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Some of the research results suggest, agricultural land are considered urban preservation lands. It has great profit in its change of use, especially for the strategies of land development for “Developing Government”. It distorts price of agricultural land and encourages their transactions. And thus leads to reduction in sales of produce sections and food shortages. Plus the threats resulted by extreme climate and environmental changes, it endangers land usages and cause more challenges for urban planning. As a result, the current research attempts to investigate through environmental diagnose and indepth field study, supported with research methods such as FLO-2D flood module etc., and layering various disaster tendency images and geology information system operation. Based on before/ after, it does suggests elevate runoff in some of the areas, result in increased potential flood tendency area and depth. The aforementioned empirical study reflects the malfunctioning of environment disasters and land commercialization urban planning in Zhubei.

1. Introduction



Changes in land use are accelerating changes in land cover, and changes in land cover also affect global or regional environmental changes (Ding Zhipan, 2002; Zhang Yaolin, 2002).

- With the rapid urbanization of Taiwan, urban buildings, roads, and infrastructure have greatly increased the area of aquiclude resulting in impaired flood discharge capacity and increased probability of flooding (Central Research Institute 2013).
- Lv Yuxun et al. (2011) believe that the higher the degree of urbanization, the greater the chance of urban flooding (causes impacts on the six major disaster prevention systems in the city: disaster prevention routes, refuges, fire protection, police, medical treatment, and material and resource distribution).

■ Site coverage ratio, water domain density, and green coverage ratio all have cooling effects. Proving that urban land use status has an influence on urban temperature environment (Lin Xiande et al., 2001).

■ Lin Jiongming (2010) pointed out that the influence of heat island effect on urban climate includes: (1) increased energy supply pressure, (2) reduced hours of sunshine, (3) decreased relative humidity, (4) changes in precipitation patterns, increased urban flood risk, (5) heat island effect accompanied by global greenhouse effect, increased La Niña and high temperature, (6) effect on quality monitoring, endanger people's health, (7) confuse global warming signals, and affect global warming assessment and other 7 main aspects.

■ Stern (2007) estimated that till mid-21st century, the economic cost of extreme weather will be as high as 0.5-1% of global GDP and will increase as the temperature continues to rise.

- Due to the frequent occurrence of extreme events in recent years, infrastructure has been subjected to extreme temperatures (such as heat waves, cold currents), heavy rain, and typhoon path changes, etc., which has delayed economic development and caused huge expenses on infrastructure repairing costs (Larsen et al., 2007).
- Human's reliance on energy supply equipment will increase accordingly. When extreme climate impacts, energy supply and economy will also be harmed, affecting the quality of life (Yu Xue Yuxun, Luo Huiwei 2014).

■ Climate can directly cause human death through different mechanisms, or indirectly lead to cardiovascular, lung, and brain damage and cancer through air pollution, etc. (Mairiaux (WMO, 2009).

- If temperature continues to rise, the public health threat caused by heavy rainfall will gradually increase. (Lin Chunchun et al., 2012).

Development Opportunity

- 1980's:** Rapid developments of international enterprise and information technology; Capital mobilization
- 1990's:** Global population and activities are highly concentrating in urban areas; The development of urban settlement tends to increase in size; The threats of environmental and global climate changing problems to the urban areas
- 2000's:** 2008 World Energy Outlook estimated 70% of CO₂ was produced by urban areas; Executive Yuan elaborated "Low Carbon Cities Program" in the "Sustainable Energy Policy Action Plan"
- 2010's:** Population highly concentrated; rainwater can't infiltrate the artificial pavement of buildings and roads and causing flood
- 2012:** Climate changes raising the frequency of Catastrophes
- 2013:** Proposing the adaption measures to mitigate climate changes; Manmade disasters happening frequently

Timeline: 1980's → 1990's → 2000's → 2010's → 2012 → 2013 → today

Urban Innovation Focus: Smart City (1980's), Sustainable City (1990's), Low-carbon City (2000's), Sponge City (2012), Resilient City (2013)

Canton(2013)

- "All hazard approach" **doesn't** mean that there is a plan for everything.
- "All hazard planning" **requires a risk-based approach.**

risk assessment

Assess with all hazard approach thinking, present it on the risk assessment of potential disaster and risk management.

risk driven

Encourages to distribute priorities and resources based on risk assessment.

multiple hazards

- ★ Replace dissipating limited resources to plan all possible hazards method in the past.
- ★ The concept of **risk assessment** is used to replace the traditional assessment method of risks which is a one aspect planning method that focuses only on specific hazards that are vulnerable to communities.



Changes in the total sales of the three major science parks in Taiwan over the years

Year	Hsinchu Science Park	Central Science Park	Southern Science Park	Tsinghua Science Park
2007	12000	2000	5000	1000
2008	10000	2500	0	0
2009	8000	2500	0	0
2010	12000	2500	0	5000
2011	11000	3000	0	6000
2012	11000	3500	0	6000
2013	11000	4000	0	6000
2014	12000	5000	0	6000
2015	11000	5000	0	7000
2016	10000	5000	0	8000
2017	10000	6000	0	8000
2018	11000	7000	0	8000
2019	11000	7000	0	8000

Changes in population and social growth rate of Zhubei City and the location of the three major science parks in Taiwan over the years.

Year	Zhubei City	Hsinchu Science Park	Central Science Park	Southern Science Park
2007	40	5	5	5
2008	35	5	5	5
2009	30	5	5	5
2010	25	5	5	5
2011	28	5	5	5
2012	30	5	5	5
2013	30	5	5	5
2014	25	5	5	5
2015	22	5	5	5
2016	22	5	5	5
2017	25	5	5	5
2018	28	5	5	5
2019	30	5	5	5

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- The diagram illustrates the relationship between adaptation and mitigation in climate change management. At the top, a blue box states: "Adjust natural and human systems to reduce negative impact on them under the influence of climate change." Below this, a central horizontal flow shows "Land utilization" leading to "Urban Development". This flow is flanked by two large ovals: a blue oval on the left labeled "adaptation" and a green oval on the right labeled "mitigation". Between these ovals, text reads: "Make integrated strategic planning to slow down and adapt with comprehensive, systematic thinking." Below the ovals, a red arrow points from right to left, labeled "Low carbon society, economics and home." At the bottom, a green box states: "Focus on reducing the causes of climate change, use human intervention means to reduce greenhouse gas emissions." Lines connect the top box to the "adaptation" oval, the "mitigation" oval to the bottom box, and the bottom box to the "Low carbon society" arrow.

The diagram illustrates the Risk Framework, showing the relationship between Hazard, Vulnerability, Exposure, and Risk, influenced by Climate, Socioeconomic process, and Greenhouse gas emissions and land use change.

Central Concept: Risk

Components of Risk:

- Hazard** (Blue oval)
- Vulnerability** (Light blue oval)
- Exposure** (Dark blue oval)

Factors Influencing Risk:

- Climate** (Top left): Includes "Rain intensity and the corresponding flood scale".
- Socioeconomic process** (Top right): Includes "Various types of land use and its vulnerability", "Socioeconomic approach", "Adapt and slow down", and "Governance".
- Greenhouse gas emissions and land use change** (Bottom): Includes "Various types of land use area".

Intermediate Concepts:

- Natural change** (Under Climate)
- Man-made climate change** (Under Climate)
- Impact** (Top center, connecting Climate and Socioeconomic process)

Relationships:

- Hazard** and **Vulnerability** lead to **Risk**.
- Vulnerability** and **Exposure** lead to **Risk**.
- Hazard** and **Exposure** lead to **Risk**.
- Risk** leads to **Impact**.
- Climate** and **Socioeconomic process** lead to **Impact**.
- Greenhouse gas emissions and land use change** lead to **Impact**.

The diagram shows a progression of flood defense strategies. On the left, a vertical timeline of four circular images shows the evolution: a traditional levee, a levee with a flood wall, a levee with a flood wall and a flood gate, and a levee with a flood wall and a flood gate. To the right of these images are three text boxes. The top box, 'Traditional Flood Defense Thinking', describes a concept of flood control focusing on improving drainage roads, diversions of embankments, and straightening of rivers. The middle box, 'Comprehensive Flood Defense', describes a concept of flood control adopting a combination of engineering and non-engineering methods, such as the introduction of multiple methods like levees and construction management and engineering, to reduce the increase in urban water level and the risk of urban flooding. The bottom box, 'Low Impact Development, LID', describes a concept of flood control focusing on the improvement of drainage roads, such as grading of river channels, diversion of embankments to expand the river running area, straightening of bends, diversification of natural waterways, increasing the height of embankments, etc. An arrow points from the 'Traditional Flood Defense Thinking' box to the 'Comprehensive Flood Defense' box, and another arrow points from the 'Comprehensive Flood Defense' box to the 'Low Impact Development, LID' box. A large blue arrow points from the 'Low Impact Development, LID' box towards the right, pointing towards the 'Consolidating existing local technologies to manage stormwater and rainwater storage and utilization methods through the functions of infiltration, storage, evaporation, reduce the area of the impervious surface in the development area, try to maintain the original hydrological state, and make full use of infiltration capacity and increase collection time' text.

Traditional Flood Defense Thinking

The concept of flood control focuses on the improvement of drainage roads, such as grading of river channels, diversion of embankments to expand the river running area, straightening of bends, diversification of natural waterways, increasing the height of embankments, etc.

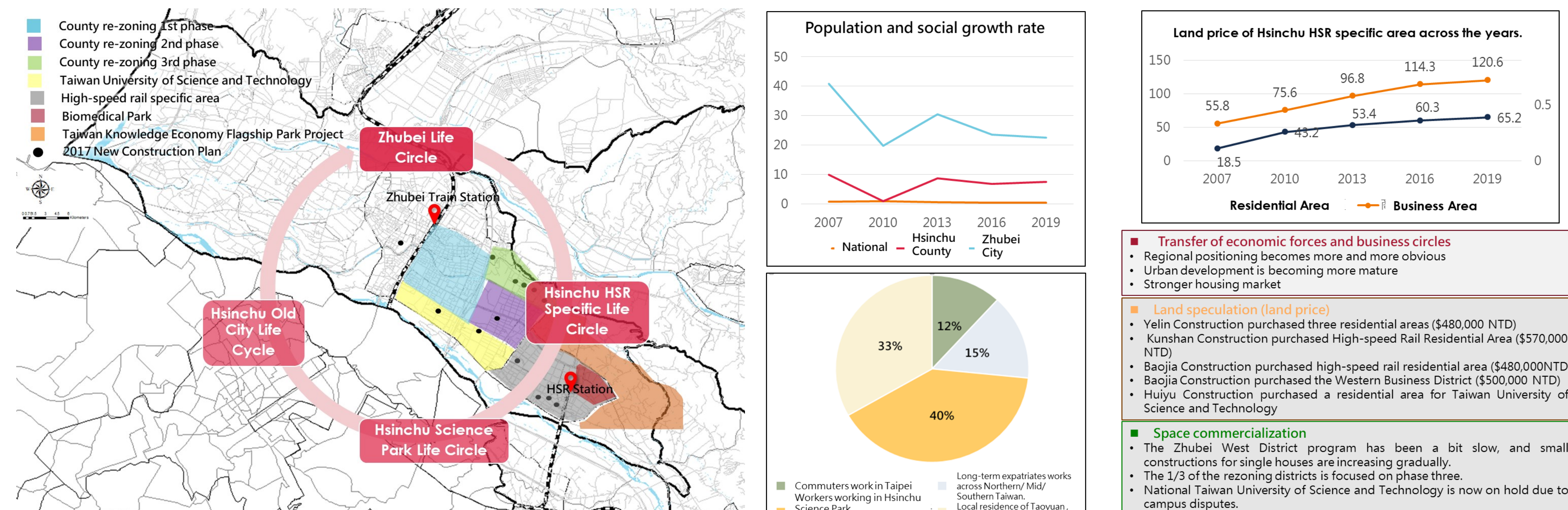
Comprehensive Flood Defense

Comprehensive flood control adopts a combination of engineering and non-engineering methods like, such as the introduction of multiple methods like levee and construction management and engineering, to reduce the increase in urban water level and the risk of urban flooding, and improve the city resilience.

Low Impact Development, LID

The concept of flood control focuses on the improvement of drainage roads, such as grading of river channels, diversion of embankments to expand the river running area, straightening of bends, diversification of natural waterways, increasing the height of embankments, etc.

Consolidating existing local technologies to manage stormwater and rainwater storage and utilization methods through the functions of infiltration, storage, evaporation, reduce the area of the impervious surface in the development area, try to maintain the original hydrological state, and make full use of infiltration capacity and increase collection time to reduce the goal of reducing the impact of development behavior on water quality and quantity. The integration of low-impact development strategies with traditional best management practices (BMPs) has become a trend called LID-BMPs.



The figure illustrates the land use planning of the NTU Zhubei Campus. It includes a map of the campus area, a timeline of planning stages, and three land use maps: Non-urban Plan (Before 2004), Urban Plan (2004), and Current National Land Use Survey (2019).

Map of the Campus Area: The map shows the location of the NTU Zhubei Branch, the International Green Energy Park, the International AI Smart Park, the Asia Pacific American Bilingual School, the China Medical University Zhubei Branch, the Taiwan University of Science and Technology Zhubei Branch, and the Cultural Education Region. The map also shows the Taiwan Knowledge Economy Flagship Park Project and the Taiwan University of Science and Technology Zhubei Branch.

Timeline of Planning Stages: The timeline shows the progression from the NTU Zhubei Branch (2004) to the International Green Energy Park (2004) to the International AI Smart Park (2004) to the Asia Pacific American Bilingual School (2004) to the China Medical University Zhubei Branch (2004) to the Taiwan University of Science and Technology Zhubei Branch (2004) to the Cultural Education Region (2004).

Land Use Maps: The figure includes three land use maps: Non-urban Plan (Before 2004), Urban Plan (2004), and Current National Land Use Survey (2019). Each map includes a legend with various land use categories and their corresponding colors.

Non-urban Plan (Before 2004): The legend includes categories such as Residential Area, Industrial Area, Commercial Area, Public Facility, and Green Space. The map shows the layout of the campus area before 2004.

Urban Plan (2004): The legend includes categories such as Residential Area, Industrial Area, Commercial Area, Public Facility, and Green Space. The map shows the layout of the campus area in 2004.

Current National Land Use Survey (2019): The legend includes categories such as Residential Area, Industrial Area, Commercial Area, Public Facility, and Green Space. The map shows the layout of the campus area in 2019.

Figure 1: Planning and development of Zhubei

Map Legend:

- County re-zoning 1st phase
- County re-zoning 2nd phase
- County re-zoning 3rd phase
- Taiwan University of Science and Technology
- High-speed rail specific area
- Biomedical Park
- Taiwan Knowledge Economy Flagship Park Project

Road Name and Service Level Table:

Road Name	Service Level
Zhonghua Road	E
Zhongzheng West Road	F
Zhongzheng East Road	F
Zhongshan Road	D
Guangming Sixth	D
Xianzheng 2nd Rd	F
Zhuangjing North Road	C
Ziqiang South Road	F

2019 Average House Price in Zhubei

2019 Average Income of each village in Zhubei City

2019 Low electricity Consumption (Household, lower than 60 kWh)

The rolling urban governance of Zhubei City has created:

1. Fragility of urban land.
2. Internal imbalances in regional development.
3. Increased endangerment on agriculture industry, and other socio-economic hazards impacts on the environment and land reuse pattern.

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