, but the research funding structure left no scope for a complete re-definition of the project objectives. Thus, researchers had little space for manoeuvring beyond the research proposal.

Another way researchers approached their work in RECOAL was to focus on the project as a process that could facilitate communication between different actors. Thus, the attention was redirected from those who benefit from the results to those who benefit from the process. In that sense, the social research group at Forest Research, supported by some other team members of RECOAL, developed activities to facilitate communication between different actors. For example, the stakeholder workshop in Tuzla was an occasion that facilitated direct communication between actors. However, the research team also put considerable effort into disseminating different perspectives among different actors. Thus, social research members made presentations to TEP about the local perspectives on the coal ash disposal sites and explained to local residents (in individual and group interviews) the position of TEP regarding the disposal sites. The underlying belief was that explaining the point of view of each actor to the other actors would eventually help to bring about a process of communication between them and help generate change.

This can be characterised as a process-based approach to environmental projects. The discussion above suggests that in some socio-political contexts, such as the one in Tuzla, researchers will always have limited influence over who benefits from the research results and how. However, although the researchers have little control over the consequences of the results, they can have a bigger role in ensuring that the process by which results are achieved is as inclusive as possible.

While bringing multiple and competing perspectives to the fore is a well established strategy to gain legitimacy for an argument, it is not clear whether focusing on the process alone has an added benefit for the project. In RECOAL, the research interviews may have been used to confer legitimacy to the project but overall, they have had little impact on the long-term impacts of the project. The confrontation is still ongoing; positive developments cannot be clearly linked with RECOAL, as most stakeholders claim either not to have seen any impacts of the project, or to perceive that the impacts are negative. Focusing on the process is not a substitute for including social research at the outset of the project to shape the research proposal. Furthermore, the long-term impacts of the project (likely to strengthen the position of TEP) remain unchallenged even though the project acknowledged the existence of different perspectives.

This can be partly attributed to the context of the research, and in particular, to the culture of blame that articulates the claims of local communities. The negotiations between TEP and other actors are adversarial because of the way they interact with each other: local residents affected by pollution (and the institutions that support them) attack TEP and position themselves as victims; equally, TEP representatives present themselves as victims.
of unjust treatment by the local residents. The consequence is that a research project will only benefit those who can appropriate the knowledge to advance their own position. Because of the project's use of scientific language, and the dependence of RECOAL on TEP's case study, TEP is the actor best positioned to use the knowledge generated by the RECOAL project. In a non-adversarial context, however, both the industry and local communities could use the results of RECOAL to move forward in looking for solutions that would benefit both of them. This does not imply that knowledge could be used to find a middle ground solution that would make everybody happy, as the Canton expected RECOAL to do. Rather, knowledge could be used to establish a common definition of the situation that different actors could agree on.

Even if TEP wins the court case against some local residents, TEP's problem will not be finished. Local residents will continue their claims because they continue to observe substantial modifications of the landscape which they perceive as seriously affecting their quality of life and livelihoods. The defensive attitude of TEP victimises local residents who feel mistreated and ignored. Contrary to the different actors' expectations, projects like RECOAL are badly positioned to resolve these confrontational disputes. Ultimately, TEP needs to acknowledge that it is affecting the lives of local residents and local residents need to acknowledge that TEP's actions can only go so far. Misplacing the blame has brought the conflict to a dead end that no research project, like RECOAL, could possibly solve.

8.6. Conclusion

This chapter argued that scientists have a limited influence on the long-term impacts of a regeneration project. In RECOAL, the research scientists performed their research according to pre-established roles. In conforming to these roles scientists fear to express their value-judgements explicitly and focus only on generating factual results, leaving the benefits of the project to be decided within the social and political context of the project. In some cases scientists with a declared political position may bring it into the project in the form of a 'disguised engagement'. In other cases, some researcher may focus on the process of research, trying to bring into it different perspectives, but it is not clear whether there is added value in this approach.

Eventually, the performance of scientists enabled TEP to use RECOAL to validate their status quo. TEP is still to decide what is to be done with the disposal sites. Other actors will need to bargain with TEP to advance their interests. The Municipality and local residents could also gain renewed strength by aligning themselves with non-nationalistic forces, supported by the international community, to counteract Elektroprivreda's arguments but whether this is possible and how it should be done is unknown. Social research into how non-nationalistic forces could gain prominence in Tuzla may help focusing on the everyday problems of people and considering how to transcend ethnic differences.

Scientists face a dilemma: on the one hand they appear to have a great power as long as they can provide the 'correct facts'; yet, on the other, they may have little impact on the benefits of a project (ultimately defined by its socio-political context). Scientists appear to be in an uncomfortable position regarding the potential benefits of their research for different stakeholders. In addition, there is a question about whether scientists should focus on benefits beyond their own research results. This chapter argues that the position of research, in relation to the benefits that science brings to society, needs to be re-examined. Challenging existing research roles may help to alleviate the uncomfortable position in which researchers operate today.
9. Conclusion

9.1. Introduction

It is now time to return to the initial question about what happens when land regeneration projects are examined within the socio-political context in which they are developed. This thesis argues that investigating how the problem of study is constructed by different actors gives the researcher a point of entry to more fully understand the social context of a project. This, in turn, helps to establish the likely local impact of the project and its distributional effects (i.e. who is likely to benefit and who not).

The question above was approached by eliciting how RECOAL stakeholders construct the environmental problem of coal ash disposal. The aim was to understand the issue of coal ash pollution in Tuzla as the actors see it (following Blumer, 1998 [1969]). Such commitment is presented as an aspiration, rather than as an achievement: as the project unfolded, the issue was even more nuanced than originally anticipated. I approached the research of local and expert narratives of coal ash pollution like a series of Matryoska Dolls, whose layers could be taken away to reach the core of the problem. Looking back on the research now, its results appear more like a Lego game, in which I have selected different pieces by colour and shape and I have assembled them as best as I could to mirror my observations of reality. The politics of ethnicity, the rhetorical tools to advance particular arguments, the construction of evidence, the attribution of stigma, are all pieces of a somewhat coarse ‘model’ that aims to represent the complex issue of coal ash pollution in Tuzla.

Yet, this ‘model’, however coarse, helps exploring common aspects of land regeneration projects. The approach presented in this thesis has provided the opportunity to go one step beyond RECOAL. RECOAL provided several ‘solutions’ as ready-made recipes to deal with the environmental pollution from coal ash in Tuzla. However, these solutions were provided as a response to the problem as constructed by the RECOAL team. This construction of the problem determined the terms in which the issue could be discussed and shaped the expectations and reactions of different stakeholders involved in the project. Local stakeholders were not necessarily critical of the solutions provided by RECOAL, but rather, contested different aspects of the construction of the problem.

Summary of research questions

Meta-question: What happens when a land regeneration project is considered within the social context in which it is developed?

Project specific question: How do RECOAL stakeholders construct the environmental problems to be addressed by the project, and how these perspectives influence, and in turn are influenced by its development?

- Sub-question 1: What are the different perspectives on coal ash pollution of local residents in Tuzla and how are they related to their perceptions of the place?
- Sub-question 2: What are the different conceptualisations of pollution that influence the views of scientists and local residents in Tuzla?
- Sub-question 3: How is knowledge about the risks associated to the coal ash disposal sites developed within RECOAL and within the local communities?
- Sub-question 4: What are the local expectations about the benefits that RECOAL should deliver, and how do RECOAL members deal with them?

Table 9-1: Summary of research questions.
In order to revisit the work of this thesis, Table 9-1 brings back the research sub-questions set at the outset of this thesis to explore the general research question. Each question is addressed in the subsequent sections of this chapter. Before turning to the specific research questions, I want to state the thesis that summarise the insights of this research.

My first thesis is that, in environmentally degraded areas, there may be multiple social constructions of the environmental problem and thus, tensions may emerge between competing definitions of the situation (following Thomas, 1923). These tensions are part of the context in which land regeneration projects are developed and thus, they influence their results in different ways. Considering sub-questions 1 and 2, section 9.2 reviews some of the claims-making activities developed by local actors in Tuzla explored in detail mainly in chapters 5 and 6.

My second thesis is that land regeneration projects adapt to accommodate these contesting definitions of the situation using different mechanisms that allow the project to maintain a ‘common front’ (following Goffman, 1997). This requires procedures for ‘knowledge management’ and ‘expectations management’. ‘Knowledge management’ procedures, for example, include formal and informal rules to deal with the uncertainty of the results in risk assessment, like those explained in Chapter 7. They relate to the practices and interactions through which knowledge about the risk associated to coal ash is constructed, as interrogated in sub-question 3. Expectations management procedures require the project members to liaise with stakeholders at different levels, like those explored in Chapter 8. They refer to the practices and interactions that result from the adjustment of the project to local expectation, as interrogated in sub-question 4. While both ‘knowledge management’ and ‘expectations management’ procedures are embedded within research practices they are rarely stated explicitly. Indeed, Chapter 8 gives some examples in which the lack of awareness of these practices appears to have separated some RECOAL researchers from the core project team. Section 9.3 reviews some of the most salient features of these procedures demonstrating the importance of socio-political factors in the development of land regeneration projects. The consideration of the four sub-questions provides a (partial) answer to the question posed in this research about how stakeholders within RECOAL construct the environmental problem to be addressed by the project and how they, in turn, influence its development.

While most researchers in almost any discipline would acknowledge that their work is developed within a socio-economic context, many may feel threatened by the assertion that their research results are themselves shaped by that context. The literature on Science and Technology Studies has explored this issue widely. This thesis, however, is not exclusively concerned with scientific practices and the production of knowledge. Rather, the aim here is to bring science out of the laboratory (following Gieryn, 1995) by exploring an applied project within its context and evaluating its likely impacts. In doing so, this research hopes to have practical implications for conducting scientific research within land regeneration projects.

Thus, my final thesis returns to the initial meta-question to argue that the examination of the social and political context may help applied research projects studying land regeneration, such as RECOAL, in improving their ‘knowledge management’ and ‘expectations management’ procedures. The social and political context can be evaluated by exploring competing definitions of the situation in the construction of the environmental problem. The literature suggests that this analysis may help to incorporate into the project contextual knowledge that ultimately may be valuable to understand what the project impact is likely to be (e.g. Harrison et al., 1998). The experience in RECOAL suggests that, in addition, analysing the social construction of the environmental problem facilitates ‘knowledge management’, because it helps the project team to understand its impacts in terms of how the project results are likely to be used by different local actors. On the other hand, understanding the social construction of the problem may help the project team to state explicitly ‘expectations management’ procedures that help the development of the
9.2. Multiple perspectives in the construction of an environmental problem

Following my question about how RECOAL stakeholders construct the environmental problems to be addressed by the project, and how these perspectives influence, and in turn are influenced by its development, I focused initially in two sub-questions. The first one sought to understand different perspectives on coal ash pollution of local residents in Tuzla and how they were related to their perceptions of the place while the second explored different conceptualisations of pollution that influence the views of scientists and local residents in Tuzla.

Answering these questions requires revisiting the social constructionist theory introduced in Chapter 2. Spector and Kitsuse (1977) established three key questions in studying the social construction of a problem: who makes the claim and how, and what is the relationship between those who make the claim and those who receive it. Hannigan (1995) proposed three stages in the construction of environmental problems: assembling the problem, presenting it and contesting other constructions of the problem. According to Hannigan (1995) the task ‘assembling’ is predominantly developed within scientific forums and the predominant layer of proof is scientific. Once the problem is ‘assembled’, claims need to be presented to command attention and legitimate the claim in media forums, where moral arguments predominate. Contestation takes place in political forums where technical and legal arguments may be called into action. This analysis may be used to explain the emergence of large scale public controversies such as acid rain or biodiversity loss (Hannigan, 1995; Hannigan, 2006); however, it may be less suited to explain the emergence of competing definitions of the situation in local contexts such as that of coal ash pollution in Tuzla.

Although this research shows that all actors (local residents, researchers, organisation representatives, and the public) contribute at some point in assembling, presenting and contesting the problem, these are not discrete activities. Instead, they occur simultaneously in different forums. For example, assemblage occurs in other forums outside the scientific realm. Hannigan (1995) acknowledged that everyday experiences of local villagers were also useful in providing practical knowledge about the environment. Irwin (1995; xi) proposed the term ‘citizen’s science’ to refer to forms of science that are ‘enacted by citizens’ and ‘generated outside scientific institutions’. The experience of Tuzla, where local residents assembled the problem of coal ash pollution by explaining how the pollution affected their everyday experiences supports this literature and suggests that local residents are able to provide contextual knowledge that can help understand the problem of pollution. However, the research suggests that in assembling the claims, local residents also bring moral arguments into their accounts. At the local level moral arguments emerged together with other assertions based on empirical observations of the environment. In conclusion, the construction of the environmental problem of coal ash in Tuzla results in multiple ‘definitions of the situation’.

Local residents draw together both moral and empirical arguments in the construction of stigma. In chapter 5, following Goffman (1990), I defined stigma as emerging within a set...
of relationships. However, I challenged conventional understandings of stigma asserting that stigma can emerge within the relationship between people and place. Thus, stigma could help explain the relationship between place and identity in environmentally degraded places (see also Simmons and Walker, 2005). In Tuzla, some local residents associated a stigma with their experiences of the place and disease. Thus, the expert assessment of risk (in particular, the reassurances about the absence of radioactivity) was unable to explain away the local fears about pollution. Some actors (like TEP, but also some Canton officials and local residents) explained that beliefs of pollution hazards were fuelled by distrust of the industry and local institutions. Their expectations of RECOAL were that the intervention of an international research team could convince local residents about the acceptability of environmental risks. However, RECOAL was unable to dissipate all local concerns about the environment. W.I. Thomas famously said: ‘If the actors define a situation as real, it is real in its consequences’ (in Janowitz, 1966). Most local residents defined the pollution as a very real hazard and documented the various ways in which it affected their lives. Even if RECOAL’s risk assessment could prove the absence of some of the risks claimed by local residents (such as the radioactivity), this was insufficient to reassure many local residents, partly because stigma symbols remained. The emergence of stigma is not always linked with the presence of risks as they are defined in the risk assessment. Yet, the social construction of stigma may help explain the relationship between people and an environment undergoing change, without needing considering whether that place is actually polluted or not.

Chapter 6 provided an account of the interactions of scientific and moral accounts of pollution, drawing on the work of Douglas (1966). One of the purposes of Chapter 6 was to demonstrate different constructions of environmental problems that compete for attention and legitimisation in public arenas (following Hilgartner and Bosk, 1988). The chapter also showed that political arguments imbue the construction of environmental problems, but these are also grounded in different symbolic worlds. Local residents’ pollution beliefs emerged associated with the technological transgression of TEP in their environment, identifying them as victims of a ‘malefactor’ industry. In former Yugoslavia, their concerns were acknowledged by the intervention of workers’ councils in the self-management system that ruled the socialist economy (I am not claiming here that the system actually worked but that something similar to the roles ‘victim’ and ‘malefactor’ was acknowledged in that system). Local residents referred to different compensation systems existing in former Yugoslavia that helped them to deal with risk (see also a discussion of risk and compensation in Adams, 1995). In the new system, however, local residents portray themselves as ‘abandoned’ and ‘forgotten’. Because the old moral code is absent, local residents resort to their pollution beliefs to claim the injustice of the situation. Natural scientists, in contrast, do not see any transgression in the presence of chemical elements on the environment but find it dangerous to participate in the political debate to take decisions about who is the polluter and how the polluter should pay. In doing so, chapter 6 illuminated the differences between different conceptualisations of pollution held by scientists and local residents.

Chapters 5 and 6 put emphasis on the performance of identities within degraded places, understanding place as the site where social relations and ‘activity spaces’ intersect (following Massey, 1994). The value of this analysis is that it relates actions dealing with the pollution to the representation system within which pollution is identified. Thus, the analysis identified four different identity types or performed identities (activism, opportunism, conformism, escapism) in terms of local residents’ ideas about stigma and place. The analysis suggests that although local residents share a common understanding of how their environment has been transformed they attribute different meanings to this transformation and thus alternative ways of engaging with the place emerge. This, however, does not establish a causal link between performed identities and emerging ideas of pollution. Local residents explain their actions to cope with pollution by referring to their own perceptions and beliefs about the causes and consequences of coal ash disposal.
However, at the same time, the local narratives about coal ash pollution could be explained as 'vocabularies of motive' (following Mills, 1940), that is, their claims act as justifications for past, present and future actions. Thus, the relationship between narrative and performance appears to be two-fold, as suggested by contemporary analyses of identity (e.g. Hall, 2000). In this context, the concept 'habitus' (Bourdieu, 2005) may help explain the continuity of identity while acknowledging its variation.

Chapter 5 suggests that the analysis of alternative performed identities in a degraded place may have implications for land regeneration practices. Studies that looked at local residents' responses to environmental degradation have shown that although the identification of pollution may lead to a collective forms of action that empowers communities (e.g. Aronoff and Gunter, 1992; Capek, 1992; Edelstein, 2004), individual responses and stigmatisation of some members of the community is also common (e.g. McGee, 1999). When RECOAL started its work in Tuzla in 2005 it emphasised the need to provide remediation solutions for those who wanted to 'use' the disposal sites for economic activities. The research documented, however, a local movement against the pollution that was causing a tension between those who wanted to cultivate the sites and those who saw intractable risks associated with the sites. Further analysis suggested that the project was at risk of overlooking the views of local residents whose ties with the place had been broken and did not find a political space to express their concerns. A preliminary exploration of the local performed identities would have been useful to tailor the project design to local concerns and demands.

9.3. Constructing knowledge and expectations

Understanding the perspectives of local actors also requires understand the knowledge underlying these perspectives. Thus, sub-question 3 sought to understand how both RECOAL and local residents developed particular kinds of knowledge about the coal ash disposal sites. This was followed-up in sub-question 4 that sought to understand the development of a web of expectations around RECOAL, and the responses of RECOAL to societal demands. Thus, I sought to move from the construction of environmental knowledge to the development of practical solutions and social demands associated to a particular land regeneration project.

Jasanoff (2004) highlighted the researchers' dilemma when developing practical applications of their research: on the one hand, researchers are asked to provide factual accounts to support decision-making regarded as free of values. On the other hand, decision-makers may appropriate, manipulate or ignore scientists’ knowledge at their convenience. The findings in Tuzla suggest that the researchers' position depends on whether they are able to present their information in a format suitable for dominant definitions of the situation: their capacity to influence policy will not only depend on the results that they obtain, but also on their capacity to form alliances with relevant social actors. Thus, this thesis explored some of the ways in which the practice of research is shaped by the need to work within a particular set of social relations. Chapter 7 was mainly concerned with 'knowledge management' procedures, that is, procedures used to present the research results about the risk of pollution in suitable formats for the audiences concerned. Chapter 8 turned to 'expectations management' procedures, exploring some of the way the research team dealt with the competing expectations of the project held by local actors.

In explaining some of the 'knowledge management' procedures, I sought to make explicit some aspects of the practice of science already known to researchers but rarely spelled out to the general public. Some of these procedures explained in Chapter 7 are directed towards dealing with uncertainty and involve the practice of expertise. The literature on risk has highlighted the importance of expert judgement in assessing risks (Ruckelshaus, 1983). However, experts may not be able to judge the significance of those risks for those affected by them (Beck, 1992). The study of scientists' practices and narratives within
RECOAL suggested that researchers have to confront both their responsibility for the knowledge produced and the perceived need to provide bare results open for interpretation to other actors. Most researchers tried to be impartial by emphasising only those pollution issues where the evidence could not be contested, but this failed to acknowledge the persistence of local concerns about pollution.

Limiting science to provide only those facts that are demonstrated beyond doubt reduces the potential benefits that science can deliver to our societies in terms of engaging with the social and political context of the project. In my opinion, this should be done by providing information beyond the results of the assessment, including researchers’ judgements about how the pollution is likely to affect those who live in affected areas. These judgements should be provided alongside the necessary caveats about the limitations of the assessment.

I am not trying to open the door to assert the primacy of scientific judgement and I am not advocating that all natural scientists should follow sociological training to be able to assess the social and political consequences of the assessment. Instead, I am proposing that scientists avoid self-censorship on the grounds that moral judgements are outside the realm of scientific assessment. Scientists are citizens with equal rights and limitations and as such should be both subject to social controls and allowed to have their own opinions about social matters. Paraphrasing Mary Douglas (1992: p. 38), I am advocating that scientists start talking politics and engage with the ‘political dirt’.

Before explaining the ‘expectations management’ procedures within RECOAL, Chapter 8 reviewed the actors’ expectations of the project. Regeneration projects and associated processes of knowledge generation are subject to high expectations. The analysis suggested that actors may pose unrealistic demands on relatively small projects, such as RECOAL. It also showed that different actors’ expectations may not be compatible, particularly when they originate from competing definitions of the environmental problem at hand. Thus, it appears that, from the outset, a scientific project is immersed in a web of expectations, where competing interests may try to capitalise on the results of the project.

The analysis in Chapter 8 suggested that the project team managed the expectations by constructing a ‘common front’ (following Goffman, 1997). This ‘common front’ facilitated the presentation to external audiences of a unified view on the results of the project. The procedures of exclusion and inclusion of individuals that dissented from RECOAL’s ‘common front’ resonate with the science boundary-making procedures described by Gieryn (1995). In RECOAL, research scientists performed their research according to pre-established roles. The need to conform to the common front moved the scientists to withdraw their moral commitments and focus only on the results, leaving the benefits of the project to be decided within the social and political context of the project. In some cases scientists with a declared commitment brought their concerns into the project in the form of a ‘disguised engagement’. In other cases, researchers examined critically the research processes but were unable to challenge RECOAL’s common front. Researchers complied with the common front without being aware of it. In some sense, the emergence of a common front was the result of the interactions between social and natural actors including local residents, industry managers, institutional representatives and researchers but also including the landscapes in Tuzla as a significant actor within the project. This resonates with co-constructionist theories of environmental sociology (see Section 2.4).

The example of RECOAL is a reminder that the power of scientific accounts to silence political debate around particular issues should not be underestimated (see also, for example Fiorino, 1989; Fischer, 1990). Furthermore this work adds to a body of literature arguing that in high uncertainty conditions, such as those pertaining to large environmental problems, determining who is an expert and what counts as valid knowledge is a highly political issue and thus, the construction of expertise needs to be open to political debate (also advocated in Funtowicz and Ravetz, 1993; Wynne and Mayer, 1993; Munda, 2004). This has generated new proposals for the role of the expert in environmental decision-making (e.g. Gibbons, 1999).
This dissertation adds to this debate that while society can play a role in the construction of expertise, it should also acknowledge the limitations of science to respond to social problems. Citizens should not expect that science is able to respond to all questions. This resonates with the criticism put forward by Funtowicz and Strand (2007) of what they call the ‘modern model of science and policy’, in which science ‘speaks truth’ to policy. The research in this dissertation has explored the complexity of the relationship between science and decision-making in a land regeneration project. Rather than providing ready-made responses, researchers appear to be mediators who negotiate solutions to environmental problems within different social definitions of the situation. The research suggests that scientists should be regarded neither as ‘superheroes’ nor as ‘mad scientists’, but rather, as engaged citizens with particular experience, skills, judgement and moral values.

9.4. The social context of research: practical implications for land regeneration projects

This dissertation developed within an engineering doctorate programme. Hence, it appears incomplete without some sort of practical recommendations for land regeneration projects. This research has provided the opportunity to examine some areas in which research practice could be improved towards reducing environmental and health impacts from coal ash disposal practices. This experience could perhaps be applied to other research projects studying similar cases of land pollution and risk. In doing so, we would like to return to the original question that initiated this research about what happen when a land regeneration project is considered within its social context.

The experience of RECOAL suggests that the local legitimacy of scientific results will be determined by their capacity to provide arguments that resonate with the concerns of stakeholders. If the view of one single powerful stakeholder is supported by the results, this is likely to be interpreted as biased research, regardless of the reputation of the researchers that conduct the risk assessment and the validity of the assessment. In Tuzla, local environmental problems will remain unsolved until the local concerns (from front-door issues to health conditions) are addressed in some way. RECOAL’s impact on the local communities in Tuzla will be determined by the dissemination and implementation of the final outputs. At the time of writing (February 2009) this is still to be completed.

In addition, the research suggests that the remediation of the characteristics that cause the pollution alone may not be enough to dissipate local concerns about environmental pollution, in particular those concerns that reinforce the attribution of a stigma to the place. Stigma can be counteracted by providing benefits that make the place more desirable (providing sources of reliable employment, embellishing the surrounding areas with the creation of greenspaces or recreation facilities or improving the local infrastructure and so on). In former Yugoslavia, industries played a considerable role in providing these benefits. Given the history of the area and the need for TEP to develop trust relationships with local residents, providing services such as district heating could help TEP to both improving its relationship with local residents and reducing the stigma associated with the place.

Finally, this research is an example of the potential of sociological research to contribute to land regeneration projects. During RECOAL, sociological research helped to identify stakeholders, elicit local demands on the environment and devise tools to engage with local actors and institutions. This thesis suggests that social research can also help to reveal the multiplicity of narratives within local communities; explain the features of different symbolic systems that mediate the communication between researchers and local residents and explain the tacit rules of ‘knowledge management’ and ‘expectations management’ inherent in scientific practice.

In Section 9.2 I have argued that sociological research could have also contributed to the design of the research proposal, by devising a research programme that responds to the
local needs of research. Thus, sociological research can make major contributions to the
definition and framing of the research problem. However, because of the funding structure
of the EU's FP6 programme RECOAL could not easily respond to the findings of the
social research team: the funding regime required project leaders to develop a full proposal
before starting the research. Because the proposal was developed without resources,
project leaders did not have the time and resources to evaluate the social context before
developing the proposal. Funding mechanisms that provide the space to investigate the
socio-political context of a research project before developing the full research proposal
may encourage researchers to focus on research that is both policy relevant and socially
robust.

9.5. Bringing together environmental engineering and social
constructionism: a research journey

Ithaca gave to you the beautiful journey;
Without her you'd not have set upon the road.
But she has nothing left to give you any more.

And if you find her poor, Ithaca did not deceive you.
As wise as you'll have become, with so much experience,
You'll have understood, by then, what these Ithaca's mean.
(C.P. Cavafy, 1911)

At the beginning of this research, in March 2005, I was asked to write a paper about the
relevance of my research (loosely described then as 'adopting a social constructionist
perspective to study sustainable land use projects') to the Engineering Doctorate in
Environmental Technology Programme. This is what I wrote then:

"[...] this research is intended to improve the performance of engineering and
scientific projects by understanding their strengths and weaknesses. Since success
should be the objective of any engineering project, understanding the factors that
may jeopardise this success is vital for a research engineer.

While all sciences must question the basic principles and procedures on which they
build their knowledge, this issue is particularly relevant when a field of study is still
in incipient form, like the field of Environmental Technology. For Environmental
Technology to develop suitable and sustainable solutions, an epistemology of such
a science must be developed."

These were quite ambitious ideas, perhaps a bit naïve. But let's assume that the journey of
this thesis started in these two paragraphs, which provide the basis for a discussion of the
relationship between engineering and sociology. There were two main reasons that moved
me in the direction of exploring social constructionism as an answer to what I perceived
then to be the needs of environmental engineering. In the first place, I was concerned with
the performance of engineering projects. In particular, I aspired to understand what were
the strengths and weaknesses of engineering projects and the factors that would be
conducive of their success. One of my first findings during this research is that success is a
relative matter. Success cannot be defined without specifying for who it is successful and
in what terms. That is precisely one of the lessons of RECOAL explained in Chapter 8:
what made RECOAL successful for some actors, made it unsuccessful for others. This
points out to the political nature of engineering projects, which is too often overlooked.
A critical perspective on engineering, whether it is grounded on social constructionism or
other theory, is, thus, crucial to understand how the results of the project are going to be
appropriated and contested by particular actors. So too is my own research, a political
exercise in terms of bringing back into the engineering project the views that are already
excluded when engineering projects begin.
This does not mean that I reject my belonging to the field of environmental engineering or that I am oblivious to the material nature of environmental problems focusing instead on the politics of the problem. Rather, I perceive that the semiotic-political and the material interpenetrate each other in ways that impede their strict separation. Often social sciences and engineering are presented as opposed, but such dichotomy overlooks the interpenetration of their objects of study and the potential synergies between the two fields, in the same way as a radicalised debate between the social constructivist and the realist positions often characterised these two perspectives too simplistically without acknowledging the convergences between the two (see extended discussion in section 2.2.4).

Indeed, the need to move beyond a simplistic presentation of engineering and social sciences as competing and somewhat opposed fields of study becomes obvious when examining the concern I posed at the beginning of the project about understanding how the environmental engineering knowledge is constructed. This question is central to both sociology and engineering. In trying to provide an answer to this question, there is no need to choose either social theory or engineering as a way to provide a response. Indeed, an answer to such a question would require considering both social theory and engineering. This has its setbacks: it may not be possible for the researcher to master the two disciplines sufficiently to satisfy both engineering and sociology peer communities. Yet, I believe this is a journey worth undertaking.

With this discussion I am not concluding this journey, but merely starting it; I, like Cavafy, hope that my journey to Ithaca is long, full of adventures and understanding.
## Appendix I: Interview and coding guides

### Interview guide I (used with local residents during the first fieldwork period)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
</table>
| **0- Introduction** | RECOAL studying the disposal sites (HEIS, TEP, BOKU)  
I am an independent researcher; I am doing a doctorate studying how the context influences projects such as RECOAL.  
**Informed consent**: I am interested the life of people in these communities. Would you like to participate in an interview?  
**Anonymity**  
Do you mind if I tape the interview? |
| **1- Opening** | Do you live near the disposal sites?  
Do you have a job nearby – how far away and how do you get there?  
Who shares your house (family, children, grandparents, lodgers etc)?  
Is it your own house? How long have you lived there? Do you pay rent for the house or land, and if so, to whom? |
| **2- Life / environment** | **Food sources**? Do you shop locally? Grow your own food? Get it from local farmers?  
Where do you get water – are there any problems with the supply?  
What arrangements exist for medical care – local doctor? Hospital?  
Are there any places here in the area that you really like? If so, what are those places and why do you like them?  
Are there any significant seasonal activities? (E.g. hunting, collecting mushrooms, medicinal plants, honey, gardening, migrating birds)?  
How are you affected by the ash disposal sites? Do you access these sites for any reason? |
| **3- General services in the area** | Are there jobs around here? What kind of jobs? Are they good jobs?  
How is the transport? Do you have public services? How do people move around?  
Do you have electricity supply? Does it come from TEP? How does that work? |
| **4- Participation / communication** | Have you been involved in any discussions about the disposal sites? If so with whom and what were discussed? Did you feel that your views were listened to and acted upon? |
| **5- Problems / solutions** | What could be done to improve life here? If so, who do you think would have to take action in that respect? |
| **6- Conclusion** | Thank you for your help, this is all very useful.  
Do you have any questions? |
Interview guide II (used with RECOAL scientists during the second fieldwork period)

Question 1: What are the main benefits that the members of RECOAL expect to deliver to the wider society?

An account of how the participants regard the project RECOAL

Beginning of the project: How did you get involved in RECOAL? Why did you want to get involved?
Can you briefly describe what do you think is the main environmental problem that the Consortium should aim to resolve? Which solutions should RECOAL prioritise?
Development of the project: Can you give an account of the development of the project? Have there been any parts of the project that you have particularly enjoyed? Has the project raised some new interests in you? How do you think this happened? Has your motivation to participate in RECOAL changed so far? What caused these changes? Has the development of the project changed your opinion about what is the main environmental problem which RECOAL needs to tackle? What motivated this change?
End of the project: Do you think the project should have some continuation? How could this be done?

Question 2: How do members of RECOAL address uncertainties associated with the project?

An account of the risks associated with the development of RECOAL

Have you identified any risks associated with the development of the project? Can you make a list of them? What could be done to address those risks?
What are the main uncertainties associated with the environmental problems that RECOAL should tackle?

Question 3: How do members of RECOAL engage with other actors influencing and influenced by the project?

An account of the relationship between RECOAL project members with other members of the project

Could you elaborate a map of the encounters you have had with other actors related to RECOAL?
Can you recall your experience working with other members of RECOAL? Can you give examples of positive experiences within the team? In contrast, were there things that did not work so well? Can you give examples of these experiences?
Have you been working with other actors associated with the project (e.g. local communities, Municipality, Canton, NGOs)? How was this experienced? Can you give some examples? Has this contributed in any way to the development of your work/RECOAL?
# Interview guide III (used with local institutional representatives during the third fieldwork period)

| 0-Introduction | RECOAL studying the disposal sites (HEIS, TEP, BOKU)  
I am an independent researcher; I am doing a doctorate studying how the context influences projects such as RECOAL.  
**Informed consent:** I am interested in life around here. Would you like to participate in an interview?  
**Anonymity**  
Do you mind if I tape the interview? |
|---|---|
| 1- Recent changes on the disposal sites | What have been the **changes or activities** with respect to the disposal sites in the last year? When were they done? Who has taken the initiative to produce those changes? What is their predicted impact?  
Are there any **future plans** for the disposal sites? What are those?  
Who is going to carry them out? How? When? |
| 2- Governance changes | What are the **initiatives of the local institutions** (perhaps refer to the interviewee’s institution) to improve the state of the environment? Do any of those initiatives have an impact on the disposal sites? |
| 3- RECOAL impact | Have you **heard about RECOAL**? Did you **contribute at some stage** in RECOAL? What is your **opinion** about their work?  
Did RECOAL **help you** in decisions regarding the disposal sites?  
How?  
Did RECOAL **help you** in decisions regarding the environment?  
How? |
| 4-Conclusion | **Thank you** for your help, this is all very useful.  
Do you have any questions? |
**Interview guide IV (used with local residents during the third fieldwork period)**

| 0- Introduction | RECOAL studying the disposal sites (HEIS, TEP, BOKU)  
| I am an independent researcher; I am doing a doctorate studying how the context influences projects such as RECOAL.  
| **Informed consent:** Would you like to participate in an interview?  
| **Anonymity**  
| Do you mind if I **tape** the interview? |
| 1- Recent changes on the disposal sites | Have you noticed any **change/activity** with respect to the disposal sites? What are those? What do you think those changes are for? Have they occurred over a long period of time, or suddenly? When were they done? Who has taken the initiative to produce those changes? \n| Have these changes **influenced your views** of the site? How have they influenced your views?  
| Is there anything else that you would like to see done at the sites? |
| 2- Governance changes | Are you aware of any **legislative changes** regarding the disposal sites or the environment in general? What are those? Have they had any influence?  
| Has the **Municipality** taken any local initiative to improve the life in these communities? When were they done? What is your opinion on it?  
| Has the **Canton** taken any local initiative to improve the life in these communities? When were they done? What is your opinion about it?  
| Has any other institution (e.g. NGOs, other social groups) taken any local initiative to improve the life in these communities? When were they done? What is your opinion about it?  
| Is there anything else you would like to see done in your community? Who should do it? |
| 3- RECOAL impact | **Have you heard about** RECOAL? When and where did you hear about the project? What is your opinion about their work?  
| Have you identified any area in which RECOAL has **influenced** your life? How did it occur? How did you notice? Is there anything that you would have liked to be done by RECOAL? |
| 4- Conclusion | **Thank you** for your help, this is all very useful.  
| Do you have any questions? |
**Coding guide I (comparison of analytic categories for systematic coding and the presentation of such categories in the thematic report)**

<table>
<thead>
<tr>
<th>Initial coding categories</th>
<th>Structure of the thematic report</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERAL INFORMATION ABOUT THE AREA</td>
<td>TOTAL POPULATION AFFECTED BY THE DISPOSAL SITES</td>
</tr>
<tr>
<td>LIFE / ENVIRONMENT</td>
<td>DISTRIBUTION IN LOCAL COMMUNITIES</td>
</tr>
<tr>
<td>PERCEPTIONS ABOUT THE STATE OF THE ENVIRONMENT</td>
<td>REFUGEES</td>
</tr>
<tr>
<td>Air pollution</td>
<td>EVIDENCE OF POLLUTION</td>
</tr>
<tr>
<td>Employment</td>
<td>RISK AND FEARS</td>
</tr>
<tr>
<td>Environmental problems (general)</td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td></td>
</tr>
<tr>
<td>Places and Recreation</td>
<td>OTHER ENVIRONMENT ISSUES</td>
</tr>
<tr>
<td>Public Health</td>
<td>WATER AND WELLS</td>
</tr>
<tr>
<td>Water and Wells</td>
<td>WATER SUPPLY</td>
</tr>
<tr>
<td></td>
<td>WATER FROM THE DISPOSAL SITES</td>
</tr>
<tr>
<td></td>
<td>WELLS</td>
</tr>
<tr>
<td>SERVICES AND STRUCTURES</td>
<td>OTHER ASPECTS OF LIFE IN THE AFFECTED COMMUNITIES</td>
</tr>
<tr>
<td>DISPOSAL SITES</td>
<td></td>
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<tr>
<td>History</td>
<td>EVOLUTION OF THE DISPOSAL SITES</td>
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<tr>
<td>Land property rights</td>
<td></td>
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<tr>
<td>Environmental problems related to the disposal</td>
<td></td>
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<tr>
<td>Pollution</td>
<td>FARMING ON THE SITES</td>
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<tr>
<td>Alternative land uses</td>
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<tr>
<td>COMMUNICATION AND PARTICIPATION</td>
<td></td>
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<tr>
<td>CITIZENS AND ENVIRONMENTAL DECISION-MAKING</td>
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<tr>
<td>PROBLEMS AND SOLUTIONS</td>
<td></td>
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<tr>
<td>PROPOSALS FOR THE FUTURE</td>
<td></td>
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<tr>
<td>REFERENCES TO FOREIGNERS</td>
<td></td>
</tr>
<tr>
<td>METAPHORS OF POLLUTION</td>
<td></td>
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<tr>
<td>COMMENTS ON COMMUNISM</td>
<td></td>
</tr>
</tbody>
</table>
Coding guide II (summary of analytical categories for the analysis of statements associated with pollution)

<table>
<thead>
<tr>
<th>Model categories</th>
<th>Sub-categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Being endangered</td>
<td>Endangering actors</td>
</tr>
<tr>
<td>Experiences of pollution</td>
<td>Dirt</td>
</tr>
<tr>
<td></td>
<td>Dust</td>
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<tr>
<td></td>
<td>Environmental transformation</td>
</tr>
<tr>
<td></td>
<td>Invasion of space</td>
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<tr>
<td></td>
<td>Meteorological phenomena</td>
</tr>
<tr>
<td></td>
<td>Waste</td>
</tr>
<tr>
<td>Fear and danger</td>
<td>Body's disease</td>
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<td></td>
<td>Death</td>
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<tr>
<td></td>
<td>Destruction</td>
</tr>
<tr>
<td></td>
<td>Environmental disease agent</td>
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<td></td>
<td>Invisible pollution</td>
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<tr>
<td></td>
<td>Poison</td>
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<td></td>
<td>Radioactivity</td>
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<tr>
<td></td>
<td>Sacrifice</td>
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<td></td>
<td>What cannot be seen</td>
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</tbody>
</table>

Coding guide III (summary of analytical categories for the analysis of the interviews with scientists)

<table>
<thead>
<tr>
<th>Coding categories- Researchers interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Views on Bosnia and Herzegovina</td>
</tr>
<tr>
<td>Definition of the environmental problem</td>
</tr>
<tr>
<td>History of the project RECOAL</td>
</tr>
<tr>
<td>Scientists’ context</td>
</tr>
<tr>
<td>Project relationships</td>
</tr>
<tr>
<td>Project concept and purpose</td>
</tr>
</tbody>
</table>
Appendix II: Risk Assessment Summary

<table>
<thead>
<tr>
<th>Food chain</th>
<th>Risk indicators</th>
<th>Methods</th>
<th>Results</th>
<th>Results discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Element uptake by plants under experimental conditions</td>
<td>Plants (n=61; different crops/tree sp)</td>
<td>Samples digested with nitric acid (HNO₃ 65%); elemental content determined with mass spectrometry methods.</td>
<td>The most elevated values were for Cd in cereals; Ni in fodder plants and Ni, Cd and Hg in potatoes. In addition, Salix sp samples showed high values of B, Zn, Cu and As.</td>
<td>Potato crops pose significant dangers for the food chain since its concentrations of Cd, Hg and Ni exceed the literature values for normal concentrations in plants and threshold values for fodder (Scheffer/Schachtschabel, 1992). These values were also exceeded by Cd in maize; comparison with the literature (Kuhnen and Goldblach, 2004) shows that Ni and Cu values are elevated in pastures.</td>
</tr>
<tr>
<td>Toxicity of ashes to soil microbes</td>
<td>Soils (n=10; 50 g)</td>
<td>Basal and substrate induced respiration according to Martens, 1995): Acrylic glass cylinders are filled with soil; flow is connected with a infrared CO₂-detector.</td>
<td>Higher respiration in older sites Negative values of respiration in newer sites suggest that alkaline ashes absorb CO₂ (CO₂ fixation to Ca(OH)₂)</td>
<td>Old sites: respiration values were similar/higher to values in 'naturally grown European sites.' (no reference) New sites: N-mineralisation evidences microbial activity (no measures given), but respiration can not be measured (CO₂ is absorbed by the ashes.) Microbial activity seems not to be affected by metals.</td>
</tr>
</tbody>
</table>

Adapted from BTUC, 2006 and RECOAL, 2008

According to Dellantonio et al (2008) (Digests and acidified aqueous samples were analysed for As, B, Cd, Co, Cr, Cs, Cu, Mo, Mn, Ni, Pb, U, V and Zn, and aqueous samples additionally for Ca, K, Mg, Na, Li, Sr, Be, and TI using inductively coupled plasma mass spectrometry (ICP-MS, Elan 9000 DRCe, PerkineElmer).
<table>
<thead>
<tr>
<th>Risk indicators</th>
<th>Methods</th>
<th>Analysis</th>
<th>Results</th>
<th>Results discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dust evolution</strong></td>
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</tr>
<tr>
<td>Element content in soil and ashes</td>
<td>Ashes (n=18) Soils (n=10)</td>
<td>Digestion in aqua regia (HCl/HNO₃) and mass spectrometry methods.</td>
<td>High concentrations of As, B, Cu, Ni, Zn and Cr were found in both ashes and soils</td>
<td>As, B, Cu, Ni, Zn and Cr exceed the tolerable thresholds for agricultural soils (Bergmann, 1988). Cd and Pb fall under the tolerable thresholds. According to German standards both top soils and ashes should be classified as ‘waste’ and deposited under controlled conditions (LAGA, 1997).</td>
</tr>
<tr>
<td>Physical and chemical properties of ash and soil covers</td>
<td>Ashes (n=18) Soils (n=10)</td>
<td>pH, Cation Exchange Capacity, Soil structure, bulk density, water holding capacity, etc.</td>
<td>Coal ash samples were very alkaline. Ash texture was sandy-like, while soil covers were clay-like.</td>
<td>As, B, and Ni concentration clearly exceeded the thresholds for drinking water standards (TVO, 2001)</td>
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<tr>
<td><strong>Polluted effluents</strong></td>
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<tr>
<td>Chemical properties of surface water</td>
<td>Several samples taken at inflow; outflow and drainage points; wells; river Jala. Downstream samples in April 2005 and September 2005.</td>
<td>Measures of pH, electric conductivity, metals and main anions. Methods unspecified.</td>
<td>High values of As, B, Mn and Ni were found in outflow points and river Jala. High Ni and B values were measures in wells. Outflow points presented high pH values (&gt;10) and high electrical conductivity (&gt;2500 μS/cm) and high concentrations of sulphates (~ or &gt; 1000 mg/l) also found in wells.</td>
<td>The effluent from the disposal sites presents concentrations of As, B, Mn, Ni and sulphates in concentrations about drinking water standards (TVO, 2001) and about the normal ranges found on the rivers Elbe and Rhein (Streit, 1994). Some of the polluted wells seem to be contaminated be receiving a leakage of water from the disposal sites since they appear to have elevated concentrations of sulphates, Ni, B and, although below standards, high concentrations of As. The river Jala has low concentration of sulphates, suggesting that the discharge from the disposal sites it is not the main pollution source.</td>
</tr>
</tbody>
</table>
References


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