

Regional Climate Change Adaptation Based on the PSR model ——Multi-case Comparative Analysis on a Global Scale

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Abstract. Regional climate change is affected by global warming, large-scale inter-regional circulation and land use/cover. As a result of different ecological, economic, and social conditions, climate adaptation actions vary from region to region. Based on the pressure-state-response model, this paper uses a combination of multi-case comparative analysis and content analysis to conduct a comparative analysis of five typical regional cases of climate change adaptation around the world. It found that: (1) The pressure to regional climate change adaptation refers to the movement of elements such as finance, population and species across regions. (2) The status is based on regional climate change predictions. (3) The response is two-fold, one being develop a hot map of climate change to assess regional climate vulnerability; the other is to take advantage of decision making and implementation by actively promoting horizontal and vertical cooperation in multi-level governance. In the future, regional climate adaptation will focus on inter-regional climate justice, regional climate change adaptation pathways optimization, and how to effectively learn from typical regional climate adaptations.

Keywords: climate change; regional adaptive development; the PSR model.

1. Introduction

Reconstructions of historical mean temperature series indicate that the globe experienced a 1°C temperature rise in the second half of the twentieth century [1] and that the intensity and frequency of future extreme climate events are expected to increase, enhanced by climate-human-carbon feedbacks. Global warming, interregional large-scale circulation and land use/cover rapidly alter regional climate, with potentially irreversible economic, social and ecological impacts. Regions can be defined geographically and ecologically, such as the Mekong River Basin or the Mediterranean region [2], but mostly regional climate change adaptation occurs at the global, national level in macro regions, and at the local level in sub regions [3]. As the impact of climate change deepens, regional climate change adaptation will contribute to the construction of the overall adaptation spatial pattern. However, most existing researches focus on regional climate change projections [4], regional agricultural climate adaptation [5], climate adaptation capacity evaluation [6] or introduction of regional climate change adaptation policies [7], and less on climate change adaptation as a whole. Based on the pressure-state-response model, this paper uses a combination of multi-case comparative analysis and content analysis to conduct a comparative analysis of five typical regional cases of climate change adaptation around the world.

2. Research Design

2.1 Research methods

This paper adopts the pressure-state-response (PSR) model and uses a combination of multi-case comparative analysis and content analysis to select five typical regional climate change adaptation cases around the world for comparative analysis. The PSR model was proposed in the 1980s by the United Nations Organization for Economic Cooperation and Development. In regional climate change adaptation, "pressure" refers to the impact of climate change on human society; "state" refers to the current state of the system; and "response" refers to regional responses to climate change adaptation that are oriented towards mitigation, prevention, restoration, and prevention.

The selection of cases in this paper was developed globally, and cases were identified based on the typicality of adaptation actions and the availability of information. The IPCC Fifth Assessment Report divides the globe into nine regions [3]. In order to respond to climate change, the different regions use a combination of natural, economic, cultural, and social factors, in combination with an assessment of local vulnerabilities and their interactions with climate change. Among these, the climate change issues and adaptation actions faced by Small Islands, Europe, Africa, Polar Regions and the Ocean are typical. We select these five typical cases (Fig 1) and replicate the differences between the cases differently, i.e.

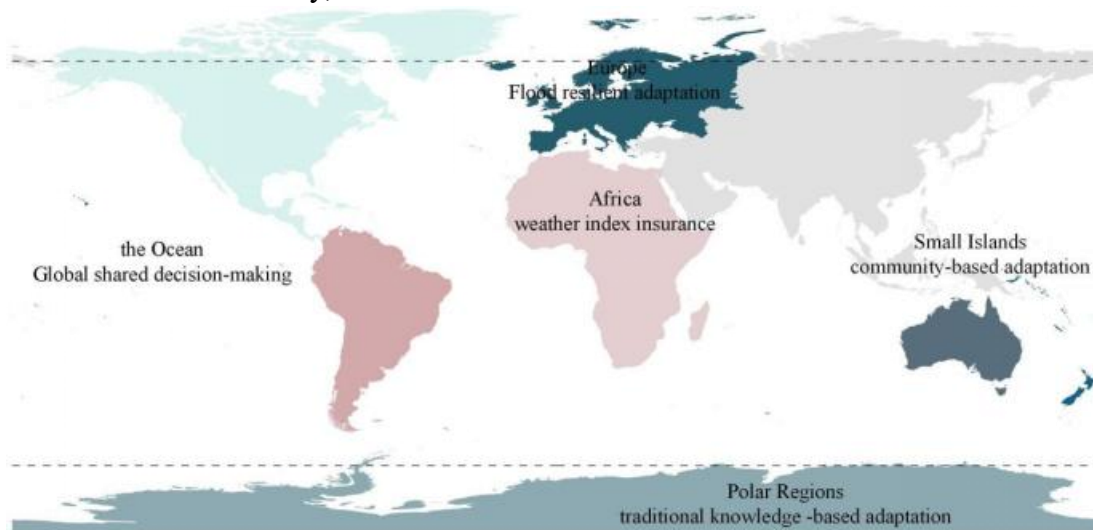


Fig. 1 Five typical regional climate change practices around the world

World map source: <https://www.resdc.cn/>

2.2 Case Description

2.2.1 Community-based adaptation in Small Islands

Rapid sea-level rise and the frequency of extreme weather events pose a huge challenge to climate change adaptation in Small Islands [3]. Community-based adaptation to climate change is rapidly gaining attention in small island states because it is effective, widely applicable, participatory, consultative and inexpensive. It specifically encompasses: ① the use of local knowledge and traditional technologies to transform communities; ② mutual support, risk sharing and community networks as core pillars of community-based adaptation; ③ community leaders to promote culture- and values-based cooperation.

2.2.2 Flood resilient adaptation in Europe

Floods are one of the biggest natural hazards facing Europe under climate change. more than 200 flood events in Europe from 2006-2013 caused a total of €52 billion in damage [8]. With global warming, more than 40% of Europe will experience more frequent 1-in-100-year floods [9], with France, the UK, Germany, Italy and the Netherlands continuing to see an increase in relative risk. The frequency of floods due to climate change has prompted European governments to take active adaptation actions: develop flood early warning systems and flood risk maps; land use planning. Through watershed management to "keep water where it falls" and designation of floodplains to "give rivers more space"; technical flood control; relocating people and assets at risk of flooding.

2.2.3 Promotion of weather index insurance in Africa

Drought is a major risk to African agriculture, causing 40 per cent of economic losses each year and accounting for 83 per cent of its agricultural disasters [10]. To adapt to climate change, Index-based Weather Insurance (IWE) has been piloted in Malawi, Kenya, Ethiopia, Tanzania, Ghana and Senegal with the help of international organizations such as the World Bank and the UN WFP. Weather index insurance is based on climate change claims and quantifies the extent of agricultural losses caused by a climatic factor to determine the triggering conditions for which the policyholder will be paid when the climatic conditions reach a predetermined threshold. Weather index insurance is considered well suited to the agricultural sector in Africa due to its low cost, free transferability and low transaction costs that help overcome moral hazard in traditional agricultural and disaster insurance markets.

2.2.4 Traditional knowledge -based adaptation in Polar Regions

The indigenous peoples of Polar Regions have a history of adaptation to changes in climate and natural resources. Indigenous worldviews are rooted in a holistic framework that connects land and water, earth and sky, plants and animals, and people and spirits, viewing the Earth as a coupled social-biological-physical system where everything is interconnected. This framework under traditional perceptions contains historical knowledge accumulated by indigenous people over generations and has gradually become a knowledge base for adaptation to climate change. Actions by indigenous communities to adapt to climate change include: changing land use and settlement locations; changing hunting, grazing and fishing times and locations; building permanent shelters on land to escape storms, etc. In addition, cultural values such as sharing, trust, perseverance, calmness and respect for elders are important.

2.2.5 Global shared decision-making in the Ocean

The oceans are a global resource, with approximately 64 per cent of the oceans located outside the exclusive economic zones and continental shelves of the world's countries, and coordinated solutions to ocean issues at the global level are essential [3]. With rapidly increasing levels of exploitation and growing calls for more effective decision-making frameworks to manage fisheries and other activities (such as bioprospecting) in these marine "commons", international frameworks are increasingly valuable. There are many existing international conventions and agreements that explicitly recognize climate change and establish cooperative mechanisms for vertical and horizontal ocean adaptation with a common goal. On the one hand, breaking down national

boundaries and planning ocean adaptation actions based on natural limits. On the other hand, global-regional linkages have been strengthened.

3. Results and Analysis

Different regions have different priorities when it comes to adjusting to climate change due to unique ecological, economic, and social factors. Regional climate adaptation pathways share some commonalities, from climate prediction to vulnerability assessment to policy implementation and enforcement base on the PSR model. Among them, the pressure to regional climate change adaptation refers to the movement of elements such as finance, population and species across regions; the status is based on regional climate change predictions; the response is two-fold, one being develop a hot map of climate change to assess regional climate vulnerability; the other is to take advantage of decision making and implementation by actively promoting horizontal and vertical cooperation in multi-level governance.

3.1 Pressure: the impact of climate change on human society

Factors such as finance, population and species are sensitive to climate change and extreme weather events. As different regions face climate change differently and have different levels of adaptive capacity, climate change will promote cross-regional flows of factors and further induce regional vulnerability.

(1) Regional climate change alters international trade patterns and financial flows by affecting the geography and investment climate. For example, warming increases the navigable area and three more routes will be added through the Arctic, which means shorter intercontinental transport distances and lower trade costs compared to the Panama and Suez Canal routes, which is beneficial to the development of international trade.

(2) Historical evidence shows that regional climate change is a contributing factor to population migration. Specifically, extreme climatic events contribute to population migration; sea level rise due to global warming, such as the islands of the Maldives have been "decimated" by massive submersion and international migration is already being planned; competition for scarce resources as a result of climate change, such as in North Africa, where competition for natural resources has led to regional security issues and continued migration.

(3) A clear impact of climate change is the natural migration of ecosystems and species. On the one hand, climate change displaces biogeographic regions, which in turn leads to ecosystem migration and functional changes. On the other hand, widespread climate warming is causing species to migrate to higher latitudes, higher elevations, or deeper oceans.

3.2 State: based on regional climate change predictions

Regional climate is the result of the interaction of multi-scale perturbations and multi-circle systems. Regional climate change (RCM) projections are an important basis for the development of regional vulnerability assessments and climate adaptation actions. Through assumptions about future changes in greenhouse gases, aerosols, and land use, RCMs use the dynamical framework of numerical weather prediction models to develop projections of regional temperature, precipitation, atmospheric circulation, climate extremes, and El Niño phenomena. Therefore, RCMs are also known as downscaling methods, including dynamical downscaling, statistical downscaling, and

combined statistical and dynamical downscaling. IPCC Fifth Assessment Report Embedding regional climate models into global climate models to make projections of climate change in nine regions of the world and to provide a basis for decision-making on regional climate adaptation.

3.3 Response: regional climate change adaptation

3.3.1 Mapping climate change hotspots to assess regional vulnerability

Climate Change Hotspots (CCHS) are defined as areas of high climate variability, high exposure, high sensitivity and low adaptation, which may be highly vulnerable to conflict or disaster and lead to social regression. Climate Change Hotspot Map (CCHM) mapping draws the attention of decision makers to areas that are particularly vulnerable to climate change by identifying possible climate change impacts and communicating them in the form of maps with strong visual elements. Examples include health risks from climate change, biodiversity hotspots, violent conflicts, flood hazards, food security and migration hotspots. Most of the different regions facing climate change have identified priorities for policy action, priority areas for further research or priority sites for funding by mapping hotspots. The value of hotspot maps is that they are data-driven, making them a more "objective" basis for decision-making by quantifying vulnerability and resilience, and downplaying culture, power relations and local ecological knowledge.

3.3.2 Regional multi-level governance Leveraging decision-making and implementation strengths

In practice, regional climate change adaptation increasingly exhibits a trend towards multi-level governance, encompassing interaction and dependence at both vertical and horizontal levels. Multi-level governance has been defined as the sharing of decision-making authority, responsibilities and benefits among decision makers in different geographic regions, in different domains, and at different administrative levels. In the case of sovereign states, this implies horizontal and vertical cooperation of state authority upwards and downwards, and laterally. The subjects of climate adaptation decision-making and the scope of their authority in various domains at different scales, encompassing international policy makers and institutions, national and local government departments, civil society organizations, the private sector at all levels, communities and individual households. From international policy makers and institutions, national and local government departments, civil society organizations and the private sector at all levels, all the way down to households and producers, everyone collaborates with each other and makes decisions from different sectors and at different scales.

4. Conclusion and Prospect

4.1 Conclusion

Based on the pressure-state-response model, this paper uses a combination of multi-case comparative analysis and content analysis to conduct a comparative analysis of five typical regional cases of climate change adaptation around the world. It found that: (1) Climate change at different scales has profound and irreversible impacts on regional economies, politics, ecology and societies, and contributes to cross-regional flows of finance, people and species. Climate adaptation practices vary across the five typical regions of the globe, with Small Islands focusing on community-based adaptations, Europe on flood resilience, Africa promoting weather index insurance, indigenous communities in Polar Regions relying on traditional knowledge to cope with climate change, and

the Ocean calling for global decision-making. (2) Even though the ecological, economic, and social conditions of different regions differ, climate adaptation actions have some commonalities. The pressure to regional climate change adaptation refers to the movement of elements such as finance, population and species across regions. The status is based on regional climate change predictions. The response is two-fold, one being develop a hot map of climate change to assess regional climate vulnerability; the other is to take advantage of decision making and implementation by actively promoting horizontal and vertical cooperation in multi-level governance.

4.2 Prospect

However, regional climate change adaptation is a long-term social learning process that requires different decision makers to strengthen their knowledge of potential future changes and enhance their ability to cope with them. (1) Starting from regional climate change adaptation pathways, combining their own characteristics and referring to typical regional adaptation actions, it has a strong significance for global countries to adapt to climate change. (2) Regional cooperation on climate change adaptation faces international and domestic challenges of climate justice and equitable development. As the hardest hit by exposure to climate change risks, less developed regions lack adequate financing for climate change adaptation and are in urgent need of official assistance from developed regions. The huge financial gap seriously affects developing countries' adaptation to climate change, and there is an urgent need to advocate for a basic consensus on climate justice to be formed and practiced globally in the future. (3) In terms of optimizing regional climate change adaptation pathways, future regional climate projections need to further understand ocean-atmosphere-land interactions to enable reduction of atmospheric circulation uncertainties; climate change hotspot maps emphasize objectivity and focus on their role in political discourse and guidance for policymaking; regional multi-level governance that gives more consideration to building trust and political commitment among leaders, providing adequate financial resources, enhancing institutional implementation capacity, promoting the participation of the private sector and civil society organizations, and strengthening policy dialogue in key sectors.

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