A Study of the Utilizable and Sustainable Strategy of Coastal Land in Taiwan

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ABSTRACT

All countries are addressing the drastic climate changes as high priority issues. The impact of climate change on coastal land use in Taiwan has been especially severe due to the country's long coastline. As such, developing strategies to promote the protection of coastal land is critical for the sustainable development of the land. At present, even though the central government has developed the relevant adaptation strategies and implementation plans in response to climate change. Due to the limited resources, determining which protection strategy should be implemented as a top priority will require a strategic evaluation for planning and reference purposes.

While most of the existing literature on coastal land use has been focused on the establishment of a vulnerability index along with an analysis of adaptation strategies very little of the existing literature discusses research that has been conducted in relation to an in-depth analysis of climate change and coastal land use. Therefore, this study uses the fuzzy analytic hierarchy process to conduct an exploration of coastal land use and protection strategy. The study compiled the literature and related data to establish five major assessment dimensions and 16 protection strategy evaluation indicators. After the empirical investigation and analysis, the findings demonstrated that the designation of coastal conservation areas is the most important aspect in terms of strategies to protect coastal land, followed by land subsidence control and the establishment of land disaster warning systems.

Keywords: coastal land, climate change, protection policy, sustainable development, fuzzy analytic hierarchy process

I. Introduction

Taiwan is surrounded by sea. As a typical island nation, located on the edge of the continental shelf, Taiwan has a long and ever-changing coastline. The coastal areas contain rich biological and landscape resources. The coastline is about 1566 km long with a vast area of coastal land. The shore area is a belt shape at the junction of the territorial waters and land territory. The shore covers two major geographic areas, which are the land and sea domains, with characteristics of the land and sea ecosystems. Coastal land use has encountered many problems such as the conflict of land use, coastal range, and unclear property ownership, and the lack of dedicated agencies and special management acts, the economic value of the surrounding coastal landscapes is not fully played and utilized. Hence, a thorough and complete response strategy is necessary to properly develop and maintain coastal land use with respect to the limited land resources.

According to a UN report, Taiwan belongs to the high-risk group for climate change. In the recent hundred years, its average temperature increase has been 1.3℃, which is two times that of the global average. With the intensity of the summer rainfall in Taiwan, heavy rain continues to increase the frequency and annual rainfall. If the sea level rises by 1 cm, the coast retreats by about 0.5-1 meter. In shallow estuaries, lagoons, coastal wetlands, sand dunes, sandbars, and other terrains, the slope will be more moderate, and the impact will be even greater.

II. Overview of Costal Land Use in Taiwan

The impact of climate change is quite broad. The most serious impact is that it will lead to sea level rise (Okmyung Bin, 2008; Francesco Bosello et al., 2012). Okmyung Bin et al. (2011) applied the hedonic price method and found that sea level rise will affect values of surrounding coastal real estate. Relative to other regions, low-lying areas and developed areas of the coastline are particularly most affected.

In recent years, research on climate change has continued, with coastal areas receiving greater attention. The coastal land studies at home and abroad included Feiyu Guo (2010) investigation of the adaptation strategies comparing the impact of climate change on Taiwan's coastal territory and proposal of climate change vulnerability assessment and structure of national land adaptation strategies. Matthew J. P. Copper et al. (2008) studied the impact of climate change on sea-level change and found that about 1-3 percent of the land area of New Jersey will be permanently submerged in the next century. Coastal

storms will temporarily flood low-lying areas. If coastal prevention and protection policies are not instituted and implmented before 2100, New Jersey will experience a lot of land loss in coastal areas, causing a widespread impact on the development of the coastal ecosystem. Okmyung Bin (2008) employed a unique integration of geographic information and economic data to estimate the impact of sea level rise on the coastal real estate in North Carolina. As the northern part of North Carolina's low-lying and densely developed coastline areas is located in the high risk area of sea level rise, compared with the southern coastline of the state, the results showed that the northern coastline of North Carolina is relatively more vulnerable to the impact of sea-level rise.

Chad J. McGuire & Jason J. Hill (2012) believes that the U.S. government has advanced reasonable policies for the development and protection of coastal resources. The purpose is to ensure that in response to sea level rise in the future, the policy with regard to the direction of the federal government policy will be conducive to the protection of the internal acceleration of marine energy development, especially for oil and gas production projects.

An average of 3.75 typhoons hit each year as Taiwan is located in the monsoon region, at the junction of Eurasia and the Pacific Ocean. In addition to causing heavy injuries and loss of life, these disasters seriously damage agriculture, fishery, construction, water conservancy, transportation, and electricity facilities, and during typhoons, the direct invasion of giant storm surges in waterfront areas often leads to waves crashing over dikes and even seawater intrusion, resulting in the flooding of low-lying coastal regions along with Taiwan's climate change and sea level rise. The following table is a simulation of the sea level rise in 5, 20, and 50 years to show the change of Taiwan's coastal land that may be submerged. See the figure 1. In addition to causing heavy injuries and loss of life, these disasters seriously damage agriculture, fishery, construction, water conservancy, transportation, and electricity facilities, and during typhoons, the direct invasion of giant storm surges in waterfront areas often lead to waves crashing over dikes and even seawater intrusion, resulting in the flooding of low-lying coastal regions along with Taiwan's climate change and sea level rise. The following table is a simulation of the sea level rise in 5, 20, and 50 years to show the change of Taiwan's coastal land that may be submerged. See figure 1 below.

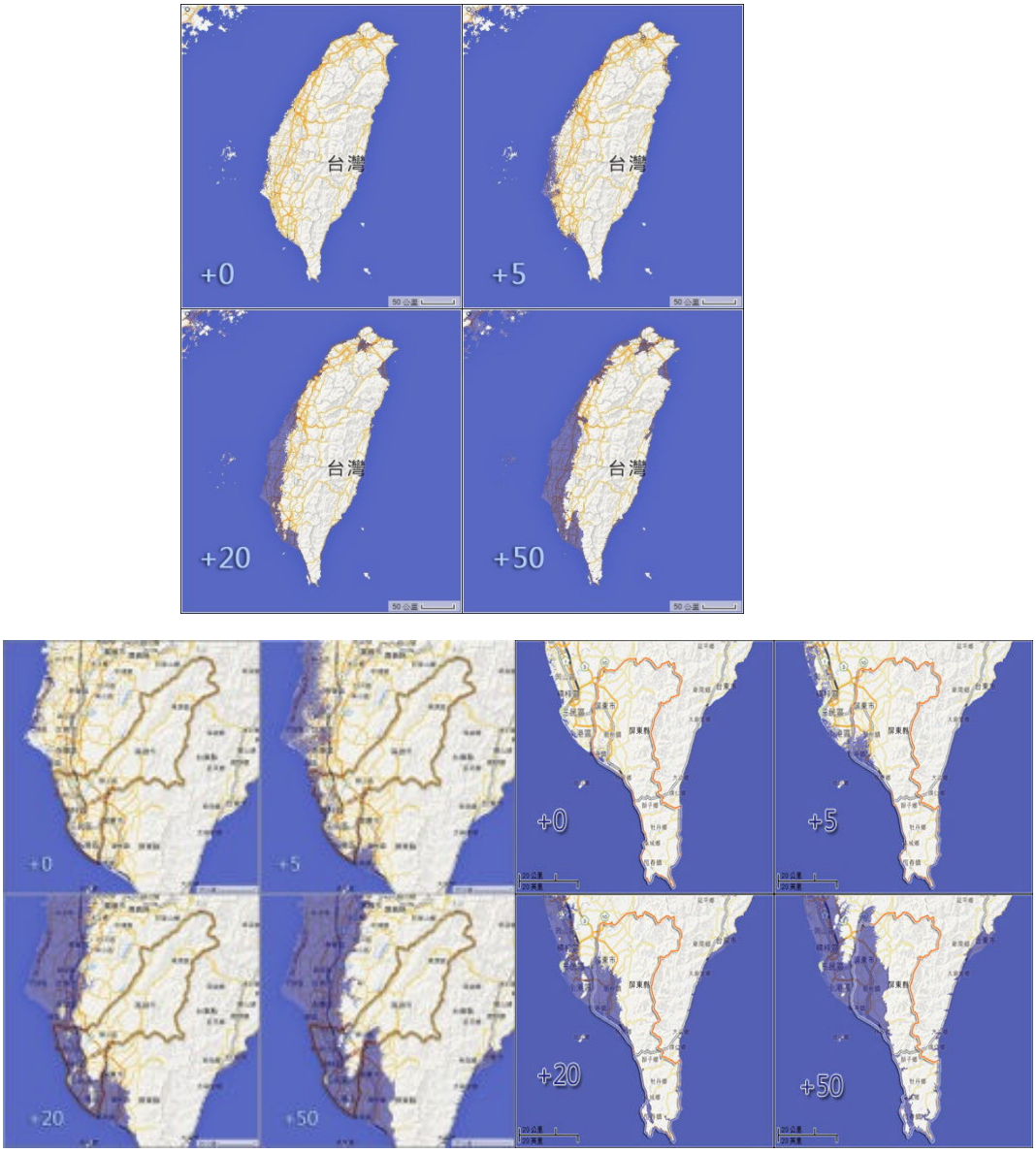

Figure 1. The change of Taiwan's coastal land that may be submerged.

The Water Resources Agency (2011) conducted a study that found the major flooding areas in the Kaohsiung coastal areas are located in the Mituo District, Yong-an District, and Nanzih District. In addition to the diffusive flood caused by tidal waves and overlapping waves, water stagnation in parts of the inland areas is also becoming more and more serious, and upstream drainage systems are also starting to be affected. In addition, the coastal area's flooding hazards are mainly caused by overflowing embankments and the adverse drainage of the river. In Pingtung, the coastal area overflow flooded the range from Donggang Town and Xinyuan Township to Linbian Township's coastal areas, with an increase in rainfall time. In addition to the diffusive flood caused by tidal waves and overlapping waves,

water stagnation in parts of the inland areas is not only becoming more serious, it is also occurring in more and more places, and water stagnation is also starting to occur in upstream drainage systems. During typhoons in the past in the area of Kaohsiung and Pingtung areas, flood hazard zones were mostly in the coastal areas. Whereas there are many groundwater control areas, and the situation of land subsidence in Pingtung County's coastal area is most serious, fortunately in recent years it has been under control.

Table 1 - Taiwan Coastal Land Use Overview

Coast	County/City	Coast Length (Km)	Domestic Important River Water System	Coast Type	Erosion and Deposition Conditions
Yilan Coast	Yilan County	106	Lanyang River, Heping River	North of Shicheng: rock bank South of Shicheng: sand bank	Erosion and deposition mutually shown
Taipei Coast	Keelung City	18	Tamsui River	East of Tamsui River estuary: rock bank South of Tamsui River estuary: sand bank	No significant change
	New Taipei City	122	Tamsui River		Slight erosion
Taoyuan Coast	Taoyuan County	39	Tamsui River	Sand bank	Erosion and deposition mutuallly shown
Hsinchu Coast	Hsinchu County	12	Fengshan River, Touqian River	Sand bank	Erosion and deposition mutuallly shown
	Hsinchu City	17	Touqian River		
Miaoli Coast	Miaoli County	50	Zhonggang River, Houlong river, Da'an River	Sand bank	Erosion and deposition mutuallly shown
Taichung Coast	Taichung City	41	Da'an River, Dajia River, Wu River	Sand bank	Siltation
Changhua Coast	Changhua County	61	Wu River, Zhuoshui River	Sand bank	The majority is siltation; a small portion is subsidence
Yunlin Coast	Yunlin County	55	Zhuoshui River, Beigang River	Sand bank	Siltation turned into erosion
Chiayi Coast	Chiayi County	41	Beigang River, Puzi River,	Sand bank	Siltation turned into erosion

			Bazhang River		
Tainan Coast	Tainan City	54	Bazhang River, Jishui River, Zengwen River, Yanshui River, Eren River	Sand bank	Slight Erosion
	Tainan City	23	Zengwen River, Yanshui River, Eren River		
Kaohsiung Coast	Kaohsiung City	37	Eren River, Ahgongdian River, Gaoping River	Sand bank	Erosion
	Kaohsiung City	26	—		Slight erosion
Pingtung Coast	Pingtung County	152	Gaoping River, Donggang River, Sichong River	Eluanbi Section: coral reefs Remaining sections: sand bank	South of Fangshan: no significant change Remaining sections: erosion
Taitung Coast	Taitung County	172	Beinan River, Xiuguluan River	North of Chenggong: rock bank South of Chenggong: sand bank	Erosion
Hualien Coast	Hualien County	175	Xiuguluan River,Hualian River, Heping River	Xincheng to Hualian River Estuary: sand bank Remaining sections: rock bank	Erosion
Penghu Coast	Penghu County	320	—	Rock bank (coral reefs)	No significant change
Taiwan Province		1, 520			
Kinmen Coast	Kinmen County			Both sand bank and rock bank available	Sand bank partly eroded
Matsu Coast	Lienjiang County			Rock bank in majority	Erosion

Source: Water Resources Agency, Ministry of Economic Affairs

http://www.wra.gov.tw/ct.asp?xItem=12592&CtNode=3133

As the sea level rises, this will cause a serious impact on the coastal resources (Okmyung Bin et al., 2007; Lara D. Guercio, 2013; Mathew J.P. Cooper et al., 2008) and coastal land use development (Francesco Bosello et al., 2012). Proper planning to carry out coastal land protection policies will be able to help reduce disaster losses (Francesco Bosello et al., 2012;. Chad J McGuire, 2012). Faced with the impact of global climate change on coastal land, the Construction and Planning Agency's (2012) study report mentioned that the two major strategies in the world are "mitigation" and "adaptation." Francesco Bosello et al. (2012) found that the sea level rise will cause a lot of land loss and increase the incidence of coastal flooding and serious economic losses however if proper responsive measures for adaptation are organized in advance, this will help reduce the various negative impacts. Thus, it is essential to carry out the coastal protection policy to effectively ensure the negative impacts of the sea level rise remain at an acceptable level.

Taiwan has submitted various research reports and recommended strategies in response to climate change. For example, in the Council for Economic Planning–National Climate Change Adaptation Program of Action–Coastal Land Conservation (draft), the Ministry of the Interior has included the "Coastal Conservation and Restoration Plan" into the "Coastal Land Conservation." In response to the sea level rise and shoreline retreat caused by climate change, as well as the increase or change of the frequency and scale of coastal effects and other issues, the dimensions of protection, construction, production, disasters, and so forth., are considered and taken into account to propose relevant adaptation in coastal areas. The following table shows the compilation of correlated plan strategies of Taiwan's spatial adaptation strategy in response to climate change. The following table shows Taiwan's coastal protection strategies in response to climate change.

Table 2 - Taiwan's coastal protection strategies in response to climate change

Sources	Contents	Strategies
Council for Economic Planning – National Climate Change Adaptation Program of Action – Coastal Land Protection	Climate change coastal land protection adaptation strategies and indicators	1. Strengthen the protection of coastal retreat of the national land. 2. Pay attention to the coastal and wetland habitat conservation and restoration of fertility. 3. Strengthen coastal settlements on the basis of survey and maintenance landscape management strategies. 4. Enhance the ability of coastal pollution control and monitoring.

(04.2010 Draft)		5. Specifically implement the national coastal environment to build the overall perception and knowledge of relevant regulations. 6. Environmental Impact Assessment Guidelines and land development permit to build the job development in coastal areas. 7. Strengthen the management of coastal areas by the agency powers with horizontal and vertical integration of the ministry.
Water Resources Agency – Coastal Disasters Adaptation Strategy and Action Plan in Response to Climate Change	Coastal protection adaptation policy and measures	1. Improve the protection of coastal protection facilities (adapted). 2. Improve the ability to preserve the object's resistance to disaster (protection). 3. Strengthen the emergency response and disaster prevention (retreat).
Academia Sinica – National Land Spatial Planning and Management Policy Proposals in Response to Climate Change (12.30.2011)	Coastal land use review policy recommendations	1. Monitor, evaluate, and review changes of the coastal land in coastal land use patterns. 2. Strengthen the protection of coastal land and coastal ecological environment restoration work. 3. Implement groundwater resources management to combat the worsening of subsidence problems. 4. Promote industrial restructuring and subsidence areas of further development.
2012 Natural Shoreline Management Issues and Countermeasures and Handling Service Group to Promote the Implementation of Coastal Sustainability	Nature Coast restoration plan operating mode	1. Distribution and type of natural coast segments. 2. Confirm the restoration goals and direction. 3. Determine the executed counterparts. 4. Follow the relevant regulatory controls. 5. Propose the adjustment strategy surrounding the land patterns. 6. Conduct natural coastal restoration operation. 7. Subsequent protection and monitoring plan.
Coastal Area Land Use Overall	Overall coastal protection strategy	1. Overall protection and sustainable thinking. 2. Compatible coexistence of coastal protection zone and coastal protected areas.

Protection Strategy Study		3. Response to the coastal protection of climate change adaptation strategies. 4. Improve coastal management mechanism. 5. Implement coastal protection concepts and technologies, and enhance coastal community participation mechanisms. 6. Strengthen the basic information related to coastal areas to monitor, investigate, and build the database. 7. Strengthen and update coastal environment conservation education and promote the upgrading of coastal research. 8. Audit mechanisms to strengthen the use of coastal area development permit.
Sustainable Coastal Overall Development Programs (Ministry of the Interior, 2009)	Retrieve coastal natural beauty, and maintain the natural shoreline proportion to no longer decrease	1. Basic policy declaration of coastal conservation 2. The survey delineated natural coastal location 3. Strict consideration of the significant coastal plan 4. Patrol investigation to establish local reporting mechanism 5. Protection of important coastal resources 6. Rational use of coastal resources 7. Restoration of deterioration of ecological resources 8. Renovation to improve coastal landscape 9. Strengthening of coastal disaster protection 10. The rational development of marine industry 11. Construction of Coast Information Systems 12. Comprehensive coastal management system 13. Strengthening of maritime education and training 14. Strengthening of public-private partnerships
Climate Change Adaptation Policy Program (approved version), (Council for Economic Planning, 2012)	Coastal disaster adaptation strategies in response to climate change	1. Strengthen national land security and coastal erosion areas. 2. Protect and restore coastal wetland habitats for wildlife. 3. Monitor the transformation and restructuring of subsidence area. 4. Review the coastal settlements in the human environment, and culture and ecology of marine landscape maintenance. 5. Build marine and coastal monitoring. 6. Incorporate sea-level rise and extreme weather condition assessment in development plan. 7. Establish an exclusive coastal development environment impact assessment and land development permit operation guidelines.

III. Using FAHP to assess the costal land use indicators weighting

In view of coastal land protection policies, most of which have multi-target characteristics, this study developed the policy of coastal land use protection to explore the target evaluation index system and index weights in order to understand coastal land use and related protection strategies. Coastal land use is required to encompass perfect protection planning to minimize disastrous loss. Guo Feiyu (2010) proposed that climate change impacts, vulnerability assessments, and adaptation are interrelated. To address the impact of climate change, it is necessary to adjust the national land planning and management response in terms of referencing climate change and globalization. Structural adjustments are required to be conducted in relation to land policy, land ownership, land use structure, and land administration. In addition, strengthening of seawalls and coastal wetland restoration are conducive to coastal land use and protection. As Taiwan is surrounded by the sea, coastal land use affects the living environment of residents and their economic vitality, therefore coastal land protection and disaster prevention is the first and the most important priority. In terms of the analysis and discussion of coastal land use protection strategies, this study will divide them into five dimensions. See table 3 & Figure 2.

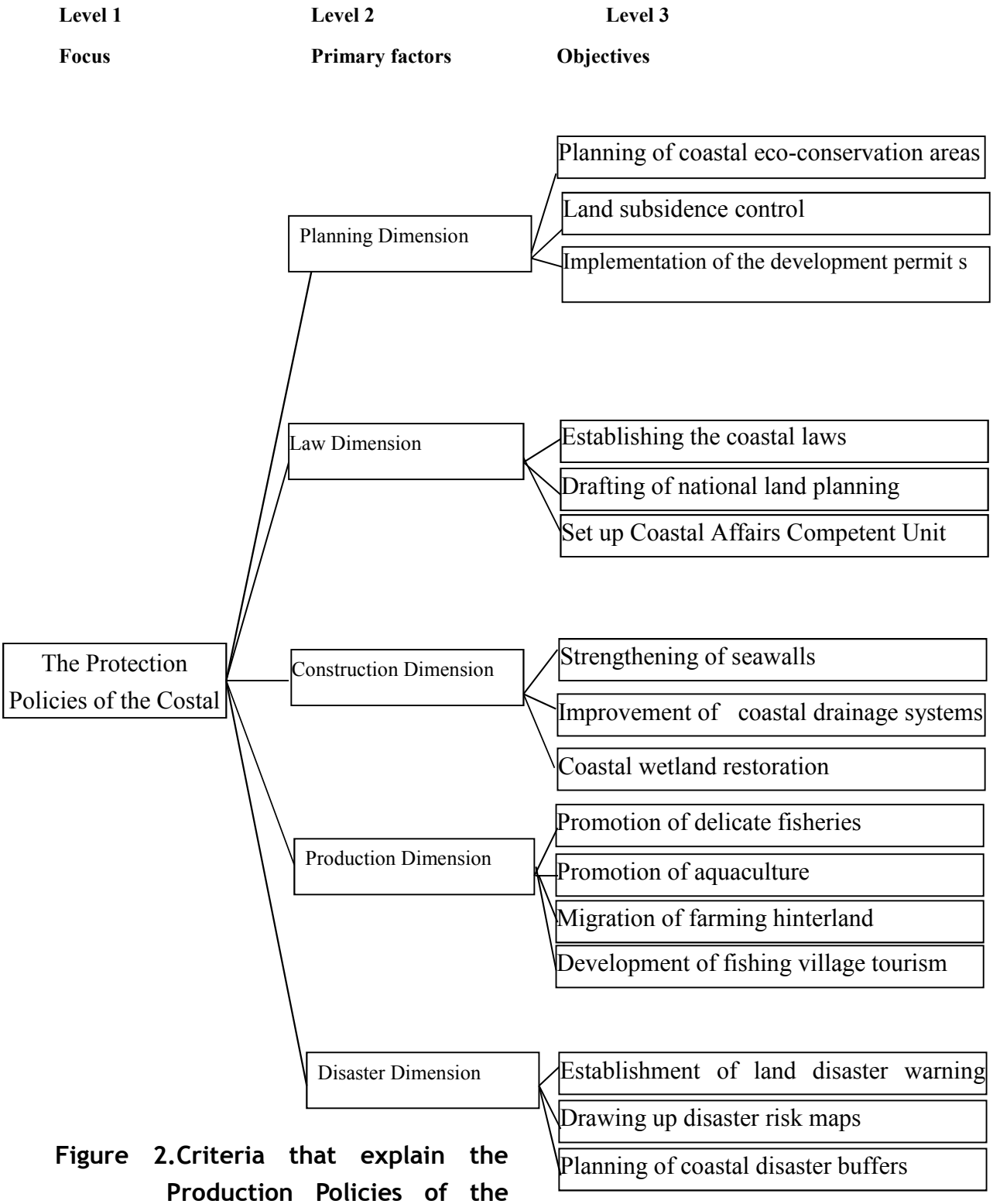

Figure 2.Criteria that explain the Production Policies of the Costal Land Use in Taiwan

Table 3. Coastal land use assessment indicators and definition description

Assessment Indicators	Definition Description
Planning of coastal eco-conservation areas	Natural landscape and ecosystems of coastal land have unique and irreversible characteristics such as the highly sensitive nature of the land. In order to avoid the over-exploitation of natural resources, leading to serious environmental damage that cannot be recovered from, Yuan designated the coastal ecosystems as protected conservation areas, to prevent the natural environmental resources from facing a catastrophe and inability for restoration to take place.
Land subsidence control	Strictly control the amount of groundwater in the coastal areas of land subsidence, and avoid excessive extraction that can result in sustained surface subsidence and ineffective use of land resources.
Implementation of the development permit system	On the coast, other than in accordance with Coast Law (Draft) level, the Coastal Protection Area designates and prohibits the development of the coastal protection zone between the two regions engaging in development and utilization above a certain size or nature and in a specific location. The applicant shall submit a prospectus of the coastal management measures, and after the application, permission should be received from the competent authority before construction can commence.
Establishing the coastal laws	Coastal laws can help to promote the sustainable development of coastal areas, protection, use, and management of resources in coastal areas, and coastal disaster and environmental damage prevention.
Drafting of national land planning	With the implementation of the national land planning, to ensure the safety and sustainable development of coastal areas, the rational allocation of resources is promoted to effectively conserve the natural environment, meet the needs of economic and socio-cultural development, and improve the quality of the living environment.
Set up Coastal Affairs administration	Establish cross-sectoral management agencies, co-ordinate and handle coast-related matters by strengthening communication and coordination mechanisms and systems, improve administrative efficiency, to achieve their goals to protect coastal land.
Strengthening of seawalls	Regarding tidal wave surges and typhoon conditions, people's lives and property on coastal embankments may receive the immediate impact of the hazards. The height of overflow traffic is increased to a safe range, and offshore dikes are set up, to protect the coast and to prevent flooding disasters that cause seawater intrusion, wave erosion, and loss of national land.
Improvement of coastal	Prevent the extreme rainfall runoff caused by the overflow of inland

Assessment Indicators	Definition Description
drainage systems	highlands to low-lying coastal land areas, resulting in flood disasters. Consider the terrain factor in the construction of intercepting ditches in appropriate locations. According to the runoff in the catchment area, direct the runoff from the existing drainage system to the main drainage path, and set up pumping stations in low-lying areas to pump less water to the sea, thereby reducing flood disaster opportunities.
Coastal wetland restoration	Conduct protection and restoration of damage caused by human factors and the impact of climate change in coastal wetlands. In addition to strengthening the detention function, also conduct habitat restoration and increase bio-diversity.
Promotion of delicate fisheries	Develop the fisheries industry toward the production of life, make intensive capital investments in technology improvements, and create good quality in line with food security, so that fisheries have greater market potential while taking into account the maintenance of the ecological environment.
Promotion of aquaculture	Promotion of aquaculture can replace the demand for freshwater, and land planning can be used to set up aquaculture areas, so as to encourage natural (ecological) farming, reduce the use of groundwater, effectively alleviate land subsidence, and promote the sustainable development of aquaculture fisheries.
Migration of farming hinterland	Move the hinterland farming to coastal waters, and use cages to grow aquaculture species of high economic value, to increase revenue and reduce the demand for farming land, thereby slowing down the land subsidence.
Development of fishing village tourism	With the aquaculture industry restructuring, combined with the local fishing village characteristics, climate change thinking is incorporated, and the specialized tourism industry is developed to cope with the impact of climate change and to increase income.
Establishment of land disaster warning systems	Geographic information systems are used to monitor the retreating shoreline, subsidence areas, changes in wetlands, coastal ecological environment changes, and other circumstances, and to develop the scope of the warning areas, in order to strengthen the disaster early warning capability.
Drawing up disaster risk maps	With the disaster risk (high, medium, and low potential) map as the basis for coastal protection, strategies are developed against coastal hazards and geological disasters that cause the erosion of coastal areas and areas of flood overflows, storm surge overflow, and land subsidence and so forth.

Assessment Indicators	Definition Description
Planning of coastal disaster buffers	Establish the standards and coastal areas designated as buffers against the retreating coastline as coping strategies for the future status of sea-level rise or other coastal hazards that exceed the design strength. At the same time, assess whether it is necessary to relocate certain infrastructure and transport facilities.

IV. Empirical Result after Assessing the Indicators

The empirical analysis data has been obtained by the researcher through interviewing one by one the supervisors of government agencies currently in charge of the coastal land management affairs. A total of 99 respondents' personnel in southerner Taiwan government were interviewed. After deducting unrecovered and invalid questionnaires, the final valid samples were 48. Basic data about the respondents are as shown in Table 4 below.

Table 4 - Analysis of respondents' data

Data Items	Data Category	Number of Samples Recovered	Percentage of Samples Recovered
Gender	Male	28	58.33%
	Female	20	41.67%
Work Experience	Less than 5 years	10	20.83%
	6~10 years	15	31.25%
	11~15 years	7	14.58%
	15~20 years	10	20.83%
	Above 20 years	6	12.50%
Educational attainment	College and below	5	12.50%
	Under-graduate	25	52.08%
	Graduate	17	35.42%
Professional Background	Civil engineering and construction	11	22.92%
	Hydraulic Engineering	2	4.17%
	Land administration	20	41.67%
	Aquaculture	5	10.42%
	Other	10	20.83%

1. Respondents' Data Analysis

In the description of respondents' data, men accounted for 58.33% of the respondents, slightly more than the women, which accounted for 41.67%. In working experience, less than 5 years accounted for 20.83%, 6 to 10 years accounted for 31.25%, 11 to 15 years accounted for 14.58%, 16 to 20 years accounted for 20.83%, and 12.50% over 20 years. With regard to work experience, respondents were evenly distributed. With respect to education, whereas college and below accounted for 12.50%, university and above accounted for 52.08%, and postgraduate institute and above accounted for 35.42%.[1]

2. Consistency Analysis

In this paper, the Fuzzy Analytic Hierarchy Process was adopted to conduct a questionnaire survey of experts. Prior to analyzing the survey data, the contents of the retrieved questionnaires were first inspected for completeness. The geometric mean was taken as the integrated function to conduct consistency checks on the questionnaire survey data.

The consistency data adopted Saaty's suggestion. The consistency index (C.I.) and consistency ratio (C.R.) of the questionnaires should be less than the tolerable standard value of 0.1 for consistency. If the standard is not reached, the questionnaire should be excluded. When C.I. <0.1 and C.R. <0.1, the questionnaire has consistency, and the result has reliability. The empirical analysis calculations showed that the questionnaire's consistency index (C.I.) and consistency ratio (C.R.) were less than the tolerable standard value for consistency (C.I. <0.1, C.R. <0.1), and each assessment project was consistent and passed the reliability test.

Table 5 . The consistency results in the survey

the consistency ratio		
examining the uniformity of all Levels	CI	0.0148
	CR	0.0132
examining the uniformity of all factors	CI	0.0118
	CR	0.0189

As far as the assessment is concerned, perfect resource planning is most important. Its weight value is equal to 29.00%. For the assessment index, planning of coastal conservation areas is most important, followed by the subsidence and permit system; the second most important is the development of a proper disaster prevention strategy, the weight value of which is equal to 23.19%. For the assessment index, disaster warning is most important, followed by the buffers and risk maps. The third most important is doing perfect construction, the weight value of which is equal to 17.97%. For its assessment index,

[1] The authors will thank the surveying work by Jin Xian You.

improvement of drainage is most important, followed by wetland restoration and strengthening of seawalls.

Table 6 - Priority of Level 2

Dimensions	Relative weight	Ranking
Planning dimension	29.00%	1
Disaster dimension	23.19%	2
Construction dimension	17.97%	3
Production dimension	15.58%	4
Law dimension	14.25%	5

Table 7 - Priority of whole factors of Costal Land Use in Taiwan

Level I	Level II--Factors	Relative Weight	Priority
Planning	Planning of coastal conservation areas	40.98%	1
	Land subsidence control	39.12%	2
	Implementation of the development permit system	19.90%	3
Law	Establishing coastal laws	32.35%	2
	Drafting of national land planning	47.67%	1
	Setup of coastal affairs administration	19.98%	3
Construction	Strengthening of seawalls	24.78%	3
	Improving the coastal drainage system	45.98%	1
	Coastal wetland restoration	29.24%	2
Production	Promotion of delicate fisheries	23.43%	4
	Promotion of aquaculture	28.51%	1
	Migration of farming hinterland	23.91%	3
	Development of fishing village tourism	24.14%	2
Disaster	Establishment of land disaster warning systems	44.65%	1
	Drawing up disaster risk maps	26.90%	3
	Planning of coastal disaster buffers	28.44%	2

According to the priority from figure 3, the importance of coastal land protection policies in response to climate change is assessed. The most important is the conservation area, which accounts for 11.88% of the total weight. The second is subsidence, which accounts for 11.34% of the total weight. The third is disaster warning, which accounts for 10.36% of the total weight, followed by the improvement of coastal drainage systems, drafting of national land planning, planning of coastal disaster buffers, drawing

up disaster risk maps, implementation of the development permit system, coastal wetland restoration, passing of coastal laws, strengthening of seawalls, promotion of aquaculture, development of fishing village tourism, migration of farming hinterland, promotion of delicate fisheries, and setup of coastal affairs administration.

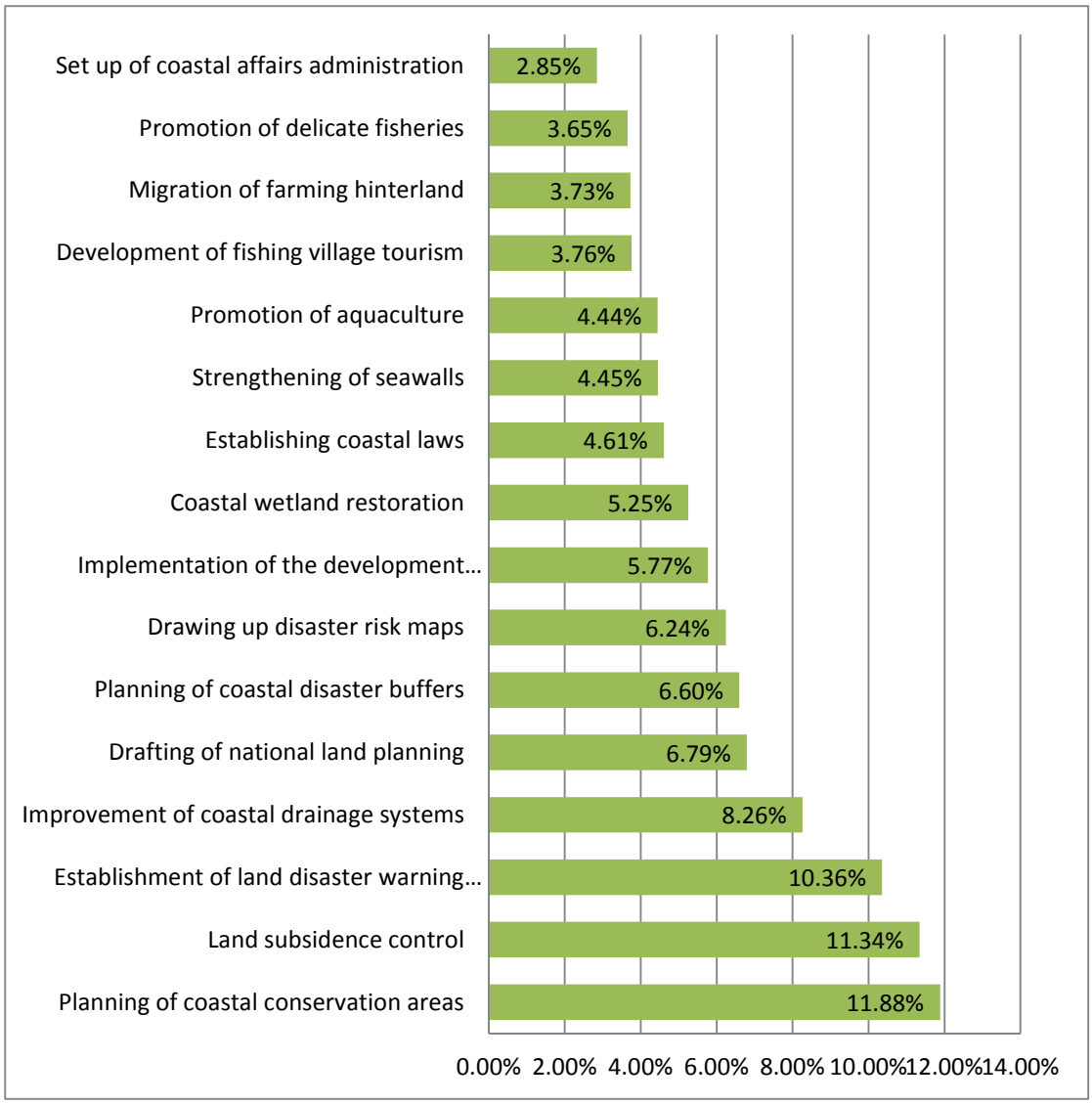

Figure 3. Ranking of the factors of costal land use

This study applied the assessment results of coastal land use protection policy of Pingtung and Kaohsiung for comparison, using expert questionnaire assessed weight values as the weight basis of importance. The weight value was multiplied by 100 to convert to benchmark scores of rating basis. Speaking of the index of planning of coastal conservation areas as an example, if the planning of coastal eco-conservation areas is implemented, then 12 points are assigned to the weight conversion value of the index. If it is under promotion, 6 points are assigned. If it is not promoted or unclear, then give 0 points,

and so on. This method is used to assess the integral of Pingtung and Kaohsiung's coastal land use protection policy promotion. The assessment results found that Kaohsiung has a higher integral in promotion and implementation of coastal land use protection. It indicates Kaohsiung has a better performance in the promotion of protection strategy, which is worthy of commendation.

Table 8 - Comparative Assessment of Coastal Land Use Protection Policy

Dimension	Factors	Absolute Weight	Giving the points	Pingtung	Kaohsiung
Planning	Planning of coastal conservation areas	12%	Implemented + 12 Under promotion + 6 Never promoted + 0	12	12
	Land subsidence control	11%	Implemented + 11 Under promotion + 5.5 Never promoted +0	11	11
	Implementation of the development permit system	6%	Implemented + 6 Under promotion + 3 Never promoted + 0	6	6
Law	Establishing coastal laws	5%	Implemented + 5 Under promotion + 2.5 Never promoted + 0	2.5	2.5
	Drafting of national land planning	7%	Implemented + 7 Under promotion + 3.5 Never promoted +0	3.5	3.5
	Set up of coastal affairs administration	3%	Implemented + 3 Under promotion + 1.5 Never promoted +0	0	3
Construction	Strengthening of seawalls	4%	Implemented + 4 Under promotion + 2 Never promoted + 0	4	4
	Improvement of coastal drainage systems	8%	Implemented + 8 Under promotion + 4 Never promoted + 0	4	8
	Coastal wetland restoration	5%	Implemented+5 Under promotion + 2.5 Never promoted +0	0	0
Production	Promotion of delicate fisheries	4%	Implemented + 4 Under promotion + 2 Never promoted + 0	2	4
	Promotion of	4%	Implemented + 4	4	0

	aquaculture		Under promotion + 2 Never promoted + 0		
	Migration of farming hinterland	4%	Implemented + 4 Under promotion + 2 Never promoted + 0	4	0
	Development of fishing village tourism	4%	Implemented + 4 Under promotion + 2 Never promoted + 0	2	4
Disaster	Establishment of land disaster warning systems	10%	Implemented+10 Under promotion + 5 Never promoted + 0	10	10
	Drawing up disaster risk maps	6%	Implemented + 6 Under promotion + 3 Never promoted + 0	3	6
	Planning of coastal disaster buffers	7%	Implemented+7 Under promotion + 3.5 Never promoted + 0	3.5	7
Evaluating Performance		100%		71.5%	81%

Note: we will give the implemented policy to 12 points, give under implemented policy 6 points and give the never implemented policy zero points.

V. Conclusions and Suggestions

The government should designate the Grade 1 coast protection area. All of the other necessary protection areas can be organized as Grade 2 protection areas, and a coast protection plan can be respectively produced to enable better management. In addition, to preventing coastal disasters, it can also enhance the investigation of the ocean environment and ecological basis data and establish a database in order to provide people with sufficient information. Coastal development and ocean pollution control laws and regulations can be formulated to strengthen the management and to clearly and strictly ban violations, so that the ocean resources can have sustainable use. Seawater intrusion and land loss should be prevented, to protect the lives of the people. Grade 1 coastal protection areas include areas of coastal erosion, overflow flooding, storm surge flooding, land subsidence, and other latent disasters in areas that promote national land restoration. And if one of the situations of coastal erosion exists including, overflow flooding, storm surge flooding, subsidence, or other latent disasters, in the scope beyond the national land restoration promotion area, it can be set up as a Grade 1 or Grade 2 coastal protection area.

After promulgation of the overall coast plan, coastal conservation plan, and coastal protection plan, the elaboration authority should conduct an overall review depending on the situation of coastal land use and may at any time review and change it in accordance with any of the “setup of important conservation

measures," "prevention of a major disaster," or "coping with major state project." After the promulgation of the project, the elaboration authority shall coordinate with the relevant authorities to amend or change the development plan, business construction plan, urban plan, or designation of land zoning or land use for regional systemization inconsistent with the coast reservation plan or coastal protection plan.

The policy to protect coastal land use will be conducive to improving the environment of coastal land and creating ecological, environmental, and economic values that the land should have, so the important strategy should be actively planned. In order to establish the oversight, governance and stewardship of sustainable coastal development that allows for the sustainable use of coastal land to attain the maximum total land use benefit, appropriate designation of protection, retention, or conservation areas should be conducted. Through the divisional management of coastal areas, the conservation direction effectively guides and specifies the inter-tidal area with the direction of the coastal land guard, protection, and conservation. If Taiwan's coastal land use is expected to attain a level of sustainable development, the concept of coastal conservation should be established as a priority for the planning of coastal conservation areas, followed by good disaster management, establishment of disaster warning systems, improvement of coastal drainage systems, drafting of national land planning, planning of coastal disaster buffers, drawing up disaster risk maps, implementation of the development of a permit system, coastal wetland restoration, passing of coastal laws, strengthening of seawalls, promotion of aquaculture, development of fishing village tourism, migration of farming hinterland, promotion of delicate fisheries, setup of coastal affairs administration, and other relevant policies that can be set forth and organized as the basis for the executive sector to develop policy and governance planning.

With respect to coastal land use protection strategy, the most important key is the planning of coastal conservation areas to ensure the sustainable survival of coastal resources, followed by land subsidence control. In recent years, the government has been actively trying to do so. As far as the Pingtung County is concerned, although the subsidence situation has improved significantly, coastal land protection policies still need to be actively built. In addition, the establishment of land disaster warning systems can notify the public in advance with an emergency response alert protocol and carry out disaster prevention and crowd evacuation to ensure the safety of the public.

The protection of coastal land and its surrounding ecology, environment, landscape, and other important resources are among the recommendations. And the overall coastal land protection policies require proper planning. In addition, the Coastal Act and other legal planning should be drawn up, and the development and construction should be appropriately assessed subject to the individual coastal ecological environment. The promotion of coastal land use and coastal ecological balance, growth, and development should be addressed carefully and thoughfully. Coastal fisheries management, production methods, and other resources should be planned and supported, and delicate fisheries should be

developed. In addition, to planning the early warning system related to coastal land disaster prevention and disaster prevention blueprints, such as tsunami early warning systems, sea tides zone cordoning, and so forth, the perfect coastal land use protection strategy should take into consideration planning, laws, construction, production, disaster prevention, and the other dimensions associated with construction.

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