

Mandatory Climate-Risk Maps Rank Highest for Regional Planning Reform in Gayo Lues

Zul Efendi

Universitas Islam Sumatera Utara, Indonesia

Email: zulefendi727@gmail.com

Keywords:

Climate Adaptation; Climate Risk Mapping; Gayo Lues; Regional Planning; Sustainable Development.

Abstract

Objective: This policy analysis identified institutional barriers to integrating climate risk considerations into regional development planning in Gayo Lues Regency and evaluated policy alternatives for operationalizing climate vulnerability information within regional planning processes. Method: Secondary data from planning documents, regulatory frameworks, and regional administrative records were examined using Urgency–Seriousness–Growth (USG) prioritization, multilevel root-cause analysis, and comparative assessments of three policy alternatives based on Bardach's four feasibility criteria and Dunn's six evaluation criteria. Results: The manuscript reported 37 hydrometeorological events between 2020 and 2025 and an estimated 20–30% decline in food production, although these contextual figures required verification against the original regional records. The highest-priority institutional problem was identified as the absence of climate risk maps at the district and subdistrict levels, primarily attributed to the lack of an operational requirement linking map preparation to regional planning approval. Among the three policy alternatives, the third option, which proposed mandatory integration of climate vulnerability and environmental carrying-capacity maps into the planning review process, received the highest evaluation scores: 18 out of 20 under Bardach's criteria and 29 out of 30 under Dunn's criteria. Conclusion: Establishing a binding and technically standardized requirement for climate vulnerability and environmental carrying-capacity mapping emerged as the preferred policy alternative within the study's evaluation framework. Effective implementation would require interagency coordination, dedicated budget allocations, clearly defined technical standards, and periodic updates to maintain the relevance of climate risk information. However, the reported evaluation scores reflected comparative policy assessments rather than empirical evidence that the proposed intervention had been implemented or had reduced climate-related losses.

INTRODUCTION

Gayo Lues Regency is located in the central mountainous region of Aceh Province, Indonesia, between 03°40'26"–04°16'55" north latitude and 96°43'24"–97°55'24" east longitude, covering an area of approximately 5,549.91 km² (554,991 hectares) (Regional Development Planning Agency of Gayo Lues Regency [Bappeda Gayo Lues], 2024). Ecologically, the regency serves as an important water catchment area and biodiversity conservation zone, supporting freshwater availability, agricultural productivity, and regional ecological stability across central and downstream areas of Aceh. Its predominantly hilly and mountainous terrain, characterized by

varying slope gradients, increases its susceptibility to climate-related hazards, particularly changes in precipitation patterns, intensified extreme rainfall, and rising average temperatures. These environmental pressures may disrupt agricultural production cycles, increase soil erosion, and compromise slope stability, thereby heightening the region's vulnerability to hydrometeorological disasters (Meteorology, Climatology, and Geophysics Agency [BMKG], 2025; World Bank & Asian Development Bank, 2021).

Between 2020 and 2025, regional records reportedly documented 37 hydrometeorological disaster events, including floods, flash floods, landslides, and droughts, resulting in substantial economic losses and damage to infrastructure, agricultural land, and residential settlements (National Disaster Management Agency [BNPB], 2025; Regional Disaster Management Agency of Gayo Lues Regency [BPBD Gayo Lues], 2025). The agricultural sector, a major contributor to the regional economy, reportedly experienced a 20–30% decline in food production compared with the average production levels of preceding periods (Agriculture and Food Security Office of Gayo Lues Regency, 2024). However, these figures require verification against the underlying regional records and clarification of the relevant baseline periods. Increasing variability in the onset and duration of rainy and dry seasons has also challenged traditional agricultural calendars, potentially increasing the likelihood of crop failure and placing additional pressure on the environmental carrying capacity of agricultural land (Wardhana et al., 2025).

Despite these environmental challenges, regional development planning has continued to rely substantially on historical assumptions regarding climatic and environmental stability (Basiago, 1998; Brooks et al., 2009). Key planning instruments, including the Regional Medium-Term Development Plan (Rencana Pembangunan Jangka Menengah Daerah, RPJMD), Regional Spatial Plan (Rencana Tata Ruang Wilayah, RTRW), and sectoral development plans, have not consistently incorporated systematic climate risk assessments, environmental projections, or evaluations of regional environmental carrying capacity (Qanun of Gayo Lues Regency No. 4 of 2024; Qanun of Gayo Lues Regency No. 6 of 2025). The Study of Environmental and Climate Policy Strategy [SKALA] (2025) highlighted the limited substantive integration of climate vulnerability assessments into regional planning documents. Available climate-related information has generally remained concentrated at national and provincial scales, with insufficient translation into spatially explicit vulnerability assessments at the district and subdistrict levels (Ministry of National Development Planning/Bappenas, 2023, 2024a; Putra et al., 2022). This limitation has constrained the availability of locally relevant evidence for development planning, infrastructure siting, land-use allocation, and disaster risk reduction.

The primary contribution of this policy analysis lies in connecting identified gaps in spatial climate information with institutional requirements governing regional planning approval. Rather than focusing exclusively on the production of climate risk maps, the analysis compares policy instruments with varying degrees of regulatory authority and examines how spatial climate information could be incorporated into established development planning procedures. Specifically, the study aims to prioritize institutional governance problems, identify their underlying causes, and determine a feasible policy mechanism for integrating climate vulnerability assessments and

environmental carrying capacity considerations into regional development decisions in Gayo Lues Regency.

Against this background, the central policy concern involves the reported occurrence of climate-related disasters and declining agricultural productivity, which may threaten sustainable regional development, economic stability, and community well-being. These challenges highlight the need to strengthen climate-responsive governance and improve the integration of environmental considerations into regional planning (Ministry of National Development Planning/Bappenas, 2024b; Yulandari et al., 2023). The analysis identifies interconnected institutional and technical constraints that limit the effective incorporation of climate risk information into development policies and investment decisions.

The regional planning gap encompasses two distinct but interrelated dimensions: the limited availability of spatially detailed climate vulnerability maps suitable for local development and land-use decisions, and the absence of operational requirements mandating the preparation, assessment, and consideration of such maps during planning approval. Addressing the spatial information gap without establishing corresponding institutional obligations could result in climate risk maps remaining disconnected from routine planning, budgeting, and spatial decision-making processes. Therefore, the central policy challenge is to establish an enforceable mechanism linking spatial climate evidence, interagency responsibilities, technical assessment procedures, and the formal review and approval of regional development planning documents (Law No. 25 of 2004; Law No. 32 of 2009; Presidential Regulation No. 22 of 2019; Yulandari et al., 2023).

Regional development priorities have also tended to emphasize short-term infrastructure expansion and economic growth, while climate resilience and environmental sustainability have often been treated as supplementary considerations rather than essential criteria for planning approval. Consequently, budget allocations, infrastructure investments, and the selection of development locations may not consistently account for environmental carrying capacity, climate vulnerability, or disaster exposure. Strengthening the regulatory integration of climate risk assessments into regional planning could therefore provide a more systematic basis for evaluating development priorities, improving resource allocation, and aligning economic development objectives with long-term environmental sustainability and climate resilience (Law No. 16 of 2016; World Commission on Environment and Development [WCED], 1987).

METHOD

This study employed a public policy analysis approach to examine the integration of climate risk considerations into regional development planning in Gayo Lues Regency, Aceh Province. The analysis drew on secondary data, including regional disaster and agricultural records for 2020–2025, national and regional planning regulations, regional planning documents, including the Regional Spatial Plan (Rencana Tata Ruang Wilayah, RTRW) 2024–2044 and Regional Medium-Term Development Plan (Rencana Pembangunan Jangka Menengah Daerah, RPJMD) 2025–2049, and relevant policy studies, particularly the study by SKALA (2025). The analysis was conducted in four stages: problem prioritization using the Urgency–Seriousness–

Growth (USG) method, with each dimension rated on a five-point scale; multilevel root-cause analysis to identify underlying institutional and regulatory constraints; gap analysis comparing existing regional planning practices with sustainable development principles, climate resilience frameworks, risk-based planning requirements, and the Sendai Framework for Disaster Risk Reduction 2015–2030 (United Nations International Strategy for Disaster Reduction [UNISDR], 2015); and the formulation and comparative evaluation of policy alternatives using criteria adapted from Bardach (2012) and Dunn (1999).

The policy alternatives were evaluated using two complementary assessment frameworks, with each criterion scored on a five-point scale. Bardach's (2012) framework was applied to assess the practical feasibility of implementing each alternative within the regional government context, while Dunn's (1999) framework was used to evaluate their anticipated effectiveness, efficiency, equity, and broader policy implications. These frameworks were selected to support a structured comparison of institutional feasibility and substantive policy outcomes. The evaluation was based on qualitative judgments informed by the reviewed documents rather than empirical measurements of policy implementation outcomes. The assessment criteria are presented in Table 1.

Table 1. Policy Alternative Assessment Criteria

Method	Criterion	Guiding Question
Bardach (2012)	Technical feasibility	Are the data, capabilities, and tools available to achieve the goal under regional conditions?
	Economic and financial possibility	Can the regional budget cover the costs, and do long-term benefits exceed resources spent?
	Political viability	Is it supported by regulations, acceptable to stakeholders, and resistant to changes of regional head?
	Administrative operability	Does it fit existing governance, avoid complex structural change, and allow a near-term start?
Dunn (1999)	Effectiveness	Does it achieve the goal: maps prepared, risk-based planning applied, and losses reduced?
	Efficiency	How economical is the use of budget, time, and effort?
	Adequacy	Is the result sufficient to resolve the root cause?
	Equity	Are benefits and burdens distributed fairly across sub-districts and community groups?
	Responsiveness	Does it meet real needs for disaster protection, food security, and welfare?
	Appropriateness	Is it consistent with national and regional values, norms, and legal mandates?

Source: Criteria adapted from Bardach (2012) and Dunn (1999), as described in the study.

RESULTS AND DISCUSSION

Problem Prioritization and Root Cause

Three problems were identified: (1) region-specific climate vulnerability and risk maps have not been prepared, as available data remain at national and provincial scales and do not reflect

mountainous topography and rainfall variation at the sub-district level; (2) climate risk analysis and carrying capacity assessment are not prerequisites for the feasibility of planning documents; and (3) there is no integrated data and permanent coordination mechanism between regional apparatus. Their prioritization is shown in Table 2.

Table 2. Problem Prioritization Using the USG Method

Problem	Urgency	Seriousness	Growth	Total
1. Region-specific climate vulnerability and risk maps have not been developed	5	5	5	15
2. Climate risk analysis is not a condition for the feasibility of planning documents	5	5	4	14
3. Data and coordination between regional apparatus	4	5	4	13

Source: Problem-prioritization assessment reported in this study.

Problem 1 is the top priority because the absence of a specific risk map is also what prevents the other two problems from being resolved: without a detailed map, there is no objective basis for making climate analysis a ratification requirement or for unifying data between agencies. Tracing its causes produced the tiered causal network in Table 3.

Table 3. Tiered Causes of the Priority Problem

First-Tier Cause	Second-Tier Cause (Why?)
(a) No policy mandate explicitly requires climate risk maps at district and sub-district scales	RPJMD and RTRW guidelines contain no obligation for detailed climate risk assessment; no review mechanism rejects documents lacking environmental–climate analysis; no common technical standard for map format, content, and procedures
(b) Limited technical capacity and resources to process climate data into spatial information	Shortage of planners trained in vulnerability modeling and carrying capacity analysis; limited budget for surveys, mapping, and spatial data processing; no operational guidelines for mountainous regions
(c) Environmental monitoring and inter-agency data are not integrated	No information system linking Bappeda, the Environment Agency, BPBD, the Agriculture Service, and others; no agreed data format; no regular forum for data synchronization and climate policy

Source: Authors' causal analysis of the priority problem.

The root of the problem is therefore the absence of a detailed, operationally binding policy mandate in the RPJMD and RTRW guidelines that requires district- and sub-district-scale climate vulnerability and risk maps as a valid condition for ratifying planning documents. Without this obligation, maps are not prepared, data remain fragmented, capacity is not built, and planning continues without a safe reference.

Policy Review and Gap Analysis

Theoretically, the Brundtland concept of sustainable development (WCED, 1987) treats environmental carrying capacity as an absolute limit, the IPCC Sixth Assessment Report (Intergovernmental Panel on Climate Change [IPCC], 2023) stresses that adaptation and mitigation

require fine-scale vulnerability data, risk-based planning replaces the assumption of a stable climate with projected threats, and the Sendai Framework mandates risk mapping down to the lowest level of government. Legally, the obligation already exists in several regulations (Table 4).

Table 4. Applicable Regulations Related to Climate-Resilient Planning

Regulation	Relevant Provision
1945 Constitution, Article 28H(1)	Right to a good and healthy environment; the state must ensure planning does not damage it
Law No. 25/2004 on the National Development Planning System	Planning must preserve environmental functions
Law No. 32/2009 on Environmental Protection and Management	Carrying capacity assessment is the basis for regional spatial plans
Law No. 16/2016 ratifying the Paris Agreement	Binds local governments to reduce emissions and increase climate resilience
Presidential Regulation No. 22/2019 on the National Climate Change Master Plan	Mandates regional climate vulnerability maps
Minister of Home Affairs Instruction No. 2/2025	Directs environmental integration in regional planning, but without detailed obligations, standards, or review mechanisms
Qanun No. 4/2024 (RTRW 2024–2044) and Qanun No. 6/2025 (RPJMD 2025–2049)	Mention environment and disaster reduction, but contain no detailed vulnerability map and do not make it a ratification condition

Source: Legal and policy documents listed in the table.

Although the mandate exists, it has not been translated into operational, standardized, and binding provisions. The resulting gaps are summarized in Table 5.

Table 5. Gap Between Legal Mandates and Planning Practice

Gap	Description
Rule gap	Laws require attention to climate and carrying capacity, but RPJMD and RTRW guidelines do not require a vulnerability map as a mandatory attachment, and there is no review mechanism or sanction for documents without it
Data gap	Climate data are at national or provincial scale and cannot capture microclimate differences between sub-districts in mountainous terrain, making them unreliable for local decisions
Capacity and coordination gap	Few personnel are trained in vulnerability modeling and spatial analysis, budgets for mapping are inadequate, and agencies hold separate data without uniform formats or regular coordination forums
Impact	Infrastructure is built in flood channels, farmland expands into drought-prone areas, and settlements are placed on landslide-prone slopes, causing repeated and avoidable losses

Source: Authors' gap analysis of planning regulations and local practice.

These gaps mean that the legal mandate remains a good intention without real implementation. Because temperatures are rising and rainfall is becoming more erratic, every planning document ratified without a risk map increases future losses, so correcting the direction of planning now is far cheaper than repairing widespread damage later.

Policy Alternatives

Three alternatives were formulated in response to the root problem. Alternative 1 reinforces directives without changing rules through a Regent's circular encouraging planners to include climate maps and carrying capacity analysis, without making them a legal condition. Alternative 2 prepares the climate risk vulnerability map and carrying capacity map as separate documents managed by an inter-agency team within one year, but they are not required for ratification. Alternative 3 stipulates, through a Regional or Regent Regulation, that the maps and a plan-suitability analysis are substantive requirements for every draft planning document; documents that do not comply are returned for refinement. Alternative 3 also sets a preparation deadline, technical standards for mountainous areas, an inter-agency review team, a fixed budget, and five-yearly updates. All three acknowledge the urgency of climate maps and align with national and international policy, but they differ fundamentally (Table 6).

Table 6. Key Differences Between Policy Alternatives

Aspect	Alternative 1: Directive	Alternative 2: Separate Map	Alternative 3: Mandatory Requirement
Binding force	Appeal	Informative	Mandatory with legal consequences
Position of the map	Complement	Separate companion document	Legal condition that cannot be waived
Guarantee of implementation	Depends on each agency's awareness	Depends on resources to compile the map	Guaranteed by regulation, unaffected by changes of officials
Response to the root problem	Does not address it	Partially addresses it	Directly and thoroughly resolves it

Source: Policy alternatives formulated in this study.

Assessment Results of Policy Alternatives

The results of the Bardach assessment are presented in Table 7. Alternative 1 is administratively easy but does not ensure that maps are prepared or used, giving it low technical and political scores. Alternative 2 produces maps but does not guarantee their use. Alternative 3 excels in technical feasibility because it ensures maps are both compiled and used, and in political viability because it strengthens existing legal mandates, although it requires an initial regulatory process.

Table 7. Assessment Results Using the Bardach Method (2012)

Criterion	Alternative 1	Alternative 2	Alternative 3
Technical feasibility	2	3	5
Economic and financial possibility	4	3	4
Political viability	3	4	5
Administrative operability	5	3	4
Total score (maximum 20)	14	13	18

Source: Policy-alternative scores reported in this study using Bardach criteria.

The Dunn assessment (Table 8) shows a wider margin. Alternative 3 is the most effective because planning cannot be ratified without a map; it is adequate because it removes the root cause; it is equitable because the map protects all sub-districts equally; it is responsive to the need for disaster protection and food security; and it is appropriate because it is consistent with Law No. 25/2004, Law No. 32/2009, Presidential Regulation No. 22/2019, and the Sendai Framework without creating overlapping rules.

Table 8. Assessment Results Using the Dunn Method (1999)

Criterion	Alternative 1	Alternative 2	Alternative 3
Effectiveness	2	3	5
Efficiency	4	3	4
Adequacy	1	2	5
Equity	3	3	5
Responsiveness	2	3	5
Appropriateness	3	4	5
Total score (maximum 30)	15	18	29

Source: Policy-alternative scores reported in this study using Dunn criteria.

Selection of the Best Alternative

Table 9. Recapitulation of the Dual Assessment

Method	Best Alternative	Highest Score
Bardach (2012), 4 criteria	Alternative 3	18 of 20
Dunn (1999), 6 criteria	Alternative 3	29 of 30

Source: Recapitulation of policy-alternative scores in Tables 7 and 8.

Within the paper's stated assessment framework, Alternative 3 achieves the highest reported scores—18 out of 20 under the four Bardach criteria and 29 out of 30 under the six Dunn

criteria. This convergence favors a binding requirement for climate-risk and carrying-capacity maps as inputs to planning approval. Nevertheless, the manuscript does not document the number or selection of assessors, score weights, or sensitivity tests; the rankings should therefore be presented as a structured policy appraisal rather than externally validated evidence of superiority.

- 1) it directly addresses the root problem by turning an existing legal mandate into an unavoidable operational obligation;
- 2) it is technically and politically feasible, uses the existing regulatory framework without conflicts of authority, and is resistant to leadership changes because it is set in a regional regulation;
- 3) it solves the problem fairly and thoroughly by ensuring the map is used to protect the whole community;
- 4) its benefits outweigh its costs, since the budget required is far smaller than recurring losses from preventable disasters;
- 5) it changes the planning culture so that every development plan is based on factual data and environmental safe limits rather than short-term physical growth.

If enacted and consistently implemented, a binding mapping requirement could make climate-risk evidence a routine condition for the review of development plans. The expected reduction in exposure and losses remains a policy hypothesis, not an observed outcome of the current document analysis.

CONCLUSION

This policy analysis identified a gap between the recognized need for locally specific climate risk information and the operational requirements governing the approval of regional planning documents in Gayo Lues Regency. The study reported 37 hydrometeorological disaster events between 2020 and 2025 and an estimated 20–30% decline in food production, although these figures require verification against the original regional records. Based on the Urgency–Seriousness–Growth (USG) prioritization framework, the absence of climate vulnerability maps at the district and subdistrict levels emerged as the highest-priority problem. The root-cause analysis attributed this gap primarily to the lack of binding regulatory requirements for integrating climate risk mapping into regional planning procedures. Among the three policy alternatives evaluated, mandatory inclusion of climate vulnerability and environmental carrying capacity maps as a prerequisite for planning review received the highest assessment scores, achieving 18 out of 20 points under Bardach's criteria and 29 out of 30 points under Dunn's criteria. Accordingly, the analysis identified the establishment of a regional regulation or an equivalent legally enforceable instrument, supported by an interagency technical team, dedicated budget allocations, and periodic map updates, as the preferred policy alternative within the study's evaluation framework. However, the anticipated benefits for disaster risk reduction, land-use safety, agricultural resilience, and sustainable regional development remained prospective and require empirical evaluation following implementation.

Effective implementation of the proposed policy would require a clearly defined legal mandate, standardized technical mapping procedures, designated responsibilities across relevant

government agencies, sufficient financial resources, and mechanisms for periodic monitoring and evaluation. The reported disaster frequencies and agricultural production losses should be verified and documented using traceable regional data sources, while the rationale for policy scoring, assessment procedures, and stakeholder contributions should be transparently reported to support independent evaluation of the policy ranking. Future research should examine the institutional, technical, and financial feasibility of implementing mandatory climate risk mapping and assess its influence on regional planning decisions, land-use allocation, infrastructure development, and exposure to climate-related hazards. Longitudinal evaluations following implementation would provide stronger evidence of whether integrating climate vulnerability and environmental carrying capacity assessments into planning approval processes improves climate resilience, reduces disaster-related losses, and supports sustainable development in Gayo Lues Regency.

REFERENCES

- Agriculture and Food Security Office of Gayo Lues Regency. (2024). *Report on evaluation of food production and extreme weather disturbances*. Gayo Lues Agriculture Office.
- Bardach, E. (2012). *A practical guide for policy analysis: The eightfold path to more effective problem solving* (4th ed.). CQ Press.
- Basiago, A. D. (1998). Economic, social, and environmental sustainability in development theory and urban planning practice. *Environmentalist*, 19(2), 145–161.
- Brooks, N., Grist, N., & Brown, K. (2009). Development futures in the context of climate change: Challenging the present and learning from the past. *Development Policy Review*, 27(6), 741–765.
- Constitution of the Republic of Indonesia of 1945. (1945).
- Dunn, W. N. (1999). *Pengantar analisis kebijakan publik* (2nd ed.). Gadjah Mada University Press.
- Intergovernmental Panel on Climate Change [IPCC]. (2023). *Climate change 2023: Synthesis report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC. <https://doi.org/10.59327/IPCC/AR6-9789291691647>
- Law No. 16 of 2016 concerning the Ratification of the Paris Agreement. (2016). Statute Book of the Republic of Indonesia No. 226 of 2016, Supplement to Statute Book of the Republic of Indonesia No. 5943.
- Law No. 25 of 2004 concerning the National Development Planning System. (2004). Statute Book of the Republic of Indonesia No. 104 of 2004, Supplement to Statute Book of the Republic of Indonesia No. 4421.
- Law No. 32 of 2009 concerning Environmental Protection and Management. (2009). Statute Book of the Republic of Indonesia No. 140 of 2009, Supplement to Statute Book of the Republic of Indonesia No. 5059.
- Meteorology, Climatology, and Geophysics Agency [BMKG]. (2025). *Indonesia's annual report on climate change in 2024*. BMKG.
- Ministry of National Development Planning/Bappenas. (2023). *Climate resilient Indonesia: The road to low carbon development*. Bappenas.
- Ministry of National Development Planning/Bappenas. (2024a). *Report on macroeconomic losses due to climate change in Indonesia*. Bappenas.

- Ministry of National Development Planning/Bappenas. (2024b). *Sustainable Development Goals (SDGs) in Indonesia: 2024 achievement report*. Bappenas.
- National Disaster Management Agency [BNPB]. (2025). *Indonesian disaster data and information in 2024*. BNPB.
- Presidential Regulation No. 22 of 2019 concerning the National Climate Change Master Plan. (2019). State Gazette of the Republic of Indonesia Year 2019 No. 573.
- Putra, A. L., Martinez, J., & Verplanke, J. (2022). Integrating climate service co-production into spatial planning in Jakarta. *International Journal of Urban Sustainable Development*, 14(1), 225–241. <https://doi.org/10.1080/19463138.2020.1843043>
- Qanun of Gayo Lues Regency No. 4 of 2024 concerning the Spatial Plan of Gayo Lues Regency for 2024–2044. (2024). Regional Gazette of Gayo Lues Regency Year 2024 No. 138.
- Qanun of Gayo Lues Regency No. 6 of 2025 concerning the Medium-Term Development Plan of Gayo Lues Regency for 2025–2049. (2025). Regional Gazette of Gayo Lues Regency No. 145 of 2025.
- Regional Development Planning Agency of Gayo Lues Regency [Bappeda Gayo Lues]. (2024). *Document analysis of regional conditions and strategic development issues*. Bappeda Gayo Lues.
- Regional Disaster Management Agency of Gayo Lues Regency [BPBD Gayo Lues]. (2025). *Hydrometeorological disaster data and losses report of Gayo Lues Regency for the 2020–2024 period*. BPBD Gayo Lues.
- Study of Environmental and Climate Policy Strategy [SKALA]. (2025). *Integration of climate risk in regional planning and budgeting*. SKALA.
- United Nations International Strategy for Disaster Reduction [UNISDR]. (2015). *Sendai framework for disaster risk reduction 2015–2030*. United Nations.
- Wardhana, M. Y., Iskandar, E., & Bahri, T. S. (2025). Impact of climate change on rice production in Aceh: Resilience and sustainability of rice production. *IOP Conference Series: Earth and Environmental Science*, 1476(1), Article 012060.
- World Bank & Asian Development Bank. (2021). *Climate risk country profile: Indonesia*. World Bank Group & Asian Development Bank.
- World Commission on Environment and Development [WCED]. (1987). *Our common future*. Oxford University Press.
- Yulandari, E. D., Murayama, T., & Nishikizawa, S. (2023). Climate change adaptation through policy integration by local governments in Indonesia. *Mitigation and Adaptation Strategies for Global Change*, 28(1), Article 3. <https://doi.org/10.1007/s11027-022-10039-0>