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Disaster Risk Management System and the Role of Insurance in the Climate Change Era—the Perspective of Taiwan

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Disaster Risk Management System and the Role of Insurance in the Climate Change Era—the Perspective of Taiwan

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Introduction

Climate change brings about more devastating environmental consequences and impacts human rights severely. How to eliminate damages from climate-related disasters is crucial for adaptation. Taiwan prescribed Disaster Prevention and Response Act (DPRA) in 2000 and amended it several times. To what extent the disaster risk management mechanism established under DPRA fulfills the need of Taiwan? What are the problems and whether it may facilitate Taiwan to cope with the challenges of climate change? These are questions remained unanswered. This paper inquiries into these questions with an eye to provide practical suggestion for policy-makers. This paper first examines the development of Taiwan's disaster risk management system, arguing that the system has evolved with a history of disasters and the development of democratization. This article then takes the experience of 2009 Morakot Typhoon as a case to see the merits and problems in reality. The third part attempts to integrate climate change adaptation to disaster risk management system and examines the DPRA mechanism from the perspective of climate change adaptation. The fourth part of the article reviews the development of disaster-related insurance and proposes catastrophe insurance for Taiwan.

Taiwan and its Disaster Risk Management System

Climate Change in Taiwan

As a small island with high mountains and short rivers, Taiwan's geographical environment is highly sensitive. Its location on the route of typhoon and monsoon further increases the risk to be attacked by extreme weather events. Its urbanization and land-overuse also aggravate its vulnerability. A study indicates that the frequency of extreme weather events is increasing. Extreme weather events occurred every 3-4 years in the past; however, in recent years, extreme weather events occurred almost every year.[2] Another study has several significant findings: rising sea level around Taiwan, the enlarging gap between dry and wet season, and the increasing frequency of scorching weather and strong typhoon.[3]

The degree of damage to extreme weather events is increasing too. According to the Ministry of Internal Affairs, three floods and 5 Typhoons in 2016 resulted in 3 deaths, 1109 injured and 1000 destroyed or half-destroyed houses. In 2017, five typhoons and three floods also caused hundreds of deaths. Property damage was severe too. The Soudelor typhoon in 2015, for example, resulted in 3.5-billion property damage and infrastructure damage.

Despite its high vulnerability, the government and society do not actively make and implement the laws against climate change. The Greenhouse Gas Reduction and Management Act, the Renewable Energy Act, and the National Framework Policy for Climate Change Adaptation are all seriously under-implemented. Compare to these adverse developments, the legal framework on disaster relief and its implementation are relatively established.

Democratization, disaster politics and The Evolution of DPRA

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[2] Liang-Chun Chen, Et al., The Science Report on Taiwan's Climate Change. 314 (2011).

[3] National Science and Technology Center for Disaster Reduction, The Past, and Future of Taiwan Climate—The Scientific Report of Climate Change in Taiwan 2017, https://tccip.ncdr.nat.gov.tw/v2/upload/book/20181112092940.pdf (In Chinese).

A catastrophic disaster easily draws public attention. The loss on lives and property incites emotions, including fears, sorrow, sympathy and angriness. These feelings easily turn out to be a blame on the incumbent government if they did not deliver satisfactory performance. The growth of free press and free speech further put the government under examination. In a democratic society, the political leaders have incentive to rescue victims and reduce damages. Therefore, some studies have indicated that, democratic governments usually address disasters much better than authoritarian ones. In Taiwan's context, democratization also contributes to the establishment and evolution of disaster management system.

The former Taiwan Provincial Government promulgated a Standard Procedure for Natural Disaster Assistance (SPNDA) after the 1964 Paiho Earthquake and established the first system of disaster risk management in 1965. 30 years after, the Nothdige Earthquake pushed the government to further established the National Hazard Mitigation Program (NHMP) requiring a four-level task force of DPRCs in normal conditions and Emergency Operation Centers (EOCs). NHMPs also required plans, including Disaster Prevention and Response Basic Plan, the Disaster Prevention and Response Operational Plan, and Local Disaster Prevention and Response Plans; yet these plans emphasized disaster response and pre-disaster preparedness.[4]

In 1999, the catastrophic September 21 earthquake in 1999 caused 2417 deaths and more than 10 thousand injured. At that time, Taiwanese society had become more democratic. Various criticisms and opinions contributed to the enactment of the Disaster Prevention and Protection Act (hereinafter, the DPRA) in 2000. The DPRA was the first law provided legal framework in natural disasters management.[5]

The poor performance of KMT party in disaster relief partly led to its failure on the next president election. In 2000, the candidate of the opposite party, Chen, Shui-Bain was elected as the President and brought out the vibrant partisan politics in Taiwan. With the development of party politics, disasters become hotspot of politics. Disasters provide valuable opportunities for the opposite party to challenge the ruling party. The critics and pressure from civil society and party politics push the government to revise the law and improve the disaster risk management system. With sharp critics from the opposite party and the society, the DPRA was amended several times in 2002, 2008, 2010, 2012 and 2016. Whenever a severe disaster occurs, it triggers amendments on the DPRA. The history of disasters and the process of democratization gradually improve the disaster risk management system in Taiwan. Local and central government now take disaster relief seriously. According to the Ministry of Interior, more than 130,000 person-time was mobilized for typhoons and floods in 2016. Most of them are firemen, policemen, and soldiers; some are auxiliary policemen and civil defense.[6]

In addition, democratization also empowers the civil society and establishes trust between people, which also contribute to Taiwan's resilience against disasters.

Features of Current System

After several amendments, current DPRA has three features: a network system, an extended risk management mechanism, and a complex financial support system.

i. A Network with Three-Tier and Two-Track

Being aware of the large scale, complexity, and emergency of disasters, the DPRA creates a trans-sectoral network for managing disasters.

The current DPRA consists of two systems: disaster management in normal time and in emergency. During the normal times, the task is assigned to competent authorities. It assigned

[4] Liang-Chung Chen, Jie-Ying Wu, and Mei-Ju Lai, *The Evolution of the Natural Disaster Management System in Taiwan*, 29 J. Chinese Institute of Engineers 633, 634 (2006).

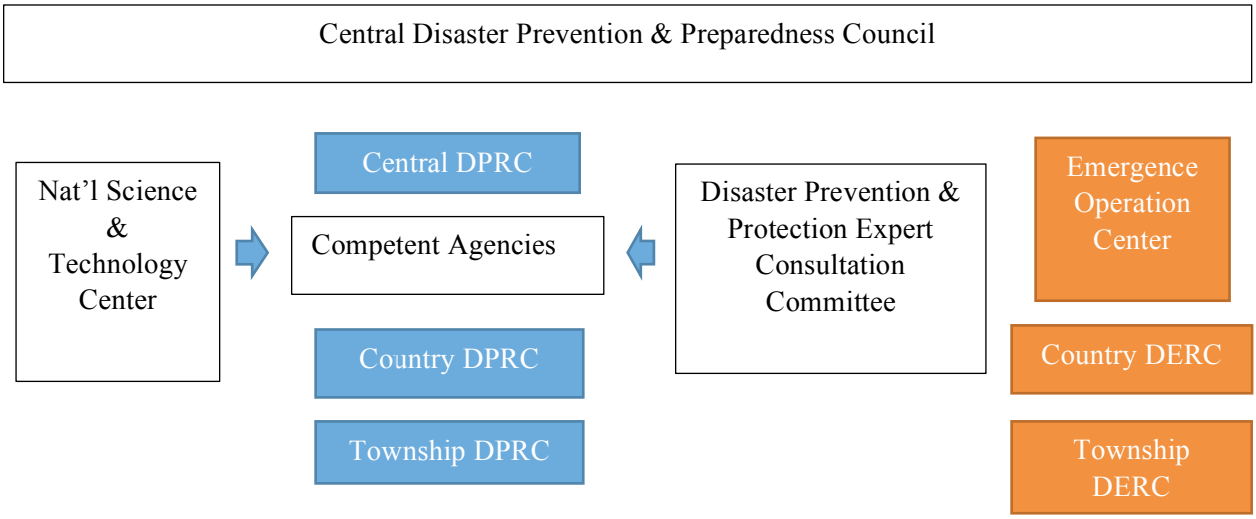
[5] The DPRA has 8 chapters, including 1) General Principles; 2) Disaster Organization; 3) Plan of Disaster Prevention and Protection; 4) Disaster Prevention; 5) Disaster Response Countermeasures; 6) Recovery & Reconstruction after Disaster; 7) Penalties; 8) Supplementary provisions.

[6] National Fire Agency, Ministry of the Interior, The Statistics on Losses of Natural Disasters in Taiwan (1958-2018) https://www.nfa.gov.tw/cht/index.php?code=list&ids=233 (in Chinese) (last visited Aug 24, 2019)

the Ministry of Interior as the competent authority of the Act while delegating regulatory power to different agencies according to the nature of disasters. For example, the Ministry of the Interior is in charge with storm and earthquake, the Ministry of Economic Affairs is delegated with authority to regulate Flooding and drought, while the Council of Agriculture is responsible for preventing landslide.[7] These central regulating authorities are responsible for managing disaster resources, organizing information, performing disaster prevention and rescue tasks, and cooperating with relevant agencies to conduct disaster prevention education for all citizens.

The disaster management system under the DPRA has three tiers of two tracks. In reasonable condition, three tiers governments--central, municipal and town-- are required to establish a Disaster Prevention and Response Council (DPRC) to make disaster management policies and plans. The Central DPRC determines the basic guidelines and plans, authorizing measures, and policies on disasters prevention and protection. The DPRC is a task force style organization. Therefore the Act establishes the Disaster Prevention and Response Committee, as well as the Office of disaster management, to oversee and implement policies and plans. Disaster Prevention and Protection Expert Consultation Committee and the National Science and Technology Center are established to provide scientific information and advises. Command Center commands, supervises and coordinates personnel of functional authorities to carry out disaster rescue missions. National Fire Agency is the actual agency to execute disaster prevention and protection missions.

In emergent times, Emergency Operation Center is required to establish in each level of government. In case of a significant disaster or risk of such major disaster presents, the central government and local government shall establish a Disaster Response Center to take adequate measures to prevent a disaster or reduce its damages. Emergency Operation Center and the Disaster Response Center are responsible for mobilizing and coordinating resources for disaster response and rescue. Military corps and civil society are both involved in the system when a major disaster occurs.



ii. An Extended Regulatory Mechanism: Prevention, Response, and Recovery

[7] Article 3 of the Disaster Prevention and Protection Act (Taiwan).

The current DPRA manages various type of disasters, including natural disasters such as flooding and human-induced disasters such as explosion and air crash.[8] On the experience of severe earthquakes and typhoons, the DPRA notices the inadequacy of disaster relief and extends the management system to prevention, post-disaster recovery and reconstruction. The comprehensive system of prevention, response, and recovery provide a legal basis to build capacity of Taiwan against disasters.

Before any disaster, competent authorities should make disaster plans, including Disaster Prevention and Response Plan of the central DPRCM, Disaster Prevention and Response Operation Plan of the duty ministry of the central government, and Local Disaster Prevention and Response Plans of local governments. These plans are subjected to periodical review every 3-5 years. The requirement of disaster plans aims to build the capacity of governments for disasters response.

Article 22-26 requires all level of governments to be prepared to reduce and prevent the occurrence of disasters, as well as to take emergent measures effectively. All level governments should also prepare plans for education and technology invention, and to conserve homeland security. Local governments are authorized to force the evacuation and provide a proper settlement for disaster refugees.

Article 27-35 prescribes response measures and organizations during a disaster. All levels of government may take measures to control traffic, provide temporary shelters, regulate hazardous materials, search and rescue. The disaster response centers may issue orders to prohibit passages, to require specific professionals for their assistance, to request facilities or searching dogs.

The DPRA also includes national army and NGOs, who have been playing an important role in disaster response and relief, in the legal regime of the disaster management system. Article 31 provides that, the commander of disaster response center may command, supervise and coordinate among the national army, government agencies, public enterprises, reserve force, civil defense organization, and voluntary civil organizations in carrying out disaster rescue works.

For post-disaster recovery and reconstruction, Article 36 suggests the work for recovery and reconstruction includes a recovery plan, the collection, and distribution of donated goods, settlement and medical care, and others. In order to reconstruct communication, settlement, or other infrastructure for people's daily life, governments may simplify administrative procedures and be immune from certain legal requirements. Article 36 especially encourages civic groups and enterprises to support disaster recovery.

iii. Financial Support for Disasters

The DPRA addresses little on compensation and financial aid, leaving the issue for other laws, such as the Public Assistance Act, or executive ordinance such as the Implementation Rules of Agricultural Natural Disaster Relief.

The DPRA prescribes financial issues in the supplement provisions. Measures include budget adjustment, subsidy, tax exemption, and other financial bailouts. The central government provides financial resources for disaster management from the annual budget, and it may adjust without being subject to Articles 62 and 63 of the Budget Act. A local government may request subsidy when they are unable to undertake necessary expenditure. The government may exempt tax, support insurance fee for the National Health Insurance and other government-run insurance. Financial institutions are required to provide various financial measures to reduce the burdens of the people who suffered from the disasters, including low-interest loan, loan offset, and repayment schedule extension.[9]

People may seek further financial support based on the Public Assistance Act or Article 48 of the DPRA. The Public Assistance Act prescribes little on disasters relief. It suggests that people who suffer from severe impacts in disasters may apply disaster aid, yet details are subjected to further regulation by local governments and competent authorities.[10] Similarly, article 48 of the DPRA

[8] Article 1 of the DPRA.

[9] Article 44-44-2 of the DPRA.

[10] Article 25-27 of the Public Assistance Act.

delegates the central regulating authorities to enact ordinances for categories and standards of support for different types of disasters.[11] Accordingly, more than ten ordinances for disaster aid and support are promulgated by different agencies with different framework and procedures.[12] The financial mechanisms under the DPRA can be illustrated as follows:

Type	Financial resource for prevention & response	Financial relief		Disaster assistance
Entity	Central and local government	Financial institutions	Government	Competent authorities
Measures	Annual budget; local subsidies	Loans, offset, & schedule extension	Tax exemption, insurance fee support, & enterprise relief	Regulated by executive ordinances

The standard of financial aid and subsidy was easily affected by public opinion, political context and politicians' personal attitude. The Executive Yuan set a standard for death subsidy as 200,000 NTD in a disaster. However, in the severe earthquake of Sep 21, the central government changed the amount of relief three times a day, from 40,000 NTD per person to one million NTD per person. No apparent reason was provided.[13]

Various public and private institutions, under the law or out of charity, provide financial support for disaster relief. In order to delineate the financial resource for victims to apply, the Executive Yuan made an inventory on available resources for disaster relief, presenting the category, standards, and institutions for financial aid in 2018. It resulted in a rulebook with 116 pages. Take death relief as an example. For death relief, one may apply 200,000 NTD separately from the Ministry of Health and Welfare, as well as the Department of Social Welfare of local governments. He may also apply for 400,000 NTD from the Relieve Disaster Foundation, whose budget was partly provided from the Executive Yuan. One can get an additional subsidy if he is a student, soldier, indigenous, or veteran. The category and standards for life assistance and property relief is much more complex and fragmented.[14]

The inventory provided the victims with a comprehensive overview for assistance, yet a complex network without sufficient coordination and cooperation may lead to an ineffective, arbitrary, and unfair result. Every institution has its budget, review procedures, and standards. How much a victim of disaster may be granted depends on his ability to take advantage of the complex rules, the available resource of each institution, as well as the turbulent political and social dynamics in the specific disaster.

How the System Works in Practice: A Case Study of the 2009 Morakot Typhoon

[11] Article 48 of the DPRA.

[12] These ordinances include categories and standards of disaster aid for landslide, flooding, drought, agricultural, natural disasters, mining disasters, toxic chemical materials disaster, windstorm, earthquake, fire, explosion, industrial pipeline disaster, and public gas, fuel pipeline, and power transmission line failure.

[13] Chii-Chen Huang, A Study on the Relief Measures on Natural Disasters 59-63 (2000).

[14] Executive Yuan, *The Affairs on Disaster Relief and Assistance*, National Disaster Prevention and Response Council (Sep. 27, 2018), https://cdprc.ey.gov.tw/Page/9DAB0C7D30ED68EB (in Chinese).

Between August 6-8 in 2009, Typhoon Morakot hit Taiwan and brought about unprecedented rainfall and flooding. In the Alishan station of the Chiayi County alone, the typhoon brought about 1623.5 mm rainfall in 24 hours and 2884 mm in 72 hours, creating a new record in Taiwan. This single typhoon caused more than 1526 billion damage to Taiwan's public infrastructure and total 2,000 billion to property losses. It also led to 651 deaths. As one of the most catastrophic disasters in the history of Taiwan, it tested the capacity of the DPRA disaster risk management system.

The disaster response and reconstruction of Morakot Typhoon revealed four major problems of the Disaster risk management system under the DPRA.

i. Delayed Actions

The damage of the disaster would have been reduced if the disaster management system had reacted appropriately and effectively.

The DPRA requires central government and local governments to establish a response center, yet the labor divisions and responsibility between them are unclear. When the typhoon caused damage, the central government believed that local governments should be the direct competent authorities. Local governments soon found that the threat of Morakot had gone far beyond their limited budget and capability. Although the central government intervened later when it found the severity of the disaster, the delayed action of the central government not only lost the prime time to reduce some damages but also brought complaints from local governments.

ii. Military Assistance: When and How

The military has a long history of involvement in disaster relief and has become a necessary part of the system, especially in the emergency response to disasters.

During the Morakot Typhoon disaster, the Military significantly participated in response, rescue, and recovery. From August 8 to September 9, the military mobilized 536, 636 soldier-times, 26,529 vehicles-times, and more than 5,400 air plants-times. They devoted to rescue, disinfection and disease prevention, road rehabilitation, transportation, medical service, refugee settlement, dredging, and many other tasks. After the disaster, the Ministry of Defense made the Plan of post-Morakot Typhoon Reconstruction and supported the work of competent authorities. Taiwan might suffer from more damage and would not recover so fast without the contribution of the army.

However, the ambiguous role and command system had delayed the assistance from the army. According to Article 34 of the DPRA at the time, local governments may request the army for assistance when they are not able to respond the disasters. It is also unclear and unstated when and how the army participates the disaster rescue and response. When Morakot Typhoon hit Taiwan, the President, who is the commander of the army, refused to mobilize the army because he believed that the Premier had ruled the army to cooperate with local governments in disaster response and rescue. While both the local governments and the army waited and relied on the command from central government. Therefore, the army initiated assistance two days after the attack of Morakot Typhoon and therefore failed to participate in rescue work at the first moment.

After the Morakot Typhoon, the Minister of Defense amended laws and regulations to include disaster prevention and response in its primary task and conducted preparatory work to enhance its capacity in disaster rescue and response. The Legislative Yuan also amended the DPRA and authorized the military as an active role to initiate disaster rescue and response.[15]

iii. Financial Support: Government Bailout, Health Insurance, and Charity

[15] The article 34, section 4 of the current DPRA prescribes that "If the municipal, or county (city) government or the central disaster prevention and protection operation regulating authorities fails to cope with the disaster, it may request supports from the national army. However, the national army shall actively support responsive measures of major disaster rescue."

It is not clear how much governmental budget was spent in the disaster response because the government did not publish the White Paper on Disaster Prevention and Rescue (hereinafter, White Paper) since 2011, two years after the Morakot Typhoon. According to the White Paper, the budget for disaster prevention and rescue was 245 billion NTD in 2010 and 220 billion NTD in 2011. The financial need for reconstruction was far beyond the budget. Therefore the central government prepared a four-year special budget for disasters reconstruction to the amount of 1,200 billion NTD. The most budget was for public infrastructure reconstructions, yet a significant amount of the budget was for disaster support an aid. According to the White Paper, 40 billion, the special budget, was prepared for flooding aid, 24.2 billion relocation aid, 37.5 billion financial assistance for various insurance and loan, 4.1 billion for death and miss aid, 10.2 billion financial support for recovery, 39.3 billion aid for agricultural losses, and 55.2 billion NTD was for the construction of the "permanent housing," a housing project for disaster refugees.[16]

After the Morakot Typhoon, victims who had suffered from physical and mental illness required medical help. By providing medical service with an affordable premium, the National Health Insurance system established in 1995 became a crucial mechanism of recovery and resilience of Taiwan.

In addition to the government budget, civil society significantly contributed to the donation. Civic groups immediately initiated charity after the news of the disaster. Schools, private enterprises, TV stations, and NGOs voluntarily organized fundraising activities to collect needed materials and money. According to the Statistic data report from the Ministry of Health and Welfare, 56 organizations had initiated fundraising for the Morakot Typhoon and collected about 145 billion NTD.[17] The Red Cross Society of Taiwan (hereinafter, Red Cross) raised 53 billion, and the Buddhist Compassion Relief Tzu Chi Foundation (hereinafter, Tzu Chi) raised 48 billion NTD. Most money was used in settlement and reconstruction, including the project of "permanent housing."[18]

The charity from civil society contributed to the relief, yet it also leads to issues of non-transparency and arbitraries. Several media found that the NGOs failed to spend the money effectively. In April 2012, the National Audit Office investigated the flow of raised funds and disclosed the fact that more than 41 billion NTD was not spent. Besides, the management of permanent house triggered conflicts as well. As a Buddhist organization, Tzu-Chi prescribed rules for the use of a permanent house and created controversies. Even though most indigenous residents in the permanent house are Christian, the Tzu-Chi changed the Community activity Center to Buddhist temple and hanged the Buddha painting in the public space. Indigenous residents who earned their living with nature could not find jobs after they moved to the permanent houses in the urban area.

iv. Sequent Litigation Against the Government

Some victims of the typhoon brought the case to the court, arguing that the Kaohsiung City government failed to instruct the district office to evacuate residents actively and resulted in 100 deaths caused by a severe landslide. The Kaohsiung City government provided three arguments. 1) The scale of rainfall was beyond any history record, the government could not foresee the possibility; 2) the government did establish an emergency response center and therefore constituted no negligence; 3) there was no causal relationship between the casualty and the inaction of district office because the landslide destroyed the settlement shelter for evacuated residents. The supreme court ruled in favor of the plaintiff, suggesting that the district should enforce the order of evacuation when the chief villager

[16] The Review Report for the Special Budget for Reconstruction after Morakot Typhoon 2009-2012 2-3 https://www.president.gov.tw/Portals/0/Bulletins/paper/pdf/6892-1.pdf

[17] The information on charity of the Morakot Typhoon provided by the Ministry of the Health and Welfare, Please see Information of Charity of the Morakot Typhoon, https://sasw.mohw.gov.tw/app39/disasterView/post?eventId=269834463 (in Chinese)

[18] Tzu-Chi has built more than 1276 houses for disaster refugees. *See* Tzu-chi, The Result and Financial Report on August 8 disaster, http://tw.tzuchi.org/financial/2009morakot/item3.html

of Xiao-Lin village refused to do so. Although the judgment invites some criticisms, the fragmentation of the system and its inefficiency has been revealed.

Climate Change Adaptation and the Deficit of the Current System

After decades of effort, the disaster risk management system has made progress. Most citizens trust and rely on the system. However, it may not be resilient enough against the challenges of climate change and its hazards.

Integrating Climate Change Adaptation to Disaster Risk Management

Climate-related extreme weather events have caused disasters around the world frequently and catastrophically. Gradually, the importance of climate change adaptation has drawn more attention nowadays.[19] The existing system of disaster management around the world is under challenges. In 2005, the Hyogo Framework for Action 2005-2015 was adopted to urge for future-oriented approaches to Disaster Risk management that consider climate change. The Bali Action Plan adopted in 2007 UNFCCC COP recognized the necessity of harnessing strategies for extreme weather events. In 2015, the Goal 13 of the UN Sustainable Development Goals is to "take urgent actions to combat climate change and its impacts through strengthening resilience and adaptative capacity to climate-related hazards,"[20] which encourages to link climate change adaptation and disaster risk management. Intergovernmental Panel on Climate Change (IPCC) has also endorsed a risk perspective for assessing the different climate-related threats.[21] Scholars and institutions are promoting the same agenda too.[22] How to integrate climate change adaption is a crucial and necessary issue in reforming disaster risk management system.

Climate change adaptation shares the core goals with Disaster risk management: to manage hydrometeorological hazards through vulnerability and exposure reduction, resilience increase, and risk transfer and sharing.[23] To achieve this goal, the disaster risk management system in climate change era should aim to reduce the impacts of climate-related disasters and associated risks on the one hand, and promote a long-term approach to disaster management on the other.[24]

For this article, climate change adaptation in a social system is "the process of adjustment to actual or expected climate change and its effects, in order to moderate harm or exploit beneficial opportunities," according to IPCC.[25] Adaptation also indicates a paradigm shift in disaster management, including the way we think and behave toward climate-related disasters. There are three principles for the disaster risk management system in the climate change era.

i. From Responses to Adaptation

[19] For example, the UN Office of Disaster Risk Reduction has emphasized the priority of disaster risk management against Climate Change. The Mid-Term Review (2010-2011) of the Hyogo Framework for Action also noticed the integration of climate change adaptation and disaster risk reduction for reducing disaster losses. *See, e.g.,* UNISDR advocates for a synergy between disaster risk reduction and climate change, https://www.unisdr.org/we/advocate/climate-change.

[20] United Nations Department of Economic and Social Affairs 2015.

[21] IPCC, Managing the Risk of Extreme Events to Advance Climate Change Adaptation (2012); IPCC, IPCC Fifth Assessment Report (2015).

[22] Begum et al., 2014; Rivera & Wamsler, 2014

[23] IPCC (2012)

[24] Giuseppe Forino, Jason von Meding & Gramham J. Brewer, A Conceptual Governance Framework for Climate Change Adaptation and Risk Reduction Integration, 6 Int'l J. Disaster Risk Sci 372, 373 (2015).

[25] IPCC, *supra* note 20, at 556.

Traditionally, disaster law was responsive. The system will be triggered when a disaster occurred, and almost ceases operating after the disaster. A disaster has been regarded as unpredictable natural misfortune and little to be prepared or prevented. Although modern discourses on disaster risk management have taken prevention and recovery into consideration, politics usually understates the importance of prevention and recovery.

Climate change has challenged the paradigm in two ways. First, in the era of climate change, disasters become more frequent and catastrophic; they may become part of our daily life. Second, climate change is caused by human-induced GHG emission, therefore it is preventable and mitigatable. In other words, extreme weather events should not be regarded as an unpredictable and unfortunate disaster: they should be addressed with preventive and precautious way.

Climate change adaptation suggests integrating disaster risk management to develop an agenda and adjust the socio-economic system to cope with disasters. Disaster risk management for climate change adaptation emphasizes the need for reducing vulnerability and enhancing socio-economic resilience in addition to disaster relief. Reducing vulnerability emphasizes preventive and precautionary functions of the system, such as preparedness, prevention, and mitigation. Enhancing resilience, on the other hand, especially stresses the capacity of a society recovering from disastrous damage. Together, climate change adaptation refers to a paradigm shift from responsive function to ex-ante prevention and ex-post recovery.

ii. From Government to Governance

Climate change also suggests a paradigm shift from the government to governance. In climate change era, a highly centralized and hierarchical system may no longer be the best form of governance.[26] The global nature and uncertainty of climate change require a reform from the traditional top-down government to de-centralized governance. The reform redistributes the power, function, and accountability from the states across a broader range to non-state actors from society and market. Forino and others scholars developed a three-pillar framework, arguing that the disaster risk management system with climate change adaptation should include actors from the state, society and market.[27]

A decentralized network is more diverse, flexible, and dynamic. If it functions well, it could amplify the advantages of various actors to deal with the complexity and uncertainty, ambiguity of changing climate. On the other side of the same token, decentralized network confronts the diversity, dynamics, and complexity of the social and market system, it could be extremely ineffective without coordination and communication.

First, disaster politics tends to encourage vagueness, duplication of responsibilities, and conflicts.[28] The government should avoid separation to increase effectiveness. Coordination is needed between multi-level governments and between the system in normal times and in an emergency. The disaster law and system should also link and collaborate with the work of climate change adaptation.

Second, state actors should coordinate public and private resources toward public goals in order to avoid waste and increase efficiency. It also empowers the private actors and facilitates an accountable mechanism for governance.

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[26] *See e.g,* Michael Howes, Peter Tangney, Kimberley Reis, Deanna Grant-Smith, Michael Heazle, *Towards networked governance: improving interagency communication and collaboration for disaster risk management and climate change adaptation in Australia*, 58 J. ENVT'L PLANNING AND MANAGEMENT 757, 757-766 (2015).

[27] Giuseppe Forino, Jason von Meding & Gramham J. Brewer, A Conceptual Governance Framework for Climate Change Adaptation and Risk Reduction Integration, 6 INT'L J. DISASTER RISK SCI 372, 374-381 (2015). *See also,* Lemos and Agrawal, 2006.

[28] Healzle et al., 2013; Howes et al., *supra* note 25, at 頁數.

Third, an arrangement to bridge different actors should be established to explore the best way to avoid the weakness of actors and to make use of the strength of another. Legal mechanism and policies such as the public-private partnership between state and market, a private-social partnership between market and social actors, and co-management between state and social actors, should be considered and institutionalized.

iii. Sustainable Financial Mechanism

The third inspiration from climate change adaptation is the importance of a stable financial mechanism capable of redistributing and mitigating risks. Climate change adaptation extends the scheme to prevention and recovery, which would significantly increase the cost. The government budget is insufficient due to the amount of loss and its uncertainty. Charity from civil society may provide temporary relief, yet it is unreliable for long-term prevention and recovery.

Policy-makers on climate change are well-aware of the importance of financial support and require to establish various financial mechanisms such as funds and insurance. A separate and sustainable financial mechanism may redistribute risk and provide a stable basis to mitigate risk and enhance social resilience.

Examining the DPRA System with the Perspective of Climate Change Adaptation

Years of efforts have contributed to the improvement of Taiwan's disaster risk management system. It is not a flexible network with strong civic participation. Yet its poor coordination, the ignorance on prevention and recovery, as well as the lack of a stable financial mechanism may make it incompetent in the face of climate change.

i. A Flexible Network with Private Participation

Under the current DPRA system, the government assumes the primary role in disaster management. From plan-making, budget allocation, response mobilization, and recovery, the government is assigned with enormous burdens. Organizationally, the current system presents a network with flexible organization and personel. The DPRA establishes a network where different agencies are responsible for a different type of disasters, and a disaster response system with three levels of governments. In this system, disaster is understood as a temporary but extraordinary crisis. During the crisis, agencies are removed from their daily work to the emergency center and disaster response center, which becomes a flexible network to coordinate rescue resources in a short time. After the disaster, these centers and personel will be dismissed. After years of practice, the system is capable to deal with most disasters.

The experience of Morakot Typhoon reflects the strong capacity of Taiwan’s civil society. When a severe disaster occurs, civil society is voluntarily mobilized to rescue and other supports for reconstruction. Without their contribution, Taiwan may suffer more damages and is more difficult to recover from disasters. Previous experiences have exhibited Taiwan society's capacity in reducing vulnerability and enhancing resilience against disasters. Decades of efforts on economic growth and democratization contribute to the capacity of Taiwan. Economic growth since the 1970s enriches Taiwan's material resources for emergent mobilization in disasters. Democratization since the 1990s incrementally builds a sense of community and the respect to human dignity. Years of practice have created a virtuous circle and integrated the contribution from civil society to Taiwan's disaster relief system. Therefore, citizens are more willing to contribute their money, techniques, and labors to rescue their fellow from suffering in severe disasters. The civic virtue and solidarity are valuable bases for a society's resilience and disaster management.

The DPRA has established a network with multi-level governments and various agencies which is open to the assistance from science experts, the military and the civil society. In some studies, decentralized governance empowers local government to help communities adapt to the changing climate These studies suggest that local government and communities may possess the

knowledge and motivation to adapt climate change than the traditional centralized government. The established disaster management system has the potential to adapt climate change better with its flexibility and network better. In addition, the well-functioned National Health Insurance System in Taiwan significantly eliminates the problem of the financial mechanism, for victims may be provided with medical care.

Several problems may seriously impede the effective operation of the system.

ii. The Dark Side of Disaster Politics

A. Incomplete Governance: Fragmentation, Unsustainability and the Deficit of Accountability

The current network is fragmented, unsustainable and unaccountable. First is the inadequate communication and coordination within the fragmented disaster management system. A severe typhoon may lead to various disasters and require efforts from many agencies. In some cases, the ministry of Interior, as a second-level agency, may not be able to command and control other agencies. The regulations provided by different agencies usually lack a shared framework and procedure, making the rule system even complicated and incompatible.

The task-force organization also results in the unsustainability of the system, deterring the accumulation of experience, techniques, and institutional culture. In the current system, almost no full-time and professional institution or personnel can sustainably concentrate on disaster management. The commander and other personnel were requested to depart from their daily work for disaster response temporally, some of the rescuers or personnel are hired as a part-time job. When the disaster settled, the center and the personals are dismissed. Personals with rescue and recovery professions are not provided job guarantee and respective welfare, which also undermines their incentive and possibility to participate in the task entirely. These problems not only deter the system from better conducting after-disaster recovery and prevention for future disasters, but also creates space for corruption and political manipulation.

Third, the current system still relies on the centralized command and control system and fails to include the local community in advance to prevent and eliminate disaster damages. Besides, efficient communication and coordination within the network requires further improvement The current system is more a fragmented centralized system without sustainability, rather than a decentralized system that adapts to climate change.

Civic involvement contributes to disaster relief, yet the previous experience has indicated that underregulated private participation may lead to inefficiency and accountability deficit. Several cases indicate that civic involvement may lead to problems of arbitrariness, inefficiency, and a private form of tyranny or corruptions. In some cases, the NGOs who receive donations have poor financial transparency and lack the ability to allocate an enormous amount of money appropriately. In some cases, misappropriatiing of disaster funds or reallocating donation to benefit affiliations has led to corruption concerns. In some other cases, controversies arise when NGOs imposed regulations.[29] Natural disasters gives interests groups an opportunity to divert public resources to themselves in the name of combating the emergency.

B. The Lack of a Sustainable Financial Mechanism

The current financial support system strongly relies on special budget and charity, which may not provide sustainable support for victims and may not provide an incentive for protective actions. Disaster rescue and relief require a vast amount of money. The cost includes 1) recovery, reconstruction, and prevention on sequent damages; 2) monetary aid; 3) low-interest load; 4) material aid; 5) budget subsidy to local government; 6) losses on tax and insurance income. As the Morakot experience suggests, the reconstruction work after a typhoon requires 1200 billion NTD. Neither the government budget nor charity can support frequent climate-related disasters.

[29] For example, the permanent housing managed by Tzu-Chi generates issues about religious freedom and cultural conflicts.

The limited budget is usually inadequate for disaster relief. The government usually have to seek financial support from "extraordinary budget" that may compromise other policies. The extraordinary measure is easy to be affected by politics. If a disaster appears to be miserable on TV or it located in an area where its mayor has a good connection with the central government, it could attract more budget from the central government.

On the other hand, public charity depends on personal economic condition and "feelings." The amount of money and efforts garnered from the civil society in a disaster depends on incidental factors, political concerns, misinformation, media report, personal feeling, and economic conditions. The current civil contribution does not provide a solid foundation for future resilience. The trust between citizens may be divided or changed along with political development, and the capacity depends on the economic basis of individuals. The uncertainty of special budget and charity make victims passively relying on politics and "good heart" from society. The National Health Insurance may support financial cost of physical illness, but it does not compensate property losses and it goes bankrupt when disasters occur more frequently and catastrophically.

C. Understated Prevention and Recovery

Even through disaster prevention is more effective than relief, research suggested that voters reward politicians much more for disaster relief spending than prevention spending.[30] Media covers the progress of disaster relief when a disaster occurred and galvanize strong public attention. A government that devoted to rescuing, settlement, and relief will fulfill the traditional ideal of "parents government" and earns popularity. However, the sequent efforts on prevention, recovery and preparedness faded out from the screen soon after the disasters. The costly and complex work on disaster prevention usually get much less attention from the media and voters.

The unsustainable personals also contribute to the asymmetric operation. The DPRCM oversees and implements disaster plans. However, it is composed of part-time persons from the National Fire Administration under the Ministry of Interior. The system functions almost only in times of disaster since it lacks full-time staff. Therefore these persons may be experts in disaster response but not in mitigation and recovery. As a result, the comprehensive legal scheme asymmetrically emphasizes in disaster response and seriously understates the importance of prevention and recovery. Moreover, without enough political attention, the system of fragmentation, unsustainability, and the unaccountable may operate toward the direction of corruption and interest group favorism.

In the era of climate change when extreme weather events may occur frequently, prevention and recovery may be more critical for the resilience of climate adaptation. With the concept of adaptation, the government should re-examine projects, policies, and laws that might cause environmental derogation since derogation may lead to more catastrophic results when extreme weather events occurred. The government also need to develop strategies to increase the resilience of our socio-economic system against extreme weather events.

D. Vulnerable and Passive Citizens

With the progress of DPRA and the contribution of civil society, Taiwan has equipped some capacity for disaster response and relief. However, the current system may unexpectedly result in vulnerable and passive citizens.

Citizens who frequently experience typhoons or floods may feel less needed to prepare for catastrophic disasters that happen only once in decades. Citizens tend to see severe disasters as unpreventable accidents and rely on the help from government bailout and charity. However, unsustainable budget and charity may make citizens more vulnerable in disasters. The government

[30] See Andrew Healy, and Neil Malhorta, *Myopic Voters and Natural Disaster Policy*, 103 AM. POL. SCI. REV. 387, 387-406 (2009).

bailout and charity may even reduce citizens' incentive to take protective actions[31]. Individuals will be less inclined to take measures for risk prevention and loss mitigation[32]. The current financial mechanism provides aid to victims and may reduce individuals' incentive to mitigate losses. It is crucial to encourage citizens to take preventive actions to distribute risk and reduce their vulnerability.[33]

Reforming the system to enhance collaboration and coordination among agencies and governments is the first task, yet how to create a more sustainable financial mechanism that could redistribute risk and empower active citizens to enhance resilience is the issue puzzling all policy-makers.

Enhancing Resilience through Insurance

In the face of the catastrophic losses from climate-related disasters, mitigation and adaptation are two fundamental policy goals. On the one hand, we need to reduce the GHG emission effectively; on the other hand, the policy should facilitate the society to adapt for climate change, including enhancing the resilience of the socio-economic system against disasters. Among other suggestions, insurance is one possible but underrated mechanism. Policymakers and scholars gradually observe the limit of government regulation in addressing climate disasters risk and notice the role of insurance.[34]

The Function of Insurance in climate risk management

Although climate change has been regarded as a change of natural system that may lead to uncertain natural disasters, it is mitigatable. Therefore, building socio-economic resilience requires preventive risk management and adaptive strategies.

Climate change has been identified as one of the highest potential socio-economic risks to our society. Policy-makers are gradually recognizing the financial impact of climate-related disasters and ineffectiveness of traditional post-disaster financial assistance, seeking for a stable financial solution with the ability to transfer and redistribute risk. Since it is constructed on the concept of risk management, insurance becomes a possible choice for climate disaster management.

Insurance can play a vital role in supporting the individuals and communities that are most vulnerable to the impacts of climate change. Insurance market may provide risk information and risk pricing expertise, innovative products to transfer risk, and mechanism to redistribute risks. A well-designed insurance policy increases communities' resilience against climate-related disasters. Countries with wide-spread market-based insurance coverage usually recover faster from the financial impacts of extreme events.

It is also believed that the insured may change behavior to reduce risk in order to avoid a higher payout. Through its underwriting business and investment strategies, including the decision on which assets to insure or on what terms, insurers may push the insured to take protective measures or to transit to low carbon society. Many scholars have suggested that a well-designed insurance system may not only facilitate a society to recover from climate-related disasters; it may also be an effective method to mitigate climate risk. They also suggest insurance is a better mechanism than direct government intervention in disaster relief.[35]

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[31] *See* JAMES M. BUCHANAN, *The Samaritan's Dilemma,* in ALTRUISM, MORALITY AND ECONOMIC THEORY, 71 (1972); *see also,* QIHAO HE, CLIMATE CHANGE AND CATASTROPHE MANAGEMENT IN A CHANGING CHINA 39 (2019).

[32] Roger Van den Bergh and Michael Faure, *Compulsory Insurance of Loss to Property Caused by Natural Disasters: Competition or Solidarity?*, 29 WORLD COMPETITION 25, 25-54 (2006).

[33] QIHAO HE, supra note 29, at 43.

[34] Sean Hecht suggests that insurance is a necessary financial risk manager in the face of climate change.

[35] *E.g.,* Dwight Jaffee & Thomas Russell, *Catastrophe Insurance, Capital Markets, and Uninsured Risks*, 64 J. RISK & INSURANCE 205 (1997); W. J. W. Botzen & J. C. J. M. Van Den Bergh, *Insurance Against Climate Change and Flooding in the Netherlands: Present, Future, and Comparison with Other Countries*, 28 RISK ANALYSIS 413, 413-426 (2008); Sean B. Hecht, *Climate Change and the Transformation of Risk: Insurance Matters*, 55 UCLA L. REV. 1559, 1559-1560 (2007-2008); Michael G. Faure, *Insurability of Damage Caused by Climate Change: A Commentary*, 155 U. PA. L. REV. 1875 (2006-2007); Porrini, D. &

In addition to the efforts of private insurance companies, catastrophe insurance has been adopted in several countries with different forms of public-private cooperation, including the National Flood Insurance Program (NFIP) in the US, catastrophes Naturelles (Cat. Nat.) in the France, Turkish Catastrophe Insurance Pool (TCIP) in Turkey and the Private flood insurance system in the UK.[36]

The Development of Disaster Insurance in Taiwan

The private insurance companies have been providing natural disaster insurance since 1980, yet the market remains small. The average insurance coverage rate on natural disasters from 1980 to 2015 was 13.8%. Primary losses are property losses of 31%, public infrastructure of 37 % and losses on agricultural and fishery of 32%. Industries and companies invest more in disaster insurance, while less than 2% of individuals buy disaster insurance for houses or other properties. Almost no insurance is invested in public infrastructure and agricultural losses.

In 2001, because of the severe damage of September 21 Earthquake, the Legislative Yuan amended the Article 138-1 of the Insurance Act, imposing earthquake insurance. The system is based on Japanese experience, requiring insurers to underwrite residential earthquake risk. All individuals who apply for a housing loan is required to buy earthquake insurance. It established the Taiwan Residential Earthquake Insurance Fund to manage the risk distributing and assume exceeded losses.[37] Since 2002, insurance companies attach the basic premium of earthquake insurance to residential fire insurance. Currently, the coverage rate of earthquake risk insurance is 33.34%. Most insured chose the basic premium of maximum 150 million NTD compensation.[38] However, the current earthquake insurance has no requirement on prevention and mitigation, nor does it categorize the degree of risk. The earthquake insurance provides no economic incentive to encourage the insured to take protective measures by the insured; the Taiwanese society still relies on the government to take measures on disaster prevention and mitigation.[39]

In addition to the earthquake insurance, private insurance companies also underwrite typhoon and flood insurance, including residential and commercial ones. Individuals may choose to attach the typhoon and flood insurance to the residential fire insurance and get compensation when their properties get damage because of typhoon or flooding. This insurance does not include landslide, mudslide, or other consequential loss from a typhoon. Insurance companies determine premiums on a risk basis, according to factors such as areas and floors that could affect the vulnerability against typhoon and flood[40]. Among the 800 million houses in Taiwan, less the 30,000 houses are covered. The insurance rate is as meager as 0.4%.[41]

Schwarze, R., *Insurance models and European climate change policies: an assessment,* 38 EUR J. L. & ECON. 7, 7-28 (2014); Anastasia Telesetsky, *Insurance as a Mitigation Mechanism: Managing International Greenhouse Gas Emissions through Nationwide Mandatory Climate Change Catastrophe Insurance*, 27 PACE ENVTL. L. REV. 691 (2009-2010).

[36] A detailed discussion on comparative experience of catastrophe insurance, please *see* QIHAO HE, *supra* note 29, at 129-175.

[37] See article 138-1, para.1-2 of the Insurance Act. The section 2, article 138-1 of the Insurance Act further prescribes "The portion of risk that exceeds the co-insurance underwriting assumption limit for non-life insurance enterprises shall be assumed by the Taiwan Residential Earthquake Insurance Fund, cede to domestic and/or foreign reinsurers, be assumed by the manner prescribed by the competent authority or assumed by the government."

[38] Huei-Ling Huang, *Low Insurance rate, and the reliance on the governmental bailout*, CHINA TIMES (Dec. 11, 2016), https://www.chinatimes.com/newspapers/20161211000268-260114?chdtv (in Chinese).

[39] HSIN-YU SHAN, FEASIBILITY STUDY OF DEBRIS FLOW INSURANCE 39 (2017) https://tech.swcb.gov.tw/Content/Upload/Innovation/土石流□害保□制度可行性之研究.pdf (in Chinese) (Last visited Aug. 23, 2019).

[40] For example, Taichung suffers fewer attacks from the typhoon and enjoys the cheapest premiums. Yilan and Hualien are more vulnerable to typhoon and subject to an expensive premium.

[41] SHAN, supra note 37, at 44-47.

In 1999, the insurance companies were allowed to underwrite insurance on land subsidence and landslide. However, the insurance is even lower because individuals hesitate to pay the high premium, and sometimes the insurers refuse to underwrite due to the high risk and losses.[42]

Taiwan frequently suffers from climate-related disasters; however, the abovementioned development indicates that Taiwanese has little incentive to manage risk on uncertain losses through insurance. This phenomenon could be attributed to people's irrational response when facing uncertain risks, yet it could be a result of the continuous government intervention and bailout. Therefore, the insurance market on disasters thus has an only limited scale in Taiwan so far. The amendment on the DPRA in 2016 further impeded the development of a climate insurance market. Being aware of the importance of a sustainable mechanism against frequent disasters, the legislators normalize post-disaster recovery measures. For example, the section 1, article 44-1 of the amendment prescribes that, "Self-use residence purchased by people from disaster-affected areas with a mortgage may have the house and land offset against the loan upon the consent of original loan financial institution if governments at all levels have determined that the residence is severely damaged during the disaster and can no longer be used. The interest of the leftover loan for the remaining years shall be subsidized by the Ministry of the Interior." According to the law, owners of residence do not have to pay premiums but enjoy unlimited loan exemption and house-offset without undergoing any review procedure. This regulation may not only encourage high-risk construction and housing but also dis-encourages the development of disaster insurance.[43]

Designing Climate Insurance for Taiwan

An insurance system against climate change should be capable of reducing vulnerability through active risk redistributing and enhancing resilience by changing the behaviors of people and potential polluters. There are several difficulties on the path to designing insurance for Taiwan against climate change.

i. Three Principles

1. To secure the capability of the insurance market

Insurability is the primary concern of the insurers when they decide whether to underwrite policies.[44] However, insurability is not limitless and comes at a price. In addition, the industry's balance sheets and profitability are also highly exposed to risk trends.

On the one hand, the insurers must have the ability to identify, quantify and estimate the risks and possible losses. Sufficient information will facilitate insurers to decide appropriate premiums for risk.[45] On the other hand, the capability of the insurance market may not be sufficient to absorb the losses with the increasing frequency and scale of climate-related extreme weather event. Capital outside the insurance market may be needed to supplement the capability of insurers. This issue is especially severe in Taiwan, considering the relatively small size and capital of the insurers.

2. To encourage potential victims to pay insurance

Another concern is whether individuals are willing to pay for the uncertain risk of climate change. Theoretically, a potential victim will invest insurance if he believes the premium to be worthy of the risks. However, most people do not purchase insurance at a reasonable price against low-probability but high consequence disasters.[46] The development in Taiwan shows that people

[42] *Ibid.*, at 50.

[43] *Ibid.*, at 71.

[44] QIHAO HE, *supra* note 29, at 63.

[45] Howard C. Kunreuther and Erwann O. Michel-Kejan, *Climate Change Insurability of Large-scale Disasters, and the emerging liability Challenge*, 155 U. PENN. L. REV. 1797 (2007); *see also* QIHAO HE, *supra* note 29, at 81.

[46] QIHAO HE, *supra* note 29, at 85.

have little incentive to invest in catastrophe insurance since they perceive climate-related risk is uncertain and rely on a government bailout. However, the small pool of the insured diminishes the size of the insurance market, undermining its capability to redistribute risks.

3. To ensure fairness for the most vulnerable groups

The third concern is fairness. The most vulnerable people may suffer from unfairness in the catastrophe insurance market. On the one hand, they have to pay a higher premium since their residential area is usually vulnerable to climate risks; on the other hand, insurers may refuse to underwrite a policy if they consider the risk and loss is too high.

Climate change adaptation requires us to facilitate the most vulnerable people since they usually contribute less GHG emission and enjoy less benefit from it. It is unjust to put much burden on them. An insurance system for the climate change era should put efforts to reduce the vulnerability of the most vulnerable. In Taiwan, many indigenous and more impoverished people reside in the most vulnerable areas such as mountainous and coastal areas and could suffer more in disasters. It is essential to ensure that market-based insurance will not exaggerate their difficulties.

ii. Compulsory Catastrophe Insurance with Substantial Government Involvement

In order to design a climate change insurance that will better equip Taiwan to adapt climate change, there are at least three issues to be answered: the type of insurance, compulsory or vulnerary, and the role of the government. A preliminary analysis suggests compulsory catastrophe insurance with substantial governmental involvement.

1. Property insurance or liability insurance?

In the face of climate change, the global insurance industry has been trying to develop new strategies to not only facilitate climate change adaptation but also to mitigate GHG emission more effectively. Insurance companies have identified three climate risks: physical risks, liability risks, and transition risk.[47] Out of concern on losses of extreme weather events, this article focuses on the physical risks of climate change. Physical risks of climate change include economic losses that arise from increasing severity and frequency of extreme weather events, as well as losses from long-term climate change. Insurance aiming at transferring physical risks of climate-related disasters is usually categorized as "catastrophe insurance."

This article suggests that Taiwan should promote catastrophe insurance first. Catastrophe insurance provides a market mechanism to redistribute risks and reduce the vulnerability of victims. Victims of a disaster can quickly get compensation for temporary relief and future recovery. By paying the insurance premium, the insured may also cultivate awareness on climate change and take risk preventive actions in advance.

Liability insurance is a useful mitigation mechanism since it targets major GHG emitters which may be legally liable for climate change hazards. The condition for well-functioned liability insurance is a clear legal rule to identify major GHG emitters and their responsibility. Although Taiwan enacted the GHG Reduction and Management Act in 2015, the detailed rule regarding liability has not been fully equipped. Since the law may impose a tax on significant emitters and motivates them to reduce GHG emission.

[47] Physical risks refer to economic risks that could arise from direct or indirect impact due to increasing severity and frequency of extreme weather events, as well as long-term climate shift. Liability risks occur when victims of climate change seek compensation from whom they blame for. Transitional risks refer to financial risks resulting from the process of transition toward a low-carbon society.

2. Free market or compulsory insurance?

An efficient insurance market should be capable of reflecting the value of goods through free choice. However, a small market is harmful to the function of redistributing risks. How to balance the freedom of consumers and the function of insurance is an issue to be determined.

The limited insurance market size in Taiwan may not be capable enough to absorb the losses of frequent climate-related disasters. It is neither practicable to raise the premium since it reduces the motivation of potential victims to buy insurance. The weak development of the typhoon and flooding insurance has set a negative example.

Compulsory insurance is one possible solution. By collecting more premiums, compulsory insurance may enlarge the market size and increase the capability to redistribute risks.

Compulsory insurance does not indicate a fixed premium. A fixed premium has negative impacts on the insurance market and deters the insurers to effectivelt evaluate the risks and possible loss. Therefore, the market cannot generate needed information and adjust its strategies to balance losses and benefits. The experience of the earthquake insurance reminds us not to repeat the mistake.

On the other hand, the insurer might request more on people living in the vulnerable area or refuse to include them if they calculate the premiums on risk-basis, and both results aggravate the difficulties of vulnerable groups.

The best way is compulsory insurance with partial subsidy for low-income families. Compulsory insurance enlarges the market basis, and subsidy may balance the possible injustice of market mechanism. Besides, as the experience of earthquake insurance has reminded us, it is crucial to create some space for the insurers to calculate risk and adjust premiums. The market mechanism will be able balance cost and benefits, and generate the necessary information in developing consciousness to take preventive actions to avoid risk.

3. The role of the government

In a well-functioned market, a government should restrain itself from intervening in the market. However, the insurance market in Taiwan will fail without the government because of the insurers' insufficient capacity, the victims' lack of willingness, and the inadequate information, the insurance market will fail without the role of the government. To provide a proper role for the government in climate insurance without jeopardizing the market is also crucial.

There are several things that the government may do to support the insurance market. First, the government should establish a legal basis for compulsory catastrophe insurance, requiring citizens who own real estate to join the catastrophe insurance. The insurer may decide the premium according to the value of a property and its risk against climate-related disasters, yet low-income family may apply for the subsidy.

Second, the government should invest in researching and collecting information regarding the changing climate. An insurer will hesitate to underwrite catastrophe insurance if it lacks sufficient information to evaluate the insurability. The risk assessment, risk zone mapping, and researches regarding climate change and its hazards are a necessary precondition for catastrophe insurance. The Disaster Prevention and Protection Expert Consultation Committee and the National Science and Technology Center are putting efforts for providing abovementioned information, offering a preliminary basis for catastrophe insurance. The government should further coordinate the information with the researches generated under the National Climate Change Adaptation Framework Policy in order to help insurers setting accurate risk-adjusted premiums.[48]

Third, it is crucial to provide a safeguard for insurers. Facing the increasing numbers of climate-related disasters, the insurers either go bankrupt or raise the premium to an unaffordable point. Neither is desirable. Traditionally, the insurers may reduce its burden through re-insurance market. However, it is not clear whether the reinsurance market can provide sufficient safeguard for Taiwanese insurers since the reinsurance market on climate change is still in its infancy. Before the

[48] J.DAVID CUMMINS & O. MAHUL, CATASTROPHE RISK FINANCING IN DEVELOPING COUNTRIES: PRINCIPLES FOR PUBLIC INTERVENTION 76-77 (2009). *See also* QIHAO HE, *supra* note 29, at 63-64.

global reinsurance market provides the mechanism for domestic insurers, the government may need to play a role as the re-insurer. As the earthquake insurance system indicates, a governmental sponsored fund could encourage the establishment of a catastrophe insurance market.

Conclusion

This article reviews the development of the disaster risk management system in Taiwan and suggests a catastrophe insurance system with the capacity of adaptation in the climate change era. The article finds that the history of frequent disasters and the development of democratization both contribute to the evolution of Taiwan's current disaster risk management system. From the experience of Morakot Typhoon, we find that the current system with the contribution of charity and the National Health Insurance System has revealed several problems that make the system incapable of dealing with more frequent climate-related disasters in the future. Through the perspective of climate change adaptation, this article points out four problems: fragmentation, understated prevention and recovery, unsustainable financial mechanism, and passive citizens.

This article further proposes to establish climate insurance system to facilitate Taiwan’s disaster risk management system. On the previous experience of disaster-related insurance, this article suggests a catastrophe insurance market where the government involves to prevent market failure.

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