

**Shaping Science and Expertise: The Political
Ecology of Karst Resource Contestation in North
Kendeng Mountains, Indonesia**

Abdul Kodir

PhD

University of York

Environment & Geography

April 2025

Abstract

This study examines the socio-environmental conflict surrounding cement mining in the North Kendeng Mountains, Indonesia, where JM-PPK (Kendeng Mountains Concerned Community Network) mobilise against state-backed corporate interests seeking to exploit karst resources. This research provides a comprehensive understanding of how different forms of power, actor-oriented (Weberian), structural economic (Neo-Marxist), and discursive (Post-structuralist), intersect in shaping governance outcomes. This 'pluralistic approach to power' moves beyond single-perspective analyses by integrating these three dimensions to capture how grassroots agency, economic structures, and discursive strategies interact in environmental conflicts. This framework is particularly useful in revealing how power is mobilised, challenged, and reconfigured through scientific and expertise claims.

A central contribution of this study is its examination of three key arenas of contestation where actors assert and challenge scientific and expert claims to justify or oppose mining activities. The first arena is the environmental assessment process, where corporations and government agencies produce Environmental Impact Assessments (EIA) and EIA Addendums to downplay ecological risks and justify industrial expansion. The second arena of contestation is the legal struggle, where scientific claims are scrutinised and debated in courtrooms. And the third and most decisive arena is the shift in policy direction of the Geological Agency, which serves as a state-sanctioned mediator in the dispute. By integrating these three arenas of contestation, this study demonstrates how power relations and scientific claims are intertwined with broader struggles over governance and environmental justice.

The implications of this study underscore the need for greater transparency in scientific assessments, participatory governance mechanisms that recognise diverse knowledge systems, and stronger institutional safeguards against regulatory capture. This study's novel contribution lies in its application of a pluralistic power approach to demonstrating that environmental governance is not just a matter of policy but a deeply contested terrain shaped by competing claims to expertise and authority.

Keywords: *Political Ecology; Karst; Pluralistic Power; Contestation; North Kendeng*

Contents

Abstract	2
Contents	3
List of Tables	9
List of Figures	10
Acknowledgements.....	11
Declaration.....	13
List of Abbreviations	14
1. Introduction	18
1.1 Background.....	18
1.2 The Context of Cement Mining Operation in the North Kendeng Mountains.....	19
1.3 Study Rationale	24
1.4 Research Objectives and Research Questions	26
1.5 Scope and Orientation of the Research	27
1.6 Thesis Structure	28
2. Literature Review and Theoretical Framework.....	30
2.1 Introduction	30
2.2 Political Ecology: An Approach.....	32
2.3 Power in Political Ecology	39
2.3.1 Neo-Marxist Perspective	41
2.3.2 Actor-oriented/Weberian Perspective	45
2.3.3 Post-structuralist Perspective.....	47
2.4 Limitations in Existing Empirical Studies	52

2.5	The Pluralistic Approach of Power as Theoretical Background.....	59
2.6	Theoretical Position	62
2.7	Locating a Pluralistic Approach to Power in Scientific and Expertise Claims over Karst Resources: An Analytical Framework.....	63
3.	Methodology	67
3.1	Introduction	67
3.2	Ethnography: A Multi-sited Reflection	69
3.3	Research Sites.....	72
3.4	Data Collection	76
3.4.1	Access.....	76
3.4.2	Participant Observation.....	77
3.4.3	Semi-structured Interviews	80
3.4.4	Informal Conversations.....	81
3.4.5	Note-taking.....	84
3.4.6	Statements Made by Experts and Policymakers in the Mass Media	84
3.4.7	Documents and Reports.....	85
3.5	Data Analysis	86
3.5.1	Data Familiarisation and Initial Coding	86
3.5.2	Theme Development and Refinement	87
3.5.3	Reviewing and Defining Themes	88
3.6	Reflexivity and Positionality	88
3.7	Research Ethics	92
3.8	Limitations.....	93
4.	Karst Governance, Cement Mining, and the Emerging of Conflict in North Kendeng Mountains	94
4.1	Introduction	94

4.2	Natural Resources Governance in Indonesia and Its Political Context	95
4.3	Situating Karst Governance in Indonesia.....	96
4.4	The Emergence of Conflict in Watuputih Groundwater Basin, the North Kendeng Mountains	101
5.	Scientific and Expert Claims in Environmental Assessment: Discourse and Policy Challenges in the North Kendeng Mountains	111
5.1	Introduction	111
5.1.1	Environmental Assessment as a Site of Contestation	114
5.2	Scientific Narratives in Environmental Assessment Reports: Examining the EIA, EIA Addendum, and SEA	117
5.2.1	Scientific Legitimacy and Temporal Dynamics in Environmental Assessment Reports.....	118
5.2.2	Scientific Objectives and Methodological Justifications in EIA and SEA: Conflicting Claims	119
5.2.3	Scientific Scope and Geographical Coverage	122
5.2.4	The Role of Scientific Experts in Assessing Economic, Environmental, and Social Impacts	124
5.2.5	Expertise and Scientific Authority in Environmental Assessments: Multidisciplinary Claims	135
5.2.6	Regulatory Framework and Scientific Authority: The Role of Expertise in Environmental Decision-making	136
5.2.7	Scientific and Policy Recommendations: Navigating Expertise and Power in the EIA and SEA	141
5.3	Dominant and Alternative Scientific Discourses.....	144
5.3.1	The Role of Scientific Expertise in Shaping Dominant Policy Discourse.....	144
5.3.2	The Alternative Narratives: Challenging the Dominant Discourse in Environmental Assessments	147
5.4	Conclusion	151

6. Contesting Scientific and Expertise Claims in the Legal Contest	153
6.1 Introduction	153
6.2 Reason for Lawsuit and Use of Expertise	154
6.3 Testimony of Expertise and Scientific Dispute	157
6.4 Public Examination and Challenging the Court Decision.....	167
6.5 Exploiting Legal Loopholes	169
6.6 Power Dynamics in the Scientific and Expert Claims in Legal Contest	173
6.7 Conclusion	178
7. Shifting Grounds: The Geological Agency's Role and Scientific Claim in Karst Resource Governance.....	180
7.1 Introduction	180
7.2 Geological Agency as a State Institution and Changing the Policy Direction.....	183
7.3 Scientific Claims, Research Comprehensiveness, and Critical Notes	187
7.4 Power and Scientific Claim: The Dual Role of the Geological Agency in Cement Mining Legitimacy.....	195
7.5 Conclusion	201
8. The Pluralistic Approach to Power and Natural Resources Contestation.....	202
8.1 Introduction	202
8.2 Power Dynamics in Karst Resource Governance: A Pluralistic Approach	203
8.2.1 Actor-oriented Perspective: How Agency and Intentions Shape Scientific Interpretations	203
8.2.2 The Neo-Marxist Perspective: The Influence of Economic Structures and Capital Interests in Scientific Research...	205

8.2.3 Foucauldian Perspectives: The Role of Discursive Power in Constructing Scientific Narratives and Policy Discourse ..	206
8.3 The Pluralistic Power and Political Ecology of Natural Resources Contestation	208
8.3.1 Challenging Integrating Science and Policy in Natural Resources Governance	209
8.3.2 Interconnectedness in the Arena Contestation	210
8.3.3 Uncertainty of the Situation	212
8.3.4 Exploiting Economic and Environmental Narratives.....	213
8.3.5 Shadow Spaces and the Informal Contestation of Expertise	214
8.3.6 State Institutions Are Not Monolithic	215
8.3.7 Investigating Power and Decision-making: A Multi-sited Ethnographic Approach.....	216
9. Conclusion	218
9.1 Introduction	218
9.2 Summary of the Findings	219
9.2.1 How Do Different Actors (e.g., Government, Corporations, Local Communities, Experts, Academics, Activists, NGOs) Construct and Contest Scientific and Expert Claims in the Governance of Karst Resources?	219
9.2.2 What Role Do Economic Structures and Interests Play in Shaping Governance Frameworks and the Scientific Claims Used to Justify or Oppose Resource Extraction in the Karst Region?	220
9.2.3 How Are Scientific Uncertainties and Environmental Risks Framed and Mobilised by Actors to Influence Decision-making Processes and Public Narratives in Karst Governance?	222
9.3 Contribution	223

9.3.1 Theoretical Contribution.....	223
9.3.2 Empirical Contribution	226
9.3.3 Methodological Contribution	227
9.4 Policy Recommendations.....	229
9.5 Further Research Agenda.....	232
List of References.....	234
Appendix A.....	256
Appendix B.....	271
Appendix C.....	272
Appendix D.....	273

List of Tables

Table 4.1:	Distribution of the Cement Industry in the Karst Areas of Indonesia	99
Table 5.1:	Comparative Expertise in Environmental Assessment Reports	136
Table 7.1:	Duties and Activities of the Geological Agency Team	189
Table 7.2:	Comparison of Research in the Watuputih Groundwater Basin Area with the Results of the Research by the Geological Agency.....	191

List of Figures

Figure 1.1: Watuputih Groundwater Basin Area	22
Figure 2.1: Influences on Political Ecology (adapted from: Benjaminsen and Svarstad, 2021).	33
Figure 2.2: Dimensions of Analysis in the Political Ecology Approach	37
Figure 2.3: Illustrating a Pluralistic Approach of Power.....	61
Figure 2.4: Analytical Framework of the Research "Contestation over Scientific and Expertise Claims in Karst Resources Governance"	64
Figure 3.1: Data Analysis Process	67
Figure 4.1: The Distribution of Karst Landscape Areas in Indonesia. The Areas Highlighted in Blue Represent the Karst Landscape Regions.....	97

Acknowledgements

First and foremost, I wish to express my deepest gratitude to Prof. Jonathan Ensor, Dr. Anika Haque, and Dr. Richard Friend. Their guidance, encouragement, and thoughtful insight have been instrumental throughout the course of my doctoral journey. I am sincerely thankful for their unwavering support and belief in my work.

I am also grateful to Dr. Karen Parkhill, my Progression Chair, and Dr. Joshua Kirshner, my TAP Member, for providing the comprehensive support and thoughtful evaluation that have been vital to my research and professional development during my PhD at the University of York.

I would also like to acknowledge the generous support from BPI, Centre of Higher Education Funding and Assessment (PPAPT) - Ministry of Higher Education, Science, and Technology of Republic Indonesia & the Indonesian Endowment Fund for Education (LPDP), whose funding made it possible for me to pursue this doctoral program. Their commitment to education and human development has opened doors not only for me but for many scholars striving to contribute to the betterment of our shared future.

Moreover, I would like to express my deepest gratitude to my home institution, my colleagues at the Department of Sociology, and the leadership of the Faculty of Social Sciences, Universitas Negeri Malang, for their unwavering support, encouragement, and permission to temporarily step away from academic responsibilities in order to pursue my doctoral studies.

To all the research participants who graciously shared their time, experiences, and knowledge, Mas Print (JM-PPK), Kang Gun, Pak Bowo (IPB), my friends at LBH Semarang, Pak Agung (Semen Indonesia), and Pak Dadang, thank you. Your trust and openness were foundational to this research, and I am deeply grateful for the paths you helped illuminate.

I acknowledge that I received assistance from Grammarly, friend/colleague, and professional proofreader to thesis in line with the Policy on Transparency in Authorship in PGR Programmes.

Above all, I am profoundly grateful to my family—my beloved mother, whose prayers and persistent encouragement have always been a source of strength—thank you for instilling in me the courage to aim higher. To my dear wife, Citra Dewi Kartika Paksi, whose love, patience, and unwavering support have accompanied me through every step of this journey—words will never be enough

to express my gratitude. And to our three children, Idea Harmonia Progressia, Amartya Makayasa Progressia, and Digdaya Britannica Progressia—thank you for bringing joy, meaning, and light into our lives. You are my greatest source of inspiration.

Declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for a degree or other qualification at this University or elsewhere. All sources are acknowledged as references.

A modified version of chapter 6 has been submitted to the journal *Environment and Planning E: Nature and Space* as part of a Special Issue themed "Mobilising and Contesting Law in Contemporary Socio-environmental Conflicts." This Special Issue stems from the International Networking Workshop entitled "The Politics of Legal Processes to Redress Environmental Injustices from Contested Natural Resource Governance," held from 15 to 17 November 2023 at the Freiburg Institute for Advanced Studies, in Freiburg im Breisgau, Germany. Therefore, I can confirm that, as the author, I was responsible for the conceptualisation and methodological design, conducted all data collection and analysis, developed the core arguments, and took full responsibility for writing and revising the manuscripts throughout the review process.

List of Abbreviations

ABD	: Accumulation by Dispossession
AMDAL/EIA	: <i>Analisis Mengenai Dampak Lingkungan</i> (Environmental Impact Assessment)
BAPEDAL	: <i>Badan Pengendalian Dampak Lingkungan</i> (Environmental Impact Management Agency)
BG	: <i>Badan Geologi</i> (Geological Agency)
BLH	: <i>Badan Lingkungan Hidup</i> (Environmental Agency)
BUMN	: <i>Badan Usaha Milik Negara</i> (State-Owned Enterprise)
CAT	: <i>Cekungan Air Tanah</i> (Groundwater Basin)
CBNRM	: Community-Based Natural Resource Management
DLH	: <i>Dinas Lingkungan Hidup</i> (Environmental Service)
DR	: Disaster Recovery
EA	: Environmental Assessment
EJ	: Environmental Justice
EPE	: Emotional Political Ecology
ESDM	: <i>Energi dan Sumber Daya Mineral</i> (Energy and Mineral Resources)
FDI	: Foreign Direct Investment
FNKSDA	: <i>Front Nahdliyin untuk Kedaulatan Sumber Daya Alam</i> (Front Nahdliyin for Sovereignty of Natural Resources)
FPE	: Feminist Political Ecology
GDPR	: General Data Protection Regulation

GRDP	: Gross Regional Domestic Product
GMNI	: <i>Gerakan Mahasiswa Nasional Indonesia</i> (Indonesian National Student Movement)
HRLS	: <i>Pusat Studi Hukum Hak Asasi Manusia</i> (Center for Law and Human Rights Studies)
HuMa Jakarta	: <i>Perkumpulan HuMa</i> Jakarta (Association for Community-Based and Ecological Legal Reform)
IAASTD	: Internasional Assesment of Agricultural Knowledge, Science, and Technology
IUP	: <i>Izin Usaha Pertambangan</i> (Mining Bussiness Permits)
ISS	: Indonesian Speleological Society
ITB	: <i>Institute Teknologi Bandung</i> (Bandung Institute of Technology)
JM-PPK	: <i>Jaringan Masyarakat Peduli Pegunungan Kendeng</i> (Kendeng Mountains Concerned Community Network)
KBAK	: <i>Kawasan Bentang Alam Karst</i> (Karst Natural Landscape Area)
KLHK	: <i>Kementerian Lingkungan Hidup dan Kehutanan</i> (Ministry of Environment and Forestry)
KLHS/SEA	: <i>Kajian Lingkungan Hidup Strategis</i> (Strategic Environmental Assessments)
KPA	: <i>Komisi Penilai AMDAL</i> (EIA Study Commission)
KPH	: <i>Kesatuan Pengelolaan Hutan</i> (Forest Management Units)
KRP	: <i>Kebijakan, Rencana, dan Program</i> (Policy, Plan, or Program)
KSP	: <i>Kantor Staff Presiden</i> (Presidential Staff Office)
KTUN	: <i>Keputusan Tata Usaha Negara</i> (The State Administrative Decision)

LBH	: <i>Lembaga Bantuan Hukum</i> (Legal Aid Institute)
MA	: <i>Mahkamah Agung</i> (Supreme Court)
MCI	: Mining Contribution Index
MVRMA	: Mackenzie Valley Resource Management Act
NGO	: Non-governmental Organisation
Permen LH	: <i>Peraturan Menteri Lingkungan Hidup</i> (Regulation of The Minister of Environment)
PK/PKMA	: <i>Peninjauan Kembali Mahkamah Agung</i> (Supreme Court's Judicial Review)
PSMB	: <i>Pusat Studi Manajemen Bencana</i> (Center for Disaster Management Studies)
PTTUN	: <i>Pengadilan Tinggi Tata Usaha Negara</i> (High Administrative Court)
PTUN	: <i>Pengadilan Tata Usaha Negara</i> (State Administrative Court)
PUKAT	: <i>Pusat Kajian Anti Korupsi</i> (Center for Anti-Corruption Studies)
RKL-RPL	: <i>Rencana Pengelolaan Lingkungan Hidup–Rencana Pemantauan Lingkungan Hidup</i> (Environmental Management and Monitoring Plan)
RPP	: <i>Rancangan Perundang-undangan</i> (Draft Government Regulation)
RTRW	: <i>Rencana Tata Ruang Wilayah</i> (Spatial Planning Documents)
SEPAHAM	: <i>Serikat Pengajar HAM Indonesia</i> (Human Rights Teachers Association)
SIA	: Social Impact Assessment
SK	: <i>Surat Keputusan</i> (Decree)
STS	: Science Technology and Society

TEK	: Traditional Ecological Knowledge
UGM	: <i>Universitas Gadjah Mada</i> (Gadjah Mada University)
UKL-UPL	: <i>Usaha Pengelolaan Lingkungan Hidup–Usaha Pemantauan Lingkungan Hidup</i> (Environmental Management and Monitoring Efforts)
WALHI	: <i>Wahana Lingkungan Hidup</i> (Indonesian Forum for the Environment)

1. Introduction

1.1 Background

Conflicts over natural resources are complex due to the interactions of various factors, such as social, political, economic, and ecological issues. The existence of various actors and interests often have competing interests and claims over access, control, and use of resources (Conde, 2014). Power imbalances further complicate these conflicts, where dominant actors can influence governance frameworks to prioritise economic and industrial goals at the expense of broader interests, such as environmental sustainability and social justice. In addition, natural resource governance must navigate environmental uncertainties, such as the risk of resource depletion and ecological degradation, which add another layer of complexity. The intersection of various interests, power dynamics, and environmental challenges makes natural resource conflicts a relevant issue to be analysed using a political ecology approach.

Political ecology, as the overarching approach of this study, provides a critical lens through which to examine these intersections, focusing on how natural resource management is a contested arena shaped by competing actors, structural inequalities, and discursive practices. Moving beyond apolitical or technocratic approaches (Robbins, 2012), political ecology reveals the socio-political and economic forces underlying environmental decision-making, highlighting the asymmetrical power relations embedded in governance systems (Bryant, 1997). This study employs the pluralistic power framework developed by Svarstad et al. (2018), which integrates actor-oriented, neo-Marxist, and post-structuralist perspectives to analyse the multidimensional nature of power in resource conflicts.

Within this framework, actor-oriented power emphasises the agency of individuals and groups in shaping environmental outcomes. Neo-Marxist power investigates the structural forces of capitalism and economic systems that drive resource exploitation. Meanwhile, post-structuralist power focuses on how discourse and knowledge are employed to legitimise or contest governance frameworks (Svarstad, Benjaminsen and Overå, 2018). By synthesising these

perspectives, this study provides a comprehensive analysis of the power dynamics shaping socio-environmental conflicts, especially those related to natural resources contestation. This pluralistic approach to power is relevant in understanding the interplay between grassroots resistance, state-corporate alliances, and the discursive strategies of environmental and economic priorities.

Accordingly, it becomes evident that resource governance, especially in contested ecosystems, is rarely neutral. Governance frameworks often prioritise industrial expansion and economic growth (Gani, 2011), aligning state and corporate interests at the expense of ecological sustainability and social justice. Political ecology critically examines these dynamics, particularly the “state-corporate alliances” that allow extractive industries to dominate governance processes. Such alliances marginalise local communities and environmental concerns, perpetuating systemic inequalities in natural resource management (Malin, Ryder and Lyra, 2019). These tensions are particularly evident in karst landscapes, which have significant ecological value but are heavily exploited for industrial purposes, such as cement production (Sun et al., 2017; Silva et al., 2021).

1.2 The Context of Cement Mining Operation in the North Kendeng Mountains

The North Kendeng Mountains, located in Central Java, Indonesia, are home to one of the largest karst landscapes in Southeast Asia. Karst is a type of geological formation primarily composed of limestone, characterised by unique hydrological systems such as underground rivers, caves, and sinkholes (Veress, 2020). These formations play a critical role in groundwater recharge, making them essential for maintaining water availability in surrounding agricultural and rural communities. The Kendeng region is inhabited by a mix of Javanese farming communities, including the Indigenous Samin people, who have historically relied on subsistence agriculture, rice cultivation, and livestock farming as their primary means of livelihood. The ecological and cultural significance of this region makes it a vital resource not only for local communities but also for environmental conservation efforts (Sumarga, E., Willemen, L., Rosleine, D., Fitria, F., Agatha, K., and Sinaga, 2024).

Despite its ecological importance, the Kendeng karst region is also highly valued by the cement industry due to its vast limestone reserves, a key raw material for cement production (Rokhmad, 2020). Indonesia's rapid urbanisation and large-scale infrastructure projects have fuelled an increasing demand for cement, positioning the Kendeng karst as a strategic resource for national economic development. The government, in partnership with state-owned enterprises such as PT. SI (formerly PT. SG), has promoted cement mining in the region as essential for industrial growth and job creation. However, this has created tensions between state and corporate actors seeking to exploit the region's limestone deposits and local communities and environmental groups advocating for its conservation.

The extraction of karst resources poses significant risks, particularly to water security and biodiversity (Lv et al., 2020). Mining operations disrupt the karst's natural water retention functions, leading to potential water shortages for agriculture and domestic use. Furthermore, the destruction of limestone formations threatens the ecological balance, impacting endemic species and altering the local environment (Clements et al., 2006; Hughes, 2017). These competing interests, i.e., economic development versus environmental sustainability, form the foundation of the socio-environmental conflict in the North Kendeng Mountains. Understanding this dynamic is crucial to examining the broader governance challenges and power struggles surrounding natural resource extraction in Indonesia.

Despite these environmental risks, the Indonesian government continues to promote karst mining as a strategic economic activity, particularly through state-owned enterprises such as PT. SI. In recent years, mining operations have expanded from Gresik and Tuban to the Pati and Rembang districts, driven by claims of limited national cement reserves and the need to support infrastructure development. Proponents of the project argue that the establishment of a new cement factory in the North Kendeng Mountains will contribute to local economic growth by providing land compensation, employment opportunities, and business development initiatives. Additionally, PT. SI has sought to mitigate environmental concerns by framing the project as utilising "environmentally friendly" mining technologies that, allegedly, minimise ecological harm.

However, the expansion of cement production in the North Kendeng Mountains has not been without significant challenges and resistance. While proponents emphasise economic benefits and sustainable mining claims, local communities have strongly opposed these projects, citing environmental degradation and lack of transparency in the decision-making process. This resistance was first evident in 2005 when PT. SG attempted to establish a cement factory in Sukolilo, Pati Regency. The project faced intense backlash due to the exclusion of local communities from key consultations and concerns over its environmental impact. In response, community members mobilised legal and grassroots advocacy efforts to challenge the project, leading to a prolonged legal battle. Ultimately, in 2010, the court revoked the environmental permit for the proposed cement factory, marking an early victory for the movement against large-scale extraction in the region (Mojo, Hadi and Purnaweni, 2017).

The failure to establish this cement factory did not deter the expansion of cement mining in the North Kendeng Mountains. Following this setback, in 2013, the government of Rembang Regency, which is also located within the Kendeng Mountain range, issued a mining permit to PT. SI for the construction of a cement factory. This permit was also approved by the Central Java Provincial Government. However, the project met strong resistance from the local community, particularly in Gunem District, an area in Rembang Regency directly affected by the proposed mining operations. Residents rejected the project due to its potential environmental impact, particularly concerns over the depletion of water resources (Suharko, 2017). The proposed mining site overlaps the Watuputih Groundwater Basin, a crucial water recharge area that sustains local agriculture. Local communities, which are dominated by peasants who rely on these water sources for irrigation, feared that mining activities would severely disrupt their livelihoods.

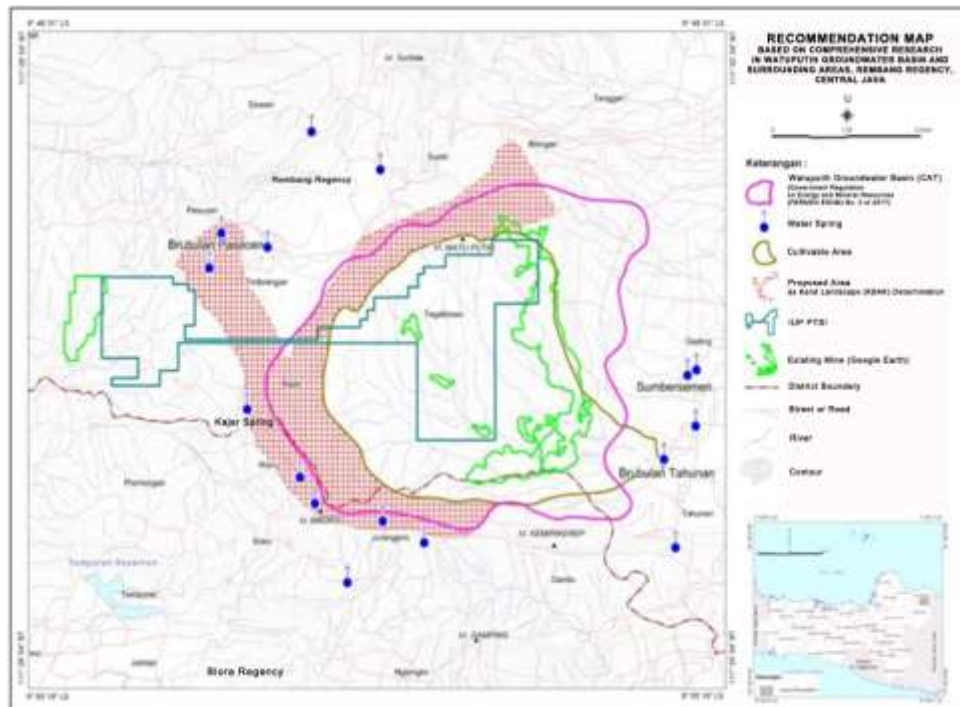


Figure 1.1: Watuputih Groundwater Basin Area
Source: Geological Agency, 2017 (Translated version)

In addition to environmental concerns, opposition to the cement factory was fuelled by irregularities in the environmental impact assessment (EIA) process. Local activists and environmental groups argued that the EIA conducted for the project contained inaccurate data regarding the geological and hydrological conditions of the region, failing to account for the karst system's critical function in groundwater storage. This led to legal challenges and further resistance efforts. Despite the growing controversy, cement industry expansion in the Kendeng region continued.

The controversy over cement mining in Rembang escalated into a large-scale resistance movement, drawing national attention in Indonesia. Inspired by the successful opposition to the cement factory in Pati Regency, the affected communities in Rembang organised protests and mobilised various strategies to challenge the project. One of their key actions was staging demonstrations at Gadjah Mada University (UGM), one of Indonesia's leading universities, which had conducted research supporting the cement factory's environmental feasibility. Protesters criticised UGM's involvement, arguing that its study failed to account for the environmental and social risks of karst mining (Apriando, 2015).

The resistance movement also employed symbolic and legal strategies to strengthen their cause. In 2016, a group of female peasants from the Kendeng region staged a powerful protest by burying their feet in cement outside the Presidential Palace in Jakarta, a symbolic act representing the irreversible damage caused by cement mining. Additionally, activists produced a documentary film titled "SAMIN vs SEMEN" (Samin vs Cement), which highlighted the perspectives of the Indigenous Samin community and their struggle against the mining project (Watchdoc Image, 2015). The movement also compiled a counter-EIA report to challenge the official government-approved study, arguing that the original assessment failed to address key hydrological and ecological risks. Their legal advocacy led to the implementation of a strategic environmental assessment (SEA) process, a broader environmental evaluation mechanism that examines cumulative and long-term environmental impacts.

In 2016, these resistance efforts culminated in a significant legal victory when the Indonesian Supreme Court ruled to revoke the environmental permit for the cement factory. However, this decision was undermined the following year when, on August 2, 2017, the Central Java Province Environmental Impact Assessment Commission (*Komisi Penilai AMDAL/KPA*) approved a revised EIA document, known as an Addendum, allowing the project to proceed. This revised assessment, issued under Central Java Governor Decree No. 660.1/4 of 2017, justified the continuation of mining operations despite previous legal rulings.

This situation has been further strengthened by the results of research conducted by the Geological Agency, which was agreed upon by both parties as a basis for proving the existence of underground rivers. The study concluded that there was no indication of the existence of underground rivers in the Watuputih Groundwater Basin area. Thus, the area could not be categorised as a karst landscape area. Consequently, the results of this study became the basis for the legitimacy of the operation of a cement factory in the area.

Despite these setbacks, the grassroots coalition the *Jaringan Masyarakat Peduli Pegunungan Kendeng* (JM-PPK), or the Kendeng Mountains Caring Community Network, has remained steadfast in its opposition to the cement factory. The coalition, composed of local peasants, environmental activists, academics, experts, and civil society organisations, continues to resist mining activities

through legal challenges, advocacy campaigns, and community mobilisation, reaffirming their commitment to protecting the Kendeng Mountains' ecological and cultural heritage.

1.3 Study Rationale

The Kendeng Mountains have been at the centre of debates over environmental sustainability, community livelihoods, and industrial development. However, despite these conflicts, the complexities of how power dynamics influence governance, scientific claims, and expertise in this context remain underexplored.

This study was motivated by a need to address gaps in the existing research on resource conflicts in Kendeng. Previous studies have largely focused on socio-legal approaches, emphasising regulatory inconsistencies, such as contradictory environmental permits and procedural loopholes exploited by state and corporate actors to maintain mining operations despite judicial rulings against them. For instance, research highlights the Central Java Governor's 2012 decree granting PT. SI an environmental permit, which became the basis of protracted legal disputes (Enggarani and Spaltani, 2019). Additionally, inconsistencies in watershed regulations, such as conflicting zoning policies, ambiguous environmental protection criteria, and weak enforcement mechanisms, have allowed over 20 mining permits to be issued since 2018 in ecologically sensitive areas. These regulatory gaps enable mining operations to proceed despite legal provisions intended to protect water resources, highlighting the inadequacy of the existing governance mechanism (Hadi, 2018). While these studies provide valuable insights, they often fail to incorporate a political ecology lens to examine the broader interplay of power, governance, and environmental decision-making.

Moreover, the regional spatial planning (RTRW) administration and the SEA process, which were designed to regulate land use and assess the environmental impacts of development projects, have been criticised for failing to prioritise environmental sustainability and for procedural deficiencies. The RTRW, updated periodically by provincial and district governments, has been criticised for accommodating industrial expansion, including mining activities, without adequate environmental safeguards. Similarly, the SEA, which was introduced as

part of environmental governance reforms, has been challenged for its inconsistent implementation and lack of enforcement mechanisms, allowing extractive projects to proceed despite identified ecological risks (Hadi, Purnaweni and Prabawani, 2019). These shortcomings raise concerns about the effectiveness of spatial planning and environmental assessments in mitigating environmental degradation in the North Kendeng region.

In addition to socio-legal and document-based analyses, actor-oriented approaches have also been widely employed to study the Kendeng conflict. The research underscores the lack of meaningful community participation in key governance processes, such as the preparation of EIA (Sudharto, Hartuti and Kismartini, 2018). Local communities have voiced their concerns over the socio-environmental threats posed by cement mining, including disruptions to agricultural land, water resources, and livelihoods (Sumarno and Wiratomo, 2019). Furthermore, divergent perceptions between central and local governments, as well as within the community itself, have exacerbated the conflict. Local governments often assert regional autonomy, while central governments emphasise national priorities (Suyahmo et al., 2020). Meanwhile, tensions within the community, including divisions based on religious and socio-political affiliations, further complicate resistance efforts (Rokhmad, 2020).

Despite these valuable contributions, the existing literature lacks a comprehensive analysis of the power dynamics underlying resource governance in Kendeng. The socio-environmental conflict in Kendeng involves not only regulatory inconsistencies and actor interactions but also the strategic framing of scientific claims and expertise. Grassroots resistance movements, such as those led by the JM-PPK, have actively contested corporate-backed narratives by leveraging local knowledge and independent scientific evidence. However, there remains a need for research that examines how power is mobilised, contested, and reconfigured within governance processes and socio-environmental conflicts in this region. Specifically, a political ecology framework is well-suited to analysing the pluralistic power dynamics at play, as it allows for a nuanced understanding of how actors navigate legal, economic, and discursive arenas to shape resource governance. By integrating structural, agency-oriented, and discursive perspectives, this approach provides critical insights into how state-corporate alliances sustain extractive projects.

By focusing on how power operates through scientific and expert claims, this research provides a nuanced understanding of resource struggles in Kendeng. This approach goes beyond single-dimensional analyses to capture the complexity of governance, resistance, and contestation in socio-environmental conflicts. By employing a multi-sited ethnographic methodology, this research traces the operation of power across multiple scales, from local community protests to national policy discussions, offering insights into the dynamics of natural resource governance in the North Kendeng Mountains.

1.4 Research Objectives and Research Questions

The primary aim of this research is to explore how power dynamics shape scientific and expert claims in the contestation of natural resources, specifically focusing on the governance of karst resources in the North Kendeng Mountains. This study seeks to understand how various actors and alliances mobilise power, construct narratives, and influence decision-making processes in the struggle over resource governance.

To achieve this aim, the study pursues the following research questions. In this thesis, the main question that I ask is: *How do power dynamics shape scientific and expert claims in the governance of karst resources in the North Kendeng Mountains, Indonesia?* To address this question, I have found it helpful to divide it into the following sub-questions:

- a) How do different actors (e.g., government, corporations, local communities, experts, academics, activists, NGOs) construct and contest scientific and expert claims in the governance of karst resources?
- b) What role do economic structures and interests play in shaping governance frameworks and the scientific claims used to justify or oppose resource extraction in the karst region?
- c) How are scientific uncertainties and environmental risks framed and mobilised by actors to influence decision-making processes and public narratives in karst governance?

1.5 Scope and Orientation of the Research

This study focuses on the conflict over karst resource mining in the North Kendeng Mountains region, located in Central Java, Indonesia. This study explores the socio-political, environmental, and legal dimensions of this conflict, focusing on the interactions between various actors, including local communities, academics and experts, religious groups, political elites, government agencies, companies, and NGOs. Meanwhile, in terms of geographical coverage, this study covers several locations that are closely related to the management of the North Kendeng Mountains area, including Rembang, Pati, Semarang, Yogyakarta, and Jakarta. Indeed, these locations reflect the multi-scale nature of the dispute involving local to national stakeholders, which is an important aspect of the political ecology approach.

In addition, the temporal scope of this study covers how karst mining began in the North Kendeng Mountains region until today, which includes the dynamics of the conflict, protest movements and campaigns to reject cement factories, legal battles, and ongoing resistance efforts carried out by local communities. This study investigates the historical context of karst mining in the North Kendeng Mountains region, Indonesia, including the development of karst resource management policies, and the broader implications of these policies for local communities and ecosystems.

Furthermore, this research orientation emphasises the theoretical framework of political ecology, which serves as a foundation for analysing the complex interactions between natural resource management issues and socio-political dynamics. Within this framework, a pluralistic approach to power is specifically at the core of the analysis, allowing the research to explore how power is exercised by various actors and how it operates at various scales, from local communities to national policy arenas. To investigate the dynamics of these contestations, the research adopts a multi-sited ethnographic methodology, focusing on the lived experiences of local communities directly affected by karst mining and how they respond to policies related to natural resource management in their areas. Through methods such as participant observation, semi-structured interviews, informal conversations, and reports of secondary data (EIA, EIA Addendum, SEA, and lawsuits), the research seeks to capture the daily struggles, resistance

efforts, and political actions of these communities. This multi-sited, ethnographic methodology provides in-depth insights into the socio-cultural dimensions of the conflict, highlighting the importance of local knowledge and practices in shaping natural resource governance.

Finally, the research is oriented towards creating policy-relevant insights that can contribute to more equitable and sustainable natural resource governance in Indonesia. By analysing the dynamics of the conflict that has occurred, it aims to offer practical recommendations that can help reduce similar conflicts in the future. Ultimately, it seeks to inform and influence the development of more equitable natural resource governance practices, ones which are based on a deep understanding of the power dynamics that occur in natural resource contestation in the North Kendeng Mountains.

1.6 Thesis Structure

This thesis is structured into nine chapters, comprising one introductory chapter, seven substantive chapters, and one concluding chapter. In the first chapter, I present an overview of the research and the rationale behind selecting this research topic. I also outline the objectives of the research and formulate the research questions, followed by the structure of this chapter. The second chapter pertains to the literature review and theoretical foundation. In the final section of this chapter, I provide a diagram of the analytical framework, which serves to explain how the theoretical framework is applied in the study's analysis. Chapter Three discusses the methodology employed in this research. I explain the reasons for using multi-sited ethnography as the chosen methodology and, most importantly, how multi-sited ethnography is relevant to the political ecology framework, which serves as the primary approach of this study. Chapter Four covers the context of the study, presenting the historical background of the resource contestation dynamics related to the karst region in the Kendeng Utara Mountains. This chapter aims to bridge the understanding of resource contestation in the Watuputih Groundwater Basin. Chapter Five is an empirical chapter that discusses how scientific knowledge and expertise shape the discourse in environmental assessment documents, including the EIA, the EIA Addendum, and the SEA. In Chapter Six, I explore the debates over contested

scientific evidence within the legal arena. This chapter examines the extent to which arguments and evidence surrounding knowledge production influence court decisions. Chapter Seven addresses the role of the Geological Agency in the final decision-making process regarding the management of the karst region in the Watuputih Groundwater Basin. Next, Chapter Eight serves as the discussion chapter of this thesis. In this study, I analyse how a pluralistic approach to power reveals the contested claims of scientific knowledge and expertise in the management of the karst region by various actors. Additionally, I highlight how this research contributes to the field of political ecology. Chapter Nine is the concluding chapter, where I present the conclusions, policy recommendations, and further research suggestions.

2. Literature Review and Theoretical Framework

2.1 Introduction

This chapter presents a literature review and examines the theoretical trajectory of the concept of power in the development of political ecology as a growing body of knowledge. Tracing this theoretical trajectory is important to understand, in depth, how conceptual understandings of power have evolved and influenced analytical paradigms in this field.

Moreover, this chapter will elaborate on the pluralistic approach of power as the main theoretical framework of the study, which aims to comprehensively analyse how knowledge production and claims to scientific expertise shape environmental governance practices and outcomes. Although the initial research question emphasises a post-structuralist approach that focuses on the dynamics of the relationship between knowledge and power, this study goes further by integrating actor-oriented perspectives and structural-economic analysis. Thus, this integrated approach offers deeper insights into how various dimensions of power, such as discursive strategies, actors, and structural-economic interests, interact and collectively influence decision-making processes in the governance of natural resources that are the object of contestation.

The chapter is composed of several interconnected objectives, which are divided into sections. In the first section, I provide an exposition on the history and emergence of political ecology as a body of knowledge. Moreover, it delves into the intersection of ecological politics with various theories, such as political economy and environmental justice. The section also scrutinises the criticisms and discussions on political ecology, as articulated by different scholars. Most importantly, this section aims to establish the compatibility of my research with the political ecology approach.

In the second section, I will delineate how power in political ecology emphasises the complex and diverse nature of power relationships in human-nature interactions. It focuses on how power dynamics shape conflicts over natural

resources, influencing both policy decisions and the interactions between stakeholders involved in environmental governance. Power is context-dependent and operates in a variety of ways, requiring a dynamic and relational understanding. Influential theoretical frameworks by Marx, Weber, and Foucault provide important tools for analysing power dynamics in environmental decision-making.

In the third section of this chapter, I discuss the limitations of previous empirical studies, especially those that explicitly use the concept of power as a theoretical framework in their research. In this section, I outline several previous studies that have limitations in the analysis of power, both those that only use one perspective of power and those that have tried to elaborate on three perspectives of power or make modifications to them. The purpose of this section is to identify gaps in the existing research, which will then be addressed in this study.

In the fourth section, I will explain how the pluralistic approach to power acts as the theoretical background of this research. A pluralistic approach to power in political ecology emphasises the importance of combining diverse theoretical perspectives to fully understand the dynamics of power relations in environmental contexts. Initially, political ecology did not explicitly adopt a pluralistic approach. However, Bryant's works in the late 1990s implicitly encouraged its development by highlighting the role of material knowledge and struggle (Bryant, 1998). He criticises neo-Marxist and Weberian approaches that ignore the formation of knowledge and advocates for integrating power/knowledge analyses into political ecology. Later, Svarstad, Benjaminsen, and Overå (2018) proposed a synthesis of various theories of power to provide a more comprehensive understanding of socio-environmental conflicts, particularly regarding the struggles over natural resources. Such an integrated approach is particularly valuable because it highlights the complexity of interactions between grassroots agencies, structural-economic forces, and discursive power. These multiple dimensions are critical in analysing conflicts related to resource governance, including issues around karst mining in the North Kendeng Mountains, where actors strategically use scientific claims and regulatory frameworks to assert competing interests and legitimacy.

In the next section, I will outline the theoretical position of this thesis. I would like to explicitly emphasise that the main analytical framework is based on the post-structuralist approach. This choice is based on the research's emphasis on aspects of knowledge production, discourse dynamics, and the construction of expertise claims. Furthermore, I will clearly explain that the main theoretical contribution of this thesis lies in the integration of the actor-oriented representation approach (Weberian) and structural political economy (neo-Marxist), as an effort to enrich and deepen the study's analysis.

In the final section, I discuss how a pluralistic approach to power can enhance the analysis of conflicts over karst resource governance by examining how competing claims to scientific expertise are constructed and utilised by different actors. This analytical framework incorporates a deeper analysis of how scientific evidence and expertise claims are mobilised by competing groups in different arena contestations. Through integrating neo-Marxist, Weberian, and post-structuralist perspectives, a pluralistic power approach highlights how power operates through structural-economic interests, discursive practices, and individual or collective agency. This comprehensive approach reveals how scientific and expert claims are not neutral but rather embedded within broader struggles for legitimacy and influence among multiple actors, thus illuminating the natural resources contestation in the North Kendeng Mountains.

2.2 Political Ecology: An Approach

The emergence of political ecology was a reaction to the wave of the global environmentalism movement in the 1970s, which critiqued numerous global economic development goals with negative consequences. This viewpoint of the environmental movement was dominated by Darwinian and Malthusian schools of thought, which oversimplified environmental difficulties (Peet and Watts, 1996). Furthermore, the emergence of political ecology served as a critique of ecological anthropology and cultural ecology, both of which were limited by their focus on environmental interactions primarily as adaptive systems, often overlooking the role of power, politics, and economic structures in shaping human-environment relationships (Peet and Watts, 1996). This perspective assumes that humans have an innate capacity to adapt to environmental change. However, political

ecology criticised this assumption, highlighting how adaptation is not always possible or equitable across groups. Ecosystem change often occurs due to external forces, such as market pressures or state intervention, which can create barriers to adaptation.

Third, the environmental problems, particularly those in developing countries, have been more than just the result of poor management, overcrowding, and ignorance. Instead, they must be addressed and examined in terms of how the local-global relationship is perceived from a political economics standpoint (Peet and Watts, 1996). Blaikie and Brookfield (1987) have suggested that environmental challenges must be considered historically, and in their economic and political context. As a result, the political ecology approach became dominated by the political economy approach. Nonetheless, numerous disciplines have had an impact on the political ecology approach.

In addition, a wide range of theoretical frameworks from different disciplines have strengthened the political ecology approach. Particularly, those from the social sciences. The theoretical views from the social science groups that have impacted the political ecology approach are depicted in Figure 2.1:

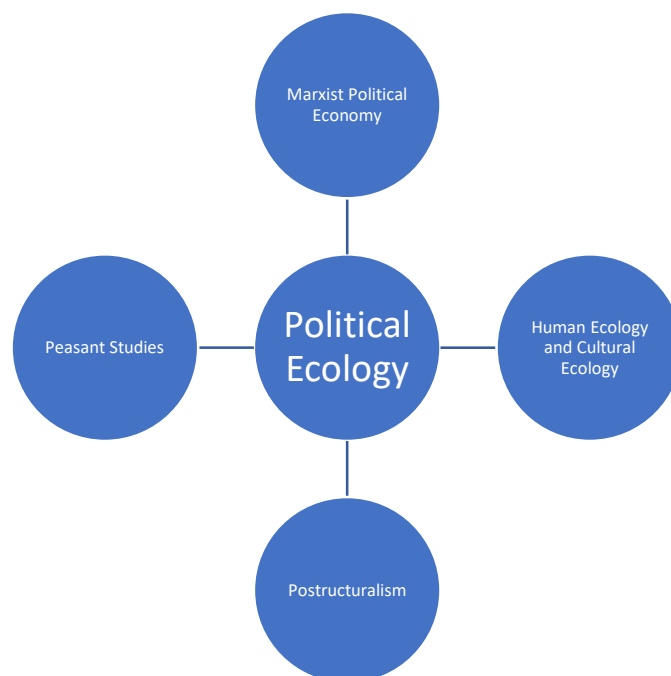


Figure 2.1: Influences on Political Ecology (adapted from: Benjaminsen and Svarstad, 2021).

Several of these theoretical frameworks have contributed to the development of political ecology as an interdisciplinary field that critically examines the intersections of environment, power, and society. While political ecology draws from multiple disciplines, including geography, anthropology, political, and environmental science, it does not constitute a singular discipline but rather a diverse and evolving analytical approach (Benjaminsen and Starvard, 2021). By analysing social structure, a mode of production, primitive accumulation, and commodity fetishism, Marxist political economy enriches the political ecology approach. Several conceptual analyses from human ecology and cultural ecology motivate the political ecology approach, including resilience, adaptability, stability, equilibrium, and smallholders. Moreover, from a post-structuralist perspective, knowledge regimes, discourse narratives, myth, governmentality, and biopower are among the analyses that contribute to improving political ecology. Finally, the study of agricultural workers provides an analysis of resistance and marginalisation.

The growth of political ecology has not been without debate and criticism, as scholars have raised concerns regarding its emphasis on political relations, ethical responsibilities, and its approach to poverty and structural inequality. One of the most significant criticisms is that political ecology overemphasises political and social relations while neglecting biophysical ecological analysis. Scholars such as Vayda and Walters (1999) argued that political ecology is often reduced to “politics without ecology” because it does not sufficiently engage with the scientific aspects of biophysical processes. This critique suggests that political ecology primarily explores power dynamics, governance, and social struggles while failing to incorporate detailed ecological analysis of environmental changes. However, this criticism is premature and oversimplified. As Walker (2005, 2007) argued, political ecology is fundamentally concerned with socio-environmental interactions, and many studies engage deeply with ecological data. Researchers working in this tradition, particularly in conservation and land-use studies, have demonstrated how political economy and ecological processes interact (Robbins, 2020). Rather than ignoring ecology, political ecologists incorporate biophysical processes into their analyses while maintaining a focus on how power structures shape environmental outcomes.

Another criticism concerns the ethical responsibilities of political ecologists concerning the communities they study. Walker (2007) highlighted that political ecology, as a normative and engaged field, requires researchers to acknowledge their positionality and ensure that their work benefits marginalised communities rather than merely extracting knowledge from them. This perspective emphasises that scholars must actively contribute to the struggles of the people they study whether through advocacy, capacity-building, or policy engagement. While some argue that such ethical engagement may compromise academic objectivity, proponents of political ecology assert that the field was never meant to be neutral. Political ecology was developed as a critical and transformative approach, challenging dominant narratives that often reinforce environmental injustices (Peet & Watts, 2004). Its ethical orientation is not a weakness but a necessary stance that distinguishes it from purely technocratic approaches to environmental governance.

A third criticism is that political ecology does not adequately address the root causes of poverty, particularly the role of capital accumulation in perpetuating inequality (Peet & Watts, 1996). Some scholars contend that early political ecology studies focused primarily on environmental degradation while failing to integrate a robust analysis of how global economic structures systematically disenfranchise poor and marginalised communities. However, political ecology has increasingly addressed these concerns by incorporating critical development studies, neo-Marxist analyses, and postcolonial critiques (Bryant & Bailey, 1997; Robbins, 2020). Recent scholarship emphasises that environmental struggles cannot be understood in isolation from historical and structural-economic forces that shape patterns of resource exploitation and social inequality (Li, 2014). As a result, contemporary political ecology explicitly examines how poverty, dispossession, and environmental change are co-produced by global capitalism and state policies.

While these critiques highlight important debates within political ecology, they do not undermine its theoretical and methodological contributions. Instead, they demonstrate how political ecology has evolved in response to shifting academic and real-world challenges. The field continues to refine its approaches by integrating biophysical sciences, ethical research practices, and structural-

economic analyses to offer a more comprehensive understanding of socio-environmental conflicts (Perreault, Bridge and McCarthy, 2015).

Moreover, political ecology shares conceptual overlaps with other approaches, particularly political economy, and environmental justice, yet remains distinct in its analytical focus. While it draws heavily from political economy, the two fields are not interchangeable. Political economy traditionally examines how economic structures and capitalist processes shape social relations, whereas political ecology extends this analysis by explicitly incorporating environmental concerns, emphasising how power and political dynamics influence human-environment interactions (Kitchen and Thrift, 2009). As an interdisciplinary approach, political ecology applies political economy concepts to environmental issues but integrates additional perspectives from anthropology, geography, and critical development studies.

Similarly, political ecology and environmental justice (EJ) share common ground in their criticism of environmental inequalities but differ in emphasis.

Environmental justice scholarship predominantly focuses on three dimensions—distributive justice (the fair distribution of environmental benefits and burdens), recognition (acknowledging marginalised communities and their rights), and procedural justice (ensuring fair participation in decision-making) (Svarstad & Benjaminsen, 2020). However, political ecologists criticise certain assumptions within EJ scholarship, particularly the tendency to treat affected communities as homogenous entities while overlooking internal power dynamics. Additionally, political ecology highlights the broader structural and institutional forces responsible for environmental injustices, which EJ frameworks sometimes underemphasise (Svarstad & Benjaminsen, 2020). By situating environmental struggles within a broader political and economic context, political ecology offers a more systemic analysis of power relations in socio-environmental conflicts.

Furthermore, political ecology continues to evolve as scholars refine its analytical and methodological tools to address increasingly complex environmental issues. In response to emerging socio-environmental challenges, subfields such as feminist political ecology (FPE) and emotional political ecology (EPE) have broadened the scope of analysis. FPE integrates gender as a central category, highlighting how environmental governance and resource access are shaped by

gendered power relations and social hierarchies (Elmhirst, 2011). EPE, on the other hand, emphasises the role of emotions in environmental conflicts, recognising how feelings of attachment, fear, and resistance influence socio-environmental struggles (Sultana, 2015). These expansions illustrate how political ecology remains dynamic, adapting to new conceptual and empirical insights.

Given this diversity of approaches, this study draws on an integrative political ecology approach that synthesises key analytical techniques to examine the socio-environmental conflict in the North Kendeng Mountains. This synthesis is particularly informed by Benjaminsen and Svarstad's (2021) discussion in "Political Ecology of Pandora", which outlines critical dimensions for analyzing human-environment interactions. Through a review of political ecology literature, I have identified four key analytical dimensions: multi-scale analysis, temporal connectivity, power relationships, and diverse knowledge systems. These dimensions allow for a more comprehensive examination of how socio-environmental conflicts unfold across different spatial and temporal scales, how power is exercised and contested, and how multiple knowledge systems intersect in environmental governance. In the following section, I illustrate how these dimensions shape my research approach and contribute to filling gaps in existing studies of human-nature relationships.

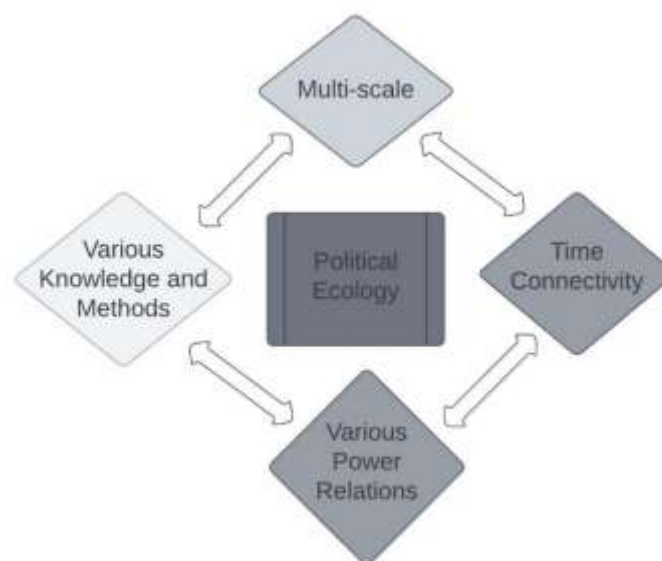


Figure 2.2: Dimensions of Analysis in the Political Ecology Approach

Political ecology employs a multi-scalar approach to analyzing environmental governance and conflicts, recognising that socio-environmental issues operate across different spatial and institutional levels (Neumann, 2009; Robbins, 2020). This framework integrates geographical scales, ranging from individual actors to global institutions, and hierarchies of socio-economic organisation, such as households, villages, regions, and states (Paulson, Gezon and Watts, 2003; Blaikie and Brookfield, 1986). For example, conflicts over coal mining in Kalimantan, Indonesia, cannot be understood solely at the local level but must be situated within broader political-economic networks that link regional, national, and international actors. A multi-scalar perspective allows researchers to trace how policies and regulations are formulated at higher levels of governance while simultaneously examining their localised socio-ecological impacts (Bridge, 2010).

Beyond spatial dimensions, political ecology also incorporates a historical perspective (time-connectivity), emphasising the trajectory of environmental change and conflict over time (Mathevet et al., 2015). This approach acknowledges that environmental governance and contestations are shaped by past policies, economic shifts, and socio-political struggles. Mathevet et al., (2015) emphasise that the historical trajectory of environmental governance enables scholars to understand how resource management decisions evolve, how power dynamics shift, and how different actors adapt their strategies over time.

Political ecology is also characterised by its methodological pluralism, drawing on multiple sources and techniques to analyse socio-environmental dynamics (Doolittle, 2015). Rather than relying solely on quantitative data such as surveys and statistical analyses, political ecologists employ qualitative methods, including ethnographic fieldwork, discourse analysis, and document reviews, to capture the lived experiences of affected communities. Ethnographic approaches, which originate from anthropology, have proven particularly valuable in political ecology research as they provide in-depth insights into local environmental knowledge, governance practices, and resistance strategies (Little, 2007). This methodological flexibility allows for a more nuanced understanding of the complex relationships between society, politics, and ecology.

A key strength of political ecology is its emphasis on power relations in environmental governance, drawing on diverse theoretical perspectives such as Weberian, neo-Marxist, and post-structuralist analyses (Svarstad, Benjaminsen and Overå, 2018). Power is central to understanding how environmental decisions are made by actors whose interests are prioritised, and how resistance emerges in response to resource extraction (Cuvelier, Vlassenroot and Olin, 2014). Neo-Marxist approaches highlight how capitalist expansion drives environmental degradation and exacerbates inequalities, often reinforcing corporate control over natural resources (Harvey, 2018). Meanwhile, post-structuralist perspectives, influenced by Foucault, examine how environmental discourses and expert knowledge shape governance practices and legitimise certain forms of resource use while marginalising alternative perspectives (Hajer and Versteeg, 2005b; Hajer, 2006). These various power analyses make political ecology distinct from other approaches to human-environment relations as they explicitly interrogate the underlying political, economic, and discursive structures that shape environmental outcomes.

By integrating these analytical dimensions, multi-scalar analysis, time-connectivity/historical perspectives, various methodologies, and power relations, political ecology provides a comprehensive framework for examining environmental conflicts and governance. This study adopts these approaches to analyse the contestation over karst mining in the North Kendeng Mountains, illustrating how science and expertise shape resource struggles and governance outcomes.

2.3 Power in Political Ecology

Power is a defining feature of political ecology, setting it apart from other approaches to understanding human-environment interactions. In political ecology, power is not only a driving force behind resource conflicts but also a fundamental lens for analyzing governance, policy decisions, and environmental change (Ahlborg and Nightingale, 2018). It shapes how different actors negotiate access to and control over natural resources. By emphasising power relations, political ecology reveals the structural and discursive forces, and the actors that

influence environmental outcomes, highlighting the contested nature of human-nature interactions.

Power is inherently complex and cannot be reduced to a singular or absolute definition (Dowding, 2012; Pansardi, 2021). Instead, it is context-dependent, operating in varied and nuanced ways across political ecology and the social sciences more broadly. Within political ecology, power is analysed through its material, social, and institutional dimensions, emphasising how it is embedded in environmental conflicts and distributed among actors with differing levels of influence. Political ecologists examine how structural forces, such as economic and political institutions, shape access to resources, while also considering the agency of local communities in resisting and negotiating control over their environments. Meanwhile, scholars in the social sciences take a broader perspective, exploring power as a relational phenomenon that functions through networks, discourses, and institutional mechanisms (Therborn, 2021). Despite these disciplinary differences, both perspectives highlight the necessity of critically examining power dynamics to understand how environmental governance decisions are made, contested, and legitimised.

The study of power is a complex and evolving field, with scholars drawing on diverse theoretical frameworks to examine its nature and operation (Turner, 2005). Three of the most influential thinkers in this area, Karl Marx, Max Weber, and Michel Foucault, have shaped distinct perspectives on power that continue to inform contemporary debates. Their contributions have given rise to Neo-Marxist, Weberian, and post-structuralist approaches, each offering unique insights into how power functions within society. In the context of political ecology, these frameworks provide critical tools for analysing power dynamics in environmental governance and resource conflicts (Svarstad, Benjaminsen and Overå, 2018).

From a neo-Marxist perspective, Marx's emphasis on class struggle and economic structures helps explain how power is concentrated among dominant social groups, particularly in the control and exploitation of natural resources (Huber, 2017). This perspective highlights the material conditions that drive environmental conflicts, where capitalist interests prioritise industrial expansion over ecological sustainability. Meanwhile, a Weberian approach shifts attention to bureaucratic authority and legal-rational forms of power, illustrating how

institutional structures and regulatory frameworks shape decision-making in environmental governance (Decaro et al., 2017). Finally, Foucault's post-structuralist view conceptualises power as diffused and productive, operating through knowledge production and discourse (Fletcher, 2010). This lens reveals how environmental policies, scientific assessments, and regulatory narratives are shaped by competing claims to expertise, ultimately influencing whose interests are legitimised in resource governance.

Furthermore, the diverse theoretical approaches to power highlight the complexity and fluidity of struggles over natural resources. Recognising and engaging with this multiplicity allows for a deeper understanding of how power operates in varied and sometimes unexpected ways in environmental governance and resource conflicts. This is particularly relevant in addressing contemporary environmental challenges, where power is exercised through multiple actors, economic structures, and discursive strategies.

2.3.1 Neo-Marxist Perspective

Neo-Marxism emerged in the twentieth century as an extension and critique of traditional Marxism, particularly in response to the limitations of classical Marxist theory in explaining the persistence of capitalism and the failures of revolutionary movements. While classical Marxism focused on industrial workers as the primary agents of class struggle, neo-Marxist scholars expanded their analysis to include broader structures of exploitation, particularly in agrarian economies and resource conflicts (Amin and Mir, 2023). This shift allowed scholars to examine how capitalism perpetuates inequality beyond the urban proletariat, particularly among peasant communities in the Global South. Unlike classical Marxists, who emphasised direct revolutionary action, neo-Marxists sought to critically analyse how power operates within capitalist production relations and how it is continuously reproduced through economic and institutional mechanisms.

The Frankfurt School played a significant role in shaping neo-Marxist thought, with theorists such as Herbert Marcuse, Theodore Adorno, and Jürgen Habermas critiquing the ideological dominance of capitalism and its ability to sustain social inequalities. From this perspective, class relations are not merely economic but

are embedded within ideological and institutional structures that maintain capitalist hegemony (Neilson, 2018). Some scholars have argued that neo-Marxist thought is particularly concerned with how class relations perpetuate power structures (Isaac, 1987), while others have added that exploitation remains central to this approach, extending beyond industrial workers to include agrarian societies. Rather than being confined to factory labour, class struggle in neo-Marxist thought extends to various domains, including rural land conflicts, labour conditions in extractive industries, and the privatisation of natural resources (Wright, 2019).

In political ecology, neo-Marxist scholars have focused on inequality, colonial legacies, and post-colonial economic structures that reinforce environmental injustices. Unlike earlier apolitical environmental theories such as cultural ecology and neo-Malthusian perspectives, which often depoliticised environmental problems, political ecology, particularly its neo-Marxist strand, has criticised capitalist development models and their impact on land and resource governance (Bryant, 1998). Early scholars such as Blaikie (1985) and Blaikie and Brookfield (1986) played a foundational role in applying neo-Marxist thought to land struggles, demonstrating how global economic forces influence local land management and exacerbate environmental vulnerability. These scholars were among the first to highlight how agrarian communities, particularly in the Global South, face increasing precarity due to the expansion of global markets and the commodification of land.

Michael Watts (1983) further advanced this evaluation by illustrating how commodification and integration into global markets intensify poverty and insecurity among peasant populations. His analysis revealed that as small-scale farmers become increasingly dependent on market economies, they are more susceptible to financial instability, debt cycles, and exploitative labour conditions. To cope with fluctuating commodity prices and economic uncertainty, many farmers are forced to take loans from informal lenders or financial institutions that impose high interest rates. This debt burden often compels them to sell their labour for exploitative wages or lease their land for industrial activities, reinforcing long-term economic dependency. The consequences of this cycle extend beyond economic vulnerability as short-term survival strategies, such as intensive farming or leasing land for extractive industries, often lead to

environmental degradation, including soil depletion and deforestation (Li, 2014; Borrás & Franco, 2024). These dynamics illustrate how economic marginalisation, labour precarity, and environmental degradation are interconnected in capitalist resource governance.

A significant contribution of neo-Marxist political ecology is David Harvey's (2003, 2021) theoretical framework of "accumulation by dispossession" (ABD), which builds upon Marx's concept of primitive accumulation. Harvey argues that capitalism is sustained through continuous cycles of dispossession, whereby marginalised communities are displaced from their land to create new opportunities for profit. He emphasises that capitalist expansion depends on the systematic removal of communities from land ownership, transforming natural resources into commodities that serve the needs of the global market. This process, he argues, is not limited to early capitalism but is an ongoing feature of contemporary economic systems. Harvey (2003) identifies two primary mechanisms through which capitalist crises are resolved: spatial displacement, where capitalism expands its infrastructure into new locations, and temporal displacement, where surplus capital is invested in long-term projects to postpone crises.

The role of state institutions in facilitating these processes is crucial. Through financial incentives, regulatory policies, and legal frameworks, the state legitimises capitalist expansion and ensures continued economic growth, often at the expense of local communities and environmental sustainability. Political ecology scholars have built upon Harvey's insights to analyse how state policies reinforce capitalist expansion by displacing Indigenous and rural populations in favour of large-scale industrial and agricultural projects. By examining the relationship between dispossession and capitalist accumulation, neo-Marxist political ecology highlights how land, labour, and environmental resources are continuously restructured to serve capital interests.

Another work of neo-Marxist scholars that has contributed to political ecology is that by Moore (2015). His work further criticises capitalism's relationship with nature, arguing that capitalist economies do not view nature as a finite resource but as an endless supply of exploitable materials. He suggests that this perspective leads to large-scale environmental destruction, as economic

incentives prioritise short-term profits over long-term ecological sustainability. Moore's analysis reveals that capitalism's contradictions, such as the depletion of natural resources and ecological degradation, ultimately threaten both the environment and the stability of the capitalist system itself.

A further contribution to political ecology is related to the issue of land dispossession which is described by Hall, Hirsch and Li (2011). They examine how capitalist expansion leads to the systematic exclusion of rural and Indigenous communities. They identify several mechanisms through which exclusion occurs, including land titling, conservation policies, cash-crop expansion, urban land speculation, conflicts with neighbouring land users, and direct coercion by corporations and the state. These exclusionary processes, while particularly visible in Southeast Asia, are widespread across the Global South, where global capital expansion continues to displace local communities from their land. This research underscores how capitalist development is not only about economic expansion but also about the restructuring of land ownership, access, and control.

Despite its significant contributions, neo-Marxist analysis in political ecology has received less attention compared to post-structuralist and actor-oriented approaches. Critics argue that while neo-Marxism highlights structural inequalities, it often underestimates the role of agency and discourse in shaping environmental conflicts (Svarstad, Benjaminsen, & Overå, 2018). However, recent scholarship has attempted to bridge these gaps by integrating economic, institutional, and discursive dimensions of power. Future research in political ecology should continue exploring how class struggle, capitalist exploitation, and ecological degradation intersect, while also incorporating insights from other approaches to capture the full complexity of environmental governance and resistance movements.

In conclusion, the neo-Marxist perspective in political ecology provides a critical framework for understanding how capitalism drives environmental degradation, land dispossession, and resource conflicts. By analysing the structural forces that shape environmental governance, this perspective reveals how economic inequalities are sustained through capitalist expansion. While neo-Marxism alone does not capture the full complexity of environmental struggles, integrating its

insights with other theoretical perspectives can provide a more comprehensive understanding of the power dynamics at play in resource governance contestation.

2.3.2 Actor-oriented/Weberian Perspective

Political ecology has long been influenced by structuralist perspectives, particularly neo-Marxist approaches that emphasise the role of economic structures, class relations, and capitalist imperatives in shaping environmental governance (Bryant, 1998). However, some scholars have criticised neo-Marxism for its tendency to overlook the agency of local actors, treating them as passive subjects rather than active agents in environmental struggles (Long & Long, 1992). In response to this limitation, actor-oriented approaches have emerged as a means of incorporating a more dynamic and relational understanding of power within political ecology.

Actor-oriented perspectives emphasise that power is not merely embedded in economic structures but is exercised and negotiated through social interactions, alliances, and contestations among different actors (Long, 2001). Rather than viewing power as a top-down imposition by capitalist forces or state institutions, this approach highlights the agency of local communities, activists, and bureaucrats in shaping environmental governance. Actor-oriented scholars argue that the knowledge, strategies, and discourses mobilised by different actors play a fundamental role in determining environmental outcomes (Mack, Ritzel and Jan, 2020; Brenner and Job, 2012). In this way, the actor-oriented perspective moves beyond deterministic explanations of power by acknowledging how individuals and groups navigate socio-environmental struggles through resistance, negotiation, and alliance-building.

While not entirely opposed to neo-Marxist analysis, actor-oriented perspectives draw significantly from the Weberian tradition, particularly Weber's conceptualisation of power and authority (Weber, 1978). He defines power as the ability of an individual or group to impose their will despite opposition, a concept often described as a distributive approach to power or a zero-sum game. In the context of political ecology, this understanding of power helps explain why certain actors, such as corporations, state agencies, or elite groups, maintain

control over environmental governance, even in the face of resistance. However, Weberian analysis also acknowledges the plurality of power sources, including bureaucratic authority, legal-rational legitimacy, and charismatic leadership, all of which shape environmental contestation in different ways (Bryant, 1997).

One of the key contributions of the actor-oriented approach is its ability to dissect the micro-politics of environmental struggles, particularly in resource governance conflicts (Brenner and Job, 2012). Studies on agrarian movements and environmental justice have demonstrated how peasant communities, Indigenous groups, and local activists engage in grassroots mobilisation to contest land dispossession, deforestation, and extractive industries. This perspective challenges the notion that power is solely determined by economic structures, illustrating instead how power is constantly renegotiated through social interactions and strategic mobilisation.

Beyond grassroots movements, actor-oriented approaches have also been applied to studies on bureaucratic governance, showing how state actors and policymakers operate within complex institutional constraints and competing political interests (Yolles, 2019). Research on environmental bureaucracies highlights that government officials are not monolithic entities acting in unison but are fragmented actors with divergent interests and allegiances (Bauer, 2006; Huang and Xu, 2019). Some bureaucrats may align with corporate interests, while others might support environmental activism or local community claims. Understanding these internal dynamics is crucial to analysing why environmental policies are inconsistently implemented or contested across different governance levels.

Moreover, actor-oriented approaches have played a pivotal role in advancing the study of power asymmetries in environmental governance. Scholars in this tradition argue that power is not only about direct control over resources but also about control over information, discourse, and legitimacy (Uphoff, 1989; Turner, 2005). For example, conservation policies that exclude Indigenous communities often rely on dominant scientific narratives that frame local land use as “unsustainable” while legitimising large-scale conservation projects (Kohler and Brondizio, 2017; Domínguez and Luoma, 2020; Brittain et al., 2021). Similarly, extractive industries frequently co-opt scientific expertise to justify mining or

deforestation, sidelining alternative knowledge claims from affected communities (Espinosa, 2021; Forsyth, 2020; Nygren, Kröger and Gills, 2022). Actor-oriented research, therefore, underscores how struggles over environmental governance are not only material but also discursive, where competing actors seek to establish authoritative claims over nature.

While actor-oriented/Weberian perspectives have expanded the analytical scope of political ecology, they are not without criticism. Critics caution that without integrating a broader political economy analysis, actor-oriented perspectives may fail to explain why certain power structures persist despite localised resistance. In response, contemporary political ecologists have sought to bridge the gap between actor-oriented, neo-Marxist, and post-structuralist approaches, emphasising the need for an integrated framework that accounts for both structural constraints and individual agency (Svarstad, Benjaminsen & Overå, 2018).

The actor-oriented and Weberian perspectives have made substantial contributions to political ecology by foregrounding the role of agency, contestation, and institutional complexity in environmental governance. These approaches have been instrumental in shifting the focus away from purely structuralist explanations of power, instead highlighting the dynamic ways in which actors negotiate, resist, and transform socio-environmental relations. However, as critiques suggest, integrating actor-oriented perspectives with broader structural analyses remains essential to fully capture the complexities of environmental conflicts. By synthesising these approaches, political ecology can offer a more comprehensive understanding of power in resource governance, bridging the divide between macro-level economic forces and micro-level social interactions.

2.3.3 Post-structuralist Perspective

The post-structuralist school of thought, emerging in the 1960s and 1970s, challenged the structuralist emphasis on fixed meanings and deterministic social structures (Belsey, 2022). At its core, post-structuralism posits that power relations are dynamic, contingent, and continuously renegotiated. One of the most significant contributions of post-structuralism is its aversion to binary

oppositions, a defining feature of structuralist thought. Post-structuralists, particularly Derrida, argue that these binaries do not merely describe reality but impose hierarchical relationships that privilege one category over the other. This is evident in dominant epistemological frameworks where rationality becomes the regime of truth, delegitimising alternative forms of knowledge (Baring, 2015). The deconstructive approach, therefore, exposes the ideological underpinnings of knowledge production and invites scholars to critically reassess the assumptions that shape their analyses.

The post-structuralist critique of knowledge and power is exemplified in Foucault's "Madness and Civilisation" (1971), where he deconstructs the historical categorisation of mental illness. Foucault demonstrates how scientific discourse does not neutrally classify deviance but actively constructs it through disciplinary mechanisms that shape societal norms (Scull, 2015). His analysis illustrates a broader post-structuralist argument: knowledge production is not an objective process but is inextricably linked to power.

A central implication of post-structuralist thought is its relevance to contemporary discussions on the "knowledge society". This concept underscores the entanglement of knowledge production, social reproduction, and political legitimacy (Keller, 2011). Within political ecology, post-structuralist insights have been instrumental in deconstructing environmental discourse, particularly how dominant narratives on natural resource use are legitimised and institutionalised (Escobar, 1996). These narratives often obscure the underlying power dynamics that shape environmental governance, framing extractive practices as rational or inevitable while marginalising alternative perspectives.

Thus, post-structuralism provides a crucial analytical lens for examining how knowledge systems function as mechanisms of social control and contestation. By shifting the focus from static structures to the contingent and negotiated nature of power relations, this approach enables a more nuanced understanding of the interplay between knowledge, power, and societal transformation (Fletcher, 2010). Consequently, scholars engaging with post-structuralist perspectives are better positioned to critique dominant discourses, uncover the politics of knowledge production, and explore alternative pathways for social and environmental justice.

The post-structuralist perspective highlights the entanglement of knowledge production with power relations, emphasising that knowledge is not neutral but serves to shape governance structures and societal norms (Keller, 2011). This perspective is particularly relevant in environmental governance, where scientific expertise plays a central role in legitimising policies and justifying development projects (Grundmann, 2017).

Expertise, as a form of institutionalised knowledge, is often positioned as an authoritative source of truth (Pfister and Horvath, 2014; Brister, 2018; Grundmann, 2017). It reinforces dominant discourse narratives that align with state and corporate interests (Forsyth, 2020). Scientific knowledge, therefore, is not merely an objective reflection of reality but a strategic tool that can be mobilised to uphold specific socio-political agendas. This raises critical questions regarding the definition and control of knowledge, as well as how expertise is deployed to reinforce or challenge prevailing power structures in natural resource governance.

In the context of political ecology, the relationship between science and expertise has been a central focus of critical research by several political ecology scholars, particularly regarding environmental governance and the politics of knowledge production. Scholars have increasingly examined how scientific expertise influences policy, governance, and contestation over natural resources at multiple scales (Forsyth, 2015; Demeritt, 2015; Carolan, 2006; Grundmann, 2017; Forsyth, 2020).

Grundmann (2017) added that expertise is not only seen as a collection of knowledge possessed by a scientist but as something given at the request of others, usually clients who want insight and guidance in decision-making, especially those related to public policy. It is this dual relationship between the expert and their client, and between the expert's knowledge and its application, which forms the core of the definition of expertise. Expertise, in this case, is not always assessed by his/her peers/colleagues but also by his/her clients, relying on the trust built with them (Grundmann, 2017). The definition proposed by Grundmann shows that the production of knowledge produced by experts has a gap in the presence of intervention or external pressure.

One of the most dominant themes discussed in political ecology is how scientific knowledge and political power interact. This refers to an article written by Tim Forsyth entitled "Integrating Science and Politics" in "The International Handbook of Political Ecology" (2015). He argues that political ecology should openly and loudly reject traditional approaches that attempt to separate science and politics. He argues that science is inherently political and that ecological problems cannot be understood or solved without acknowledging how scientific knowledge and political norms evolve in tandem. This argument challenges the conventional approach that argues that science is neutral and apolitical, instead advocating an understanding of science as a product of broader processes that include political, social, and economic processes.

A further theme that is discussed in political ecology is the position of expertise. The idea of expertise as a neutral authority has been criticised by Carolan (2006), who proposed the concept of the "democratisation of expertise" in environmental governance. Carolan argues that traditional approaches, which maintain rigid boundaries between science and policy, often prevent meaningful public involvement in decision-making. He calls for a move away from the concept of science as supposedly "objective" and value-free towards a participatory model where scientific knowledge is open to scrutiny and input from a variety of stakeholders. This critique reflects the current situation that often marginalises local and Indigenous knowledge systems in every technocratic decision-making process.

In addition, in "Who Shapes the Politics of Expertise?", Forsyth (2019) develops the argument that scientific expertise is not simply a tool of state control but rather a product of co-production by many actors, including those involved in local resistance movements. Using the case of Thailand's political forests, Forsyth illustrates how simplified scientific narratives, such as those related to the watershed function of forests, are used to justify state control over land. However, this narrative is also adopted by local actors to legitimise their claims, thereby strengthening certain forms of environmental knowledge. This co-production perspective emphasises that knowledge gains political authority not because of its objective truth but because the knowledge produced by experts is left unchallenged by a variety of actors. This notion of co-produced knowledge challenges previous Marxist-influenced frameworks in political ecology, which

tend to view environmental knowledge as being shaped solely by dominant political and economic structures.

Another important theme highlighted in the relationship between science and expertise is public participation in policymaking. This theme is crucial because it is an effort to democratise knowledge by involving the public (non-experts) in public policy. Much of the literature discusses the need for greater public participation in environmental science and decision-making. Demeritt (2011) explored the promise and challenges of democratising science, particularly in the context of political ecology. He noted that public engagement was increasingly seen as a way to enhance the legitimacy of scientific knowledge and to ensure that environmental policy which democratised expertise must be accompanied by a critical examination of who is allowed to participate, how participation is structured, and how different forms of knowledge are valued. This approach aims to prevent participation from being exploited by powerful actors to reinforce existing power dynamics.

Similarly, Carolan (2006) criticised models of scientific decision-making that exclude non-experts from key discussions, particularly in areas of high uncertainty and complexity. He argued that environmental problems, characterised by their complexity and value-laden nature, could not be solved through traditional scientific methods alone. Instead, they required a more open and deliberative approach that included input from a variety of stakeholders, including those traditionally excluded from scientific discourse.

It can be concluded that post-structuralist perspectives provide a critical lens for analysing the power dynamics embedded in knowledge production, particularly in environmental governance. By foregrounding the knowledge production, scientific approach, and role of expertise, this approach reveals how knowledge operates as both an instrument of control and a site of contestation.

Understanding these mechanisms is essential for critically engaging with dominant environmental narratives and exploring alternative pathways for knowledge production and policymaking.

2.4 Limitations in Existing Empirical Studies

Power is the main focus of analysis in the political ecology approach. However, not all political ecology scholars explore and debate the theory of power in political ecology. In the current literature, there are empirical studies that explore power well. As I have discussed earlier, there are three perspectives of power in political ecology.

The neo-Marxist perspective has become a prominent analytical perspective in the political ecology literature, with many scholars emphasising the role of power, exclusion, and inequality in shaping environmental conflict and access to natural resources (Svarstad, Benjaminsen and Overå, 2018). Several empirical studies published in recent years have revealed how entrenched power structures create and perpetuate inequalities, often marginalising local communities and reinforcing class and spatial inequalities. Studies in this perspective explore diverse environmental contexts, including land (Kansanga, Arku and Luginaah, 2019) and water resource conflicts (Nolan, 2019; Otero et al., 2011). Each of these issues illustrates the complex interplay between socio-political forces and ecological outcomes.

For instance, Kansanga et al. (2019) offered an analysis of land conflicts, examining how power dynamics influence land ownership and disputes in areas with undocumented boundaries. This perspective highlighted the political nature of land ownership, where vulnerable groups often found themselves excluded due to systemic inequities in tenure documentation, thus reflecting how political power shapes land access and ownership. Similarly, Nolan (2019) explored issues of power and access in Ghana's coastal fisheries, highlighting how socioeconomic pressures and ecological decline pushed local fishers to adopt unsustainable fishing methods. Nolan's study illustrates how environmental degradation and social inequality are closely intertwined, with marginalised fishers increasingly disadvantaged while wealthier entities profit from scarce resources.

In their analysis of water scarcity in Catalonia, Otero et al. (2011) focused on how elite power shapes access to essential resources, particularly through the water monopoly in the municipality of Matadepera. Framing water scarcity as a social and political construct, Otero et al. (2011) emphasised how power

relations dictated not only who could access resources but also who was systematically excluded from them, deepening class-based inequalities in resource distribution. Also, in a related discussion, they discussed how market forces, through impact assessments, perpetrated processes of exclusion against communities.

Representing the neo-Marxist perspective, these studies provided a nuanced understanding of how environmental conflicts are shaped by power relations and social injustice. By focusing on diverse contexts, these scholars underscored the pervasive influence of political and economic power on environmental issues. The neo-Marxist perspective in the political ecology literature reveals that environmental problems cannot be separated from the socio-political systems in which they occur.

In addition to the neo-Marxist perspective, other scholars have adopted actor-oriented or Weberian frameworks in political ecology to examine how power relations and institutional arrangements influence environmental governance. These approaches emphasise the complex interactions among multiple actors, illustrating how power is exercised and contested at different scales (Thompson, 2018; Das and Deka, 2020; Sovacool, Tan-Mullins and Abrahamse, 2018; Andrews, 2021; Green, 2016). By focusing on actor relations, these studies illuminate the nuanced ways in which resource management, policy implementation, and social differentiation play out in environmental contexts.

In the context of environmental resource management, Green (2016) explored the concept of politics of scale, revealing the hidden power dynamics in CBNRM (Community-based Natural Resources Management). Through an analysis of politics of scale, the author illustrated how CBNRM often becomes a battleground for control of natural resources among various actors, each seeking to assert authority over management decisions. Still, in the context of environmental resource management, Thompson (2018) examined actor inequality in the context of mangrove reforestation policy in Thailand. His research revealed that power gaps among actors lead to gaps between policy design and implementation, with marginalised communities often feeling excluded from the decision-making process. Similarly, several of these authors focused on the same area. Das and Deka (2020) provided a historical analysis of wetland resource

management in Merbeel, illustrating how resource control has shifted over time through the influence of various hegemonic actors. Initially, religious regimes dominated resource governance, which was later taken over by British colonial authorities who restructured wetland resources from common to private ownership. This transformation reflects a broader trend in the privatisation of resources, as powerful actors impose systems that favour private ownership over communal access.

In the field of disaster recovery, the inequality of actor relations is revealed. Sovacool et al. (2018) identified four main problems in DR (disaster recovery): closure, exclusion, encroachment, and appropriation. Closure involves expanding the role of the private sector in recovery efforts, often at the expense of public control. Sovacool et al.'s analysis highlights how DR practices can inadvertently reinforce existing inequalities and exacerbate environmental vulnerability, emphasising the need for a more inclusive and equitable approach to post-disaster recovery. And finally, a study by Andrews (2021) focused on hydrocarbon extraction in Ghana. This study used a power-oriented approach to analyze social differentiation in the resource extraction process. Its findings suggested that power relations among social groups with vested interests in hydrocarbon extraction determine who benefits from these resources and who is excluded.

Several studies with actor-oriented perspectives, presented earlier, illustrate how actor-oriented or Weberian perspectives in political ecology can provide valuable insights into the mechanisms of power, exclusion, and resource control. By focusing on actor relationships and institutional arrangements, scholars have revealed the complexity of environmental governance, where competing interests and power imbalances influence policy implementation, resource management, and social differentiation.

Finally, certain scholars have analysed environmental issues through a post-structuralist perspective, where this perspective emphasises how power operates through discursive practices and shapes environmental governance. This approach, rooted in post-structuralist and Foucauldian theory, investigates how knowledge, language, and discourse produce power relations that determine which environmental practices and perspectives are legitimated (Gonda, 2019;

Boelens, Shah and Bruins, 2019; Patrick Bixler, 2013). By focusing on discourse, scholars in this framework explore how narratives and representations of environmental issues construct social realities and reinforce certain power dynamics.

For example, in an empirical study, Boelens et al. (2019) examined the role of discourse in the context of large dams and mega-hydraulic developments, where competing knowledge systems collided. The authors highlighted that the construction of such large-scale infrastructure projects became a battleground for knowledge, with local or Indigenous knowledge often subordinated to dominant technocratic development discourses. They argued that the knowledge regimes that governed these projects typically prioritised scientific and economic reasons over socio-environmental concerns, thereby marginalising local voices in decision-making.

In a related context, Bixler (2013) discussed how local environmental narratives play a significant role in shaping conservation policy, particularly in the context of mountain deer conservation. Bixler argued that alternative local knowledge, often rooted in community experiences and Indigenous perspectives, provided valuable insights for sustainable landscape management. However, such knowledge was often overshadowed by scientific discourses that framed environmental issues in technical terms. This marginalisation of local narratives reflects the discursive hierarchy in which scientific knowledge is authoritative, limiting the potential for diverse perspectives in environmental decision-making.

As the authors noted, empirical studies produced with a post-structuralist approach underscored the emphasis on the discursive construction of environmental issues and the power relations embedded in the production of knowledge. Through a focus on discursive practices, scholars in this field have revealed how certain narratives and knowledge systems gain prominence, often at the expense of local or marginalised perspectives. In addition, some of this literature can illustrate the need for a counter-discourse by challenging the dominance of technocratic and scientific narratives. This is done using a broader recognition of local and Indigenous knowledge systems as essential to developing just and effective environmental policies.

Other scholars have also integrated the dual approach to power. They have highlighted how different dimensions of power, economic structure and discourse, interact to shape governance outcomes. Ahlborg and Nightingale (2018) contributed significantly to this debate by theorising the spatiality of power in resource governance projects. Their work bridged neo-Marxist and post-structuralist perspectives, identifying four key dimensions through which power is manifested: (1) the shaping of governance processes through knowledge and ontologies, (2) the contingent interplay of power within dynamic systems, (3) the structuring of access and entitlements, and (4) the embeddedness of power in the everyday lives of people. By situating power within these overlapping spheres, their framework advanced a nuanced understanding of how political ecology can account for both material constraints and the discursive strategies that shape governance.

Similarly, Gonda (2019) applied a post-structuralist lens combined with Weberian insights to analyse gender and climate change adaptation policies in Nicaragua. Her study reflected on how adaptation projects frequently depoliticise women's roles, framing their contributions in traditional gender norms rather than recognising them as agents of transformation. By employing an FPE approach, Gonda challenged these dominant narratives and called for a re-politicisation of gender in environmental governance. This dual approach, integrating discourse analysis with an institutional critique of power structures, demonstrates how gendered knowledge production intersects with broader governance frameworks, reinforcing or contesting hegemonic power relations.

Further contributions to the dual approach in political ecology emerge in studies of resource extraction and corporate influence. Delabre and Okereke (2020) examined the role of SIA in the palm oil industry, demonstrating how these assessments function as mechanisms of power rather than neutral tools for mitigating harm. Their study employed a neo-Marxist critique to expose the entrenchment of global capitalist interests in the palm oil sector while also incorporating an actor-oriented perspective to explore the competitive dynamics between stakeholders in the assessment process. By revealing how SIAs legitimise neoliberal governance structures, Delabre and Okereke highlighted the dual nature of power in resource governance—simultaneously structural and contested by multiple actors.

Spiegel (2017) further extended this analysis in the context of EIAs and small-scale mining. EIAs serve as a critical site for understanding power relations in extractive industries, operating as both a regulatory tool and a mechanism of control. Through a post-structuralist lens, Spiegel illustrated how expert knowledge is mobilised to justify large-scale mining operations, often at the expense of small-scale, community-led mining efforts. His analysis built on Weberian insights by emphasising the multiplicity of actors involved in these struggles, i.e., corporations, state agencies, environmental experts, and local communities, each competing for influence within the regulatory landscape. This interaction between technocratic expertise and capitalist imperatives underscores the techno-politics of resource governance, demonstrating how power is enacted through both structural hegemony and the strategic use of discourse.

Overall, some of the empirical studies above are detailed and clear enough to explore how power operates through various perspectives. However, although each approach contributes a distinct lens to understanding natural resource contestations, they are limited when used independently. A more comprehensive analysis requires integrating these perspectives to capture the complex interplay between individual agency, economic structures, and discursive power in resource governance. When analysing natural resource struggles from a power perspective, each of the theoretical approaches, actor-oriented, neo-Marxist, and post-structuralist, provides unique insights as well as presents certain limitations when applied independently or with a single employ perspective. Actor-oriented approaches emphasise the role of individuals, groups, and alliances, focusing on the relationships and strategies that actors use to influence resource governance. For example, studies that have been conducted by several scholars, have emphasised an actor perspective, highlighting the intricate dynamics between various actors, and showing how power is both exercised and challenged across multiple levels (Green, 2016; Thompson, 2018; Sovacool, Tan-Mullins and Abrahamse, 2018; Das and Deka, 2020; Andrews, 2021). However, when used alone, actor-oriented perspectives can overlook broader structural forces, such as the economic drivers behind resource extraction, and this perspective may not fully capture the role of discourse in shaping public perception and policy debates.

In contrast, neo-Marxist approaches highlight the influence of economic structures and capitalist imperatives in driving resource extraction, often demonstrating how these processes marginalise local communities. For instance, neo-Marxist scholars have emphasised that the exploitation of natural resources supported by state policies displaces Indigenous landholders, reinforcing capitalist control. While this perspective effectively explains class dynamics and the economic motivations behind resource conflicts, it often under-explores the agency of local actors (Otero et al., 2011; Nolan, 2019; Kansanga, Arku and Luginaah, 2019).

Finally, post-structuralist approaches reveal how discursive practices and knowledge production shape environmental governance. Within this framework, scholars examine how narratives and representations of environmental issues shape social realities and sustain particular power relations (Patrick Bixler, 2013; Boelens, Shah and Bruins, 2019; Gonda, 2019). However, while this perspective captures the ideological and linguistic dimensions of power, it often lacks engagement with the material and economic structures that drive resource conflicts. Furthermore, it provides limited insight into how grassroots actors negotiate power beyond discourse, such as through legal mobilisation or direct action.

As it has evolved, scholars have increasingly recognised the importance of integrating power dynamics into their analyses, especially in the field of conservation. With slight modifications through institutionalism, Shackleton et al. (2023) outline four dominant approaches to power—actor-centred, institutional, structural, and discursive—each of which captures different dimensions of influence in conservation governance. While actor-centred approaches emphasise individual and organisational agency, institutional power highlights the role of formal and informal rules, policies, and norms that shape conservation outcomes. Similarly, Saif et al. (2022) argue that power asymmetries are often embedded in conservation relationships, where trust and fairness depend on structural and institutional factors rather than simply individual interactions. These academics show that institutional power, particularly in the form of environmental governance mechanisms and policy frameworks, can reinforce or mitigate existing inequities in conservation practices. By modifying conventional power analysis to include institutional structures, researchers can offer a more

comprehensive framework that considers how conservation policies, participatory mechanisms, and governance structures mediate access to resources and decision-making authority. This nuanced understanding allows for the critical examination of conservation interventions, ensuring that they do not simply reproduce existing power imbalances but also promote more just and equitable conservation outcomes.

Drawing on recent empirical studies, my research has identified several gaps in the existing scholarship on power dynamics in conservation and natural resource governance. While scholars like Shackleton et al. (2023) and Saif et al. (2022) have expanded conventional power analysis by incorporating institutionalism alongside the actor-centred, structural, and discursive approaches, these frameworks remain limited in fully capturing the contested nature of knowledge production and legal mobilisation in environmental governance. Both of the studies that integrate institutional power tend to focus on conservation policies and governance structures, emphasising formal mechanisms of participation and rule enforcement. However, they did not explore how the process of scientific claims becomes contested, i.e., where actors mobilise power to shape governance outcomes. Furthermore, while these studies acknowledge power asymmetries, they do not explicitly engage with how competing knowledge claims, especially between scientific institutions, grassroots actors, and corporate entities, are negotiated within legal and regulatory frameworks. My research addresses these gaps by applying a pluralistic power approach that not only synthesises actor-centred, structural, and discursive power but also incorporates them into different arenas of contestation where governance struggles unfold. By focusing on how different actors mobilise scientific knowledge and expertise, claiming to contest resource extraction, my study contributes to a deeper understanding of how pluralistic power operates in contested landscapes.

2.5 The Pluralistic Approach of Power as Theoretical Background

The concept of emphasising pluralistic approaches to power did not explicitly provide the basis for the early formation of political ecology. Nonetheless, Bryant (1997, 1998) implicitly encouraged the development of the power approach in

political ecology research. He argued in his work "Beyond the Impasse: The Power of Political Ecology in Third World Environmental Research" (1997) that actors not only control resources such as land, sea, and so on, but they also win the battle of knowledge or ideas. According to Long and Long (Eds) (1992), the implementation of a policy is determined by the victory gained in the battle of knowledge.

This theory proposes that actors control resources and knowledge to gain legitimacy. The legitimacy of scientific knowledge implies that whatever is done in the field of natural resource management will not be an issue unless it results in environmental degradation or excludes Indigenous people. Additionally, negative emotions from the general public should be minimised.

Bryant presented a new perspective in the field of political ecology in his second paper titled "Power, Knowledge, and Political Ecology in the Third World: A Review" (1998). In this paper, he extensively discussed the importance of materials and knowledge in the context of struggles. The paper offered several alternatives for developing a political ecology analysis that was not solely land-centric. The author made two major points. First, he criticised Weberian and neo-Marxist political ecology approaches for omitting knowledge formation analysis. Second, he emphasised the urgency and significance of developing power/knowledge analysis in the analysis of political ecology studies. At the same time, he did not advocate abandoning the two alternative approaches.

Two decades after Bryant's work (1997, 1998), an article review explicitly emphasised the elaboration of variant power. Svarstad, Benjaminsen, and Overå (2018) demonstrated that certain political ecology studies were less theoretically sophisticated in their treatment of power. As a result, they proposed a synthesis of diverse approaches to bolster the research of political ecology.

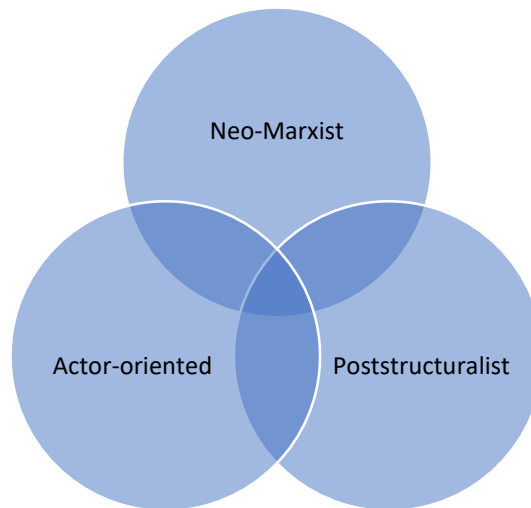


Figure 2.3: Illustrating a Pluralistic Approach of Power

Source: (Svarstad, Benjaminsen and Overå, 2018)

According to Figure 2.3, the authors argued that a comprehensive understanding of natural resource contestation dynamics required integrating all three approaches, as each provided unique insights that, when combined, led to a more comprehensive explanation. However, the explanation they provided demonstrated the uniqueness of some of these techniques, since they each had several defects and advantages that reinforced one another. The Weberian approach has only one point of view regarding actors and ignores the inequality of power resources. Nonetheless, this approach can be used to analyse how power may be exercised by state agencies, corporations, political elites, and so on. Furthermore, the neo-Marxist approach disregards the knowledge discourse generated by multiple actors. Nonetheless, it was able to explain how the economic structures allow some actors to accumulate capital while marginalising others. Meanwhile, post-structuralism approaches the subject passively, with no self-reflection or discussions of how structures can be changed. However, multiple actors can wield discursive power in this approach (Svarstad, Benjaminsen and Overå, 2018).

However, while Svarstad et al. (2018) emphasise the necessity of combining these perspectives, their framework remains primarily conceptual, lacking detailed empirical illustrations of how power operates in specific socio-environmental conflicts. My study builds upon their contributions by applying this pluralistic approach in a grounded case study of the North Kendeng conflict. By

tracing the interactions between multiple actors, economic structures, and discursive strategies, I empirically illustrate how these power dimensions are manifested and interact in real-world governance disputes. Additionally, whereas Svarstad et al. (2018) focus on the advantages of combining perspectives, my research challenges their approach by demonstrating that these dimensions do not merely coexist but are actively contested, reconfigured, and mobilised by different actors within environmental struggles.

By integrating these perspectives into an empirical investigation, my study not only extends existing theoretical debates but also refines how political ecologists conceptualise power. This research illustrates how a pluralistic power approach can provide deeper insights into resource governance contestation, particularly concerning scientific and expertise claims, offering a more comprehensive lens for understanding environmental conflicts beyond traditional single-framework analyses.

2.6 Theoretical Position

The analytical framework of this thesis primarily adopts a post-structuralist perspective to explore the socio-environmental conflict in North Kendeng, emphasising the central role of knowledge production, discourse, and expertise in shaping resource governance outcomes (Newman, 2017; Forsyth, 2020). This approach is crucial because it reveals how scientific narratives and expert claims are employed to legitimise or delegitimise particular actions in environmental disputes (Grundmann, 2017). Existing post-structuralist analyses, while effectively capturing discursive strategies and the politics of knowledge, sometimes under-examine the concrete actions, relationships, and structural-economic forces driving resource extraction conflicts.

Therefore, this study advances a more comprehensive analytical framework by integrating two additional perspectives: the actor-oriented (Weberian) perspective and the structural-economic (neo-Marxist) perspective. The actor-oriented perspective provides detailed insights into how different actors (communities, activists, governmental bodies, and corporations) mobilise resources and form alliances to influence governance outcomes (Long, 2002). Concurrently, the structural-economic lens highlights how underlying economic

interests, capitalist imperatives, and state-corporate alliances shape regulatory frameworks and development agendas. Together, these three dimensions—discursive (post-structuralist), actor-oriented (Weberian), and structural-economic (neo-Marxist) —constitute a pluralistic approach to power.

By bringing actor-oriented and structural-economic analyses into dialogue with a fundamentally post-structuralist inquiry, this research reveals how power operates simultaneously at discursive, relational, and structural levels, enriching our understanding of resource governance conflicts. This pluralistic integration not only deepens the critical insights provided by a discourse-based investigation but also highlights how discourses interact with material interests and social actions, thus addressing the limitations inherent in single-perspective analyses (Svarstad, Benjaminsen and Overå, 2018).

2.7 Locating a Pluralistic Approach to Power in Scientific and Expertise Claims over Karst Resources: An Analytical Framework

Karst resource governance presents a variety of arenas that become contestation sites where scientific expertise and knowledge claims are central to shaping policy decisions. Using a power-based approach, this study seeks to understand how various actors, companies, governments, local communities, environmental NGOs, experts, and university academics utilise, challenge, and reinterpret scientific expertise to legitimise their interests in karst management. Unlike technical or managerial approaches, which emphasise efficiency and problem-solving (Li, 2007), this study focuses on power dynamics that reveal how scientific knowledge is not neutral but is deeply embedded in political, economic, and social struggles over natural resource extraction and the environment. In this context, where scientific expertise becomes a contested resource to advance competing claims about the ecological and economic value of the region.

With its unique hydrological system (Ford and Williams, 2013), the karst ecosystem functions as a vital environmental resource and an economically valuable commodity, both of which are mutually exclusive. Accordingly, its governance is fraught with disputes over how scientific knowledge about the area

should be interpreted and applied in the management of the karst in the Watuputih Groundwater Basin area. Pro-development actors, such as companies and government agencies, attempt to use scientific reports to frame karst mining as something that can be managed by emphasising the potential for economic growth and identifying environmental risks that can be minimised. On the other hand, anti-development actors, or, in this case, the JM-PPK, challenge these scientific claims by presenting scientific evidence that highlights the ecological fragility of the karst system if limestone mining is forced in the Watuputih Groundwater Basin area. The conflict manifested from the differences in how to interpret these scientific claims shows that expertise is not only a tool for understanding environmental systems but also a site of power struggles, where various actors use knowledge strategically to shape policies in the area.

To understand the dynamics of power operating through scientific and expertise claims, I outline the pluralistic approach of power in this part and employ them to analyse the different arena contestations on karst resources (Figure 2.4).

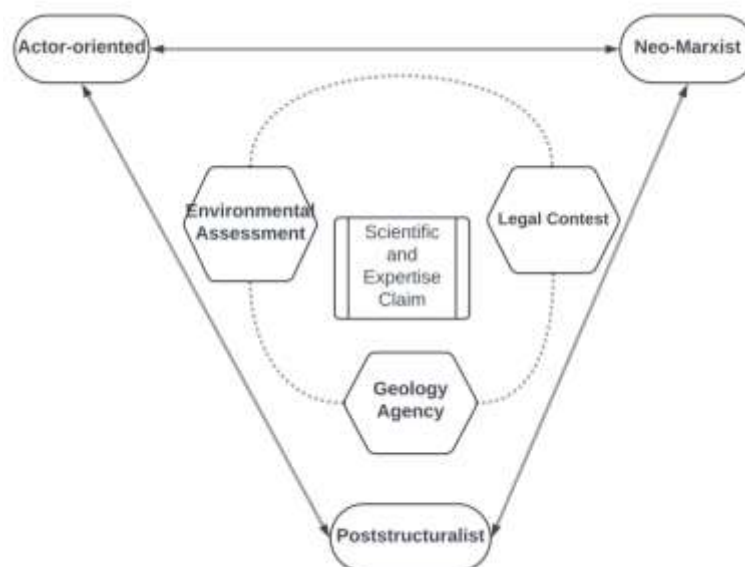


Figure 2.4: Analytical Framework of the Research "Contestation over Scientific and Expertise Claims in Karst Resources Governance"

In this diagram, I would like to demonstrate how a pluralistic approach to power serves as an analytical framework for elucidating the complex nature of power, encompassing various dimensions and mechanisms. A pluralistic approach to power is essential to analysing scientific claims and expertise in karst resource

governance in the North Kendeng Mountains. This approach combines neo-Marxist, actor-oriented, and post-structuralist perspectives to explain how power operates in various arenas of contestation. In the context of karst resource contestation in the North Kendeng Mountains, I identified several arenas that may be considered sites of struggle, including environmental assessment reports, legal contests, and the role of state institutions such as the Geological Agency. Each of these arenas plays an important role in determining how scientific expertise is used, and challenged, and ultimately influences governance decisions.

One key arena of debate is the environmental assessment process, in which actors create and interpret scientific reports to support their opposing positions on resource extraction. Here, the companies and government agencies sought to commission EIAs and the EIA Addendum (revised version) which downplayed the risks associated with karst mining, presenting the activity as safe and economically beneficial. These reports often emphasised scientific findings that highlighted the absence of significant environmental threats, allowing the pro-cement actors to legitimise their mining operations. In contrast, the anti-cement coalition used a counter-scientific narrative, presenting SEA reports that focused on the ecological importance of karst systems, such as their role in maintaining groundwater storage and biodiversity. The alliance argued that mining posed significant long-term risks to the environment, risks that had been ignored or minimised in official environmental assessments.

A second arena that can become the site of struggle is the legal contest, which is where scientific claims are debated and examined in the courtroom and open trial. In a legal dispute over the extraction of karst resources, each party, both the plaintiff and the defendant, presents scientific evidence to support their arguments. The proof of these claims is through using expert witnesses to testify about the environmental impacts or benefits of mining. Each party has experts who become expert witnesses in the trial. Most of these experts have various scientific fields and come from different universities. In this case, the defendants argued that their mining operations were based on scientific research that showed that mining had no significant impact on the environment. Meanwhile, the plaintiffs opposed these claims by emphasising scientific uncertainty and the

long-term ecological consequences of karst mining. In this legal arena, the credibility of scientific experts became a major point of contention.

The last arena of contestation concerns the proof of research conducted by the Geological Agency. The Geological Agency plays a crucial role in this context because it is appointed directly, through an agreement between the parties to the conflict, to be a mediator and final proof related to the disputed scientific evidence. In this particular context, it is about the existence of an underground river in the Watuputih Groundwater Basin area. The Geological Agency initially presented findings that emphasised the environmental sensitivity of the Karst Area, warning against resource extraction. However, along with changes in the structure of positions within the institution and possible political and economic pressures, the agency's position has changed. The latest research results align its scientific assessment with the interests of pro-development actors in this context based on mining plans carried out by the cement factories. This shift suggests that scientific institutions, such as the Geological Agency, may not be entirely neutral but can be shaped by broader power dynamics surrounding resource extraction.

By applying a pluralistic approach to power, I can understand how scientific expertise operates in these different arenas. Through a neo-Marxist perspective, I can highlight the structural power relations between corporations, the state, and local communities, where economic interests dominate the production and use of scientific knowledge. From a post-structuralist perspective, scientific discourse itself is a form of power, with actors competing not only over the content of scientific reports but also over who controls the production of knowledge and who is recognised as a legitimate expert. Meanwhile, through an actor-oriented perspective, I can observe how each contesting party strategises and builds groups and alliances to maintain their claims to scientific evidence in the governance of karst resources in the Watuputih Groundwater Basin area, North Kendeng Mountains.

3. Methodology

3.1 Introduction

In this chapter, I explain what ethnography is and outline the importance of ethnographic methods for investigating the contestation of natural resources in the North Kendeng Mountains. Then, I describe why I selected a multi-sited ethnography approach for this research, detailing how it effectively captures the complexity and multiple dimensions of the conflict. Political ecology is characterised by its focus on multiple scales and locales due to the dispersed nature of various actors not centred in one specific location. This research was carried out in various regions in Indonesia; precisely, in Pati, Rembang, Semarang, Yogyakarta, and Jakarta. The rationale for selecting these study locations will be explained in the following subsection to provide a comprehensive understanding of the research context.

Furthermore, this section describes how the data collection process was carried out. Several stages and procedures were designed following the norms governing data collection in multi-sited ethnographic research.

In the following section, I outline the data analysis process employed in this study. This analysis consisted of several key stages that followed a systematic approach to qualitative thematic analysis (see Fig. 3.1).

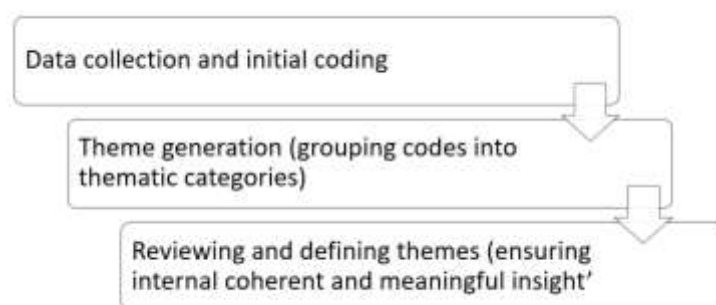


Figure 3.1: Data Analysis Process

Source: Modified from (Braun and Clarke, 2006)

The first stage was data familiarisation and initial coding, where I familiarised myself with the data collected through reading, taking notes and identifying initial patterns emerging in the dataset. Next, I moved on to the theme development and refinement stage, where I organised and grouped the identified codes into broader categories or themes, while also refining the thematic structure based on relevance to the research question. The final stage was reviewing and defining themes, which involved an in-depth evaluation of the themes developed to ensure that each theme had internal cohesion and provided meaningful insights into the phenomenon being studied.

At this point, I would like to address my reflexivity and positionality within the context of this investigation. For political ecology research, these two aspects are of paramount importance and warrant explicit acknowledgement by researchers. Both underscore the imperative for me, as a researcher, to engage in critical reflection on my perspectives, biases, and relationships with the subjects and contexts under study.

In the third section, I will explain the technical and ethical aspects of the research applied in this study. Here, I will explain the process of obtaining ethical approval from the research ethics committee, including the procedures followed to ensure compliance with applicable ethical standards. I also explain, in detail, the contents of the project information sheet and consent form provided to participants, to ensure that they have a clear understanding of the purpose, procedures, and potential risks and benefits of their involvement in this study.

In the final section, I will discuss the limitations encountered during the implementation of the study, especially related to the difficulty in reaching some participants who, for various reasons, were no longer involved or had any connection to the Kendeng case. This created an obstacle in my effort to collect representative data, considering that these participants had played an important role in the dynamics of the conflict studied. The analysis of these limitations becomes a reflective part of the study intended to improve the methodological approach in the future.

3.2 Ethnography: A Multi-sited Reflection

As part of social science methodology, ethnography has developed alongside various interdisciplinary perspectives that have developed in the social sciences, including feminism, human geography, etc. Initially, ethnographic methods were used by anthropologists to study specific isolated communities in a particular place. However, with the increasing process of globalisation and the complexity of social structures, this method has developed and now interacts with various other disciplines, such as sociology, communication, politics, and geography. As a consequence, ethnography has changed, especially making its definition more flexible and context-dependent.

In the context of this research, I have used George Marcus' concept of multi-site ethnography, which offers a suitable framework. Through multi-sited ethnography, Marcus (1995) emphasises that ethnographers today must go beyond studies that focus on a single place, and, instead, follow people, objects, ideas, or discourses across multiple locations and scales to capture the complexity of modern phenomena (Marcus, 1995). This approach is in line with the political ecology framework, where the dynamics of environmental issues, such as the struggle for karst resources, play out across multiple scales and involve local communities in policy decisions at the national, and even global, levels.

One of the ethnographic works by Annette Watson and Karen E. Till (2010) on ethnography and participant observation provides valuable insights into how ethnography can be conducted in different locations. They describe ethnography as an intersubjective qualitative research method that involves negotiating relationships between researcher and participant, insider and outsider, local and global. This framework is particularly important when conducting multi-site ethnography because it highlights how researchers must navigate different spaces—physical, social, and political—to uncover broader phenomena. In this context, ethnographers are advised to use a variety of methods, such as participant observation, interviews, and document analysis, across multiple locations to trace how actors, institutions, and environments interrelate.

In this study, I employed multi-site ethnography as the primary methodology because it allowed the study of karst resource struggles across multiple sites representing different scales of political and ecological influence. This is because fieldwork was conducted in several regions in Indonesia, including Rembang (the local location of cement mining operations), Pati (the initial location of cement planning), Semarang (the location of local government regulations), Yogyakarta (the centre of expert knowledge), and Jakarta (the home of central government decision-making). These sites reflect the multi-scale nature of political ecology, where local environmental conflicts are linked to local government policies and central (national) government decisions.

This multi-sited ethnography provided advantages for this study, particularly in exploring how the struggles over karst resources involved not only local actors but also actors at the regional and broader national levels. For example, local resistance in Rembang to a cement factory was directly linked to decisions made by government agencies in Jakarta. The processes of communication, lobbying, and negotiation between local communities, government agencies, environmental NGOs, academics/experts, and companies involved in this case illustrate a complex web of interactions that are well-suited to multi-site ethnography.

As with traditional ethnography, participant observation remains central to multi-site ethnography. However, in this study, participant observation was conducted at multiple sites to explore how different actors, groups, or alliances engaged with contested environmental landscapes. For example, in Rembang, observing the daily struggles of residents revealed how the operation of a cement factory impacted their livelihoods and the ecosystem in the Watuputih Groundwater Basin. Conversely, in Jakarta, observing interactions between central government officials and environmental activists provided insight into the processes of communication and political negotiation in decision-making regarding the operation of a cement factory.

The process of participant observation that moves between these sites, allowed me to not only capture local and everyday actions; but also explore how these actions were influenced by and connected to decisions made at higher political and institutional levels. The multi-site approach allowed for observations of how

environmental and political dynamics moved between these sites, thus providing a more comprehensive view of the political ecology of karst resource management in the North Kendeng Mountains.

In addition to participant observation, other data sources used in multi-sited ethnography are also diverse and may include official reports or documents. In the context of this research, I collected several documents from various sources such as EIA and EIA Addendum reports, SEA documents, and court decisions. These documents were not only locally relevant but also important for understanding the broader regulatory framework and national policies that affected the local resource disputes.

In this study, discourse analysis was employed to systematically examine critical policy documents, including the EIA, the EIA Addendum, and the SEA, as will be discussed in detail in Chapter 5. Through this method, the study analysed how language and scientific claims within these documents were strategically used by different actors to justify or oppose mining activities. This analysis provided insights into the underlying power dynamics shaping regulatory decisions and public debates, thus clarifying how scientific reports were interpreted and mobilised by various stakeholders within the socio-environmental conflict.

By carefully examining the documents and integrating the results of field observations and in-depth interviews, this study not only succeeded in collecting comprehensive and detailed data but also carried out a validation process that guaranteed the quality and credibility of the findings. The triangulation approach used allowed cross-confirmation between various sources of information so that the results of the analysis could be trusted and reflect reality more accurately.

In this case, multi-sited ethnography has proved to be a highly effective approach because it has allowed me, as a researcher, to follow the flow of political and environmental discourse from local protests in Rembang to policy meetings in Jakarta. Collecting data from these various sources has underlined the interconnectedness of various actors, groups, alliances, and scales that help to shape environmental outcomes, which is a key element of multi-site ethnography and political ecology.

Furthermore, this approach has been an invaluable tool for studying political ecology, particularly when the focus is on issues such as resource struggles that span multiple scales. As Neely and Nguse (2015) have highlighted, ethnography is particularly relevant for political ecology because it allows researchers to immerse themselves in the social and cultural contexts of environmental issues. By engaging actors, groups, and alliances across multiple sites—such as local communities, government agencies, corporations, and academics/experts—multi-site ethnography reveals the complex dynamics that shape environmental governance and decision-making.

In this study, multi-sited ethnography has not only captured the local experiences of communities affected by cement mining but also followed the broader institutional and governance processes that influence these local realities. The study highlights how environmental issues are not confined to a single scale or location but are shaped by networks of relationships and interactions across multiple sites, a core tenet of political ecology.

3.3 Research Sites

The determination of the research location in this study is in line with the principle of multi-sited ethnography which accords with Marcus (1995). This approach is valuable for exploring the topic of the struggle for natural resources, which is complex and multi-scale. The approach offered by Marcus recommends tracing the relationship in various locations to understand how global and local processes intersect. In the context of this research, these locations were not studied separately but were closely interconnected, reflecting how political and ecological processes occur at various scales—from struggles at the local level to public policy decisions at the national level. This multi-sited ethnographic approach was very important for understanding the issue of environmental governance, which is at the core of political ecology.

This fieldwork covered five main sites in three different provinces, namely Rembang, Pati, Semarang, Yogyakarta, and Jakarta. Each site represented a different scale of interaction and governance in the broader context of the struggle for karst resources in the North Kendeng Mountains. This multi-scale approach is important for multi-site ethnography and political ecology, where

understanding the dynamics of natural resource conflicts requires exploring how power, knowledge, and decision-making processes in public policy cross geographical and institutional boundaries.

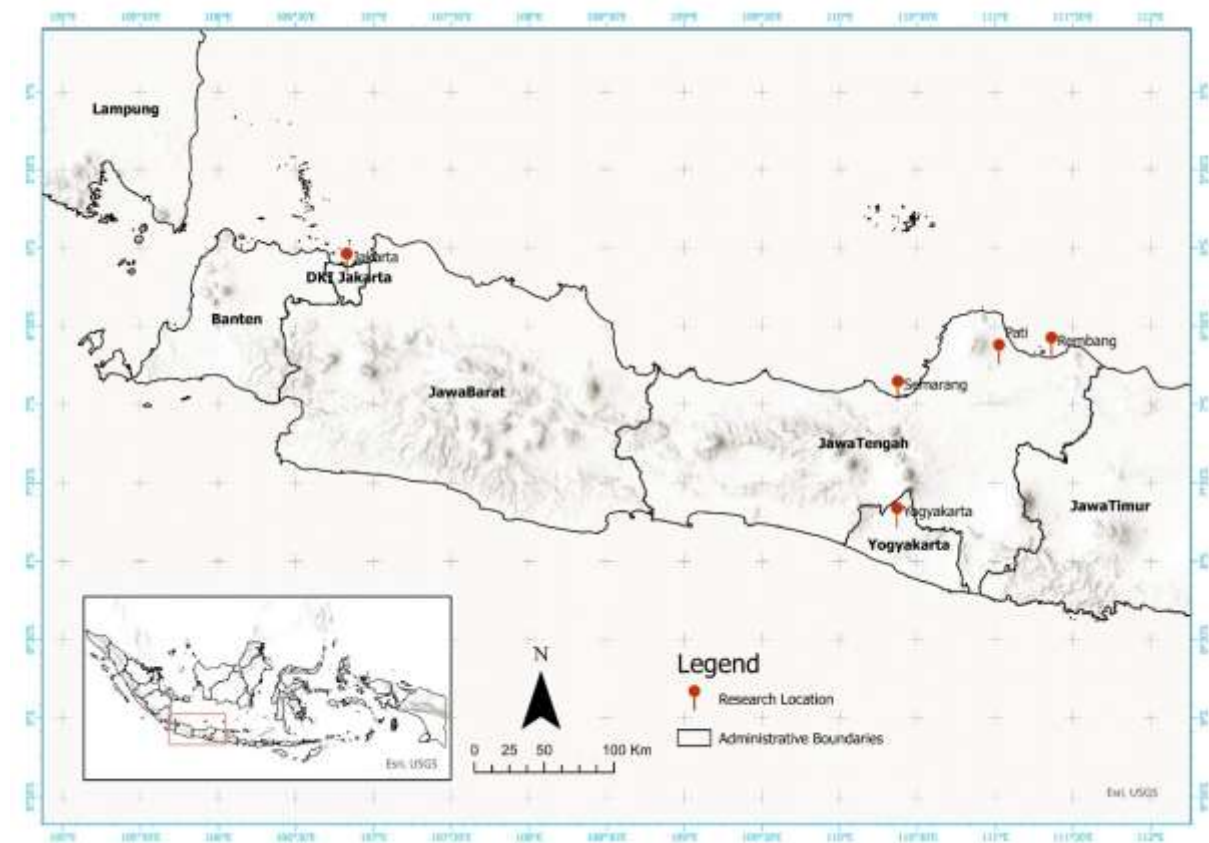


Figure 3.2: Research Sites

Rembang: Rembang is one of the districts where cement mining operations are located: precisely, in Gunem District. This area experiences the environmental and social impacts of resource extraction. It is the focal point of the local resistance movement (JM-PPK-Rembang) opposing the destruction of the Watuputih Groundwater Basin, which is the location of limestone mining providing the main requirement in making cement. This location provides a local perspective on how environmental degradation affects daily life, agriculture, and community relations. The multi-site approach here allows for research on how local communities engage not only with their immediate environment but also with the broader national discourse regarding the sustainability of the karst area in the North Kendeng Mountains.

Pati: Pati is one of the districts where the initial planning for cement mining operations began, but due to the strengthening of grassroots movements, the cement factory was forced to cancel its project plans. This is because the Sukolilo Pati area is an area designated as a karst landscape area. It can be said that the Pati area, especially in the Sukolilo sub-district, is an important historical site for understanding how corporate and government interests initially framed the development of karst resources. Beyond this, the strengthening of the JM-PPK Rembang movement was also influenced by the movement to save the Kendeng Mountains from Pati. By including Pati as a research site, this study can trace the trajectory of mining operations from initial planning to implementation, providing a longitudinal view of the political and economic forces that are taking place. Within a multi-site ethnographic framework, this has allowed for a deeper understanding of the continuity and shift in political strategies over time and space.

Semarang: As the capital city of Central Java Province, Semarang represents governance at the subnational or regional level. It is where regional policies are developed and government institutions such as the Governor of Central Java, the Central Java Environmental Agency, the Energy and Mineral Resources Agency, and the concentration and consolidation of civil society organisations, such as legal aid institutions, academics from various universities, students, and other civil society groups. This location allows research to focus on how local actors, including bureaucrats and policymakers, navigate the competing interests of local communities, companies, and national government agencies. From a multi-site perspective, Semarang is an important node where local conflicts intersect with regional regulatory frameworks and political negotiations.

Yogyakarta: Home to various universities, it is known as the student city in Indonesia. In the context of this research, Yogyakarta is home to many academics and experts involved in the debate on karst management and environmental sustainability. Initially, the design of this research did not include Yogyakarta as one of the study sites but, due to the processes used during the fieldwork, the research became focused on the city. By including Yogyakarta as a research site, this study acknowledges the role of scientific knowledge and expert discourse in shaping the struggle for natural resources. In line with Marcus' multi-site approach, Yogyakarta represents the intellectual and scientific

dimensions of the conflict, where knowledge production and the technical framing of environmental issues play an important role in influencing public policy and opinion.

Jakarta: As the capital city of Indonesia, Jakarta is where the central government agencies responsible for environmental and mining policy are located. These include institutions such as the Ministry of Environment and Forestry, the Geological Agency, and the Presidential Staff Office. Jakarta represents national-scale governance and decision-making, where policies that directly affect local communities are formulated. In multi-site ethnography, this location is important for understanding how national-level decisions are made and how power is negotiated between central authorities and local actors.

The location of this research reflects the focus in the political ecology framework on multi-scale analysis, which emphasises that environmental issues are shaped by interactions at multiple levels—local, regional, national, and even global. Using a multi-site ethnographic approach, this research explores the relationships between these scales, examining how decisions made at the national level in Jakarta affect local communities living around a cement factory in Rembang, and how local resistance movements protest, communicate, negotiate, and feed back into national policy debates. The interactions between actors, groups, alliances, and institutions at multiple scales of ecological governance and management are a central concern of the political ecology approach, which seeks to understand the distribution of power in natural resource or environmental governance.

The case of karst resource contestation in the northern mountains shows that natural resource governance conflicts are not limited to local communities living near mining operations. Instead, these conflicts involve a variety of stakeholders—from farmers, local activists, environmental NGOs, and academics/experts to national government agencies, regional policymakers, and corporations. Each of these actors operates in different geographical and institutional contexts, but their actions are interconnected through environmental governance processes. Multi-site ethnography, therefore, provides a methodological framework to explore these relationships across sites, allowing

for a more comprehensive understanding of how environmental conflicts are negotiated and contested at different scales.

3.4 Data Collection

One advantage of multi-sited ethnographic research, which is typically conducted in a variety of settings such as communities, institutions, or specific cultural groups, is that it does not rely on a single data collection method. This approach often involves gathering rich, in-depth data through interviews with participants who serve as research subjects, thereby enabling researchers to gain a comprehensive understanding of the social and cultural dynamics within the specific context being studied. Occasionally, what is transmitted through interviews fails to explain empirical facts. On the other hand, participants occasionally provide inaccurate information if their trust has not been earned.

In contrast to other methodologies, multi-sited ethnography enables data collection from various sources, including close observations through interaction and the interpretation of expressions. This allows the validation of information supplied by participants through observations of commonplace phenomena.

3.4.1 Access

Before describing the data collection techniques I employed, I will briefly discuss data access. Access is one of the most crucial components for academics wishing to acquire pertinent data and information. Often, not all the research participants provide complete details to others, even to me as a researcher.

My engagement with the socio-environmental issues in the North Kendeng Mountains began in 2015 through my involvement as an activist supporting local community campaigns. Between 2015 and 2017, I actively participated in cultural events associated with the #SaveKendeng and #TolakSemen (Reject Cement) campaigns, interacting closely with community members from the region. This provided direct access to the local grassroots movement, allowing me to develop an in-depth understanding of their perspectives, motivations, and activities.

I conducted preliminary fieldwork in August and September (2022) to do a scoping study. Our communication channels were reestablished through this exercise, although I had only originally communicated via WhatsApp and Facebook. During the preliminary fieldwork, I encountered several vital sources. Some were questioned directly, while others were approached informally for information on the development of conflict over natural resources in the North Kendeng Mountains.

During my initial scoping visit, I informed participants that this was my first in-person interaction with them, following prior communication through digital platforms. I explained the purpose of my research and requested their assistance in facilitating further contacts. The participants were receptive and helped establish connections with other relevant actors involved in the conflict, such as community leaders, academics, experts, activists, government representatives, pro-cement local communities, and cement company officials, allowing me to arrange subsequent interviews. This distinction between initial participants and other actors was important because it enabled a more comprehensive and balanced exploration of the diverse perspectives surrounding the conflict.

3.4.2 Participant Observation

Participant observation is an essential method for bridging the gap between what participants state and the actual events that occurred in the field. It allows the researcher to directly engage with and validate observations through active involvement in the phenomena being studied. This approach helps ensure that the data collected reflect genuine interactions and events, providing deeper insights into participants' lived experiences. This position is in line with the explanation of Watson and Till (2010), that observation encompasses the documentation and contemplation of embodied and emotional experiences, intersubjective and material exchanges, as well as social and non-human interactions.

During my preliminary fieldwork, I engaged in participant observation as part of my initial data collection process. However, the participant observation method had to be adapted depending on the setting, type of event, and actors being observed. For instance, observing informal community gatherings required a

different approach from observing formal government meetings or discussions with NGOs. In each context, I adjusted my role and interaction style accordingly, sometimes as a passive observer, and other times participating more actively, to build trust and ensure the authenticity of the observations.

In my interactions and conversations with government officials, I noted their cautious responses and general reluctance to engage openly, which became evident during formal interviews rather than participant observation. During these formal interviews, officials often expressed visible frustration, evident through their expressions and tone of voice, particularly regarding the involvement of NGOs and external actors. However, as these observations were made during structured interviews, they fall outside the specific method of participant observation.

In contrast to participant observation of local communities directly involved in conflict dynamics, I can also interact based on my experience. I stayed at the home of a community member who was actively involved with the JM-PPK, the grassroots coalition that had been consistently vocal in opposing cement mining activities in the North Kendeng Mountains. I was active in the daily routine of his community from sunrise until night. I followed them as they worked on their farms. I was able to participate in various local or cultural activities they held during the preliminary fieldwork, such as *Kupatan Kendeng* (Kendeng Rice Cake Festival), *Hari Kemerdekaan* (Indonesian Independence Day), *Hari Tani* (Peasants' Day), *Malam Tirakatan* (Night of Reflection), *Lamporan* (Torchlight Procession), *Temon Banyu* (Water Ritual), *Brokohan* (Traditional Feast for Celebration), and *Arak-arakan Kupat* (Rice Cake Parade), all of which are key cultural events organised by the JM-PPK. Each event carries deep cultural and symbolic meanings tied to the Kendeng community's identity and its connection to the land. For example, *Kupatan Kendeng* symbolises gratitude for nature's bounty, while *Temon Banyu* involves rituals to honour water sources as sacred. Similarly, *Malam Tirakatan* provides an opportunity for reflection and unity among community members as they reaffirm their commitment to preserving Kendeng's cultural and environmental heritage.

During my preliminary fieldwork conducted from July to September 2022, I utilised multi-sited ethnography as the main method for data collection. I

identified several participant observation tasks that required more focused attention during the main fieldwork. Specifically, these tasks included physically observing environmental conditions and changes around the Watuputih Groundwater Basin area. During this initial visit, I conducted direct field observations at multiple spring locations to verify their existence and status since some were not documented in the official EIA reports. Additionally, I examined the locations of active limestone mining operations to document their proximity to critical groundwater resources. During one of these site visits, I noted a loud explosion, which local informants confirmed was caused by blasting activities related to limestone extraction near the Watuputih Basin. Informants also mentioned that such explosions typically occurred daily around noon, shortly before Dhuhr (the Muslim midday prayer). To reach the exact location of these mining activities, I followed the route used by trucks transporting extracted limestone from the quarry sites.

Importantly, observations were also made about the daily struggles and politics surrounding the presence of factories, particularly regarding how the community members discussed the cement factory between themselves and how they engaged with locals who supported the cement factory. This observation was made in an effort not to rely solely on residents who rejected the cement mining.

Additionally, during my fieldwork, I had the opportunity to directly observe the limestone mining production process at the factory area, having obtained permission from the director of human resources. I visited the mining site owned by PT. SI in the Watuputih Groundwater Basin area. I witnessed the initial blasting of limestone, followed by its transportation via large trucks with a capacity of eight tonnes to the crusher, before being conveyed to the factory. During this observation, I was accompanied by one of the crew members responsible for the mining process. He provided extensive information about the mining techniques used by the cement factory, and he also informed me that there remains an area of land within the community that has not been acquired by the cement factory. This is because the owner is involved in a movement opposing the cement factory. Furthermore, I visited several ecosystem locations in the Watuputih Groundwater Basin, such as *Sumber Semen*, *Sumber Brubulan*, and *Gua Wiyu*. These areas of the ecosystem, which are embroiled in the

dynamic conflicts of the cement factory mining process, have become contested subjects among experts.

To summarise, I could better comprehend the social phenomena and human behaviour of the residents of the area around the cement factory by participating in participant observation. Also, I was able to have a better understanding of how people who worked closely with the currently operational cement factories behaved and how their psychological circumstances were affected. Particularly, I witnessed how they had to deal with neighbours who opposed the cement factory, or with neighbours who favoured the factory or worked there as employees.

3.4.3 Semi-structured Interviews

Semi-structured interviews are an effective data collection method used in research. In this research, I conducted semi-structured interviews with 29 diverse participants whose daily actions we could observe, such as political elites, bureaucrats, and industry representatives. Therefore, conducting an in-person or an online interview was the best option.

Due to the variety of actors involved in this research, I developed multiple interview guides. These guides were tailored based on the specific positions and roles of the actors operating within the dynamics of the karst resource conflict in the North Kendeng Mountains. The full set of interview guides is provided in Appendix D.

The majority of the interview questions prepared were open-ended to enable participants to submit information freely and without constraints. In addition, according to this approach, I could immediately react to and confirm the responses. This technique was employed to encourage dialogue.

The following procedure was used to interview those involved in the administration. First, I arranged an appointment with a member of their staff. A few days before the interview, the staff member reviewed the interview questions. This was to ensure that the questions I had prepared for their leaders were pertinent and did not touch upon sensitive information. Secondly, during the interview, the participants were allowed to suspend recording or not record

specific responses they deemed sensitive and likely to spark future controversy. This did not occur when I interviewed academics, NGOs, and local figures, who provided me with the necessary information openly.

The general situation was not markedly different from the preliminary fieldwork in which I primarily used semi-structured interviews with participants who were predominantly government representatives, company representatives, experts (including academics), activists, and members of political elites. Most of them resided in Semarang, Yogyakarta, and Jakarta.

The primary challenge in conducting these semi-structured interviews was related to the availability of time. All the participants I interviewed could be described as individuals busy with their respective professions, particularly those in high-level positions. I had to schedule appointments in advance, either through their secretaries or directly with the participants themselves. Some informants were open to online interviews, especially those who did not reside within the research area.

Despite these logistical challenges, during the preliminary fieldwork, the provincial bureaucrats were cautious in providing information due to Ganjar Pranowo (GP) still serving as an active governor. However, during the main fieldwork, these bureaucrats became more open, as GP was no longer governor at that time. Conversely, informants from the Geological Agency were particularly open, explaining that the issue was no longer considered sensitive given its prolonged duration. They readily shared various reports and data that they possessed.

3.4.4 Informal Conversations

During my preliminary fieldwork, informal conversations proved to be a highly effective method for data collection (Swain and King, 2022). Particular attention needed to be given to collecting information from participants representing local communities, especially those who were actively involved in protest activities. This included individuals who, during the same period, were aligned with or supportive of the pro-mining cement factory initiatives. I engaged with 15 individuals (nine males/six females) who possessed a comprehensive understanding of the conflict dynamics in both the Rembang and Pati regions. In

contrast to the semi-structured interviews, our discussions were not restricted by a series of questions and time constraints, which could have caused participants to purposefully withhold some of the knowledge they possessed.

Conversation helps break down the barrier between the researcher and the subject being studied. The conversation is a step above the interview since the informant and the researcher have a mutual sense of confidence. In some circumstances, the participants believe that the researchers have integrated into their group and encouraged the researcher into a conversational community (Gudeman and Rivera, 1990). Accordingly, the researcher can draw on the different skills and knowledge of community members to approach complicated issues in new ways.

Even with my prior engagement and familiarity with the communities, several obstacles emerged during the informal conversations. First, initiating contact and building trust required a careful and gradual approach. Establishing rapport took considerable time and effort, starting with personal introductions and informal meetings before conducting formal, in-person interviews. Consequently, during the preliminary fieldwork, I delayed beginning the data collection process until I had spent several days observing and interacting with the participants to better understand their daily activities and to build trust.

Second, once the data collection began, I informed the participants about the study's purpose and explained the consent form. Unlike semi-structured interviews, where an introduction was provided at the beginning of each interview, informal conversations began only after the participants were aware of and had agreed to my research objectives. I initiated conversations in various settings where the participants felt comfortable and had sufficient time to respond without interruptions. In this way, conversations could be conducted multiple times to ensure clarity and depth of information.

Third, because conversations took place in informal settings, it was often not possible to take notes openly without disrupting the flow of discussion or making participants uncomfortable. In such cases, I refrained from writing during the conversation and instead documented key points immediately afterwards. However, when participants appeared comfortable, I took notes during the

conversation. Additionally, if permitted, I recorded conversations to ensure accuracy. This ability to recall and document discussions effectively was essential for capturing the information shared by the participants.

In this context, the dialogue could be more accurately described as an informal conversation. I conducted these informal conversations predominantly when interacting directly with residents, whether they opposed or supported the cement factory. These encounters were not limited to a single meeting; I met each informant at least twice, often following them in their daily activities, like farming, or I visited their homes, typically in the late afternoon or evening when they spent more time at home. During our initial meeting, I always introduced myself and explained the purpose of my visit, to which they generally responded positively.

During these informal conversations, the topics discussed or the questions I posed did not always relate directly to the data I intended to collect. I usually began by asking about their daily activities, challenges in farming, and changes in the village. Often, after this initial discussion, the participants would start a conversation or discussion related to the dynamics of cement factory mining, covering both positive and negative aspects.

Reflecting on this, I found that informal conversations allowed for more open and candid data collection. The local community appeared more at ease when I adopted this approach, as evidenced by their relaxed body language and willingness to share detailed information. Notably, some informants, particularly those who gathered in social settings such as coffee stalls or communal resting areas, seemed more inclined to engage in deeper discussions. In these settings, where drinking coffee and smoking were part of their daily routines, conversations flowed naturally, and the participants appeared less guarded. The informal atmosphere helped reduce any perceived formality of the interview process, making them more willing to share their perspectives without hesitation. The challenge for me was that the topics discussed were not always systematic or orderly as they spoke based on what they remembered at the time. Moreover, it required significant effort on my part as a researcher to recall and compile their conversations into coherent notes of important information for the research.

3.4.5 Note-taking

Two essential objects should be carried at all times by the researcher. A recorder comes first since humans speak more quickly than we can write. A notepad comes next. This helps me when recording the material uncovered through observations, interviews, and conversations when conducting fieldwork. Often, material that we consider essential and pertinent to our research topic may emerge in unanticipated circumstances. Because of this, we must always carry a notepad. This is especially so for observing first impressions, significant events, and nonverbal reactions (Emerson et al., 2013). However, we must take care when using a notepad because using one in certain settings may affect the social relationships we are building, especially when it comes to circumstances, such as rituals, which are usually held in the highest regard.

I typically make field notes when I am not interacting with people, using my free time to do so. For example, when I return to my accommodation at night, I might write down several notes that I consider important and relevant to my research topic. This practice allows me to document insights and observations while they are still fresh in my mind, ensuring that the details of my interactions and the information gathered throughout the day are accurately recorded. This approach to note-taking is crucial for maintaining the integrity and usefulness of the data collected during fieldwork.

3.4.6 Statements Made by Experts and Policymakers in the Mass Media

One of the reasons I chose to incorporate data from the mass media (online) was based on a suggestion from an informant after an interview. During our discussion, the informant remarked, "You can check my opinions in the media for more details, in case something was missed". This statement highlighted the potential of media sources as an additional data stream for capturing experts' and policymakers' perspectives on the Kendeng mining conflict. Given that my key informants included representatives from the Geological Agency, scientific experts, and bureaucrats, their statements in the media often provided further context, elaboration, or even strategic positioning beyond what was disclosed during direct interviews.

Gathering data on an older case presents unique challenges. First, some informants I contacted did not respond to my interview requests. This occurred because several policymakers involved at the time either moved on from their positions, retired, or passed away. Second, even when some participants agreed to be interviewed, several had difficulty recalling the events in detail. Some were kind enough to open old files on their laptops to review and share information with me for further examination. Thus, I am convinced that employing data from statements in the mass media can be relevant.

3.4.7 Documents and Reports

As a researcher, I should consider using data from documents and reports to supplement my study data, specifically policy-related research. I can assess and validate data collected from the field through these documents or reports. Frequently, participants supply little or less specific information. A researcher can summarise the trajectory of recently decided policies through public papers or documents.

In my research, various documents and reports were of significant relevance to the topic under investigation. These documents were acquired during my preliminary fieldwork. Examples of such documents include EIA reports, EIA Addendum reports, EIA Addendum response letters, KLHS/SEA I and 2 reports, EIA review documents, lawsuit files, rapid assessment documents, and field verification reports from KLHK, Amicus Curiae reports, and public examination results from the 2017 Geological Agency investigation report on the Watuputih Groundwater Basin. It is important to note that these documents played a critical role in the research process, as they provided valuable insights and data that were analysed to answer the research questions. These documents were analysed using a discourse analysis approach to understand how they were constructed, particularly for the EIA and SEA documents that discussed what their underlying assumptions were, and how they shaped power relations among different actors. This analysis contributed to the actor-oriented research approach by explaining the different perspectives and interests of the various actors involved in the contestation over natural resources in the Kendeng Mountains.

3.5 Data Analysis

Data analysis was a crucial and complex component of my ethnographic research. After completing the fieldwork, I faced an extensive volume of data collected from multiple sources, including participant observations, field notes, interview transcripts, and various documents, such as EIA reports, SEA assessments, Geological Agency reports, and other data related to cement mining issues. Organising and synthesising these diverse sources required a structured approach to ensure a comprehensive and meaningful interpretation of the findings.

This study employs a reflexive thematic analysis approach (Braun and Clarke, 2006) to systematically examine the contestation over natural resource governance in the North Kendeng Mountains. The analysis follows a step-by-step process to identify how power operates in environmental conflicts, specifically focusing on how scientific and expert claims are mobilised, contested, and legitimised across different arenas. Given the study's pluralistic power framework, the analysis is structured to capture the interplay between agency, institutions, and discourse in shaping governance outcomes.

3.5.1 Data Familiarisation and Initial Coding

The analysis began with an extensive process of familiarisation during which I reviewed the collected data, including interview transcripts, field notes, and relevant documents. This stage involved reading and re-reading the material, taking notes, and identifying recurring patterns or key themes that would guide the subsequent stages of coding and analysis.

An initial round of open coding was conducted to generate broad themes. This included categorising statements related to scientific claims, legal arguments, corporate justifications, and community resistance strategies. The codes were then refined through a process of axial coding, allowing key patterns to emerge organically from the data. Through this process, three primary arenas of contestation became evident: environmental assessment processes, legal contests, and Geological Agency research. Rather than being predefined categories, these arenas were identified inductively through iterative

engagement with the data, reflecting the recurring themes that surfaced during coding.

Among the three primary arenas of contestation analysed in this study, there are differences in the sources of coding data. For the environmental assessment report theme, which is discussed in Chapter 5, I utilised three key reports, namely the EIA, the EIA Addendum, and the SEA, to identify the framing and narratives produced by experts and academics using discourse analysis. However, for the themes of legal contestation (Chapter 6) and institutional mediation (Chapter 7), I drew upon a diverse range of data sources collected during the fieldwork.

3.5.2 Theme Development and Refinement

Once the initial codes were organised, the next step involved searching for broader patterns within the data, aligning with the study's theoretical framework. Each of the three arenas was examined in depth to uncover the strategies employed by different actors in framing scientific expertise to advance their interests.

In the environmental assessment process, corporate and state actors were found to rely on EIA and EIA Addenda to downplay environmental risks and justify mining operations. This contrasted with the counter-narratives presented by anti-mining coalitions, who mobilised SEA to highlight the ecological sensitivity of the karst landscape. The analysis focused on identifying the discursive strategies used by both sides to construct legitimacy through environmental knowledge production.

The legal arena was then examined as a key site where scientific claims were contested through litigation. Thematic analysis in this stage involved identifying how expert testimonies were presented in court, how credibility was established, and how legal arguments were structured to support or oppose mining activities. Coding at this stage emphasised the role of legal-rational authority in shaping governance decisions and the extent to which courtroom deliberations reflected broader structural and political pressures.

Finally, the institutional mediation process was analyzed, particularly focusing on the evolving role of the Geological Agency. The initial coding revealed that the agency initially emphasised the environmental risks of karst mining but later shifted its position to align with pro-development interests. The thematic analysis here examined internal reports, public statements, and policy revisions to trace how institutional knowledge was reinterpreted under political and economic pressure.

3.5.3 Reviewing and Defining Themes

Following the identification of the key themes, a review process was conducted to ensure coherence and distinctiveness among the themes. This involved cross-checking the coding framework to verify that the themes accurately captured the complexities of governance contestation. Each theme was then refined to reflect how different forms of power, actor-oriented agency, structural-economic influences, and discursive strategies were deployed across the three arenas.

The final stage of analysis involved defining and naming the themes, ensuring that they were both theoretically grounded and empirically robust. The results were then structured to highlight how scientific and expert claims were mobilised, contested, and strategically used to shape governance frameworks.

3.6 Reflexivity and Positionality

Undoubtedly, reflexivity and positionality constitute indispensable concepts within the realm of political ecology and, more extensively, in the social sciences. Both notions emphasise the imperative for researchers to engage in critical reflection concerning their perspectives, biases, and relationships with the subjects and contexts under investigation. Drawing from the work of Abigail H. Neely and Thokozile Nguse, specifically their publication titled "Relationships and Research Methods", a distinction is made between reflexivity and positionality (Neely and Nguse, 2015).

To elaborate, reflexivity refers to the ongoing process of self-examination and critical reflection that researchers undertake to acknowledge and comprehend how their background, experiences, and values shape the research process and

its outcomes. Within the context of political ecology, reflexivity assumes paramount importance as it aids researchers in recognising how their preconceptions, assumptions, and interests potentially influence data interpretation, research question formulation, and the presentation of findings. By actively engaging in reflexivity, political ecology scholars can strive to produce more robust, nuanced, and ethically sound research (Neely and Nguse, 2015).

Conversely, positionality pertains to the social, cultural, political, and economic contexts that mould a researcher's perspective, subsequently impacting their research approach. In political ecology, factors such as citizenship, ethnicity, gender, educational background, and professional affiliations, among others, may influence a researcher's positionality. Acknowledging one's positionality is of vital importance as it enables researchers to discern how their perspectives and relationships with the research subjects may affect the research process, knowledge construction, and power dynamics between researchers and research participants (Mason-Bish, 2019).

Therefore, as a researcher, I have the responsibility to introduce who I am by briefly explaining my family background, education, and how my environment and experiences have shaped the values or principles that I hold today. Additionally, I also need to explain how my initial encounter with this issue led me to decide to take up this research topic. This is an attempt to ethically account for and reduce bias in the research.

I am a man of Madurese ethnic background. However, I was born and raised in Surabaya, which is the second-largest city on the island of Java. I was born into a conservative Muslim family from a lower middle-class background. Despite a fairly limited economic background, I have a strong ambition to change my and my family's lives. Both of my parents always told me that "you can change your life with education". With these values and beliefs, I pushed myself to achieve academically so that I could pursue higher education, which, at that time, was not an opportunity available to everyone.

At college, I studied a sociology programme in the Faculty of Social and Political Sciences. With this academic background, I became familiar with and involved in the world of activism. I joined the GMNI organisation (Indonesian National

Student Movement). This organisation is based on *Marhaenism*, which is a doctrine from Sukarno. At this point, I interacted a lot and was involved in advocating social and political issues. Subsequently, when pursuing a master's degree in the same field, I remained involved in the world of activism.

It can be said that activism has greatly contributed to shaping my perspective, logic, and character as an individual, especially regarding the internalisation of the values and principles that I developed, such as humanity, justice, and equality. These are the values that I always emphasise when I try to understand and interpret social reality. I carried these principles when I chose my path to be a lecturer. I felt that by becoming a lecturer, I could still be involved and network with activism while becoming an academic/scholar.

Since becoming a lecturer, I have gradually become involved in the environmental movement in Indonesia. This was especially the case when I became the coordinator of FNKSDA (Front Nahdliyin for Sovereignty of Natural Resources) in the Malang Raya region. FNKSDA is an organisation that holds the principles of Muslim progressivism by combining a Marxist approach and the values of liberation and humanity from Islam. I have gradually become more involved and I now actively campaign on issues of agrarian justice, natural resources, and the environment. One campaign involves the movement to reject the cement factory in the North Kendeng Mountains.

At that time, I also became part of the movement campaign, actively organising documentary film discussions about SAMIN VS SEMEN at several universities. I made the film as part of the discussion materials I used with my students when in class. From 2015 to 2017, I also conducted research related to the transformation of local wisdom and women's movements in the North Kendeng Mountains. These experiences directly explain my positionality in this research.

Several considerations prompted me to propose this research plan in the doctoral study programme that I am pursuing. First, my involvement as part of the #TolakSemen campaign at North Kendeng Mountains. I consider that, currently, the Kendeng Mountains are facing systematic threats of damage due to karst mining that has been carried out since 1995. Second, I am quite familiar with the issues of the North Kendeng Mountains due to my previous research experience.

And third, what must be taken into consideration is access. With my experience, I have easy access to reach actors or stakeholders and collect their information.

Given my background as an activist, I recognise the potential risk of bias in my research (Podsakoff, MacKenzie and Podsakoff, 2012), particularly regarding sympathies toward the resistance movement against cement mining. This poses challenges in maintaining an objective and balanced analysis, especially when engaging with actors from different ideological and institutional backgrounds. My commitment as a researcher is to ensure that my prior activism does not lead to an uncritical validation of one side of the conflict but rather contributes to a nuanced and empirically grounded understanding of power dynamics in resource governance.

To mitigate any bias in this research, I have implemented several methodological strategies to ensure a balanced and rigorous analysis. First, I have incorporated diverse perspectives by not limiting my focus to resistance movements but also including voices from state actors, corporate representatives, local pro-mining communities, and regulatory bodies. By engaging with stakeholders from various backgrounds, I aim to provide a more comprehensive examination of the conflict, ensuring that multiple viewpoints are considered rather than privileging a single narrative. Second, I have employed data triangulation through a multi-method approach that combines participant observation, semi-structured interviews, and document analysis. This methodological integration has allowed me to cross-verify claims made by different actors, reducing the risk of one-sided interpretations, and enhancing the reliability of my findings. Finally, I have ensured rigorous data coding and reflexivity throughout the analytical process. Using systematic coding techniques, I identified patterns and themes without imposing preconceived activist biases. Furthermore, I have maintained a research diary to critically reflect on my positionality, acknowledging how my prior experiences may shape interpretations and actively working to counteract any potential biases. These combined measures have strengthened the validity of my research by fostering a critical and balanced approach to analyzing power dynamics in resource conflicts.

While my personal experiences and advocacy work have informed my interest in this topic, my role as a researcher is to offer a scholarly contribution that

critically examines the pluralistic power dynamics at play in the governance of the North Kendeng Mountains. By adopting a rigorous methodological approach and embracing reflexivity, I have strived to produce research that is empirically grounded, analytically robust, and ethically responsible.

In conclusion, the reflexivity and positionality that I have explained above show the subjectivity of this research. I also believe that all forms of research will always be political and ideological, and this is especially the case with research topics related to environmental issues, natural resources, or agrarian conflict.

3.7 Research Ethics

The ethics of this research have been approved by the Department of Environment and Geography Ethics Committee. The process of submitting and approving the ethics form was carried out twice, namely at the preliminary fieldwork stage, which took place between July and September 2022, and at the follow-up stage, between September 2022 and April 2024.

As part of compliance with the GDPR in collecting data from the participants, I provided information related to the research project (attached in Appendix B), a consent form (Appendix C), and an explanation at the time of my initial contact. All of these documents have been translated into Indonesian to facilitate participant understanding. In the explanation regarding the project information, I described the planned interview duration, the use of a digital recorder to record the interview to ensure data accuracy, and the personal data management policy. The personal data recorded in this study were limited to name (anonymised), institution, and contact (telephone number or e-mail).

The participants were given the freedom to refuse to be interviewed or refuse to answer certain questions if they felt uncomfortable. In addition, I also explained that the results of this study would be written in English. However, I was willing to provide an executive summary in Indonesian if the participants wished.

The consent form given to the participants, which was also translated into Indonesian, included the willingness of the participants to voluntarily participate in the research without any coercion. The form also included the participants'

consent to be interviewed and to permit the interview results to be transcribed as part of the research needs. Before starting the interview, the participants were required to sign the consent form as a sign of agreement.

3.8 Limitations

This study has several limitations, especially related to the data collection process involving the participants. First, the case that is the focus of this study occurred almost a decade ago. Although the dynamics of the case are ongoing, several key participants, especially those who played significant roles in the dynamics of the case, are no longer in relevant positions of responsibility. For example, during the data collection process, I was unable to interview the heads of the Environmental Service (DLH) and the Energy and Mineral Resources (ESDM) Service of Central Java Province because they had retired. However, I tried to trace other participants who were also involved in the dynamics.

Second, several individuals involved in this case no longer lived in the research area because they had changed jobs and were spread across various regions in Indonesia. I overcame this obstacle by conducting online interviews.

Finally, I found an interesting dynamic expressed by one of the key participants in the study. The individual, who initially sided with the JM-PPK coalition or the anti-cement group, now supports the policies of the Governor of Central Java. This shift in alliance made the person concerned reluctant to be interviewed further. To address this, I attempted follow-up communication to clarify their reasons for the shift and, where possible, sought supplementary perspectives from other participants familiar with their change in stance. This unexpected shift underscores the evolving nature of alliances in environmental conflicts and highlights the complexities of political positioning within local advocacy movements.

4. Karst Governance, Cement Mining, and the Emerging of Conflict in North Kendeng Mountains

4.1 Introduction

This chapter aims to explain the study context for this research related to the conflict that occurred in the North Kendeng Mountains as a consequence of contestation over karst resources. In the first section, I briefly outline the trajectory of natural resource management in Indonesia, focusing on the regime change from the New Order to the Reformation era. This transition has had significant impacts on natural resource governance, especially in the context of the shift in authority from the central government to local governments through decentralisation policies. Although decentralisation aims to increase efficiency and local participation in resource management, its implementation faces serious challenges, especially due to the weak regulatory framework and rampant corruption.

Then, the governance of the karst industry in Indonesia will be discussed. Indonesia is believed to have one of the largest karst reserves in the world, covering an area of 15.5 million hectares in Java, Sulawesi and Papua. Karst areas in Indonesia have an important role regarding water reserves and have economic value for mining, especially cement production. However, mining poses a significant threat to karst ecosystems, driven by population growth, agricultural intensification, and infrastructure development.

In the last subsection, I will elaborate on the North Kendeng Mountains area, particularly the Watuputih Groundwater Basin, which harbours crucial karst resources vital for cement production. This region became a focal point of considerable conflict due to the government's plan to expand karst mining operations through PT. SI. The proposal to establish a cement factory in Rembang was met with strong opposition from local communities and environmental groups, who cited threats to water resources, biodiversity, and insufficient EIA. Despite legal challenges and protests resulting in the revocation

of permits and temporary halts, the government and PT. SI persisted in their mining activities, often employing political manoeuvring and navigating regulatory inconsistencies. This conflict garnered national attention, engaging a range of stakeholders from local activists to the President of Indonesia. Nonetheless, the JM-PPK's resolve remained unwavering in its efforts to safeguard the ecological integrity of the Kendeng Mountains.

4.2 Natural Resources Governance in Indonesia and Its Political Context

Indonesia has a long history of natural resource exploitation, where resources such as forests, minerals, and water have played a major role in the growth of the national economy. Resource management policies are often shaped by colonial legacies and post-independence industrialisation. This was so, especially during the Suharto regime, when the 1967 Foreign Investment Law was passed, marking a new chapter in natural resource management in Indonesia. During that era, natural resources in Indonesia were already parcelled, owned and controlled by foreign investment and business elites, who were Suharto's cronies.

After the New Order era (Suharto regime) fell in 1998, the political situation pushed to decentralise the administration, redistributing the authority to manage resources to local governments, to increase regional autonomy (Negara and Hutchinson, 2021; Spiegel, 2012). However, this also led to fragmented and, sometimes, contradictory governance practices.

This shift in governance had profound implications for how local governments managed natural resources. With greater control over resource management, local authorities prioritised short-term economic gains through resource extraction over long-term sustainability in pursuit of economic growth and local revenue. This is especially evident in regions with superior commodities in several sectors such as mining and forestry (Rusli and Duek, 2010). In addition to economic incentives, political dynamics further shaped resource governance at the local level. Political connections often play a significant role in resource allocation, with companies lobbying for favourable policies. For example, this may occur when a company contributes to funding a regional head in contesting

elections at the regional/city or provincial levels (Habib, Muhammadi and Jiang, 2017).

Issues such as corruption and weak enforcement of environmental regulations are recurring challenges in resource governance as officials may prioritise corporate partnerships over ecological considerations. The influence of political interests often results in inconsistent environmental policies. Although Indonesia has laws to protect ecosystems (e.g., the Environmental Protection and Management Law), enforcement is weak (Dewantara and Larasati, 2022; Mahardika and Bayu, 2022).

Resource management has led to significant environmental degradation, particularly in sensitive areas such as tropical forests and karst landscapes (Gutiérrez et al., 2014; Breg Valjavec, Zorn and Čarni, 2018). The impacts are not only ecological but also social as communities dependent on these ecosystems often experience displacement, loss of livelihoods, and social conflict. NGOs and local communities have become important in advocating for sustainable resource management. They actively oppose policies or projects that threaten environmental sustainability (Sitorus, 2019).

In this context, karst governance in Indonesia reflects challenges not dissimilar to other natural resources, as limestone-rich karst areas are critical to cement production and industrial raw materials. Political dynamics, such as local economic interests, national corporate influence, and environmental neglect, shape policies around karst resource use, leading to conflicts such as those in North Kendeng. Understanding general trends in Indonesian resource governance helps contextualise the specific case of karst governance, highlighting why regulatory inconsistencies and political interests have led to ongoing conflicts over karst landscapes.

4.3 Situating Karst Governance in Indonesia

Indonesia has one of the largest karst reserves in the world. Karst distribution in Indonesia reaches 15.5 million hectares and is located in the central and eastern parts of the islands of Java, Sulawesi, and Papua (Waluyo et al., 2005). Karst formations play a crucial role in the use of natural water reservoirs, serving as

essential components of groundwater storage within the broader framework of natural resource management. Furthermore, the existence of karst can be used to increase the country's foreign exchange, especially from the mining sector (Adji, Haryono and Woro, 1999).



Figure 4.1: The Distribution of Karst Landscape Areas in Indonesia. The Areas Highlighted in Blue Represent the Karst Landscape Regions.

Source: (ESDM, 2020)

The map illustrates the distribution of karst landscapes across Indonesia, with particular emphasis on key regions such as Java, Sulawesi, and Papua, which are central to this study. Notably, Java is home to approximately one-third of Indonesia's population, making the allocation of mining concession permits on the island especially consequential. The expansion of mining activities in these areas poses a substantial risk of ecological degradation, particularly concerning the sustainability of water resources.

According to Balazs (1968), at least 17 locations in Indonesia have been identified as being karst, based on geological and hydrological characteristics. However, comprehensive exploration and validation of some of these locations are still lacking, making it necessary to conduct further research to confirm their classification. The existence of karst often leads to habitat destruction, where the issue is frequently triggered by population growth, agricultural intensification, infrastructure development, and mining (Sulistiyowati, Setiadi and Haryono,

2021). Therefore, the Indonesian government regulates the Karst Area through laws and regulations.

Adji, Haryono, and Woro (1999) argued that specific regulations governed the Karst Area as a natural resource conservation area. The first was the Environmental Law No. 4 of 1984. This law explicitly stated that the Karst Area should first be turned into a conservation area. Second came Government Regulation No. 28 of 1985 on Forest Protection. One of the articles stated that the existing caves should be managed by the forestry department and local governments, both in forested and non-forested areas. Finally, several regulations such as Law No. 11 of 1967, PP No. 51 on EIA, and Minister of Mining and Energy Regulation No. 04/P/M/1977 have been used to regulate mining in the Karst Area.

However, the last three regulations governing mining in the Karst Area have become a paradox in karst conservation efforts. On the one hand, the government expects that the existence of karst must be preserved and protected. At the same time, it legitimises karst rock mining operations, mainly regarding the presence of a cement factory.

Waluyo et al. (2005) argued that national resource managers thought that the ecological value of karst was unimportant and should be deemed to be minimal. Meanwhile, from an economic point of view, karst was the primary raw material for cement production. This situation has caused severe degradation of the Karst Area in Indonesia. It has been exacerbated by the fact that the law for the protection of the karst ecosystem still has many weaknesses in its protection from the threat of environmental damage. Until now, no regulatory standards defining the criteria for environmental degradation in karst ecosystems have been established. Additionally, the permissible boundaries for business activities within these ecosystems remain unclear, leading to potential mismanagement and environmental risks (Widyaningsih, 2017).

WALHI, one of the environmental NGOs in Indonesia, has explained that the cement industry threatens the karst ecosystem in Indonesia. Hundreds of IUPs (mining business permits) have been given by the government to companies to

mine karst in several regions in Indonesia. The following table demonstrates the karst area used by the cement industry (Chandra, 2016):

Table 4.1: Distribution of the Cement Industry in the Karst Areas of Indonesia

Karst Area	The Number of IUP (Mining Business Permits)	Space Allocation	Dominate Mining Company
Karst Maros – Sulawesi Selatan	34	19.666 Ha	PT. Semen Bosowa, PT. Tonasa, PT. Conch
Karst Bukit Barisan – Sumatra Barat	13 Production Permits 2 Exploration Permits	12.186 Ha	PT. Semen Padang. PT. Semen Asia, PT. Camcrown
Karst Meratus – Kalimantan Selatan	28 Production Permits 47 Exploration Permits	312.391 Ha	PT. Indocement Tunggal Perkasa (ITP), PT. Conch South Kalimantan Cement
Karst Sangkulirang- Mangkalihat – Kalimantan Timur	17	6800 Ha	PT. Semen Bosowa, PT. Semen Kalimantan
Karst Gunung Sewu – Jawa Tengah	1	10.057 Ha	Ultratech Mining

The data from the table above do not fully represent karst mining for the cement industry in Indonesia because some areas have not been identified, such as those in Gresik, Tuban, Pati, and Rembang. Government policies and development plans indicate a tendency to prioritise the economic potential of the

karst areas over their ecological functions. For instance, the issuance of mining permits and large-scale extraction projects in karst landscapes suggests a commodification approach, where karst is primarily viewed as a resource for economic growth.

The issuance of mining permits in the Karst Area has become increasingly massive since the Decree of the Minister of Energy and Mineral Resources No. 17 of 2012 concerning the Karst landscape area. Initially, the policy sought to solve the problem of handling the use and protection of the Karst landscape area in Indonesia (Nugroho, Hidayat and Memed, 2020).

However, some experts think otherwise, that the existence of this regulation seems to be a shortcut to facilitating mining licensing in the Karst Area. First, the management of Karst Areas in P.17/2012 only regulates the determination of them as protected areas. This is in contrast to the two previous regulations which included comprehensive management through their classification. As a result, there are no guidelines for the areas that are not designated as protected areas. Second, P.17/2012 does not have clear limitations regarding activities permitted in these areas, while the previous regulations classified them into three classes based on the type of activity employed there and their utilisation. As a result, mining activities are still ongoing in several Karst Areas that have been designated as the Karst Natural Landscape Area (KBAK). Third, ESDM Regulation No. 17/2012 only emphasises the physical geological protection of the karst ecosystem as a regulator of water management, without taking into account the function of the Karst Area as a complex ecosystem that includes flora, fauna, and socio-cultural values of the local community. Up until 2020, 10 karst landscape areas were designated by the Minister of ESDM with a total area of 317,663 hectares. However, the determination of KBAK has the potential for bias in the investigation process because ESDM No. 17/2012 does not mention community participation (Jaya, 2022).

4.4 The Emergence of Conflict in Watuputih Groundwater Basin, the North Kendeng Mountains

The political trajectory of karst mining in the Kendeng area is dynamic and involves high-level political intervention. As the company planned to begin mining, this state-owned enterprise manipulated EIA documents and ignored legal decisions related to the revocation of environmental permits. It bypassed the requirement for a Strategic Environmental Assessment (SEA) and pressured the governor's office to approve the EIA commission's outcome, despite procedural and substantive objections. This pressure was exerted through political lobbying and inter-agency influence, exploiting the company's close ties to central government actors and its strategic framing of the mining project as part of national development priorities. These dynamics effectively limited the governor's capacity to reject or delay the approval. This situation is unusual for karst mining for cement companies in Indonesia, which generally runs smoothly, without any resistance. To understand the dynamics of conflict and contestation over the karst resources in the North Kendeng Mountains, I have summarised the chronological events or the trajectory of disputes related to cement mining in Rembang through several phases.

a) Initial Government Action and Issuance of Permits (2011–2012)

The conflict in the North Kendeng Mountains began with government actions that caused controversy among the community. In 2011, the Watu Putih Groundwater Basin was officially designated as a protected area due to its important ecological role as a water catchment zone for the surrounding community through Presidential Decree No. 26 of 2011. This determination emphasised the importance of preserving the karst ecosystem, which functions as a vital natural resource for agricultural irrigation, drinking water, and biodiversity conservation. However, this area has been a limestone mining area since the 1990s. So, in this case, the local and provincial governments faced increased pressure to balance conservation efforts with industrial development ambitions.

During the same period, the government issued a permit to PT. SG, allowing the construction of a cement plant inside a protected area. The

issuance of this permit could be said to have marked the beginning of a heated debate between the state, corporate stakeholders, and local communities. Government officials justified the decision to allow mining activities inside a designated protected area as a strategy to boost economic development and meet the country's growing demand for cement production. They considered the project vital to national infrastructure development and regional economic growth, emphasising job creation and increased regional income.

However, the permit had been strongly opposed by local communities, environmental activists, and civil society organisations. This was based on their concerns about the status of the Watuputih Groundwater Basin as a protected area. Residents and advocacy groups argued that allowing mining operations in such a sensitive ecological zone posed significant risks to water resources reserves, which had implications for the livelihoods of farming communities.

Indeed, the granting of the permit to the cement company exposed inconsistencies in Indonesia's environmental governance framework, particularly in aligning conservation goals with economic development priorities. These inconsistencies highlighted structural and institutional issues that were seen as prioritising corporate interests over environmental protection. This phase set the stage for a broader conflict that would develop into legal battles, grassroots mobilisation, and national debates on the governance of karst as a natural resource, one that should be protected in the years to come.

It can be concluded that the underlying tensions between state-corporate alliances and community resistance are rooted in the conflicting priorities of economic development and environmental conservation. The approval of mining permits within the Watuputih Groundwater Basin not only triggered the Kendeng conflict but also illustrated the broader challenges of balancing Indonesia's environmental governance with its industrial ambitions.

b) Local Protest and Lawsuit (2013–2015)

The period of 2013–2015 can be considered crucial for the JM-PPK movement to mobilise resources and gather strength. They began to pioneer a grassroots resistance movement against the construction of a cement factory in the Watu Putih Groundwater Basin. This resistance was rooted in concerns over the irreversible environmental damage caused by limestone mining, particularly the extraction of high-purity white limestone, commonly used in cement production and industrial processes. The mining process involves large-scale excavation, blasting, and crushing of limestone formations, which disrupts the fragile karst ecosystem. Of particular concern is the destruction of the underground river network, which plays a crucial role in water recharge, sustaining both local agriculture and community water supplies. The removal of limestone alters groundwater flow patterns, leading to increased water scarcity, soil degradation, and long-term ecological instability (Sumarga, E., Willemen, L., Rosleine, D., Fitria, F., Agatha, K., & Sinaga, 2024). The JM-PPK group, which is mostly local farmers, feared that the mining operation would threaten their water supply and the ecological balance of the area. In response, the group mobilised community members and collaborated with environmental NGOs, academics, and activists to strengthen their cause. This movement used various means, such as media campaigns, demonstrations, and protests, in cultural and symbolic forms. One form of protest that received national and international media attention was when the Kendeng women placed their feet in cement in front of the Presidential Palace.

In addition to public advocacy, the JM-PPK, supported by its alliance, took legal action by filing a lawsuit with the Semarang PTUN to challenge the environmental permit granted to PT. SG. The plaintiffs argued that the permit violated environmental laws designed to protect groundwater basins and karst ecosystems. In addition, they highlighted the EIA process which was considered procedurally flawed, where the drafting process was considered less transparent and one that involved the community less. For example, in their lawsuit, they presented evidence that public signatures collected during unrelated events, such as rice

distribution, were misused as approval for the EIA. In addition, the EIA contained factual inaccuracies, such as denying the existence of an underground river, and appeared biased towards PT. SG. They considered that the EIA compilers hired by the company tended to minimise the environmental risks of the mining process while exaggerating the economic benefits that would later impact the community.

However, the Semarang State Administrative Court rejected the lawsuit on procedural grounds without discussing the substantive environmental and legal issues raised. They considered that the lawsuit was out of date because it exceeded the deadline set by the court. This rejection did not dampen the JM-PPK's struggle; instead, it sparked further protests and strengthened their determination to appeal to a higher court. The EIA process, which was considered procedurally flawed, and the rejection of their case in court triggered public distrust of state and corporate actors. This situation then drew national attention to the Kendeng conflict and framed it as a broader environmental governance issue.

The legal and public advocacy challenges faced by the JM-PPK and its alliance highlight the interplay between grassroots resistance and formal legal mechanisms in socio-environmental conflicts. By leveraging legal and public platforms, the movement demonstrated how local communities could challenge state-corporate alliances that prioritise industrial expansion over environmental sustainability.

c) Increasing the Conflict and National Attention (2016–2017)

The period of 2016–2017 marked a turning point in the struggle against cement mining in the North Kendeng Mountains as the conflict gained national visibility and intensified through large-scale protests and legal battles. The movement, led by the JM-PPK, employed increasingly strategic acts of resistance, mobilising broader public support and amplifying their message beyond local communities. This escalation was largely driven by the persistence of local authorities in issuing new environmental permits, despite a Supreme Court ruling that had revoked the previous permit granted to PT. SG.

One of the most striking moments of the resistance occurred in 2016 when a group of Kendeng women staged a powerful and symbolic protest by encasing their feet in cement outside the Presidential Palace in Jakarta. This act of civil disobedience served as a painful representation of their struggle, emphasising the irreversible damage that cement mining would cause to their land and livelihoods. The image of these women, standing barefoot in solidifying cement, captured widespread media attention and became an enduring symbol of environmental activism in Indonesia. This protest not only increased public awareness but also pressured national authorities to reconsider their stance on the environmental and social consequences of cement mining in the region.

While the protest generated national sympathy and political discourse, the movement also saw a significant legal victory. In 2016, the Supreme Court ruled in favour of the Kendeng activists, revoking the environmental permit for PT. SG's mining operations. The decision was based on findings that the EIA process had been flawed, failing to adequately account for the ecological risks posed by mining activities in the Watuputih Groundwater Basin. This ruling was a crucial milestone for the movement as it validated their claims of environmental degradation and procedural irregularities in the permitting process.

However, despite this legal victory, the conflict did not subside. Local government officials and corporate actors sought alternative legal routes to continue mining operations. In response to the Supreme Court ruling, the Central Java Provincial Government issued a revised environmental permit under a new corporate entity, PT. SI. This manoeuvre demonstrated the persistent alignment between state and corporate interests in prioritising industrial development over environmental protection. The issuance of a new permit effectively undermined the Supreme Court's decision, highlighting the limitations of judicial interventions in the face of entrenched state-corporate alliances.

As tensions continued to rise, the Kendeng resistance movement adapted by further strengthening alliances with national and international environmental organisations. Advocacy groups such as WALHI and

Greenpeace Indonesia amplified the voices of local communities, framing the Kendeng struggle as part of a broader movement for environmental justice. The increased attention on the case also led to discussions in academic and policy circles about the role of legal strategies in socio-environmental movements and the structural challenges of enforcing environmental rulings in Indonesia.

The period of 2016–2017 underscored both the potential and the challenges of using legal and public advocacy strategies in resource governance conflicts. While the Supreme Court ruling affirmed the legitimacy of the movement's claims, the continued issuance of permits exposed the gaps in regulatory enforcement and how legal victories could be circumvented. These developments reinforced the importance of sustained public pressure, legal persistence, and coalition-building in the ongoing struggle to protect the Kendeng Mountains from extractive threats.

d) The SEA and Presidential Engagement (2017)

The year 2017 marked a critical juncture in the Kendeng conflict, as the movement's persistent advocacy and legal battles gained recognition at the highest levels of government. Following years of protests, legal struggles, and growing national attention, President Joko Widodo personally engaged with representatives of the Kendeng community to discuss the future of cement mining in the region. This dialogue led to the decision to initiate an SEA, which temporarily halted mining activities while allowing for a more comprehensive evaluation of the region's ecological significance and sustainability. The SEA was intended to serve as a mechanism for ensuring that future resource governance decisions were based on scientific assessments and aligned with environmental preservation goals.

The SEA process brought together multiple stakeholders, including government agencies, environmental experts, civil society organisations, and community representatives. This multi-stakeholder approach was designed to incorporate diverse perspectives, to address concerns about water security, land degradation, and the long-term impact of cement

mining in the Watuputih Groundwater Basin. The Kendeng movement welcomed this step as an opportunity to ensure greater transparency and accountability in decision-making. However, despite this progress, tensions remained high as local communities and advocacy groups remained sceptical about the government's commitment to upholding environmental protections over economic interests.

While the SEA provided a reprieve, it did not put an end to the conflict. Mining operations were paused, but legal ambiguities surrounding the SEA's authority allowed local government officials and corporate actors to continue manoeuvring within regulatory frameworks. The Kendeng resistance movement remained vigilant, closely monitoring the assessment process and mobilising public pressure to ensure that the SEA would not simply be used as a tool for legitimising mining activities. Community groups continued to organise demonstrations, legal challenges, and public advocacy campaigns, emphasising that any decision allowing cement mining in the Kendeng region would pose irreversible environmental and social harm.

Despite the government's attempts to mediate the conflict through the SEA, activists viewed the process with cautious optimism. Past experiences have shown that legal victories and policy interventions could be easily undermined by state-corporate alliances that prioritised industrial expansion over ecological sustainability. Many community leaders feared that the SEA could be used to justify modified mining operations rather than to enforce a complete prohibition on extraction in protected Karst Areas. The movement, therefore, remained actively engaged in advocacy efforts, demanding that the SEA process be conducted transparently and that its findings be implemented without political or corporate interference.

Ultimately, the implementation of the SEA and the involvement of the president in addressing the Kendeng conflict underscored the growing recognition of the movement's demands at the national level. However, the persistence of local resistance also highlighted the continued struggle for meaningful environmental governance reforms in Indonesia. The

Kendeng movement's experience with the SEA process exemplified both the potential and limitations of institutional mechanisms in addressing socio-environmental conflicts, reinforcing the need for sustained community engagement, legal vigilance, and public mobilisation in the fight for environmental justice.

e) Final Adjustments and Ongoing Tension (2018–2020)

As the Kendeng conflict entered its next phase, the struggle shifted from direct legal contestation to policy implementation and spatial planning. Following the completion of the SEA, efforts were made to integrate its findings into regional spatial planning regulations. However, the process of translating SEA recommendations into enforceable policy proved slow and contentious. The JM-PPK, alongside allied environmental organisations, continued to pressure local and national authorities to uphold the SEA's environmental protections and prohibit cement mining in the Watuputih Groundwater Basin. Despite these efforts, inconsistencies in policy enforcement and resistance from industrial stakeholders prolonged tensions between the government, corporations, and the local community.

The spatial planning adjustments, meant to reflect the SEA findings, faced bureaucratic hurdles and political pushback. While some areas were designated for environmental protection, allowing for stricter regulations on resource extraction, local governments remained reluctant to fully comply with SEA mandates. In particular, the Central Java Provincial Government and the district authorities in Rembang and Pati faced scrutiny for their ambiguous stance on mining permits. While they acknowledged the SEA's importance, they also attempted to reconcile environmental concerns with regional economic development goals. This resulted in partial adjustments to spatial planning rather than a comprehensive ban on cement mining, leaving local communities dissatisfied.

Throughout 2018–2020, the JM-PPK and its allies continued to mobilise public advocacy efforts to ensure that the SEA findings were not ignored or selectively implemented. Activists emphasised that failure to fully

enforce the SEA's recommendations would further undermine trust in environmental governance and set a dangerous precedent for future extractive conflicts. However, state officials and industry representatives argued that modifications to mining operations, rather than outright bans, could serve as a compromise. This approach sparked renewed debate over the legitimacy of corporate influence in policy adjustments, as well as concerns that spatial planning regulations were being shaped to accommodate industrial interests rather than to prioritise environmental sustainability.

Despite the JM-PPK's persistence, mining activities continued in some parts of the Kendeng region, with companies exploiting legal ambiguities and lobbying for permit modifications. The resistance movement remained divided over strategy, with some members advocating for sustained legal challenges, while others focused on community-led conservation efforts to protect karst ecosystems through grassroots environmental monitoring. Meanwhile, the JM-PPK continued to call for stricter governmental oversight to prevent further encroachment into protected Karst Areas, highlighting the ongoing failure of regulatory enforcement despite legal and policy victories.

By 2020, it had become evident that while the SEA process represented a milestone in environmental governance, its implementation remained incomplete and contested. The Kendeng movement's struggle underscored the broader limitations of legal strategies in environmental conflicts, demonstrating how state-corporate alliances could adapt to judicial and policy constraints to maintain extractive activities. As the movement looked beyond legal avenues, it increasingly embraced alternative resistance strategies, such as community-based conservation initiatives and continued public advocacy, ensuring that the fight for Kendeng's environmental protection remained alive.

To conclude, this chronology is an important component in providing clarity, context and a structured picture of the North Kendeng karst mining conflict. It increases understanding, supports decision-making, and serves as an invaluable

reference tool for me, as the researcher, to understand the complexities of studying these issues.

5. Scientific and Expert Claims in Environmental Assessment: Discourse and Policy Challenges in the North Kendeng Mountains

5.1 Introduction

In this chapter, I will explain how environmental assessment reports, EIA, EIA Addenda, and SEA, are used as scientific methodologies to influence and navigate policy directions in environmental governance in the Watuputih Groundwater Basin area in the Kendeng Mountains. These assessments are more than just bureaucratic tools; they function as contested arenas where scientific expertise and empirical evidence are strategically mobilised by various actors, groups, or alliances. By examining these reports and their scientific bases, this chapter reveals how claims of scientific authority are used to strengthen the economic and environmental narratives contested by these actors.

In the context of this study, the EIA and SEA serve as arenas of contestation. The framing of environmental 'problems' within these assessments differs, as they are supported by distinct discourses, knowledge bases, and actor alliances. These competing narratives reflect the important role of scientific knowledge in shaping environmental policy. The interaction between scientific, socio-political, and ecological claims reveals how various actors use expert knowledge to validate their perspectives, thus shaping policy decisions regarding the North Kendeng region. Especially, the use of SEA highlights a new battleground in environmental governance in the region. The core of the argument from SEA does not only provide alternative policies in managing policies in the Watuputih Groundwater Basin area but also implicitly questions the validity and scientific robustness of the EIA methodology itself. This critique targets the suitability of EIA as a rigorous scientific framework for decision-making in the supposedly ecologically sensitive North Kendeng Mountains.

Through discourse analysis, this chapter elucidates the emergence of framing and narratives in environmental assessment reports. These assessments were utilised to gauge the environmental viability of mining operations for cement factories in the North Kendeng Mountains region, with particular attention to their potential impact on local economic advancement and community well-being.

To flesh out this analysis, it is important to define the conceptual framework underlying this research, specifically, the notions of narrative, discourse, and framing, which are important for understanding the construction and communication of environmental issues in policy documents. Narrative, in the context of environmental policy analysis, refers to a form of storytelling that involves selecting and organising events, characters, and themes to create a coherent and meaningful picture of a particular situation or issue (Leipold et al., 2019). These narratives are constructed through discourse, a system of language, terminology, and symbolic representation that facilitates the expression of knowledge and values about the environment (Hajer, 2006). Therefore, discourse includes ways of expression that define and limit what can be said about an environmental issue. Framing, as stated by Hajer and Versteeg (2006), is an important concept in discourse analysis that highlights the power of language to shape our understanding of social and environmental issues. By analyzing the framing strategies used by various actors, discourse analysts can gain insight into the discursive construction of environmental issues and how different actors construct and legitimise their perspectives.

These conceptualisations are pivotal in dissecting the strategic use of language in EIA, EIA Addendum, and SEA. In particular, the different implications of certain terms in Indonesian, such as *partisipasi* (participation) and *pemberdayaan* (empowerment), underscore the importance of linguistic and cultural context in shaping environmental narratives. *Partisipasi* in environmental governance is often interpreted in a procedural sense, where communities are formally involved in consultations but without real decision-making power. On the other hand, *pemberdayaan* implies a more substantive engagement, suggesting active capacity-building and agency for affected communities in shaping policies. However, in practice, both terms are frequently co-opted by state and corporate actors to create an illusion of inclusivity while maintaining control over

governance processes. This strategic ambiguity allows environmental policies to be framed as participatory while limiting grassroots influence over decision-making. Given the significance of these linguistic distinctions, this study further examines how the terminology used in EIA, EIA Addendum, and SEA reports reflects power dynamics and influences governance outcomes. Being aware of this linguistic richness is crucial to understanding the framing of environmental issues in policy discourse in Indonesia, emphasising the need for nuanced and context-aware interpretations of these documents (Lakoff, 2010).

The discourse analysis utilised in this chapter aligns with the overarching political ecology framework adopted in this research. Political ecology asserts that environmental policy documents are inherently entangled with power dynamics (Hajer and Versteeg, 2005b). The interplay between discourse analysis and political ecology is mutually beneficial (Neil Adger et al., 2001; Scoville-Simonds, 2009). Discourse analysis serves as a valuable tool for comprehending the influence of language in environmental matters, while political ecology furnishes a broader context for contextualising these linguistic insights in the domains of power, politics, and socio-economic structures. Therefore, discourse analysis emerges as a pertinent methodology for dismantling the power dynamics embedded in environmental reports, in line with the objectives of this study.

Discourse analysis emerges as a pertinent method for critically examining environmental policy documents for several reasons (Hajer and Versteeg, 2005a; Hajer, Hoppe and Jennings, 2020). First, within the framework of analytical discourse, these documents are recognised as reflective of underlying ideologies and power dynamics. They extend beyond technicality, serving as mirrors of the societal and political contexts from which they emanate. Discourse analysis, in this context, proves invaluable in dissecting the embedded ideology and power relations manifest in the language of these reports. Such scrutiny can unveil how environmental issues are framed, subsequently shaping public perceptions and influencing policy decisions. Second, discourse analysis facilitates the identification and examination of diverse actors' perspectives. Given the complex nature of environmental issues, various stakeholders, including government bodies, corporations, NGOs, and Indigenous communities, often harbour distinct interests and viewpoints. Discourse analysis offers a means to explore how these disparate perspectives are either represented or marginalised in environmental

reports. Third, discourse analysis enables a critical evaluation of specific concepts and terminology employed in these documents. The choice of language, words, phrases, and concepts is far from neutral in environmental reporting. Discourse analysis affords the opportunity to critically scrutinise the terminology employed. For instance, terms such as “sustainable development” or “biodiversity” possess complicated interpretations and implications which can be unpacked through a discourse analysis lens. Finally, discourse analysis serves as a means to unearth implicit biases and assumptions in environmental policy documents. These documents have the potential to harbour concealed biases and preconceptions that can influence decision-making processes. Consequently, comprehending the construction of particular narratives and their potential impact on environmental decision-making is of paramount importance.

5.1.1 Environmental Assessment as a Site of Contestation

Within the context of the contestation surrounding karst resources in the Northern Kendeng Mountains, environmental assessment assumes a pivotal role in the evolving dynamics of the resistance movement against cement factories in the region. EA emerges as a battleground where various actors vie for legitimacy in the management of karst resources. In this context, there are three distinct reports directly associated with the environmental assessment of karst mining in the area, namely the reports of the EIA, the EIA Addendum, and the SEA.

These three reports, EIA, EIA Addendum, and SEA, recognise the existence of a unified objective on the surface: to protect the integrity of the Karst Area in the northern part of the Kendeng Mountains against potential losses arising from the construction of a cement factory. However, this stated goal raises concerns about its true depth and the sincerity of the commitment behind it. The complexity of this situation, characterised by contestation over karst resources, means that although the documents may have similar objectives, the interpretation and implementation of these objectives may vary among the stakeholders involved. These differences raise questions about the extent to which these goals were actively achieved or, in some cases, simply declared to mitigate environmental problems. A more critical examination of the content of each report, the methodology used and the transparency of the findings, is essential to see how these assessments align with the stated goal of protecting the Karst Areas.

However, it should be stated that these three reports should not be perceived as integral components that seamlessly complement each other; instead, they represent responses to the ever-evolving dynamics surrounding the cement factory development. In the realm of environmental governance, both the EIA and SEA are policy tools deployed to acquire legitimacy in the policymaking process (Therivel and González, 2021). This legitimacy is founded on dissertation-style arguments bolstered by rigorous scientific explanations and comprehensive methodologies. The ultimate aim is to create a document that can be thoroughly evaluated and held accountable to the public.

The EIA and its subsequent addendum, known as the EIA Addendum, constitute specific environmental assessment reports designed to scrutinise the environmental repercussions of developmental undertakings. In this context, the EIA and its subsequent addendum, known as the EIA Addendum, are not just technical documents; they are commissioned by experts on behalf of cement companies, which places them deeply within the complex dynamics of industrial interests and environmental governance. This commissioning process underscores the importance of understanding the political and institutional context in which such knowledge is created and disseminated. This research highlights how the creation of environmental assessments is influenced by a variety of stakeholders, including corporate entities, regulatory bodies, and community groups, each of which has its own agenda and power structure. Therefore, as these documents emerged from a complex interaction between scientific inquiry, political will, and institutional practice, it became important to critically evaluate the underlying motivations and broader context that shaped their content and conclusions.

The evaluation process for these documents involves the active participation of local government entities. It is worth noting that despite their apparent similarities in content, these two documents exhibit distinct administrative characteristics. The EIA, commissioned by PT. SI in 2012, initially served as the foundational basis for the issuance of an environmental permit by the Governor of Central Java. However, the advent of the anti-cement resistance movement led to the revocation of this document. The rationale behind this revocation stemmed from the Supreme Court's decision in a Judicial Review, which subsequently invalidated the environmental permit.

From the perspective of the Governor of Central Java, it is important to clarify that the Supreme Court's Judicial Review Decision did not completely invalidate the EIA as the primary document. Rather than outright rejection, the Supreme Court's Judicial Review Decision highlights the need for improvement by identifying and addressing specific gaps. These gaps are mainly related to document coverage and compliance with basic environmental principles. The court's criticism pointed out that although the EIA provided a basic assessment of the project's environmental impacts, it did not adequately consider all the relevant environmental factors and regulations; in particular, reducing the area of mine delineation and depth of drilling points. By highlighting these shortcomings, the decision calls for a more thorough integration of environmental principles into the EIA process to ensure that all aspects of a project's potential impact on the environment are fully examined and addressed.

This mandate prompted a thorough revision of the EIA document, ultimately resulting in its transformation into the EIA Addendum. During the preparatory phase of the EIA Addendum, a diverse array of expertise was engaged, further legitimising the improvements made to the EIA document. Consequently, the EIA Addendum assumed the pivotal role of serving as the foundational basis for the issuance of environmental permits for cement factories.

In response to their discontent with the aforementioned decision, the anti-cement mining coalition resorted to a symbolic act of protest by cementing their feet in front of the Presidential Palace. As previously discussed, the cement-foot protest was not just an act of defiance but a strategic move that reshaped public engagement with the mining issue. This bold gesture eventually garnered the attention of President Jokowi, who subsequently agreed to engage in a discussion with the coalition members. The meeting was convened in the presence of a senior adviser from the KLHK and the head of the KSP. During this deliberation, a consensus was reached, leading to the decision that a SEA would be conducted encompassing the Watuputih Groundwater Basin area, as well as the entirety of the North Kendeng Mountains region.

The primary objective of the SEA conducted by the collaborative team from the KSP and the KLHK was to offer an alternative environmental evaluation aimed at reassessing the management policies concerning the Karst Area in the North

Kendeng Mountains. While both the EIA and its subsequent Addendum (EIA Addendum) indicated that karst mining in the region had no significant cumulative environmental impact, the SEA, in contrast, recommended the designation of the Watuputih Groundwater Basin area, utilised for mining activities, as a protected area. This recommendation stemmed from the area's crucial role as a water catchment area.

In this chapter, the discussion is divided into several parts. In the first part, I will explore the scientific narratives produced through three environmental assessment reports. I will identify the language used in writing these reports, which I will then categorise based on several aspects, such as purpose, scope, expert involvement, regulatory basis, and the form of recommendations conveyed. Then, in the following section, I will analyse the scientific narratives formed from these reports, highlighting how power relations operate through dominant and alternative discourses.

5.2 Scientific Narratives in Environmental Assessment Reports: Examining the EIA, EIA Addendum, and SEA

This section delves into a detailed examination of three documents through the analytical prisms of framing and discourses, uncovering the competing narratives that underpin them. It presents the SEA as a deliberate effort to establish an alternative narrative amidst the persuasive attempts by powerful corporate actors to rationalise the extraction of karst.

The results of this report uncover a comprehensive exploration of the initiator and time frame, justifications and objectives, a geographical scale and scope study, and various impacts, including economic, environmental and social aspects. They will also examine decision-making processes, regulatory considerations, the contribution of experts, and strategic recommendations. These aspects form the basis for explaining the complex dynamics and implications of the report's aims.

5.2.1 Scientific Legitimacy and Temporal Dynamics in Environmental Assessment Reports

The EIAs were initiated by the consortium involved in the mining. They represented the institutional and political context in which such studies (and knowledge more broadly) were conducted and raised questions as to the neutrality and real purpose of such studies. In this context, the initiation of an EIA document prepared by a cement company (PT. SG, which later became PT. SI) showed how the framing of environmental issues can be constructed to reflect the priorities of the initiator. Initially, the EIA recommendations supported issuing environmental permits aimed at facilitating industrial development, which could come at the expense of comprehensive environmental management. The timeline, following the initial assessment in March 2012 and then subsequent revisions leading to the SEA in January 2017, highlights how shifts in the social, legal and environmental context required adjustments in the assessment framework. The emergence of the EIA Addendum and the initiation of SEA, which was triggered by community resistance and legal challenges, indicates a re-evaluation of previously raised concerns, indicating a realignment of the assessment focus towards broader environmental and social implications.

In the initial stages, local community protests and wider community concerns regarding the environmental impacts in the Watuputih Groundwater Basin area were not enough to prevent the issuance of an environmental permit.

Unfortunately, this concern was not identified in the initial EIA. This initial scrutiny signals how societal concerns about the environment have been framed, reflecting a potential gap between industry goals and ecological and societal well-being. Additionally, the initial EIA main framework placed little emphasis on the unique environmental sensitivities of North Kendeng and instead concentrated on the expected benefits of the project. It was only through judicial intervention and the resulting SEA that a more inclusive approach to environmental considerations began to emerge, indicating a shift in what issues were deemed important to frame.

The dynamics of the preparation process in this case study, from the initial EIA recommendation to the revision of the EIA and SEA, illustrate the changing nature of what was considered relevant or irrelevant in environmental

assessments. Initially dominated by the economic and development ambitions of cement plant proponents, the framework was later challenged and reshaped by legal decisions, public resistance, and broader environmental review mandates. These dynamics suggest that social and legal pressures are expanding the scope of environmental assessments to ensure a more comprehensive consideration of ecological impacts and stakeholder concerns. The introduction of SEA, in particular, signals an effort to adopt a more holistic view of environmental governance, where the implications of policies, plans and programmes are evaluated in a way that aims to cover broader environmental and social issues, including the management of the Watuputih Groundwater Basin.

5.2.2 Scientific Objectives and Methodological Justifications in EIA and SEA: Conflicting Claims

The Justification and Purpose sections of the EIA report, EIA Addendum, and SEA provide a clear picture of how decision-making can shape the narrative and focus of an environmental assessment. These documents, each with different purposes and audiences, navigate the complexities of environmental, social, technical, and economic justifications in unique ways, highlighting what is considered important (“framed in”) and what is not prioritised or omitted (“framed out”).

In the framed context, the EIA report emphasises the legal and procedural urgency for environmental permits based on Law Number 32 of 2009, with a focus on the environmental impact of the construction of a cement factory. This legalistic framework emphasises compliance with an assessment of direct environmental impacts, thereby prioritising narratives that align with regulatory requirements and the project’s urgent environmental management needs.

Apart from framing in the legal framework, the objectives written in the EIA report also emphasise the impact of the construction of the cement factory on environmental changes.

*Identify the **(significant impacts)** of planned mining activities and the construction of a cement factory in Rembang Regency, Central Java Province, at the pre-construction, construction, operation and post-operation stages. – EIA Report*

The objectives highlighted in the EIA report for the proposed mining activities and establishment of a cement factory in Rembang Regency, Central Java Province, aim to see 'significant impacts' at various stages of the project life cycle. The use of the term *significant impact* implies an acknowledgement that certain environmental changes, such as deforestation, water depletion, or biodiversity loss, may have long-term and potentially irreversible consequences. This phrase is often employed in EIA and regulatory frameworks to indicate that a project's environmental effects require careful consideration, mitigation measures, or even policy intervention. By using this term, decision-makers and regulatory bodies implicitly recognise the need for further assessment and accountability in managing environmental risks. However, the term *significant* is still not defined, giving rise to a degree of subjectivity in the assessment process. This ambiguity gives EIA preparers the authority to determine what impacts are considered significant, giving rise to subjective interpretations of environmental impacts.

The crux of the issue lies not only in the subjective nature of this assessment but also in the understanding that determining significance is a value judgement. This judgement is influenced by various stakeholders' priorities, perspectives, and interests, making it an inherently political process. The question of "significant for whom, for what, and when" further complicates the evaluation, as it underscores the various implications for different ecological components, community groups, and temporal contexts. Thus, the identification of significant impacts transcends mere environmental assessment, reflecting broader societal values and political negotiations.

Given these complexities, there is an urgent need for a more explicit, objective and transparent framework in the EIA report. The framework should clarify how impacts are classified as significant, incorporating a comprehensive and inclusive approach that considers the diverse values and interests of all stakeholders. By doing this, it can ensure a fairer and more impartial evaluation of potential environmental impacts at all stages of a project, while recognising the political nature of environmental decision-making.

In contrast, the EIA Addendum expanded the framework to include administrative and socio-economic considerations, such as changes in project

scope and potential local economic improvements. This shift in focus reflects the socio-economic benefits of the project, describing the project as a contributor to local development and community empowerment through job creation and corporate social responsibility initiatives.

Meanwhile, the SEA report takes a broader approach, including concerns and input from local communities affected by cement factory operations. By emphasising sustainable use and management of the Kendeng Mountains and advocating for policy improvements, the SEA positions itself as a document that seeks to balance development goals with environmental sustainability and community welfare. The SEA is a direct manifestation of the public interest because it is part of their request.

(Requests) from residents who are JM-PPK members due to policies, plans, or initiatives that potentially have an environmental impact/risk.
– SEA Report

The excerpt from the document elucidates the current standing of SEA within the context it is situated. The employment of the term *request* signifies that the document's emergence is a direct consequence of public demand, particularly from local communities. Such demands for the execution of SEA in the Kendeng Mountains region stem from a profound scepticism regarding the EIA reports' findings. The local populace contended that the EIA reports did not accurately reflect the on-ground realities, nor did they use legitimate data. Consequently, an initiative undertaken was the execution of an SEA in the Watuputih Groundwater Basin area to address these concerns. It is important to note that the appeal for an SEA received prompt endorsement from the President during a direct meeting at the Presidential Palace, underscoring the government's responsiveness to public appeals.

Although EIAs and EIA Addenda concentrate on legal compliance, project impacts, and socio-economic benefits, they tended to frame (out) broader considerations regarding sustainable environmental management and the socio-economic and ecological dynamics at play. In particular, the initial focus on compliance and administrative updates tended to prioritise regulatory formalities over substantive environmental concerns. This approach often resulted in

overlooking the long-term environmental consequences, such as groundwater depletion, habitat destruction, and soil degradation, which extended beyond the project's immediate impacts. Moreover, community concerns, particularly those related to cultural heritage, local livelihoods, and broader ecological sustainability, were frequently marginalised in the assessment process. As a result, the environmental impact discourse became narrowly framed around legal compliance rather than a holistic evaluation of socio-environmental risks.

In contrast, a broader SEA perspective suggested that the EIA process may have been framed in comprehensive environmental governance strategies, including precautionary principles and holistic resource management approaches. This indicated a potential gap in addressing the complex interactions between environmental conservation and socio-economic development within a conventional EIA framework.

In conclusion, the justification and objectives aspect of the EIA report, EIA Addendum, and SEA explains the process of preparing a complex framework for environmental assessment. This situation shows how the choice of what to include (frame in) or not to include (frame out) in an assessment framework can significantly influence the focus of the assessment, thereby potentially influencing the range of environmental and socio-economic considerations included in the decision-making process.

5.2.3 Scientific Scope and Geographical Coverage

The depiction of the geographic scale and scope of the study in the EIA report, EIA Addendum, and SEA is an important aspect of preparing an environmental analysis. This aspect not only determines the extent of the assessment but also shows environmental problems that are prioritised or ignored. Through examining the geographic scale and scope detailed in these reports, I was able to identify and observe how the processes of framing in and being framed out shaped environmental narratives. However, it should also be noted that from an approach and methodological aspect, EIA and SEA have differences.

In the framed context, indeed, the EIA report explains that a detailed enumeration of the specific areas involved in mining and construction activities, with a comprehensive coverage of 900 hectares around the project site,

constitutes the framework for a broad assessment of the project's direct environmental impacts and determination of what constitutes a "significant impact". This level of detail allows for analysis of environmental and mining impacts at specific locations, with a focus on areas impacted by project activities.

Beyond that, the EIA report also explicitly explains the direct impacts of the mining process. This identification is an effort to mitigate by conducting assessments and preparing environmental planning to monitor the impacts of mining and taking steps to minimise these impacts.

*Identification of significant environmental and mining consequences; **measuring** and **assessing** the major effects of mining; creating environmental management and **monitoring** action suggestions – EIA Report*

Through these quotes, it can be seen and concluded that the language in the EIA report is used to construct a reality where environmental impacts are a significant but manageable challenge. The use of special vocabulary (measuring, assessing, and monitoring) focuses on active actions and contributes to the formation of a discourse that promotes a scientific and rational approach to environmental management.

In contrast to the EIA report, the EIA Addendum report attempts to reduce the scope of potential impacts, thus making their management more feasible, and it shows a reduction in geographic scale to 563.58 hectares. These adjustments included a revised perspective on environmental management and monitoring requirements, with a focus on significant impacts and modifications required due to scaled-back project plans.

Reducing the geographic scale in mining delineation sought to show and provide guarantees to the public that this reduction was a prudent step taken by the company. It assured the public that the mining area would not have an impact on the karst ecosystem in the Watuputih Groundwater Basin area, including caves and water springs.

Unlike the two previous reports, which did not specify geographical coverage, this SEA specifically targeted the Watuputih Groundwater Basin area. It

differentiated itself by not defining the area in hectares but instead, it opted for a qualitative description of its geographic extent. This approach allowed the SEA to provide a local but comprehensive environmental assessment, focusing on the unique ecological and hydrological characteristics of the Watuputih area, without limiting the analysis to predetermined spatial measurements. This approach allowed an evaluation of broader environmental impacts in the Kendeng Mountains region, with an emphasis on groundwater resources, ecology and related factors.

The geographic scale and scope of the study significantly contributed to the environmental assessment in the EIA, EIA Addendum, and SEA reports. The detailed focus in the EIA reports and EIA Addenda on specific areas, including comprehensive analyses of direct environmental impacts and management needs, had the potential to frame broader ecological and social considerations.

5.2.4 The Role of Scientific Experts in Assessing Economic, Environmental, and Social Impacts

Economic Narratives: A Tale of Growth of Disparity

Exploration of the economic narrative in the environmental assessment report reveals a complex story of growth and inequality, illustrating the diverse economic impacts of the cement plant project. These narratives reveal different stories about the potential for prosperity juxtaposed with the challenges of equitable development.

Central to this narrative is an emphasis on economic benefits as highlighted in the EIA report. This report prioritised efforts to increase regional income and improve community welfare as the main themes. The construction of the envisioned cement factory had been described as a catalyst for the infusion of significant revenue into local government accounts through taxes and other levies, indicating a direct pathway to improving regional facilities and infrastructure. The narrative also included the creation of job opportunities and business prospects and positioned the project as a key driver of improving the overall well-being of local communities. This optimistic economic narrative is summarised in the 2012 EIA Report, which stated:

Increasing community welfare through the development of regional facilities and infrastructure, providing employment opportunities and business opportunities. – EIA Report, 2012

The use of the phrase “increasing community welfare” meant that the people living in the planned cement factory area were less prosperous communities. Thus, the establishment of a cement factory can be seen as a catalyst for enhancing the community’s welfare and quality of life.

In terms of the previous explanation, the position of the EIA Addendum document also emphasised and expanded these economic benefits with a special focus on the community around the cement factory in Rembang. This report highlighted the potential for improving the local economy through increasing regional income originating from levies and taxes. Apart from that, the role of the cement factory project was to contribute to increasing these central and regional government revenues. This narrative showed that community involvement in cement factory activities would have a positive impact on their economic welfare. This was also supported by the development plan of PT. SI (Persero) Tbk, which was expected to increase GRDP, especially in 2016. Gunem District, as highlighted in the 2017 EIA Addendum report.

The Mining and Cement Factory Development Plan of PT. SI (Persero) Tbk
is expected to increase GRDP in the study area, especially in Gunem District – EIA Addendum Report, 2017

Excerpts from this report reveal how language may construct narratives around industrial development, economic growth, and impact on communities. The framework emphasises positive economic outcomes and has the potential to frame out the complexity of environmental and social impacts. This reflects a broader discourse on development that prioritises economic growth with corporate participation, which can shape public understanding and policymaking in ways that may not fully consider the sustainability of karst ecosystems.

Meanwhile, the SEA report also broadened its perspective to capture the potential for regional economic expansion and its prospects for employment and business. This assessment described the establishment of cement factories and

the mining activities associated with them as an advantage for regional economic growth, indicating an increase in job creation and business opportunities, especially in areas around factories and mining sites.

However, behind the narrative of economic growth, there was a subtext of inequality. Although these environmental assessment reports collectively underlined the direct economic benefits for local governments and communities, they often overlooked the long-term environmental consequences and socio-ecological disruptions that may arise from large-scale industrial projects. Furthermore, the reports tended to prioritise economic growth narratives while downplaying community concerns related to water scarcity, pollution, and loss of agricultural livelihoods. The wide range of perspectives and considerations detailed in each document, from the EIA and EIA Addendum's focus on regional revenues and societal well-being to SEA's broader regional economic outlook, reflected the spectrum of economic implications. These narratives weave a story about the economic opportunities promised through the operation of a cement factory the potential disparities of which would be difficult to overcome.

Environmental Narratives: The Tension Between Conservation and Development

The environmental narrative that appeared in the environmental assessment report presented a narrative about the dichotomy of conservation versus development, which underlined critical studies regarding the ecological impacts of cement factory construction projects. These narratives covered a wide range of topics, from detailing the environmental consequences identified in the EIA document, such as land expansion, the creation of mine shafts and the resulting ecosystem disruption, to highlighting broader concerns about biodiversity loss and water resource degradation outlined in the SEA report.

The narratives about environmental impact warrant closer examination. Within the EIA document, a comprehensive range of environmental consequences has been identified. These encompassed the expansion of open land, the creation of mines, runoff, erosion, and sedimentation. The extraction and transportation of mining materials were identified as contributing factors to the disruption of terrestrial flora and fauna migration patterns. Furthermore, particular attention was drawn to the potential degradation of air quality, stemming from dust

emissions during various stages of cement production, including raw material grinding and combustion processes.

The EIA Addendum document provided a more detailed analysis of the environmental impacts. It identified specific impacts, such as reduced forest and agricultural land, microclimate disturbance, vegetation and wild fauna disturbance, changes in morphology/landscape, and decreased environmental conditions resulting from land clearing and topsoil stripping. The mining activities were expected to reduce the abundance and richness of vegetation and cause disruptions to the local fauna. Additionally, cement production activities, notably the burning of raw materials, were identified as harming the microclimate and environmental conditions in the surrounding area.

The SEA document highlighted the potential loss of biodiversity and the negative consequences of mining activities in the Watuputih Groundwater Basin. It emphasised the importance of preventing biodiversity loss as it played a crucial role in ecosystem balance. The document also estimated the economic losses that could occur if the groundwater basin was damaged, including water resources, agricultural land, ecosystem services, and tourism losses. It emphasised the threats to underground water resources, which were essential for local agriculture and household needs. The SEA document acknowledged the concerns of community members and their request to prevent environmental impacts and risks, including the damage, deterioration, and extinction of biodiversity and the decline in natural resource quality and abundance.

*If the Watuputih Groundwater Basin as a protected area under any pretext turns out to be still being mined, **losses of the equivalent of IDR 2.2 trillion per year will arise as a result of damage to water resources,** for agricultural land and households, degradation of ecosystem services (bats), the loss of the economic value of Pasucen water tourism and cave tourism, as well as medical expenses. – SEA Report, 2017*

The discourse presented in the 2017 SEA report was complex, involving themes of environmental preservation, economic impacts and health implications. This report aimed to frame the discussion in a way that encouraged readers to consider the broader impacts of environmental degradation, not only from an ecological perspective but also from economic and social welfare perspectives. By

detailing the losses incurred and establishing groundwater basins as critical resources, it supported stronger protection and enforcement measures. This reflected a critical attitude towards the implementation of environmental policy and the gap between protection in theory and practice, and it called for a re-evaluation of how natural resources are valued and protected.

These differences in the environmental impact aspect reflect each document's varying scopes and approaches. The EIA focuses on the immediate impacts of mining and cement production activities, such as land disturbance and air pollution. The EIA Addendum document provides a more comprehensive analysis of the direct and indirect environmental impacts, including changes in microclimate and vegetation/fauna disturbances. The SEA document takes a broader perspective, considering the potential impacts on biodiversity, water resources, ecosystem services, and the livelihoods of local communities.

In terms of the environmental impact aspect, one particular concern that greatly worried the community was the threat of a water crisis. The three documents attempted to present distinct frames on this matter. According to the EIA report, the activities were anticipated to lead to a decline in water quality and a reduction in surface water availability. This assertion implied that the mining and construction processes adversely affected the overall quality and accessibility of water resources in the region.

On the other hand, the EIA Addendum report provided a more detailed analysis. It highlighted that construction activities, such as closing dirt roads with waterproof construction and land preparation, could lead to increased runoff and decreased groundwater quantity. The document explicitly expressed concerns regarding the potential risk of erosion and water scarcity as a consequence of changes in water absorption capacity. The report further detailed how the process of stripping topsoil and clearing land during mining activities exacerbated water runoff rates, potentially disrupting local groundwater supplies. This assertion was taken directly from the document, which emphasised the anticipated environmental impact of mining operations, such as cement production, on water resources and the surrounding ecosystem.

The JM-PPK's concerns were also discussed in both reports. The EIA Addendum report emphasised the concern of residents about losing their sources of clean water during the construction and operation phases. This fear was rooted in the potential removal of springs and its negative consequences for their livelihoods. The report emphasised the need for PT. SI (Persero) Tbk. to pay attention to the environment and mitigate these concerns to maintain community support.

Moreover, the EIA Addendum report mentioned the surplus of water resources within a specified radius around the factory and mine areas. It suggested utilising this surplus by constructing ponds and drilling underground water sources to meet the community's water needs. This finding presented a potential positive impact on water resources, as it could ensure an adequate water supply for both the factory operations and the surrounding environment.

*Based on the balance of water resources within a 10 km² radius around the factory and mine areas, it shows a surplus value from 2013 to 2050 with a surplus value ranging from 41,450,136 m³/year to 43,334,978 m³/year. Meanwhile, the balance of water resources within the Gunem anticlinal hills located in the Gunem District around the factory and mining areas shows a surplus value from 2013 to 2050 with values ranging from 14,117,407 m³/year to 12,474,774 m³/year. **The surplus value has taken into account the need for water for mining activities and the construction of the cement factory of PT. SI (Persero) Tbk.** This surplus value can be used to meet the water needs of the community in the environment around factories and mines by building ponds and drilling underground water. The activity of providing water to the quantity of groundwater has a positive impact because the need for water for both factory operations and the surrounding environment can be fulfilled and has a surplus value. – EIA Addendum Report, 2017*

The text above shows that the availability of water resources exceeded the needs caused by industrial activities and the needs of local communities. This framing effort functioned to build a narrative where industrial development and environmental sustainability could go hand-in-hand. The use of quantitative data (e.g., "41,450,136 m³/year to 43,334,978 m³/year") gave an impression of objectivity and scientific precision to the claims, designed to convince stakeholders of the environmental impacts of manufacturing and mining operations.

In addition, the quoted paragraph starting from "This is surplus value....." highlighted the positive environmental and social implications of the surplus water value identified in the EIA Addendum Report of 2017. Through discourse analysis, this assertion can be interpreted as a strategic narrative aimed at framing the cement factory and mining operations by PT. SI (Persero) Tbk as beneficial for local water resource management. The proposal to utilise surplus water for community needs and environmental sustainability was positioned as a solution that offset the potential environmental impacts of the operations. This framing served to align the company's activities with community welfare and environmental stewardship, potentially influencing public perception and policy discussions around water resource allocation and industrial development. The language used suggested an effort to construct a narrative that portrayed the company's operations as not only compatible with but also contributory to local water sustainability and community development.

Furthermore, the text positioned PT. SI (Persero) Tbk as a responsible natural resource manager, capable of managing water resources that were beneficial for company operations and the surrounding community. This situation may have obscured existing power dynamics, where corporate interests and actions directly influenced the environmental and social landscape. Communities were implicitly positioned as passive beneficiaries of water resource management carried out by companies, without much agency or say in how these resources were managed or allocated.

In contrast, the SEA report focused on the damage caused to the Watuputih karst water resources on a wider geographical scope. It highlighted the threat to underground water resources, which were crucial for local agricultural activities and the household water needs of the residents. The report raised concerns about decreasing water resources for domestic and agricultural purposes, which could adversely affect food production and the residents' welfare. The sustainability of livelihoods, particularly those relying on wells and springs for water supply, was also at risk.

When limestone and clay are exploited as mining materials, underground water resources which are an important support for agricultural life and the household needs of residents become threatened. – SEA Report, 2017

One of the texts quoted from the 2017 SEA report summarised a critical perspective on the environmental and social impacts of mining activities, especially the extraction of limestone and clay. The choice of the word “exploited” had the connotation of excessive and inappropriate use of natural resources, giving rise to a critical tone towards mining activities. In the context of Bahasa Indonesia, “exploited” (*dieksplotasi*) might carry a more nuanced or critical connotation than in English, especially when used in environmental or social discourse. In discourse analysis, this distinction is crucial as it reflects cultural and contextual differences in language use. Words like exploited can be interpreted differently depending on the linguistic and societal context, often implying overuse or misuse in Bahasa Indonesia, especially concerning natural resources. This highlights the importance of understanding the specific linguistic nuances and the cultural connotations of terms in their original contexts to accurately convey their intended meaning.

The phrase “underground water resources which are an important support for the agricultural life and household needs of residents” raises the importance of these resources beyond just environmental considerations, taking on an important socio-economic role. By highlighting their importance for “agricultural life” and “household needs,” this text underscores the interconnectedness of natural resources, local economies, and community well-being.

In addition, such statements in this text raise the main themes of environmental degradation, resource scarcity, and the vulnerability of local communities, building a narrative that extraction activities pose a direct threat to the sustainability of local ecosystems and the quality of life of residents. The use of the word “threatened” reinforces the sense of urgency and potential crisis, suggesting that the consequences of mining extend far beyond the extraction site and impact broader social and ecological systems.

To conclude, these reports shed light on the potential consequences of mining and construction activities on water reduction and pollution. While the EIA Addendum report acknowledged the negative impacts and community concerns, it also offered potential solutions to mitigate these effects by utilising surplus water resources. On the other hand, the SEA report highlighted the damage to

important karst water resources and the potential risks posed to agriculture and local livelihoods.

Social Narratives: Community Engagement and Social Conflict

The social narratives in these documents reveal a complex interweaving of community involvement and conflict, reflecting the different interactions between the ambitions of the cement factory construction project and the socio-cultural structural conditions of the communities directly affected by the project. These narratives attempted to investigate the diverse social impacts of the cement factory project, from employment initiatives and empowerment to the more controversial aspects of land acquisition and community resistance.

In the EIA document, various social impacts were addressed, encompassing the recruitment of local workers at a rate lower than required, community empowerment initiatives, positive attitudes and perceptions resulting from community empowerment efforts, amplified noise and traffic disruptions, reduced comfort levels, and unfavourable perceptions arising from employment termination.

The EIA Addendum document emphasised the potential for social conflict among residents and between residents and managers due to the mining activities and the construction and operation of the cement factory. It mentioned potential issues such as the recruitment of construction workers, land acquisition for the project, conflict arising from differences of opinion among community leaders, and concerns and rejections among the community triggered by poor post-mining management in other areas. The document also highlighted the potential for conflict related to land acquisition, competition among job applicants, and concerns about negative impacts and land use conversion.

*In this case, plans for mining activities and the construction and operation of a cement factory also have the **potential** to create **social conflict among the residents themselves** as well as **between residents and managers**, as well as with the communities participating in it, especially those that are predicted to cause disruption to public order and security. Based on a study conducted in 2011, the construction of a cement factory has the potential to trigger conflict. – EIA Addendum Report, 2017*

The text explicitly recognised the potential for social conflict resulting from planned industrial activities. The term “potential” indicated that although conflict could be avoided, the risk of it occurring was large enough to warrant mention in the environmental impact analysis. This situation placed industrial development as an environmental concern and a matter of social cohesion and public order.

In addition, the narrative that emerged identified several actors: residents, managers (perhaps those working in mines and cement factories), and the wider community who participated in or were affected by development. By distinguishing between these groups, this quote emphasises the complex network of relationships and interests that can be influenced by development activities. The mention of “social conflicts among residents themselves” shows internal divisions in society, while conflicts “between residents and managers” and “with the communities participating in it” show external tensions. This differentiation underscored the complex nature of social impacts, encompassing both intra-community and inter-community relations. By doing so, it can be said that the EIA Addendum report filled in the main considerations and explored the social situation better than the previous EIA document. Nevertheless, this document did not address the social conflict issues.

The SEA document stated that the mining and construction activities in Gunem and Bulu Districts had faced resistance from residents and environmentalists due to the mining activities that had been carried out in the CAT Watuputih area. However, specific social impacts should be explicitly mentioned in this section.

*Mining and construction of a cement factory in Gunem and Bulu District, Rembang Regency, by PT. SI (formerly PT. SG). In 2012 PT. SG obtained an environmental feasibility permit. Since 2015 PT. SI has built a factory site. Residents and environmentalists **refuse** because mining activities are carried out in the CAT Watuputih area. – SEA Report, 2017*

The text excerpt, written in the 2017 SEA report, provides a brief overview of the complex situation involving the development of the cement industry, the environmental problems, and the community responses in Rembang Regency, especially in the Gunem District area. The narrative structure outlines a series of events: the transition of PT. SG to PT. SI, obtaining an environmental feasibility

permit, the construction of a cement factory, and the rejection by residents and environmental observers. A switch from one company name to another may have indicated a significant change in corporate identity or strategy, which may have been relevant to understanding the broader context of a cement plant construction project.

Implicitly, the text appears to attempt to frame the development project from a neutral to a positive viewpoint by stating the acquisition of an environmental feasibility permit, which implies regulatory approval and indicates that the project meets certain environmental standards. However, this positive picture is contrasted with the emergence of resistance from residents and environmental activists, who highlight the conflict between industrial development and environmental and societal problems.

In addition, the use of “refuse” in the SEA report, 2017, extends beyond simple language choice, symbolising the residents and environmentalists’ determined opposition to the mining activities proposed by PT. SI. This opposition should be contextualised with a broader spectrum of documented responses, such as public demonstrations, legal challenges, and detailed EIA. Such evidence provides a robust foundation, illustrating not merely a narrative of resistance but a concerted effort to safeguard the Watuputih Groundwater Basin from the potential adverse effects of industrial development. This comprehensive approach enriches the analysis, portraying a dynamic interaction between community agency and environmental advocacy.

In conclusion, the EIA and EIA Addendum documents provide a more detailed analysis of the social impacts associated with the cement factory project. They highlight potential conflicts related to recruitment, land acquisition, competition among job applicants, and concerns about the negative impacts and changes in land use. The SEA document focuses more on the opposition and resistance from residents and environmentalists due to the location of mining activities in the Watuputih Groundwater Basin.

5.2.5 Expertise and Scientific Authority in Environmental Assessments: Multidisciplinary Claims

The EIA, EIA Revised, and SEA documents in the environmental assessment reports for the North Kendeng Mountains require different areas of knowledge to conduct a comprehensive evaluation. The EIA document draws on a range of experts who are EIA-certified. This includes professionals in fields such as chemical engineering, geology, industry, hydrology, chemistry, biology, socioeconomics, institutional knowledge, and transportation. These diverse areas of expertise highlight the multidisciplinary approach needed to assess the environmental impact of the proposed cement factory project. This multidisciplinary approach is not only a procedural requirement but also a reflection of the interdependence of a complex system that connects ecosystems and communities. Through such a multidisciplinary approach, the project becomes emblematic of the complex interplay between industrial progress and ecological preservation, illustrating the narrative tension inherent in these endeavours.

In the refined EIA document, emphasis is placed on areas that are important for cement factory operations, including expertise in mining, geology and socio-cultural dynamics. The deliberate inclusion of “socio-cultural expertise” marks an important shift towards a holistic assessment, underscoring a deep engagement with the cement plant’s comprehensive impact on local communities. This approach signals a move beyond environmental impacts, towards the evaluation of diverse social and cultural impacts, indicating substantial, rather than superficial, integration of community interests into project evaluation.

In contrast, the SEA document engages academics, scholars, and researchers from various universities or research institutes with expertise in different fields. This includes knowledge in spatial planning, forestry, karst geohydrology and biodiversity, biology, cave biology, anthropology, environmental earth economics, earth science, economic valuation, public administration law, and agricultural economics. This document transcends the immediate concerns of project impacts to contemplate the longer-term storyline of regional sustainability. It can be proved by a collective inquiry into how land, water, and biological resources can

be managed in a way that preserves their value for future generations, integrating knowledge from spatial planning to agricultural economics.

Table 5.1: Comparative Expertise in Environmental Assessment Reports

EIA	EIA Revised	SEA
Academics/experts who are EIA-certified	Academics/experts who are EIA-certified	Academics/scholars/researchers from a variety of universities or research institutes
- Chemical Engineering - Geology - Industry - Hydrology - Chemistry - Biology - Socioeconomics - Institutional - Transportation	- Mining - Production Process - Geology - Geohydrology - Hydrology - Social Community - Socio-culture - Public Health - Transportation - Environmental Engineering	- Spatial Planning - Forestry - Karst Geohydrology and Biodiversity - Biology - Cave Biology - Anthropology - Environmental Earth Economics - Earth Science - Economic Valuation - Public Administration Law - Agricultural Economics

Source: EIA, EIA Addendum, SEA Reports

The comparative analysis of knowledge and skills, as delineated in Table 5.1, transcends a mere inventory of environmental management competencies. The diversity in expertise demonstrated across the EIA, its revisions, and the SEA documents epitomises a transition from a narrowly focused mitigation of the environmental impacts of development projects to a more integrated and sustainable development approach.

5.2.6 Regulatory Framework and Scientific Authority: The Role of Expertise in Environmental Decision-making

All three documents are firmly grounded on a legal basis, which serves as the foundation for the document submission. However, the EIA report explicitly

displays all of these legal documents. This demonstrates the extensive legal framework that businesses must comply with when conducting activities with significant environmental impacts.

*In this document, there are as many as **69 regulations** related to the activity plan for the construction of a cement factory in the Rembang area, Central Java. These regulations consist of laws, government regulations, presidential decrees, ministerial regulations for the environment, ministerial regulations for forestry, decrees for the state minister for the environment, decrees for the Minister of Energy and Mineral Resources, decisions for the Head of the BAPEDAL, provincial regulations. Central Java, Decree of the Governor of Central Java, Regional Regulations of Rembang Regency, and other regulations. – EIA Report*

The citation of 69 regulations in the EIA report robustly supports the legal foundation for the operation of a cement factory. This comprehensive legal compliance signifies that all necessary administrative requirements have been met, allowing for the interpretation that the establishment of the cement factory proceeds within the bounds of regulatory guidelines, without infringing upon any legal tenets.

The EIA Addendum report highlights the changes in the legal framework due to the transfer of the project from PT. SG (Persero) Tbk. to PT. SI (Persero) Tbk. It mentions the specific permits and decrees obtained by the project initiators, including environmental feasibility decisions and environmental permits. The report also references a Supreme Court decision that pointed out procedural flaws in the previous EIA document and called for the revocation of the environmental permit. This illustrates the dynamic nature of the legal framework and the need for compliance and adaptation throughout the project's lifecycle.

The SEA report discusses the legal framework in the context of environmental protection and management. It refers to Law Number 32 of 2009 concerning environmental protection and management, which mandates the implementation of SEA as a preventive measure against environmental pollution and damage. The report highlights the legal basis for conducting SEA, including the residents' right to request an SEA when a KRP can potentially cause environmental impacts and risks. It also mentions various laws and regulations related to protected

areas, protected geological areas, and the sustainable utilisation and management of the Kendeng Mountains region.

Interpreting these differences in the legal framework, it is evident that the EIA reports primarily focus on the specific regulations and permits required for the construction and operation of the cement factory. They provide a detailed overview of the legal obligations and compliance procedures related to EIA and permits.

On the other hand, the SEA report takes a broader perspective, emphasising the legal framework for environmental protection and management in general or beyond any specific project. It highlights the legal basis for conducting SEA and addresses the legal requirements for protected areas, protected geological areas, and sustainable development. Moreover, the issue at hand revolves around the decision-making authority for the establishment of a cement factory in the Kendeng Mountains in Central Java, Indonesia. The decision-making process involves two key narratives: the EIA and SEA.

According to the EIA, as per Law Number 32 of 2009 on Environmental Protection and Management, any business or activity with a significant environmental impact must have an EIA document. This document is used to make decisions on environmental feasibility (*kelayakan lingkungan in Bahasa Indonesia*). Environmental feasibility is determined through a comprehensive assessment process that evaluates the potential environmental impacts of a proposed project. This includes analyzing the project's direct, indirect, and cumulative effects on the environment while considering factors like biodiversity, water quality, air quality, and soil integrity. The determination by the responsible agency, in this instance, the Governor of Central Java, is based on whether the project meets established environmental standards and regulations, ensuring it does not significantly harm the environment.

*This environmental feasibility assessment recommendation is used for the process of making decisions on environmental feasibility (which will be decided) **by the responsible agency (Governor of Central Java)**. – EIA Report, 2012*

An excerpt from the 2012 EIA Report outlines the procedural role of the environmental feasibility assessment recommendations in the decision-making process regarding environmental feasibility, specifically highlighting the decision-making authority of the Governor of Central Java. This text frames environmental feasibility assessment recommendations as an important element in the decision-making process regarding environmental feasibility. It is clearly stated that these recommendations serve as basic input for decisions to be taken by the responsible agency, which is explicitly identified as the Governor of Central Java. This circumstance underscores the structured and hierarchical nature of environmental governance, where specific assessments form the basis of administrative decision-making at higher levels.

By establishing the Governor of Central Java as the decision-making authority, the text allocates a large amount of responsibility and power to one government position. This designation indicates the existence of a centralised decision-making process, which implies that the final decision regarding environmental issues in this context resides in one identifiable entity and is not spread across various institutions or stakeholders. Naming a specific role (the governor) personalises accountability, which can centralise authority and define responsibilities.

However, in 2016, the Supreme Court issued a Judicial Review Decision outlining procedural flaws in the EIA of PT. SG (Persero) Tbk. The Governor of Central Java was ordered to revoke the environmental permit. As a result, the Central Java Province EIA Assessment Commission recommended an EIA document review, and PT. SI (Persero) Tbk. was instructed to apply to change the environmental permit. The Governor of Central Java then issued a decree revoking the previous environmental permit and directing PT. SI (Persero) Tbk. to refine the addendum to the EIA reports.

On the other hand, the SEA was initiated in response to the urgency and conflicts surrounding access to natural resources in the Kendeng Mountains. The President of Indonesia, Joko Widodo, met with peasants from the JM-PPK and agreed upon the need for an SEA. The SEA process, coordinated by the Presidential Staff Office and chaired by the Ministry of Environment and Forestry, aimed to analyze

the carrying capacity and accommodation capacity of the Watuputih Groundwater Basin and involve a healthy multi-stakeholder dialogue.

The establishment and implementation of the Kendeng Mountains SEA was a result of the agricultural workers' request to President Joko Widodo, leading to his order for its creation. The SEA process aligns with the legal norms outlined in Government Regulation Number 46 of 2016, which allows for community requests.

*The Kendeng Mountains SEA was created and implemented due to a request from peasants who are members of the JM-PPK to President Joko Widodo at the State Palace in Jakarta on August 2, 2016. **Fulfilling this request President Joko Widodo ordered the creation and implementation of the SEA coordinated by the Staff Office President.** This order was contained in the Decree of the Presidential Chief of Staff Number 9 of 2016 concerning the Making and Implementation of the SEA for the Policy on the Sustainable Utilisation and Management of the Kendeng Mountains. The Kendeng Mountains SEA is thus implemented in the corridor of the legal norms of Government Regulation Number 46 of 2016, which is made at the request of the community {Article 3 paragraph (2) letter b}. – SEA Report, 2017*

The quotation extracted from the SEA report document unequivocally demonstrates that its inception was rooted in a structured legal framework. This document not only emerged from a formal legal process but also rested on a foundation underpinned by direct presidential decree. Such presidential endorsement transcends mere formal legality, signifying a political gesture that reflects the president's alignment with public interests.

In conclusion, the establishment of a cement factory in the Watuputih Groundwater Basin area, Kendeng Mountains, Central Java, Indonesia, reveals a narrative involving a complex legal landscape and regulatory requirements, which is underscored by the link between the detailed environmental impact analysis, strategic environmental evaluation, and the important role of community involvement and judicial oversight in guiding sustainable development decisions.

5.2.7 Scientific and Policy Recommendations: Navigating Expertise and Power in the EIA and SEA

Finally, one of the most critical aspects that became a battleground for framing the narratives in these three documents was the recommendations stage. The EIA report evaluated the impact of a proposed activity, specifically the establishment of a cement factory.

*According to **partial and holistic effect interpretations**, there was an **18%** increase in environmental quality and no change in the magnitude and quality of the environment, allowing it to be pronounced environmentally feasible. – EIA Report*

Upon examining the previously cited statement, two notable concerns emerged from the language employed. The first concern arose from the use of “partial and holistic interpretation”, which revealed a lack of clarity regarding the integration of such interpretations into the conclusions posited. The terms “partial” and “holistic” interpretations, in the context of an EIA, signified distinct approaches to evaluating environmental quality. A “partial” interpretation refers to an analysis that considers specific environmental aspects or sectors individually, without necessarily accounting for their interconnections or the broader ecosystem. In contrast, a “holistic” interpretation aimed to encompass all environmental dimensions, integrating various components to understand the cumulative impact on the environment fully. This distinction was crucial as it underscored the importance of comprehensive analysis in EIA reports. It suggested that for conclusions about environmental feasibility to be robust, they must consider the intricate interplay between different environmental factors, ensuring that evaluations capture the full scope of potential impacts, both beneficial and detrimental.

The inclusion of a precise 18% improvement statistic in the environmental assessment represented a quantifiable measure of progress, potentially enhancing the credibility of the report by providing specific data as opposed to vague qualifiers such as “moderately/quite” or “very”. This specificity aimed to convey a rigorous empirical approach to evaluating environmental impacts. However, this posed questions about the methodology used to calculate these

figures, the aspects of environmental quality that were being measured, and how these improvements aligned with broader environmental goals. A deeper exploration of these areas would help clarify the importance of these statistics and their implications for environmental sustainability and policymaking.

Moreover, the phrase “environmental quality” seemed to suggest selective improvements, neglecting a comprehensive clarification. The relevance of this 18% increase to the overarching environmental feasibility of cement plant endeavours necessitated additional inquiry. This would involve a closer examination of how “environmental quality” was being defined and measured in the report. Acknowledging the EIA’s provided reasoning clarified how specific environmental metrics were improved by 18% and the impact of such improvement on the overall environmental feasibility of cement plant projects. Furthermore, scrutinising the balance between highlighted improvements and unaddressed negative impacts would offer a more nuanced understanding of the report’s findings. Asserting that the quoted statement lacked depth or clarity needed to be substantiated by critically evaluating the evidence and definitions the EIA report employed to support its conclusions.

Meanwhile, the revised version of the EIA Addendum report maintained the recommendation of the initial report, stating that the activity plan (establishment of the cement factory) was environmentally feasible. However, the revised recommendation needed to provide specific details or changes.

In contrast, the SEA report took a broader perspective, focusing on the overall SEA of the region. It recommended actions beyond the specific project, proposing the designation of the Watuputih Groundwater Basin region as a protected area. Additionally, it suggested initiating the process of determining the KBAK and temporarily suspending mining operations.

Recommendation of the Watuputih Groundwater Basin region as a protected area and implementation of the Karst Natural Landscape Area (KBAK) determination process; temporary suspension of mining operations – SEA Reports, 2017

Based on the quotation from the SEA report, it was founded on the set of complex interactions between environmental protection efforts, policy

recommendations, and regulatory actions regarding the Watuputih Groundwater Basin and the broader karst landscape. The text began by recommending the Watuputih Groundwater Basin area as a protected area, indicating a priority for environmental and water resource conservation. The push for the implementation of the KBAK designation process increasingly emphasised the importance of protecting sensitive karst landscapes, which are known for their unique geological features and significant biodiversity.

The use of the words “recommendations” and “implementation” indicated a proactive approach to environmental management, implying a level of urgency and importance for these actions. These terms also signalled a transition from mere recognition of value to actionable policy steps, reflecting a discourse that valued conservation and sustainable management of natural resources.

In addition, the use of the phrase “temporary suspension of mining operations” indicated direct intervention aimed at reducing environmental impacts as well as suggesting something more profound about questions regarding the overall direction of development. This suspension served as a regulatory action, demonstrating the agency’s ability to enforce environmental protection even though doing so could have conflicted with economic activities. This report could be read as reflecting a discourse that recognised the need for a balance between development and conservation, achieved by prioritising the preservation of ecological integrity in the face of potential threats from industrial activities, especially in Karst Areas.

To sum up, based on the aspects discussed above, it becomes evident that the EIA reports primarily concentrated on evaluating the environmental impact of the proposed cement factory project. Their assessments suggested that the project was environmentally feasible based on the criteria and interpretations used in the reports. In contrast, the SEA report took a more comprehensive approach, considering the region’s broader environmental context and long-term sustainability. It recommended protective measures for the Watuputih Groundwater Basin, such as designating it as a protected area. Furthermore, the temporary suspension of mining operations indicated the concern for preserving the natural landscape and minimising potential environmental risks.

5.3 Dominant and Alternative Scientific Discourses

In this section, I will discuss how scientific narratives shape the dominant environmental discourse, which shapes public policy. I will analyse how cement companies, through scientific reports such as the EIA, create a narrative of economic necessity while marginalising ecological risks. Meanwhile, the alternative scientific discourse presented by the SEA will be explored as a counter-narrative that advocates for long-term environmental protection. Through discourse analysis, I will identify the terminology and unpack the narrative used by the document's authors.

5.3.1 The Role of Scientific Expertise in Shaping Dominant Policy Discourse

The formation of dominant discourses demonstrates the use of discursive power where scientific expertise is used to shape public narratives. Environmental assessments such as the EIA and EIA Addendum are far from neutral but serve as tools to legitimise industrial development by framing ecological problems as something that can be managed or minimised through sophisticated technology (Hajer and Versteeg, 2005a). This is in line with Foucault's concept of discursive formation (Foucault, 1980), which highlights how the production of knowledge reinforces dominant political and economic agendas while negating alternative perspectives. As Leipold et al. (2019) argue, dominant policy discourses are often driven by scientific arguments put forward by powerful actors such as governments and corporations, which frame environmental challenges in a context that prioritises economic growth over ecological sustainability. In this case, the cement industry's reliance on scientific claims about "zero runoff" mining and reclamation efforts served to legitimise resource extraction despite potential ecological problems.

Based on the identification and analysis of the three reports, it can be seen that the EIA and EIA Addendum represented the dominant policy discourse. The dominance produced the main narrative about resource extraction as an economic necessity with inevitable but relatively minor downsides. Indeed, this narrative was supported by other key discourses that emerged in these reports.

First, environmental issues were strategically framed alongside economic considerations. The documents explicitly emphasised economic narratives, such as meeting the nation's cement demands, stimulating regional economic growth, increasing revenues through levies and taxes, creating employment opportunities, and fostering community empowerment. These economic narratives effectively reoriented the public's focus towards welfare as the most pressing concern. This claim can be substantiated by examining public discourse or surveys conducted post-release of these documents, which have revealed a shift in public opinion favouring economic benefits over environmental concerns. Thus, the establishment of a cement factory in the Rembang area was positioned as a solution to enhance people's welfare, anticipated through the multiplier effects generated by factory activities, including the creation of job opportunities for residents. This approach effectively shifted public and community attention away from environmental issues and towards economic considerations (Anspach and Draguljić, 2019; Molthan-Hill, 2015).

The technical solutions narrative was deeply rooted in claims of scientific expertise, particularly around the use of advanced technology. Both the EIA and its Addendum drew on scientific claims about zero runoff mining techniques and reclamation efforts as evidence of the industry's ability to mitigate environmental damage. The report used the language of scientific innovation to construct a narrative in which the environmental risks posed by limestone mining for cement could be managed through technological interventions, thereby strengthening the legitimacy of sustainable industrial development in the region. The presence of technological narratives in these documents endeavours to shape public opinion suggested that environmental risks associated with cement factory operations could be adequately anticipated and mitigated.

Moreover, the neglect of water sustainability issues in the policy discourse illustrated discursive power dynamics, where dominant actors reframe conflicts to minimise ecological concerns. By shifting the narrative focus to issues such as land compensation and social jealousy, this discourse reduced the importance of critical ecological risks. While conflicts and protests primarily revolved around the threat of spring depletion due to the ecosystem's damage in the Watuputih Groundwater Basin, the EIA Addendum implied that these conflicts mainly arose from land compensation issues and social envy related to worker recruitment.

This strategic framing sought to diminish the significance of water sustainability, a critical matter warranting earnest consideration in the document.

Finally, the government reinforced the narratives using legal instruments, regulations, and decision-making authority. For instance, first, this discourse could be found in the EIA document which explicitly explained that the cement factory plan had been accompanied by at least 61 valid legal government documents. It can also be seen that the government sought to frame the Supreme Court's decision to revoke the environmental permit as an administrative matter, allowing the defendants to rectify and resubmit the document. Consequently, the decision to compile the EIA Addendum was made to justify the granting of a new environmental permit for the operation of the cement factory.

Alongside obtaining support from key discourses that were produced based on knowledge/expertise, the position of the EIA and EIA Addendum was shaped by powerful actors such as the cement corporations and the government. These actors held crucial positions in constructing the framing and narratives presented in the reports (Bednarek et al., 2022; Fleming et al., 2014). The interconnected actors collaborated to support the cement mining operation in the Watuputih Groundwater Basin. They played distinct roles in reproducing the framing and narratives within the report. The cement mining companies reproduced narratives emphasising the urgency of mining for national cement needs in the North Kendeng Mountains region. Additionally, they underscored that the presence of the cement industry in the area would guarantee the economic development and welfare of the local communities.

Dominant policy discourse can be seen as a form of power as it shapes how policy issues are understood and addressed and can limit the range of policy options considered. However, it can also be contested and challenged by alternative discourses that offer different perspectives and policy solutions (Feindt and Oels, 2005).

5.3.2 The Alternative Narratives: Challenging the Dominant Discourse in Environmental Assessments

Hajer and Versteeg (2006) have argued that alternative discourse refers to non-dominant or marginalised ways of talking and thinking about a particular issue or topic. The discourse challenges or subverts the prevailing or mainstream ways of understanding and responding to social and environmental issues. Moreover, alternative discourse can be used by social movements, grassroots organisations, and other actors who are excluded from or marginalised in dominant discourse. It can provide a platform for voices and perspectives often silenced or ignored by mainstream media and policymaking. For example, alternative discourses on climate change may frame it as a social justice issue that requires systemic change rather than a technical problem that can be solved through market-based solutions.

The main narratives that were revealed in the EIA and its Addendum tended to present the policy for the cement factory in the Kendeng Mountains area as rational, seemingly disregarding alternative policy options for managing the karst landscape in the region. However, the dominant discourse, held to be reasonable to the stakeholders involved, faced challenges from alternative discourses. In this context, the existence of the SEA provided an alternative perspective and challenged the prevailing discourse.

In the context of alternative scientific discourse, the SEA report was initially intended to seek policy alternatives by challenging the dominant narrative presented in the EIA and its Addendum by introducing counterclaims based on scientific evidence. While the EIA and EIA addendum emphasised the economic benefits to local communities and local governments derived from the multiple effects of the cement plant operation, the SEA report drew on expert assessments of the ongoing ecological consequences, specifically highlighting the risks of mining in the Watuputih Groundwater Basin to groundwater resources and biodiversity. This alternative discourse was shaped by a more cautious approach to environmental management, advocating for the protection of the karst landscape based on scientific evaluation of its unique ecological value and the ecosystem services it provided. The SEA report presented a broader narrative

that framed resource extraction as a fundamental threat to essential ecosystem services and local livelihoods.

Based on the justifications stated in the SEA document, it is evident that this report represented an alternative narrative that offered policy options for karst management in the Watuputih Groundwater Basin. The decision to conduct the SEA was requested by the community members who were part of the JM-PPK. They wished the president to explore alternative approaches for managing the karst region in the Kendeng Mountains. As a result, the president directly appointed the KSP and the Ministry of Environment and Forestry to take responsibility for implementing the SEA.

Contrasting actor networks leveraged the SEA report to highlight the power frameworks through which agency is exercised by multiple stakeholders to reshape environmental governance. Unlike the EIA, which was dominated by corporate and government actors, the SEA report was more broadly mobilised by experts and grassroots organisations to advocate for sustainable resource management. This actor-oriented perspective revealed the dynamic interplay between agency and structure in challenging dominant governance models. Notably, these actors and experts demonstrated an interest in supporting sustainable management practices for the Northern Kendeng Mountains area.

As a result, the findings of the SEA presented a contrasting perspective compared to the EIA and EIA Addendum reports, indicating a challenge to both of those documents. Firstly, the SEA explicitly elucidated that mining activities in the Watuputih Groundwater Basin were mutually exclusive. In the context of natural resource management in the Kendeng Mountains region, the extraction of limestone and clay for mining purposes posed a considerable threat to the underground water resources crucial for agricultural activities and the daily needs of local inhabitants. On the other hand, preserving the underground water resources rendered the exploitation of limestone and clay for mining unviable. This underscored how the operation of a cement factory could carry environmental risks, particularly concerning landscape alterations. Despite claims in the EIA and EIA reports about implementing advanced technology and responsible mining principles to minimise environmental damage, cement factories still presented significant environmental challenges.

The second aspect pertains to karst management. While the EIA and EIA Addendum reports tended to adopt an economic viewpoint or concentrate on exploiting natural resources, the SEA report adopted a more encompassing perspective, advocating for the sustainable utilisation and management of the Kendeng Mountains. It placed considerable emphasis on implementing the precautionary principle, particularly in resolving disputes and conflicts related to access to natural resources. Furthermore, the report proposed enhancements to the policies, plans, and programmes outlined in the national spatial plan, the Central Java provincial spatial plan, and the Rembang spatial plan, primarily focusing on promoting the sustainable utilisation and management of the Kendeng Mountains.

Third, The SEA report, indeed, distinguished itself by basing its findings on a comprehensive economic and ecological assessment conducted by experts from a variety of disciplines. Unlike the EIA and its Addendum, which prioritised economic growth and industrial development, the SEA combined scientific expertise from fields such as hydrology, biodiversity, and environmental economics to assess a broader spectrum, including the potential costs of ecosystem degradation caused by mining in the Watuputih Groundwater Basin. This alternative assessment provided a more holistic view of the environmental significance of the Karst Area, underscoring the need for conservation based on rigorous scientific analysis. However, the SEA report challenged this reasoning. The report calculated the total economic costs incurred annually until 2020 if mining activities were to be exploited in the Watuputih Groundwater Basin by employing an economic valuation approach. The estimated cost amounted to IDR 2.2 trillion per year.

This economic valuation analysis methodology followed a standard minimum cost reference for all indicators involving price, cost, or quantity units. Additionally, the analysis did not encompass environmental and economic valuations for several aspects, namely: 1) the biodiversity of timber and non-timber plants (such as teak, sandalwood, and fruit trees like durian and banana); 2) the cost associated with decreased productivity due to the prevalence of silicosis; 3) The economic valuation of environmental damage includes the estimated cost of reduced agricultural productivity in plantations caused by dust exposure. This estimate is based on a standardised minimum-cost reference commonly used for

agricultural impact assessments in environmental economics; and 4) the cost linked to reduced life expectancy due to prolonged silicosis lung disease.

Furthermore, regarding regulatory aspects, the SEA report extensively explored the legal dimensions surrounding environmental protection and management. Of particular focus was Law Number 32 of 2009, which specifically dealt with environmental protection and management. This legal framework imposed the mandatory implementation of SEA as a proactive safeguard against environmental pollution and the mitigation of associated damages. Notably, the report accentuated the legal underpinnings that underlay the execution of SEA, which encompassed the right of residents to request such an assessment whenever a proposed KRP held the potential to engender environmental impacts and risks. Additionally, the report alluded to various laws and regulations governing the safeguarding of protected areas, geological protected areas, and the sustainable exploitation and management of the Kendeng Mountains region.

Finally, the SEA report adopted a comprehensive outlook particularly on scope and geographical area, centring on the holistic SEA of the area. It put forth recommendations that extended beyond the confines of the particular project, advocating for the designation of the Watuputih Groundwater Basin region as a protected area. Furthermore, it proposed initiating the process to identify the KBAK and advocated for temporarily suspending mining operations.

The overarching narratives presented in the SEA reports constituted an alternative discourse aimed at providing alternative options for managing the karst region in the Northern Kendeng Mountains. The primary objective of this alternative discourse was to offer choices in the management of the area. As a result, the recommendations generated from the study proposed the cessation of all mining operations in the Watuputih Groundwater Basin.

To sum up, the discourse analysis conducted on the environmental assessment reports for the North Kendeng Mountains reveals a complex interplay between dominant and alternative discourses, highlighting the power dynamics involved in policy framing and decision-making. Dominant discourses, shaped by powerful actors like cement corporations and the government, prioritised economic development and framed the cement mining operation as crucial for national

needs, often at the expense of environmental sustainability. Conversely, the alternative discourse, as evidenced by the SEA, challenged this narrative by emphasising the environmental risks associated with mining activities and advocating for sustainable management of the Kendeng Mountains. The SEA report not only presented a contrasting perspective to the dominant discourse by stressing the importance of preserving natural resources and employing a comprehensive economic evaluation but also underscored the necessity of legal safeguards for environmental protection.

The competition between dominant and alternative scientific narratives, as revealed through discourse analysis, underscores the critical role of expert knowledge in shaping environmental assessments. This analysis was conducted by systematically coding key documents, such as the EIA and SEA, and identifying recurring themes related to legitimacy, scientific authority, and environmental risk, as mentioned in Chapter 3. The EIA and SEA reports were not merely administrative documents; they were grounded in scientific claims that carried significant weight in policy outcomes. This analysis highlights how the framing of environmental assessments is inherently tied to the expertise and authority of the actors involved, making the scientific rigour and transparency of these reports crucial in determining the direction of environmental governance. The positioning of actors, coupled with their domain expertise and the interests they represent, plays a pivotal role in shaping public opinion and facilitating the realisation of targeted policy objectives. This dynamic interaction between framing, narrative, and actor influence highlights the complex interplay of knowledge, power, and policymaking in environmental governance.

5.4 Conclusion

This chapter has provided a comprehensive analysis of how scientific claims in the EIA, EIA Addendum, and SEA influenced the governance of the karst resources in the North Kendeng Mountains. These reports were not merely administrative tools but were rooted in complex scientific methodologies that were strategically used to shape and challenge policy decisions related to karst governance. By examining the use of scientific expertise in these assessments, this chapter has highlighted the important role of empirical evidence that was

compiled by experts to both legitimise and challenge the operation of the cement factory.

This analysis highlights how scientific authority, particularly in fields such as geology, hydrology, speleology, environmental engineering, and biodiversity, plays a significant role in the economic versus ecological debates surrounding cement mining and karst conservation in the North Kendeng Mountains. The chapter also reveals that environmental governance is heavily shaped by contestations of scientific expertise, where different actors use their knowledge bases to frame narratives that prioritise economic development or emphasise ecological sustainability.

6. Contesting Scientific and Expertise Claims in the Legal Contest

6.1 Introduction

This chapter examines the role of scientific expertise in the legal contestation over cement mining in the North Kendeng Mountains, focusing on how both pro-mining and anti-mining groups strategically mobilised scientific claims to support their legal arguments. Rather than adopting a purely normative legal approach, the analysis explores how expert testimonies, the EIA, regulatory interpretations, and legal rulings served as key battlegrounds for competing interests.

The legal contestation over mining permits in Kendeng illustrates how scientific knowledge can be contested by different actors. The conflict intensified in 2014, when local communities, led by the JM-PPK, challenged PT. SI's environmental permit, arguing that it violated environmental laws and overlooked the ecological sensitivity of the groundwater basin. Despite multiple legal setbacks, the movement persisted through appeals and a Judicial Review, culminating in a 2016 Supreme Court ruling that revoked the permit. However, in 2017, the Central Java Provincial Government issued a revised EIA Addendum, effectively reviving the project.

In this chapter, data collection was conducted through various methods. I conducted semi-structured interviews with several participants involved in the trial process, both from the plaintiff and defendant sides. The participants included activists from the Semarang Legal Aid Institute (LBH), lawyers, the Governor of Central Java, expert witnesses presented at the trial, as well as academics and experts who played a role in the public examination. In addition to formal interviews, I also conducted informal conversations with residents living around the mining area, both those who supported and those who opposed the development project. In addition to interviews and field observations, I analysed a series of lawsuit documents filed by the JM-PPK and the public examination report.

This chapter comprises several sections, each with a different focus and scope of analysis. In the first section, I explain the background and legal basis used by the JM-PPK group in filing a lawsuit against the defendant, highlighting relevant laws and regulations. The next section describes the role of academics and experts presented as expert witnesses, both by the JM-PPK and by the government and the company, to strengthen their arguments and present evidence aimed at providing an objective view to the panel of judges. The next section discusses how the JM-PPK group organised a public examination in response to the Semarang PTUN decision to reject their lawsuit on grounds that were considered insubstantial. This public examination then became the basis for the JM-PPK to educate the public and file an appeal to a higher court. In the next section, I analyze how the government exploited legal loopholes to issue new environmental permits for cement companies, in response to the Supreme Court's Judicial Review decision that should have benefited residents by revoking PT. SG's environmental permit. The final section of this chapter focuses on a discussion of how the pluralistic approach to power analytical frameworks can explain the dynamics of the use of mobilising expertise and the use of argument and scientific evidence in legal processes.

6.2 Reason for Lawsuit and Use of Expertise

The lawsuit against the construction of the cement factory was rooted in a complex array of conflicting scientific claims and environmental concerns, particularly focused on the Watuputih Groundwater Basin, a vital water recharge area. The plaintiffs argued that the EIA conducted for the cement factory was fundamentally flawed, lacking crucial data that accurately reflected the ecological sensitivity of the region.

The key argument revolved around the designation of the Watuputih Basin as a protected groundwater recharge area. This area was deemed essential for maintaining water levels for agriculture and local ecosystems, as stipulated by several Indonesian regulations:

- Law of the Republic of Indonesia Number 7 of 2004 concerning Water Resources.

- Decree of the President of the Republic of Indonesia Number 26 of 2011 regarding the determination of groundwater basins, which designates the Watuputih Basin as a crucial groundwater basin for conservation.

The plaintiffs argued that the improper or selective use of environmental data in the EIA overlooked the basin's geological significance, thereby violating multiple regulations that protected such ecologically sensitive areas:

- The Law of the Republic of Indonesia Number 26 of 2007 on Spatial Planning emphasises the protection of karst landscapes and groundwater recharge areas.
- The Law of the Republic of Indonesia Number 32 of 2009 concerning environmental protection and management highlights how the EIA contained errors and misrepresentations regarding the environmental impact of mining in the basin.

This case underscored how science and environmental data were at the heart of the legal battle. The plaintiffs contended that the EIA downplayed the long-term ecological consequences, including potential disruptions to the groundwater system, which would negatively affect local agriculture and water security. This omission of critical geological data not only undermined the legitimacy of the mining permits but also violated the spirit of environmental protection laws in Indonesia.

The lawsuit was further bolstered by public opposition, especially from the local Samin community, which exemplified simplicity, self-sufficiency, and environmental preservation (Asrawijaya and Hudayana, 2021). This socio-cultural context amplified the legal and scientific claims as the community saw the Watuputih Basin not just as a scientific resource but as a lifeline integral to their way of life. The community's traditional knowledge and relationship with the land further strengthened the argument against the cement factory, contrasting scientific assessments that prioritised short-term economic benefits.

The Governor of Central Java, representing the defendant, contested these claims by pointing to procedural compliance, asserting that all necessary environmental permits were issued according to legal requirements. The governor's defence rested on the argument that:

- The EIA and the UKL-UPL had been completed, fulfilling the mandatory conditions for obtaining the environmental permits.
- The lawsuit, from the defendant's perspective, was time-barred as the plaintiffs failed to act within the statutory deadline following the permit announcement in 2012.

Moreover, the defendant claimed that the lawsuit was premature, arguing that the plaintiffs had not exhausted all administrative remedies before resorting to legal action. This suggested a tactical use of legal technicalities to challenge the validity of the lawsuit, without addressing the core environmental concerns raised by the plaintiffs.

The basis of the legal battle lay in the opposing scientific testimonies presented by both sides. While the plaintiffs argued that the karst system was highly sensitive and could not sustain large-scale mining activities, experts representing the cement company asserted that the karst in the North Kendeng Mountains was "young" and stable enough to support mining without significant ecological disruption.

This dispute over the geological and hydrological properties of the region illustrates the broader issue of how scientific expertise is contested in court. On the one hand, the anti-mining coalition presented scientific evidence that emphasises the environmental risks, while the cement company's experts framed the issue in terms of technological mitigation and economic development.

The lawsuit was more than a legal challenge, it was a contest over scientific authority and environmental ethics. The plaintiffs argued that the omission and manipulation of critical environmental data in the EIA invalidated the permits granted for mining in the Watuputih Basin. This case highlights how the improper use of scientific expertise can obscure ecological risks, reinforcing the need for more rigorous and transparent environmental assessments in Indonesia's legal framework.

6.3 Testimony of Expertise and Scientific Dispute

The residents of the Kendeng Mountains in the Gunem region began protesting plans to establish a cement factory in the Watuputih Groundwater Basin area. This situation highlighted different perspectives among the experts regarding the establishment of the cement factory in Rembang, particularly concerning their roles as expert witnesses in the ensuing trials. The testimony of these experts was conducted in an open trial at the Semarang PTUN level, which became the initial lawsuit of the JM-PPK group against the defendants, namely the Governor of Central Java and PT. SG.

"So, the only open trial in that event happens at the first level, while at higher levels, they only submit case files (appeal memorandum)" – IW

In court disputes, experts representing both parties are often called upon to provide testimony. These experts typically possess diverse scientific backgrounds and, in many cases, are academics affiliated with various universities across Indonesia.

The first expert witness from the JM-PPK, Dr. RT, an expert in state administrative law from Atmajaya University, Yogyakarta, initiated his testimony by referencing a comparable legal case: the Jakarta PTUN trial on December 12, 1994, concerning the lawsuit filed by a coalition of NGOs against the PTPTM Regulation funds. Dr. RT argued that the verdict in that trial served as a valuable benchmark. Additionally, he discussed several relevant regulations regarding community lawsuits in environmental cases, whether filed by individuals or NGOs. These regulations included Law Number 53, paragraph 1 of the PTUN Law, and Law No. 5 of 1986. Dr. RT highlighted the primary focus of Law Number 53, paragraph 1 of the PTUN Law, which stipulates that plaintiffs in state supervision disputes must be individuals or legal entities that are registered and have experienced a perceived grievance.

In his statement, Dr. RT reinforced the JM-PPK lawsuit by elaborating on the role of public participation in administrative law. He emphasised the importance of community involvement in state administrative decisions, particularly for those communities that would be directly affected. Dr. RT explained that if a decision

was broad in scope and had significant implications, a comprehensive impact study had to be conducted. Based on the findings of such a study, the affected community or compensatory group should then be afforded the greatest possible opportunity to file a lawsuit. While objections from the defendant, particularly in cases involving employment disputes, are permissible, they should not obstruct the PTUN from adjudicating the matter. In the context of a PTUN dispute, regional regulations functioned merely as normative guidelines, but they must be applied in a manner that allowed for scientific intervention. This approach ensured that the core issues of the case could be directly addressed by the compensatory community, who served as the plaintiffs.

RT then addressed the deadline for filing a lawsuit, which was set at 90 days from the time the plaintiff became aware of the issue. This time limitation weakened the lawsuit filed by the JM-PPK. To illustrate this point, RT cited another PTUN decision that operated under a different time frame, specifically 90 days from when the plaintiff became aware of the impact of the resulting losses.

Dr. SA, an expert in the EIA method and an academic at the Bogor Agricultural Institute, provided testimony addressing concerns about the inconsistency of the EIA document in the Rembang case with the updated methodologies and regulations for EIA preparation. He began by discussing the updated method for EIA preparation as stipulated in the latest Ministerial Regulation Number 16 of 2012. Dr. SA argued that the traditional “before and after” method was now considered invalid, having been replaced by the “minus without” formula. This formula shifted the focus from estimating impacts based on conditions before and after a project to assessing the differential impact between scenarios with and without the project, given that an EIA was typically conducted before project implementation. He emphasised the importance of establishing a sound basis for creating an EIA document, noting that the nature of environmental impacts was not always homogeneous, may be unevenly distributed, and could manifest itself over different times and spaces. The preparation of the EIA document must, therefore, begin with a consideration of these characteristics, followed by a feasibility evaluation, as these processes are interconnected.

The EIA document for the Rembang project employed the “before and after” method, which contradicted current regulations. In Indonesia, the EIA had not

served as the primary determinant of whether a project would proceed for some time. Article 22 stated that "if science and technology cannot mitigate the impact, the project shall be cancelled". However, in practice, no project has been cancelled on these grounds; rather, rejections tended to focus on the EIA document itself.

Dr. SA underscored the regulation concerning significant impacts as outlined in Government Regulation No. 27. He noted that not all major impacts qualified as significant impacts, which were largely dependent on the local community's context. These values needed to be accurately captured in the EIA document. Often, significant impacts were downplayed to avoid categorisation as such. The more thoroughly significant impacts were identified, the more effectively they could be anticipated and managed.

The criteria for determining the suitability of an EIA document are outlined in Attachment 2 of the Minister of Environment Regulation No. 16 of 2012.

According to Dr. SA, there were three key aspects to assessing an EIA: identification, estimation, and evaluation. Estimation encompassed two dimensions: magnitude and significance. The magnitude of the impact pertained to its intensity, making it essential to base the estimation chapter on both the intensity and significance of the impact.

Dr. SA emphasised that a crucial aspect of an EIA was ensuring the validity of the tools used, as stipulated in Permen LH No. 16/2012. The accuracy of an EIA was contingent upon the correct application of the criteria established for its creation. These criteria were particularly vulnerable, as impact studies often tended to be generalised rather than tailored to the specific needs of more contextual subjects, such as differences in gender and age.

In the case of the Rembang EIA document, the criteria used were self-defined, with references to Government Regulation No. 27 already mentioned, but the definition of impact was determined by the EIA compilers themselves. While modifications to the methodology for compiling an EIA were permissible, they must not violate established minimum standards.

Another witness presented at the trial was Dr. BB, a geologist from the ITB. In his testimony, he explained the concept of groundwater storage in geology,

known as hydrogeology. He elaborated that, in general, the soil is divided into the vadose zone (upper layer), which primarily functions to receive and absorb rainwater, allowing the water to flow downward to the phreatic zone (water storage layer), typically composed of rocks where water moves through the pores.

However, the division of these zones differs in characteristically dry limestone areas. In such regions, the soil is divided into the fluctuation zone and the phreatic zone (Jukić and Denić-Jukić, 2009). Unlike in wetter zones, where water is typically found beneath the rock, in limestone areas, water is located near fractures in the rock. Regardless of how deep drilling is conducted in this area, water will not be found unless the drilling occurs near these fractures.

Karst areas, from a geological perspective, are regions where rock dissolution occurs over tens of thousands or even millions of years. The only type of rock that can dissolve in water, or be dissolved by water, is limestone, and this process defines karst landscapes (De Waele, Plan and Audra, 2009). The features of ponors in karst areas are unique; caves and ponors are not always visible as holes but can also manifest as cracks in rocks that do not resemble traditional caves or ponors. Consequently, ponors in karst areas can extend for tens of metres.

The classification of dry and wet zones from a geological perspective aligns closely with the explanations provided by the expert witness in speleology. Dr. BB elaborated that the dry zone functions as a conduit for water flowing to the wet zone, which often consists of underground caves. The process of water moving from the dry zone to the wet zone spans hundreds to thousands of years, eventually leading to significant accumulation. This long-term hydrogeological system is frequently misunderstood, with a common misconception being that rainwater above the karst simply passes through and flows directly into springs. In reality, the dry zone (karst) serves as a pathway for water to reach the wet zone. This characteristic is one of the potentials of karst landscapes, allowing them to store clean water as a future reserve. Additionally, karst areas offer other valuable potentials, such as habitats for cave fauna and their impact on agriculture.

Dr. BB also articulated his opposing view on mining activities in karst areas. He discussed the landscape alterations that could result from mining and their subsequent impacts. A reduction in the surface or dry zone of karst could significantly affect the quality of water absorption. Without the natural filtration that slows water flow, the water that falls and penetrates the subsurface will emerge more quickly. This means that during the rainy season, water will be received by the wet zone more rapidly (due to the shortened route), leaving no reserves for the dry season.

If the Rembang Karst Area met the criteria of an exokarst landscape, characterised by features such as water infiltration, caves, and active underground rivers, it must be preserved. The use of reservoirs as a solution for mining activities is ineffective because water will seep into the ground. Even if mining occurs far from settlements, it still poses a risk of water pollution due to the shortened route of water flowing from the dry zone to the wet zone, bypassing the natural filtration provided by the pores of dry zone rocks.

Finally, one of the expert witnesses presented at the trial was PW. Unlike the previous experts, who were affiliated with universities, PW was an activist from the Indonesian Speleology Society with research experience related to the ecosystems of the Kendeng Mountains. In his testimony, he explained that a cave was defined as a cavity in the rock that functioned to channel water. Caves could serve as both inputs, where water entered, and outputs, where water emerged as springs. Caves possessed both biological and physical aspects. The physical aspect included a hydrological system, which was also the primary mechanism of karstification (speleology typically focuses on exokarst, which refers to surface formations). The biological aspect encompassed the relationship between the cave and the organisms that inhabited it. Changes in the behaviour of these organisms could signal alterations in the ecosystem.

PW explained that the composition of soil layers included a surface layer of soil, followed by fractured rocks beneath it, and as one went deeper, the layers became more massive, eventually forming cavities. PW further elaborated on the process of karstification and the hydrological cycle from a speleological perspective. Caves were initially formed due to the presence of water flow and surface cracks. As the water was absorbed from above, it initiated the

karstification process, which involved the weathering of rock and the formation of cave passages, ultimately directing the water flow to a specific point. This process led to the formation of multi-level underground rivers.

During the dry season, the cycle is reversed, as stored water rises and reaches the areas around the cracks, resulting in the emergence of springs. Contrary to common assumptions, the dry season is the period when the most water is stored for the dissolution process. Cracks on the surface play a crucial role in retaining and storing water for karstification. In other words, the greater the storage capacity (through cracks), the more water will be produced. However, if this upper layer is removed, it may be easy to fill the cavities below, but the water will not be stored effectively; instead, it becomes surface water, replacing the lost surface layer. When the upper zone is disturbed, the cave's development is hindered, and the karstification process is halted.

In speleology, there are two types of caves: dry zones and wet zones. The dry zone serves as a conduit for water, where water may not accumulate but rather flow through the cave. A ponor, which can be either a visible or hidden crack, typically forms in valley areas. A hidden ponor is often covered by sand or soil, which can be washed away during the rainy season, allowing water to enter it. The presence of a ponor can indicate the process of karstification. Additionally, at least two rainy seasons are required to observe the behaviour of water as it moves into the cracks, a process that can be studied using a dye test to trace the water's path and identify the springs where the dyed water emerges.

Subsequently, several expert witnesses representing the Central Java Provincial Government and cement companies presented differing scientific perspectives on the management of the Karst Area. The first testimony was provided by Prof. HH, a hydrology expert from Gadjah Mada University.

In his statement, Prof. HH discussed the concept of the CAT, which refers to the geological and hydrological conditions underground. Groundwater basins consist of recharge and discharge areas, with the groundwater recharge area being particularly important for protection. According to the principle of "per glass", actions taken within one groundwater basin will not impact other groundwater basins.

Prof. HH further explained that, in hydrogeological terms, a ponor was a “hole” that could swallow water, typically found in limestone areas where underlying cavities allowed water to enter. A ponor could influence groundwater, but this was not always the case. Whether the water that seeped into the ponor affected groundwater depended on whether the underground cavities were interconnected.

Prof. HH also expressed his disagreement with the assertion made by the plaintiff's expert witnesses, PW and BB, that limestone can serve as a water-bearing medium (aquifer). According to Prof. HH, there are various types of limestone, and not all are aquifers. Only those types of limestone that contain cavities can function as aquifers, whereas limestone without cavities is impermeable. In contrast, rocks such as sand, typically found in highlands or volcanic regions, are composed of granules that create cavities capable of holding water. This characteristic of porous rocks is fundamentally different from limestone formed from marine deposits and typically located in lowlands.

Prof. HH emphasised that the nature of limestone varies depending on its location, and he contended that some types of limestone possess impermeable properties. Therefore, whether pollution occurs or not can be determined by examining the cavities—specifically, whether they are interconnected and whether they reach the lower zones where water is stored. The mere presence of numerous cavities does not necessarily indicate the potential for pollution if the cavities are not connected.

Additionally, Prof. HH argued that mining within a groundwater basin area is permissible as long as proper conservation measures are implemented. The three main points of conservation are:

- Conservation: Taking actions to preserve and protect natural resources
- Control: Managing and mitigating the consequences that arise from human activities
- Utilisation: Implementing both conservation and control measures effectively

The next expert testimony was provided by Prof. EH, a specialist in karst geomorphology. He elaborated on the classification of karst landscapes into four

stages: early, young, mature, and old karst. According to the criteria outlined in the ministerial decree, only mature and old karst areas are subject to protection. Prof. EH noted that the Karst Area in Rembang, based on theoretical considerations (as he had not conducted direct research in Rembang), falls into the young karst category. Consequently, according to existing regulations, the Rembang Karst Area is not designated as a reserve. It is important to note that not all karst areas designated as protected in Indonesia necessarily fall within the protected karst classification; thorough investigations are required to determine their status.

Prof. EH further explained that the presence of large caves and interconnected networks in a karst area typically indicates a mature karst. Conversely, if the area contains only small caves, it is likely classified as young karst. A straightforward method for assessing the age of karst is to count the number of caves—the greater the number, the more mature the karst. The southern part of Java Island is characterised by mature karst, while the northern part is classified as a young karst area.

Karst features (regardless of whether the area is early, young, mature or old) are:

- a) Limestone
- b) Hydrology
- c) Climate
- d) Culture

Regarding the characteristics of limestone, Prof. EH explained that it can be easily identified by observing white marks, which are pores through which liquids and gases pass. He noted that limestone contains small pores, allowing water to penetrate but only gradually seep through. According to Prof. EH, while the impact of mining on young karst is inevitable, it is relatively easier to manage. However, when addressing whether karst areas should be mined, he emphasised that his position aligns with the guidelines outlined in the ministerial regulation (as experts typically refer to the applicable regulations when asked about the feasibility of mining in karst areas).

Prof. EH also mentioned that karst formations can naturally erode over time, with approximately 0.8 millimetres disappearing each year through natural processes. Effective reclamation in karst areas involves creating “artificial epikarst” formations which should leave an intact natural epikarst zone approximately 10-50 metres thick, with the remainder being artificially constructed. The mined area should be contoured concavely to prevent water from escaping. Additionally, Prof. EH emphasised the importance of establishing clear policies and management strategies for karst areas, determining which zones are suitable for mining and which are not, as well as ensuring that spatial planning is appropriately regulated from a policy perspective.

Another expert witness presented by the government was Dr. SW, an EIA expert from the University of Indonesia. Dr. SW's testimony was intended to counter the arguments of Dr. SA, who had previously questioned the EIA methodology used by the cement company.

At the outset of his discussion, Dr. SW offered comments on the EIA methodology. He provided an optimistic perspective on the EIA preparation process, highlighting that it is conducted by experts and undergoes various studies and dialogues, ensuring continuous updates before final ratification. He critiqued the focus on the “with or without” and “before and after” methods, arguing that the most important aspect of an EIA document is not solely its methodology. According to Dr. SW, an EIA document should contain comprehensive content. He emphasised that the EIA methodology is flexible and constantly evolving, meaning there is no perfect method; therefore, different methods can be combined. He further noted that many methods exist and are not fixed standards, as they will be re-evaluated within the environmental management plan.

During the court proceedings, Dr. SW testified that the methodology of the EIA could be scrutinised in scientific forums. He stated that if the methodology posed significant environmental risks, established mechanisms and agencies were responsible for oversight. According to Dr. SW, modifications to the EIA were permissible as long as they adhered to the guidelines outlined in Ministerial Regulation 16/2012. He further emphasised the limitations of the role of the EIA

assessor, clarifying that their responsibility was confined to evaluating documents and did not extend to monitoring the implementation of the RKL-RPL.

Beyond the EIA, Dr. SW discussed his views on the relationship between ecology and humanity. He argued that the concept of the environment must be understood holistically, recognising its diversity and interconnections. The key aspect is achieving harmony, but this harmony should not be measured solely by human standards. In other words, non-human entities must also be considered in the pursuit of environmental harmony.

During the court proceedings, Dr. SW testified that ecology, as the foundational science of the environment, employs a holistic approach. He stated that the guidelines for compiling an EIA emphasise a holistic causative approach, which includes cultural considerations. However, he acknowledged that achieving meaningful community involvement is often more challenging in practice than the guidelines suggest, requiring coordination with representatives to facilitate participation. Dr. SW further argued that the preparation of the EIA document must adhere to what he termed *natural standards* rather than *human standards*. When questioned about this distinction, he explained that natural standards refer to ecological integrity and environmental sustainability as determined by scientific ecological assessments, whereas human standards often reflect economic or political considerations that may compromise environmental protections.

Finally, one of the expert witnesses presented was Dr. BS, a mining expert from ITB. It should be noted that during the trial, the plaintiff, representing the JM-PPK coalition, objected to Dr BS's testimony due to his employment with PT. SI through PT. LAPI, where he served as the mine designer for PT. SI.

In his testimony, Dr. BS detailed the mining plan and preparation process used by PT. SI in Rembang. He reported that cave mapping had been conducted and hydrological data for the Rembang karst had been obtained. Drilling has reached a depth of 115 metres, with all the results indicating dry conditions. Mining was planned to occur in a dry zone which was believed not to store water, and the location of the mine was outside the water recharge area. The underground mining, as outlined in the EIA, would extend to a depth of 270 metres. Dr BS

asserted that no permanent rivers would be affected, and the mining would be conducted using a combination of mechanical methods and controlled blasting. Reclamation of the site was expected to take 130 years. However, he acknowledged that there was no guarantee that environmental damage would not occur following the blasting and dredging operations, nor could the continued availability of water be assured.

6.4 Public Examination and Challenging the Court Decision

The decision of the Semarang PTUN in this case was an unexpected development. From the beginning of the lawsuit filing process until the series of trials that were held, the plaintiffs (the JM-PPK) believed that their application would be granted. Substantially, the plaintiffs argued that the EIA submitted by PT. SG contained various procedural and substantive defects. However, the court's decision did not side with the public interest.

In response to the ruling, the plaintiffs took further steps by conducting a public examination of the Semarang PTUN Decision No. 064/G/2015/PTUN.SMG stated that their lawsuit was considered out of date. Such a public examination has several main objectives. First, the examination aims to provide an interdisciplinary legal study in the form of legal annotations that can be used as a reference for judges or judicial institutions in making decisions at the appeal or cassation level. Second, this examination functions as a means of legal education for judges, academics, students, and the wider community in understanding a case that has social, economic, cultural, as well as environmental and ecological impacts. Finally, a public examination is intended to encourage public participation in overseeing the principles of social justice and realising a transparent, professional, and just outcome.

"This (public examination) became a learning experience about a case for both the legal community and the public. It encouraged public participation and ensured a professional judiciary" – HW, Law Expertise – Gadjah Mada University

The examination was held on July 6, 2016, at the Faculty of Law, Diponegoro University. It involved a collaboration of various academic institutions and

organisations that were concerned with legal issues and social justice. The institutions involved in this activity included the Faculty of Law, Diponegoro University, the Centre for Anti-Corruption Studies (PUKAT) of the Faculty of Law, Gadjah Mada University, the Centre for Law and Human Rights Studies (HRLS) of the Faculty of Law, Airlangga University, SEPAHAM Indonesia (Human Rights Teachers Association), the Masters Programme in Environment and Urbanism (PMLP) of Soegijapranata Catholic University, EPISTEMA Institute Jakarta, and the Association for Community-Based and Ecological Legal Reform (HuMa Jakarta). This collaboration reflected a shared commitment to developing interdisciplinary legal studies and strengthening advocacy for environmental and social justice.

Based on the examination results, several findings and conclusions can be identified. First, the Examination Panel decided that there was an error in determining the expiration date of the lawsuit in the Semarang PTUN Decision No. 064/G/2015/PTUN.SMG (Joko Prianto et al. v. (I) Governor of Central Java; (II) PT. SG). The decision was considered to have no clear legal basis, especially because the panel of judges did not conduct a more in-depth analysis regarding the process and purpose of announcing the object of the State Administrative Decision (KTUN) dispute to the public, especially to the parties directly affected.

The Examination Panel thought that the decision was only known to the affected community after Baskoro received a response from the Central Java Environmental Agency (BLH) on June 18, 2014. This information was then conveyed to the plaintiffs. Thus, there was a strong indication that before June 18, 2014, the plaintiffs were only involved in rejecting the EIA document of the Semen Indonesia Factory, which they considered to have substantial defects and were detrimental to their interests, without knowing the existence of the Decree (SK) of the Governor of Central Java which was the object of the dispute. This indicated a problem in the openness of information and public access to administrative decisions that may have a significant impact on their lives.

The Examination Panel further assessed that the lawsuit filed with the Semarang PTUN on September 1, 2014, was still within the legal time limit, namely on the 73rd (seventy-third) day after the plaintiffs received information about the disputed decision. Thus, the lawsuit has not passed the 90-day time limit, as

stipulated in the applicable legal provisions. Therefore, the Examination Panel affirmed that the decision of the Semarang PTUN Panel of Judges stating that the plaintiffs' lawsuit was inadmissible (*Niet Onvankelijk Verklaard*) was a legal error and had no strong legal basis.

In addition, based on an analysis of the court decision, expert testimony, and public testimony, the Examination Panel found indications that the Semarang PTUN Panel of Judges was less sensitive in digging deeply into the various fundamental issues behind the issuance of the SK of the Governor of Central Java No. 660.1/17 of 2012. The issues included the legal aspects of permits that were prerequisites for issuing SK, including the methods used in preparing EIA, as well as the reality of significant social and environmental impacts resulting from the policy. Furthermore, there were shortcomings in efforts to critically reveal the mechanism for announcing the permit to the public, which had implications for limited access to information for affected parties.

The results of the examination of this decision then became a strategic basis for the community coalition, especially the JM-PPK, in filing further legal efforts. The findings of the examination strengthened the argument to file an appeal against the Semarang PTUN decision to a higher level, namely the Surabaya High State Administrative Court (PTTUN), and then to the Supreme Court (MA). In addition, the results provided a basis for filing an extraordinary legal effort in the form of a Judicial Review (PK) against the Supreme Court's decision to ensure that the substantive and procedural aspects in this case received more comprehensive and fair legal considerations.

6.5 Exploiting Legal Loopholes

In the context of the conflict related to the construction of a cement factory in Kendeng, Rembang, the Supreme Court's Judicial Review Decision Number 99 PK/TUN/2016 explicitly stated that: first, the lawsuit filed by the plaintiffs was fully granted; second, the Decree of the Governor of Central Java Number 660.1/17 of 2012, dated June 7, 2012, which granted an environmental permit for mining activities by PT. SG (Persero) Tbk in Rembang Regency, was declared null and void; and third, the defendant was required to revoke the Decree.

Legally, the Judicial Review is final and binding, so this decision should have provided clarity that the lawsuit was in favour of the residents and resulted in the cement factory being unable to operate anymore because its environmental permit had been revoked. However, in reality, until the time of the writing of this thesis (March/2025), the cement factory is still operating and continuing to carry out mining activities in the Watuputih Groundwater Basin area, which should have the status of a conservation area, by relying on the new environmental permit.

The continued operation of this cement factory cannot be separated from the political dynamics and consolidation of interests among various actors, including politicians, bureaucrats, experts, and companies, who are trying to maintain the continuity of the industry's activities. By exploiting the legal loopholes in the Supreme Court's Judicial Review decision, they are still trying to ensure the continuity of the cement factory's operations, even though, legally, the decision should have sided with the residents and ended the mining activities in the area.

"I contacted the public relations of the Supreme Court. 'What is this? Where is the decision?'. 'Mr. GP, there is a decision. First, the delineation is reduced, and then the depth is reduced. After that, the mining procedures are improved, that's all.' 'If I fix this, does it mean it can continue?'. 'Of course, it can.' That's the Supreme Court, so then I issued a regulation to implement the Supreme Court's decision, reducing the delineation. 'Hey, executor, it can't be from this much to that much. This is a technical calculation from the engineers, the depth is at this level, let's raise it by this much so it won't cause damage. Second, the procedures are improved like this', and that's it." – GP, Central Java Governor

The legal loophole in this context can first be seen from the fact that the legal decision of the PK, which should have cancelled the environmental permit which had the consequence of stopping the cement factory, was interpreted as an effort to improve mining activities. The Governor of Central Java as the party with the regional authority for mining directly responded to the decision by communicating with the Supreme Court. He claimed that he had conducted a legal consultation on the decision with the Supreme Court where the results of the consultation stated that the decision did not immediately close the factory. However, there were provisions regarding administration that should be obeyed

by the government, especially concerning minimising environmental risks by reducing the delineation of mining exploitation. In essence, the governor claimed that the court decision did not close the factory but required it to make improvements.

Next, consolidation was carried out by forming the EIA Addendum Supervision Team. Before this team was formed, consolidation efforts were carried out by convening the Central Java Province EIA Commission Team to discuss the environmental technical study related to the results of the Supreme Court review decision. The discussion in this forum was then followed up by the Governor of Central Java by making improvements and refinements to the EIA document, which was later known as the EIA Addendum document.

There were several reasons for and considerations in the preparation of the EIA Addendum document. First, the refinement and assessment of the EIA Addendum document by the AMDAL Assessment Commission Team was claimed to be an effort to fulfil the considerations of the panel of judges, as stated in the judicial review decision. Second, in substance, this document was prepared to respond to the judge's considerations regarding mining procedures in the Watuputih Groundwater Basin area, the sustainability of the aquifer system in the area, and concrete solutions to various problems faced by residents, such as the lack of clean water and the need for water for agriculture.

However, the JM-PPK, which was also a representative of the Ministry of KLHK, assessed that the EIA Addendum was not a decision agreed upon by all parties. If referring to the results of the meeting attended by the minister of KLHK and his staff, the deputy of the KSP, the minister of BUMN, the Governor of Central Java, and the president director of PT. SI, a small team should have been formed to assist the Governor of Central Java in preparing a response letter to the judicial review decision. In practice, however, this team was never formed.

The next legal loophole exploited by the governor was related to the change of company name and the extent of mining activities of the cement factory. This was clearly stated in the EIA Addendum document.

With the change in the proponent's name and adjustments to the area of the Mining Business Licence (IUP) for Limestone and Clay Production Operations, PT. SI (Persero) Tbk. obtained an environmental permit in accordance with the Decree of the Governor of Central Java No. 660.1/30 of 2016, dated November 9, 2016, regarding the Environmental Permit for the Mining Activities of Cement Raw Materials and the Construction and Operation of the Cement Plant of PT. SI (Persero) Tbk in Rembang Regency, Central Java Province. – EIA Addendum Document

First, the issuance of environmental permits by PT. SI was stated to be under applicable legal provisions. However, it is important to note that the latest environmental permit was issued in the name of PT. SI was different from the Supreme Court ruling, which previously determined the permit in the name of PT. SG.

In this context, it is important to emphasise that the Supreme Court ruling referred to the environmental permit granted to PT. SG, while the newly issued environmental permit as per the change of the company's name to PT. SI. As a consequence of this change, the new environmental permit had different characteristics from the previous permit. Therefore, the legal argument used in this case highlighted the fundamental differences between the environmental permits granted to PT. SG based on the Supreme Court ruling and the new environmental permit granted to PT. SI.

The government, represented by the Central Java Provincial Environmental Agency, stated that in this latest environmental permit change, the licensing process did not need to go through the same initial stages as when the company first applied for an environmental permit. This view was based on the interpretation that the Supreme Court ruling had given directions to cement factories to make improvements and adjustments to their environmental permits.

Second, there were changes in the operational area and monitoring of mining activities. The general manager of the corporate secretary of PT. SI confirmed that the company had applied for modification of the environmental permit that had been granted. This application was based on the change of the company's name and adjustment of the operational area.

The changes in the operational area include adjusting the limestone mining area from 520 hectares to 296 hectares, reducing the clay mining area from around 200 hectares to around 90 hectares, and adjusting the land used for road access. Agung emphasised that these changes would have a significant impact on the company's RKL-RPL. Therefore, in this context, adjustments to the relevant environmental permits were required, with the permits needing to be renewed every six months following changes in the company's operational conditions.

However, the main factors that then influenced or intervened in the court's decision were based on dominant economic considerations. In this case, government agencies and corporate representatives involved in the cement factory project justified the reinterpretation of the environmental regulations and scientific assessments by emphasising the factory's economic significance, particularly its status as a BUMN with an investment of approximately 5 trillion rupiahs.

"Here's the thing, there are issues I see here—this is a state-owned enterprise (BUMN). No matter what, a BUMN means it's the people's money too. That massive 4.5 trillion investment can't just go to waste." – SAA

Official statements from regulatory bodies and court proceedings reflected this justification, as they framed the economic benefits as outweighing environmental concerns, leading to decisions that favoured the factory's continued operation despite ecological risks.

6.6 Power Dynamics in the Scientific and Expert Claims in Legal Contest

The contestation in the legal domain related to the operation of a cement factory in the Karst Area, North Kendeng Mountains shows that power relations are dynamic and complex. This dynamic involves efforts to mobilise scientific and expert claims. Both the anti-cement mining coalition and groups supporting the establishment of the cement factory use scientific claims to support their legal process, with different interpretations of EIAs, geological data, and court rulings. This reflects a broader trend in conflicts over natural resources and

environmental governance, where scientific evidence is a primary tool for advocacy and resistance, but its use is inseparable from the structure of political-economic power (Pereira and Laube, 2018).

The contestation took place through the mobilisation and involvement of experts as witnesses in open trials. They provided testimony based on their respective fields of knowledge and research experience to strengthen the position of the party they represented. The JM-PPK group, supported by various environmental NGOs and academics, implemented their resistance strategy by mobilising scientific evidence that had been verified in the field to challenge the EIA that had been produced by the cement company. Their arguments were strengthened by various laws and regulations that were intended to protect the area, especially regulations regarding water resource management and the determination of the Watuputih area as a groundwater basin area. Experts, such as Dr. SA and Dr. BB, were brought into the courtroom to explain the problematic EIA and ecological risks, highlighting the long-term consequences of mining activities on local water supplies and biodiversity. This was in line with the strategy often used by environmental activists to frame industrial projects as existential threats to local ecosystems (Sneddon, Magilligan and Fox, 2017).

The defendant adopted a similar strategy. The defendant's main argument was that the EIA document, along with the Environmental Management Efforts-Environmental Monitoring Efforts (UKL-UPL) document that they submitted, was complete and met all administrative and substantive requirements to obtain an environmental permit. The defendant also stated that the lawsuit filed by the plaintiff should have been rejected because it was considered to have expired.

The defendant also mobilised experts to strengthen their arguments in the open trial, especially involving several professors or experts who had competence and research experience in the fields of karst and hydrology. These experts expressed different views compared to the experts who supported the JM-PPK group, even though they had similar scientific backgrounds. For example, Prof. HH expressed his disagreement with the argument of the plaintiff's expert witness who stated that limestone generally functions as a water-carrying medium (aquifer). According to him, there are various types of limestone, and not all types of limestone can function as aquifers. Limestone that has certain cavities does

function as an aquifer, while limestone without cavities is watertight. Furthermore, Prof. EH argued that the karst area in the Watuputih Groundwater Basin was classified as a young karst area so that the environmental impacts due to mining activities were relatively easier to control.

The testimonies of experts in the Rembang case illustrate how scientific knowledge can be contested and interpreted in multiple ways, depending on the interests of the parties involved. While the anti-mining coalition's experts warned of irreversible damage to the karst system, the government and PT. SI relied on scientific interpretations to argue that mining could proceed safely. This conflict over expertise highlights the broader issue of how scientific authority is mobilised in environmental legal struggles, with both sides using science to legitimise their claims and influence judicial outcomes.

Through an actor-oriented perspective, this mobilisation reflected how grassroots actors deliberately use scientific expertise to challenge state and corporate narratives. This is done as an effort to utilise their agency within the constraints of the broader political-economic structure. This interaction highlights the strategic agency of the JM-PPK in strengthening local issues in a system dominated by institutional and industrial interests.

During the trial process that took place in several stages, the JM-PPK group showed confidence that they would win the lawsuit in court. This confidence was based on the strong regulatory basis, scientific evidence, and critical findings related to the EIA report. However, the developing situation showed the opposite; the court decision ultimately rejected the lawsuit filed by the group on procedural grounds that, according to the JM-PPK, were not substantial, namely that the lawsuit was considered to have passed the time limit or expired.

The JM-PPK group assumed that this court decision did not reflect the principles of justice that should be upheld in the legal system, and even suspected that there was political intervention or pressure in making the decision. This assumption was based on the strong evidence and scientific arguments that they had presented during the trial. This perspective is in line with the neo-Marxist view that corporations and government entities have overlapping frames of thought and interests, tending to accommodate and support capital expansion.

Responding to court decisions that were not in their favour, the JM-PPK group, supported by academics from various universities, used public examination to bolster their scientific claims about the environmental risks posed by mining, highlighting the initial decision of the court. By framing the cement plant as a serious threat to the ecosystem and local livelihoods, the coalition was able to garner broad public support and pressure the government to reconsider its decision because it did not base sustainability principles on the environment.

The public examination, led by the anti-cement mining coalition, illustrates actor-oriented power, showing how grassroots actors can mobilise expert scientific evidence to accumulate public support. By using various media platforms, especially social media, to share scientific reports and expose irregularities in the company's EIA documents, the coalition countered the dominant pro-mining narrative by emphasising the ecological risks of the project. This is reflected the coalition's ability to use scientific discourse as a tool of resistance to challenge broader political-economic structures. The mobilisation of scientists and experts to support environmental advocacy was consistent with findings from other environmental conflicts, where campaigns conducted to the wider public relied on expert knowledge to challenge the continuation of mining projects (Arancibia and Motta, 2019).

In addition to aiming to criticise court decisions and educate the wider community, the use of public examinations, although they do not have direct legal force in influencing court decisions, encouraged the JM-PPK group to file further legal efforts at the PTTUN and the MA. Unlike the first-level trial process, at the appeal level, open trials are no longer held, with the process of submitting written appeal memos and counter-appeal memos replacing them. Finally, with the discovery of novum (new evidence), the JM-PPK group succeeded in winning their lawsuit through the PK mechanism at the Supreme Court, which decided to revoke the environmental permit.

However, the legal victory did not immediately guarantee the cessation of the cement company's operational activities. The defendants again fought back through various political manoeuvres by stating that the Supreme Court's judicial review decision did indeed revoke the environmental permit, but the revocation

of the permit did not explicitly require the cessation of the cement factory's operational activities.

The government selectively utilised legal loopholes and used scientific data to justify continued mining operations, demonstrating how economic forces shaped the interpretation of scientific evidence through their reinterpretation of scientific data, especially in the EIA Addendum report, which illustrates the interplay between neo-Marxist and post-structuralist power dynamics. By reframing environmental issues as technical (Li, 2007), the government legitimised industrial expansion while providing a counter-narrative to anti-mining groups. This action reflects how knowledge is instrumentalised within the framework of capitalist interests to justify resource extraction by constructing a discourse of ecological risks that can be minimised by technology. Thus, the existence of mining activities has a greater economic impact than the environmental problems that can be solved.

Their selection of specific data, in line with economic interests, underlines how power operates through the penetration of scientific and expert knowledge into natural resource or environmental governance (Van Assche, Beunen and Duineveld, 2017). The government actors and PT. SI were able to maintain control over natural resources in the region by framing their actions as scientifically justified while avoiding legal outcomes that were not favourable to their position. Broad economic interests in the cement production industry were the main drivers of this selective interpretation of science.

The continued operations of PT. SI highlight neo-Marxist power dynamics, where economic interests, such as investment, drive policymaking processes. As a state-owned company, its alignment with industrial development goals reflects broader patterns of capital accumulation, which prioritise economic growth over ecological preservation. This alignment highlights how state institutions, influenced by economic structures, facilitate industrial expansion by incorporating scientific findings that serve as convenient avenues to support the interests of financiers. The economic dependence of local and central governments on the operations of PT. SI illustrates how economic pressures can shape environmental decision-making and governance.

The exploitation of legal loopholes and selective reinterpretation of scientific findings in the Kendeng case demonstrates how environmental governance can be undermined by political and economic interests. The ability of PT. SI and the Central Java government to continue mining operations, despite a Supreme Court ruling to the contrary, reveals the limitations of relying on legal and scientific processes for environmental protection. Without stronger enforcement mechanisms and a more transparent use of scientific expertise, environmental laws will continue to be vulnerable to manipulation by powerful actors.

This legal and scientific manoeuvring illustrates the asymmetrical power dynamics at play in environmental conflicts, where corporations and government officials can exploit legal loopholes and reinterpret scientific findings to maintain the status quo. It reflects that scientific and expert knowledge are not neutral in this contest (Grundmann, 2017) but are actively mobilised by both sides to strengthen their respective legal claims. The coalition opposing the operation relied on scientific testimony and field evidence to frame how mining posed significant risks to the environment, while the government and companies or groups supporting it downplayed these risks by emphasising the potential for technological solutions and innovative mining techniques.

This situation illustrates how conflicting scientific claims and the use of expertise in both the legal and public spheres can be contested and used to shape perceptions of environmental risk. Both sides are attempting to redefine the “truth” about the environmental impacts of mining, with each group using scientific evidence to construct competing narratives that suit their interests (Neimark et al., 2019).

6.7 Conclusion

In conclusion, the debate on scientific and expert knowledge in the North Kendeng case shows that power dynamics are deeply embedded in the way knowledge is produced, interpreted, and mobilised. Both groups employed scientific evidence to legitimise their positions, indicating that expertise is not neutral but is shaped by broader political, economic, and social forces. The government’s ability to reinterpret legal decisions and selectively apply scientific findings to defend mining operations shows that there is a complex interaction

between science, legal aspects, and power in natural resources and environmental governance.

7. Shifting Grounds: The Geological Agency's Role and Scientific Claim in Karst Resource Governance

7.1 Introduction

This chapter will explain the dynamics of the involvement of the Geological Agency as a state institution when responding to the contestation of karst resource management in the Watuputih Groundwater Basin area. In this context, the Geological Agency is visible in their change of attitude towards the management of the Karst Area in the North Kendeng Mountains. When the conflict began, the Geological Agency became an institutional actor that firmly rejected the cement factory mining plan for the area. Even the former head of the Agency at that time issued an official letter stating that the area was very vulnerable if forced to host a mining project. The area was identified as a KBAK (*Kawasan Bentang Alam Karst*/Karst Natural Landscape Area), functioning as a critical water reserve due to its ongoing karstification process, as highlighted by Wacana et al. (2011).

However, at the end of the journey, the Agency showed a change of attitude regarding its position in managing karst in the Watuputih Groundwater Basin area. In this case, it conducted what it claimed to be a comprehensive study on the basin, specifically investigating the existence of underground river networks—a key determinant in classifying an area as KBAK. According to Indonesian environmental regulations, an area is designated as a KBAK if it contains underground river systems that play a critical role in groundwater storage and ecological sustainability. The Geological Agency's study initially identified underground river networks, suggesting that the area met the criteria for KBAK protection. However, in later assessments, the agency's findings became more ambiguous, with reports downplaying the hydrological significance of the basin. This shift in interpretation allowed regulatory bodies to justify continued mining activities, despite earlier scientific evidence indicating that the area should be legally protected. As a consequence, this research legitimised the

operation of the cement factory because the findings of the research nullified the Watuputih Groundwater Basin area as a karst landscape area.

The cement mining project in the North Kendeng Mountains, Central Java, has become the centre of controversy that has attracted widespread public attention, especially regarding its environmental impact on the karst landscape, particularly in the Watuputih Groundwater Basin area (Hadi, 2018). The operation of this project, which is supported by local government and industry stakeholders, has faced strong opposition from local communities, environmental NGOs, and academics from various universities in Indonesia, who are concerned about irreversible damage to the fragile ecosystem in the area (Kunz, Hein and Sobirin, 2024; Hadi et al., 2023). At the core of the debate is the role of state institutions, particularly the Geological Agency, which holds the formal mandate to determine the geological and environmental characteristics of the region.

As the main authority under the Ministry of ESDM, the Geological Agency is responsible for delineating protected karst areas and assessing environmental risks associated with large-scale industrial projects. As such, its decisions carry significant weight in shaping policy and determining the fate of controversial initiatives, such as the cement plant.

In this context, the Agency was given the mandate to serve as the final arbiter of the debate on scientific claims regarding the status of the Karst Area, where there was no mutual agreement between environmental NGOs, local communities opposing the cement factory, and government officials and industry stakeholders supporting it. The mandate was carried out by conducting comprehensive research in the Watuputih Groundwater Basin area to prove the existence of the underground river network which was the core of the debate. This mandate was necessary at that time as there were signs of geological uncertainty (Vu, Drebenstedt and Bao, 2020).

The Geological Agency's position was pivotal. By producing and interpreting geological data, the Agency wields considerable influence over government decisions and public opinion. Its findings on the status of the Watuputih Basin, for example, were instrumental in justifying continued mining operations, despite mounting evidence of potential harm to the groundwater system. The agency's

knowledge production process, which includes data collection, geological mapping, and scientific analysis, serves as the basis for these important policy decisions.

However, questions have been raised about the transparency and objectivity of the process, with some stakeholders, including environmental groups and academics, suspecting that the agency favours corporate interests at the expense of environmental protection. This situation suggests that science also contributes to environmental conflicts (Ozawa, 1996). The Geological Agency's dual role, as a producer of scientific knowledge and a state agency tasked with balancing development and conservation, places it at the heart of the ongoing debate about the legitimacy of cement mining projects.

The shifting stance of the Geological Agency regarding the classification of the Watuputih Groundwater Basin demonstrates that knowledge is not neutral, especially when it has significant implications for the policy process. Accordingly, the debate about subjectivity and objectivity in knowledge will always be relevant. Therefore, I propose a pluralistic approach to power theories in the political ecology approach. The aim is to see how the veil of power operates in knowledge production and scientific interpretation regarding the Karst Area in the Kendeng Mountains.

Data collection in this study was conducted through various methods to obtain a comprehensive understanding of the dynamics of the conflict being studied. I conducted semi-structured interviews with several officials and former officials and researchers at the Geological Agency, especially those who, at that time, had the authority and were directly involved in the decision-making process and the dynamics of the conflict. In addition, interviews were conducted with experts who were involved in discussions and mediation efforts to find common ground for resolving the conflict, including those who recommended the need for comprehensive research which was then entrusted to the Agency.

Moreover, I interviewed Central Java Provincial Government officials and activists who were involved in or supported the JM-PPK group. To complement and deepen the findings, I also conducted informal conversations with groups of residents who had participated in the research, especially those involved in

mapping water sources and monitoring the research process carried out by the Geological Agency over several months. In addition to the interviews, I also collected data through analyses of statements from actors and stakeholders involved in this conflict, as documented in online media reports that are still accessible. This approach aimed to gain a more detailed understanding of the chronology and the specifics of relevant information, as well as create a form of data triangulation to increase the validity of the research findings.

This chapter comprises several sections that discuss various aspects related to policy changes and power dynamics in the management of the Watuputih Groundwater Basin area. In the first section, I will describe the changes in policy direction carried out by the Geological Agency in regulating the area. This change is perceived by the anti-cement coalition as a result of economic and political pressures that influence institutional decisions. Then, I will present a comparison of data between previous research findings conducted by various academics and experts, especially those related to geomorphological and hydrological conditions in the Watuputih area. This analysis aims to understand how various scientific studies have described the environmental characteristics of the area and their implications for the policies devised. In the last section, I will discuss how power relations and scientific findings are intertwined in the decision-making process. The interaction between political dynamics, economic interests, and the production of scientific knowledge has implications for the operational legitimacy of cement factories, especially in the context of resource exploitation in the Watuputih Groundwater Basin area.

7.2 Geological Agency as a State Institution and Changing the Policy Direction

The Geological Agency is a state institution operating under the official authority of the Ministry of ESDM, where it plays a key role in regulating and supervising geological issues throughout Indonesia, particularly those related to environmentally sensitive areas such as karst areas and groundwater basins. One of the Agency's main responsibilities is the designation of karst areas, a duty which determines which areas should be protected and which can be exploited

for mining and other industrial purposes. This authority has come under scrutiny because it only views karst areas in terms of physical parameters.

Uniquely, as an institution that has a crucial function related to the determination of the karst areas, the Geological Agency has changed its attitude regarding the controversy of cement factory mining. At the beginning of the conflict over the cement mining project in the Watuputih Groundwater Basin area, there was tension between local communities, environmental NGOs, academics who opposed the project, and government officials and industry stakeholders who supported it. The core of the conflict involved the environmental risks posed to the fragile karst ecosystem and the potential depletion of vital water reserves, which were at odds with the economic benefits expected from industrial development. The Geological Agency, whose head at that time was Dr. SR, became the leader in rejecting the operation of the cement factory. At that time, he asserted that the Watuputih Groundwater Basin area was a karst area the ecosystem of which must be protected. He believed this was the best approach to taking preventive measures against karst damage.

"The problem is, even though CAT Watuputih has not been officially designated as a KBAK, according to the data it is indeed karst" – (Dr. SR, Former Head of the Geological Agency)

To underpin this, during his tenure during the conflict period, he issued a letter that explicitly stated the karst area should be protected. Their letter included the following points:

- a) A comprehensive technical study of groundwater recharge should be conducted to understand its dynamics and vulnerabilities.
- b) The carrying capacity and functionality of recharge areas should be maintained through proactive management strategies.
- c) Reclamation measures should be established to restore groundwater conditions and the surrounding environment in exploited areas.
- d) Monitoring wells should be established to track groundwater level fluctuations and tools installed to measure spring discharge accurately.

- e) Environmental impact management plans, including regular monitoring and analysis, should be enforced to sustain the aquifer's carrying capacity during mining activities.

The issuance of this letter received responses from various parties. The Governor of Central Java criticised the move and encouraged the head of the Geological Agency to revoke the letter. In addition, at the internal level of the ministry, the head of the Geological Agency faced pressure from within the Ministry of Energy and Mineral Resources because it was perceived that he had bypassed institutional protocols by issuing the directive independently, without proper consultation or approval from higher authorities within the Geological Agency. Finally, it was considered too rash for such a decision to have been made without any scientific evidence, a decision based solely on assumptions and interests biased toward environmental NGOs.

However, over time, with changes in the institutional structure of the Agency, there has been a change in political direction regarding showing its policies in public. Initially, as a state institution, the Geological Agency adopted a preventive policy direction aimed at protecting the Karst Area in Watuputih from potential environmental damage. However, this stance later shifted to supporting industrial projects, as reflected in its policy decisions to legitimise cement mining operations despite earlier concerns about environmental risks.

In the case of the cement factory in Rembang, the role of the Geological Agency as the final arbiter in determining whether mining could be continued or not became the focus of political and scientific controversy. The Geological Agency played a role in mediating the dispute, stating that it had been appointed by the President's mandate to act as a mediator in the Rembang controversy, specifically to resolve the dispute over the proof of the existence of an underground river.

"But he explained, 'It's like this, Prof (and) all the attendees when it comes to matters of land at a certain depth, water, that's the geologists. So we ask for the final judge, the Geological Agency.'" – SAA, KLHK

"It's just that the conflict was where at that time the president's directive was for the Geological Agency to become a mediator, which became the

referee whether to continue or not in the context, first of all, what about the water if there is mining? Is it dangerous?" –TS, Geological Agency

Looking at the political position of the institution, the Geological Agency is in the middle, trying to be a meeting point between the debates on scientific claims related to the Karst Area in the North Kendeng Mountains. This dual role places it at the crossroads of competing interests, balancing its responsibilities as a scientific authority with its function as a mediator between companies pushing for industrial development, government priorities for economic growth, and environmental concerns raised by local communities and NGOs.

In the end, the results of the comprehensive research conducted by the Agency made one party, i.e., the anti-cement coalition, dissatisfied with the findings. The findings of the Agency, including its confirmation of non-connectivity between underground rivers and the minimal contribution of surface activity to groundwater depletion, supported the industry's claim that cement plant operations posed minimal environmental risks.

"Underground rivers that are not connected to each other, and the position of the water source that was feared to be lost, turned out not to be like that." – TH, Geological Agency

This finding is believed to have been influenced by the Agency's relationship with the cement companies. The Agency was not trusted by the environmental activists, academics, and the JM-PPK group and was accused of having close ties with industry stakeholders, especially cement companies. There was evidence of an informal alliance between the Geological Agency and the Indonesian Cement Association, which drove the push for cement plant projects across Indonesia.

"The Indonesian Cement Association then, together with the Geological Agency, especially the one that oversees karst issues, they kind of formed an unofficial alliance, to achieve cement factory construction projects in Indonesia. That was one of them, so, coincidentally, I was also involved in it, helping the Ministry of Environment and Forestry to draft a government regulation plan on karst area management. That was in 2010, sir, at that time we were working on it. Well, then this RPP reached the state secretariat's desk, but because of obstacles from the Geological Agency and the Cement Association, it ended up being pulled and tugged, and the

government regulation plan on karst area management did not progress.” – ABR, ASC

“Oh, it's been a long time. Well, I used to be the head of the geological research centre there in Bandung. I even became the head of the Agency. I know (the relationship between the Geological Agency and the cement company).” – Dr. SR, Former Head of the Geological Agency

This shows that although the Geological Agency was positioned as a state agency tasked with regulating industrial development, its relationship with the cement industry raised questions about conflicts of interest. Changes in the institutional structure at the Geological Agency, such as shifts in leadership and organisational priorities, had shifted policies from a preventive approach focused on protecting karst areas to policies that were considered supportive of industrial development.

7.3 Scientific Claims, Research Comprehensiveness, and Critical Notes

Initially, the scientific claims used to assess the impact of mining on the Karst Area in Watuputih were largely based on assumptions, without solid scientific evidence. Dr. SR, the former head of the Geological Agency, for example, was criticised for relying on the assumption that the existence of springs would be affected if the area was mined, without any comprehensive scientific study at the time. During his tenure, he was seen as being closer to environmental NGO groups, which advocated for the protection of karst areas. However, this stance contrasted with subsequent allegations of institutional bias by the Geological Agency in favour of cement factories, highlighting the dynamics of relationships and changing priorities over time. This sparked debate within the Geological Agency, where some researchers felt that scientific research should not have been rushed without sufficient data.

“Yes! Oh, there's the possibility of danger too, but Dr.SR knows for himself that this person is said to be very pro-environment, in the context of being close to NGOs in that way, right? In the context of what sciences are like that, so that in quotation marks in a scientific context it was a bit reckless at that time.” TS –Geological Agency

At that time, Dr. SR of the Agency had designated the status of the Watuputih area as a groundwater basin, based on the provisions of Law Number 7 of 2004 on Water Resources and related geological protection regulations. As a groundwater basin area, Watuputih automatically became part of a geological protected area, which, according to the regulation, was often treated in the same way as a nature reserve to protect critical water resources and ecological functions. This meant that any form of activity, including mining, could not be carried out without an in-depth study. Although, at that time, Watuputih had not been officially designated as a KBAK, the indication of an underground network in the area was an important reason to take preventive measures.

Dr. SR emphasised that the scientific indication of the existence of an underground river in the area was quite clear and could be observed in general. This preventive measure was taken to avoid further damage before Watuputih was designated as a KBAK. With the reason that nature is not easily restored if damaged, the approach taken by the head of the Geological Agency at that time was to prioritise the protection of this area before further determination of its karst status.

But, at that time, the scientific debate did not reach a commonly agreed conclusion. Experts supported by the cement industry argued that the area did not contain an underground river, challenging claims made by environmental groups and earlier assessments by the Geological Agency. They also argued that the existence of cement factory mining had not had an impact on water sources. Due to this conflict of interests, it was then agreed that the Geological Agency should conduct a comprehensive geological study to prove the existence of an underground river in the area. This study was based on internationally recognised standards by the International Association of HydroGeology, which aims to ensure that hydrogeological assessments are carried out objectively and following global scientific standards (Milanović and Stevanović, 2021). The approach used included stable isotope geophysical methods and subsurface conceptual models to map the character of springs against surface conditions. This study took one year to collect the relevant data.

The Geological Agency also formed five teams and deployed more than 50 personnel to conduct detailed field research. There were several teams, including

a geology team, a geophysics team, a hydrology team, a cave exploration team, and a drilling team.

Table 7.1: Duties and Activities of the Geological Agency Team

Geology Team	Geophysics Team	Hydrology Team	Cave Exploration Team	Drilling Team
Interpreting Terrasar-X imagery data nine metres resolution; Updating 1:50,000 scale geological map.	Electrical Resistivity Tomography (ERT): 76 Trajectories, Profile length >49 km; number of data >154,000; Micro Gravity: 298 points, number of data >770 data, north-south and west-east trajectories; Georadar: 17 trajectories, number of data >6,250 data (per 20 cm measurement), around the cave exploration location; Well logging + borehole camera: conducted at WP-	Measurement of Discharge, and basic chemical properties in the rainy and dry seasons; A sampling of a total of 60 water sources, in the form of springs (39), water excavations (17), and water caves (4); Tracing of water flow (tracer) using salt (NaCl) and fluorescent dye (Uranine).	Cave exploration in five locations, namely Manuk Cave, Menggah Cave, Rambut Semen Cave, Temu Ireng Cave, and Wiyu Cave 1. Only Manuk Cave and Temuireng Cave have a water flow with a discharge of approximately 1 litre/second.	Conducting core drilling (coring) at three drill point locations, with a maximum depth of 150 metres each, to verify the results of the Geophysics team and determine the condition of the rocks below the surface.

Geology Team	Geophysics Team	Hydrology Team	Cave Exploration Team	Drilling Team
	1 and WP-2 drilling points.			

Source: Geological Agency, 2017

All these processes were carried out to ensure the accuracy of the data before conclusions were drawn. One important finding was that the underground flow in the area was not interconnected, and the water sources that were feared to be lost due to the mining process would not be significantly affected. The research findings indicated that only about 10-11% of large water sources were affected by previous mining activities.

In this study, the Geological Agency also referred to the five criteria of the KBAK, which evaluate the ecological, hydrological, and geological significance of an area to determine its classification and protection status. The results of the study showed that the limestone mining area covered by the cement factory in the Kendeng Mountains did not meet the KBAK criteria because the expected underground river network was not interconnected.

The results of this study also corrected two research results in the Watuputih Groundwater Basin area, which were there was no basis for scientific claims that the area had an underground river network and that if mining operations took place, they would disrupt water sources in the area. Here are the details of the research data comparison.

Table 7.2: Comparison of Research in the Watuputih Groundwater Basin Area with the Results of the Research by the Geological Agency

Key Aspect	Previous Research (Nandra Eko Nugroho, 2017, and Ananta Purwoarminta, 2012)	Geological Agency (BG) Findings	Discrepancies and Contradictions
Paciran Formation and Water Storage	Described as functioning as an epikarst aquifer, capable of storing and slowly releasing water.	Identified as a conduit rather than a storage system, meaning water moved through but was not retained.	Previous studies suggested long-term water retention, while the Geological Agency stated water was not stored but flowed through quickly.
Spring Discharge Data (Sumber Semen Spring)	Previous research measured discharge at significantly lower rates (~500 l/s).	The Geological Agency reported much higher values (~1500 l/s).	Discrepancies in measurement methods and timing raised concerns over data consistency.
Fault-Controlled Springs	Earlier studies suggested that local topography was the primary factor influencing spring locations.	Geological structure (faults) was the main control over water flow and spring locations.	A shift in focus from topographical to geological structural control changed the assessment of water availability.

Hydrogeological Connectivity	Found evidence of a connected epikarst aquifer, suggesting surface water infiltration affected underground flows.	The Geological Agency denied the existence of a connected system, suggesting minimal interaction between surface and subsurface water.	This dispute impacted arguments regarding the vulnerability of water resources to mining.
Impact of Mining on Springs	Previous studies suggested significant risks to water discharge and ecosystem stability due to mining activities.	The Geological Agency reported minimal impact, asserting that mining would not substantially affect water discharge.	Contradictory interpretations influenced policy decisions on whether mining should be allowed.

Source: Geological Agency, 2017

It can be seen in the table that the research of Nandra Eko Nugroho (2017) and Ananta Purwoarminta (2012) in the CAT Watuputih area highlighted several aspects regarding the characteristics of springs and geological functions in the area. Nandra identified a water-saturated zone around the Brubulan Spring and Semen Spring and classified the springs as perennials that were not affected by rainfall. However, the BG stated that the springs were artesian types controlled by geological faults, so the concept of a water-saturated zone did not apply. BG also emphasised that the current spring discharge was much larger than that reported by Nandra, and the Paciran Formation did not function as a place to store water, but only a place for water flow to pass through.

Ananta Purwoarminta (2012) stated that water infiltration in the research area affected the Brubulan Spring, but the Geological Agency emphasised that both

springs were controlled by fault structures, with the Paciran Formation only slightly affecting the Brubulan Spring. Ananta also noted the relationship between Mount Watuputih and the Brubulan Spring, but BG's test results showed that the Paciran Formation did not act as an aquifer. Both researchers mentioned the impact of mining on the springs, but the Geological Agency denied that mining would affect the spring discharge because the Paciran Formation was only passed through by rainwater which was then channelled through the rock formations below.

However, the research conducted by the Geological Agency had not been without its share of criticism. The first note was the aspect of openness in the results. The Geological Agency could claim that this comprehensive research was not conducted alone but also involved parties who were against monitoring the research process at that time. After the research was completed, the results were not immediately released to the public. Despite requests from the anti-cement coalition, the Geological Agency did not release a detailed explanation of their findings. Attempts to access the full report were unsuccessful until 2020, as the report itself was unavailable. Interestingly, the financial report related to the research was accessible and displayed, raising questions about transparency in the dissemination of scientific findings.

The report was not made publicly available until 2024. Then, it was subsequently reviewed by various stakeholders, including academics and environmental experts, who provided substantive criticism regarding its methodology, findings, and implications. Several experts raised substantive criticism regarding the Agency's research during the Public Examination of the Geological Agency Investigation Report on the CAT Watuputih. This examination took place on February 12, 2024, in Yogyakarta and was organised by the Pusat Studi Manajemen Bencana (PSMB, Centre for Disaster Management Studies) at Universitas Pembangunan Nasional Veteran Yogyakarta (UPN "Veteran" Yogyakarta) and the Indonesian Speleological Society (ISS). The following are key points raised by academics and experts in relevant scientific fields.

The Geological Agency's research was met with substantial criticism from academics and experts, particularly regarding its methodology and conclusions about the Watuputih Groundwater Basin. One significant issue raised was the

Agency's apparent violation of stratigraphic logic. Critics pointed out inconsistencies in how geological boundaries were drawn, arguing that the stratigraphic patterns did not align with the geological structures. This discrepancy was particularly evident in the claim that only the upper karst morphology could be preserved, while the lower part was deemed irrelevant, an assertion described as lacking scientific justification. Additionally, the Agency's redefinition of the Watuputih Groundwater Basin's boundaries was seen as problematic. Experts argued that these changes, which allowed for more permissive land use, could exacerbate environmental risks and undermine the region's ecological integrity.

Further concerns emerged over discrepancies between the EIA, SEA, and the Geological Agency's report. For instance, the Agency divided the Paciran Formation into two parts but did not acknowledge the underlying Ledok and Wonocolo formations, contradicting established regional stratigraphy and calling the validity of its conclusions into question. Field observations also highlighted residual mining sediment emerging from the Sumber Sewu spring, which indicated ongoing mining impacts, including a decline in springwater discharge. These findings, supported by data from Kebunharjo Forestry KPH, raised serious doubts about the Agency's claim that mining activities posed minimal environmental risks.

Critics also questioned the Agency's assertion that the Paciran Formation does not undergo karstification. They argued that, given the shared genesis of the Paciran and Bulu formations, karstification should be present in both. Moreover, field observations conducted as part of the SEA identified key karst features in the Watuputih area, including caves, ponors, and underground rivers, providing clear evidence of karstification processes. Experts challenged the Agency's dismissal of these features, particularly its failure to adequately account for the interaction between meteoric water and the limestone that forms these structures. The absence of a thorough explanation for excluding evidence of exokarst and endokarst further undermined the credibility of the Agency's conclusions.

7.4 Power and Scientific Claim: The Dual Role of the Geological Agency in Cement Mining Legitimacy

The changing role of the Geological Agency in the context of the operation of a cement factory which then mined limestone in the Watuputih Karst Area illustrates how state institutions can adjust their policy direction under the influence of changing circumstances. Although the anti-cement coalition suspected that the change in policy direction from the Agency was due to political and economic pressures that drove the policy change, it was also possible that the change in direction may have been influenced by recent scientific findings. However, the Agency stated that the change was after citing new research that challenged previous assumptions about the existence of an underground river system presented by its previous head. This change played an important role in legitimising the continuation of mining activities. This dual perspective highlights the complexity of understanding the power relations behind the policy change.

Initially, the Geological Agency took a strong position in defence of the environmental integrity of the Watuputih area, opposing cement mining because of its potential negative impacts on the sensitive karst landscape. The Agency, particularly under its early leadership, highlighted the importance of the Karst Area as a geologically protected area that serves as a water reserve, issuing warnings about the dangers of disrupting the groundwater system that was vital to the ecological balance of the area (Gunn, 2021). This stance positioned the Agency as a conservation advocate who sided with environmental NGOs, local communities, and academics who opposed mining projects on the grounds of protecting natural resources and preventing long-term ecological damage (Conde, 2017).

Over time, the Geological Agency's stance changed as it adopted new scientific findings that contradicted its previous assessments. These findings questioned the existence and significance of underground river systems previously identified as important to the ecosystem. However, the anti-cement coalition disputed the validity of these findings, arguing that the lack of transparency, such as the delay in publication of the Geological Agency's research, as well as its previous

research engagement with several academics, raised concerns about potential political motivations. This dispute underscores the need to evaluate both the scientific evidence and the broader political context to fully understand the Agency's policy changes. From a neo-Marxist perspective, these changes can be interpreted as an alignment with the priorities of capital accumulation, where industrial expansion takes precedence over ecological preservation. The reclassification of the Karst Area and the reinterpretation of its geological features illustrate how state institutions can facilitate the commodification of natural resources, allowing their extraction for economic gain. These changes highlight the intersection of power and economic structures, where industrial growth reshapes the policy direction of an agency that is supposed to be involved in environmental governance.

The Agency's revised initial interpretation, presented as the result of a more comprehensive study, effectively downplayed the environmental risks, thereby directly providing a scientific basis to support the company's claim that the ecological risks from cement mining impacts were minimal. This shift in its position facilitated the approval of mining activities and aligned more closely with the interests of industry stakeholders and government agencies promoting economic development (Poelzer, 2019).

This shift not only reflected a change in the agency's scientific interpretation but also illustrated the broader role that scientific knowledge plays in legitimising industrial expansion (Miguelote and de Camargo, 2010). By supporting new findings that support mining operations, the Geological Agency became a key player in the political and economic machine, one that seeks to justify large-scale industrial activities in environmentally sensitive areas.

This evolution underscores the malleable nature of scientific authority in state institutions, revealing how shifts in political and economic priorities can influence the production and interpretation of scientific data (Whitley, 2011). It also raises critical questions about the potential for conflicts of interest when state institutions charged with protecting the environment are also responsible for facilitating industrial development. In this regard, the revised institutional stance reflects a broader trend in which state institutions, under pressure from corporate and state actors, may shift their priorities from conservation to

supporting economic interests, thereby legitimising industrial activities through the strategic use of scientific findings.

The scientific findings from the comprehensive research conducted by the Geological Agency which provides space for companies to legitimise industrial activities in the Watuputih Karst Area reflect the operation of post-structuralist discursive power. As Foucault emphasises, knowledge production is inherently tied to power, shaping the narratives that influence decision-making (Daviter, 2015; Radaelli, 1995; Weible et al., 2012). By framing scientific evidence to downplay the ecological risks of mining, the Geological Agency not only validated corporate claims but also shifted public discourse to align with industrial priorities. This strategic use of discourse demonstrates how knowledge can be mobilised to support dominant political-economic agendas while at the same time attempting to alienate alternative perspectives and reinforce the legitimacy of environmentally contentious projects.

In the case of cement mining in the Watuputih Karst Area, the Agency's scientific findings became central to the discourse that ultimately justified industrial activity in a previously protected and environmentally sensitive area. Initially, the scientific data highlighted the ecological risks posed by mining, particularly those related to the disruption of groundwater systems that are critical to the sustainability of the area. This data reinforced opposition to the mining project from environmental groups, local communities, and some government sectors. However, as the Agency's findings evolved, they began to align with corporate interests, presenting new interpretations that minimised these risks and supported continued mining activities.

This shift underscores a broader trend in environmental governance where scientific discourse can be exploited by powerful economic actors to validate industry claims. In this context, knowledge production does not simply reflect objective and neutral truths but it also becomes an active participant in political and economic negotiations (Turnhout et al., 2020; Turnhout, 2018). The Geological Agency, as a state institution, had the authority to produce and validate scientific data that carried significant weight in shaping public discourse and government policy. By presenting revised findings that downplayed the environmental risks of mining, the Agency provided a critical foundation for the

company's narrative, that industrial development in the Watuputih area was safe and necessary for economic progress.

The broader implications of this dynamic reflect how environmental governance is increasingly shaped by discourses aligned with industrial and corporate interests (Leipold et al., 2019). Scientific knowledge, often considered a neutral basis for decision-making, can be appropriated by powerful actors to serve as a tool to legitimise projects that may face opposition (Delborne, 2011; Conde, 2014). This is in line with the theory of power that recognises knowledge as an instrument of control and influence, where those who control the production and dissemination of knowledge have significant advantages in shaping policy and public opinion. In this case, the Geological Agency mediated scientific and political debates, using its authority as a scientific body to validate industry claims, while simultaneously influencing the trajectory of environmental policy and natural resource management.

This trend raises important concerns about potential bias and conflicts of interest in state agencies responsible for environmental oversight and economic development (Kuehn, 2015). The role of the institution in mediating these debates highlights the tension between its duty to protect environmental resources and its position within a broader political and economic system that prioritises industrial expansion. The use of scientific knowledge in this context thus reflects a key mechanism through which state institutions facilitate corporate goals under the guise of scientific legitimacy, ultimately shaping the discourse around environmental governance in a way that favours economic growth over ecological preservation (van der Molen, 2018; Duit, 2016; Turnhout, 2018).

The Geological Agency's dual role as a scientific authority and political mediator highlights the complex power dynamics at play in environmental decision-making, where institutions, structures and discourses intersect to shape outcomes. As a scientific body, the Agency holds considerable authority in producing and interpreting data that informs public policy, giving it the ability to influence how environmental issues are framed and addressed (Lalor and Hickey, 2013, 2014). At the same time, as a state institution operating within political and economic structures, it also acts as a mediator between competing interest

groups, balancing government priorities, corporate interests, and environmental concerns. This dual role places the Geological Agency at the heart of a critical decision-making process, where its scientific findings serve not only as a basis for policy but also as a tool for negotiation and political legitimacy.

Drawing an actor-oriented perspective, the Geological Agency is not simply a passive implementer of state directives but actively negotiates between competing interests. On the one hand, environmental advocates, including NGOs, local communities, academics, and experts, seek to use scientific data to challenge mining activities on ecological grounds. On the other hand, companies and state actors, motivated by economic interests, pressure the Agency to align its findings with industry goals. By positioning itself as a mediator, the Geological Agency seeks to balance these contested pressures by exercising its role within the normative corridors and constraints of broader political-economic structures.

A pluralistic approach to power provides a nuanced framework for understanding the complexity of this situation. Unlike monolithic views of power that might assume a single source of influence, a pluralistic approach recognises that power operates across multiple dimensions such as actors, political economies, and discourse (Svarstad, Benjaminsen and Overå, 2018). Within this framework, the Geological Agency is not seen as a passive institution that merely provides neutral scientific assessments, but as an active participant in the power relations that shape the governance of natural resources, in this case, the Karst Area. The Agency's decisions, informed by scientific discourses, are also shaped by broader economic and political pressures. Its alignment with corporate and government actors, who supported industrial expansion in the Watuputih Karst Area, highlights how power operates through multiple channels to influence environmental decision-making.

The Agency's navigation among various interest groups illustrates the layered nature of power dynamics. Environmental advocates, including NGOs, local communities, and academics, have sought to use scientific data to oppose cement mining on the grounds of ecological preservation (Conde, 2014). In contrast, corporations and government agencies, motivated by economic growth and industrial development, pressured the Agency to support mining projects. Positioned between these competing forces, the geological survey carried out

initially sided with environmental protection but, eventually, it shifted to support corporate interests. This shift underscores how scientific discourse can be shaped to suit dominant political and economic agendas, especially when those in power exercise influence over state institutions (Wesselink et al., 2013; Brown, 1993; Brown and Malone, 2004).

The relationship between the Geological Agency and the Cement Factory Association, as stated by the anti-cement coalition during an informal conversation, illustrates the intersection of actor-oriented power dynamics and discursive power. The anti-cement coalition has raised concerns about potential conflicts of interest, suggesting that informal collaborations may have influenced the Agency's framework for its scientific findings. From an actor-oriented perspective, these collaborations highlight how the Agency navigates pressures from corporate stakeholders while maintaining its role as a scientific authority. Simultaneously, however, the knowledge production they produce demonstrates the interplay between knowledge production and power in legitimising controversial projects.

By presenting new data that minimised concerns about the groundwater system in the karst region, the Agency helped reshape the narrative around the environmental impacts of cement mining. This reflects Michel Foucault's theory of power/knowledge (Foucault, 1970), in which the production of knowledge is not neutral but serves to reinforce the interests of dominant groups (Bryant, 1998). In this case, the body's role as a scientific authority provides a veneer of objectivity to decisions that are, in reality, heavily influenced by political and economic power structures.

It can be said that the Geological Agency's dual role demonstrates the complex relationship between power, discourse, and decision-making in environmental governance. The Agency's decisions were not simply the result of objective scientific analysis but were shaped by the broader context of political and economic power dynamics. Its shift in position toward supporting corporate expansion demonstrates how state institutions can be implicated in supporting industrial projects through the strategic use of scientific discourse, thereby perpetuating the interests of those in power while sidelining environmental and societal concerns. This case illustrates the importance of recognising the multi-

layered nature of power in environmental decision-making and natural resource management, where knowledge production, political influence, and economic interests converge to shape policy outcomes.

7.5 Conclusion

This empirical chapter highlights the important role of the Geological Agency in the governance of karst resources contested by various actors with vested interests. Initially, the Agency positioned itself to protect the environment based on the ecological sensitivity of the Karst Area and indirectly opposed cement mining operations. However, over time, this stance shifted as new research findings emerged, where the results of the research claimed the absence of underground rivers in the area, which was eventually interpreted as the Watuputih Groundwater Basin area could not be categorised as a Karst Area. This shift reveals the complexity of the role of the Geological Agency, where the production and interpretation of scientific knowledge were not neutral but were closely related to political and economic pressures. This chapter highlights how the evolving position of the Geological Agency reflected broader power dynamics, where scientific claims could be influenced by external forces, such as corporate interests and government development priorities, leading to significant consequences for environmental policy and resource management.

In addition, this chapter illustrates how the Geological Agency's dual role as a scientific authority and a state institution mediating between competing interests poses inherent challenges to its objectivity and legitimacy. The criticisms levelled at the Geological Agency demonstrate the need for accountability in the production of scientific knowledge, especially when it directly impacts public policy. This case study provides an example of how scientific discourse can be used strategically to legitimise the expansion of capital, by highlighting the importance of maintaining rigorous and independent scientific inquiry in environmental governance. This is intended to ensure that policy decisions are based on objective and evidence-based assessments, rather than shaped by economic gain or political pressure.

8. The Pluralistic Approach to Power and Natural Resources Contestation

8.1 Introduction

The main objective of this discussion chapter is to analyse the governance struggles regarding the karst resources in the Watuputih Groundwater Basin area, located in the North Kendeng Mountains, Indonesia. This chapter explores how the interweaving of science and expertise with power dynamics contributes to influencing and shaping policy decisions related to limestone mining carried out by a cement factory in the area. The Watuputih Groundwater Basin has become a focal point of conflict, involving multiple actors and stakeholders engaged in governance disputes over karst resources in an area that should be geologically protected. The conflicts that occur in the area are not only about resource allocation but also specifically reflect power struggles by utilising knowledge production and the use of scientific expertise to legitimise or challenge policy decisions (Giller et al., 2008).

In addition, this chapter will elaborate, in depth, on how the pluralistic approach makes an important contribution to understanding the complex dynamics of natural resource governance. By integrating multiple perspectives, this approach not only highlights the complexity inherent in natural resource conflicts and contestations but also produces valuable findings that provide deep insights. These findings are relevant not only to the empirical case under discussion but they also have the potential to enrich broader discussions in the field of political ecology, particularly regarding natural resource governance.

This study uses a pluralistic approach to power as the main framework, which refers to a combination of actor-oriented, neo-Marxist, and post-structuralist perspectives (Svarstad et al., 2018). This theoretical framework starts from the point where most political ecology scholars tend to use one singular perspective of power. The use of applications that only emphasise one approach cannot comprehensively explain the dynamics of complex resource management contestations that have been explained in Chapter 2.

By elaborating on these three perspectives, the pluralistic approach to power provides a holistic understanding of how scientific expertise operates in natural resource contestations, especially in karst areas. This approach helps researchers explore how actors use scientific evidence to either challenge or reinforce power structures, how economic interests shape resource governance, and, finally, how scientific discourse is mobilised to legitimise certain policy decisions (Svarstad, Benjaminsen and Overå, 2018).

8.2 Power Dynamics in Karst Resource Governance: A Pluralistic Approach

8.2.1 Actor-oriented Perspective: How Agency and Intentions Shape Scientific Interpretations

An actor-oriented perspective in political ecology emphasises the analysis of how individual agencies and intentions actively shape scientific narratives in contested natural resource governance, such as the karst resource dispute in the Watuputih Groundwater Basin. This approach reveals how actors, groups, or alliances mobilise scientific expertise to influence policy decisions and reinforce their agendas and interests (Fischer et al., 2014; Turner, 2012).

In this context of conflict, scientific knowledge does not exist as an objective force but as a dynamic tool that can potentially be manipulated by actors to legitimise competing claims to karst resources in the North Kendeng Mountains. For example, a local community alliance (the JM-PPK), in collaboration with NGOs and independent experts, actively challenged the EIA supported by the company and local government, while simultaneously advocating for alternative approaches, such as the SEA. These efforts, detailed in Chapter 5, illustrate how actors leveraged scientific authority to challenge the company's narrative that minimised environmental risks. By leveraging local ecological knowledge, field verification, and research participation, the JM-PPK and its allies exposed perceived biases in the company's assessment and reframed the karst landscape as a vital ecological asset worthy of protection.

Similarly, in the legal arena (Chapter 6), an actor-oriented perspective contributes to explaining how agency is exercised by both pro- and anti-cement groups. Scientific testimony becomes a focal point for contestation as expert witnesses selectively interpret data to support the ecological preservation advocated by the JM-PPK or the industrial development promoted by the cement companies and the provincial government. This selective presentation of scientific evidence illustrates how knowledge production is not a neutral endeavour but an exercise in advocacy, heavily shaped by personal and institutional affiliations. Experts, in this context, are not passive transmitters of information but active participants whose interpretations are influenced by their affiliations and the strategic needs of those seeking their support (Healey, 2024; Stamenkovic, 2023).

This dynamic is further emphasised in the changing attitude of the Geological Agency, as discussed in Chapter 7. Initially, this institution opposed mining due to environmental concerns, but the Agency later showed a different attitude. This change in policy navigation, for the anti-cement coalition group, is considered to be an indication of political pressure within their institution and broader economic pressures and institutional vulnerabilities that affect scientific attitudes. This evolution shows that scientific institutions, although initially independent, are vulnerable to external influences that can reshape their positions to align with prevailing political and economic interests (Lemma and Velde, 2017).

Across the empirical chapters, an actor-oriented perspective emphasises the importance of understanding scientific expertise as a contested domain in natural resource governance. Scientific narratives and regulatory assessments, whether through EIAs, SEAs, or expert testimony in courtrooms, emerge not as static truths but as products of complex negotiations among actors. These narratives, shaped by the active agency of multiple actors, reveal how natural resource governance operates as an arena of power struggles in which knowledge serves as a tool for empowerment and marginalisation, depending on the strategic positioning of the parties involved (Forsyth, 2020).

The actor-oriented perspective ultimately highlights that governance in karst areas such as the Watuputih Basin is not a purely technical or top-down process. Rather, governance is a dynamic and contested space where actors, groups, and

alliances use scientific knowledge to align environmental policies with their interests.

8.2.2 The Neo-Marxist Perspective: The Influence of Economic Structures and Capital Interests in Scientific Research

A neo-Marxist perspective highlights how capitalist structures and economic pressures shape the extraction and governance of natural resources, with scientific expertise often serving as a tool to justify and facilitate these processes. In the context of a limestone mining project in the Watuputih Groundwater Basin, this approach reveals that scientific knowledge is not only neutral but is embedded in capitalist motivations that prioritise economic profit over environmental sustainability and local livelihoods (Neilson, 2018; Svarstad, Benjaminsen and Overå, 2018).

One way to observe this dynamic is through the strategic use of EIAs as an instrument of capitalist expansion. These analyses, explored in detail in Chapter 5, served corporate interests by framing mining activities as having minimal environmental risks, effectively minimising regulatory barriers to extractive activities. This framing highlights how EIAs are shaped by corporate economic objectives and supported by state institutions, in this case, local governments. In this context, the production of scientific knowledge is aligned with economic agendas, positioning mining as essential to development and downplaying potential ecological vulnerabilities (Ho, Nor-Hisham and Zhao, 2020; Brown and Spiegel, 2017). This process reinforces the role of the state as a driver of capital accumulation, illustrating how scientific reports commissioned by corporations are biased and potentially support profit-oriented interpretations rather than environmental protection (Aghion and Roulet, 2014).

In the legal context, discussed in Chapter 6, a neo-Marxist perspective explains the asymmetry of power in resource governance. The legal dispute over the Watuputih Basin reveals a sharply delineated class conflict between marginalised rural communities and corporate elites, in this case, corporations and governments, who have greater access to legal and scientific resources. Corporations and local governments, as defendants, use their economic power to influence legal outcomes, by hiring experts whose testimony aligns with capitalist

interests in ongoing extraction. This reflects a broader structural inequality in which scientific testimony is not a neutral arbiter but a tool that can potentially be manipulated to align with elite economic goals (Deakin et al., 2017). State involvement in corporate interests aligned in legal battles allows economic forces to shape narratives and influence regulatory decisions.

The changing stance of the Geological Agency, as detailed in Chapter 7, illustrates how state institutions tasked with managing scientific governance are potentially subject to pressure from economic interests. Initially opposed to mining due to environmental concerns, the Agency's position shifted as research results moved to accommodate corporate interests. This shift, for the JM-PPK or anti-cement coalition, is a reflection of the deeper structural forces of capitalism, where scientific institutions, while ostensibly serving the public, can be co-opted to legitimise resource extraction and align themselves with profit-centred agendas. This is highlighted by the previously established informal relationship between the Geological Agency and the Cement Association. This case highlights the role of state-sponsored scientific knowledge as a tool for capital expansion, indicated by framing the scientific findings they produce to support mining interests (Smessaert, Missemer and Levrel, 2020).

Taken together, these insights reveal that scientific expertise regarding the Watuputih Groundwater Basin is not a dispassionate process, but rather one that is closely intertwined with the economic pressures of capital expansion. Whether through environmental assessments, legal testimony, or institutional attitudes, scientific narratives are shaped and utilised to support capitalist expansion, often at the expense of environmental and social concerns. This analysis highlights the neo-Marxist claim that resource governance, particularly in karst landscapes, is a place where economic interests wield significant influence over the production and application of scientific knowledge, driving policy decisions that prioritise profits over ecological sustainability and community welfare.

8.2.3 Foucauldian Perspectives: The Role of Discursive Power in Constructing Scientific Narratives and Policy Discourse

From a post-structuralist perspective, the governance of the Watuputih Groundwater Basin is a vivid illustration of how scientific knowledge functions not

as objective truth but as a discursive tool shaped by power dynamics. This perspective underlines that scientific narratives are constructed and contested by various actors to legitimise or challenge policy decisions, suggesting that scientific expertise in environmental governance cannot be separated from the influence of discursive power (Forsyth, 2015).

EIA and SEA, for example, served as sites of discursive contestation where corporations and anti-cement coalitions constructed conflicting narratives around the risks and benefits of mining activities in karst landscapes. As discussed in Chapter 5, pro-development actors framed the results of the EIA and EIA Addendum to underscore the scientific certainty and economic necessity of mining, constructing a narrative of minimal environmental risk. This framing is in line with Foucault's notion of power/knowledge, where the production of scientific knowledge is inherently tied to the power structures that shape public understandings and policy priorities (Van Assche, Beunen and Duineveld, 2017). In contrast, the anti-cement coalition's use of the SEA represents a counter-narrative, leveraging scientific data to emphasise the ecological fragility of the area and argue for its protection, thereby resisting the development agenda imposed by state and corporate interests.

In the legal context, as illustrated in Chapter 6, a post-structuralist perspective reveals that scientific expertise was mobilised by the government and the anti-mining coalition to influence judicial outcomes. Legal discourse became another arena in which scientific knowledge was used to either bolster or refute corporate claims, with both sides constructing narratives that framed their actions as scientifically responsible. For example, the government and the company portrayed their activities as environmentally sound, relying on technocratic discourses to validate their operations. In contrast, the anti-cement coalition emphasised alternative scientific findings. The group reframed mining risks to expose the negligence in environmental assessments that underpinned the company's judgements. This use of scientific discourse highlights Foucault's assertion that the production of knowledge is intimately tied to systems of power, shaping policy by influencing which narratives are given authority (Richardson Oakes, 2018; Accetti, 2021).

The changing position of the Geological Agency indicates the influence of discursive power in scientific governance, as discussed in Chapter 7. Initially, the Geological Agency's position was based on environmental caution, prioritising the protection of the Watuputih Groundwater Basin due to ecological issues. However, this position shifted after the results of their research showed conclusions that were the opposite of their initial position. According to the JM-PPK group, or even the former head of the Geological Agency, the change reflected the power structure at play. This shift exemplifies Foucault's concept of governmentality, where state institutions are considered to align scientific narratives with broader economic goals. This is supported by scientific expertise to justify decisions that facilitate the commodification of resources while managing public perceptions of environmental impacts (Escobar, 1996; Van Assche, Beunen and Duineveld, 2017).

Overall, a post-structuralist analysis underlines that governance in the karst areas is not simply a matter of the neutral application of scientific knowledge. Rather, it is a contested terrain in which scientific narratives become tools of empowerment or marginalisation, depending on the agenda they serve. Discursive power shapes which forms of knowledge gain legitimacy, with pro-development actors operating a cement plant using scientific assessments to align with the goals of capital expansion, while anti-cement coalitions produce counter-narratives that foreground ecological concerns. These dynamics reveal that scientific expertise is a battleground in which power is negotiated through discourses that highlight the complex interplay between knowledge, authority, and policy in environmental governance.

8.3 The Pluralistic Power and Political Ecology of Natural Resources Contestation

The pluralistic approach to power not only enriches the theoretical understanding of power dynamics in karst resources governance but also of the broader context of natural resources and struggles. Moreover, through this theoretical framework, the valuable findings and insight provided can be expanded for further discussion in the field of political ecology.

8.3.1 Challenging Integrating Science and Policy in Natural Resources Governance

This theoretical framework reveals the challenges of integrating science and policy in natural resources governance. Integrating scientific research into policymaking is complex and difficult, especially when scientific findings are contested or subject to multiple interpretations (Connelly et al., 2021; Edler, Karaulova and Barker, 2022). In the case of karst areas, the complexity of the ecosystem, combined with the priorities of various actors, makes it difficult to translate scientific knowledge into clear and actionable policies. One of the main challenges is the inherent uncertainty and variability in scientific data related to karst ecosystems, as illustrated in the comparison research findings in Chapter 7. Referring to studies conducted by different experts regarding the environmental impacts of mining activities, in this case, produced conflicting results regarding the environmental impacts of mining activities, leading to confusion and indecision among policymakers. Edler et al., (2022) argue that these difficulties are further compounded by the fact that scientific research in this context is not conducted in a vacuum; it is heavily influenced by the economic, political, and social agendas of the actors involved.

Scientific dissent and consensus play a significant role in shaping policy decisions related to karst areas. On the one hand, consensus among scientists, particularly those aligned with the interests of cement companies and government agencies, is often used to justify continued mining activities. This consensus is strategically emphasised in policy discussions to create the impression of scientific certainty and to marginalise opposing views. On the other hand, scientific dissent, particularly from independent experts and environmental groups, challenges the prevailing consensus and highlights the uncertainties and potential risks associated with mining. Such dissent is critical in drawing attention to the limitations of existing studies and the need for a more comprehensive and careful approach to policymaking. However, the presence of dissent also complicates the policy process, as it forces policymakers to navigate a landscape in which scientific knowledge is not monolithic but contested (Aklin and Urpelainen, 2014; de Melo-Martín and Intemann, 2014). The challenge, therefore, lies in balancing

these competing scientific perspectives and making policy decisions in a context of uncertainty and conflict.

Karst governance policy processes are heavily influenced by conflicting scientific interpretations presented by different actors. These differing perspectives often reflect the underlying power dynamics and interests of the actors involved (Ramirez and Belcher, 2019). The Geological Agency's findings support the feasibility of mining in karst areas, are aligned with the economic objectives of the cement industry, and are, therefore, given significant weight in policy discussions. In contrast, scientific perspectives offered by environmental groups, which highlight the ecological risks of mining, are often dismissed or dismissed as overly cautious or alarmist. These differences in scientific interpretation create a fragmented policy landscape, where decisions are not based on a unified understanding of the scientific evidence but are the result of negotiations and compromises between conflicting interests (de Melo-Martín and Intemann, 2014).

The existence of conflicting scientific interpretations has significant implications for sustainable resource management in karst areas. The dominance of certain scientific perspectives in the policy process, particularly those supporting economic exploitation, often leads to decisions that prioritise short-term economic gains over long-term environmental sustainability (Weber and Rohrer, 2012). This is evident in the continuation of mining activities despite ongoing scientific controversies and a lack of consensus on potential environmental impacts. The marginalisation of alternative scientific perspectives, which advocate a more cautious approach, undermines efforts to implement policies that can ensure sustainable management of karst resources. As a consequence, policy decisions made in this context are often reactive rather than proactive, addressing immediate economic concerns while ignoring broader ecological and social implications (Shi, 2004).

8.3.2 Interconnectedness in the Arena Contestation

A pluralistic approach to power demonstrates the interconnected nature of the various arenas of contestation in karst resource governance. These arenas are not isolated but interconnected, where competing actors assert their claims and

rebuttals. In the case of North Kendeng, contestation does not occur in one domain but is spread across multiple arenas, including framing in environmental assessment reports, legal battles, and the use of scientific evidence, as discussed in Chapters 7, 8, and 9. Each of these arenas represents a unique platform through which actors seek to influence policy outcomes and decisions on karst resource governance in the Watuputih Groundwater Basin.

Each arena of struggle in North Kendeng exhibits its dynamics shaped by the strategies and interests of the actors involved. For example, environmental assessment reports, such as the EIA, EIA Addendum and SEA, serve as battlegrounds for constructing narratives about the ecological impacts of mining activities. On the other hand, legal disputes highlight the use of expert testimony and legal interpretations to validate or refute claims over the management of the Watuputih Groundwater Basin. Similarly, the arena of scientific evidence is characterised by the production and mobilisation of knowledge to support industrial or ecological priorities. These different dynamics illustrate the complex nature of disputes over karst resources, where actors navigate different arenas to pursue their interests.

Despite their unique characteristics, the three arenas are interconnected. The interconnectedness of these arenas can be traced to the way scientific claims and expertise circulate and influence outcomes across domains. For example, environmental assessments provide the foundational evidence that shapes legal arguments, while legal decisions validate or challenge the findings of assessments through the views of expert witnesses. At the same time, scientific evidence supports both arenas, acting as a resource for all actors to legitimise their positions and challenge competing claims. These interconnections suggest that governance frameworks are not formed in a single space but through ongoing processes of negotiation and contestation across multiple arenas. The overlapping nature of these domains highlights the complex multi-scalar strategies employed by actors, groups, or alliances that attempt to reveal how power, knowledge, and legitimacy are continually constructed and contested in the governance of the karst resources in the Watuputih Groundwater Basin.

8.3.3 Uncertainty of the Situation

This theory exposes the uncertain situation in karst resources governance. First, scientific uncertainty can be seen in the research findings related to the Watuputih Groundwater Basin area shown in Chapter 7. Forsyth (2015) argues that scientific uncertainty about environmental issues often arises from diverse worldviews that produce and interpret knowledge, having been directed to audiences according to their own social and political goals. This thesis extends this argument by providing empirical evidence from the karst resource conflict in Indonesia, where both pro- and anti-development actors use scientific knowledge not only as a neutral tool but also as a strategic means to legitimise their agendas. In this context, both parties in conflict claimed that their positions on karst area management in the area were based on the scientific evidence they had gathered. For example, the company had arguments and explanations related to mining management in Watuputih there would be no significant environmental impact. This was built on the expert visibility study they commissioned. But, at the same time, the anti-cement coalition also had valid arguments about the dangers of mining operations based on two previous studies that were discussed in Chapter 8 and the SEA report.

Second, regulatory uncertainty was related to the management of natural resource governance, especially regarding the Watuputih Groundwater Basin area, as discussed in Chapter 6. Regulatory uncertainty refers to the lack of clarity or predictability about laws, regulations, or law enforcement practices, which can make it difficult for organisations to plan and operate effectively. This uncertainty can arise due to conflicting regulations, the absence of a regulatory framework, or ambiguity in the application or interpretation of the law (Engau and Hoffmann, 2009, 2011). When referring to the trial report and documentation, each of these two parties had a written legal basis to support their arguments in the legal arena. This condition forced the legal battle between the two parties not only at the civil lawsuit level but also up to the Supreme Court, which resolved the case through a judicial review decision.

8.3.4 Exploiting Economic and Environmental Narratives

Through its pluralistic approach, this study has uncovered the exploitative economic and environmental narratives that were used by each side. These findings are reflected in Chapter 6, where the environmental assessment reports are explained. Most studies that explore contestation in development projects usually focus on the debate over the environmental and economic narratives, which are characterised as polarised: anti-development groups, often composed of local communities or environmental NGOs, are seen as primarily leveraging environmental concerns, while pro-development actors, such as corporations and governments, typically focus on economic growth and development benefits (Tuckwell, 2012). However, this empirical study introduced a deviant finding by showing that both sides used the same economic and environmental narratives.

This study reveals the flexibility of both parties in adopting the other's dominant framework to strengthen their respective positions. The JM-PPK's use of economic valuation techniques produced through SEA, for example, challenges the assumption that environmental groups focus solely on ecological preservation. By conducting economic valuations in SEA, which is discussed in Chapter 5, the coalition showed that preserving the karst landscape offered more substantial long-term economic benefits in terms of ecosystem services, tourism, and agricultural sustainability than the short-term profits from cement production. These findings add depth to the current understanding of resource conflicts, showing that environmental arguments are not inherently at odds with economic logic, and can be aligned to counter industrial projects.

At the same time, however, the pro-development actors also adopted environmental narratives. Rather than ignoring ecological concerns outright, companies and governments frame their activities as environmentally responsible. In this case, by asserting that the absence of an underground river negates the area's status as a sensitive karst landscape, pro-development groups used scientific data to argue that mining operations posed minimal environmental risks. This dual narrative strategy—where both parties use economic and environmental frames—provides a more complex and nuanced understanding of the discursive strategies used in natural resource disputes.

8.3.5 Shadow Spaces and the Informal Contestation of Expertise

This theoretical framework highlights the role of shadow spaces in understanding how scientific expertise is contested and negotiated in karst resource governance. Shadow spaces refer to informal interactions and networks that occur outside formal governance processes but significantly shape decision-making outcomes (Pelling et al., 2008). These spaces include behind-the-scenes engagements such as informal consultations, private meetings, and discussions involving a variety of actors including scientists, policymakers, companies, NGOs, and local communities aimed at negotiating the legitimacy of scientific claims. Unlike formal arenas, such as public consultations or court hearings, shadow spaces allow actors to engage flexibly, adapt strategies, and build alliances. For example, companies can informally align with policymakers to influence regulatory outcomes, and open up the possibility of private dialogue to negotiate with the anti-cement coalition; this was illustrated by the interaction between the Governor of Central Java and JM-PPK members. Meanwhile, the anti-cement coalition and environmental NGOs built and explored support with independent experts and academics from various campuses to help them produce alternative scientific narratives that challenged industrial activities.

These findings suggest that shadow spaces are crucial to understanding the micro-politics of expertise. They serve as platforms where scientific claims are not only created and mobilised but also debated and refined. EIAs, although formally created, often emerge from informal negotiations, illustrating the subtle ways in which power is exercised outside of public view. The EIA Addendum was introduced as a revised version of the original EIA following the Supreme Court's ruling, which identified flaws in the initial assessment. This addendum was presented as an effort to address the court's concerns while allowing the continuation of mining operations. Similarly, grassroots movements led by the JM-PPK leveraged informal networks to build trust with academics and activists, which strengthened their strategies of resistance. By analysing the legal loopholes that were exploited by the governor, as shown in Chapter 6, and the shifting policy direction of the Geological Agency, which is explained in Chapter 7, this thesis reveals that governance outcomes are shaped not only by formal structures but also by informal systems that foster innovation, collaboration, and the co-production of knowledge. Shadow spaces, therefore, provide insight into

complex power struggles over expertise, highlighting their crucial role in shaping resource governance.

8.3.6 State Institutions Are Not Monolithic

Ultimately, the pluralistic approach to power reveals that state institutions are not entirely aligned with the interests of capital or state capitalism (Alami and Dixon, 2023, 2020; Alami, 2023), as is often explained in the neo-Marxist perspective. The case of the cement factory struggle in the Kendeng Mountains offers empirical facts that differ from this assumption. Although there were indications of government support, especially from the Central Java Provincial Government and the Ministry of ESDM, for the company, the dynamics at the institutional level showed a variety of positions and approaches. This fact indicates the complexity of the state's role in natural resource conflicts.

On the one hand, local governments and technical ministries such as ESDM are often seen supporting companies, especially through the licensing and resource allocation processes. However, on the other hand, there are state institutions that take different positions or even try to mediate the conflict. For example, the KLHK and the KSP appeared to play a mediating role. Both institutions were involved in the process of verifying documents such as the EIA and providing alternative solutions based on the SEA, as illustrated in Chapter 5. They attempted to accommodate the interests of the community, especially the anti-cement coalition, by proposing more sustainable management of the Karst Area in the Watuputih Groundwater Basin.

The positions taken by the Ministry of Environment and Forestry and the KSP cannot be separated from broader political dynamics, including the presence of activists in government structures since 2014. The KSP, for example, has become a space where several environmental activists have gained access to influence policy. This factor, together with President Joko Widodo's accommodating approach to environmental issues, is the reason why he directly provided direction in resolving the conflict in Kendeng. This effort reflects the government's efforts to maintain a balance between the needs of economic development and environmental sustainability.

Overall, the pluralistic approach to power shows that the state is not a monolithic entity. In the cement factory conflict in Kendeng, the state became an arena where various interests met, competed, and negotiated. This fact challenges the assumption that the state is entirely an extension of the power of capital. Instead, the state emerged as a complex mediation space, although it did not always succeed in managing the conflict fairly.

8.3.7 Investigating Power and Decision-making: A Multi-sited Ethnographic Approach

This study provides a detailed analysis of decision-making processes in karst resource governance by integrating a pluralistic approach to power with a multimethodological design. Using multi-sited ethnography (Marcus, 1995), which is explained in Chapter 3, by elaborating data collection with semi-structured interviews, informal conversations, participant observations, and document analysis, the study has investigated how scientific expertise is contested, appropriated, and mobilised by multiple actors in formal and informal arenas. Fieldwork conducted in multiple sites—Rembang, Pati, Semarang, Yogyakarta, and Jakarta—reveals how decision-making processes took place at multiple scales. EIAs and other scientific studies, for example, served as key battlegrounds where companies framed mining as essential for economic growth, while NGOs and local communities challenged these claims by mobilising alternative scientific evidence to highlight ecological risks through SEA reports. The multi-sited approach captures how power dynamics manifest in specific settings, from policy meetings and legal hearings to informal consultations and shadow spaces, where actors negotiate outcomes behind the scenes.

This integrated methodological approach not only enriches the empirical understanding of decision-making processes but also highlights the implications of using a pluralistic power framework (Svarstad, Benjaminsen and Overå, 2018). By combining ethnographic methods with theoretical analysis from a pluralistic approach to power, this thesis shows that decision-making in natural resource governance is highly political, where science is not a neutral tool but a contested tool used by actors to influence policy outcomes. This methodological innovation provides a comprehensive and multi-layered understanding of

decision-making, capturing the visible and hidden power dynamics that shape governance in contested environmental arenas (Morrison et al., 2019).

9. Conclusion

9.1 Introduction

This chapter, the closing part of this thesis, is designed to reflect on the main findings of this research. The first part of this chapter will present a summary of findings as answers to the research questions. This subsection aims to highlight important findings that provide significant contributions to new understandings in the field of political ecology. This description will be the basis for assessing the relevance of these findings to the research questions, while also showing how this research has answered various issues raised in the theoretical framework.

Moreover, the contribution of this research to the field of political ecology will be discussed. In this section, reflection on the theoretical framework used will be the focus, including how the findings here provide valuable insights to strengthen existing theories. This discussion not only refines existing theoretical perspectives but also extends its contribution to the empirical and methodological aspects of broader political ecology studies.

Furthermore, policy recommendations based on the research findings will be offered. This subsection aims to show the political position of political ecology research in advocating for better environmental and natural resource governance changes. These recommendations are expected to be a bridge between theory and practice, while also showing how this research can directly contribute to more equitable and sustainable policymaking. Thus, this closing chapter both summarises the research results and emphasises the position of research as an instrument of change in social and environmental contexts.

In the last section, suggestions for future research agendas, particularly related to pluralistic approaches to power, will be proposed. Aware of the limitations of this study, both in terms of method and scope, I will suggest further research to build on these findings and address areas that might be missing and still unexplored.

9.2 Summary of the Findings

In this section, I present a reflection on the findings of this thesis, structured around the research questions proposed at the outset of the study.

9.2.1 How Do Different Actors (e.g., Government, Corporations, Local Communities, Experts, Academics, Activists, NGOs) Construct and Contest Scientific and Expert Claims in the Governance of Karst Resources?

The contestation of karst resources in the North Kendeng Mountains demonstrates how different actors, groups, or alliances assert agency to construct and challenge governance frameworks. The JM-PPK, often at the forefront of resistance, utilises grassroots mobilisation strategies, forming alliances with environmental activists, NGOs, academics, and experts. Through these collaborations, they generate alternative scientific claims, such as evidence of an underground river network that is essential for water resources. By reframing the Watuputih Groundwater Basin as an ecologically sensitive area, they challenged industry narratives and advocated for sustainable governance policies. Their agency was expressed through protest, public advocacy, and participation in alternative knowledge production that sought to highlight the ecological significance of the Watuputih Groundwater Basin. These efforts asserted their right to their ecosystem by reframing the conflict through evidence-based evidence that they had found to counter dominant industry discourses.

In contrast, the corporations asserted their agency by using economic narratives and government-backed scientific expertise to legitimise resource extraction. The companies prioritised their financial resources, such as funding large-scale campaigns and commissioning EIAs deemed by the anti-cement coalition to be in line with their goals, as well as forming partnerships with government agencies and experts. These efforts aimed to frame karst exploitation as essential to national economic development, producing narratives that emphasised its role in infrastructure projects, job creation, and regional growth. Similarly, government officials play dual roles: while some side with corporate interests to encourage

industrial expansion, others act as mediators in governance processes, facilitating negotiations among stakeholders. Environmental NGOs and academics contribute by critiquing corporate and state-backed knowledge production and promoting counter-narratives, such as challenging the company's claims that karst mining is sustainable and essential for economic development, while also highlighting the environmental degradation and threats to water security caused by mining operations. These counter-narratives amplify local voices by framing the conflict as a struggle for environmental justice and community rights that resonates from local to international scales.

The findings suggest that scientific and expert claims are important to all actors involved. Scientific expertise is not only a technical tool but also a political instrument, with actors using it to build legitimacy and influence governance outcomes. Local communities collaborate with independent research and SEA reports to challenge company-sponsored EIAs, while companies use studies supported by geological agencies to support their operations. These interactions reveal a dynamic interplay of power, where governance frameworks are shaped through negotiation, contestation, and strategic alliances among multiple actors.

9.2.2 What Role Do Economic Structures and Interests Play in Shaping Governance Frameworks and the Scientific Claims Used to Justify or Oppose Resource Extraction in the Karst Region?

Economic structures, such as corporate investment in industrial development and reliance on the extraction of natural resources for regional and national economic growth had a crucial role in shaping the governance framework for karst resource management in the Northern Kendeng Mountains. Cement companies, driven by the imperatives of capital accumulation and national economic development goals, position karst resource extraction as pivotal to national economic growth and as support for infrastructure development. The cement companies work with state institutions (Ministry of Energy and Mineral Resources (the Geological Agency), Central Java Province, and Rembang District Government) to align the governance framework with their economic goals, using state-sponsored EIAs to legitimise mining operations. By framing karst mining as an important driver of

regional economic development, including job creation and revenue generation, the companies effectively align their interests with government policy.

The government, influenced by the dependence of economic growth on revenue streams from natural resource extraction, tends to support industrial expansion in karst areas. This tendency is evident from policies that prioritise economic growth through extractive industries, such as the granting of mining permits, simplification of regulatory processes, and the provision of incentives to attract corporate investment. For example, the issuance of new environmental permits related to mining operations in the Watuputih Groundwater Basin by the Central Java Provincial Government, due to revisions to mining mechanisms and changes to the company's name, despite a court ruling that had previously revoked the permit, illustrates how state actors facilitate industrial projects. Such practices underscore a broader pattern of prioritising economic development over ecological preservation. This situation reflects the structural alignment between state interests and corporate agendas. Economic narratives, such as meeting national cement demand and enhancing regional development, are deeply embedded in the governance framework to justify natural resource extraction, which, in this context, is in the Watuputih Groundwater Basin area. This narrative is further legitimised through scientific claims sponsored by state institutions, which attempt to frame it in a way that minimises the ecological risks of mining processes in sensitive karst landscapes.

Local communities/the JM-PPK, NGOs, and independent academics challenged the governance frameworks and scientific claims produced and disseminated by corporate actors and state institutions. These groups criticised the economic justifications for resource extraction, arguing that the environmental and long-term sustainability costs of karst ecosystems outweigh the claimed economic benefits. This is evident from the results of the SEA conducted in the Watuputih Groundwater Basin. By reframing karst governance as a question of environmental justice and sustainability, these actors, groups, and alliances challenged the dominance of profit-driven governance frameworks. These findings underscore the centrality of economic interests in shaping the content and direction of governance frameworks that tend to override ecological and social considerations in resource management.

9.2.3 How Are Scientific Uncertainties and Environmental Risks Framed and Mobilised by Actors to Influence Decision-making Processes and Public Narratives in Karst Governance?

Scientific uncertainty and environmental risks play a significant role in shaping decision-making processes and public narratives in karst governance as various actors strategically frame these issues to support their goals. Local communities, environmental NGOs, and independent academics emphasise the ecological fragility of karst ecosystems, particularly the critical role of underground river systems in providing water resources for agricultural areas. These actors frame environmental risks as existential threats to local livelihoods, biodiversity, and water resources, mobilising these narratives to challenge industrial expansion. By highlighting the scientific uncertainties associated with mining in the Watuputih Groundwater Basin, such as the potential for irreversible ecological damage, they aim to undermine the legitimacy of the EIA produced by experts sponsored by the company and facilitated by a state institution (the Central Java Provincial Government) through the EIA assessment mechanism.

In contrast, corporations and state agencies attempt to frame scientific uncertainty to minimise environmental risks and emphasise the feasibility of resource extraction. Corporations use technical assessments, often produced by state-backed agencies, to frame karst mining as a low-risk activity that can be managed through advanced technology. These assessments attempt to downplay uncertainty and highlight economic benefits, such as job creation and infrastructure development, to bolster the legitimacy of industrial projects. In this way, environmental risks are recontextualised as manageable challenges rather than unmanageable obstacles.

The framing of environmental risks is also a key strategy in shaping public narratives. Local and environmental advocates attempt to prioritise grassroots campaigns, utilise social media, build networks with activist nodes in various regions, and hold public demonstrations to strengthen their framing of karst governance as an ecological justice issue. At the same time, corporations and state actors use formal communication channels to disseminate their narratives that minimise risks and also frame opposition groups as obstacles to regional progress. The findings suggest that the framing and mobilisation of scientific

uncertainty and environmental risks are not neutral processes, but are shaped by the power dynamics and strategic goals of competing actors. Ultimately, these contested narratives influence the legitimacy of governance frameworks and the public perceptions of resource management in the karst region of the North Kendeng Mountains.

9.3 Contribution

In this section, I will discuss the potential contribution of this research to the existing literature. It addresses the theoretical contribution, empirical contribution, and methodological contribution, as well as how this research contributes to karst resources governance.

9.3.1 Theoretical Contribution

First, this thesis makes a theoretical contribution to the study of natural resource contestation by using a pluralistic approach to power as its primary analytical framework. Power is a fundamental element in political ecology, and its analysis is crucial to understanding the dynamics of resource governance. However, existing studies often adopt a monolithic perspective that tends to be limited to one dimension of power. For example, actor-oriented studies (Das and Deka, 2020; Andrews, 2021; Sovacool, Tan-Mullins and Abrahamse, 2018) emphasise the agency of individuals or groups in shaping environmental outcomes, while neo-Marxist approaches (Delabre and Okereke, 2020; Kansanga, Arku and Luginaah, 2019) focus on the structural-economic forces that drive resource extraction and environmental degradation. Similarly, post-structuralist perspectives (Gonda, 2019; Boelens, Shah and Bruins, 2019; Brown and Spiegel, 2017) highlight the role of discourse and knowledge production in legitimising or challenging environmental practices. While these perspectives offer valuable insights, their singular focus limits their ability to capture the multidimensional nature of power dynamics. The pluralistic approach proposed by Svarstad et al. (2018), which integrates actor-oriented, neo-Marxist, and post-structuralist perspectives, has offered a new perspective by providing a more comprehensive framework for analysing the complexities of power in struggles over natural resources or the environment.

By applying this pluralistic framework, this thesis demonstrates that power dynamics in resource conflicts operate through interconnected channels and mechanisms across multiple arenas, including agency, structural constraints, and discursive practices. For example, empirical findings reveal how actors such as local communities (the JM-PPK), companies, and state institutions engage in efforts to advance their interests within structural-economic imperatives. At the same time, these actions are shaped and legitimised by discourses constructed through scientific and policy narratives.

This thesis suggests that a single perspective is less capable of fully explaining resource struggles, as demonstrated by the limitations in existing literature that often focus on a singular lens. For instance, studies adopting a neo-Marxist approach predominantly highlight the role of economic structures and class-based exploitation (e.g., Delabre and Okereke, 2020; Kansanga et al., 2019) but tend to overlook the agency of grassroots actors or the influence of discursive strategies. Similarly, actor-oriented approaches emphasise individual or group agency (e.g., Das and Deka, 2020; Sovacool et al., 2018) but often understate the structural and institutional constraints shaping resource governance. Post-structuralist analyses (e.g., Boelens et al., 2019; Gonda, 2019) focus on power and discourse but may neglect the tangible economic and political structures underpinning resource struggles.

By integrating these perspectives into a pluralistic approach to power, this thesis provides a more comprehensive understanding of resource struggles. For example, in the Kendeng conflict, combining neo-Marxist insights into state-corporate alliances, actor-oriented perspectives on grassroots resistance, and post-structuralist analyses of discursive framing reveals the interconnected dimensions of power. This pluralistic approach not only uncovers the layered nature of governance frameworks but also highlights how the interplay of economic structures, agency, and discourse shapes socio-environmental outcomes. As such, this thesis demonstrates that integrating multiple perspectives yields richer and more nuanced results than relying on a single theoretical lens.

Second, this thesis contributes to the understanding of the interaction between science and expertise in policy processes, particularly in the context of

environmental governance. Existing literature tends to highlight the idealised role of science and expertise in making significant contributions to policymaking. Numerous scholars emphasise the normative assumption that scientific inputs should lead to evidence-based policy outputs (Montuschi, 2017; Saretzki, 2019; Pfister and Horvath, 2014; Lalor and Hickey, 2013). However, as Forsyth (2015) and Grundmann (2017) argue, this process is far from linear, often involving scientific uncertainty and competing truth claims. Previous research also suggests that knowledge production in environmental governance involves interdisciplinary efforts (Whatmore, 2009) and the inclusion of local non-scientific stakeholders who bring practical knowledge and lived experience (Carolan, 2006).

Building on existing literature, this thesis seeks to offer new insights into the complexity of knowledge production in environmental and natural resource governance. Through empirical analysis, I have shown that expertise is not the exclusive domain of scientists but is co-produced by a range of actors, including local resistance movements, corporate stakeholders, and government officials. This study provides evidence that the process of expertise creation is shaped by the goals of these actors, who claim truth to legitimise their interests in situations of scientific uncertainty. While Forsyth (2020) emphasises the co-production of knowledge within the STS framework, where scientific knowledge and social order are co-constructed through the interaction of institutions, practices, and power dynamics, this thesis extends this idea by focusing on the active role of local resistance movements in shaping and contesting expertise. Forsyth's approach highlights how knowledge systems are not neutral but embedded in socio-political and environmental contexts, which often reflect the priorities of dominant actors and institutions. His work highlights how local actors, despite being marginalised, contribute to knowledge production by questioning dominant narratives and proposing alternative frameworks that challenge the status quo.

Drawing on Forsyth's insights, this thesis shows how local resistance movements in the Kendeng conflict engaged in the co-production of expertise by combining their local knowledge with scientific evidence and regulatory frameworks to challenge scientific claims supported by companies and the state. For example, the JM-PPK prioritised alternative environmental assessments and collaborated

with academic experts to produce an independent report highlighting the ecological importance of the Watuputih Groundwater Basin. These efforts not only challenged the legitimacy of the EIA but also reframed the conflict as a struggle for environmental justice.

Furthermore, this thesis highlights the dynamic interplay between scientific and non-scientific knowledge in shaping environmental governance. It shows how interdisciplinary and multi-stakeholder knowledge production processes not only complement policymaking but actively reshape the framing of environmental issues and their governance. For example, the study reveals that expertise is often prioritised at the request of clients, including corporations and governments, as a strategic tool to justify policy decisions (Grundmann, 2017). These findings enrich the existing literature by providing a more nuanced understanding of expertise as a contested and relational process, rather than a neutral or objective input into policy.

9.3.2 Empirical Contribution

This thesis also makes a significant empirical contribution to the study of karst resource governance by adopting a political ecology perspective whereby this approach frames karst landscapes as contested spaces shaped by the interactions of multiple actors and interests. While most karst-related research focuses on geophysical aspects, such as the hydrology of groundwater systems (Jourde and Wang, 2023; Veress, 2020) or ecological features (Lukač Reberski et al., 2022; Zhang et al., 2023), this study shifts the focus to the socio-political dimensions of karst governance. In the Indonesian context, karst research tends to be oriented towards aspects of conservation biology (Sulistiyowati, Setiadi and Haryono, 2022, 2023, 2021), physical geography (Kurniawan et al., 2019), and economic development through tourism (Maharani and Sudrajat, 2018; Agus Mandong, Budiarti and Munandar, 2023). In contrast, this thesis examines karst landscapes as arenas of conflict, where power relations, competing claims to resources, and environmental governance intersect. This approach reveals the multidimensional and contested nature of karst resource management in Indonesia, thereby broadening the scope of empirical research in this area.

One of the key empirical insights of this thesis lies in highlighting the multi-scalar dynamics of karst governance. Through an analysis of the North Kendeng Mountains, this study reveals how resource conflicts over karst areas are not simply local phenomena, but are interconnected within broader regional and national governance structures. The resistance of local communities (the JM-PPK) to cement mining in Rembang, for example, cannot be fully understood without considering the influence of central government policies and corporate lobbying at both the national and regional levels. This research shows that karst governance involves an interconnected network of actors that have operated at multiple scales to shape environmental decision-making. By tracing these interactions, this thesis provides a comprehensive understanding of how local environmental conflicts are shaped by, and in turn shape, broader political-economic and institutional dynamics.

Furthermore, this study contributes to a deeper understanding of resource struggles and power dynamics in karst governance. The findings revealed here suggest that karst landscapes are not only ecologically and geologically significant sites but also spaces where competing actors employ diverse strategies to assert their claims. Local communities, for example, use scientific narratives about the sustainability of underground river networks and cultural heritage to resist industrial expansion, while companies frame karst resource extraction as essential to national development and economic growth. These competing narratives are then mediated by state institutions, whose policies are often seen as pandering to broader political-economic agendas. By documenting these dynamics, I can illustrate how karst landscapes become sites of discursive, material, and institutional struggles, offering new insights into contested natural resource governance. This empirical approach not only advances the study of karst governance, but also contributes to the broader political ecology literature by showing how resource conflicts are shaped by the interplay of power, scale, and discourse.

9.3.3 Methodological Contribution

In addition to the theoretical and empirical aspects, this thesis also provides a methodological contribution in that it has integrated a pluralistic power framework with a multi-site ethnographic approach to analyse natural resource

contestation. The pluralistic framework, which synthesises actor-oriented, neo-Marxist, and post-structuralist perspectives, provides a theoretical basis for exploring power dynamics at multiple levels and dimensions (Svarstad et al., 2018). By applying this framework in a multi-site ethnographic design (Marcus, 1995), I have captured the complex interactions between various actors while tracing the political-economic structures and discourses that shape natural resource governance, especially in the North Kendeng Mountains region. The use of multi-sited ethnography in this study provides an opportunity for a comprehensive analysis of karst resource conflicts by offering insights into local interactions and broader systemic power dynamics.

Through multi-sited ethnography, I conducted fieldwork at multiple locations and scales, including communities directly impacted by mining, cement company headquarters and government agencies involved in policymaking, universities that house academics and experts, and networks with activists. This approach allows the tracing of power relations and knowledge production in various interconnected arenas. This tracing effort reveals how actions at the local level are influenced by political-economic and strategic discursive pressures. For example, informal conversations, semi-structured interviews, and ethnographic observations highlight how local resistance movements prioritise claims of scientific expertise to challenge corporate and government narratives. Simultaneously, the research examined how corporate and state actors framed environmental assessments to legitimise industrial projects, demonstrating the interplay of agency, structure, and discourse in shaping governance outcomes.

Combining the breadth and depth of multi-sited ethnography and pluralistic approaches to power, this approach offers an important and relevant tool for researchers seeking to unravel complex resource conflicts. It emphasises the importance of bridging micro-level interactions with macro-level structural and discursive analyses, ensuring a holistic understanding of power dynamics. Furthermore, this methodological approach has practical implications for policy and advocacy in that it has offered insights into how inclusive governance frameworks can address power asymmetries and promote equitable resource management. This combination of methodological and practical relevance arguably makes this thesis a pioneering contribution to the study of political ecology and environmental governance.

9.4 Policy Recommendations

Reflecting on the results of this study, I propose several policy recommendations related to governance to address karst resource disputes, especially in the Watuputih Groundwater Basin area, the Northern Kendeng Mountains and similar areas.

First, I propose strengthening the existing multi-stakeholder governance framework for karst resource management. While Indonesia has multi-stakeholder governance mechanisms, such as EIAs and consultations, these processes often do not involve meaningful participation from grassroots actors, such as local communities and NGOs. Key weaknesses include limited transparency, procedural irregularities, and the dominance of state and corporate interests, which marginalise alternative perspectives and local knowledge. For example, public consultations are often shallow, with signature reports often misused to falsely indicate community consent.

To address these weaknesses, I recommend enhancing the framework by institutionalising more inclusive and participatory decision-making processes. This involves establishing legal safeguards to ensure grassroots representation, requiring third-party oversight to prevent procedural violations, and improving access to information for all stakeholders. By addressing these gaps, a strengthened multi-stakeholder governance framework can foster fair and transparent decision-making, ensuring that the voices of local and marginalised communities are included in karst resource governance.

Second, there is a need for increased transparency and accountability in knowledge production. This study highlights that the nature of scientific knowledge in karst governance is often contested and shaped by competing interests. To address this issue, the government should establish an independent scientific review body tasked with disseminating environmental assessments (EIA, EIA Addendum, SEA) and other reports related to resource governance. This body should include interdisciplinary experts and civil society representatives to ensure balanced and unbiased evaluations.

A similar model can be found in the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), which brings

together a range of stakeholders, including scientists, policymakers and civil society representatives, to evaluate agricultural practices and their impacts on sustainability and development (Beverly et al., 2009). This approach demonstrates the importance of integrating multiple perspectives to produce credible, transparent and inclusive knowledge. Adapting this model to a national context, such as Indonesia, could involve establishing a legally mandated review body for environmental assessments. This would aim to assure transparency and public trust in the review process.

By adopting best practices from international models such as IAASTD and adapting them to natural resource governance, especially karst, Indonesia could encourage a more transparent knowledge production process. This would build trust among stakeholders and reduce the potential for bias and contested narratives so that decision-making was more equitable in resource governance.

Third, I recommend that stakeholders integrate local knowledge into natural resource and environmental governance practices. The findings of this thesis highlight the important role of local knowledge in shaping sustainable governance. Governments should formalise the integration of local community insights and traditional ecological knowledge (TEK) into governance frameworks (Ludwig and Macnaghten, 2020; Li, Zhou and Tao, 2024). This could include incorporating community-led environmental monitoring programmes and empowering local stakeholders to co-develop management strategies. By valuing, recognising, and institutionalising local knowledge, governance processes can become more adaptive and culturally sensitive.

Several countries have successfully integrated TEK into their decision-making frameworks, including Canada and New Zealand. In Canada, the use of TEK is mandated in EIAs and land-use planning, particularly in the context of Indigenous peoples' rights. For example, Canada's MVRMA explicitly incorporates TEK into land and water resource management processes, ensuring that Indigenous perspectives inform decisions (Fitzpatrick, Sinclair and Mitchell, 2008). Similarly, New Zealand has integrated the Māori concept of kaitiakitanga (trusteeship) into its environmental governance frameworks, including co-management agreements such as the Waikato River Authority (McAllister, Hikuroa and Macinnis-Ng, 2023). These frameworks emphasise the cultural and

ecological dimensions of resource management, with the substance of the framework being to promote the value of Indigenous knowledge in achieving sustainable outcomes.

By learning from several proven frameworks at the international level, stakeholders can adapt them to the unique context of Indonesia. It is crucial to integrate local knowledge into the governance process because it will have an impact on increasing cultural sensitivity and adaptability while addressing socio-environmental challenges more effectively.

Fourth, I suggest improving public access to information and the decision-making processes. Governments or policymakers should ensure that information related to natural resources and environmental governance, including environmental assessments and policy decisions, is accessible to the public in a timely and transparent manner. Transparency is the foundation of effective governance, where providing access to environmental information promotes accountability and public participation (Mol, 2006).

This study shows that limited access to information in karst resource governance contributed to mistrust among local communities and the wider public. For example, procedural irregularities in EIAs and the lack of publicly available reports exacerbate public scepticism about the legitimacy of policy decisions. Drawing on international examples, the Aarhus Convention in Europe offers a strong framework for public access to environmental information, emphasising the right of communities to access reports, participate in decision-making, and seek legal recourse when these rights are violated (Ryall, 2023; Hartley and Wood, 2005).

To replicate these lessons in the Indonesian context, the government can build a centralised online platform where environmental assessments, policy updates, and regulatory decisions are available in real time. In addition, public consultation should be institutionalised as a mandatory part of the decision-making process. Indeed, this must be supported by mechanisms that ensure meaningful public participation. By adopting these steps, the government can create a more inclusive governance process that is in line with global best practices in environmental governance.

Last but not least, I propose that the government clarify and strengthen legal and institutional coordination related to natural resource governance, especially karst regulation. This thesis highlights gaps and inconsistencies in the legal framework governing karst areas, especially between national and regional policies. The government should ratify and operationalise the RPP on karst to provide a unified legal basis for karst governance. This should be accompanied by a clear institutional mandate that describes the roles and responsibilities of local, regional, and national authorities to prevent overlapping jurisdictions and improve policy coherence.

9.5 Further Research Agenda

The findings of this study provide valuable insights into the complexity of power dynamics in karst resource struggles, particularly through the application of a pluralistic approach to power. This framework, which combines actor-oriented, neo-Marxist, and post-structuralist perspectives, has proven effective in uncovering the multidimensional nature of power in resource governance. However, as a researcher, I acknowledge that the study has limitations and that some aspects of the pluralistic approach could benefit from further exploration and refinement.

Future research can, hopefully, expand the understanding of the pluralistic approach by examining how these dimensions of power interact over time and across contexts. For example, longitudinal studies could reveal how actors' strategies evolve in response to changing structural conditions or discursive landscapes. Furthermore, although this study primarily focuses on power interactions in the North Kendeng Mountains region, comparative studies across different geographical or political settings could test the adaptability and applicability of the pluralistic framework. Such research would strengthen the theoretical robustness of the approach and highlight potential variations across contexts.

Another area that needs further research is the operationalisation of the pluralistic framework in governance practices. While this study demonstrates the usefulness of the framework in analysing conflict, further research is needed to translate these insights into actionable strategies for stakeholders, especially

policymakers. For example: How can an understanding of actor, structural, and discursive power inform the design of more equitable governance systems? And: What methodologies or tools can be developed to identify and mitigate structural bias in resource governance?

Finally, this study highlights the strengths and limitations of the pluralistic approach. While it effectively captures the complexity of power dynamics, its multidimensional nature can also present analytical challenges, particularly in untangling overlapping power mechanisms. Future research could address this by exploring ways to integrate perspectives more systematically. In doing so, the pluralistic approach could become more accessible and operational for researchers and practitioners.

By addressing these areas, further research could contribute not only to the theoretical advancement of political ecology but also to the development of practical solutions for resource governance in contested landscapes.

List of References

- Accetti, C. I. (2021). Repoliticizing Environmentalism: Beyond Technocracy and Populism. *Critical Review*, 33 (1). [Online]. Available at: doi:10.1080/08913811.2021.1908023.
- Adji, N. T., Haryono, E. and Woro, S. (1999). Kawasan Karst dan Prospek Pengembangannya di Indonesia. In: *Seminar PIT IGI*. 1999. pp.1–10.
- Aghion, P. and Roulet, A. (2014). Growth and the smart state. In: *Annual Review of Economics*. 6. 2014. [Online]. Available at: doi:10.1146/annurev-economics-080213-040759.
- Agus Mandong, I., Budiarti, T. and Munandar, A. (2023). Kajian Potensi Objek Daya Tarik Wisata Alam Karst Rammang-Rammang di Kabupaten Maros Provinsi Sulawesi Selatan. *Jurnal Lanskap Indonesia*, 15 (1). [Online]. Available at: doi:10.29244/jli.v15i1.41579.
- Ahlborg, H. and Nightingale, A. J. (2018). Theorizing power in political ecology: The where of power in resource governance projects. *Journal of Political Ecology*, 25 (1). [Online]. Available at: doi:10.2458/v25i1.22804.
- Aklin, M. and Urpelainen, J. (2014). Perceptions of scientific dissent undermine public support for environmental policy. *Environmental Science and Policy*, 38. [Online]. Available at: doi:10.1016/j.envsci.2013.10.006.
- Alami, I. (2023). Ten theses on the new state capitalism and its futures. *Environment and Planning A*, 55 (3). [Online]. Available at: doi:10.1177/0308518X231156910.
- Alami, I. and Dixon, A. D. (2020). The strange geographies of the 'new' state capitalism. *Political Geography*, 82. [Online]. Available at: doi:10.1016/j.polgeo.2020.102237.
- Alami, I. and Dixon, A. D. (2023). Uneven and combined state capitalism. *Environment and Planning A*, 55 (1). [Online]. Available at: doi:10.1177/0308518X211037688.
- Amin, M. Al and Mir, M. A. R. (2023). A Comparative analysis of classic-Marxism

and Neo-Marxism in the International Political Economy system. *HISTORICAL: Journal of History and Social Sciences*, 2 (2). [Online]. Available at: doi:10.58355/historical.v2i2.43.

Andrews, N. (2021). Oil, power and social differentiation: a political ecology of hydrocarbon extraction in Ghana. *Journal of Political Ecology*, 28 (1). [Online]. Available at: doi:10.2458/JPE.2837.

Anspach, N. M. and Draguljić, G. (2019). Effective advocacy: the psychological mechanisms of environmental issue framing. *Environmental Politics*, 28 (4). [Online]. Available at: doi:10.1080/09644016.2019.1565468.

Apriando, T. (2015). *Warga Rembang dan Pati Minta Dosen UGM Jujur Selamatkan Kendeng. Ada Apa?*

Arancibia, F. and Motta, R. (2019). Undone Science and Counter-Expertise: Fighting for Justice in an Argentine Community Contaminated by Pesticides. *Science as Culture*, 28 (3). [Online]. Available at: doi:10.1080/09505431.2018.1533936.

Asrawijaya, E. and Hudayana, B. (2021). The Power of a Leader in the Samin People's Opposition Movement to the Development of a Cement Factory in the North Kendeng Mountains. *Jurnal Humaniora*, 33 (1). [Online]. Available at: doi:10.22146/jh.56224.

Van Assche, K., Beunen, R. and Duineveld, M. (2017). The will to knowledge: natural resource management and power/knowledge dynamics. *Journal of Environmental Policy and Planning*, 19 (3). [Online]. Available at: doi:10.1080/1523908X.2017.1336927.

Balazs, D. (1968). Karst Regions in Indonesia. *Karszt-Es Barkangkutatas-Volume V*.

Baring, E. (2015). Intellectual History and Poststructuralism. In: *A Companion to Intellectual History*. [Online]. Available at: doi:10.1002/9781118508091.ch4.

Bauer, S. (2006). Does bureaucracy really matter? The authority of intergovernmental treaty secretariats in global environmental politics. *Global Environmental Politics*, 6 (1). [Online]. Available at:

doi:10.1162/glep.2006.6.1.23.

Bednarek, M., Ross, A. S., Boichak, O., Doran, Y. J., Carr, G., Altmann, E. G. and Alexander, T. J. (2022). Winning the discursive struggle? The impact of a significant environmental crisis event on dominant climate discourses on Twitter. *Discourse, Context and Media*, 45. [Online]. Available at: doi:10.1016/j.dcm.2021.100564.

Belsey, C. (2022). *Poststructuralism: A Very Short Introduction*. [Online]. Available at: doi:10.1093/actrade/9780198859963.001.0001.

Benjaminsen, T. A. and Svarstad, H. (2021). *Political Ecology: A Critical Engagement With Global Environmental Issues*. Palgrave Macmillan.

Beverly, M., Herren, H., Wakhungu, J. and Watson, R. (2009). *International assessment of agricultural knowledge, science and technology for development (IAASTD) : global report /*.

Blaikie, P. and Brookfield, H. (1986). Land degradation and society. *Land degradation and society*. [Online]. Available at: doi:10.2307/633496.

Boelens, R., Shah, E. and Bruins, B. (2019). Contested knowledges: Large dams and mega-hydraulic development. *Water (Switzerland)*, 11 (3). [Online]. Available at: doi:10.3390/w11030416.

Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3 (2). [Online]. Available at: doi:10.1191/1478088706qp063oa.

Breg Valjavec, M., Zorn, M. and Čarni, A. (2018). Human-induced land degradation and biodiversity of Classical Karst landscape: On the example of enclosed karst depressions (dolines). *Land Degradation and Development*, 29 (10). [Online]. Available at: doi:10.1002/ldr.3116.

Brenner, L. and Job, H. (2012). Challenges to actor-oriented environmental governance: Examples from three mexican biosphere reserves. *Tijdschrift voor Economische en Sociale Geografie*, 103 (1). [Online]. Available at: doi:10.1111/j.1467-9663.2011.00671.x.

Brister, E. (2018). Proceduralism and Expertise in Local Environmental Decision-

Making. In: *International Library of Environmental, Agricultural and Food Ethics*.
26. [Online]. Available at: doi:10.1007/978-3-319-92597-4_10.

Brittain, S., Tugendhat, H., Newing, H. and Milner-Gulland, E. J. (2021).
Conservation and the rights of Indigenous peoples and local communities:
Looking forwards. *ORYX*, 55 (5). [Online]. Available at:
doi:10.1017/S0030605321000946.

Brown, B. and Spiegel, S. J. (2017). Resisting coal: Hydrocarbon politics and
assemblages of protest in the UK and Indonesia. *Geoforum*, 85. [Online].
Available at: doi:10.1016/j.geoforum.2017.07.015.

Brown, R. H. (1993). MODERN SCIENCE: Institutionalization of Knowledge and
Rationalization of Power. *Sociological Quarterly*, 34 (1). [Online]. Available at:
doi:10.1111/j.1533-8525.1993.tb00135.x.

Brown, R. H. and Malone, E. L. (2004). Reason, Politics, and the Politics of Truth:
How Science Is Both Autonomous and Dependent. In: *Sociological Theory*. 22
(1). 2004. [Online]. Available at: doi:10.1111/j.1467-9558.2004.00206.x.

Bryant, R. L. (1997). Beyond the impasse: The power of political ecology in Third
World environmental research. *Area*, 29 (1). [Online]. Available at:
doi:10.1111/j.1475-4762.1997.tb00003.x.

Bryant, R. L. (1998). Power, knowledge and political ecology in the third world: A
review. *Progress in Physical Geography*, 22 (1). [Online]. Available at:
doi:10.1191/030913398674890974.

Carolan, M. S. (2006). Science, expertise, and the democratization of the
decision-making process. *Society and Natural Resources*, 19 (7). [Online].
Available at: doi:10.1080/08941920600742443.

Chandra, W. (2016). *Walhi: Eksosistem Karst Indonesia Terancam Industri
Semen*.

Clements, R., Sodhi, N. S., Schilthuizen, M. and Ng, P. K. L. (2006). Limestone
karsts of southeast Asia: Imperiled arks of biodiversity. *BioScience*, 56 (9).
[Online]. Available at: doi:10.1641/0006-3568(2006)56[733:LKOSAI]2.0.CO;2.

Conde, M. (2014). Activism mobilising science. *Ecological Economics*, 105.

[Online]. Available at: doi:10.1016/j.ecolecon.2014.05.012.

Conde, M. (2017). Resistance to mining: A review. *Ecological Economics*, 132.

[Online]. Available at: doi:10.1016/j.ecolecon.2016.08.025.

Connelly, S., Vanderhoven, D., Rutherford, R., Richardson, L. and Matthews, P. (2021). Translating research for policy: the importance of equivalence, function, and loyalty. *Humanities and Social Sciences Communications*, 8 (1). [Online].

Available at: doi:10.1057/s41599-021-00873-z.

Cuvelier, J., Vlassenroot, K. and Olin, N. (2014). Resources, conflict and governance: A critical review. *Extractive Industries and Society*, 1 (2). [Online].

Available at: doi:10.1016/j.exis.2014.07.006.

Das, B. and Deka, S. (2020). Political ecology in Merbeel: A power play around past and present Wetland resource management. *Space and Culture, India*, 7 (4). [Online]. Available at: doi:10.20896/SACI.V7I4.599.

Deakin, S., Gindis, D., Hodgson, G. M., Huang, K. and Pistor, K. (2017). Legal institutionalism: Capitalism and the constitutive role of law. *Journal of Comparative Economics*, 45 (1). [Online]. Available at:

doi:10.1016/j.jce.2016.04.005.

Decaro, D. A., Chaffin, B. C., Schlager, E., Garmestani, A. S. and Ruhl, J. B.

(2017). Legal and institutional foundations of adaptive environmental governance. *Ecology and Society*, 22 (1). [Online]. Available at: doi:10.5751/ES-09036-220132.

Delabre, I. and Okereke, C. (2020). Palm oil, power, and participation: The political ecology of social impact assessment. *Environment and Planning E: Nature and Space*, 3 (3). [Online]. Available at:

doi:10.1177/2514848619882013.

Delborne, J. A. (2011). Constructing audiences in scientific controversy. *Social Epistemology*, 25 (1). [Online]. Available at:

doi:10.1080/02691728.2010.534565.

Demeritt, D. (2015). The promises of participation in science and political ecology. In: *The Routledge Handbook of Political Ecology*.

Dewantara, A. M. and Larasati, D. K. (2022). Implementation of Progressive Law in Enforcement of Environmental Law in Indonesia: The Current Problems and Future Challenges. *Indonesian Journal of Environmental Law and Sustainable Development*, 1 (2). [Online]. Available at: doi:10.15294/ijel.v1i2.58044.

Domínguez, L. and Luoma, C. (2020). Decolonising conservation policy: How colonial land and conservation ideologies persist and perpetuate indigenous injustices at the expense of the environment. *Land*, 9 (3). [Online]. Available at: doi:10.3390/land9030065.

Doolittle, A. (2015). The best of many worlds: Methodological pluralism in political ecology. In: *The International Handbook of Political Ecology*. [Online]. Available at: doi:10.4337/9780857936172.00047.

Dowding, K. (2012). Why should we care about the definition of power? *Journal of Political Power*, 5 (1). [Online]. Available at: doi:10.1080/2158379X.2012.661917.

Duit, A. (2016). The four faces of the environmental state: environmental governance regimes in 28 countries. *Environmental Politics*, 25 (1). [Online]. Available at: doi:10.1080/09644016.2015.1077619.

Edler, J., Karaulova, M. and Barker, K. (2022). Understanding Conceptual Impact of Scientific Knowledge on Policy: The Role of Policymaking Conditions. *Minerva*, 60 (2). [Online]. Available at: doi:10.1007/s11024-022-09459-8.

Elmhirst, R. (2011). Introducing new feminist political ecologies. *Geoforum*, 42 (2), pp.129–132. [Online]. Available at: doi:10.1016/j.geoforum.2011.01.006.

Engau, C. and Hoffmann, V. H. (2009). Effects of regulatory uncertainty on corporate strategy-an analysis of firms' responses to uncertainty about post-Kyoto policy. *Environmental Science and Policy*, 12 (7). [Online]. Available at: doi:10.1016/j.envsci.2009.08.003.

Engau, C. and Hoffmann, V. H. (2011). Corporate response strategies to regulatory uncertainty: Evidence from uncertainty about post-Kyoto regulation. *Policy Sciences*, 44 (1). [Online]. Available at: doi:10.1007/s11077-010-9116-0.

Enggarani, N. S. and Spaltani, B. G. (2019). Disorder of law as alternative

enforcement of environmental law: Rembang public lawsuit against PT. cement Indonesia TBK case study. *Humanities and Social Sciences Reviews*, 7 (3). [Online]. Available at: doi:10.18510/hssr.2019.7312.

Escobar, A. (1996). Construction Nature: Elements for a post-structuralist political ecology. *Futures*, 28 (4). [Online]. Available at: doi:10.1016/0016-3287(96)00011-0.

Espinosa, C. (2021). Reducing power disparities in large-scale mining governance through counter-expertise: A synthesis of case studies from Ecuador. *Extractive Industries and Society*. [Online]. Available at: doi:10.1016/j.exis.2021.101000.

Feindt, P. H. and Oels, A. (2005). Does discourse matter? Discourse analysis in environmental policy making. *Journal of Environmental Policy and Planning*, 7 (3). [Online]. Available at: doi:10.1080/15239080500339638.

Fischer, A., Wakjira, D. T., Weldesemaet, Y. T. and Ashenafi, Z. T. (2014). On the interplay of actors in the co-management of natural resources - a dynamic perspective. *World Development*, 64. [Online]. Available at: doi:10.1016/j.worlddev.2014.05.026.

Fitzpatrick, P., Sinclair, A. J. and Mitchell, B. (2008). Environmental impact assessment under the Mackenzie Valley Resource Management Act: Deliberative democracy in Canada's North? *Environmental Management*, 42 (1). [Online]. Available at: doi:10.1007/s00267-008-9098-2.

Fleming, A., Vanclay, F., Hiller, C. and Wilson, S. (2014). Challenging dominant discourses of climate change. *Climatic Change*, 127 (3-4). [Online]. Available at: doi:10.1007/s10584-014-1268-z.

Fletcher, R. (2010). Neoliberal environmentality: Towards a poststructuralist political ecology of the conservation debate. *Conservation and Society*, 8 (3), pp.171-181. [Online]. Available at: doi:10.4103/0972-4923.73806.

Forsyth, T. (2015). Integrating science and politics in political ecology. In: *The International Handbook of Political Ecology*. [Online]. Available at: doi:10.4337/9780857936172.00015.

Forsyth, T. (2020). Who Shapes the Politics of Expertise? Co-Production and Authoritative Knowledge in Thailand's Political Forests. *Antipode*, 52 (4). [Online]. Available at: doi:10.1111/anti.12545.

Foucault, M. (1970). The archaeology of knowledge. *Social Science Information*, 9 (1). [Online]. Available at: doi:10.1177/053901847000900108.

Foucault, M. (1980). *Power/Knowledge: Selected Interviews and Other Writings*. [Online]. Available at: doi:citeulike-article-id:798470.

Gani, A. (2011). Governance and growth in developing countries. *Journal of Economic Issues*, 45 (1). [Online]. Available at: doi:10.2753/JEI0021-3624450102.

Giller, K. E., Leeuwis, C., Andersson, J. A., Andriesse, W., Brouwer, A., Frost, P., Hebinck, P., Heitkönig, I., Van Ittersum, M. K., Koning, N., et al. (2008). Competing claims on natural resources: What role for science? *Ecology and Society*, 13 (2). [Online]. Available at: doi:10.5751/ES-02595-130234.

Gómez-Baggethun, E. (2020). More is more: Scaling political ecology within limits to growth. *Political Geography*, 76. [Online]. Available at: doi:10.1016/j.polgeo.2019.102095.

Gonda, N. (2019). Re-politicizing the gender and climate change debate: The potential of feminist political ecology to engage with power in action in adaptation policies and projects in Nicaragua. *Geoforum*, 106. [Online]. Available at: doi:10.1016/j.geoforum.2019.07.020.

Green, K. E. (2016). A political ecology of scaling: Struggles over power, land and authority. *Geoforum*, 74. [Online]. Available at: doi:10.1016/j.geoforum.2016.05.007.

Grundmann, R. (2017). The Problem of Expertise in Knowledge Societies. *Minerva*, 55 (1). [Online]. Available at: doi:10.1007/s11024-016-9308-7.

Gudeman, S. and Rivera, A. (1990). *Conversations in Colombia*. [Online]. Available at: doi:10.1017/cbo9780511558009.

Gunn, J. (2021). Karst groundwater in UNESCO protected areas: a global overview. *Hydrogeology Journal*, 29 (1). [Online]. Available at:

doi:10.1007/s10040-020-02206-x.

Gutiérrez, F., Parise, M., De Waele, J. and Jourde, H. (2014). A review on natural and human-induced geohazards and impacts in karst. *Earth-Science Reviews*, 138. [Online]. Available at: doi:10.1016/j.earscirev.2014.08.002.

Habib, A., Muhammadi, A. H. and Jiang, H. (2017). Political Connections and Related Party Transactions: Evidence from Indonesia. *International Journal of Accounting*, 52 (1). [Online]. Available at: doi:10.1016/j.intacc.2017.01.004.

Hadi, S. P. (2018). Critical Review of Spatial Planning of CAT Watuputih, Rembang Zone, Central Java, Indonesia. In: *E3S Web of Conferences*. 31. 2018. [Online]. Available at: doi:10.1051/e3sconf/20183109006.

Hadi, S. P., Purnaweni, H. and Prabawani, B. (2019). The Powerless of Strategic Environmental Assessment (SEA): A Case Studies of North Kendeng Mountain Area, Central Java, Indonesia. In: *E3S Web of Conferences*. 125. 2019. [Online]. Available at: doi:10.1051/e3sconf/201912502014.

Hadi, S. P., Purnaweni, H., Prabawani, B. and Hamdani, R. S. (2023). Evaluation of Development Policy through Water Environmental Carrying Capacity Analysis in North Kendeng Mountain, Indonesia. *Indonesian Journal of Geography*, 55 (2). [Online]. Available at: doi:10.22146/ijg.71917.

Hajer, M. A. (2006). Doing discourse analysis: Coalitions, practices, meaning. *Nederlandse Geografische Studies*, (344).

Hajer, M. A., Hoppe, R. and Jennings, B. (2020). Discourse Coalitions and the Institutionalization of Practice: The Case of Acid Rain in Great Britain. In: *The Argumentative Turn in Policy Analysis and Planning*. [Online]. Available at: doi:10.1515/9780822381815-003.

Hajer, M. and Versteeg, W. (2005a). A decade of discourse analysis of environmental politics: Achievements, challenges, perspectives. *Journal of Environmental Policy and Planning*, 7 (3). [Online]. Available at: doi:10.1080/15239080500339646.

Hajer, M. and Versteeg, W. (2005b). A decade of discourse analysis of environmental politics. *Journal of Environmental Policy and Planning*, 7 (3).

Hall, D., Hirsch, P. and Li, T. M. (2011). *Powers of exclusion: land dilemmas in Southeast Asia*. Singapore: National University of Singapore.

Hartley, N. and Wood, C. (2005). Public participation in environmental impact assessment - Implementing the Aarhus Convention. *Environmental Impact Assessment Review*, 25 (4). [Online]. Available at: doi:10.1016/j.eiar.2004.12.002.

Harvey, D. (2018). The 'New' Imperialism: Accumulation by Dispossession. In: *Karl Marx*. [Online]. Available at: doi:10.4324/9781315251196-10.

Healey, R. (2024). Scientific Objectivity and Its Limits. *The British Journal for the Philosophy of Science*. [Online]. Available at: doi:10.1086/716169.

Ho, P., Nor-Hisham, B. M. S. and Zhao, H. (2020). Limits of the environmental impact assessment (EIA) in Malaysia: Dam politics, rent-seeking, and conflict. *Sustainability (Switzerland)*, 12 (24). [Online]. Available at: doi:10.3390/su122410467.

Huang, Q. and Xu, J. (2019). Rethinking environmental bureaucracies in River Chiefs System (RCS) in China: A critical literature study. *Sustainability (Switzerland)*, 11 (6). [Online]. Available at: doi:10.3390/su11061608.

Huber, M. T. (2017). Value, Nature, and Labor: A Defense of Marx. *Capitalism Nature Socialism*, 28 (1), pp.39–52. [Online]. Available at: doi:https://doi.org/10.1080/10455752.2016.1271817.

Hughes, A. C. (2017). Understanding the drivers of Southeast Asian biodiversity loss. *Ecosphere*, 8 (1). [Online]. Available at: doi:10.1002/ecs2.1624.

Isaac, J. . (1987). *Power and Marxist theory: a realist view*. Itacha: Cornell University Press.

Jaya, A. F. (2022). *Menakar Pengelolaan Ekosistem Karst di Indonesia*.

Jourde, H. and Wang, X. (2023). Advances, challenges and perspective in modelling the functioning of karst systems: a review. *Environmental Earth Sciences*, 82 (17). [Online]. Available at: doi:10.1007/s12665-023-11034-7.

Jukić, D. and Denić-Jukić, V. (2009). Groundwater balance estimation in karst by

using a conceptual rainfall-runoff model. *Journal of Hydrology*, 373 (3–4). [Online]. Available at: doi:10.1016/j.jhydrol.2009.04.035.

Kansanga, M. M., Arku, G. and Luginaah, I. (2019). Powers of exclusion and counter-exclusion: The political ecology of ethno-territorial customary land boundary conflicts in Ghana. *Land Use Policy*, 86. [Online]. Available at: doi:10.1016/j.landusepol.2019.04.031.

Keller, R. (2011). The Sociology of Knowledge Approach to Discourse (SKAD). *Human Studies*, 34 (1). [Online]. Available at: doi:10.1007/s10746-011-9175-z.

Kitchen, R. and Thrift, N. (2009). *International encyclopedia of human geography*. [Online]. Available at: doi:10.5860/choice.48-0052.

Kohler, F. and Brondizio, E. S. (2017). Considering the needs of indigenous and local populations in conservation programs. *Conservation Biology*, 31 (2). [Online]. Available at: doi:10.1111/cobi.12843.

Kuehn, R. R. (2015). Bias in environmental agency decision making. *Environmental Law*, 45 (4).

Kunz, Y., Hein, J. and Sobirin, M. (2024). Beyond Protection, toward Respect: Struggle for Environmental Justice in the Kendeng Mountains. *Society and Natural Resources*, 37 (5). [Online]. Available at: doi:10.1080/08941920.2023.2267497.

Kurniawan, I. A., Adji, T. N., Nurkholis, A., Haryono, E., Fatoni, H., Waskito, W. A., Cahyadi, A. and Agniy, R. F. (2019). Karst aquifer response by time series analysis applications in Jonggrangan Karst, Java Island, Indonesia. *Environmental Earth Sciences*, 78 (13). [Online]. Available at: doi:10.1007/s12665-019-8386-x.

Lakoff, G. (2010). Why it Matters How We Frame the Environment. *Environmental Communication*, 4 (1). [Online]. Available at: doi:10.1080/17524030903529749.

Lalor, B. M. and Hickey, G. M. (2013). Environmental science and public policy in Executive government: Insights from Australia and Canada. *Science and Public Policy*, 40 (6). [Online]. Available at: doi:10.1093/scipol/sct022.

Lalor, B. M. and Hickey, G. M. (2014). Strengthening the Role of Science in the Environmental Decision-Making Processes of Executive Government.

Organization and Environment, 27 (2). [Online]. Available at:

doi:10.1177/1086026614525641.

Leipold, S., Feindt, P. H., Winkel, G. and Keller, R. (2019). Discourse analysis of environmental policy revisited: traditions, trends, perspectives. *Journal of Environmental Policy and Planning*, 21 (5). [Online]. Available at:

doi:10.1080/1523908X.2019.1660462.

Lemma, A. and Velde, D. W. te. (2017). State–Business Relations as Drivers of Economic Performance. In: *The Practice of Industrial Policy*. [Online]. Available at:

doi:10.1093/acprof:oso/9780198796954.003.0004.

Li, J., Zhou, W. and Tao, C. (2024). The Value of Traditional Ecological Knowledge in Stormwater Management: A Case Study of a Traditional Village.

Land, 13 (2). [Online]. Available at: doi:10.3390/land13020242.

Little, P. E. (2007). Political ecology as ethnography: a theoretical and methodological guide. *Horizontes Antropológicos*, 12 (25).

Long, N. (2002). An Actor-oriented Approach to Development Intervention. In: *Rural Life Improvement in Asia*. 2002. Tokyo: Asia Productivity Organization (APO).

Long, N. and Long, A. (Eds). (1992). *Battlefields of Knowledge: The Interlocking of Theory and Practice in Social Research and Development*. London: Routledge.

Ludwig, D. and Macnaghten, P. (2020). Traditional ecological knowledge in innovation governance: a framework for responsible and just innovation. *Journal of Responsible Innovation*, 7 (1). [Online]. Available at:

doi:10.1080/23299460.2019.1676686.

Lukač Reberski, J., Terzić, J., Maurice, L. D. and Lapworth, D. J. (2022).

Emerging organic contaminants in karst groundwater: A global level assessment.

Journal of Hydrology, 604. [Online]. Available at:

doi:10.1016/j.jhydrol.2021.127242.

Lv, Y., Jiang, Y., Hu, W., Cao, M. and Mao, Y. (2020). A review of the effects of

tunnel excavation on the hydrology, ecology, and environment in karst areas: Current status, challenges, and perspectives. *Journal of Hydrology*, 586. [Online]. Available at: doi:10.1016/j.jhydrol.2020.124891.

Mack, G., Ritzel, C. and Jan, P. (2020). Determinants for the Implementation of Action-, Result- and Multi-Actor-Oriented Agri-Environment Schemes in Switzerland. *Ecological Economics*, 176. [Online]. Available at: doi:10.1016/j.ecolecon.2020.106715.

Maharani, N. and Sudrajat. (2018). Valuasi Ekonomi Museum Karst Indonesia Di Kawasan Geopark Gunungsewu , Kabupaten Wonogiri , Jawa Tengah. *Jurnal Bumi Indonesia*, 7 (3).

Mahardika, E. R. and Bayu, M. A. (2022). Legal Politics of Indonesian Environmental Management: Discourse between Maintaining Environmental Sustainability and Economic Interests. *Indonesian Journal of Environmental Law and Sustainable Development*, 1 (1). [Online]. Available at: doi:10.15294/ijel.v1i1.56781.

Malin, S. A., Ryder, S. and Lyra, M. G. (2019). Environmental justice and natural resource extraction: intersections of power, equity and access. *Environmental Sociology*, 5 (2). [Online]. Available at: doi:10.1080/23251042.2019.1608420.

Marcus, G. E. (1995). Ethnography in/of the World System: The Emergence of Multi-Sited Ethnography. *Annual Review of Anthropology*, 24 (1). [Online]. Available at: doi:10.1146/annurev.an.24.100195.000523.

Mason-Bish, H. (2019). The elite delusion: reflexivity, identity and positionality in qualitative research. *Qualitative Research*, 19 (3). [Online]. Available at: doi:10.1177/1468794118770078.

Mathevet, R., Peluso, N. L., Couespel, A. and Robbins, P. (2015). Using historical political ecology to understand the present: Water, reeds, and biodiversity in the camargue biosphere reserve, southern france. *Ecology and Society*, 20 (4). [Online]. Available at: doi:10.5751/ES-07787-200417.

McAllister, T., Hikuroa, D. and Macinnis-Ng, C. (2023). Connecting Science to Indigenous Knowledge: kaitiakitanga, conservation, and resource management. *New Zealand Journal of Ecology*, 47 (1). [Online]. Available at:

doi:10.20417/nzj ecol.47.3521.

de Melo-Martín, I. and Intemann, K. (2014). Who's afraid of dissent? Addressing concerns about undermining scientific consensus in public policy developments. *Perspectives on Science*, 22 (4). [Online]. Available at: doi:10.1162/POSC_a_00151.

Miguelote, V. R. da S. and de Camargo, K. R. (2010). Knowledge industry: A powerful mechanism. *Revista de Saude Publica*, 44 (1). [Online]. Available at: doi:10.1590/s0034-89102010000100021.

Milanović, P. and Stevanović, Z. (2021). Fifty years of history of the Karst Commission of the International Association of Hydrogeologists. *Hydrogeology Journal*, 29 (1). [Online]. Available at: doi:10.1007/s10040-020-02261-4.

Mojo, E., Hadi, S. P. and Purnaweni, H. (2017). Sedulur sikep's environmental wisdom in conservation of North Kendeng mountains Sukolilo. *Advanced Science Letters*, 23 (3). [Online]. Available at: doi:10.1166/asl.2017.8657.

Mol, A. P. J. (2006). Environmental governance in the Information Age: The emergence of informational governance. *Environment and Planning C: Government and Policy*, 24 (4). [Online]. Available at: doi:10.1068/c0508j.

van der Molen, F. (2018). How knowledge enables governance: The coproduction of environmental governance capacity. *Environmental Science and Policy*, 87. [Online]. Available at: doi:10.1016/j.envsci.2018.05.016.

Molthan-Hill, P. (2015). Making the business case? Intercultural differences in framing economic rationality related to environmental issues. *Critical Perspectives on International Business*, 11 (1). [Online]. Available at: doi:10.1108/cpoib-07-2012-0033.

Montuschi, E. (2017). Using science, making policy: what should we worry about? *European Journal for Philosophy of Science*, 7 (1). [Online]. Available at: doi:10.1007/s13194-016-0143-3.

Moore, J. . (2015). *Capitalism in the Web of Life: Ecology and the Accumulation of Capital*. London: Verso Books.

Morrison, T. H., Adger, W. N., Brown, K., Lemos, M. C., Huitema, D., Phelps, J.,

- Evans, L., Cohen, P., Song, A. M., Turner, R., et al. (2019). The black box of power in polycentric environmental governance. *Global Environmental Change*, 57. [Online]. Available at: doi:10.1016/j.gloenvcha.2019.101934.
- Neely, A. H. and Nguse, T. (2015). Relationships and research methods: Entanglements, intra-actions, and diffraction. In: *The Routledge Handbook of Political Ecology*. [Online]. Available at: doi:10.4324/9781315759289-21.
- Negara, S. D. and Hutchinson, F. E. (2021). The Impact of Indonesia's Decentralization Reforms Two Decades On: Introduction. *Journal of Southeast Asian Economies*, 38 (3). [Online]. Available at: doi:10.1355/ae38-3a.
- Neil Adger, W., Benjaminsen, T. A., Brown, K. and Svarstad, H. (2001). Advancing a political ecology of global environmental discourses. *Development and Change*, 32 (4). [Online]. Available at: doi:10.1111/1467-7660.00222.
- Neilson, D. (2018). In-itself for-itself: Towards second-generation neo-Marxist class theory. *Capital and Class*, 42 (2). [Online]. Available at: doi:10.1177/0309816817723299.
- Neumann, R. P. (2009). Political ecology: Theorizing scale. *Progress in Human Geography*, 33 (3), pp.398–406. [Online]. Available at: doi:10.1177/0309132508096353.
- Newman, J. (2017). The politics of expertise: Neoliberalism, governance and the practice of politics. In: *Assembling Neoliberalism: Expertise, Practices, Subjects*. [Online]. Available at: doi:10.1057/978-1-137-58204-1_5.
- Nolan, C. (2019). Power and access issues in Ghana's coastal fisheries: A political ecology of a closing commodity frontier. *Marine Policy*, 108. [Online]. Available at: doi:10.1016/j.marpol.2019.103621.
- Nugroho, A. D., Hidayat, T. and Memed, M. W. (2020). IMPLEMENTASI PERMEN ESDM NO. 17 TAHUN 2012 SEBAGAI SOLUSI ANTARA PENGUSAHAAN MINERAL DAN PERLINDUNGAN KAWASAN KARST DI INDONESIA. *Prosiding Temu Profesi Tahunan PERHAPI*, 1 (1). [Online]. Available at: doi:10.36986/ptptp.v1i1.126.
- Nygren, A., Kröger, M. and Gills, B. (2022). Global extractivisms and transformative alternatives. *Journal of Peasant Studies*, 49 (4). [Online].

Available at: doi:10.1080/03066150.2022.2069495.

Otero, I., Kallis, G., Aguilar, R. and Ruiz, V. (2011). Water scarcity, social power and the production of an elite suburb. The political ecology of water in Matadepera, Catalonia. *Ecological Economics*, 70 (7). [Online]. Available at: doi:10.1016/j.ecolecon.2009.09.011.

Ozawa, C. P. (1996). Science in environmental conflicts. *Sociological Perspectives*, 39 (2). [Online]. Available at: doi:10.2307/1389309.

Pansardi, P. (2021). Why we do need a concept of power. *Journal of Political Power*, 14 (2). [Online]. Available at: doi:10.1080/2158379X.2021.1901195.

Patrick Bixler, R. (2013). The political ecology of local environmental narratives: Power, knowledge, and mountain caribou conservation. *Journal of Political Ecology*, 20 (1). [Online]. Available at: doi:10.2458/v20i1.21749.

Paulson, S., Gezon, L. L. and Watts, M. (2003). Locating the political in political ecology: An introduction. *Human Organization*, 62 (3). [Online]. Available at: doi:10.17730/humo.62.3.e5xcjnd6y8v09n6b.

Peet, R. and Watts, M. (1996). Liberation Ecologies - Development, sustainability, and environment in an age of market triumphalism. In: *Liberation Ecologies: Environment, Development, Social Movements*.

Pereira, A. R. B. and Laube, W. (2018). Knowledge Politics in Environmental Conflicts: A Case from Brazil. *Gestión y Ambiente*, 21 (2Supl). [Online]. Available at: doi:10.15446/ga.v21n2supl.77761.

Perreault, T., Bridge, G. and McCarthy, J. (2015). *The Routledge handbook of political ecology*. [Online]. Available at: doi:10.4324/9781315759289.

Pfister, T. and Horvath, A. (2014). Reassessing expert knowledge and the politics of expertise. *Innovation: The European Journal of Social Science Research*, 27 (4). [Online]. Available at: doi:10.1080/13511610.2014.986436.

Podsakoff, P. M., MacKenzie, S. B. and Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology*, 63. [Online]. Available at: doi:10.1146/annurev-psych-120710-100452.

Poelzer, G. (2019). A view from the top: State perspectives on legitimacy and the mine development process. *Environmental Science and Policy*, 94. [Online]. Available at: doi:10.1016/j.envsci.2019.01.002.

Ramirez, L. F. and Belcher, B. M. (2019). Stakeholder perceptions of scientific knowledge in policy processes: A Peruvian case-study of forestry policy development. *Science and Public Policy*, 46 (4). [Online]. Available at: doi:10.1093/scipol/scz003.

Richardson Oakes, A. (2018). Judicial Resources and the Public Trust Doctrine: A Powerful Tool of Environmental Protection? *Transnational Environmental Law*, 7 (3). [Online]. Available at: doi:10.1017/S2047102518000213.

Robbins, P. (2012). Political Ecology: A Critical Introduction, - Paul Robbins. *John Wiley & Sons Ltd*.

Robbins, P. (2020). Is less more ... or is more less? Scaling the political ecologies of the future. *Political Geography*, 76. [Online]. Available at: doi:10.1016/j.polgeo.2019.04.010.

Rokhmad, A. (2020). Configuration and the role of community leaders in the conflict of natural resources of limestone mining for the cement industry in Rembang Indonesia. *International Journal of Energy Economics and Policy*, 10 (2). [Online]. Available at: doi:10.32479/ijeep.8321.

Rusli, R. and Duek, A. (2010). *The natural resources industry in decentralised Indonesia: how has decentralisation impacted the mining, oil and gas industries?*

Ryall, Á. (2023). A Brave New World: The Aarhus Convention in Tempestuous Times. *Journal of Environmental Law*, 35 (1). [Online]. Available at: doi:10.1093/jel/eqac023.

Saretzki, T. (2019). Evidence-based policy-making? The meaning of scientific knowledge in policy processes. *Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen*, 144–145. [Online]. Available at: doi:10.1016/j.zefq.2019.05.008.

Scoville-Simonds, M. (2009). Discourse Analysis in Political Ecology Towards an analytical framework of environmental controversies. *Graduate Institute of*

Scull, A. (2015). Madness in civilisation. *The Lancet*, 385 (9973). [Online]. Available at: doi:10.1016/S0140-6736(15)60591-8.

Shi, T. (2004). Ecological economics as a policy science: Rhetoric or commitment towards an improved decision-making process on sustainability. *Ecological Economics*, 48 (1). [Online]. Available at: doi:10.1016/j.ecolecon.2003.08.004.

Silva, T. A. da C., Paula, M. de, Silva, W. S. and Lacorte, G. A. (2021). Deposition of Potentially Toxic Metals in the Soil from Surrounding Cement Plants in a Karst Area of Southeastern Brazil. *Conservation*, 1 (3). [Online]. Available at: doi:10.3390/conservation1030012.

Sitorus, H. (2019). Negotiating livelihoods access to coastal resources: Environmental citizenship by NGOs in Indonesia. In: *Population, Development, and the Environment: Challenges to Achieving the Sustainable Development Goals in the Asia Pacific*. [Online]. Available at: doi:10.1007/978-981-13-2101-6_11.

Smessaert, J., Missemer, A. and Levrel, H. (2020). The commodification of nature, a review in social sciences. *Ecological Economics*, 172. [Online]. Available at: doi:10.1016/j.ecolecon.2020.106624.

Sovacool, B. K., Tan-Mullins, M. and Abrahamse, W. (2018). Bloated bodies and broken bricks: Power, ecology, and inequality in the political economy of natural disaster recovery. *World Development*, 110. [Online]. Available at: doi:10.1016/j.worlddev.2018.05.028.

Spiegel, S. J. (2012). Governance Institutions, Resource Rights Regimes, and the Informal Mining Sector: Regulatory Complexities in Indonesia. *World Development*, 40 (1). [Online]. Available at: doi:10.1016/j.worlddev.2011.05.015.

Stamenkovic, P. (2023). Facts and objectivity in science. *Interdisciplinary Science Reviews*, 48 (2). [Online]. Available at: doi:10.1080/03080188.2022.2150807.

Sudharto, P. H., Hartuti, P. and Kismartini, K. (2018). Inequality in Public

Decision Making Process: Case Studies of Cement Factories in Central Java, Indonesia. In: *E3S Web of Conferences*. 73. 2018. [Online]. Available at: doi:10.1051/e3sconf/20187309002.

Suharko, S. (2017). Masyarakat Adat versus Korporasi: Konflik Sosial Rencana Pembangunan Pabrik Semen di Kabupaten Pati Jawa Tengah Periode 2013-2016. *Jurnal Ilmu Sosial dan Ilmu Politik*, 20 (2). [Online]. Available at: doi:10.22146/jsp.24776.

Sulistiyowati, E., Setiadi and Haryono, E. (2021). Karst and conservation research in Indonesia and its implication to education. In: *IOP Conference Series: Earth and Environmental Science*. 1796 (1). 2021. [Online]. Available at: doi:10.1088/1742-6596/1796/1/012071.

Sulistiyowati, E., Setiadi and Haryono, E. (2022). Food traditions and biodiversity conservation of the Javanese Community in Gunungkidul Karst, Yogyakarta Province, Indonesia. *Biodiversitas*, 23 (4). [Online]. Available at: doi:10.13057/biodiv/d230443.

Sulistiyowati, E., Setiadi, S. and Haryono, E. (2023). The Dynamics of Sustainable Livelihoods and Agroforestry in Gunungkidul Karst Area, Yogyakarta, Indonesia. *Forest and Society*, 7 (2). [Online]. Available at: doi:10.24259/fs.v7i2.21886.

Sultana, F. (2015). Emotional political ecology. In: *The International Handbook of Political Ecology*. Edward Elgar Publishing. pp.633–645. [Online]. Available at: doi:10.4337/9780857936172.00056.

Sumarga, E., Willemen, L., Rosleine, D., Fitria, F., Agatha, K., & Sinaga, N. (2024). Water provision benefits from karst ecosystems: An example for Watuputih groundwater basin, North Kendeng Mountain, Indonesia. *Environmental and Sustainability Indicators*. [Online]. Available at: doi: Environmental and Sustainability Indicators.

Sumarno, M. and Wiratomo, G. H. (2019). *Social Conflict in the Construction of Cement Industry in Kendeng Mountains, Central Java Indonesia with A Human Security Approach*. Atlantis Press., pp.192–195. [Online]. Available at: doi:10.2991/ICORSIA-18.2019.47 [Accessed 22 October 2023].

Sun, H., Cheng, M., Su, C., Li, H., Zhao, G., Su, M., Li, S., Zhang, B., Zhang, L. and Li, K. (2017). Characterization of shallow karst using electrical resistivity imaging in a limestone mining area. *Environmental Earth Sciences*, 76 (22). [Online]. Available at: doi:10.1007/s12665-017-7112-9.

Suyahmo, S., Puryanto, S., Setyowati, D. and Nugraheni, A. (2020). *The government's perception of the conflict at the cement plant in Rembang*. European Alliance for Innovation n.o. [Online]. Available at: doi:10.4108/EAI.29-6-2019.2290261.

Svarstad, H., Benjaminsen, T. A. and Overå, R. (2018). Power theories in political ecology. *Journal of Political Ecology*, 25 (1). [Online]. Available at: doi:10.2458/v25i1.23044.

Swain, J. and King, B. (2022). Using Informal Conversations in Qualitative Research. *International Journal of Qualitative Methods*, 21. [Online]. Available at: doi:10.1177/16094069221085056.

Therborn, G. (2021). Knowledge and power: Social science and the social world. *International Sociology*, 36 (5). [Online]. Available at: doi:10.1177/02685809211057557.

Therivel, R. and González, A. (2021). "Ripe for decision": Tiering in environmental assessment. *Environmental Impact Assessment Review*, 87. [Online]. Available at: doi:10.1016/j.eiar.2020.106520.

Thompson, B. S. (2018). The political ecology of mangrove forest restoration in Thailand: Institutional arrangements and power dynamics. *Land Use Policy*, 78. [Online]. Available at: doi:10.1016/j.landusepol.2018.07.016.

Tuckwell, E. (2012). Science in dispute: Debating the authority of knowledge in an environmental contestation. *Oceania*, 82 (3). [Online]. Available at: doi:10.1002/j.1834-4461.2012.tb00136.x.

Turner, J. C. (2005). Explaining the nature of power: A three-process theory. *European Journal of Social Psychology*, 35 (1). [Online]. Available at: doi:10.1002/ejsp.244.

Turner, S. (2012). Making a living the Hmong way: An actor-oriented livelihoods

approach to everyday politics and resistance in upland vietnam. *Annals of the Association of American Geographers*, 102 (2). [Online]. Available at: doi:10.1080/00045608.2011.596392.

Turnhout, E. (2018). The Politics of Environmental Knowledge. *Conservation and Society*, 16 (3). [Online]. Available at: doi:10.4103/cs.cs-17-35.

Turnhout, E., Metze, T., Wyborn, C., Klenk, N. and Louder, E. (2020). The politics of co-production: participation, power, and transformation. *Current Opinion in Environmental Sustainability*, 42. [Online]. Available at: doi:10.1016/j.cosust.2019.11.009.

Uphoff, N. (1989). Distinguishing Power, Authority & Legitimacy: Taking Max Weber at His Word by Using Resources-Exchange Analysis. *Polity*, 22 (2). [Online]. Available at: doi:10.2307/3234836.

Veress, M. (2020). Karst Types and Their Karstification. *Journal of Earth Science*, 31 (3). [Online]. Available at: doi:10.1007/s12583-020-1306-x.

Vu, T., Drebenstedt, C. and Bao, T. (2020). Assessing geological uncertainty of a cement raw material deposit, southern Vietnam, based on hierarchical simulation. *International Journal of Mining Science and Technology*, 30 (6). [Online]. Available at: doi:10.1016/j.ijmst.2020.05.022.

Wacana, P., Rodialfallah, A., Chandra, F., Mesah, D. and Raimon, R. (2011). Study of The Potential of Karst Region in North Kendeng, The Districts of Grobogan and Pati. In: *Asian Trans-Diciplinary Karst Confeence 2011*. 2011.

De Waele, J., Plan, L. and Audra, P. (2009). Recent developments in surface and subsurface karst geomorphology: An introduction. *Geomorphology*, 106 (1–2). [Online]. Available at: doi:10.1016/j.geomorph.2008.09.023.

Waluyo, H., Sadikin, S. R., Gustami and Whiting, P. (2005). An economic valuation of biodiversity in the karst area of maros, south sulawesi, indonesia. *Biodiversity*, 6 (2). [Online]. Available at: doi:10.1080/14888386.2005.9712763.

Watchdoc Image. (2015). *SAMIN vs SEMEN (full movie)*.

Weber, K. M. and Rohrer, H. (2012). Legitimizing research, technology and innovation policies for transformative change. *Research Policy*, 41 (6). [Online].

Available at: doi:10.1016/j.respol.2011.10.015.

Weber, M. (1978). *Economy and Society: An Outline of Interpretative Sociology*. Berkeley: University of California Press.

Wesselink, A., Buchanan, K. S., Georgiadou, Y. and Turnhout, E. (2013). Technical knowledge, discursive spaces and politics at the science-policy interface. *Environmental Science and Policy*, 30. [Online]. Available at: doi:10.1016/j.envsci.2012.12.008.

Whatmore, S. J. (2009). Mapping knowledge controversies: Science, democracy and the redistribution of expertise. *Progress in Human Geography*, 33 (5). [Online]. Available at: doi:10.1177/0309132509339841.

Whitley, R. (2011). Changing Governance and Authority Relations in the Public Sciences. *Minerva*, 49 (4). [Online]. Available at: doi:10.1007/s11024-011-9182-2.

Widyaningsih, G. A. (2017). Permasalahan Hukum dalam Perlindungan Ekosistem Karst di Indonesia (Studi Kasus : Ekosistem Karst Sangkulirang – MangkaliHat, Provinsi Kalimantan Timur). *Jurnal Hukum Lingkungan Indonesia*, 3 (2). [Online]. Available at: doi:10.38011/jhli.v3i2.44.

Wright, E. O. (2019). Foundations of a neo-Marxist class analysis. *Sociology: Theory, Methods, Marketing*, (Stmm 2019 (1)). [Online]. Available at: doi:10.15407/sociology2019.01.009.

Yolles, M. (2019). Governance through political bureaucracy: an agency approach. *Kybernetes*, 48 (1). [Online]. Available at: doi:10.1108/K-09-2017-0329.

Zhang, J., Liesch, T., Chen, Z. and Goldscheider, N. (2023). Global analysis of land-use changes in karst areas and the implications for water resources. *Hydrogeology Journal*, 31 (5). [Online]. Available at: doi:10.1007/s10040-023-02650-5.

Appendix A



Department of Environment & Geography, University of York
Research Ethics Approval Form (Form 2)
Research involving human subjects/participants or using related data not publicly available.

Read this first

Who should apply?

You should apply if you are carrying out any research activity or consultancy project through the Department of Environment and Geography, University of York: This includes:

Members of academic, research and SEIY staff

Honorary members of staff associated with the Department.

Research degree students (masters and PhD).

Undergraduate students and taught postgraduate students who are doing research projects.

Can I begin work before the project is ethically approved?

NO primary data collection can begin until you have approval from one of the following:

The Departmental Ethics Committee

An External Research Ethics Committee (NHS Research Ethics Committee, Lead Partner University etc) and communication of such to the departmental ethics committee

What will happen if I proceed without approval or falsely self-certify research ethics approval?

Collecting primary data in the absence of ethical approval or falsely self-certifying the level of risk associated with a project will constitute a disciplinary offence. This will result in:

Student – Disciplinary action resulting in immediate failure in any module or project associated with the research and potentially dismissal from the University.

Staff - Disciplinary action which may potentially lead to dismissal.

If you do not have ethical approval, the University's insurers will not cover you for legal action or claims for injury. In addition, you may face debarment from membership of some professional or statutory bodies and excluded from applying for some types of employment or research funding opportunities. You may not be able to publish your research.

You should consider the following codes of ethical practice and conduct relevant to your project before completing your form:

The University's Code of practice and principles for good ethical governance

The University's Research Data Management Policy

Social media guidelines for researchers

1. Does this project need full ethical review?

1a)

Does the project involve collecting primary data from, or about, living human beings? **Yes**

1b)

Does the project involve analysing primary or unpublished data from, or about, living human beings? **Yes**

1c)

Does the project involve collecting or analysing primary or unpublished data about people who have recently died, other than data that are already in the public domain? **No**

1d)

Does the project involve collecting or analysing primary or unpublished data about or from organisations or agencies of any kind, other than data that are already in the public domain? **No**

1f)

Does the project place the participants or the researchers in a dangerous environment, risk of physical harm, psychological or emotional distress? **No**

If you answered **Yes** to any of these questions, please proceed to **fill out this form. Expand spaces as necessary to give full information.**

If you answered **No** to all of the above questions, you are using the wrong form please look at the other download option – Form 1 and Form 3.

2. Project Information

2a)

Give the title of the project

Political Ecology of Natural Resources Contestation In North Kendeng Mountain, Indonesia

2b)

Name of Principal Investigator (PI) or Research Student and Supervisor

- Abdul Kodir
- Dr. Richard Friend
- Dr. Jon Ensor

2c)

Degree course (students) or SEI-Y or Env & Geography Dept (staff)

PhD Human Geography and Environment

2d) Names of Co-investigators (CIs) and their organisational affiliation

-

2e)

How many additional research staff will be involved with the data for the project?

Give names and their organisational affiliation (please specify country)

-

2f)

Proposed project start date (At least four weeks in the future)

1 September 2024

2g)

Estimated project end date

30 April 2024

2h)

Who is funding the project and has funding been confirmed?

Research bench fee

3. More detail about the project

3a)

What are the aims and objectives of the project?

1. Explaining how the demand for cement at the international and national levels has implications for the governance of Karst resources in the Kendeng mountain region.
2. Investigating how actors build networks and mobilize power to respond to Karst mining operations.
3. Delineating on how knowledge about Karst resource management is produced and contested by experts.

3b)

Briefly describe the principal methods, the sources of data or evidence to be used and the number and type of research participants who will be recruited to /involved in the project.

I will conduct participatory observations by observing the activities of the residents of the cement factory area. Semi-structured interviews will be conducted with government officials (local, sub-national, national level), company representatives of cement factories, and several community leaders about the latest developments in the cement factory conflict in the northern Kendeng Mountains area. In doing so, the interview will be recorded in a recording device. In addition, the author will take notes on observations such as first impressions, key events, and nonverbal expressions. This step will be taken in an effort to broaden the researchers' field memory.

3c)

What research instrument(s), validated scales or methods will be used to collect data (e.g. questionnaires, interview schedules etc)?

Interview guides

3d)

If you are using an external research instrument, validated scale or research method, please specify.

-

3e)

If you are not using an externally validated scale or research method, please attach a copy of the research instrument you will use to collect data. For example, a measurement scale, questionnaire, interview schedule, observation protocol for ethnographic work or in the case of unstructured data collection a topic list. **Please submit as attachments to the e-mail that submits this form.**

3f)

In which country/countries will research be conducted?

Indonesia

3g)

In which country/countries will the data analysis take place?

Indonesia and the UK

4. Does the project require Disclosure and Barring Service (DBS) previously known as Criminal Records Bureau checks?

4a)

Does the project involve direct contact by any member of the research team with children or people under 18 years of age? **No**

4b)

Does the project involve direct contact by any member of the research team with adults who have learning difficulties? **No**

4c)

Does the project involve direct contact by any member of the research team with adults who are infirm or physically disabled? **No**

4d)

Does the project involve direct contact by any member of the research team with adults who are resident in social care or medical establishments? **No**

4e)

Does the project involve direct contact by any member of the research team with adults in the custody of the criminal justice system? **No**

4f)

Has a Disclosure and Barring Service (DBS) check been stipulated as a condition of access to any source of data required for the project? **No**

4 g)

If you answered **Yes** to **any** of the 4a-f questions, please explain the nature of the contact required and the circumstances in which contact will be made during the project.

If you require a DBS check, please contact the DBS or check their website for more details <https://www.gov.uk/disclosure-barring-service-check/contact-disclosure-and-barring-service>

5) External Ethical Reviews

5a)

Is this project liable to scrutiny by external ethical review arrangements? **No**

5b)

Has a favourable ethical opinion been given for this project by a social care research ethics committee, NHS, or by any other external research? **No**

5c)

Will this project be submitted for ethical approval to a social care committee or any other external research ethics? **No**

Please submit any external review documents that you can along with this form

6 Confidentiality and personal data

Does your project involve personal data as defined by the UK GDPR? **Yes**

If you answer YES to 6, please continue, if you answer NO, please go to 11

7a)

What types of personal data will you be collecting and/or processing?

[Use as many terms from the following list that apply: Personal data; Special category personal data; Criminal offence or conviction data; data of children (under 18 years of age); data on vulnerable individuals (e.g. elderly or individuals with certain disabilities); Pseudonymised data (e.g. an NHS digital dataset); anonymised data where there is a risk of re-identification].

- Names but the participants will be anonymous in the writing
- Organisation/Institution
- Position/status in a research context

7b)

Describe the nature of the personal or special category data you will be collecting or using (e.g. opinions, contact details, financial information, health data, information on beliefs)?

N.B. This response should be in line with the project details given in section 3 above and any attached research instruments (e.g. questionnaire survey)

- Opinion
- Phone number/email follow-up

7c)

Where will the personal data be sourced from (e.g. direct from the participant, from a (named) organisation/source, indirectly from observation, national data registry, from social media, etc.)?

- direct from the participant

7d)

If the data is from NHS Digital, a registry (e.g. Eurostat) or organisation, give the identifiers for the datasets and/or reference the sharing agreements

NA

8. Data Protection Impact Assessment

In line with UK Data Protection requirements, please confirm that you have completed the Data Protection Impact Assessment Screening Questionnaire.

Yes

If the questionnaire suggests you need to carry out a DPIA have you contacted the University's data protection officers about this? **Yes, the questions clarified that I do not need DPIA**

9. Data protection by design and default

9a)

Will you be collecting the minimum amount of personal data necessary for the specified research purpose e.g. ensuring all data to be captured can be justified? **Yes**

9b)

Will you use the data only for the purposes of this research project? **Yes**

9c)

If you plan to use the data for additional purposes, will you bring this to the attention of the research participants at point of data collection or, where this is not possible, the University's Data Protection Officer? **NA**

9d)

Will you anonymise personal data wherever and as soon as possible: either at point of data capture, collation, analysis or output? **Yes**

9e)

Will you use pseudonymised data wherever possible in cases where information cannot be anonymised e.g. will you separate research participant contact details from the data to be analysed and/or remove identifiers e.g. specific date of birth and replace with age within a date range? **YES**

9f)

Will you issue research participants with a GDPR compliant participant information sheet/privacy notice at the point of data collection if you are gathering personal data (an example is given with the department ethics information) and will you attached your sheet/notice with this form when submitted? **Yes**

9g)

Will you process personal data to take 'measures or decisions' about particular individuals? [An exception can apply in the case of (NHS REC) approved medical research]. **No**

9h)

Where you are working collaboratively, will you document data flows between the various research partners (e.g. in a basic data flow diagram) and retain a copy of this document with your ethics application? **N/A**

9i)

Where you are working collaboratively, will you ensure the Research and Knowledge Exchange Contracts Team are consulted before any data is gathered or shared to ensure appropriate contracts and/or data sharing arrangements are in place? **N/A**

9j)

Where you are looking to engage third party services such as a transcription service, will you ensure the Research and Knowledge Exchange Contracts Team are consulted before any data is gathered or shared to ensure appropriate contracts and/or data sharing arrangements are in place? **Yes**

9k)

Where you are working collaboratively, will you ensure data transfers to the collaborators are undertaken in accordance with IT guidance? **N/A**

9l)

No data subjects will be identifiable in the final research output / data publication(s)? E.g. there will be no publication of direct quotations from respondents or publication of data that might allow the identification of individuals. **Yes**

9m)

If you answered no, to any of 9a-9l, please confirm that you have consulted the University's Data Protection Officer and obtained any necessary approval. **Yes**

10. Data retention

Data retention may be set by University policy, a data sharing agreement/data provider, be based on professional guidelines, or be approved by a York ethics committee. If the data is not going to be destroyed within a set time-scale please include a justification for this. The University's Research Data Management (RDM) policy applies to research undertaken by postgraduate research students and research staff only. This recommends retaining important data for a period of 10 years. Taught students should retain such data until their degree is awarded. Useful links are given with questions and another useful link on [data sharing is here](#).

10a)

Where will results that include/may include personal data be reported and disseminated (e.g. reference data output, research publication)?

No personal data will be reported and disseminated

10b)

How long will you keep personal data after the project, in what form and for what reason?

I save information data in University York data storage (password and encrypted)

10c)

When will the research data be destroyed, by whom, and how?

After ten years, I will submit an application to the University data sharing to have the data deleted.

10d)

Will any personal or special category data (i.e. data that is not truly and irrevocably anonymised) be deposited in an archive or external repository? **NO**

10e)

Where personal data are to be transferred to an archive or repository, please confirm that your information sheet or privacy notice will: (i) cover the archiving and reuse of any personal data and participant agreement to this; (ii) explain to participants the benefits of any data sharing; (iii) indicate where possible whether research data will be deposited in a named, recognised repository (e.g. Archaeology Data Service, UK Data Service, York's institutional repository, etc.) **NA**

10f)

Where you have special category personal data or criminal data, will it be destroyed in line with an agreed retention policy (set by the University, the data provider, or approved by this ethics committee)? **N/A**

The rest of the form is for all applicants, regardless of whether personal data are being processed

11. Informed consent**11a)**

Will all participants be fully informed why the project is being conducted and what their participation will involve, and will this information be given before the project begins? **Yes**

11b)

Will every participant be asked to give informed consent to participating in the project, before it begins? **Yes**

11c)

Will all participants be fully informed about what data will be collected, and what will be done with these data during and after the project (note if personal data is collected you should have completed sections 7 to 10)? **Yes**

11d)

Will every participant understand what rights they have not to take part, and/or to withdraw themselves and their data from the project if they do take part? **Yes**

11e)

Will every participant understand that they do not need to give you reasons for deciding not to take part or to withdraw themselves and their data from the project and that there will be no repercussions as a result? **Yes**

11f)

If you seek audio, video or photographic recording of participants, will consent be sought? **Yes**

11g)

If the project involves deceiving, or covert observation of, participants, will you debrief them at the earliest possible opportunity? **N/A**

11h)

Explain how you will implement the informed consent scheme and attach copies of your participant information, consent scheme and privacy notice (if personal data being collected)

Participant information: I will use a participant information sheet

Consent: I will use a consent form

Privacy notice: I will use a privacy form
All of the documents will translated in local language (Bahasa)

11i)

If you answered NO to any of a-e, please give a full explanation here.

12. Data Security

12a)

How will the data be collected and stored electronically?

Digital audio recording and stored the data at university data storage with password and encrypted

12b)

Please detail who will have control of, and act as custodian(s) for, data generated by the study.

I as the principal investigator/student take full responsibility for the data I collect through fieldwork

12c)

Will you use University approved software? (if no, please provide further details and consult IT Services before proceeding)

YES

12d)

Will you use University approved file storage (Google Drive, University networked storage, research computing)? (if no, please provide further details)

Google Drive

12e)

Will you store personal or confidential data on laptop(s) with appropriate device encryption? (if no, please provide further details)

Yes

12f)

If capturing audio, will you use an encrypted device for recording (e.g. an Apple iOS device or encrypted voice recorder)? (if no, please provide further details)

YES

12g)

Where data is held on an encrypted portable device (e.g. laptop, tablet) will you back it up to a University approved service as soon as possible and perform periodic checks to ensure data is being backed up appropriately? **Yes**

12h)

Will you ensure confidential information is encrypted before it is transmitted/shared digitally?

Yes

12i)

Please detail what other protections will be used for digital data (e.g. access/edit permissions, procedural safeguards re downloads/making copies, remote access via VDS/VPN, 2 factor authentication)?

Access/edit permissions and remote access for VPN

12j)

Have you reviewed the user commitments under the Policy for the safe use of University information on devices. **YES**

12k)

Detail anything in the user commitments that will pose a challenge in carrying out your proposed research.

I do not face any challenges related to user commitments

12l)

How will hard copy/analogue data (e.g. in paper form) be collected, sent and stored?

The primary data in this study were obtained through interviews, either informal or semi-structured interviews, so that data were obtained through audio from recordings. Following that, the data is transferred directly to laptop/devices and the time of data collection is described. In addition, some data will be written on note book, and I will keep them with me in my locked bag or university office.

12m)

Will you ensure that personal data or confidential data held on paper are stored in a lockable filing cabinet or container, and/or a locked room in secure premises? (if no, please provide further details)

Yes, I will

12n)

How will devices be physically protected (e.g. in transit, when not in use or left unattended)?

I applied lock system in my Laptop and other devices, and keeping them in the locked bag at the office.

12o)

Will you ensure the device(s), accounts, or storage area(s) used to store data are not accessible to any unauthorised parties? **Yes**

12p)

Set out any other measures or procedures for maintaining the confidentiality of information about the participant and information that the participant shares (e.g. other methods of anonymisation)

To ensure data confidentiality, I will ensure that information about participants' personal data is anonymous.

13. Risk of harm

13a)

Is there any significant risk that your project may lead to physical harm to participants or researchers? **No**

13b)

Is there any significant risk that your project may lead to psychological or emotional distress to participants? **No**

13c)

Is there any significant risk that your project may lead harm to the reputation of participants, or their employers, or of any other persons or organisations? **No**

13d)

Is there a significant possibility that the project will encourage children under 18 to access inappropriate websites, or correspond with people who pose risk of harm? **No**

13e)

Will the project incur any other risks that arise specifically from the use of electronic media ([useful link to social media research](#))? **No**

13f)

If you answered Yes to any of a-e: explain the nature of the risks involved; why it is necessary for the participants or researchers to be exposed to such risks; how you propose to assess, manage and mitigate any such risks; the arrangements by which you will ensure that participants understand and consent to these risks; the arrangements you will make to refer participants or researchers to sources of help, if they are seriously distressed or harmed as a result of taking part in the project; the arrangements for recording and reporting any adverse consequences of the research.

14. Risk of disclosure of harm or potential harm

14a)

Is there a significant risk that the project will lead participants to disclose evidence of previous criminal offences, or their intention to commit criminal offences? **No**

14b)

Is there a significant risk that the project will lead participants to disclose evidence that children or vulnerable adults are being harmed, or are at risk of harm? **No**

14c)

Is there any significant risk that your project may lead harm to the reputation of participants, or their employers, or of any other persons or organisations? **No**

14d)

Is there a significant risk that the project will lead participants to disclose evidence of serious risk of other types of harm? **No**

14e)

If you answered **Yes** to any of these questions explain: why it is necessary to take the risks of potential or actual disclosure; what actions you would take, if such disclosures were to occur; what information you will give participants about the possible consequences of disclosing information about criminal or serious risk of harm.

15. Payment of participants

15a)

Do you intend to offer participants cash payments or any other kind of inducements or compensation for taking part in your project? **No**

15b)

Is there any significant possibility that such inducements will cause participants to consent to risks that they might not otherwise find acceptable? **No**

15c)

Is there any significant possibility that the prospect of payment or other rewards will systematically skew the data provided by participants in any way? **No**

15d)

Will you inform participants that accepting compensation or inducements does not negate their right to withdraw from the project? **No**

15e)

If you answered Yes to any of these questions explain the nature of the inducements or the amount of the payments that will be offered; the reasons why it is necessary to offer payments; why you consider it is ethically and methodologically acceptable to offer payments.

16. Capacity to give valid consent

16a)

Do you propose to recruit any participants who are under 18 years of age? **No**

16b)

Do you propose to recruit any participants who have learning difficulties? **No**

16c)

Do you propose to recruit any participants with communication difficulties, including difficulties arising from limited facility with the English language? **Yes**

16d)

Do you propose to recruit any participants who are very elderly or infirm? **No**

16e)

Do you propose to recruit any participants with mental health problems or other medical problems that may impair their cognitive abilities? **No**

16f)

Do you propose to recruit any participants who may not be able to understand fully the nature of the research and the implications for them of participating in it? **No**

16g)

If you answered Yes to any of the questions explain: how you will ensure that the interests and wishes of participants are understood and taken into account; how in the case of children the wishes of their parents or guardians are understood and taken into account.

YES, Native speaker

17. Is participation genuinely voluntary?

17a)

Are you proposing to recruit participants who are employees or students of the University of York or of organisation(s) that are formal collaborators in the project? **No**

17b)

Are you proposing to recruit participants who are employees recruited through other business, voluntary or public sector organisations? **No**

17c)

Are you proposing to recruit participants who are pupils or students recruited through educational institutions? **No**

17d)

Are you proposing to recruit participants who are clients recruited through voluntary or public services? **No**

17e)

Are you proposing to recruit participants who are living in residential communities or institutions? **Yes**

17f)

Are you proposing to recruit participants who are in-patients in a hospital or other medical establishment? **No**

17g)

Are you proposing to recruit participants who are recruited by virtue of their employment in the police or armed services? **No**

17h)

Are you proposing to recruit participants who are being detained or sanctioned in the criminal justice system? **No**

17i)

Are you proposing to recruit participants who may not feel empowered to refuse to participate in the research? **No**

17j) If you answered Yes to any of these questions explain: how your participants will be recruited; what steps you will take to ensure that participation in this project is genuinely voluntary.

18. Other ethical risks

18a)

Are there any other ethical issues or risks of harm raised by your project that have not been covered by previous questions? **No**

18b)

If you answered Yes to this question, explain: the nature of these ethical issues and risks; why you need to incur these ethical issues and risks; how you propose to deal with these ethical issues and risks.

19. Principal Investigator's Declaration

Please ensure that you can answer YES to all questions below:

19a)

I have completed all the required sections and kept a copy for my own records. **Yes**

19b)

I confirm that I will carry out the project in the ways described in this form. I will immediately suspend research and request a new ethical approval if the project subsequently changes the information I have given in this form. **Yes**

19c)

I confirm that I, and all members of my research team (if any), have read and agree to abide by the University's Code of practice and principles for good ethical governance **Yes**

19d)

I confirm that I, and all members of my research team (if any), have read and agree to abide by the University's Research Data Management Policy **Yes**

Signatures

Submit this form and any attachments by e-mail **including your surname** in the filename.

You should type your name in the signature space.

An email attachment sent from your University inbox will be assumed to have been signed electronically.

Students must get their Project Supervisor to countersign this declaration. Students should not submit forms directly. The supervisor must check the application and submit it.

Principal Investigator

Signed Abdul Kodir (Principal Investigator or Student)

Date

Students must ask their Project Supervisor to type their name here and to submit the application.

The email submission will be taken as an electronic countersignature

Countersigned J E Ensor (Student's Project supervisor)

Date

I have read this form and confirm that it covers all the ethical issues raised by this project fully and frankly. I also confirm that these issues have been discussed with the student and will continue to be reviewed in the course of supervision.

Submit to: environment-ethics@york.ac.uk

For office use only

Date form initially received: 21/06/2023

Date considered by committee: 27/06/2023

Approve? Yes

Comments:

Date of reply to applicant: 27/06/2023

Signature: Colin McClean

Ref: DEGERC/Res/21062023/1

Appendix B

PARTICIPANT INFORMATION SHEET

Invitation to take part in Political Ecology of Natural Resources Contestation in the North Kendeng Mountains research

My name is Abdul Kodir, and I am a PhD student at the Department of Environment and Geography, University of York, England. My research focuses on the dynamics of natural resource management in the North Kendeng mountain region, mainly how the public responds to Karst mining for cement factory needs.

This research interview has the purpose of seeking your views. Your contribution will help research related to the study of Natural Resource Management in North Kendeng Mountain, and therefore your voice will be very important in this thesis.

The semi-structured interview will last about an hour, and I would like to digitally record the interview to ensure that your views are wholly and accurately reflected in my thesis. The personal data I will collect from you is only your name, institution, and your phone or email, and will be shared only with the University data sharing team.

In addition, I will use an encrypted voice recorder to maximize data security. If you prefer the interview is not recorded, please let me know, and I will stop it and take notes for the record. Moreover, if you decide to participate, you are welcome to request a break or interview anytime. Besides that, you can decline a specific answer and can also provide other information.

What I will do with the data?

Any data as part of this research will be anonymized after I have collected will be held securely. In addition, any documents containing personal details (i.e. consent forms) will be kept in a separate cabinet from electronic data, and all electronic data will be stored securely for ten years.

The thesis will be published in English and online version in the university thesis website. If you would like to obtain the results of this thesis in Indonesian, I will provide executive summaries of this thesis in Indonesian.

This research will help explore the study of Natural Resources Contestation in Indonesia and significantly improve the implementation of Natural Resources Governance. Your contribution is significant, and I hope you agree to participate in this research.

If you have any questions after the interview, you can contact me: ak2067@york.ac.uk or my supervisor Dr Richard Friend at richard.friend@york.ac.uk.

Do you have any questions before we start the interview?

Appendix C

CONSENT FORM

Title: The Political Ecology of Natural Resources Contestation in North Kendeng Mountain

My name is Abdul Kodir, and I am a PhD student at the Department of Environment and Geography, University of York, England. My research focuses on the dynamics of natural resource management in the North Kendeng mountain region, mainly how the public responds to Karst mining for cement factory needs. If you have questions after the interview, you can contact me: at ak2067@york.ac.uk or my PhD thesis supervisor Dr Richard Friend at richard.friend@york.ac.uk and Professor Jonathan Ensor at jon.ensor@york.ac.uk

I would be grateful if you would sign this consent form stating that I have explained the interview process to you thoroughly and that you understand the interview process and all procedures related to data storage and analysis.

Participant Consent

You are over 18 years old, and you are willing to provide information without any coercion and pressure.

☐

I voluntarily agree to take part in this research to give information related to Natural Resources Contestation in North Kendeng Mountain, which Abdul Kodir is conducting.

☐

I agree for my anonymised data to be used in the PhD dissertation or scientific publication
(Book or journal)

☐

I confirm that I have read and understood the information sheet for the above study and have had the opportunity to ask any questions.

☐

I understand that my participation is voluntary and that I am accessible to withdrawal
any time during the interview without giving any reason.

☐

I agree that Abdul Kodir can record, transcribe and translate the interview.

☐

Name of Participant

Date

Signature

Name of Interviewer

Date

Signature

Appendix D

DRAFT - INTERVIEW GUIDE 1

Background Information:

- Name
- Expertise Background
- Relationship with the project

Production of Knowledge and Expertise (EIA and SEA Reports)

- Drafting on EIA and SEA Process
- Expertise involved in
- The objective of EIA and SEA
- Recommendation from EIA and SEA
- Review of the EIA and SEA results

Challenges to Knowledge and Expertise:

- Perspective on Karst Management in the North Kendeng Mountains
- Alternative studies for Karst management in the North Kendeng Mountains (except EIA/SEA)
- Influencing EIA/SEA to decision-making

Karst Ecosystem and Underground River:

- Academic/expertise perspective on the Karst ecosystem
- The debate about old Karst and young Karst
- Relation Karst with the underground river
- Discussion of Karst ecosystem in the EIA and SEA reports

Community Involvement:

- Involvement of local communities in EIA & SEA report
- Local Community's Response to EIA and SEA Report
- A survey conducted by local communities and NGO
- Influencing surveys from local communities to decision-making

Academic Perspective:

- Positions and roles of scientists/academics/expertise involved in the cement case in the North Kendeng Mountain region
- Contributing expertise on decision-making in Karst management
- Perspective from expertise/academics on the recommendation or result from EIA and SEA