



Adaptive Governance in Regional Development Planning: An Assessment of North Sumatra's Preparedness to Face Energy and Environmental Uncertainty

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Abstract: This study assesses the degree to which adaptive governance principles are incorporated into four regional development planning documents of North Sumatra Province, aiming to manage the increasing energy crises and climate threats. Four aspects of adaptive governance are included in the analysis using a document-based evaluation framework: (1) reactivity to uncertainty; (2) scenario-based projection; (3) flexibility of development indicators; and (4) institutional coordinating capacity. The 2025–2045 Regional Long-Term Development Plan (Rencana Pembangunan Jangka Panjang Daerah, RPJPD), the 2025–2029 Technocratic Draft of the Regional Medium-Term Development Plan (Rencana Pembangunan Jangka Menengah Daerah, RPJMD), the 2024–2026 Regional Development Plan (Rencana Pembangunan Daerah, RPD), and the Development Planning Agency's 2024–2026 Strategic Plan are among the documents examined. Document content was categorized using a qualitative thematic coding process in relation to the assessment matrix. The findings show that planning is still technocratic and linear, lacking institutional tools to facilitate adaptive decision-making, risk-responsive indicators, and alternative scenarios. This disparity indicates that the planning tools required to anticipate crisis-driven disruptions in the energy and environmental sectors are not aligned with the sustainability agenda. In order to improve provincial readiness and hasten the achievement of Sustainable Development Goals (SDGs) 7, 13, and 16, the study suggests integrating risk-based planning, dynamic performance indicators, and cross-sector institutional platforms.

Keywords: Adaptive governance; Regional development planning; Energy uncertainty; Climate risk; Document analysis; Planning instrument; Indonesia

1 Introduction

Because of growing global uncertainty, regional growth is at a turning point right now [1]. Planning requirements have changed from sectoral and linear to more adaptive, anticipatory, and risk-responsive due to the pandemic, geopolitical conflicts, energy problems, and dramatic climate change. In light of this, adaptive governance has become a key concept in the formulation of public policies and the planning of sustainable development [2]. A governing paradigm with roots in social ecology, adaptive governance was created to deal with intricate and unpredictable systems [3]. Adaptive governance acknowledges that social and ecological systems are dynamic and uncertain, in contrast to traditional governing approaches that place an emphasis on stability and predictability. Adaptive governance is distinguished by its capacity to incorporate a variety of players in decision-making, react swiftly to change, and learn from experience [4]. This method necessitates improved inter-institutional collaboration, alternative scenarios, and adaptable indicators in the context of development planning.

Through responsive, adaptable, and learning-based procedures, institutions and policies can adjust to uncertainty, according to the concept of adaptive governance. In the context of the environment and energy, adaptive governance encompasses the following, according to literature [4–6]: (1) responding to systemic risks; (2) anticipating changes through scenarios; (3) flexibility of indicators and policies; and (4) cross-sector institutional coordination.

While adaptive governance has been widely discussed conceptually, empirical evidence from regional planning practice shows that the implementation gap remains persistent. According to recent empirical research, Indonesian regional planning practices prioritize output-oriented, linear development above adaptive, risk-responsive strategies.

Long-term planning frameworks still rely on fixed economic growth projections and lack contingency mechanisms for disaster and energy disruptions, according to research on the use of provincial planning instruments in West Java and Central Kalimantan [7, 8]. According to studies [9, 10], provincial governance in the energy sector frequently views the energy transition as an infrastructure goal rather than a systemic change that calls for institutional reform and proactive coordination. Similar trends have also been reported across Asia, where weak cross-agency coordination and the limited integration of adaptive governance mechanisms have constrained the mainstreaming of the SDGs [11, 12]. These empirical results show that adaptive governance is still not widely used in Indonesian planning.

Research from Southeast Asia confirms this trend. Due to disjointed institutional mandates, provincial administrations in Malaysia and Thailand struggle to include climate-risk scenarios into medium-term development plans [13]. When taken as a whole, these studies show that a persistent policy issue in emerging economies is the disconnect between sustainability narratives and adaptive planning tools. This emphasizes how important it is to look at whether adaptive governance principles are fundamentally incorporated into North Sumatra's planning documents rather than just using terms related to sustainability.

Given that Indonesia is going through an energy transition and facing growing environmental hazards, this background is extremely pertinent to the country [14]. More precisely, North Sumatra Province has many complicated features, including a large land area, climate change susceptibility, fossil fuel reliance, and the requirement for sustainable and equitable economic transformation. The North Sumatra Provincial Medium-Term Development Plan (Rencana Pembangunan Jangka Panjang Daerah, RPJPD) 2025–2045, the North Sumatra Technocratic Medium-Term Development Plan (Rencana Pembangunan Jangka Menengah Daerah, RPJMD) 2025–2029, the Regional Development Plan (Rencana Pembangunan Daerah, RPD) 2024–2026, and the Strategic Plan (Renstra) of the Research and Development Agency (Bappelitbang) 2024–2026 are among the strategic planning documents that the provincial government has prepared [15–18].

The wide region of North Sumatra Province (around 72,981 km²) has a variety of geographical features, from volcanic plateaus to coastal regions vulnerable to erosion and flooding [19]. North Sumatra continues to rely significantly on fossil fuels for both transportation and energy, according to data from the National Development Planning Agency (Badan Perencanaan Pembangunan Nasional, BAPPENAS) [20]. Geothermal, hydro, and solar energy are examples of innovative and renewable energy sources whose promise has not yet been fully realized. In addition, a National Disaster Management Agency (Badan Nasional Penanggulangan Bencana, BNPB) research states that during the previous five years, North Sumatra has seen a rise in hydrometeorological disasters, such as landslides and floods [21]. The necessity of a growth planning system that can foresee energy and environmental risks through an adaptable and responsive institutional approach is highlighted by this circumstance.

Initial assessments, however, show that despite the growing complexity and interconnectedness of the challenges being addressed, these agreements have not consistently embraced an adaptive governance strategy.

Table 1 demonstrates that the four primary planning documents for North Sumatra Province do not entirely represent an adaptive approach in both structure and content. Furthermore, the performance metrics in use are not made to adjust to the changing dynamics of environmental, energy, and global crisis concerns. However, Sustainable Development Goal (SDG) 13 (Addressing Climate Change) of the 2030 Agenda for Sustainable Development specifically calls for risk-based and adaptable institutional responses and policy frameworks [22]. The significance of adaptable policy frameworks that are prepared to take on new issues is further emphasized by SDG 7 (Affordable and Clean Energy) and SDG 16 (Effective, Accountable, and Inclusive Institutions) [23].

Table 1. North Sumatra Provincial planning documents' reflection of adaptive features and pertinence to the Sustainable Development Goals (SDGs)

Adaptive Dimension	RPJPD	Technocratic RPJMD	RPD	Bappelitbang Strategic Plan	Related SDGs
Climate and energy resilience vision	General and normative	There is, but it is explicit	Not visible	There isn't any	SDG 7, 13
Alternative development scenarios	Not available	Not available	Not available	Not available	SDG 13
Risk-based and flexible indicators	There are no adaptive indicators	Fixed indicators	Not detailed	There isn't any	SDG 13, 16
Institutional responses to uncertainty	Not mentioned	Minimal explanation	There isn't any	There isn't any	SDG 16
The elaboration of SDGs in energy and environmental sector policies	General and normative	Not yet integrated programmatically	There isn't any	Not referenced	SDG 7, 13

Note: RPJPD, Regional Long-Term Development Plan (Rencana Pembangunan Jangka Panjang Daerah); RPJMD, Regional Medium-Term Development Plan (Rencana Pembangunan Jangka Menengah Daerah); RPD, Regional Development Plan (Rencana Pembangunan Daerah).

The comparison presented in Table 2 illustrates how the adaptive governance principles identified in the literature are (or are not) reflected in the planning documents of North Sumatra Province.

Table 2. Comparing the application of adaptive governance principles in North Sumatra Provincial planning

Principles of Adaptive Governance [24, 25]	Implementation in North Sumatra Documents
Responsive to uncertainty (risk-aware)	Not yet included as a basic principle
Scenario-based and long-term projections	No scenarios or projection models found
Dynamic and customizable indicators	Indicators are fixed, not risk-based
Coordination between sectors and actors	Weak, no cross-sectoral mechanism yet
Policy learning mechanisms	No reflective evaluations were found

The aforementioned comparison supports the conclusion that North Sumatra’s planning documents do not yet adhere to the literature’s stated principles of adaptive governance. This disparity is a major obstacle to the region’s ability to adapt to the complexity of the energy transition and climate change. This article is significant because it adds to the body of knowledge on how governance readiness can be assessed systemically at the subnational level, (1) by offering an evaluative framework based on adaptive governance that can be directly applied to official regional documents, (2) by highlighting the disconnect between planning orientation and current global challenges, and (3) by adding to the body of knowledge on the subject.

Based on the theoretical construction and empirical needs, the conceptual framework of this study is illustrated in Figure 1.

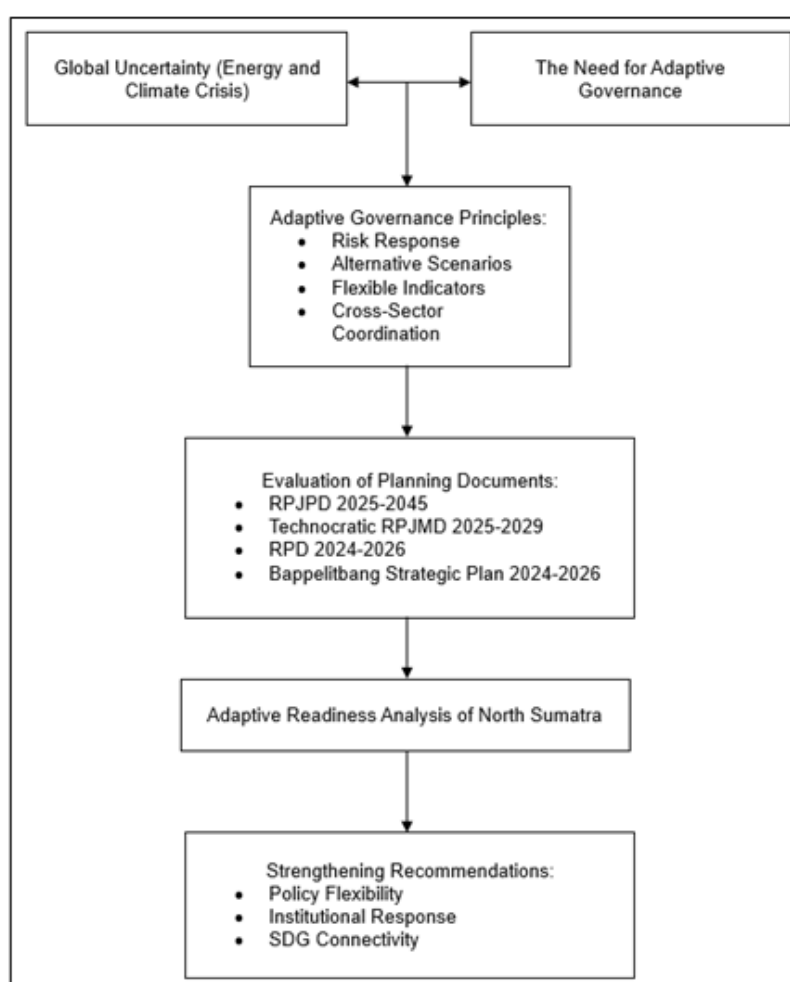


Figure 1. Research thinking framework

Note: RPJPD, Regional Long-Term Development Plan (Rencana Pembangunan Jangka Panjang Daerah); RPJMD, Regional Medium-Term Development Plan (Rencana Pembangunan Jangka Menengah Daerah); RPD, Regional Development Plan (Rencana Pembangunan Daerah); SDG, Sustainable Development Goal.

This framework illustrates how global unpredictability necessitates adaptive governance, whose tenets are assessed in regional planning documents to assess North Sumatra Province's preparedness and ultimately produce specific suggestions connected to the SDGs.

"To what extent do regional development planning documents in North Sumatra Province contain adaptive governance principles to address energy and environmental uncertainty, and how can they be strengthened?" is the research question based on this description. Analyzing the suitability of adaptive principles in regional planning documents, identifying policy gaps with global demands, and formulating systemic recommendations for bolstering regional institutions and planning based on adaptive governance and the SDGs are the goals of this study.

This study examines four important planning documents in North Sumatra Province using a document-based evaluative approach (policy document analysis) to address these problems. Reflecting adaptive governance concepts and their applicability to sustainable development objectives will be the main focus of the evaluation.

By operationalizing adaptive governance concepts as an analytical tool, this work contributes to ongoing scholarly conversations on subnational environmental and energy governance, while also providing a case-based assessment of provincial planning documents. The study focuses on the internal architecture of formal planning instruments and investigates whether these instruments are structurally equipped to respond to uncertainty arising from energy transition and environmental risks, rather than evaluating sustainability narratives or policy commitments alone. In this way, adaptive governance is viewed as a diagnostic tool for determining rigidity and flexibility in development planning systems rather than just as a normative goal.

Additionally, this study provides insight into how technocratic planning logics may limit institutional flexibility in uncertain times by applying this paradigm to various planning instruments with varying temporal horizons. The analytical approach developed in this study applies to other subnational governance contexts, especially in emerging economies where development planning systems are under increasing pressure to balance administrative stability with disruptions related to energy and climate change, even though the empirical analysis is located in North Sumatra Province.

2 Methodology

2.1 Type and Method of the Research

This study used a document-based policy evaluation method in conjunction with a descriptive-qualitative methodology [26]. This approach's main goal is to evaluate how far the adaptive governance concepts required to handle energy and environmental uncertainty have been incorporated into regional development planning papers.

This approach's theoretical foundation is based on the ideas of Moynihan and Soss [27] and Cairney [28], who highlighted that public papers are expressions of the beliefs, tactics, and policy directions of state actors rather than just administrative outputs. As a result, document analysis enables scholars to assess the institutional and cognitive frameworks that influence the course of regional development.

2.2 Sources and Types of Data

The official planning documents for North Sumatra Province, which were created and prepared by the local government between 2023 and 2024, provide the study's main source of data. These files are:

- (1) The Regional Medium-Term Development Plan for North Sumatra Province, 2025–2045;
- (2) The Regional Medium-Term Development Plan 2025–2029 of North Sumatra Province;
- (3) The Regional Development Plan 2024–2026; and
- (4) The Strategic Plan (Renstra) 2024–2026 of North Sumatra Province.

These publications include technical materials from planning organizations as well as the long-term, medium-term, and short-term directions for regional planning. The RPJMN 2020–2024 and the Indonesian SDGs document, as well as scholarly works and publications from global organizations like the United Nations Development Programme (UNDP) and Organisation for Economic Co-operation and Development (OECD), provide further data.

2.3 Assessment Tool for Adaptive Governance

The assessment tool is founded on the adaptive governance concepts established by the OECD [3, 29, 30]. Table 3 presents the assessment matrix used to evaluate adaptive governance in regional planning documents based on the four analytical dimensions.

- (1) Reaction to ambiguity;
- (2) Making use of long-term forecasts and scenarios;
- (3) Adaptable and dynamic indications; and
- (4) Institutional responsiveness and coordination across sectors.

The four analytical dimensions, response to uncertainty, use of alternative scenarios, flexibility of indicators, and institutional coordination, were chosen based on how directly they relate to the formal development planning tools' structural design. Instead of just stating policy goals, these dimensions show the fundamental processes by

which planning systems convert uncertainty into operational decision-making guidelines. These components are widely recognized in the literature on adaptive governance as fundamental characteristics that allow organizations to recalibrate plans, indicators, and coordinating arrangements when baseline assumptions are no longer valid.

Table 3. Assessment matrix for adaptive governance in planning documents

Evaluative Dimension	Assessment Criteria	Evaluation Questions
Response to uncertainty	There is recognition of the risk of energy/climate crisis	Does the document mention potential energy crises or climate change as development challenges?
Use of alternative scenarios	The existence of scenarios or alternative development paths	Is there a backup scenario if the main projections are not achieved?
Flexible indicators	Indicators can be adapted to risk dynamics	Can development indicators be adjusted if the context changes?
Institutional response	The existence of crisis response policies and inter-sectoral collaboration	Are there mechanisms for institutional adaptation, cross-OPD coordination, or responsive reform?

Note: OPD, Regional Apparatus Organizations (Organisasi Perangkat Daerah).

The current study emphasizes aspects that are clearly visible in the textual and procedural architecture of planning documents, in contrast to more general adaptive governance frameworks that also place an emphasis on participation, social learning, or budgetary flexibility. Stakeholder participation and feedback learning are examples of dimensions that are less clearly traceable in formal planning tools since they frequently appear during policy implementation and deliberative processes. On the other hand, planning logic and regulation design incorporate uncertainty recognition, scenario utilization, indicator flexibility, and institutional coordination, enabling systematic document-based review.

As a result, the suggested framework serves as a diagnostic tool for assessing the extent to which planning tools are structurally able to accommodate uncertainty rather than as a normative checklist of sustainable features. This method offers a transportable analytical lens for assessing governance readiness in subnational contexts dealing with energy and environmental volatility and allows for a more accurate evaluation of rigidity versus adaptability within development planning systems.

2.4 Methods of Data Analysis

A thematic document content analysis approach was used to analyze the data [31]. Key indicators were identified based on adaptive dimensions, each document was thoroughly read and open-coded, document content was grouped according to themes (thematic grouping), and the content's alignment with the SDGs (specifically SDGs 7, 13, and 16) and the principles of adaptive governance was evaluated. Table 4 presents the thematic coding framework used to categorize document content according to the adaptive governance dimensions and their correlation with the SDGs.

Table 4. Flexible thematic coding framework

Main Theme	Document Content Indicator	SDGs Correlation
Energy uncertainty	Energy crisis narrative, dependence on fossil fuels	SDG 7
Environmental risks	Climate change, hydrometeorological disasters	SDG 13
Anticipatory scheme	Alternative scenarios, contingency planning	SDG 13
Flexible indicators	Risk-based adaptive indicators	SDG 16
Institutional response	Institutional reform, coordination of regional apparatus organizations	SDG 16

2.5 Coding Procedures and Reliability

A systematic thematic coding process was used for the document analysis. Initially, four adaptive governance dimensions, recognition of uncertainty, use of alternative scenarios, flexibility of indicators, and institutional

coordination and learning, derived from OECD [3, 29, 30], were used to deductively develop an initial codebook. Second, as new patterns, such as “normative sustainability references”, “infrastructure-centered energy transition”, and “absence of contingency mechanisms”, emerged during document reading, inductive codes were added.

Statements and clauses related to each analytical dimension were identified using open coding. The four provincial planning documents were then compared after these codes were categorized into axial themes. Table 5 presents an example of the coding process, illustrating how document excerpts were transformed into open codes and subsequently grouped into axial themes.

Table 5. Example of coding process from document excerpts to axial themes

Excerpt from Planning Document	Open Code	Axial Theme
“...increasing energy access through infrastructure development and urban expansion initiatives...”	Expansion-oriented energy agenda	Absence of adaptive energy transition
“...indicator targets for the next five years remain fixed to maintain consistency in budgeting...”	Fixed indicators	Lack of indicator flexibility
“...coordination of priority programs is carried out by each OPD according to its mandate...”	Sectoral program execution	Weak cross-sectoral institutional mechanisms

Note: OPD, Regional Apparatus Organizations (Organisasi Perangkat Daerah).

Peer checking was used to verify coding reliability. The first and second authors independently coded the RPJPD and RPJMD and compared their interpretations. Until an agreement was reached, disagreements were discussed. The final codes were then uniformly implemented across the Bappelitbang Strategic Plan and the RPD. The analytical process’s dependability and transparency were enhanced by the application of a theory-driven codebook and iterative peer review.

The four documents were evaluated using the same evaluative approach despite their differences in planning horizons and legal hierarchy because they are all tools that direct provincial growth. Therefore, the assessment matrix was designed to ascertain if adaptive governance components were structurally integrated within each document in accordance with its respective function rather than to equate their institutional roles.

2.6 Validity and Reliability of the Data

Document searches were carried out methodically using papers that had been approved or formally published by provincial government entities in order to preserve the validity of the material [32]. The lead researcher carried out the full coding process by hand, avoiding interpretation bias by cross-validating (peer-checking) the RPJPD and RPJMD documents.

The use of standardized, theory-based assessment tools from numerous worldwide studies, including those conducted by the OECD and UNDP, preserved consistency (reliability). This method provides a uniform framework for comparing documents and principles.

2.7 Location and Justification for Choosing the Study Area

One of the biggest provinces in Indonesia with major energy and environmental issues is North Sumatra Province, which is why it was selected [33]. The region is vulnerable to environmental hazards, has a significant reliance on fossil fuels, and has a sizable population. Renewable energy potential is also underused. It is very pertinent to the adaptive preparedness study since its planning documents are thorough and span the short, medium, and long term.

It is anticipated that using this method, the study will thoroughly uncover significant discrepancies between the regional development goal and the real requirements for environmental and energy sector adaptation to global concerns. The results of the additional evaluation will be shown in the section that follows.

3 Results

The evaluation shows that the four provincial planning papers all follow the same basic pattern. None of the documents have adaptive mechanisms that would enable plans, indicators, or institutional arrangements to alter in response to volatility generated by energy and climate change, even if they present development problems and sustainability rhetoric. A comparison study for each analytical dimension is shown in the results below.

3.1 Recognition of Uncertainty

Although national and international trends are acknowledged in all publications, uncertainty is presented descriptively rather than practically. Global disruptions are mentioned in the RPJPD, but they are not converted into risk-responsive strategies. The RPJMD completely ignores any mention of ambiguity, portraying development as a linear and stable process. While the Bappelitbang Strategic Plan similarly views uncertainty as background information with no institutional ramifications, the RPD observes socioeconomic variations without creating mechanisms for responsive adjustment (Renstra Bappelitbang). To put it briefly, uncertainty is acknowledged at the narrative level but is not included in planning logic.

3.2 Use of Alternative Scenarios

All of the documents lack scenario-based paths. A single long-term growth trajectory without backup plans is described in the RPJPD. Scenario-driven adaptation is fundamentally excluded by the RPJMD, which states that indicators stay fixed for planning consistency. In order to adjust programs during external shocks, the RPD adopts set annual priorities without triggers. According to Renstra Bappelitbang, the Bappelitbang Strategic Plan also assigns duties according to regular mandates without permitting deviation under changing development situations. This illustrates how deterministic planning predominates and anticipatory decision-making is lacking.

3.3 Flexibility of Indicators

Instead of being adaptable benchmarks, performance indicators are designed as set targets. To preserve institutional continuity, the RPJPD creates reliable long-term indicators. Five-year indicators are not intended to alter during the planning cycle, according to the RPJMD. The Bappelitbang Strategic Plan preserves Regional Apparatus Organizations (Organisasi Perangkat Daerah, OPD)-specific metrics regardless of external circumstances, while the RPD defines annual indicators without any recalibration process (Renstra Bappelitbang). As a result, the indicator system does not provide learning-based performance adjustment and instead assumes stable operating settings.

3.4 Institutional Coordination and Learning

Instead of fostering collaborative learning, institutional frameworks perpetuate sectoral fragmentation. By dividing up duties by sector, the RPJPD establishes vertical rather than cross-sector connections. Instead of using interagency platforms, the RPJMD assigns coordination domestically to each OPD in accordance with current mandates. By placing coordination within OPD units rather than between them, the RPD employs comparable patterns. There are no shared reflection or crisis response procedures in the Bappelitbang Strategic Plan, which formalizes routine coordinating formats (Renstra Bappelitbang). Therefore, rather than collective flexibility, institutional capacity depends on sectoral autonomy.

3.5 Cross-Document Pattern

A distinct planning paradigm is evident in all four documents: the provincial planning system is intended to be stable, predictable, and administered in an orderly manner. Although this paradigm guarantees continuity, it restricts the province's ability to deal with uncertainty. Development performance becomes extremely susceptible to external shocks in the absence of tools for alternative scenarios, dynamic indicators, or interagency institutional learning. As a result, despite the articulation of sustainability goals, the planning tools do not offer structural support for flexible decision-making.

4 Discussion

The degree to which four important provincial development planning tools in North Sumatra use adaptive governance principles was investigated in this study. Through the use of a document-based evaluative framework based on adaptive governance literature, the analysis shows that although environmental risk and energy transition-related sustainability challenges are acknowledged narratively, the formal architecture of planning instruments is still primarily technocratic, linear, and stability-oriented.

The results show that the documents under review do not consistently include adaptive governance mechanisms, including flexible performance indicators, scenario-based planning, and institutional platforms for cross-sectoral learning. Crucially, this absence should not be seen as a lack of general policy awareness or governance capability. Instead, it represents the design logic of formal planning tools, which place more emphasis on administrative control, predictability, and accountability than on learning-based adjustment and uncertainty-responsiveness. In this way, institutional frameworks meant to guarantee consistency and order in development planning give rise to rigidity rather than opposition to change.

From a theoretical standpoint, this study advances research on adaptive governance by illuminating how planning tools themselves might serve as sources of institutional rigidity. This study focuses on the procedural and

structural characteristics of planning documents, whereas adaptive governance is frequently considered in relation to implementation procedures, stakeholder participation, or policy results. In doing so, it echoes larger discussions on performance rigidity and policy adjustment in public administration by highlighting how fixed metrics and predictable trajectories may limit policy adaptation under volatile conditions [34].

The results have important practical ramifications for subnational environmental and energy governance. Development planning systems without built-in flexibility run the risk of misinterpreting necessary adaptation as underperformance in environments marked by climate-related disruptions, energy price volatility, and fast socioeconomic change. SDG 7 (Affordable and Clean Energy), SDG 13 (Climate Action), and SDG 16 (Effective, Accountable, and Inclusive Institutions) may be more difficult to achieve as a result of this dynamic [22, 23]. Therefore, it becomes crucial to incorporate adaptive processes into planning tools rather than depending just on ad hoc policy responses in order to match operational governance capability with sustainability goals. The analytical framework created in this study has wider applicability for other subnational governance contexts, especially in developing and emerging economies, even if the empirical analysis is concentrated on North Sumatra Province. Coordinating across sectors, managing environmental variability, and striking a balance between stability and flexibility are common problems in many such environments. This study enhances previous research on institutional collaboration and adaptive governance by offering a diagnostic lens to evaluate governance readiness through formal planning tools [30, 35].

There are a few restrictions to be aware of. This study does not look at how planning instruments are interpreted or changed during implementation; instead, it solely depends on document analysis. In order to investigate how adaptive mechanisms, or their lack thereof, shape real-time policy responses, future research could build on this work by integrating document analysis with interviews, process tracking, or budgetary analysis. Understanding how various institutional designs affect adaptive ability in subnational governance systems would be further enhanced by comparative research across provinces or sectors.

This study's conclusion emphasizes the significance of reconsidering development planning tools as governance technologies that influence how public institutions handle uncertainty. Stronger sustainability narratives and planning frameworks that enable recalibration, learning, and coordinated response when development realities deviate from initial assumptions are both necessary for bolstering adaptive governance at the subnational level.

5 Policy Implications

The results of this study show that North Sumatra's province development planning needs structural mechanisms that allow the planning system to adapt to volatility caused by energy and climate. Therefore, rather than concentrating on isolated agencies, policy reform should concentrate on multi-level governance tools that foster flexibility, anticipatory capacity, and institutional learning across administrative scales. There are three suggested areas of intervention.

Adaptive development scenarios should first be incorporated into long-term and medium-term planning tools at the provincial level. Scenario-based pathways that distinguish between baseline, disruption, and transition situations can be incorporated into the RPJPD and RPJMD. Program choices and financial arrangements should be included in each scenario. Bappelitbang is in charge of requiring OPD to map the effects of scenario variations for sectoral programs and integrating scenario tools into the plan writing process.

Second, performance metrics should be modified at the district/municipal level to enable dynamic adjustment in response to shifting external circumstances. Key indicators should use trigger-based thresholds in place of single numerical targets. These thresholds activate changes in priorities or budgets if they are surpassed. To coordinate changes and avoid inconsistencies between province and district/municipal work plans, Bappelitbang Provinsi and Bappeda Kabupaten/Kota can collaborate to create a standard indicator protocol. Without waiting for a new planning cycle, learning-based recalibration is made possible by this method.

Third, institutional platforms for cross-sectoral learning are necessary at the national-provincial-local interface. OPD mandates alone are insufficient to address the challenges posed by the energy transition, climate impacts, and infrastructure resilience, which transcend sectoral responsibilities. To: (1) exchange risk intelligence; (2) assess indicator deviations brought on by external shocks; and (3) suggest short-term policy changes, a multi-level coordination platform encompassing Bappenas, Bappelitbang Provinsi, and specific OPD energy/climate stakeholders can be created. This platform adds adaptive learning to sectoral authority rather than replacing it.

Together, these approaches seek to incorporate flexibility within the current institutional architecture rather than drastically changing the planning system. The province can maintain administrative order while allowing for recalibration when reality deviates from long-term assumptions, thanks to multi-level adaptive governance. The province may better align itself with SDG 7 (energy transition), SDG 13 (climate resilience), and SDG 16 (institutional effectiveness) practically by basing sustainability targets on adaptive planning tools.

6 Conclusions

This study evaluated the degree to which North Sumatra Province's four provincial development planning instruments incorporate adaptive governance principles. The analysis reveals that although sustainability goals, environmental hazards, and energy transition issues are recognized at the story level, the formal design of planning instruments is still primarily technocratic, linear, and focused on administrative stability.

The results show that important adaptive mechanisms are not consistently included in the documents under review, including scenario-based planning, adaptable indicators, and institutional platforms for cross-sectoral learning. This state is a result of planning structures that stress predictability and control over uncertainty-responsiveness, not a fundamental lack of governance capacity. In this way, formal planning instruments' design logic, rather than opposition to change, is the source of institutional rigidity.

By emphasizing how planning tools can act as sources of rigidity in uncertain situations, this work theoretically advances the field of adaptive governance scholarship and supports discussions on performance rigidity and policy modification in public administration. Practically speaking, the lack of adaptive elements in planning tools may limit subnational environmental and energy governance, especially in situations where energy volatility and climate-related disruptions are prevalent. This could have an impact on the advancement of SDGs 7, 13, and 16.

The analytical paradigm is applicable to various subnational governance contexts dealing with comparable issues, notwithstanding its empirical foundation in North Sumatra. This study enhances previous research on adaptive governance and institutional coordination under uncertainty by concentrating on the structural characteristics of planning instruments.

Author Contributions

Conceptualization, F.T. and W.O.G.; methodology, F.T. and W.O.G.; validation, F.T. and W.O.G.; formal analysis, W.O.G.; investigation, W.O.G.; resources, F.T.; data curation, W.O.G.; writing—original draft preparation, W.O.G.; writing—review and editing, F.T. and W.O.G.; visualization, W.O.G.; supervision, F.T.; project administration, F.T. All authors have read and agreed to the published version of the manuscript.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

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Conflicts of Interest

The authors declare no conflicts of interest.

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