Policy strategies for climate-resilient infrastructure in climate change adaptation : jurisdictional comparison between Chile and Indonesia

Maskun Maskun[1], *Nurul Habaib Al* Mukarramah[2*] , and *Josse Charmario Wara* Angi[2]

[1]International Law Department, Faculty of Law, Hasanuddin University 90245 Perintis Kemerdekaan KM.10, Makassar, Indonesia
[2]Research Assistants, Faculty of Law, Hasanuddin University 90245 Perintis Kemerdekaan KM.10, Makassar, Indonesia

Abstract. The impact of climatic change such as extreme weather events and sea level rise have resulted in a greater burden for countries surrounded by waters including Indonesia as an archipelagic state and Chile as a coastal state to adapt to climate-related disasters and building resilience by developing climate-resilient infrastructure. This article is purposed to analyze legal regulation to strategize preparedness in climate adaptation policy by incorporating climate-resilient infrastructure. This article utilizes jurisdictional-based comparative legal methods as a part of normative legal research, with statutory approach through laws and regulations as its primary data, with country practices obtained through literary sources used as secondary data. The result reveals that there are two strategies needed to be taken by countries for climate adaptation policy: 1) Policy initiation and formulation based on climate change risk mapping by considering potential financial cost, appearing social problems and environmental impact; 2) Policy enactment through legal instruments mandating state to provide climate-resilient infrastructure to adapt to climate change. Chile demonstrates best practice in policy formulation strategies through initiation of ARClim and enacting climate change legislation in 2022, compared to Indonesia with no existing climate change legislation and national climate risk mapping. In conclusion, this research implies that countries prone to climate change impacts including Indonesia shall urgently initiate, formulate and enact policies incorporating climate-resilient infrastructure through the proposed strategies.

1 Introduction

The historical emission from global north countries during its industrial revolution period till current, have become the main driver of rapid changes across climate system and environment due to the warming of atmosphere, ocean and land [1]. Climate change will

* Corresponding author: habaib.edu@gmail.com

continue accelerate sea level rise (SLR) which potentially submerge countries with low-lying coastal ecosystems and encroaching coastal settlements and infrastructure, thus putting threat to the ecosystem from irreversible biodiversity loss [2]. Majority of affected countries located in global south, including Chile and Indonesia [3,4]. Due to the disparity of capacity to adapt to climate change between global north and global south countries, this further widen the gap of inequality which obstructs the pathway in achieving climate justice. Therefore, it is in dire need for the common but differentiated responsibility (CBDR) [5,6] principle to be implemented in the effort of limiting the temperature increase to 1.5°C and simultaneously building resilience from climate change including establishing climate-resilient infrastructures.

Various international legal instruments and policy directives such as the Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) have urged states to establish strategies in adapting to disasters. The Sendai Framework adopted by both Chile in 2015 and Indonesia in 2020 mandated states to substantially reduce affected society from disaster through investing in resilient infrastructure and land use planning to minimize vulnerability from danger [7,8]. Simultaneously, the CBDR principle should play a pivotal role to substantially increase financial and technical support to developing countries for capacity building in disaster risk reduction [8]. However, not every country have the ability to interpret this framework to be linked in strategizing adaptation from climate-related disaster. This led to few countries having regulatory framework on climate adaptation, particularly providing access to climate infrastructure. Although most research only identifies climate-resilient infrastructure, this research offers a novel approach by providing a micro-comparison on perspectives of two selected country.

On a national level, climate adaptation policymaking remains a challenge. While climate-related disasters continue accelerating and impacting vulnerable communities which urgently require climate adaptation policies including climate resilient infrastructure [7], several countries do not yet put climate change issues as a priority legislative agenda. Lack of a detailed national-local level climate risk-mapping further affects an evidence-based climate policymaking which potentially can be ineffective after its enactment. Based upon the background, there are two identified problems: lack of regulatory framework putting priority to climate adaptation, and lack of detailed local and national climate risk assessment. This research attempts to explore and answer two questions: 1) What are the necessary policy framework strategies in incorporating climate-resilient infrastructure in climate change adaptation policy? 2) How does Chile and Indonesia strategize in climate-resilient infrastructure and climate adaptation policy?

2 Research Method

The method utilized in this research is a jurisdictional comparative legal method as a part of normative legal research with statutory approach. This paper will not compare different legal systems in Chile and Indonesia, given that both countries are adopting European continental legal systems. Therefore, this paper will compare and contrast practices of each countries' climate law and policymaking, particularly in the area of climate change adaptation upon the policy domain elaborated in figure 1.

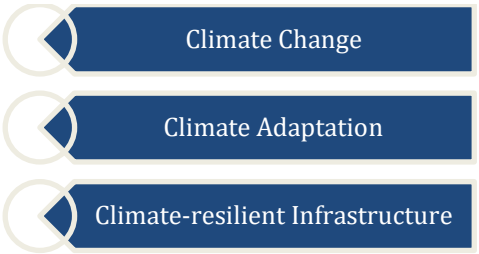


Figure 1. Selected policy domains.

The primary legal materials are obtained from relevant national regulations and authoritative legal materials including policy directives, the secondary legal material are obtained from various related literatures. All collected materials relates to the three policy domains, and will be analyzed qualitatively by describing facts and its linkage to the regulations to construct argumentations as the result of the legal analysis.

3 Results and Discussions

An infrastructure is defined to be climate-resilient if it is planned, designed, built and operated specifically to anticipate, prepares for, adapts and can recover rapidly from the changing climate [7]. Climate resilient infrastructure is a critical component to climate adaptation, it is essential to promote resilience in areas vulnerable to climate disaster [9]. The first necessary step from the three stages as portrayed under figure 2 prior to establishing climate resilient infrastructure is to strategize a climate adaptation policy which incorporates a comprehensive climate resilient infrastructure planning.

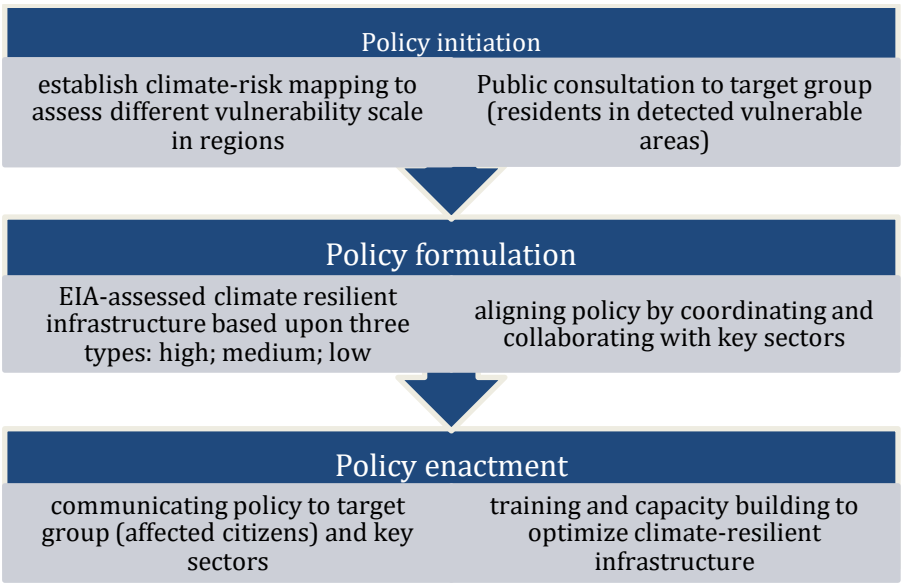


Figure 2. Climate adaptation policy framework strategies.

There are three critical stages in strategizing climate adaptation policy : initiation, formulation, enactment. On the initiation stage, climate disaster risk among cities (including types of climate disaster, frequency of hazard, possible economic losses and socio-economic background) shall be assessed and recorded. This recorded assessments will function as a guideline to provide an evidence-based policy in the formulation stage, given there are

possibilities of different extent and types of climate-risk infrastructure in various cities and detecting high risk climate disaster areas. The assessments shall be ensured to be coherent with empirical fact that can be obtained from public consultation to target groups, this includes the residents located in detected vulnerable areas.

The climate-risk mapping shall accommodate information of areas divided into three different risk scales: high; medium; low. In the policy formulation stage, climate risk infrastructure shall be planned to prioritize high risk areas, with considering precautionary principle by only establishing infrastructures with a prior Environmental Impact Assessment (EIA). Furthermore, policymaker should ensure to align targets and strategies by coordinating and collaborating with related key sectors (including public, private, society) through various approaches such as (but not limited to) multi-stakeholder dialogue [10]. This stage is important for early detection of possible issues including fragmenting agencies.

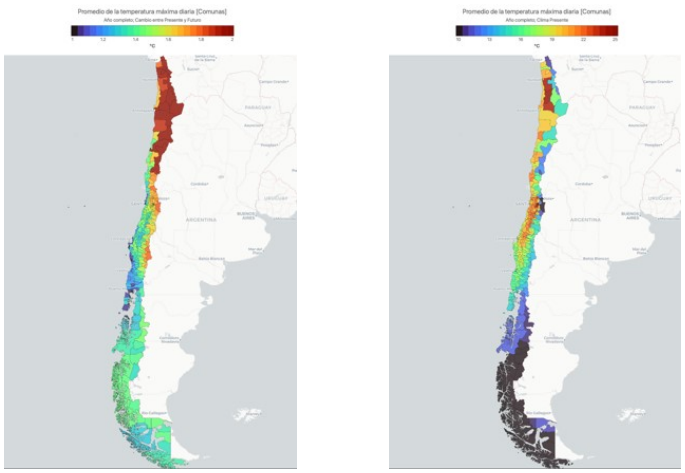
Once the climate adaptation policy with climate-resilient infrastructure planning enacted, it shall provide pathways of communicating policy to targeted groups and key sectors. The policy shall be able to encourage optimizing climate-resilient infrastructure through training and capacity building. On this stage, the CBDR-based substantial increase of Sendai Framework has critical role to provide technical and financial support for infrastructure building and achieving adaptation goals as mandated under the enacted policy. It is also essential to ensure a harmonized cooperation between local governments in targeted areas, with a gradual monitoring and evaluation upon the policy implementation.

3.1 Discussion: Jurisdictional Comparison

This section will compare different approaches between Chile and Indonesia in strategizing climate-resilient infrastructure and climate adaptation policy. The established comparison aspects includes : the existence of a national climate change legislation, local/national climate change adaptation policy, national climate risk mapping and policy directives on climate disaster risk reduction (DRR) / disaster risk management (DRM), and coherence to submitted Nationally Determined Contribution (NDC).

3.1.1. Chile

Chile is highly vulnerable to climate change impacts, particularly from coastal erosion and SLR [11]. Therefore, the Chilean Ministry of Environment established the *Atlas de Riesgos Climáticos* (ARClim), a national atlas of current and projected climate change risk in Chile. With 14 designated working groups including coastal and climate adaptation, those are specifically enacted to strategize suitable pathways for adaptation, DRR and DRM in various areas based upon climate risk mapping.



(a) (b)

Figure 3. Maximum Daily Temperature Change ((a) Current/2023; (b) Future)[12].

Chile also puts climate change as a priority legislation agenda, through promulgating the Climate Change Framework Law No.21,455 in 2022. This Law strategizes its provisions based upon the limited amount of time to reverse serious effects of climate change, therefore establishing management instruments at national, regional and local level by assigning responsibilities to specific ministries in addressing climate change. The law mandated to establish financing for mitigation and adaptation projects and actions by environmental protection fund and climate change financial strategy [13].

The climate-risk mapping and laws have strengthened and further optimize the implementation of Chile's National Climate Adaptation Plan 2014 and Adaptation Communication 2022, in coherence to the submitted NDC aimed to fully implement the National Policy for Disaster Risk Reduction 2019-2030 [14]. Several climate DRR examples includes the construction of artificial beaches and beach nourishment in several areas (Iquique, Tocopilla, Antofagasta) to reduce areas with high erosion rates [15]. However, existing implementation barriers crucial to be addressed includes community knowledge and awareness on climate change and DRR, coherent implementation to regional and local level, adequate support on financial and human resources to municipal government [16].

3.1.2. Indonesia

Indonesia is a part of coastal areas that are likely to be highly vulnerable and threatened due to climate change [17]. It is crucial to develop a legal framework that can adequately respond to the challenges posed by climate change [17,18]. However, the country has not yet introduced or implemented comprehensive climate change legislation since the ratification the Paris Agreement by Law No. 16 of 2016. Indonesia is focusing on advancing infrastructure as "economic transportation", with a planned total budget of IDR 392 trillion which increased by 7.8% compared with the infrastructure budget in 2022 that reached Rp363.8 trillion [18,19]. With this budget, Indonesian development is expected to focus on sustainable infrastructure development and climate change mitigation-based infrastructure.

The primary obstacle to advancing resilience-based climate change mitigation strategies in Indonesia is the absence of explicit references to climate change within its legislative framework. Specifically, Law of the Republic of Indonesia Number 24 of 2007, which pertains to Disaster Management, notably omits any mention of the terms 'climate' or 'climate change' within its provisions. Consequently, the disasters regulated by this law encompass a wide array of common events in Indonesia, such as floods, earthquakes, and landslides [20].

Similarly, Law of the Republic of Indonesia Number 27 of 2007, which deals with the Management of Coastal Areas and Small Islands, aligns with the definition and provisions regarding mitigation as outlined in Law Number 24 of 2007 [21].

In this law, the concept of 'mitigation' is exclusively associated with natural disasters, thus neglecting the specific considerations required for addressing climate-related issues. Conversely, when compared to its predecessor legislation, Law No. 6 of 1996, which pertains to the Ratification of the Climate Change Convention, presents a more comprehensive approach. This earlier law enhances the definition of mitigation by incorporating climate change as a crucial element within its climate change mitigation framework [22].

There is a noticeable lack of synchronization between different legislative acts in Indonesia, leading to legal uncertainties. This lack of alignment has significant implications for the formulation of policies and regulations related to climate change [23]. This issue is particularly critical as Indonesia experiences rapid infrastructure development. Despite Indonesia's commitment to addressing climate change, as evident in its existing regulations, these regulations remain insufficient to adequately incorporate the essential aspect of climate change resilience into the country's infrastructure development efforts.

Conclusion

There are three strategies in incorporating a climate-resilient infrastructure in climate adaptation policy: initiation, formulation, enactment. This shall be carried out by assessing climate disaster risk coherent with empirical fact among cities, aligning targets and strategies by coordinating and collaborating with related key sectors, communicating policy to targeted groups and key sectors.

Certain contrasts exists between Chile and Indonesia's strategy in climate-resilient infrastructure and climate adaptation policy. While Chile have been taking substantial measures by policy intervention by enacting Climate Change Framework Act and ARClim, Indonesia still grapple with the absence of a comprehensive climate change legislation. This obstructs the formulation of essential policies and guidelines for enhancing climate resilience, particularly within the context of rapid infrastructure development. It is imperative for the Indonesian government to draft and implement comprehensive climate change legislation that will serve as a guiding framework for subsequent laws and regulations.

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