Terr. Atmos. Ocean. Sci., Vol. 28, No. 1, 83-97, February 2017 doi: 10.3319/TAO.2016.04.17.01(CCA)

Examining resilience in local adaptation policies – pilot studies in Taipei and Tainan, Taiwan

Peiwen Lu[1], Ellie Yu-Hui Huang[2], Shu-Yun Liang[2], and Gin-Rong Liu[3, *]

[1] *Department of Geography, National Changhua University of Education, Changhua County, Taiwan*
[2] *Centre of Environmental Studies, National Central University, Taoyuan City, Taiwan*
[3] *Centre of Space and Remote Sensing Research, National Central University, Taoyuan City, Taiwan*

Article history:
Received 20 December 2015
Revised 12 April 2016
Accepted 17 April 2016

Keywords:
Resilience, Climate change, Adaptation, Local adaptation policies, Tainan (Taiwan), Taipei (Taiwan)

Citation:
Lu, P., E. Y. H. Huang, S. Y. Liang, and G. R. Liu, 2017: Examining resilience in local adaptation policies – pilot studies in Taipei and Tainan, Taiwan. Terr. Atmos. Ocean. Sci., 28, 83-97, doi: 10.3319/TAO.2016.04.17.01(CCA)

ABSTRACT

Resilience has gained considerable attention over recent years in both theories and decision-making practices. In Taiwan, the term resilience is generally considered as a synonym for adaptation. This may limit the use of the notion. By understanding resilience in terms of adaptation and mitigation, we identify six attributes for assessment. The assessment is addressed in local level climate change adaptation policies in two selected cities. The city of Taipei represents places where local adaptation policies were directed mainly by the national government. The city of Tainan represents places where the municipal government plays a more critical role in framing these policies. This can result in different policymaking considerations. The assessment points out that the proposed actions of these policies are broader than a general understanding of adaptation. Mitigation strategies are addressed and sometimes highly recommended. Because of this, we can interpret these actions as resilience strategies covered under the use of the term adaptation. The notion of resilience does not stay on the rhetorical level alone. It is happening in shaping decisions – without using the terminology directly. The broadness of the resilience notion, in spite of being abstract, can provide a more general framework for cross-sectorial discussion and collaboration in policy-making. This is particularly important for dealing with complex issues, such as climate-related disturbances, which cannot be managed by a single group of professions.

1. INTRODUCTION

This paper explores how the notion of resilience is embedded in local-level climate change policies. Resilience has a variety of disciplinary origins, including ecology, business studies, material science, engineering, and psychology (Holling 1973; Gunderson 2000; Hyslop 2007; Downing et al. 2012). Across many definitions, the issue of change often plays a central dimension in illustrating the notion of resilience, both in terms of resistance to change and recovery from it. Promoting resilience in practice is about increasing the capacity of robustness and rapidity of response and recovery. Robustness is related to the 'strength' to carry and minimise disturbances, whilst rapidity refers to the flexibility to rearrange itself into a new stable state (which is not always the same as its previous state) after a collapse or disturbance occurs (Lu and Stead 2013). Considering the flooding issue, for example, protection infrastructure can be proposed to increase robustness. Strategies such as rescue plans and resource management are related more to rapidity, the speed of return.

In spite of having many theoretical discussions, the notion of resilience is often used implicitly in policy-making and addressed in combination with other concepts, such as adaptation, mitigation, and sustainability (Lu 2014). In Taiwan, the notion of resilience is generally considered a synonym for adaptation. At the national level, the *Adaptation Strategy to Climate Change in Taiwan* (Council for Economic Planning and Development 2012a) was designated by the National Development Council. It is aimed at developing adaptation capacity in eight categories: disasters, infrastructure, water resources, land use, coastal zones, energy supply and industry, agricultural production and biodiversity, and

* *Corresponding author*
E-mail: grliu@csrsr.ncu.edu.tw

health. At the local level, the local government is responsible for initiating climate adaptation action plans reflecting these eight categories.

The study examines the way in which resilience is addressed in local policies to cope with climate change and the relevant impact. It holds on a wider understanding of resilience, while gives room to discuss the general, perhaps oversimplified understandings between the notion of resilience and adaptation. This paper is structured in four parts. We first review the notion of resilience in the literature. Secondly, we illustrate the analytical framework and the steps for assessment. Third, we evaluate local climate change adaptation action plans in Taipei and Tainan. The city of Taipei is one of the pilot study areas where local adaptation policies were promoted mainly at the national level. In Tainan, the municipal government plays a critical role in framing local adaptation strategies. This may shape the focus, as well as the directions of spatial development differently. Based on this, we illustrate the underlying considerations in local decision-making. We also reflect on the resilience notion in framing strategies as the concluding remarks.

2. UNDERSTANDING RESILIENCE

2.1 Historic Review

Resilience is a concept incorporating a vast range of contemporary risks (Coaffee 2008, 2013). As Gunderson and Holling (2001) pointed out, the notion of resilience is often represented as the way in which systems (e.g., urban systems, ecological systems, or flood risk management systems) perform in coping with shocks and surprises and shift into a new stable. Resilience studies were originated from studies on ecological equilibrium in the 1970s – with a focus on the capacity of a specific species to sustain itself from large-scale ecological disturbances (Holling 1973). For example, a forest fire might cause a species to collapse. However, after the fire, some species bounce back to the previous balance or shift into a new stable status. This self-organising or self-reorganising ability was the initiation for the concept of resilience (Ludwig et al. 1978; Walker et al. 1981; Fiering 1982; Walters 1986). Pimm (1984) highlighted the importance of measuring resilience in terms of the speed of return, and this was also known as engineering resilience in Holling's study (1996). Studies on engineering resilience focused on the efficiency, constancy, and predictability of a system in facing a disturbance (Pimm 1991; Ludwig et al. 1997). The faster the system bounced back, the more resilient it was.

The growing interest in resilience in social sciences often relates to the consequences of increasing complexity, uncertainty, and insecurity and thus new approaches for adaptation and survival are being sought (Christopherson et al. 2010). Vayda and McCay (1975) and Zimmerer (1994) both applied the notion of resilience in analysing the capacity of a self-organising system (e.g., settlements and societies) to withstand disturbances (e.g., disasters, diseases, crisis, and natural hazards) without being destroyed. According to their study, the ability to 'learn' from previous experiences was critical. For example, a fishery settlement would be more resilient than a modern new town in coping with flooding. The past flooding experiences allowed the settlement to be more aware and more capable of resisting and adapting to floods (Lamson 1986).

Applying resilience is about increasing robustness, as the capacity to resist the disturbances, and rapidity in doing so, represents the ability to bounce back (Newman 2009; Newman et al. 2009; Lu and Stead 2013). Figure 1 presents an illustration. The curve shows the trajectory of a system with a disturbance. Line A illustrates a possible response through growth, conservation, collapse or release, and renewal and reorganisation. Line B shows a more resilient system that does not drop far in performance. The difference between Lines A and B is robustness. Line C drops as far but recovers quickly. This shows the different speeds of recovery. Line D indicates a system that drops less, recovers more quickly and achieves higher performance as the outcome result. The increased performance that results may represent learning in the system, either the evolution of a natural system or changes in policy.

2.2 Resilient Cities

Applying resilience in cities has been discussed widely, including energy insecurities, terrorism, and the variety of socio-ecological disturbances (Folke 2006; Walker and Salt 2006; Coaffee 2009; Newman et al. 2009). From the energy perspective, resilience represents an effective counter to cope with the vulnerability of energy insecurities, for example, the availability of energy resources, the constraints in the energy supply and the impact on political disruptions (O'Brien and Hope 2010). Embedding resilience in this aspect is often referred to interdependent energy, transport infrastructures and lowering the carbon pathway (Newman et al. 2009; O'Brien and Hope 2010; Sircar et al. 2013). Studies on terrorism increasingly use the notion of resilience to describe how cities and regions attempt to embed security and risk management into the system of governance and physical development (Coaffee 2008, 2009; Coaffee and Rogers 2008). This is also related to resilience in the field of psychology. Resilience in this context represents a broader drive that can promote a city to be safer and more sustainable. Practical cases are often addressed in public transportation (e.g., metro systems) for an active emergency response to terrorist attacks (Bruyelle et al. 2014).

The notion of resilience is also embedded in urban studies of socio-ecological disturbances, such as global economic crisis, natural disasters, and the impact of climate change. Studies in this track highlight the complexity of the

disturbances and the difficulty to be managed in advance (Folke 2006; Walker et al. 2006). Realising the uncertainty is particularly highlighted in this track in comparing with other tracks of resilient studies (Wardekker et al. 2010; Schelfaut et al. 2011; Gomes et al. 2014; Kojima et al. 2014). The capacity of learning is critical to minimise the disturbances that may be addressed in the future. Actions to promote resilience in this track often lead to changes in institutions, which enable a wider set of actors to collaborate and share responsibilities in coping with the uncertainty (Gomes et al. 2014; Kernaghan and da Silva 2014).

There is an increasing number of resilient studies in relation to climate change and its relevant impact – not only associated with disruptive events such as storms or heat waves, but also with gradual trends like rising sea level or the increase in average global temperatures that could give rise to large disturbances if left unchecked (Wardekker et al. 2010). Policy-makers increasingly use the term resilience to signify adaptation or mitigation strategies, sometimes both. Resilience in this context provides a means of both adapting to the adverse impact of climate change and reducing the emissions (e.g., CO_2 emission) that contribute to climate change. According to Davoudi et al. (2012), it represents more about a versatile umbrella term without an exact, defined way of understanding.

Framing resilience in climate change studies often focus on developing mitigation and adaptation, especially at the local levels (Godschalk 2003). While both adaptation and mitigation efforts are both important for framing resilience to cope with climate change, they may not necessarily be compatible with each other and applicable in the same direction. For example, although high-density, mixed-used settlements can reduce energy demand and emission from transportation, it could also intensify the urban heat island effect that causes more energy to be consumed by air conditioning (Howard 2009).

Strategies for either mitigation or adaptation (or both) highly depend on the scale of decision-making. Promoting resilience at the upper, i.e., regional, national and transnational, level is more related to mitigation. At the local level, it may have more of a focus on adaptation (Howard 2009). Mitigation strategies may be insufficient to prevent disturbances from occurring. For example, coastal settlements need to strengthen sea defences and drainage facilities to cope with rising sea levels and the extreme rainfall caused by the impact of climate change. These generally require more than actions at the local or community level.

Based on this general understanding, we define the analytical framework to explore the embodiment of the resilience concept in local policies. The research design and the empirical studies are presented in the following sections. The assessment result also gives us the opportunity to argue the scope of resilience considered in Taiwanese contextual policy-making. This confirms the general understanding of the theoretical reflections.

3. RESEARCH DESIGN

3.1 Attributes of Resilience in Policy-Making

Many studies have discussed the attributes of resilience. A brief review is illustrated below and presented in Table 1. Only the literature that is specific to policy-making has been included in the review. There is a multitude of more general references on the resilience of cities (e.g., Baker 2012; UNISDR 2012; ICLEI 2013; Jha et al. 2013); however, these studies are not specifically directed to policy-making.

A general understanding of resilience is related to robustness (strengths, mitigation) and rapidity (flexibility, adaptation). In addition to this, Godschalk (2003) identified resilience in terms of redundancy, diversity, efficiency,

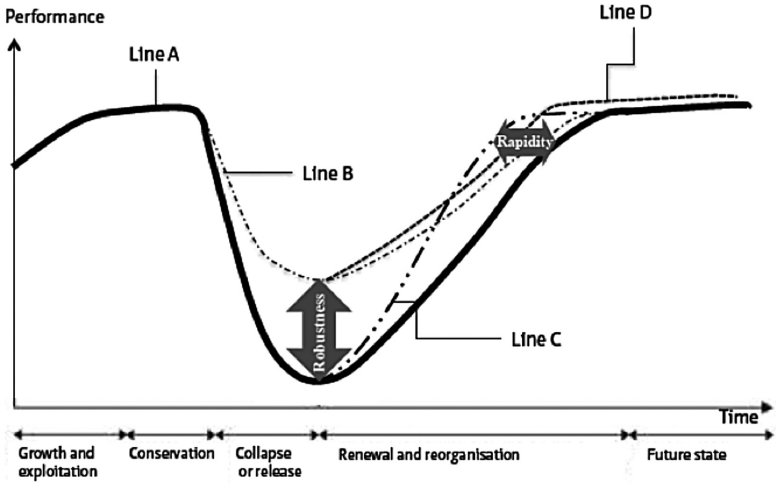

Fig. 1. Relationship between resilience, robustness, and rapidity through four phases of the adaptive cycle (source: based on Linnenluecke and Griffiths 2010).

Table 1. Summary of studies characterising resilience.

Source	Characterising resilience
Linnenluecke and Griffiths 2010; Wardekker et al. 2010	Robustness (or strengths, mitigation) and rapidity (or flexibility, adaptation)
Godschalk 2003	Redundancy, diversity, efficiency, autonomy, strength, interdependence, adaptability, and collaboration
Fleischhauer 2008	• to keep areas free of development under the threats of climate change • to initiate decisions of land use according to the intensity and frequency of hazards • to bind land use or zoning plans legally • to encourage he development be able to contribute on reducing the potential hazards
Davoudi and Strange 2009	Fluidity, reflexivity, contingency, connectivity, multiplicity, and polyvocality
Cabinet Office 2013	Preparedness, subsidiarity, direction, information, integration, cooperation, and continuity
Walker and Salt 2006	Diversity, ecological variability, modularity, acknowledge slow variables, tight feedbcks, social capital, innovation and overlap in governance, and ecosystem services
Hutter 2007, 2011, 2013; Bernhard 2010; Hutter et al. 2013	• the changes in organizational contexts • the perceived and unperceived threats • the attentions to analyse the consequences of the failures • the process of response and the (positive or negative) outcomes
Gupta et al. 2010; Van den Brink et al. 2011	Variety, learning capacity, room for autonomous change, leadership, resources, and fair governance

autonomy, strength, interdependence, adaptability, and collaboration. This illustrated resilience in social, especially the urban dimensions. Fleischhauer (2008) further developed Godschalk's (2003) attributes in the planning context as (1) to keep areas under the threat of climate change free of development; (2) to initiate land use decisions according to the intensity and frequency of hazards; (3) to legally bind land use or zoning plans; and (4) encourage development that is able to contribute to reducing potential hazards. These principles highlighted the importance of using planning tools to guide spatial development into becoming more resilient.

From the perspectives of decision-making studies, Davoudi and Strange (2009) illustrated resilience in terms of fluidity, reflexivity, contingency, connectivity, multiplicity, and polyvocality. Their argument highlighted the importance of collaboration and communication. This also related to studies that emphasise a process of communication to make export judgements, so that policy-making can be more systematic and transparent (Moss and Schneider 2000; Willows and Connell 2003; Moss 2011). The UK government *Emergency Response and Recovery* guidance offered the resilience principles as preparedness, subsidiarity, direction, information, integration, cooperation, and continuity (Cabinet office 2013; Coaffee 2013). In addition to the focus on communication, these principles also considered scientific studies on future trends and potential threats as important – to form a platform or communication by presenting scenarios of future situations (Bouwer et al. 2010).

Scholars from the ecological perspectives highlighted the social dimensions of resilience in finding the dynamic equilibriums between human and nature (e.g., Klein et al. 2003; Folke et al. 2004; Walker and Salt 2006). Walker and Salt (2006) proposed the 'quality' of resilience in human society in terms of diversity, ecological variability, modularity, acknowledging slow variables, tight feedbacks, social capital, innovation, overlap in governance, and ecosystem services. These characteristics focus mainly on a systems' ability to consider the socio-environmental relations and learn from previous failures or collapses. For example, a settlement might learn from previous flooding experiences, develop adaptive solutions and therefore become more resilient.

The organisational studies on resilience highlighted the importance of a system of learning from previous disturbances and revealing the shifts in policy-making due to experiences from the disturbances (Hutter 2007, 2011, 2013; Bernhard 2011; Hutter et al. 2013). From this perspective, resilience often referred to a capability, a capacity or ability of an actor or a system (1) to change in the organisational context; (2) to cope with perceived and unperceived threats; (3) to analyse the consequences of failures; and (4) to provide responses and outcomes. Recent Dutch scholars indicated the importance of studying the power of governance in responding to uncertainties. Gupta et al. (2010) and Van den Brink et al. (2011) both emphasised the importance of variety, learning capacity, room for autonomous change, leadership, resources, and fair governance to promote resilience in policy-making.

Building on existing resilience knowledge, the study concludes by proposing six policy-making resilience attributes as (1) considering the current situation; (2) examining trends and future threats; (3) learning from previous experience; (4) setting goals; (5) initiating actions; and (6) involving the public. Summary of the attributes and the relevant sources is presented in Table 2. Referring to Lu and Stead (2013) and Lu's (2014) study on resilience, we present the assessment criteria for each attribute in Table 3. These criteria were also

Table 2. Attributes of resilience and the relevant source.

Attributes of resilience	Source
Considering the current situation	Walker and Salt 2006; Cabinet Office 2013
Examining trends and future threats	Bouwer et al. 2010; Cabinet Office 2013
Learning from previous experience	Walker and Salt 2006; Bernhard 2010; Gupta et al. 2010; Hutter 2011, 2013; Van den Brink et al. 2011; Hutter et al. 2013
Setting goals	Godschalk 2003; Fleischhauer 2008; Gupta et al. 2010; Van den Brink et al. 2011
Initiating actions	Fleischhauer 2008; Bernhard 2010; Hutter 2011, 2013; Hutter et al. 2013
Involving the public	Godschalk 2003; Davoudi and Strange 2009; Bernhard 2010; Gupta et al. 2010; Hutter 2011, 2013; Van den Brink et al. 2011; Cabinet Office 2013; Hutter et al. 2013

Table 3. Assessment criteria and description of resilience attributes.

Attributes of resilience	Assessment criteria	Description
Considering the current situation	• monitor current situation • evaluate and maintain the current condition	Attention to the current situation indicates the ability to understand and maintain the existing conditions of the environment. It addresses physical facilities and the monitoring and evaluation of policy
Examining trends and future threats	• predict regional trends and patterns • identify and assess the probability of risks and disturbances • forecast	Attention to trends and future threats concerns the ability of prediction on the basis of current information, for instance, scientific scenarios, models of future impacts, and the probability of risks in policy-making. This characteristic relates to issues of trust and learning
Learning from previous experience	learn from past experiences	Urban resilience also draws on experiences from the past and requires the capacity to utilise the necessary knowledge to deal with similar conditions in the future
Setting goals	• set up 'priorities' based on risk assessment and probabilities • propose new standards	The ability to set goals indicates the willingness (and power) to respond to issues of change such as climate change and flood risk management. Visioning exercises involving multi-sectoral collaboration may be used to formulate goals
Initiating actions	• invest in and develop scientific scenarios for risk assessments • collaborate decision-making between different levels of governance • authorise and mandate infrastructural actions • coordinate readiness actions • innovate and propose economic-benefit actions • propose and elaborate actions	The ability to initiate actions is related to the authority of policy-making, including formal and informal forms of power. These involve different kinds of resources (e.g., experts, knowledge producers, projects) which allow actions to occur
Involving the public	• communicate findings (concepts, skills, actions) in planning policy • raise public awareness and preparation education	The ability to involve the public addresses the degree of public participation in policy decisions, both in terms of informing the public and responding to concerns from the public

qualified using expert interviews and brainstorming.

3.2 Assessing Resilience – Research Protocol

The assessment includes three steps:

Step1: preparation and data collection

The material used for assessment is local adaptation policies of Taipei and Tainan. They are: *Taipei Climate Change Adaptation Plan* (Council for Economic Planning and Development 2012b) and *Tainan Climate Change Adaptation Plan* (Tainan City Government 2014). The quality of the assessment highly depended on the examiners' ability to interpret the meaning of each criterion. Three experts were invited to do the assessment. They were professionals in political science, social science, and environmental science. Climate-related professions were also included. However, we agree that these three professions could represent a majority of the active expertise in climate change decision-making. We invited these experts to provide continual assessment. Short lectures were given.

Step 2: analysing the data

The three experts were responsible for reviewing the policy documents. The individual work involved listing each proposed action into the Table 3's criteria according to the eight adaptation categories designated by the National Development Council (i.e., disasters, infrastructure, water resources, land use, coastal zones, energy supply and industry, agricultural production and biodiversity. and health).

Not all of them were addressed in both policy documents. For example, the coastal zone category was not in Taipei policy document because the city is not close to the coast.

Discussion was allowed if the proposed actions were confusing or misleading to the others. This helped to ensure assessment transparency and robustness in the result. The calculated result is shown in Table 4 (Taipei) and Table 5 (Tainan). The raw result is presented in Appendix I and II.

Step 3: interpretation and visualisation

The last step of the assessment was to interpret the information and present the findings for public assessment and further discussion. We used pie charts for illustration. This visualised the focus, i.e., preferences and interests, as well as the room for further development in policy-making.

4. PRACTICAL ASSESSMENT

4.1 Taipei

Taipei Climate Change Adaptation Plan (Council for Economic Planning and Development 2012b) was used for assessment. The focus of resilience in policy-making was examined according to Table 3 and listed in Table 4.

The pattern of governance interests in each adaptation category is presented in Fig. 2. Concerning the disaster category, a prior interest was about initiating actions – about half of the proposed actions were related to this (44%). Governance interests in considering the current situation (14%), examining trends and future threats (14%), setting goals (12%), and involving the public (16%) were similar. Infrastructure actions represented a clear focus on considering the current situation (45.9%) and on initiating actions (45.9%). Other resilience attributes were hardly considered. The extremely high rate (83%) in the attribute of initiating actions was shown in water resources category. Only a few proposed actions directed to examining trends and future threats (8.3%) and involving the public (8.3%). The major focus in the land use category was rather initiating actions (29.2%) but setting goals (62.5%) – the highest amount of all the categories. This could be interpreted as a consequence that presenting visions to directing guidance was a core value for land use management.

The initiating actions attribute gained many considerations in the energy supply and industry category (42.86%). Interests in involving the public are presented as follows (33.3%) – most of them were related to energy saving education. In the agricultural production and biodiversity category, considering the current situation (31.25%) gained similar attention with initiating actions (37.5%). This indicated that both environmental conditions and adaptive actions were considered to be important. Only 18.75% of the governance interests were given to the examining trends and future threats attribute. However, this was the highest attribute performance among the categories. Actions in relation to health focused on involving the public (68%) and initiating actions (32%). Most of them were related to education and public announcements. Limited consideration of learning from previous experience was shown in all of the categories.

4.2 Tainan

Tainan Climate Change Adaptation Plan (Tainan City Government 2014) was used for assessment. The focus of resilience in policy-making was presented as in Table 5 and Fig. 3. As shown in Table 5, the attribute of initiating actions (35.8%) and of involving the public (34%), gained most of the governance interests in the disaster category. We interpreted that policy-makers consider public awareness to be as important as faming actions for disaster management. Most of the proposed actions in the infrastructure category were set to initiating actions (60%) and considering the current situations (24%). Examining trends and future threats, learning from previous experiences and involving the public were hardly considered. Different from the situation in Taipei, actions in the water resources category presented a more balanced pattern – about half of the governance interest was set to initiating actions (56.3%). The attribute of examining trends and future threats gained 18.8% of governance interests. This was not high, but was the highest attribute performance among the categories.

Land use management actions remained focused on setting goals (63.6%) – similar to the situation in Taipei. In the coastal zones category, initiating actions (41.2%) gained most of the government interests. Setting goals (23.5%) was considered as critical as involving the public (23.5%) – most of them were related to public education for coastal protection. 11.8% of the proposed actions involved the attribute of considering the current situation.

Energy supply and industry actions were mainly about initiating actions (53.6%). The rest are presented in order: setting goals (28.6%), involving the public (14.3%), and examining trends and future threats (3.57%). The governance interests in agricultural production and biodiversity and health both presented a more balanced pattern. In the agricultural production and biodiversity category, the attributes of initiating actions (37.5%), involving the public (25%), and setting goals (20%) were primarily considered. Proposed actions for considering the current situation (7.5%) and examining trends and future threats (10%) mainly involved scientific studies and assessment. Actions in the health category were mainly about involving the public (41.9%). Policy-makers set a focus on increasing public awareness in this category.

5. DISCUSSION AND CONCLUDING REMARKS

In the previous section, we examined the embodiment

of resilience attributes in policy documents. Policy-makers mostly considered the attribute of initiating actions. Subtle differences exist among the categories and also between the two cities. As shown in Fig. 4, around half of the proposed actions are directed to the attribute of initiating actions (44.95% in Taipei and 43.79% in Tainan). Practical works, i.e., engineering facilities, were perhaps the major focus in policy-making. The second prior focus presented in the policies varies between the two cities. In Taipei, it was set to the involving the public attribute (18.34%). In Tainan, it was about setting goals (21.79%), and involving the public (18.47%) was also critical. Both policy documents presented a similar pattern in relation to the attribute of considering the current situation – 15.67% in Taipei and 11.26% in Tainan. The characteristic of examining trends and future threats and of learning from previous experience had lower performance or was rather addressed in the policies. The lower consideration for examining trends and future threats might result from a lack of integrating projective information into local decision-making. In spite of presenting potential climate change impact scenarios, policy-makers might not give the outcomes of scientific projections much importance. This would challenge the effectiveness of the policies in the longer term. The missing capacity of learning from previous experience could be illustrated by considering the focus of the documents – they were set on framing new strategies rather than lessons learned from the past. However, limited reflection on previous experiences is also illustrated in policy-making.

Subtle differences related to the attributes might be interpreted in the underlying policy-making framework. In Taipei, larger numbers of academics participated with the support of national resources and scientific projections. Decision-making represented more interest in considering the current situations and examining trends and future threats. In Tainan, the municipality played a key role in shaping decisions. Setting goals, i.e., presenting visions of the city was highlighted and required more involvement from the public.

From the theoretical perspective, we prefer that policy makers give more comprehensive consideration among all the attributes – to have a more balanced framework of promoting resilience. The assessment result is also sufficient to be considered as a basis for further revision of these policies. Since resilience is an iterative, changing process, it requires long-term observations in order to understand a system of learning and revealing the shifts in policy-making. The

Table 4. Taipei: the focus of resilience in policy-making – shown in percentage.

Attribute of resilience	**Calculated in percentage (%)**						
	Disasters	**Infrastructure**	**Water resources**	**Land use**	**Energy supply and industry**	**Agricultural production and biodiversity**	**Health**
Considering the current situation	14	**45.9**	0	4.17	14.3	31.25	0
Examining trends and future threats	14	2.7	8.3	4.17	0	**18.75**	0
Learning from previous experience	0	0	0	0	0	0	0
Setting goals	12	2.7	0	**62.5**	9.52	12.5	0
Initiating actions	44	45.9	**83**	29.2	42.86	37.5	32
Involving the public	16	2.7	8.3	0	33.3	0	**68**

Table 5. Tainan: the focus of resilience in policy-making – shown in percentage.

Attribute of resilience	**Weight in percentage (%)**							
	Disasters	**Infrastructure**	**Water resources**	**Land use**	**Coastal zones**	**Energy supply and industry**	**Agricultural production and biodiversity**	**Health**
Considering the current situation	15.1	**24**	18.8	0	11.8	0	7.5	12.9
Examining trends and future threats	1.89	0	**18.8**	0	0	3.57	10	3.23
Learning from previous experience	0	0	0	0	0	0	0	0
Setting goals	13.2	16	6.25	**63.6**	23.5	28.6	20	3.23
Initiating actions	35.8	**60**	56.3	27.3	41.2	53.6	37.5	38.7
Involving the public	34	0	0	9.09	23.5	14.3	25	**41.9**

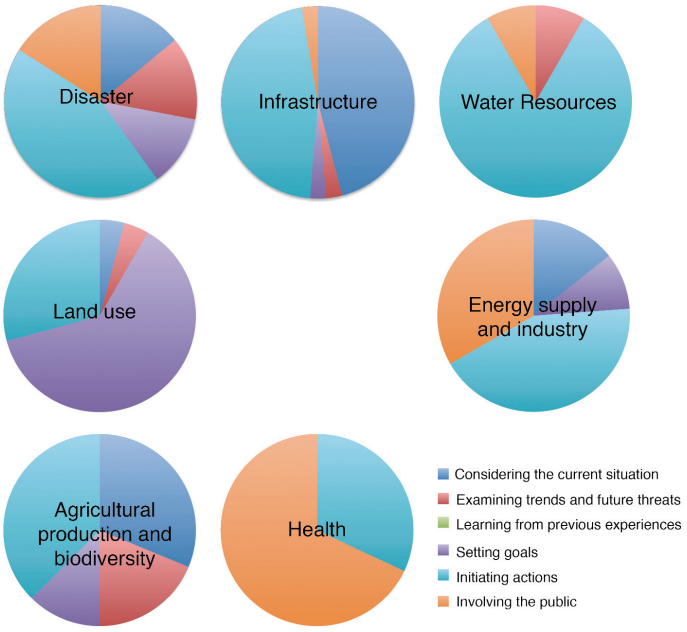

Fig. 2. Taipei: the pattern of governance interests in each adaptation category presented according to the resilience attributes. (Color online only)

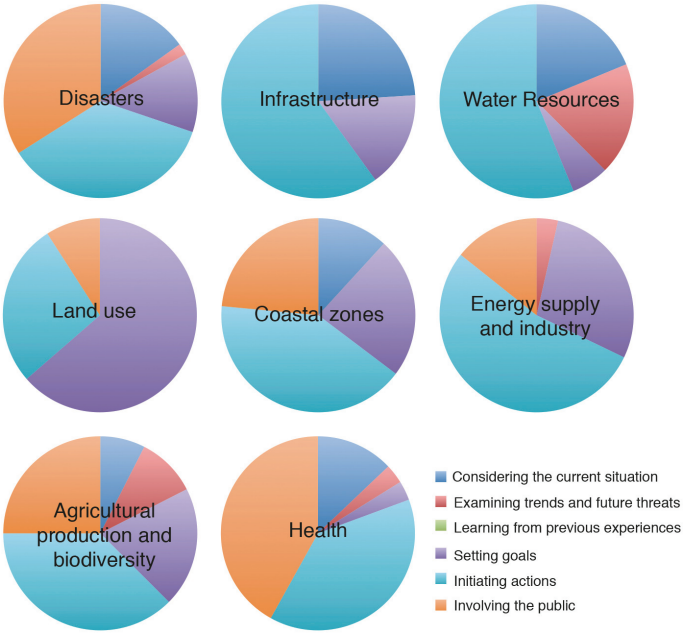

Fig. 3. Tainan: the pattern of governance interests in each adaptation category presented according to the resilience attributes. (Color online only)

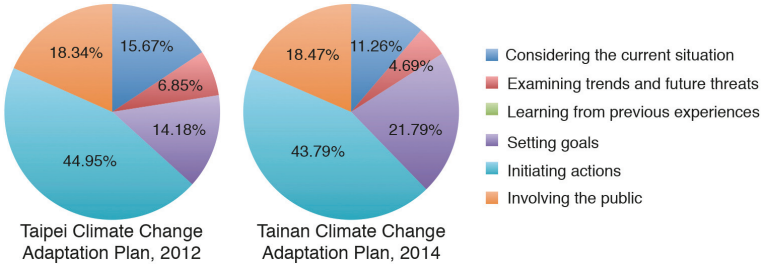

Fig. 4. The overall pattern of governance interests presented according to the resilience attributes. (Color online only)

criteria used in the assessment could help identify practical issues, the prior focus, for promoting resilience. These can be equally applicable to different level of government.

The assessment also illustrates that a number of the proposed actions are revealed in terms of mitigation strategies that seek to provide environmental improvement over a longer term. According to this, we argue that the content of the policy documents, i.e., the initiated actions, are in fact broader than the general understanding of adaptation that is mainly about the ability to accommodate in the extremity. Practical implementation may be restricted and limited in reflecting to the intention of decision-making.

Considering the policies as resilient strategies with use of the term adaptation may give more room for implementation. The notion of resilience is widely considered as a synonym for adaptation in the Taiwanese context. According to this assessment, however, this may be risky in directing the practices. The notion of resilience does not remain in the rhetorical level – it is happening in shaping decisions without using the terminology directly. Promoting resilience includes adaptation as well as mitigation actions. The broadness of the resilience notion, in spite of causing the concept to be fuzzy and abstract, can provide a more general framework for cross-sectoral discussion and collaboration. This is particularly important for dealing with complex issues, such as climate-related disturbances, which cannot be managed by a single group of professions.

Acknowledgements The advanced support from the Taiwan Integrated Research Programme on Climate Change Adaptation Technology (TaiCCAT) is acknowledged and deeply appreciated (MOST 104-2621-M008-001).

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Appendix I. Taipei: numbering the action proposals in terms of the category.

Attribute of resilience		**Adaptation categories (National Development Council)**						
	Criteria	**Disasters**	**Infrastructure**	**Water resources**	**Land use**	**Energy supply and industry**	**Agricultural production and biodiversity**	**Health**
Considering the current situation	monitor current situation	2 (D1-1-3, D3-2-2)	8 (I1-3-1, I4-1-1, I4-1-2, I4-2-4, I4-3-2, I4-3-3, I5-1-2, I5-2-1)	0	1 (L5-2-1)	3 (IE2-1-1, IE2-1-2, IE2-1-3)	4 (AB1-3-1, AB2-2-1, AB2-2-2, AB2-2-3)	0
	evaluate and maintain the current condition	5 (D1-1-5, D3-1-1, D3-1-2, D3-1-3, D5-2-1)	9 (I1-2-1, I1-2-3, I2-1-4, I3-1-1, I3-3-2, I3-3-4, I3-3-5, I4-2-2, I5-1-1)	0	0	0	1 (AB5-2-1)	0
Examining trends and future threats	predict regional trends and patterns	1 (D2-1-2)	0	1 (W3-1-1)	0	0	3 (AB1-2-1, AB1-4-1, AB6-2-1)	0
	identify and assess the probability of risks and disturbances	3 (D1-1-1, D2-1-1, D3-2-5)	0	0	1 (L5-1-1)	0	0	0
	forecast	3 (D1-1-1, D2-1-1, D3-2-5)	1 (I1-1-1)	0	0	0	0	0
Learning from previous experience	learn from previous experiences	0	0	0	0	0	0	0
Setting goals	set up priorities based on risk assessment and probabilities	3 (D1-2-2, D1-2-3, D2-2-1)	0	0	9 (L1-1-1, L1-2-3, L1-2-4, L2-1-1, L2-2-3, L2-2-4, L2-3-5, L3-1-1, L4-1-1)	2 (IE4-1-1, IE4-1-2)	2 (AB6-1-1, AB6-2-3)	0
	propose new standards	3 (D1-2-2, D4-1-1, D4-2-1)	1 (I3-2-1)	0	6 (L2-2-01, L2-30-4, L20-3-3, L2-3-4, L3-1-2)	0	0	0

Appendix I. (Continued)

Attribute of resilience		Adaptation categories (National Development Council)						
	Criteria	**Disasters**	**Infrastructure**	**Water resources**	**Land use**	**Energy supply and industry**	**Agricultural production and biodiversity**	**Health**
Initiating actions	invest in and develop scientific scenarios for risk assessments	2 (D4-1-2, D5-1-1)	0	1 (W3-1-2)	1 (L4-1-2)	0	0	0
	collaborate decision-making between different levels of governance	3 (D5-3-1, D5-3-2, D5-3-3)	0	2 (W2-3-1, W2-3-2)	0	0	0	0
	authorise and mandate infrastructural actions	6 (D1-2-4, D2-2-2, D3-2-3, D3-2-4, D3-2-6, D4-2-2)	9 (I1-2-2, I1-3-2, I2-1-1, I2-1-3, I3-3-3, I6-1-1, I6-2-1, I6-2-2, I6-2-3)	1 (W2-2-1)	0	1 (IE1-3-1)	1 (AB4-1-1)	0
	coordinate readiness actions	4 (D1-1-2, D1-1-4, D1-1-6, D5-1-2)	4 (I2-1-2, I2-2-2, I2-2-3, I4-3-4)	1 (W1-1-1)	1 (L1-2-2)	2 (IE1-2-1, IE2-2-2)	1 (AB6-1-2)	6 (H1-1-1, H1-2-1, H4-1-1, H4-1-2, H4-2-1, H4-2-2)
	innovate and propose economic-benefic actions	1 (D6-2-4)	0	2 (W2-1-3, W4-1-1)	0	1 (IE2-2-1)	0	0
	propose and elaborate actions	6 (D2-2-6, D2-2-7, D5-2-2, D5-2-3, D5-2-4, D6-1-1)	4 (I2-2-1, I3-3-1, I4-2-1, I4-2-3)	3 (W2-1-1, W2-1-2, W4-2-1)	5 (L1-2-1, L2-2-2, L3-2-1, L3-2-2, L5-1-2)	5 (IE3-1-1, IE3-1-2, IE3-1-3, IE3-1-4, IE3-2-1)	4 (AB1-1-1, AB2-1-1, AB5-2-2, AB5-2-3)	2 (H2-1-1, H2-1-2)
Involving the public	communicate findings (concepts, skills, actions) in planning policy	1 (D6-2-2)	0	0	0	0	0	0
	raise public awareness and preparation education	7 (D6-1-2, D6-1-3, D6-1-4, D6-1-5, D6-1-6, D6-2-1, D6-2-3)	1 (I4-3-1)	1 (W4-2-2)	0	7 (IE1-1-1, IE1-1-2, IE1-1-3, IE1-2-2, IE1-3-2, IE1-3-3, IE1-3-4)	0	17 (H1-3-1, H1-4-1, H3-1-1, H4-2-3, H4-2-4, H5-1-1, H5-2-1, H5-2-2, H5-3-1, H5-3-2, H5-3-3, H6-1-1, H7-1-1, H7-1-2, H7-1-3, H7-1-4, H7-1-5)

Appendix II. Tainan: numbering the action proposals in terms of the category.

Attribute of resilience		Adaptation categories (National Development Council)							
	Criteria	**Disasters**	**Infrastructure**	**Water resources**	**Land use**	**Coastal zones**	**Energy supply and industry**	**Agricultural production and biodiversity**	**Health**
Considering the current situation	monitor current situation	6 (D1-1-1, D1-1-2, D1-4-4, D1-5-4, D2-2-2, D2-2-5)	1 (I1-2-2)	1 (W3-1-2)	0	1 (C1-1-2)	0	3 (AB6-2-1, AB6-2-4, AB6-2-5)	2 (H3-1-3, H5-1-1)
	evaluate and maintain the current condition	2 (D1-4-1, D1-4-2)	5 (I1-2-1, I1-2-5, I2-1-1, I3-1-2, I3-2-3)	2 (W2-2-5, W3-1-1)	0	1 (C2-2-2)	0	0	2 (H2-1-1, H2-1-2)
Examining trends and future threats	predict regional trends and patterns	0	0	0	0	0	0	0	0
	identify and assess the probability of risks and disturbances	1(D1-1-5)	0	2 (W2-2-3, W3-1-3)	0	0	1 (IE4-3-1)	4 (AB4-1-5, AB4-2-1, AB4-2-2, AB4-2-3)	1 (H3-1-7)
	forecast	0	0	1 (W2-2-2)	0	0	0	0	0
Learning from previous experience	learn from previous experiences	0	0	0	0	0	0	0	0
Setting goals	set up priorities based on risk assessment and probabilities	5 (D1-5-5, D1-5-6, D2-1-2, D2-1-3, D2-1-4)	4 (I1-2-3, I3-1-3, I3-2-2, I3-2-3)	1 (W2-2-6)	10 (L1-1-2, L1-1-5, L1-2-1, L2-1-1, L2-1-2, L2-1-3, L2-1-4, L2-2-2, L2-2-3, L3-2-2)	4 (C1-1-1, C1-3-1, C2-1-1, C3-1-2)	3 (IE1-1-1, IE6-1-2, IE6-1-3)	8 (AB2-2-1, AB2-2-2, AB2-2-3, AB2-2-4, AB4-1-2, AB4-1-3, AB4-1-4, AB4-3-2)	0
	propose new standards	2 (D1-4-3, D2-1-1)	0	0	4 (L1-1-1, L1-2-2, L1-2-4, L2-2-1)	0	5 (IE1-2-4, IE2-1-3, IE2-1-4, IE3-1-2, IE4-1-1)	0	1 (H3-1-4)

Appendix II. (Continued)

Attribute of resilience		Adaptation categories (National Development Council)							
	Criteria	**Disasters**	**Infrastructure**	**Water resources**	**Land use**	**Coastal zones**	**Energy supply and industry**	**Agricultural production and biodiversity**	**Health**
Initiating actions	invest in and develop scientific scenarios for risk assessments	0	0	0	0	0	1 (IE6-1-1)	1 (AB4-1-1)	3 (H2-1-3, H3-1-6, H3-1-10)
	collaborate decision-making between different levels of governance	4 (D1-2-1, D1-2-2, D1-3-1, D2-3-3)	0	0	0	0	0	0	1 (H3-1-5)
	authorise and mandate infrastructural actions	1 (D1-4-5)	8 (I1-1-1, I1-1-2, I1-1-3, I2-1-3, I2-1-4, I2-2-3, I3-1-1, I3-3-3)	2 (W1-1-3, W2-1-5)	0	0	5 (IE1-3-3, IE2-1-1, IE2-1-5, IE5-1-1, IE5-1-2)	1 (AB6-2-3)	0
	coordinate readiness actions	2 (D1-5-1, D2-3-4)	4 (I2-1-2, I2-2-1, I2-2-2, I3-3-2)	3 (W1-1-4, W2-1-4, W2-2-1)	5 (L1-1-3, L3-1-1, L3-1-2, L3-1-3, L3-2-1)	4 (C1-1-3, C1-1-4, C2-2-3, C2-3-1)	5 (IE1-2-1, IE1-2-2, IE1-2-3, IE3-1-1, IE3-1-4)	4 (AB2-3-3, AB2-3-4, AB3-1-1, AB5-2-2)	1 (H1-1-1)
	innovate and propose economic-benefic actions	0	0	1 (W1-1-2)	0	0	0	0	0
	propose and elaborate actions	12 (D1-1-3, D1-1-6, D1-1-7, D1-5-2, D1-5-3, D2-2-1, D2-2-3, D2-2-6, D2-3-1, D2-3-2, D2-3-5, D2-4-5)	3 (I1-2-4, I3-2-1, I3-3-1)	3 (W1-1-1, W2-1-3, W2-2-4)	1 (L1-2-3)	3 (C2-2-1, C2-3-3, C3-1-1)	4 (IE2-1-2, IE3-1-3, IE4-2-1, IE4-2-2)	9 (AB2-3-1, AB2-3-2, AB3-1-2, AB4-2-4, AB4-3-1, AB5-2-3, AB6-1-1, AB6-3-1, AB6-3-2)	7 (H1-1-2, H1-1-3, H1-2-1, H3-1-1, H4-1-4, H4-1-5, H5-1-3)
Involving the public	communicate findings (concepts, skills, actions) in planning policy	3 (D2-5-1, D2-5-2, D2-5-3)	0	0	0	1 (C3-1-4)	0	0	0
	raise public awareness and preparation education	15 (D1-1-4, D1-3-2, D1-3-3, D1-3-4, D1-3-5, D2-1-5, D2-2-4, D2-2-7, D2-4-1, D2-4-2, D2-4-3, D2-4-4, D2-4-5, D2-4-6, D2-4-7)	0	2 (W2-1-1, W2-1-2)	2 (L1-1-4, L3-2-3)	3 (C1-2-1, C2-3-2, C3-1-3)	4 (IE1-3-1, IE1-3-2, IE4-1-2, IE4-1-3)	10 (AB1-1-1, AB1-1-2, AB1-2-1, AB1-2-2, AB1-2-3, AB2-1-1, AB5-1-1, AB5-1-2, AB5-1-3, AB5-2-1)	13 (H1-2-1, H1-2-2, H3-1-2, H3-1-8, H3-1-9, H4-1-1, H4-1-2, H4-1-3, H4-2-1, H4-2-2, H5-1-2, H5-1-4, H5-1-5)