博士論文

From Vulnerable to Valuable City:

A Comprehensive Analysis of Landscape Adaptive Capacity and Characteristics Through Analytical Studies of Urban Agriculture Changes and Tendency

(脆弱な都市から価値ある都市へ：都市農業の変化と傾向に対するランドスケープの適応可能性およびその特性の包括的分析)

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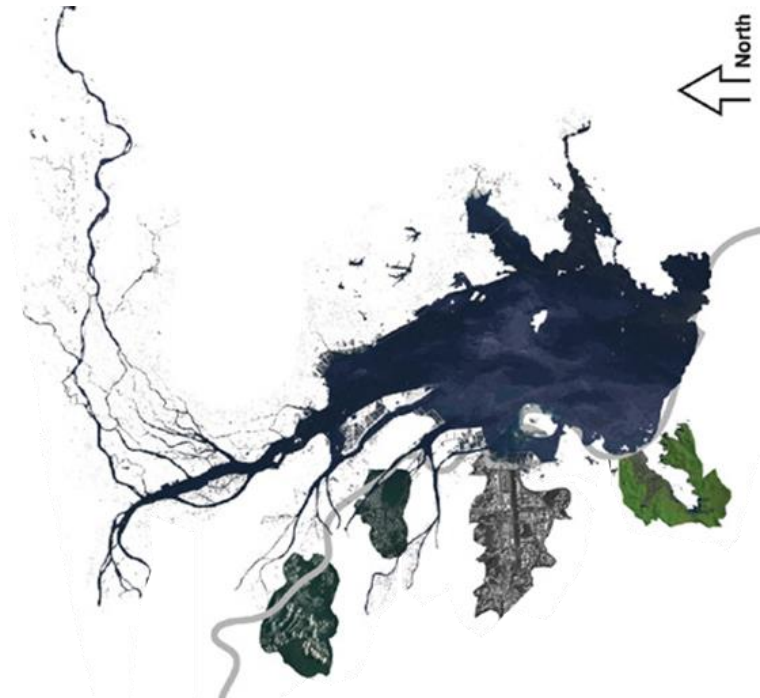
Graduation School of Engineering

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Water course development in Hong Kong, drawn by Bosco So

ACKNOWLEDGMENTS

This thesis represents not only my work in the specific area, it is also an essential future exploration of landscape architecture disciplines at The University of Tokyo at the Landscape Lab, Department of Civil Engineering. My studies in Doctoral degree in Design and Landscape have been nothing short of incredible. After these three years of intense studying, I have learnt that what are the crucial aspects and primary landscape aspects to cope with. The thesis examines what I have learnt through the historic analysis of agricultural development and see how the landscape function changes from the Landscape engineering development.

Historical analysis on the Agricultural development and figure out the co-relationship between landscape and adjacent development are the result of my studies by dozens of explorations and interviews of multi-disciplinary expertise, whom I wish to thank. Meanwhile, this thesis is also the result of many experiences I have had at The University of Tokyo from dozens of remarkable individuals whom I would like to acknowledge.

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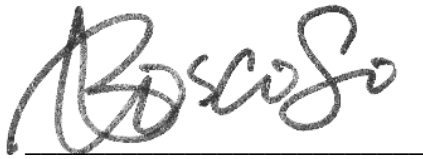
In the absence of. Ivy Lam's kindness, I could not stand until now.

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STATEMENT OF ACADEMIC INTEGRITY

I declare that this thesis represents my own work, except where due acknowledgment is made, and that it has not been previously included in a thesis, dissertation or report submitted to this University or to any other institution for a degree, diploma or other qualification.

(Signature)

Abstract

This study examines the unexpected consequence of the richness of the ecosystem, land use re-planning and new typology of vegetation caused by the civil engineering implementation works. It aims to examine the outcome of conducting civil engineering works may only carry one single effect or it could result in a chain of causations. The Green Infrastructure Strategy indicates GI as a Strategically build network and consist of semi-natural areas with supplementary features designed for the ecosystem, which will accommodate to both rural and urban settings (EC, 2013a).

In prior to configuring the historic processes of UA contingency, it is essential to examine various geography before theorizing these steps. This study illustrates and categorizes various types of environmental hazards in correspondence to situated disasters in their dimensions and respond to their physical and sociological context. Urban agriculture reflects the landscape radioactivity in agriculture, second fold and the prototype of restoring urban environment to elevate the landscape evolution caused by civil engineering works and natural disasters. The "Novel ecosystem" demonstrates the adaptation of non-native species that have been altered by landscape

The background of the Urban Agriculture and Natural Hazard

patterns caused by natural disasters which have radically evolved to adapt to new environment.

By adapting to variable environmental influences such as flooding, landslides, drought, the cities of landscapes are inevitably approaching landscape resilience. Through social metabolism, we learn that "socio-natures" is a contingent immediately after revealing how social and natural processes are co-produced—argued by Marxian geographers and political ecologists (Harvey, 2006; Swyngedouw, 2006; Smith, 2008). The pessimistic physical and mental illness can be tackled by the following: Agriculture serves a multi-purpose usage. Agriculture land can utilize as a tool to reduce unforeseen disastrous risks and bring substantial, ecological, and agricultural tradeoffs and opportunities. Urban environment is constant changing, due to contextual factors such as climate, economy, and infrastructure, this study aims to analyze the causation of natural hazards and civilization. Farmland can be adapted to serve multiple functions such as floodplains, storm management water run-off areas, peak flows discretion area and a stream with high capacity.

Keywords: urban agriculture, community, landscape engineering

1. Introduction

Previous studies suggest Urban Agriculture (UA) predominantly aids developing countries, due to the change in economic structure, domestic agriculture has increasing declined in those cities, and the needs of agriculture is based on the distinctive conditions at targeted region. During financial crisis, Urban agriculture (UA) is distributed in both vacant and marginal land for functions, food resources, citizen's entertainment, ecosystem services, and agriculture industry occupation. This study identifies UA's multifunctional applications from an undifferentiated perspective. In a city, it can respond to as a panacea for the urban ill. The consequence and identification of urban farming, natural hazard mitigation, and ecological evolution.

Three interrelated measurements of UA are evaluated, including production, social, and environmental aspects. When natural hazards occur environmental rifts is damaged, to overcome these rifts, UA needs to implement and rescale production to reclaim abandoned land for urban dwellers to obtain food allocation. Stable food supply, close social networking, enhanced environment, improved health condition, and quantified economic contribution regarded as the essential functions of UA to meet the needs of urban communities. By further evaluating the actual value of UA, we discover that it does not meet the requirement of academic gap. Still, it also brings

insights to inhabitants in pursuing a sustainable way of life, through alternating the use of latent territories, adaptive of abandoned farmlands, setting up goals for necessary agricultural development, and to facilitate policy making.

2. Data collection and Methodology

From the 46 rivers in Hong Kong, this study examines the rivers condition through stratified randomization research method. Firstly, it eliminates location with commercial districts due to their local agricultural productivity. Secondly, it reduces the construction period of river channel and its complexity. Thirdly, it eliminates low ecological value evaluation where it simply coexist with nature. Which concludes of 3 remaining rivers, including Kam Tin Valley River, Long Valley, and Lam Tsuen Valley River, Hong Kong.

Literature review on resilience and urban sustainability together with observation and secondary data analysis on the living environment and civil infrastructure will be carried out to study the impacts of UA on social network and unfavorable conditions which were caused by human activities and natural disasters. The urban landscape measurements in terms of UA include functionality, urban fabric, and culture to micro-politics of place-making will identify through the analysis of the pivotal functions of UA by survey and mapping. In this study, an aerial photograph comparison lists out the place's development from the 1960s to 1990s. The drastic environmental land-use change, reduction of farmland and enhancement of ecological

The background of the Urban Agriculture and Natural Hazard

land use is discussed. The illustration of this spatial and transformation of the land in

the result as today's resilience landscape. Geographic Information System (GIS) was

conducted and the interview was proceeded to contribute to the landscape analysis. To

understand more about the public awareness to the river construction in HK, a

questionnaire methodology of simple sample taking is conducted.

2-1. Causes of Flooding and site context

Rainfall is the cause of flooding in most of the circumstances. Flooding has been

caused by several aspects, which include precipitation, surface runoff, river

aggradation, backwater effects, surrounding surface impoundment, sewage systems,

river blockages by sediments, storm surge and insufficient flood plain. For instance,

composed of steep topography and brief river water catchments, rapid surface water

runoff has resulted. Water surface runoff is the main principle that causes flooding in

the first generation of agricultural lands, such as Kam Tin Valley River, Long Valley

and Lam Tsuen Valley River, Hong Kong. The Significance of the river represented

the naturalistic forms of landscape resources, customs, indigenous clans, and tenant

farmers. For Riverbed aggradation, when there is a higher volume of sediment

accumulated to a river channel, the additional sediment is therefore deposited into the

riverside and caused blockage to water channel. It will eventually lead to decline in

velocity and the depth of water flow, resulting in discharged being released to

riverbanks, with a corresponding increase in flood risk.

2-2. Flood Prone, Infrastructure and Remote

Natural disaster such as flooding has occurred there are no records of casualties, however there are still several other consequential effects of Kam Tin Valley River, Long Valley River and Lam Tsuen River. Because of agricultural development, direct inundation was more devastating owing to the central development of agriculture, ecology, residential usage, and assets. Previous case studies of flooding have been examined. In 1962 Typhoon Wanda, have caused numerous damaged properties and agricultural lands. Before the river widening application for civil engineering works, transport and communication connections were often buried due to the links occasionally blocked out by streambed aggradation. Houses and farmland have initially been situated adjacent to the main flood river. Floodwaters washed out 20 meters of surrounding agricultural land, as well as exposing a home and the related facilities to floodwaters. The ecologies, farmers and the villagers lost their living environment when flooding occurred henceforth Long valley is known for heavy rain continually destructing the living area.

2-3. Multicriteria Layering analysis

First, I summarized the three river numbers and the types of events encountered in this study rivers with a farm. Mainly, it characterizes overall patterns across Hong Kong. I then sought to explain patterns of project type and frequency based on various

factors. Setting up the river project characteristics (e.g., measurements, category) as dependent variables, and analyzed by seven independent variable factors.

The dependent variables include the types of analysis, including waterfront environment, traffic atmosphere, slope analysis, and topography analysis, ecological analysis, and air quality index analysis. Together with the chronicle analysis and questionnaire methodology as summary statistics for the result of this analysis, such as social suitability and economic suitability rate, the investigation takes a different portion of each variable factor as a baseline.

3. Findings and Discussion

The primary purpose of this study is to investigate the critical resilience criterion that eventually can be used for developing the assessment blueprint. The preliminary stage research result is far from being exhaustive. A comprehensive review of adaptation and disaster risk reduction criteria would be clarified. To defend the vulnerable urban spaces against natural disasters, the best way is to review past case studies. Hong Kong and other international cities shared similarities with divergences, where significantly represent the importance of UA in developed cities in the world. A disaster brings an impact to the landscape, which consists of a diversity of manifestations of the interaction between contemporary civil engineering infrastructure and the natural environment.

The background of the Urban Agriculture and Natural Hazard

Over the centuries, Kam Tin Valley River, Long Valley and Lam Tsuen Valley River, Hong Kong, Hong Kong – where the farmland alongside the water, constituting a community, faced problems such as flooding and natural hazards. These valleys' topography is significant to villagers. From the year of 1985 to 2020, Hong Kong underwent the change of landscape functions from the productive landscape, food miles, social solidarity, food security, and business tradeoff to environmental degradation. An urban population is shrinking owing to the change of the population lives in urban areas. These farmlands that are at risk to maintain their cultural landscape and UA. The signature of the forms of these agricultural lands has been identified. It exemplifies the degree of these independently variable factors are driving the current result. The green infrastructure designation will include river widening work, ecological neglect intervention, uniform a river function will be the next prioritized work.

Furthermore, the integration between river function expansion and urban agriculture seemed not to be precisely built-in some former civil engineering constructions. Due to the limitation of the lack of enough data on most geological and geomorphological aspects, this study is based on the remotely sensed imagery and concentrate on morphological changing of the rivers and farming pattern. Assuredly, some unquantified factors also affect river and farming development, such as culture

and ecological synergy effect. Likely, it could explain some differences between these 3 case studies.

4. Conclusions

Notwithstanding, the functions of agriculture may vary for a couple of configurations, cultural integration of custom, history and ecological conditions are based upon a set of processes resulting in a community. After the civil engineering landscape works have been applied, it made the significant deviations and the cause of natural disasters have been going through. To defend the ever-changing and complex natural climate changes, a more holistic and multi-disciplinary landscape orientated approach is an indispensable factor. It has evolved from the traditional farming practice landscape into a multi-diverse and ecological agricultural landscape. By using the value of using an empirical study, this research revealed that the site-based and infrastructure with river specific flooding risks under linked with social-ecological could be found on a local scale.

Invariably, the result of planning urban agriculture and civil engineering evaluations are crucial to appraise a relevant policymaker and activists concerning planning the parameters for mitigating the impact of climate change and adapting the innovations from the planning policy by way of a transdisciplinary participatory to the

city. To conclude, when the infrastructure helps to mitigate the flood issue, it also creates another type of farmland and ecosystem. On the other side, biodiversity has changed the river engineering works original function, revealed the unanticipated aspects. These changes included generating multifunctional farms and enhancing the ecological value. Ultimately, a recommendation – on restoring the potential extent in an urban environment, enhancing the city's livability towards urban life, and developing an urban agricultural prototype which can be applied worldwide – will be delivered. In due course, an appropriate priority of green infrastructure and the allocation of resources can be set towards the system of resilience and sustainable livelihoods. At long last, UA regards as evitable factors for framing a theoretical framework to connect urban geography, political economy, agroecology, ecosystem, and public health. The academic contribution would not only made to agricultural practitioners, but it would be a guide for all disciplines related to the disciple of urban planning and ecosystems.

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Preface

Preface

This study examines the unexpected consequence of the richness of the ecosystem,
land use re-planning and new typology of vegetation caused by the civil engineering
implementation works. The research on how rivers had been formed to reduce the
flood damages in the past and developed should become an extraordinary part of the
record.

The landscape changes in the captioned rivers is pivotal to prevent errors in future
studies. It would only carry one single effect, or it could result in a chain of
causation.This thesis explores the unforeseen consequence of the habitat diversity,
land use re-planning and new vegetation typology induced by the implementation
works of civil engineering.

Figure 1. Implementation of Civil engineering

Chapter 1: Introduction
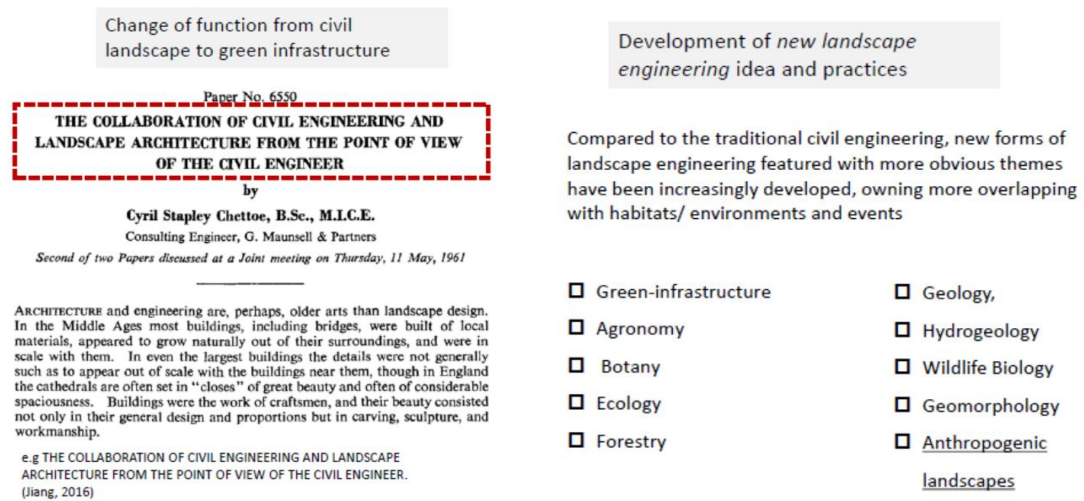
Figure 2. Collaboration of civil engineering and landscape architecture from the point of view of the civil engineers

It aims to examine whether the outcome of carrying out civil engineering works would have only one effect, or could result in a causation chain.

Figure 3. Speciality and features of infrastructures as valuable landscape aspects

Chapter 1: Introduction

STEP 1 Data Collection and Processing	STEP 2 Category System for content analysis	STEP 3 Category-based Representation for contents	STEP 4 Statistical data analyzing

Tab.1 Dataset overview	Time period	Number of river branches	Number of farms	Total length of review content	Number of specific housing unit nearby the site development
Agriculture (existing farm)					
Site A	1981~2020	235	-	17,715	1,927
Site B	1983~2020	94	-	6,305	1,573
Site C	1987~2019	48	-	6,991	1,175
The new town development near the existing farm area				-	45,260	3,115
Site A	1997~2018	710	-	48,149	2,864
Site B	1999~2018	626	-	38,677	2,756
Site C	2001~2020	302	-	24,760	2,045

※ The collection process had accessed to all available records about the study objects at the time and demographic profile has been identified for an explanation on the population bias and group deviation   7

Figure 4: Step1. Date collection

STEP 1 Data Collection and Processing	STEP 2 Category System for content analysis	STEP 3 Category-based Representation for contents	STEP 4 Statistical data analyzing

Tab.2 Categorization system of content for landscape values - based on Landscape identification and Heterogeneity (Bieling, 2014)

Categories of Landscape values	Operational definition and description for the index	Corresponding CES constructs under Relationship	Representation sample of typical words
Forms (F)	physical, tangible and measurable aspects of objects		
FN (Nature)	Physical forms of nature elements		River, sky, mountain, valley
FS (Structure)	Physical forms of infrastructure elements		Bridge, dam, river, building
Practices (P)	Activities and practices of human at place, as well as natural process		Walk, farming, living…
Relationships (R)	Values based on the interaction of human-landscape and human-place		
Natural disaster	Natural hazard to affect landscape evolution	unpredictable	Restoration/ reconstruction
Architecture	The built architecture elements on site	Functional, user-needs	Residential, institution
Topography	Physical forms of nature elements	The natural geology	Ridge, summit, Valley, Floodplain
Farming	Activities and practices of human at place, as well as natural process	Tradition, education, culture	Wet farm, dry farm
Ecological network	Activities and practices of ecology place	cultural heritage	Aviation, marine, river ecology
Social network	Activities and practices of the neighborhood	Recreational, Education, & tourism	Tenant, new town development citizens

※1. Terms filtering for the categorization: Threshold setting
※2. Validation and reliability for categorization process (Barry, 2014)

Figure 5 Step 2. category system for content analysis

Chapter 1: Introduction

STEP 1 Data Collection and Processing	STEP 2 Category System for content analysis	STEP 3 Category-based Representation for contents	STEP 4 Statistical data analyzing

Review landscape content in origin:	After a several natural hazard attacked, there are some changes have been revealed by Landscape and civil structure such as water channel measurement		
① Segmentation Process			
Review content in units:	Civil works develop (Transportation, etc)	Urban Atmosphere (residential)	Ecology + Farming (Waterfront)	Topographic slope
② Categorization Process (Step 2)			
Review content in values:	Expansion size	Variety and type	Diversity	Precipitation
③ Weight calculation Process – using *MCDM*			
Review content in value weights:	0.2884 +	0.2075 +	0.3507 +	0.1534
④ By conducting document review, site survey and questionnaire to verify the result			
Review content in value proportion:	Water channel expansion +	Development % +	Biodiversity % +	Land use change %

Figure 6 Step 3. Category-based Representation for contents

1. Content analysis for GIS layering reviews → Vulnerable landscape feature (embedded landscape values)

2. Content analysis for images
Part II
Used to investigate the content and variation of landscape attributes and view-objects
Objects: River profile/ Ecology distribution/ Topography → Vulnerable viewpoint and view-objects

3. Field Survey

4. Online questionnaire

Figure 7 Step 4. Statistical analysis

Thesis Framework

OBJECTIVE 1:
To investigate the presence of diversity, naturalness, coherence and additional attributes that forms experiences of a green infrastructure network in the agriculture area

OBJECTIVE 2:
To identify uses and experiences that residents make of the green infrastructure and feelings that they have towards the properties and attributes.

OBJECTIVE 3:
To determine the effects of experiential contacts with the green infrastructure network, and the relationships to well-being of residents, physically, cognitively and socially.

Final GOAL (Combination of 3 objectives)
To propose a conceptual model eliciting the interrelationships of residents' experiential contacts with the green infrastructure network to physical, cognitive and social well-being.

KEY RQ 1:
How does Natural Hazard (Flood and Typhoon) influence the urban agriculture pattern?

KEY RQ 2:
How can Urban Agriculture enhance the ecological value and widen the biodiversity?

KEY RQ 3:
How can Urban Agriculture integrate with engineer works and cultural landscape?

1. Problem identification
2. Prioritizing problem
3. Problem analysis
4. objectives
5. Hypothesis

1. General and specific
2. Sampling
3. Variables
4. Data Collection
5. Plan for data collection, processing and analysis

1. Ethics
2. Quantitative methodology
3. Survey
4. Chronicle analysis

5

Source: Paper of Occurrence and human health implications of chemical contaminants in vegetables grown in peri-urban agriculture
https://www.sciencedirect.com/science/article/pii/S0160412018315290

- Urban Agriculture in London: Rethinking our Food Economy, Tara Garnett
- Urban Agriculture and Ecosystem Services:
  A Typology and Toolkit for Planners, Kathleen Doherty

Other than the land recovery can be helped by **UA, Ecosystem**, rethink of food economy and community development can be enhanced as mentioned in the previous journal.
Conserve agriculture while sustainably produce more food in limited land area while minimizing the impacts on the environment for future growth demands. Besides, they identify how agricultural practices and policies can help to reduce flooding and protect the environment.

Figure 8 Underpinning theory

Prior to figuring out the historical processes of UA's contingency, the necessitated step is theorizing its numerous geographies. The objective of this study exemplifies two-fold.

In the first step, this study defines and categorizes the types of environmental hazards in several dimensions. The aspects reflect the landscape radioactivity in an urban pattern, especially on the side of Urban Agriculture.

On the second fold, it discusses the landscape pattern has been altered by natural disasters and the "Novel ecosystem." It demonstrates how the non-native species adapt to the evolved landscape environment radically.

Chapter 1:

Introduction

Chapter 1: Introduction

General Introduction

As to adapt the spatial structure in the environment, we can always learn the consecutive reorganization of the cultural landscape. The changes in the landscape are the movement of natural and cultural forces in the background. Antrop, 2005. To defend the vulnerable urban spaces against the natural disaster, the best way is to review the past and learned from the case studies—the relationship between water and agriculture farmland of the movement in Long Valley. Over the centuries, Long Valley – where the farmland along the water constitutes a community suited to flooding and natural hazard. In this chapter, we will discuss why to make Long Valley topography and its Significance to villagers in Hong Kong.
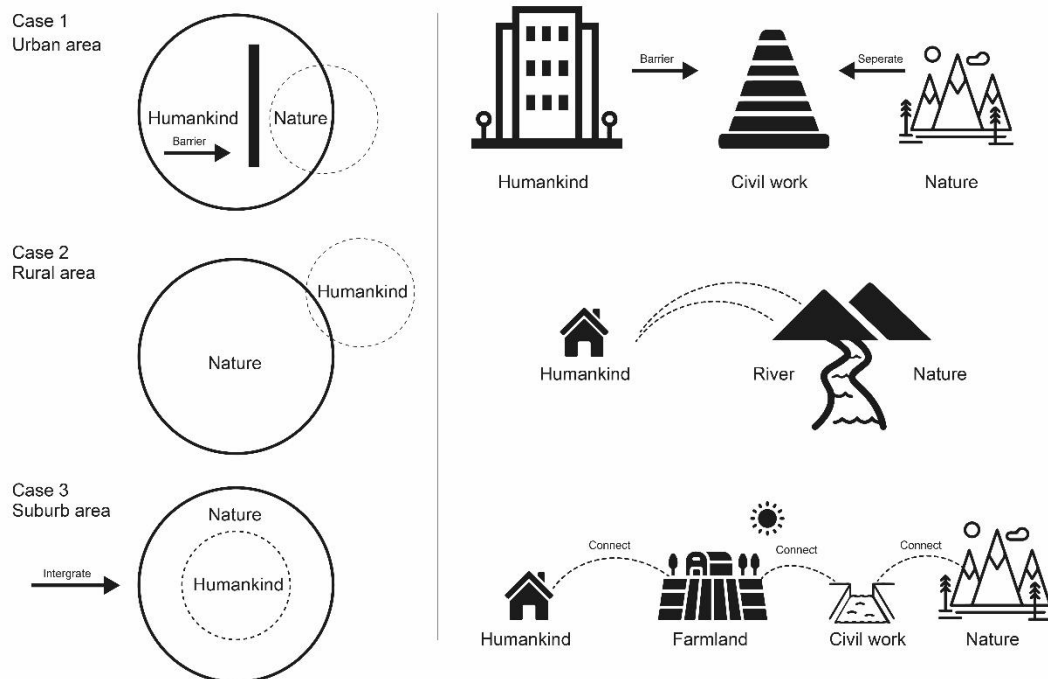
Figure 9. Concept of urban farming

1.1 The Definition of Agriculture and landscape

Agriculture farmland as a Cultural landscape, to represent different countries in the

world, there is a wide variety of landscapes that existed in different places. These

landscapes authentically manifest how the intimacy of humankind and the naturistic

environment being integrated. As a part of our collective cultural identity, the cultural

landscape includes gardens, rice paddies, sacred places. Together with social

development, creative genii such as civil work and traditional architecture adaptions

to the landscape. All of these are the spiritual vitality of humankind. By UNESCO

1.2 Research Question

1. How can Urban Agriculture heal lives in an urbanized city under Natural

Hazard

"Healing Detroit by healing and cultivating the earth" by Urban Root. A century ago,

a vast majority of the world's population was rural and tended to be an agricultural

system orientated. In 1990, Low- and middle-income countries relied on urban

agriculture to remain the food security problem. UA is described as a multifunctional

intervention that affects food justice, food security, community space and social

health, etc. In the past studies, UA is mainly aiding the third-developed countries but

not the developed countries. What if we transform UA to an emergency factors to giant cities under one of the compulsory development criteria? It is therefore we can portray how UA influences health and its determinants in the following chapter. Over the past decades, Urban agriculture becomes one of the considerations in citizen's mindsets. In terms of functionality, food justice, and food security. However, in some cities where do not have emergency food justice and food security problems. Does it mean UA is not an important element in city development? This thesis hypothesis that UA has its own significant impact in a concrete forest city and plays a role in the healing garden.

This retrospective idea of having urban agriculture can be delivered to the citizen and resolve the physical and mental problems. Urban Agriculture functions as Flood Plain. To create farmland as the Floodplain function. It can potentially bring ecological and agricultural tradeoffs and opportunities. Stormwater runoff management, the discretion of peak flows and the high capacity in the streams can be minimized by Urban Agriculture

Chapter 1: Introduction

Figure 10 Wet fields at Long Valley,Hong Kong August 29, 2017,

source: https://www.birdinghongkong.com/blog-update-february-2019

II. What challenges and opportunities are received according to different income

levels and sociodemographic characteristics citizens?

"The landscape of our food future appears bleak, if not apocalyptic" by Caleb Harper.

According to the statistic, more than 50% of the population in the world is urbanized.

To meet the daily needs of food, cities have totally relied on the food import system.

Several aspects are kept intensifying which includes population growth, urbanization,

the demand of the food. Some articles pointed out that UA function as a crucial tool to

increase the food security where demanded by city dwellers. Regarding a historical

retrospective of UA to analyze the recent city planning policies and agriculture

industry, this thesis research the possibility of inserting UA under the insufficient land

and hydraulic resource.
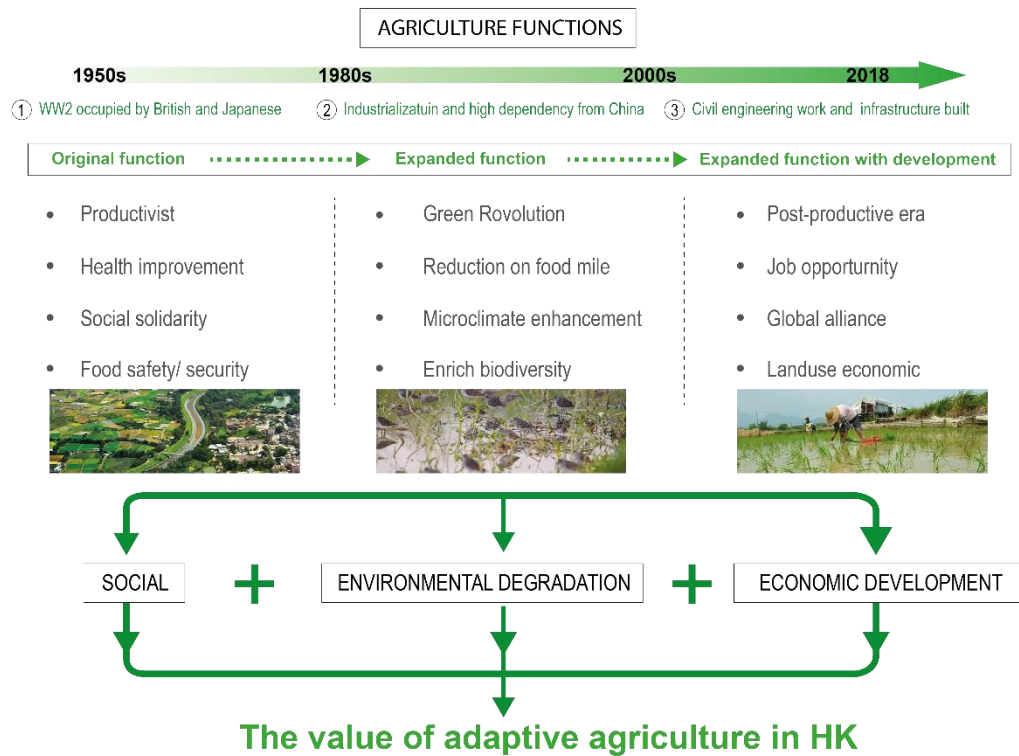
Figure 11. The value of adaptive agriculture in HK

At the same time, food intake and qualitative food maybe improved by Urban

agriculture as the poor income family group can consume more fresh vegetables.

Human activity is undoubtfully bring a certain level of impacts to our environment.

Globalization rapid catalytic the extreme unusual weather condition such as flooding,

extreme drought, tsunami, typhoon, and other subsequent impact. UA also influence

to the community Health in relate to nutrition and food security.

III. Can therapeutic landscapes network apply to Urban agriculture through urban form, governance, and urban regeneration?

 "Urban agriculture (UA) is spreading across vacant and marginal land. Many environmental sociologists have used the theory of metabolic rift to explain." by Nathan McClintock. The approach of dichotomous way seemed to be manipulating the contemporary city planning constantly and the application of antonyms of Urban Agriculture take over precedence than the last century. Is land use change trajectory as an obstacle in TYO/HKG land development correlated to agriculture land use. The concept of UA has been delivering amongst vacant land internationally which promoted by different country's policy making manager or decision maker. In addressing the economic crisis, ecological value, human being, and food market system. More rifts Ecological Rift: Rescaling metabolism

This thesis research the hypothesis that Urban Agriculture as Healing garden, Restoration and aesthetic point of view enhancement.

"Any landscape, wild or designed, urban or suburban or rural, large or small, that facilitates health. And preferably the health of not just humans but animals and the planet." By therapeutic landscapes network.com

UA is a lifelong active style and it becomes a part of personal wellness. UA is beneficial to public health and food security. Some researches stated that UA can help to solve the problem of Mental Health. Sickness prevention and healing purposes can be triggered by working with vegetations and work in the outdoors. Particularly, some patients

IV. How can Urban Agriculture enhance the ecological value and widen the biodiversity?

Urban agriculture farmland provides an opportunity and land to attract migration bird, microbes, insects, and other mammals within the city. Not purely provide the function of productivity, UA also contributes to enhance the existing green space connectivity. It brings a positive impact for some species. For instance, decomposers, seed dispersers, pollinators and other potential species that prey on pests inhabit the farmland.

1.3 Research objective

01. OBJECTIVES   Research strategy

Introduction

| Part I | Chapter I: Synopsis | Outcome |
| Theoretical framework | Chapter II: Positioning - Theoretical framework for flooding area in HK | Urban Framework Criteria and process |

| Part II | Chapter III: Reinvestigating civil engineering adaption for resilient city – Case studies | District plan and flooding area in the past and present |
| Analytical part | Chapter IV: Review of the Landscape function change - Landscape & Civil Engineering Works | Case studies selection |

| Part III | Chapter V: Civil engineering works for agricultural improvement | Study area characteristic and landscape engineering work by natural hazard |
| Proposal & Conclusion | Chapter VI: Conclusion and recommendation | |

Start from theory and prove the hypothesis after conducting analysis

Figure 12. Thesis structure and work flow

In the following chapters, the implementation of rehabilitation by introducing UA in

an urbanized city will be introduced. In the past century, most of the government

decision maker have a high demand of promoting Urban agriculture to community

and society without successful effect.

1.4 Hypothesis

Apparently, the great amount of the land has been occupied by property developers

rather than the public. If we assume that Urban Agriculture as a necessity of green

infrastructure under the city's redevelopment, UA became an essential item to be an

undeniable item to execute. It forms as prototype for the urban regeneration.

Not limited to food security and justice, UA can play a role of a natural hazard rescue tool. Not solely bring a beneficial to an individual group of people but also the neighborhood. Therefore, it contributes to all levels of community health.

Transcend the mental, hard core and emotional health condition, it leaves a long-lasting impact on individual and community space. It so-called a lifelong activity, and its health advantages exceed the several graders' generation. To satisfy the productivity, mental health release, community, and food beauty itself. Overall to say, it is a mean of health intervention system as it solves simultaneously the hardcore, psychology, spiritual, and help to tight up the community's network.

Landscapes of Disaster: The Landscape of disaster is created and formed by different forms of natural hazards and human being. Through analyzing the causes, consequence of natural and social science, it explores the position of human activities and what is the appropriate way to mitigate natural disasters.

Natural Disaster's Dimension

This study aimed to define and categorize the types of environmental hazards along several dimensions. To respond the situate disasters within their physical and societal contexts

Chronical analysis and reasoning

By using scientific principles, data analysis and reasoning to assess environmental hazards. Also, looking at the reasons and consequences of natural disasters. To apply an appropriate mitigation and disaster risk reduction strategies in the summary.

Correlations between Physical and human Factors

To evaluate both the physical, socioeconomic, and cultural influence on human vulnerability for natural disasters.

General Introduction of Shrinkage agriculture landscape

Landscape of disaster consists of a diversity of manifestations of the interactions between contemporary civil engineering infrastructure and natural environment. Until such time as the recent centuries, it is note that an agricultural district is playing an important key in New Territories in Hong Kong. Meanwhile, the quality and result of landscape application have been affecting the agricultural activities.

According to the historical analysis, it is understood that Long Valley is one of the traditional indigenous in Hong Kong. It is the place where villagers practiced the traditional rice crop agriculture over 100 years in the chronical reference. There are some private lands where comprises a high ecological value in Hong Kong. These

lands are usually tiny and fragmented and an active management proposal us urged to

sustain their unique and precious ecological value from the point of landscape

conservation, Long Valley is of the farmland which is in risk to maintain their cultural

landscape.

Figure 13. Important ecological sites on private lands in Long Valley, Hong Kong

(source: https://www.biosch.hku.hk/ecology/porcupine/por34/34-cover.htm)
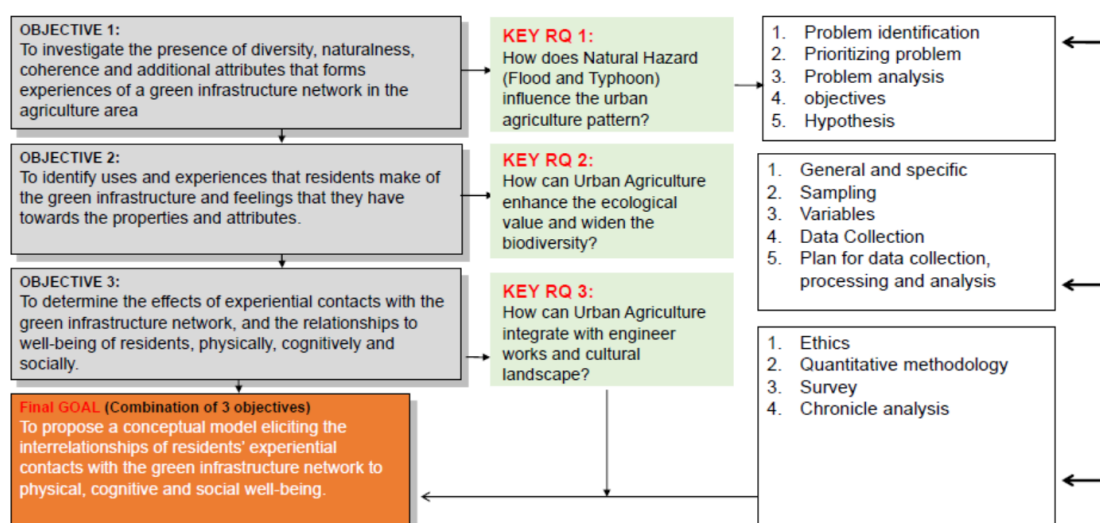
1.3 Research questions

Figure 14. The thesis obective and key research question

Research Questions

I. How does Natural Hazard (Flood and Typhoon) influence the urban farming pattern

II. How can agriculture heal lives in an urbanized city

In the recent year, Hong Kong received typhoon and climate changes frequently. Owing to the effect of typhoon, flooding becomes an inevitable force majeure to Hong Kong. Apparently, Hong Kong citizens have already experienced and familiar with these natural disasters, alongside the negative subsequence effects with them can be concluded as, erosion, inundation, destruction of public infrastructure, unbalance of natural habitat's environment and so on. Particularly, the characteristic of agriculture is not purely serving as productive farmland, but it also serves as a flood plain, habitat's shelter and community's gathering space. Going back to the history in Hong Kong, farmers get used to adapt the issue of flood risk increasing. Not surprised to know, every single changes of the land use actions by the farmers will ultimately influence the community stakeholder in downstream - culture inheritance and ecological cycle. This thesis study attempts to figure out the function of each relevant parties, farmers, village' stakeholders and ecology in view of farmers tended to get along of flood issue in the current circumstance. On the other hand, government applied a landscape engineering work as a resolution to minimize the flood damage impact to farmers, village's stakeholders, and ecology inhabitants. This thesis premise is that taking the consideration of intensively climate change and flooding impact on

agriculture nearby riverbed and streams into account, it aimed to figure the diverse ways to advise farmers to follow, protect their farms and downstream associated stakeholders and inhabitants.

1.2 Research objective - Historical review of agriculture land in an urban city, Hong Kong

I. Agricultural landscapes under the process of Natural Disaster

Going through a variable scale of natural hazard such as Tsunami, earthquake, typhoon, landslides and nuclear power explosion in Japan, it is crucial to understand how the role of natural system is hinder or affect under the process of natural hazard. Likewise, looking into a highly populated cities like Hong Kong, it also suffered by Typhoon, Landslides, and flooding in an inner city dramatically. Notwithstanding the flooding issue is critically affecting the agricultural productivity and urban city system, habitants still choose to stay in the origin where they live or operate the placed inherited by their ancestors. Despite natural disasters destructed the city infrastructure and existing farmland time, it created a chance for decision maker to review the impotency of using natural system as Green infrastructure whether to minimize the impacts caused by natural hazard or increase the positive Eco-values to our cities.

It is generally recognized that food security, food justice and food mile placed the high priority in some places where rely on the agricultural product productivity. However, when the shortage of products supply from the source of agricultural place,

it immediately causes an acute shortages of market supplies in an urban city where does not have their own food production farms. Certainly, tightening supplies and increased of demand will directly cause upward pressure on product costs. Not only trigger the agricultural area, natural hazard also triggers the urban city regarding a food chain principle. Approaching flooding from a holistic perspective, by restoring a natural ecosystem to create a soft countermeasure such as providing a protection against tidal surges, sandstorms, and strong wind. In addition, it provided a certain mitigation when Tsunami comes. It functioned as a filter to stop drift and debris included the wreckage of damaged ship, decrease, and procrastinate the tsunami power come to the land; provides a platform for people to evacuate the disaster area.

A lesson learned from the past, by analyzing the reconstruction plans and the levels of destructed land recovery can give an adequate sign for the natural disaster recovery proposal. For the complementary solutions, a more comprehensive network between engineered infrastructure and natural system and so on. More importantly, documenting every event of natural hazards can let the decision-maker assure the optimize the mitigation measures, risk reduction, reconstruction, and recovery planning system precisely. In order to enhance the livelihood resilience, the complex restoration of natural system is decided to be minify the potential impacts by natural hazards.

The coastal area near Sendai city, Japan is situated in the northeast of Japan's Honshu Island. Except the urban infrastructure, industrial usage, cluster settlements, agriculture (majority are rice paddies) are placed in the flood plain area mostly.

Chapter 1: Introduction

Owning to climate change, the natural disasters are frequently increased in number and intensity which influenced different cities in the world. Out of 353 natural disasters, 198 hazards defined as natural catastrophes in resulting economic losses exceed USD 92 billion.[2]

The increasing number and intensity of natural disasters, likely related to climate change, is affecting countries all over the world. In 2015, severe floods affected areas including the UK, eastern and southern Africa, India, and the United States. According to Swiss-Re, a reinsurance company, 2015 saw 353 disasters globally, of which 198 were natural catastrophes – the highest ever in any single year with resulting economic losses USD 92 billion in total.

The growing threat from natural disasters has led to a call for action to improve the planning of resilience measures, but many places are still unprepared in terms of flood disaster prevention. One of the few regions in the world that has taken significant steps to address the risk of flooding is the Tokyo Metropolitan Area, or Greater Tokyo.

Subsequently, a numerous of coastal cities have been affected by flood issue. The destruction of flooding is respectively destructing the cities according to the climate land subsidence, river sediment supply, sea level rise and climate conditions. Some over development eventually declined the original function of these space and the maintenance function changed to be unstainable. In this thesis, I hypothesis that a green infrastructure composited by ecosystem and natural restoration can enhance a higher return in conveying a more sustainable and conventional coastal engineering

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globally [3]

A desk-based research study was examined to analyze the existing mechanism for developed city's risk reduction and reconstruction methodology. In the next chapter, some research gaps, and future analyses suggestion which to be considered as beneficial to the affected places are highlighted.

[i]1.4 <u>Hypothesis of Study</u>

It is well known that there has been a flood issue in the Long Valley, but the flood issue has been mitigated in 2000. As the village is a propitious site, according to the interpretation of Feng Shui. Though it is not a scientific analysis. Furthermore, Long Valley had been formed and developed in intimate relationship with typhoons and floods before the modernization of civil engineering works for flood risk reduction management.

This study is aimed to evaluate residential environment characteristics in a representative riverside village, Long Valley. To verify the correlation ship between natural disaster and the flood prevention point of view so that to investigate landscape changes of the village due to model civil engineering works and landscape works, especially for flood risk reduction management. This study is based on proving the below two hypotheses.

I. First, the flooding issue lasted for a long period until the modernization exerted a strong influence in the landscape formation of the village, ecology, and topography. Land use planning, spatial hierarchy and spatial structure were changed over the decades.

Figure 15. The general river water condition

II.   Second, apparently, the flood issue has been greatly reduced after introduced the civil engineering works and landscape works regarding the typhoon and flood control. It created a safe platform for people to release from flood disasters. Nevertheless, did the landscape has been rescued owning to the application of civil engineering works.

Figure 16. The flooding situation in small vallage in HK

1.5   Subject & Methodology

Suitability rating				
Factor	weight	Unit factor	Unit factor weight	Compound weight
Transportation convenience	0.2884	-------	-------	0.2884
Waterfront	0.3507	Waterfront environment	0.3519	0.1234
		Forest atmosphere	0.3108	0.1090
environment		Air quality	0.3373	0.1183
Urban atmosphere	0.2075	-------	-------	0.2075
Topographic	0.1534	Topographic level	0.6682	0.1025
slope		Slope level	0.3318	0.0509

Figure 17. The GIS suitability rating content

Analysis methods

The research was performed using different analytical methods. Based on a study of the GIS stimulation system literature and the analysis of the Chronicle typology chart,

the research reveals various aspects of distribution in Kam Tin River and describes how the river management affects the Kam Tin River.

(1) GIS analyze each factor per the selected site location

- Use to examine of each landscape value in the corresponding area.
- As well as define its unit factor weight

(2) MCDM

By processing the combination of multi-criteria decision making (MCDM) with geographical information systems (GIS) proposed in the present research proportion between the two group: (hazard, exposure, and vulnerability), in which the social, economic, and/or environmental vulnerabilities can be assessed.
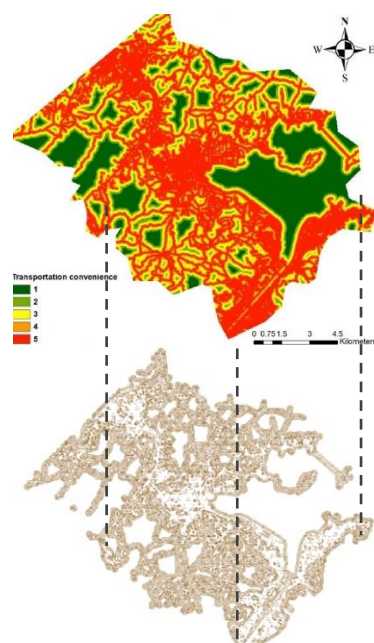
GIS stimulation method

The research performs surveys using the GIS system of stimulation. In the GIS section, this diagram shows various distribution aspects in the Kam Tin River, including Geology, Land Use, Vegetation, and Vegetation Hotspots. The research consisted of integrating the diagrams and data details to demonstrate the relationship between the distribution aspects of the Kam Tin River.

Figure 18. GIS analysis of road network in Lam Tsuen River

Chronicle topography map analysis

The results show modifications in residential pattern and population development over the last 40 years, and shows how the change in residential pattern influences farming.

Collecting and analyzing data

A) The historical transformation phase (timeline) of development of agriculture in Kam Tin Valley

-- For example, rice paddies fade out / River expansion / pre-flood measurement

Research Scope

Specialty and features of infrastructure as valuable landscape aspects	Current problems indicated in civil engineering practices
□ The presence of diversity, naturalness, coherence and additional attributes in urban agriculture landscape pattern	□ Resoled the flooding issue
□ Civil works as **main appreciation** rather than the properties and attributes.	□ Viewing landscape pattern and response (for domestic habitat and migration bird)
□ Appealing to the ordinary citizens with an existence of special interested group, habitat and environment	□ Relation with locality for area and region
□ A model analysis for the ordinary and normal objects in locality green infrastructure network	□ Efficiency on the quality and sustainability of landscape

Table 1. The specialty and feature of infrastructure as valuable landspcae aspects table

1. Content analysis with Landscape function analysis

STEP 1 Data Collection and Processing	STEP 2 Category System for content analysis	STEP 3 Category-based Representation for contents	STEP 4 Statistical data analyzing		
Table.1 Dataset overview	**Time period**	**Landscape type**	**Feature**	**Total length of review content**	**Works to be implemented**
Agriculture (existing farm)					
Site A – Lam Tsuen River	1981~2020	Farmland Wetlands	Eco River/ High ecological value-	10.8km	straightening, widening and deepening 2.6 km of the upper river
Site B – Long Valley River	1960~2020	Farmland Wetlands/ Dryland	over 300 bird species, 25 key conservation species	29.5km	Channelisation
Site C – Kam Tin River	1987~2019	Farmland. Fishponds and shrimp ponds	Forest & Shrubland/ Flood plain	11.8km	Channelisation
The new town development near the existing farm area	**Time period**	**Catchment area**	**Feature**	**Total length of review content**	**Housing development**
Site A – Lam Tsuen River	1997~2018	21km2	Drinking and irrigation water	12km	14.5 % (transport/ village and residential)
Site B – Long Valley River	1999~2018	57km2	400 more farms	32km	7.3% (recreation/ village and residential)
Site C – Kam Tin River	2001~2020	44.3km2	Water quality improved	13km	12.37% (village & residential)

Table 2. Content analysis with Landscape function analysis

2. Content analysis with Landscape function analysis - Landscape identification CVM: Contingent Valuation Method

Tab.2 Categorization system of content for landscape values - based on Landscape identification and Heterogeneity (Bieling, 2014)

Categories of Landscape values	Operational definition and description for the index	Corresponding CES constructs under Relationship	Representation sample of typical words
Forms (F)	physical, tangible and measurable aspects of objects	-	-
FN (Nature)	Physical forms of nature elements	-	River, sky, mountain, valley
FS (Structure)	Physical forms of infrastructure elements	-	Bridge, dam, river, building
Practices (P)	Activities and practices of human at place, as well as natural process	-	Walk, farming, living…
Relationships (R)	Values based on the interaction of human-landscape and human-place	-	-
Natural disaster	Natural hazard to affect landscape evolution	unpredictable	Restoration/ reconstruction
Architecture	The built architecture elements on site	Functional, user-needs	Residential, institution
Topography	Physical forms of nature elements	The natural geology	Ridge, summit, Valley, Floodplain
Farming	Activities and practices of human at place, as well as natural process	Tradition, education, culture	Wet farm, dry farm
Ecological network	Activities and practices of ecology place	cultural heritage	Aviation, marine, river ecology
Social network	Activities and practices of the neighborhood	Recreational, Education, & tourism	Tenant, new town development citizens

Table 3. Content analysis with Landscape function analysis
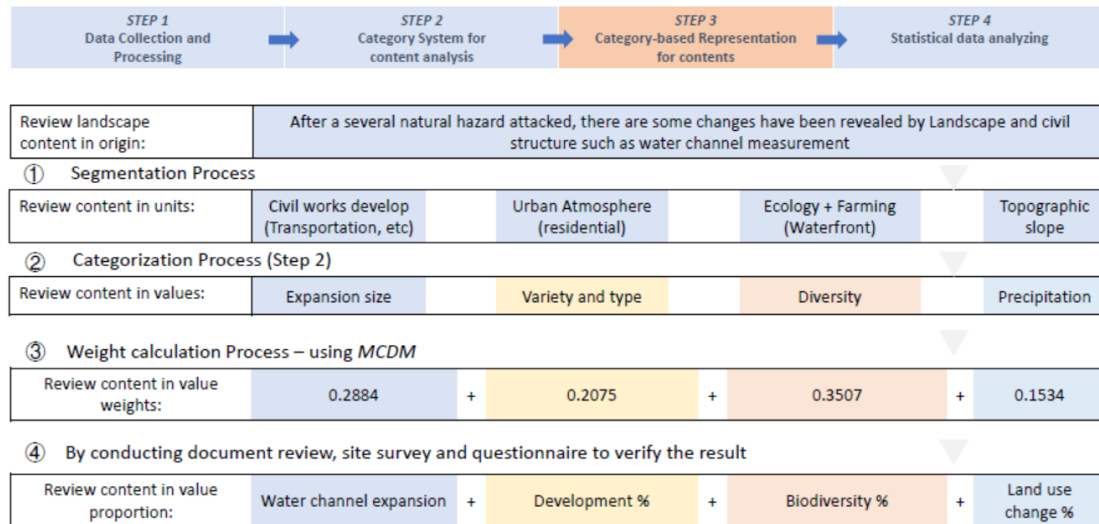
3. Content analysis with GIS modeling

STEP 1 Data Collection and Processing		STEP 2 Category System for content analysis		STEP 3 Category-based Representation for contents		STEP 4 Statistical data analyzing

Review landscape content in origin:	After a several natural hazard attacked, there are some changes have been revealed by Landscape and civil structure such as water channel measurement			
① Segmentation Process				
Review content in units:	Civil works develop (Transportation, etc)	Urban Atmosphere (residential)	Ecology + Farming (Waterfront)	Topographic slope
② Categorization Process (Step 2)				
Review content in values:	Expansion size	Variety and type	Diversity	Precipitation
③ Weight calculation Process – using *MCDM*				
Review content in value weights:	0.2884 +	0.2075 +	0.3507 +	0.1534
④ By conducting document review, site survey and questionnaire to verify the result				
Review content in value proportion:	Water channel expansion +	Development % +	Biodiversity % +	Land use change %

Table 4. Content analysis with GIS modeling

4. Overview for methodology

1. Content analysis for GIS layering reviews

| 2. Content analysis for images |
| Part II |
| Used to investigate the content and variation of landscape attributes and view-objects |
| Objects: River profile/ Ecology distribution/ Topography |

| 3. Field Survey |

| 4. Online questionnaire |

Vulnerable landscape feature (embedded landscape values)

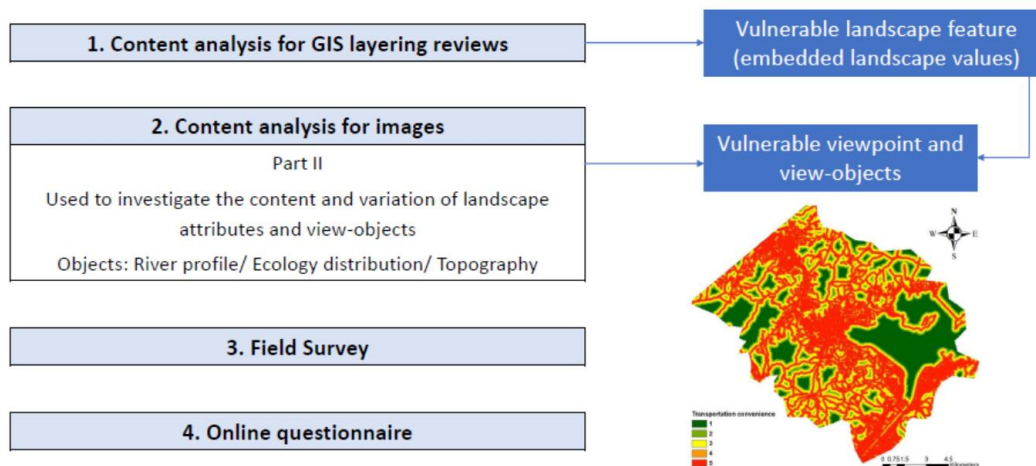Vulnerable viewpoint and view-objects

Table 5. Overview for methodology

1.6 Previous research

1.6.1   Civil works condition of River in Hong Kong

Agriculture land stand alongside river usually provides good support to different stakeholders, farmers and ecology except for the flooding impact enforced farmers to adapt to flooding place. The more sustainable approach adaptations are seeking

community stakeholders to assure the lands are more vulnerable owing to the adaptations from the upper stream.

1.6.2 Village near the Kam Tin Valley, Long Valley and Lam Tsuen Valley rivers

"An adaptation of natural hazard" is referring to a process or treatment of adapting the abnormal impacts by the natural disaster. It is common to see the terminology has been applied by journal, academic publications, and research papers. The definition of natural disaster adaption can describe as a virtue adjustment process to the happened or predicted natural hazard as well as its influences.

Without a hesitation, agriculture is received the direct climate fluctuation pattern matters from one season to the next.

1.7 Specific characteristics on the transition of the flood plain in Hong Kong over the decades

Natural landscape functions as infrastructure

This study attempts to search for the development of the Agri-infrastructure from the landscape sustainability demarcation level. The consequence of the principle of landscape land use has been well known.
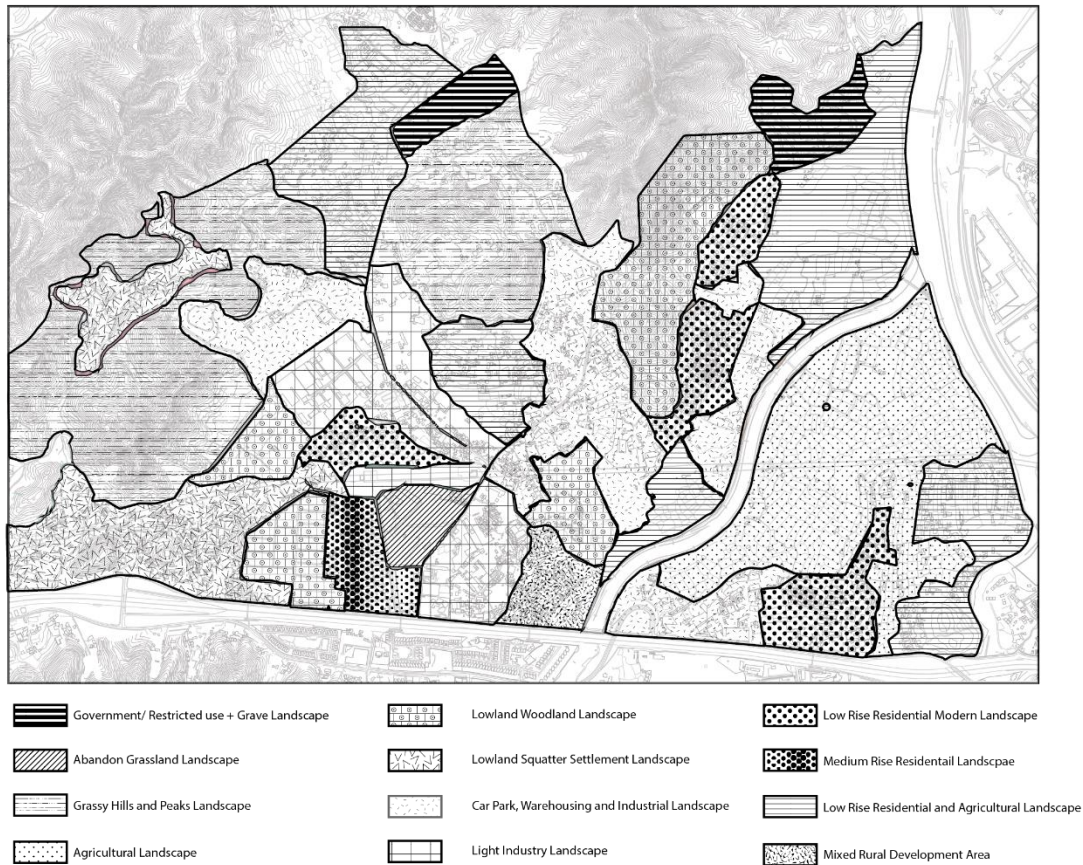
Figure 19. The landuse distribution of Long Valley, Hong Kong

Change in land use may cause some disruption to various factors, pristine wilderness,

ecology, or Agri-biodiversity, etc. Apart from developing a manifested ecosystem to

enrich the biodiversity of wildlife, agriculture also acts as an infrastructure for

minimizing the effects of natural hazards. Natural landscape Agriculture worked as a

protected infrastructure for the landscape to soften the impacts created by natural

hazards. Particularly, the awareness on the conservation of "protected landscape."

Which is has been raised by European and international world heritage conservation.

This thesis discussed how are qualified and identified the essential elements of the

protective landscape.
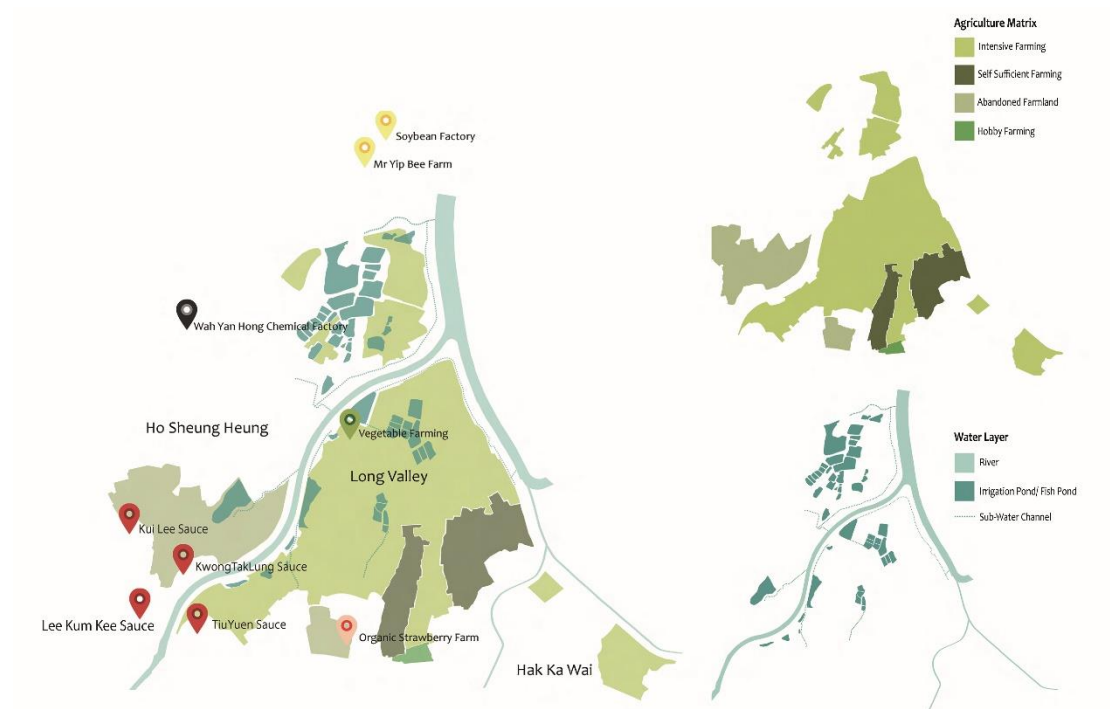
Figure 20. Diagram showing agriculture type and water layers

"Wilderness," "Primitive areas," and "in a state of nature" are reasons that European

people find conditional thought by control. Culture includes "animal" and "plant" and

something that is not produced by civilized creation, and that is not for humanity.

Rather than committing to an exploitative approach, the early conservation

practitioner strongly supports a protectionist approach. There are examples given in

1872 in Yellowstone, Wyoming, USA national park. The position of Yellowstone

National Park is a vivid sample of transformation into a preserved landscape scenery

due to the low portion of park usage, and local communities have been removed from

the site entirely. Under the intruder's arsenal and pushed out by the army, Yellowstone

was a clear example of how to turn an active park into a conservation park. Up to the

20th century, it seemed that people were tilting and shifting the prevalent perception

of understanding nature. Nature identification depends on how the mother nature

system is being composed and how the vulnerability of nature is related to human

intervention. No doubt, humans is the leading environmental threat to nature and its

neighboring network (ecology, agriculture, and vegetation).

Nature versus humankind, agriculture, Civil work, and stereotype culture

A dynamic relationship between people's presence, fishing, civil work, and the

richness of landscape culture, it is not only an effect generated by humans, but it is

also a trigger driven by economic development and the uncomprehensive method of

reacting to population growth. To sum up the above, four claims reassess the

relationship between nature and human beings.

- The cultural landscape reveals the sustainable system and land use

- In some consequence, civilization work disturbance can be beneficial to

  natural habitats and their surrounding environment.

- The 'mythical pristine environment exists only in imagination' (Pimbert and

  Pretty, 1995, P.6)

- 'In the agriculture landscape, it is mainly the people who create and manage

  biological diversity' (Haverkort and Millar, 1994, P.5)

Chapter 1: Introduction

In Long Valley, it holds the highest ecological value and spectacular distribution of biodiversity, wetland, marshland, wetlands, topographical uniqueness, and Hong Kong heritage of the Fengshui culture. These are the products of the evolution of the land after several centuries of combining civilization, culture, and civil works and agricultural practice. The manifest relationship between ecology and land use management is the representative estimate associated with Hong Kong's cultural landscape and "Agri-infrastructure."

There is nothing genuinely natural left on earth: even the 'pristine' environments of the polar regions are affected by the action of humankind. (McKibben, 1990, P.60). An example is given, ecological value and the habitats species richness can be enhanced by the native desert agriculture in North America, sometimes it is more significant than in adjacent or analogous habitats that are not being cultivated, quoted by Reichardt et al., 1994. Looking at Asia's side, a typical low-intensity crop shift forms in many Asian countries; it can incur herbivores, wild boars, wild cattle, and deer. As a result, it often encourages predators to begin searching for their food. Some agriculture sector advocates people to cultivate a more considerable amount of fruit tree and vegetation, and it attracts numerous graminivorous and fruit predators, including monkeys, squirrels, fruit bat to the specified sites. (Pimbert and Pretty, 1995, P.26)

Rice paddies agriculture and ecological value

It is essential to refer to the current case studies to run better sustainable landscape management. It is one of the results measured throughout many hundreds of years in some traditional landscape patterns and based on sustainable methods.

Either domesticated crops or animals, the conventional agriculture system confers the abundance of ecological values and species diversity. The cultivation of agriculture has been driven by humanity through the centuries. No matter how many numbers of lowland, valley, or mountain hillside for rice crop fields or agriculture estate. Most of these conventional methods of farming are replaced by high-bred crop cultivars that conceal chemical input and cause monoculture cultivation problems.

The long valley has had an abundance of farmland for rice terrace ecosystems in the past. Feng shui 's proposal tightly bound up farmers, animals, land, and the environment to agriculture. There is no question that the incredibly beautiful landscape was bonded with the deep cultural heritage of Fengshui, and annual farmland cycled by lifelong Valley rice paddies have a history of over 100 years. Low flat ground, where water volume was obtained directly at a high level. A unique ecological environment has been developed, induced by a warm, unstable climate, land patterns in agriculture, and civil works.

 It exemplifies that a harmonious dialogue of humanity, civil works, and nature can

evolve the significant aesthetic and distinct characteristics. A safe way of handling is

the secret to ensuring the landscape 's continued connotation.

1.8. International case studies

Figure 21. International case studies

All the International cases are intended to create the ecosystem by the so-called

"Green Infrastructure" purpose but the results are still yet to be confirmed. The case

studies included Chao Phraya River (South), (Bangkok Thailand), Marikina River

(Manila Philippine), Pingshui River in Dongyuan (Jiang Xi, China, Ciliwung River

(Jakarta, Indonesia). For Hong Kong, it is unintentionally to create ecological network

and restoration, all the ecosystem and landscape pattern changed due to

the natural evolution of the landscape itself.

Chapter 2:

Positioning - The overall review of flooding area in Hong Kong

Chapter 2: Positioning – The overall review of flooding review of Hong Kong

2.1 Problem statement

The main character of the research is management at Lam Tsuen, Long Valley and Kam Tin River. The following parts of the study deal with the following questions

1) How does river management alter three River's drainage network for flood problem and surround fabric settlement

2) How it works in alleviating the flooding problems for the three River agriculture trend

3) How the river's effects impact the three river's ecological settings

Approach

This research was performed using various analytical methods to evaluate surveys by the authorities, data analysis to perform surveys using the GIS stimulation process, and the following diagrams display various facets of distribution well into the Lam Tsuen River, along with geology, land use and ecosystem. All such diagrams contain information that evaluates their relationship and how the distribution in Tai Po impacts the Lam Tsuen River.

Research limitations

Throughout the study, the targeted area will be Tai Po. The review will proceed step

by step in either the discovery of delivery and formation from the Hong Kong Review

to the Tai Po and Lam Tsuen Rivers.
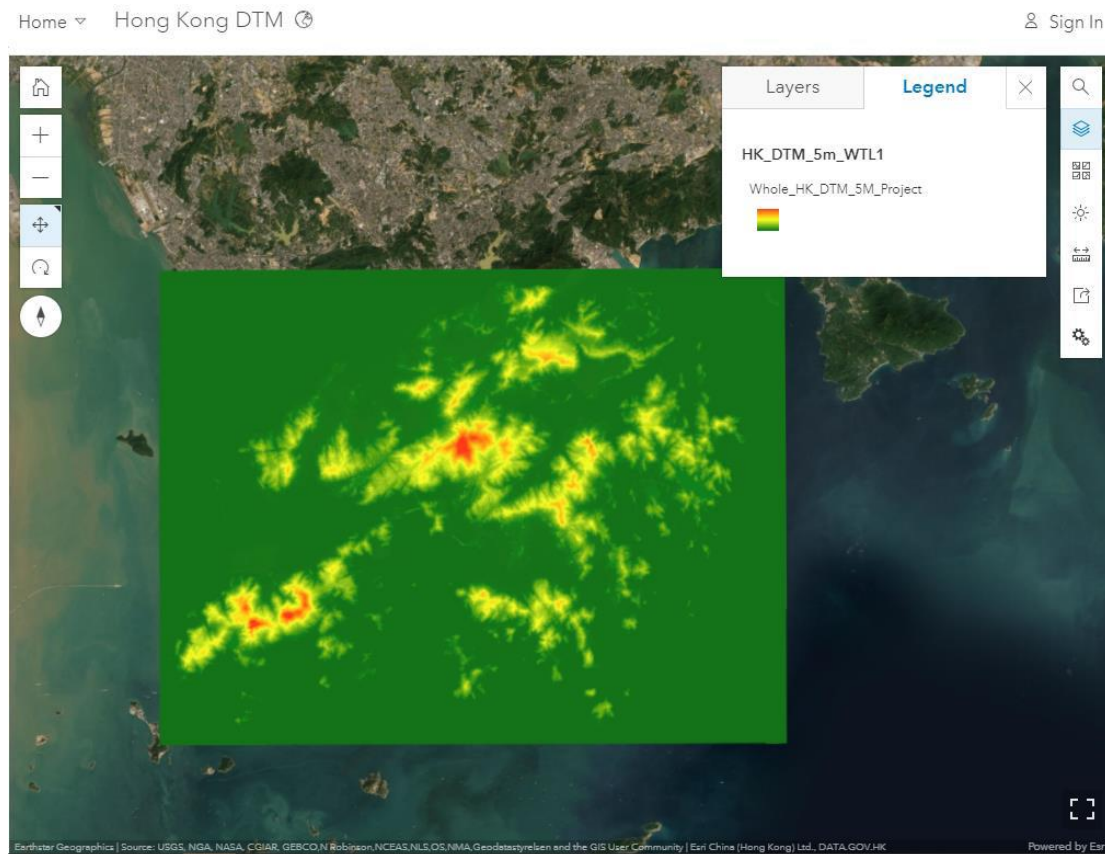
Figure 22. DTM model image from Esri (HK)

Sample size

The number of urban agriculture is diversely in a high-dense urban city, sub-urban

city. Some farms number and record cannot be reached via farm registry under

government.

Lack of digital model information

DTM (Demographic Transition Model) is available up to 2013. The model

stimulation without actual DTM of the 1980s Hong Kong.

Results

The result demonstrates that the hypothesis is legitimate. Possible effective measures and achievable methods can be made to protect the landscape and strengthen the conservation for the Lam Tsuen River. Strategy management in 2012 consistently shows mitigated destruction from natural hazards and realistic design and sustainable approaches are essential to reduce pollution and maximize the resilience of the Lam Tsuen River.

Conclusions

The strategic management for the Lam Tsuen River since 2012 is a long-term success of sustainable development that can be stretched to the climate and biodiversity. The research shows strategic management in 2012 that mitigated damage from natural hazards and viable design and sustainable strategies become conceivable to restore the environment and strengthen the stability of the Lam Tsuen River. There is the possibility of genuine 'restoration' from major anthropogenic changes that can benefit more than the mere 'prior to disruption' recovery of conditions.

2.2. Purpose of this chapter

This study targets to examine the efficiency of the strategy planning and management method of Lam Tsuen River in 2012. Regardless the advantages of sustainable idea in urban planning where beneficial to the surrounding environment, natural habitats, and the overall condition.

This study would prove the strategy management in 2012 for this reason that mitigated harm from natural hazards and realistic design and feasible solutions are possible to conserve the environment and improve sustainability of the Lam Tsuen River. Then, the selected portion of this analysis convinces the true 'restoration' probability. Afterward, the selected portion of this analysis convinces the true 'restoration' probability. The major anthropogenic transformations will contribute more than the just 'before disturbance' restoration of conditions.

2.3. The Selected case studies in relating to agriculture improvement review

The objective of the overall analysis focusing on Lam Tsuen River is to prove that the management in 2012 restored the ecosystem of Lam Tsuen River, which has been marked as Area with Site of Special Scientific Interest (SSSI) in the year 1979. This thesis aims to discover the Lam Tsuen River strategy management in 2012 for the benefit of sustainable development that can be applied to the environment and the ecosystem. This study would prove the strategic management in 2012 for this reason that mitigated harm from natural hazards and realistic design and feasible solutions are possible to preserve the environment and improve the sustainability of the Lam Tsuen River. Then, the selected part of this study convinces the real ' restoration ' possibility. The major anthropogenic changes will contribute more than the just ' before disturbance ' restoration of conditions.

This research hypothesizes that damage mitigation has resulted, and climate change hazards were also caused by the Lam Tsuen River management in 2012 to improve biodiversity protection.
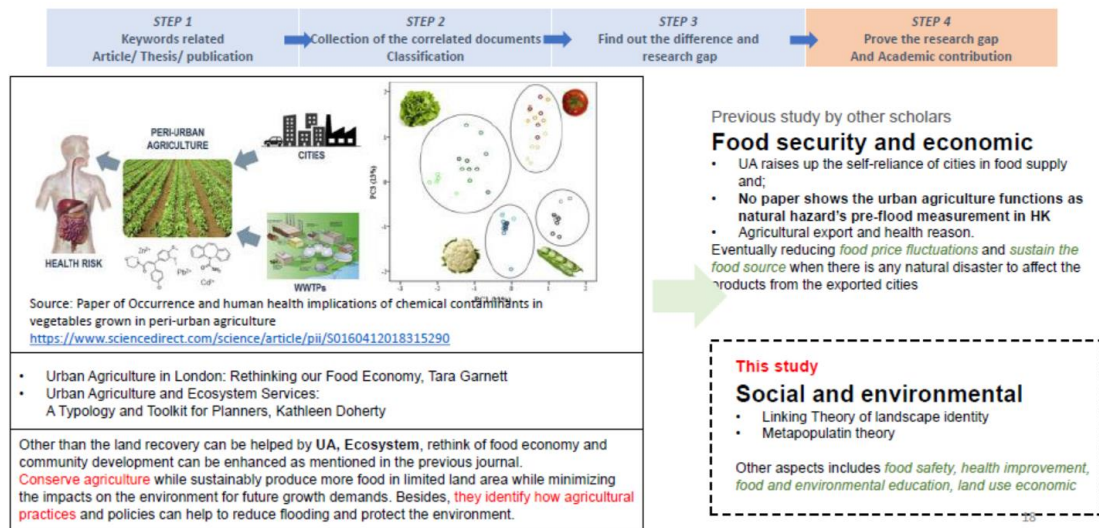
Figure 23. The prove of research gap

Research gap

Although many studies have addressed that several authors have pointed out that true 'restoration' is rarely feasible (Bernhardt, Palmer 2007) and for most cases have proposed alternate meanings, such as preserving or enhancing water quality (Downs, Gregory 2014)(Bernhardt, Palmer 2005)(Dong, Sun 2007). Early river restoration principles appeared to emphasize pre-disturbance restoration, This analysis focuses on possible steps at Lam Tsuen River with concrete design and feasible solutions that can be developed to conserve the environment and enhance the conservation of Lam Tsuen River with specific 'rebuild.'

Step 1	Detecting the floodprone area (From overall HK map)
Step 2	Classification of the flood area characteristic (Narrow down the study area)
Step 3	Select the type of flood area – Valley and proceed the analysis
Step 4	Analyses the type of Valley, Similarity and dissimilarity
Step 5	Analyze the landuse changes after facing natural disaster
Step 6	Analyze the result of agricultural land after experiencing natural disaster (Land use/ ecology/ landscape Value)
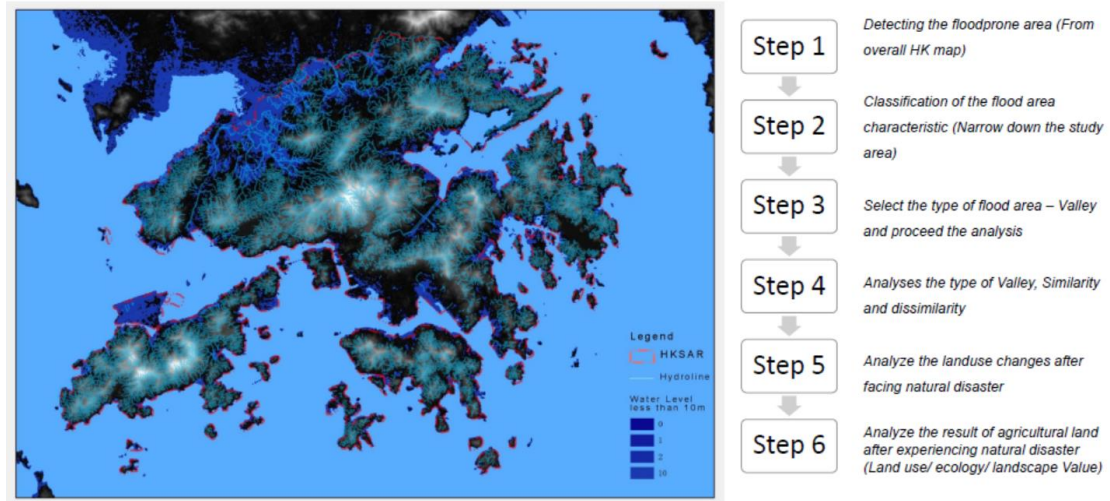
Figure 24. General flooding stimulation of Hong Kong
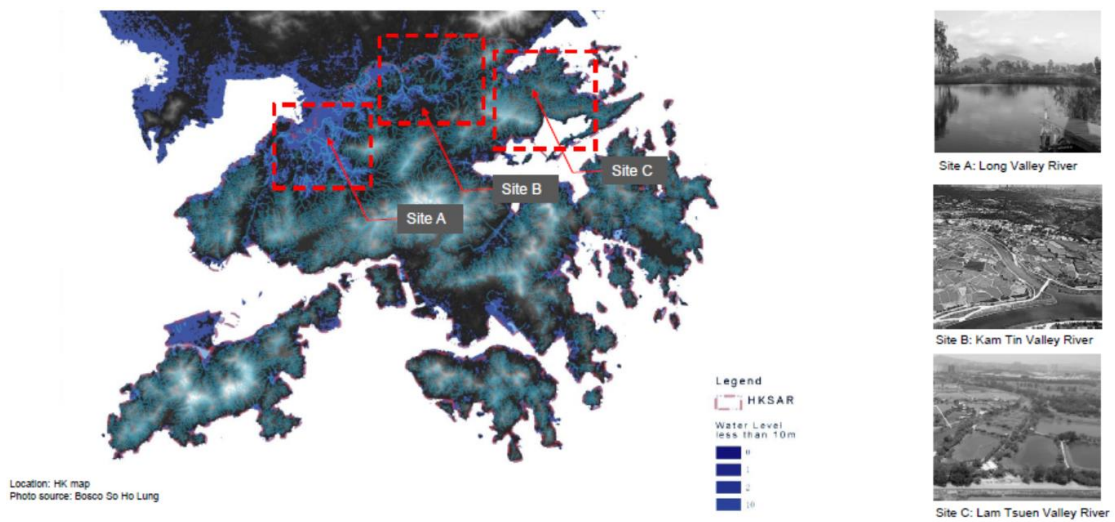
Figure 25. General fooding of Hong Kong and the selection of three case studies
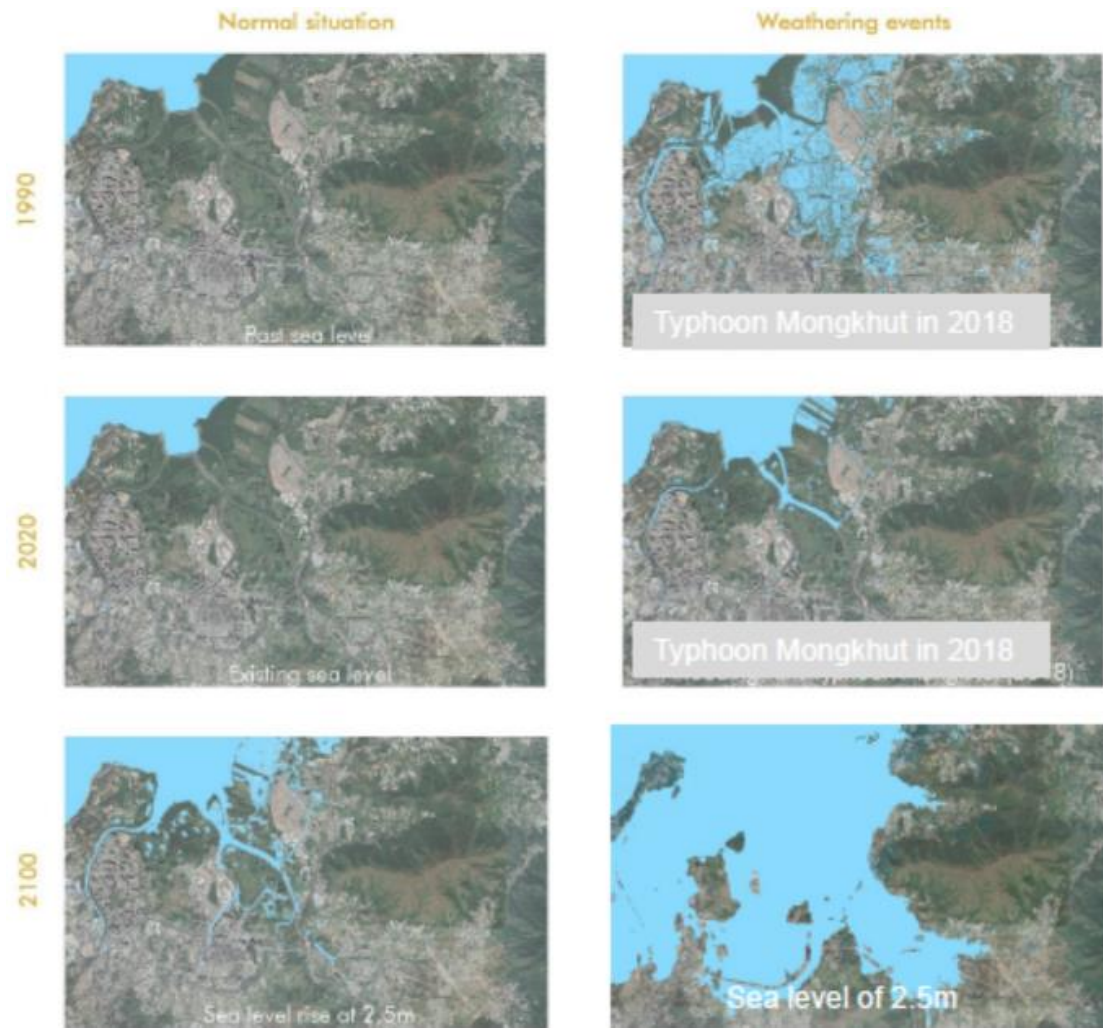
Figure 26. Typhoon flooding simulation – GIS analysis

Synthesis

Infrastructure importance & Climate change trend - past river study and future flooding prediction of sea-level rise in different cases

Importance of infrastructure

At the past, the rainstorm flooded most of the farmland and took several lives.

Nowadays, the river works greatly improve the flooding issue. Most of the excessive water will go to the canal.

Prediction of future scenario

Given that the actual flooding scenario is unpredictable in future, the above image will indicate the situation of flooding in 10 meters to showcase the consequences at different water level.

2.4 The formation development of Lam Tsuen Valley, Long Valley and Kam Ting Valley River and the history

Figure 27. Overview of Long Valley from PlanD, Hong Kong
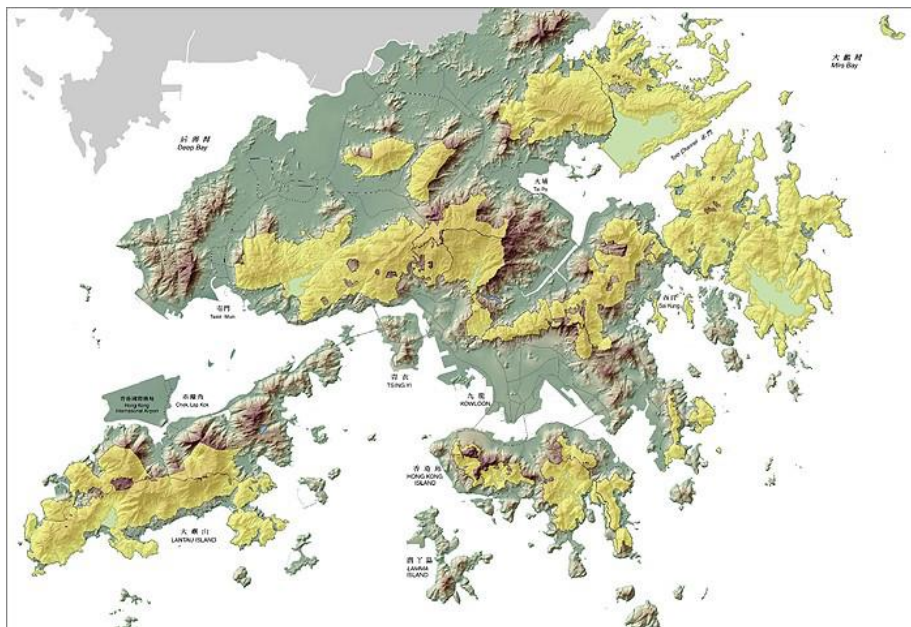
Figure 28. 40% of land belong to designated country park, image source PlanD, HK

Located on the northern side of HKSAR's urban fringe, Long Valley is the highest,

contiguous, low-lying agricultural wetland remaining in HKSAR. It is Hong Kong's

largest agricultural freshwater wetland and is about 50 hectares in area. Long Valley

was linked to over 400 small farmlands. While before assessing Long Valley 's

chronic transformation, a premature knowledge of Long alley's traditional farming

practice and its landscape evolution recorded in history will be provided. Knowing

this is one of the main factors. In this chapter, it briefly describes the history of the

Long Valley and its related communities, culture, and urban growth. In Hong Kong,

the total land area is approximately 1,105,62 square kilometers. Within the Country

Parks Ordinance, country parks pay for 40 per cent of the land area. It also covers

most wild upland regions, a vast stretch of scenic coastline, and provides excessive

segments for the outlying islands.

Figure 29. Historical photo of Long Valley and ex-Lo Wu colonial military camp in 1910s (Source：鄭寶鴻《新界街道百年》)

Indigenous settlement in Long Valley

Until the 1898s the word "New Territories" was introduced to China again. In the southern part of China, such as Panyu, Poklo, Bao'an inhabitants who have been competing for space and water resources among clans in previous years. During the past, the Long Valley farming region was divided into other indigenous settlements and had an influence on their history, village ecosystems.

Figure 30. Photo of Sheung Yu River, Long Valley HK

Abandonment of paddy farmlands

One of the essential agricultural categories was paddy rice harvesting. The portion of agricultural land including rice field in Hong Kong was over 70%, which contained around 9,500 hectares after WWII. The size of agriculture land - rice field industry had greatly deducted lesser than 10 hectares in 1986. For the rice cultivation, it only remained less than 1 hectares of farmland. Paddy-rice harvesting was one of the main agricultural categories. The share of agricultural land in Hong Kong, including rice field, was over 70 percent, which after WWII comprised around 9,500 hectares. In 1986, the size of agricultural land - rice field industry had deducted significantly less than 10 hectares. This only remained less than 1 hectare of farmland for the rice cultivation.

Mr. Lau considered the new urban development policy to be the crucial initiative to motivate the transformation of agriculture to other industries as well as the influx of qualified farmers from mainland China during the 1950-60s. It was made of squatters and several villages in Long Valley, they are the squatter district of Tin Kwong Po, village of Ho Sheung, village of Yin Kong, village of Kam Tin and village

of Tsong Pak Long.
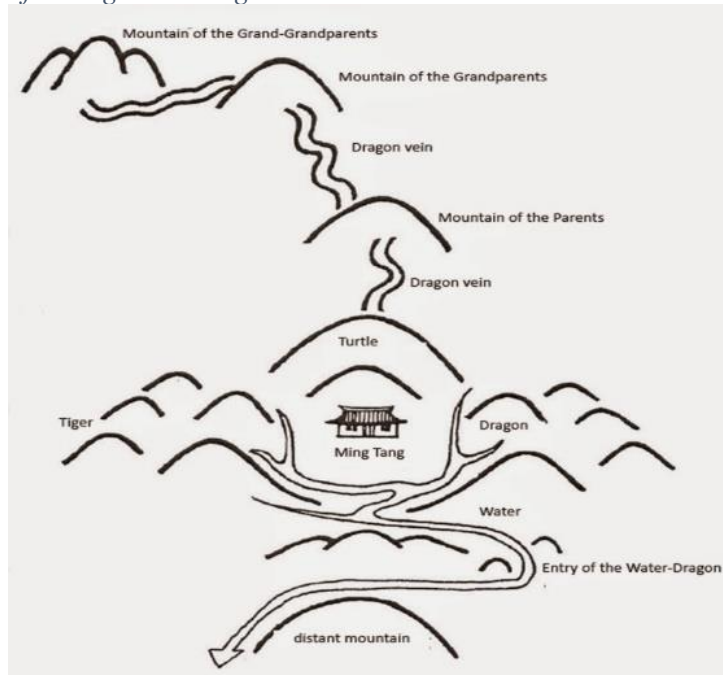
Figure 31. The principle of Fungshui, Diagram from online resource

For a long decade, fungshui has been stamped into traditional Chinese and urban development. From the village setting and analysis, we can trace that to create these places, the village set up, environment, agricultural areas, graves, or even dwelling planning (knapp, 1992), the ancestors fellow Fungshui principle. The theory of fungshui was commonly applied in Long Valley.

River represented water elements

In Fungshui theory, if water situates in front of the house, it would be the best arrangement. Tin to allow the villagers to receive the "Qi" force, it is the most ideal place if water is placed in front of the villages. Mountain, wind, and forest are the 3 main elements in the traditional Chinese culture. Mountain position is always at the back of the village, water elements can be found in river or stream and woodland as a barrier and natural partition to coexist with nature and villagers to live together. Ho

Sheung Village is the most typical village which follows Fungshui. It retains Ah Ying Mountain and the back side of the Fungshui forest road, as well as the winding Sheung Yue River where it flows through Long Valley fields in front of the village. As a consequence, the agricultural resource was composed of low-lying, flat, fertile land with ready water supply.

For some reason, the village setting has been greatly influenced by the civilization work in Sheung Yue river during the year of 2000

.
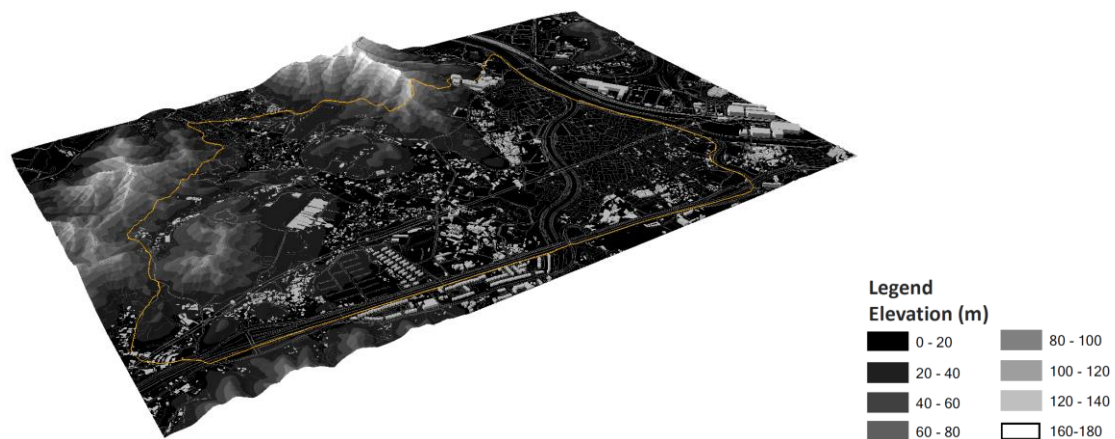
Figure 32.Topographical analysis of Long Valley, Hong Kong

Except for the changes to the Sheung Yue river, the modern civilization built by the Hong Kong government in the 1990s has altered other crucial components of the villages. For example, several fishponds adjacent to the village of Long Valley were in fact transforming the existing open storage spaces. Ho Sheung Heung (almost) area was invaded because of the village's aggressive development. Fly-tipping has also had a significant impact on the village of Ho Sheung Heung.
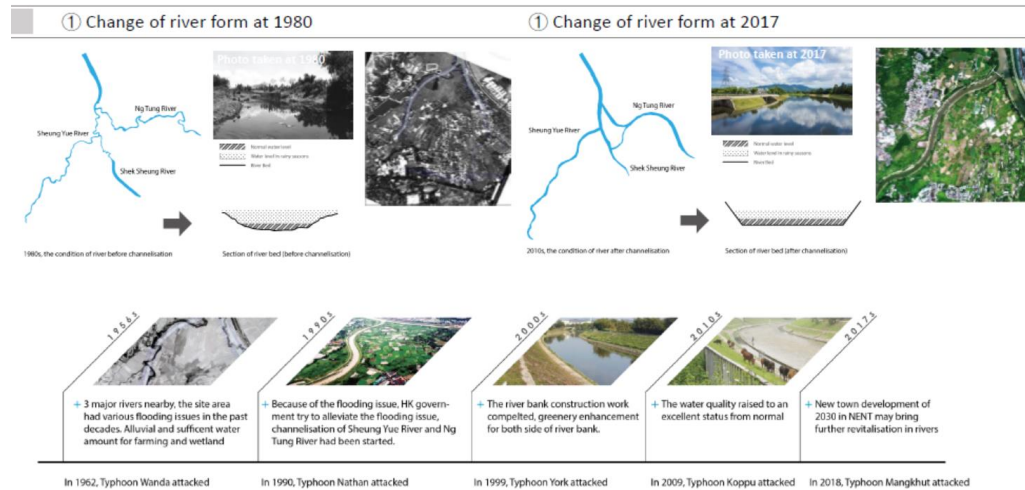
Figure 33. River works development in Long Valley, Hong Kong

Building waste and leveled filled the area with fishponds, natural wetlands and most farmlands according to Long Valley 's history. In such event more than 300,000 square feet of the agricultural area were inflected and registered. In 2010 an illegal barbecue site named "Long Valley Farm" was built on the fly-tipping site to entertain village demand. Planning Department demanded the re-establishment order of the fly-tipped site but there was still no restatement intervention by the appropriate authority somehow.

2.4 Historical Transition process of agriculture development in Long Valley; Kam Tin Valley and Lam Tsuen Valley

Refer to the Kwu Tung New Construction Area, it is known that in Long Valley there are several farmlands that will eventually be converted to residential development. The size of wetland, marsh land, and fish pons will then decline for the time being. Other than that, it is proposed to merg the urban lifestyle into a country area that has

evolved into a new town. It can result from growing high-value crops for the productivity of agricultures. Owing to land-use transition, the portion of the wetlands can be reduced. Long Valley is currently considered a refresh water wetland, the man in the long run alter its importance. Based on the current scheme the New Planning Area does not deeply consider the impact of urban growth for the future. Certain changes in civilization, such as switching from untreated effluent channels to stormwater drainage work, will certainly affect Long Valley 's natural ecology, aquatic habitats.

Figure 34. The photo of Long Valley village, Hong Kong

This chapter will describe the water network, ecological importance, and so on, of the Long Valley. A good use of the water supply would be some good case studies.

The following map showing the water network and ecology of Long Valley
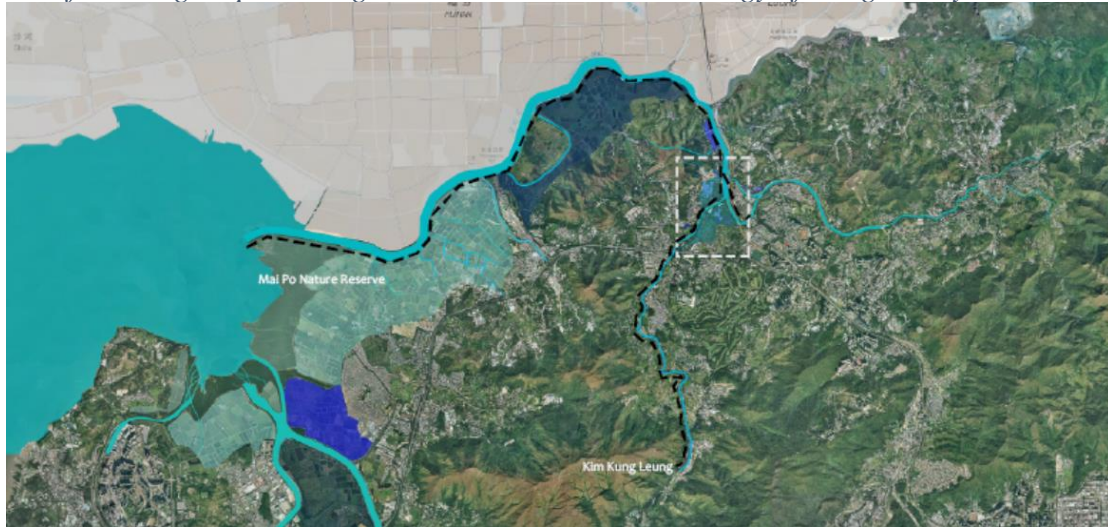
Figure 35. water network and ecology of Long Valley

It is well known that the captioned study area – Long Valley functions as a flood plain. Situated between Sheung Yue River and Shek Sheung River.

It begins from Kim Kung Leung and across Kwu Tung which is adjacent to Shek Sheung River, for Sheung Yue River. The river goes across the river Shenzhun and the river end stopped at Mai Po. One of the popular Mai Po nature reserve recourses. Because Long Valley is the only refreshing water wetland in Hong Kong 's Northwest New Territories.

According to the characteristics of the river, there are many forms of channels in Long Valley that were found. First river type is still overflowing with water, second river type is in dry condition unless there is heavy rain to induce dredging of the water.

Figure 36. Type 1 – River with civil engineering treatment

Figure 37. Type 2 – River with landscape treatment

Figure 38. Type 3 – Rivert with vegetation

Is used as a green patch buffer between Hong Kong and Shezhen. Mai Po is surrounded by Long Valley and is protected from urban development. Long Valley has benefited from diverse types of ecosystems. Except for habitats, the Long Valley also strikes a balance for rice paddies, wetland, marshland, fishponds, and outlet water for irrigation, and so on.

A considerable number of species of migratory birds were recorded
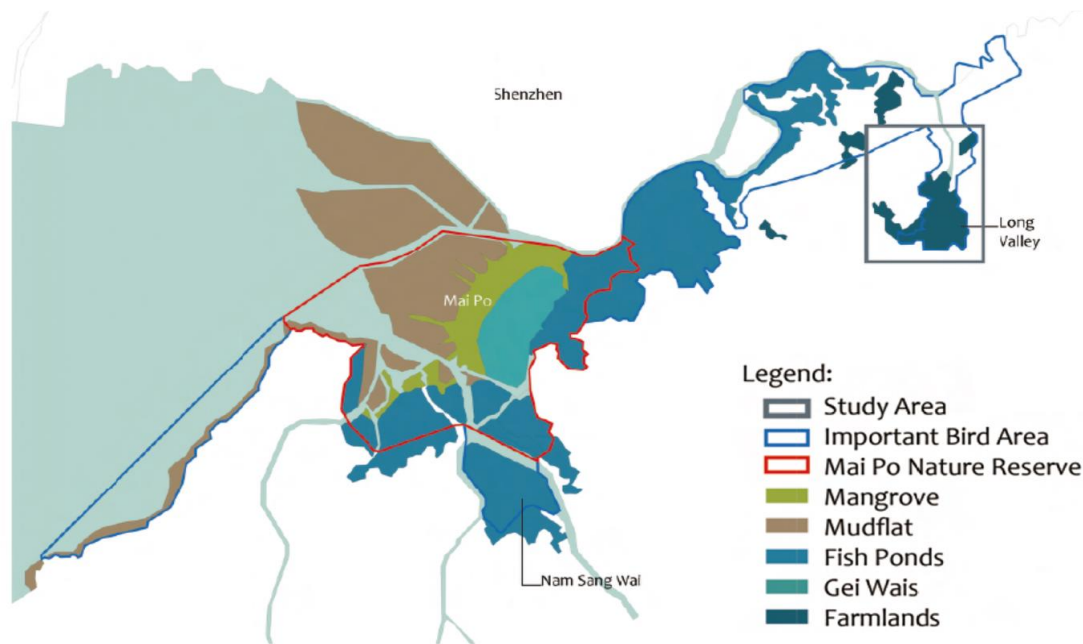
Figure 39. Study area and its land use

Project Title	Start Date	Compl. Date	Brief Description	Location of Significant Improvements and Benefits
North West New Territories development -main drainage channels for Yuen Long and Kam Tin,stage 1 phase 1	10/1993	03/1999		
North West New Territories development -main drainage channels for Yuen Long and Kam Tin,stage 1 phase 2	10/1995	12/1998		
Main drainage channels for Yuen Long and Kam Tin stage 2 –Kam Tin Road to Tai Kek section	07/1999	03/2002	Construction of drainage channel from Kam Tin Road to Tai Kek	Kat Hing Wai, Tai Hong Tsuen, Shek Wu Tong, Tin Sam Tsuen, Tai Kek
Village flood protection for Yuen Long, Kam Tin and Ngau Tam Mei,	12/2001	12/2004	Construction of floodwater pumping staton in Wang Chau; and construction of Pok Wai drainage	Wang Chau and Pok Wai
Main drainage channel for Yuen Long and Kam Tin – Shan Ha Tsuen to Lam Hau Tsuen section	09/2003	03/2006	Construction of drainage channel in Lung Tin Tsuen	Lung Tin Tsuen, Lam Hau Tsuen

Figure 40. Table of Typhoon in the Past Hong Kong (Part 1)

Main drainage channels for Yuen Long and Kam Tin stage 2 – Kam Tin San Tsuen to Wang Toi Shan section	08/1999	03/2004	Construction of drainage channel from Kam Tin San Tsuen to Wan Toi Shan	Kam Tin San Tsuen, Wing Lung Wai, Kiu Tau Tsuen, Pang Ka Tsuen, Shek Kong San Tsuen, Wang Toi Shan
Main drainage channels for Yuen Long and Kam Tin, stage 2 – remainder	05/2001	07/2003	Construction of drainage channels near Ng Ka Tsuen and Shek Tau Wai	Tsz Tong Tsuen, Ng Ka Tsuen, Kam Tsin Wai, Nam Hing Lei, Chung Sum Tsuen, Pak Pin Tsuen, Uk Tau Tsuen, To Uk Tsuen, Shek Tau Wai, Tsz Tong Tsuen
Yuen Long, Kam Tin, Ngau Tam Mei and Tin Shui Wai drainage improvements, stage 1, phase 2A – Kam Tin and Ngau Tam Mei	06/2004	06/2007	Construction of secondary drainage channels in Kam Tin and Ngau Tam Mei	Cheung Kong, Tai Kong Po, Tsat Sing Kong, Ha Che, San Wai Tsuen
Yuen Long, Kam Tin, Ngau Tam Mei and Tin Shui Wai drainage improvement, stage 1, phase 2B – remaining works	12/2007	02/2011	Construction of secondary drainage channels in Kam Tin	Yuen Kong San Tsuen, Cheung Po, Ma On Kong

Figure 41. Table of Typhoon in the Past Hong Kong (Part 2)

2.5 The key to incubating agriculture which beneficial to environment and human activity

Beneficial to environment and human activity
In Hong Kong, Floodplain farm fields in Long Valley provide a novel rearing ecology. When floodwaters inundate, floodplain produces other key elements for different habitat types such as mamma fauna and birds. Some river valleys have been extensively flattened and floodplain wetlands drained in Long Valley due to floodwater management and the development of agriculture. A crucial question comes up, how do we find a viable way to maintain this valley so that it can be beneficial to current ecologies and retain the agricultural land 's historical footprint. The farmlands are located alongside the rivers that also sustain local communities and the natural environment. This directly pressures farmers to adjust to the flooding in the villages due to climate change and floodwater inundation. Local communities must ensure that the more vulnerable impacts to the farmland are not generated due to the upstream adaptations. Humanity and natural habitats can be found living together in a coherent way unlike other urban farmlands in Hong Kong.

Wide variety of habitats live with humankind

Figure 42. Farm in Long Valley, Hong Kong

Long Valley cater for a wide range of habitats to love here. To provide the food and shelters, Long Valley has become the most diverse and valuable natural environment inside the urban setting.

Figure 43. Long Valley boasts shrublands and grasslands.

It incubates other habitats as it provides the ecosystems for adaptation with a high ecological value and climate. Wildlife species can be found here in the river and wetlands, including rodents, bats, insets, reptiles, amphibians, and other aquatic wildlife.
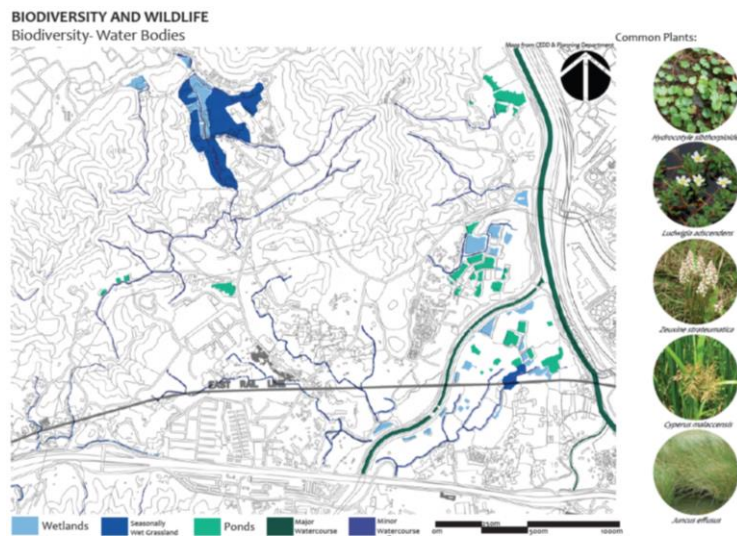
Figure 44. Biodiversity distribution map in Long Valley, Hong Kong
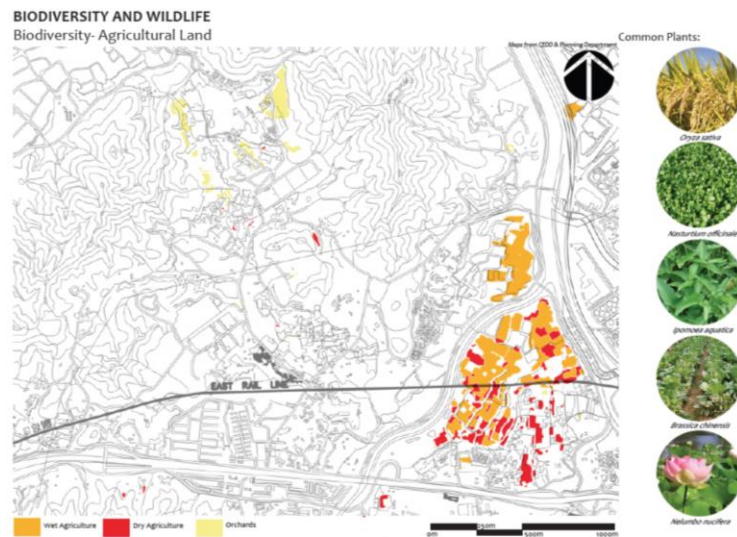
Figure 45. Biodiversity distribution map in Long Valley, Hong Kong

Water cress is the most productive species in wet farmland in wintertime; and in summertime water spinach is the species that is the most common species to be found there. There are many keys for us to conserve Long Valley including preserving the farming landscape and preserving the diverse biodiversity of the ecosystem, particularly for those wetland-adapted avifauna and amphibians. To maintain the local

farming industry and avoid degradation of the ecosystem. Educating consciousness

among the public becomes one of the important points.

2.6 Historical Transition process of agriculture development of Lam Tsuen Valley, Long Valley and Kam Ting Valley River in Hong Kong
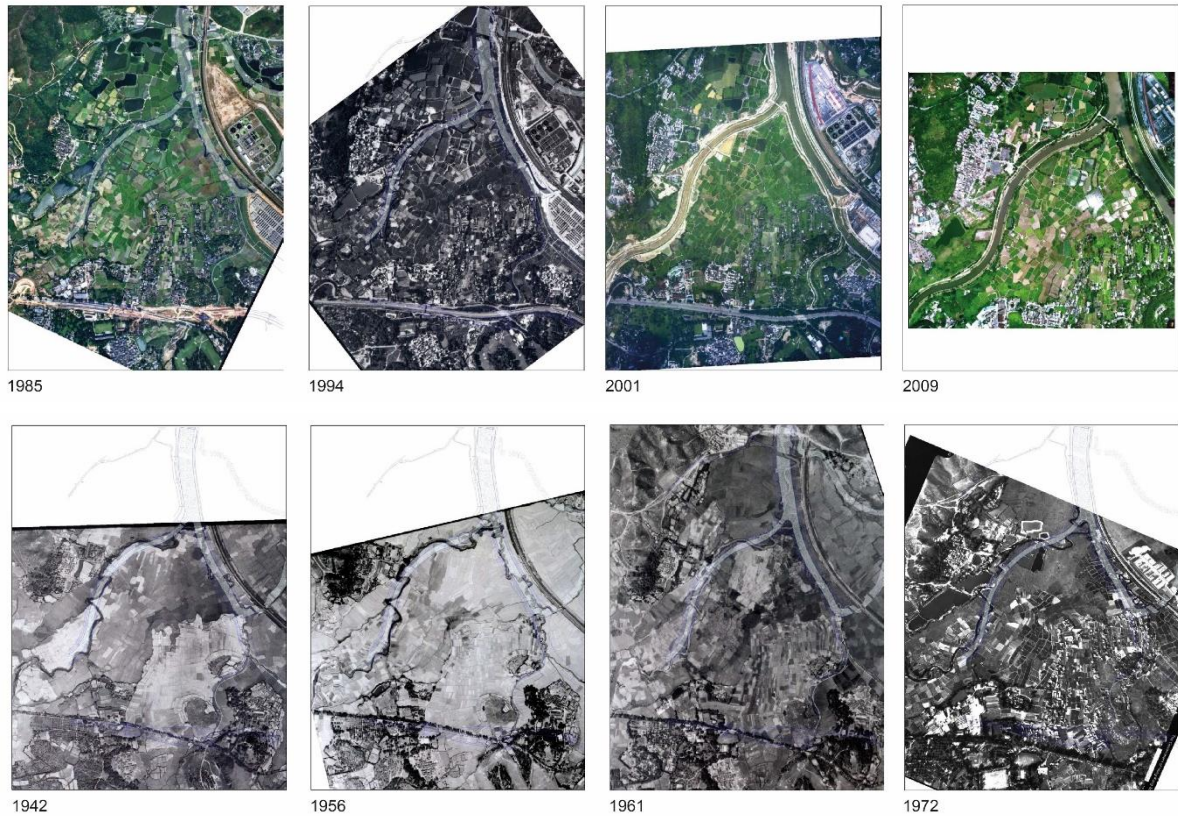
Figure 46. History of aerial photographs of Long Valley

(Source: Survey & Mapping Office, Lands Department, The Government of HKSAR)

Kwu Tung North New Growth Area is situated in the North New Territories next to the west of Fanling and Sheung Shui New Town, and east of San Tin. The field of study is surrounded by the closed frontier border at the North East. The topography of Long Valley is formed mainly by the faults of the San Tin Thrust. Whereas it contributes to the high topographical (i.e. moderate to low relief) region on the south-east north-west and low-lying (i.e. extensive flood plain).

In the northern part of KTN NDA, there are large variety of striking hills, including Tai Shek Mo and Fung Kong Shan in the north, Tit Hang and Pak Shek Au in the northwest and Ki Lun Shan in the northwest. In addition, there are numerous smaller valleys in the northwest and southeast orientation subdivided from the high ground. Meanwhile, on the low-lying land of the southern portion of KTN NDA, for example Long Valley and some village-built area, there are many extensive floodplains.

Chapter 3:

Reinvestigating civil engineering adaption for resilient city – Case studies

Chapter 3: Reinvestigating civil engineering adaption for resilient city – case studies

3.1 Abstract

The constant flooding problem has affected agricultural development on one of Hong Kong's most important agricultural areas, the Kam Tin district, over the last decades. Previous research has shown that the damage caused by countless typhoons caused the flocking, and river management at Kam Tin, Long Valey and Lam Tsuen Valley River is generally effective in reducing the flooding problem

The purpose of this current study will help decide how the past natural hazard has affected local developments like grey and green infrastructure and policy in Kam Tin, Long Valey, and Lam Tsuen Valley River.

In this context, green infrastructure is characterized as the degree to which ecosystems are preserved and enhanced, and at least 15 percent of degraded ecosystems are restored (European Union, 2014).

3.1.1 Overall Review of Kam Tin River, Long Valley and Lam Tsuen River

Mapping

Fig (2a) Mapping of land use distribution   Fig (2b) Distribution data
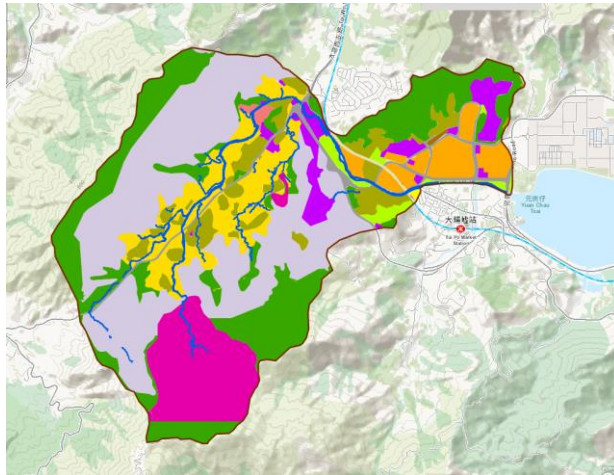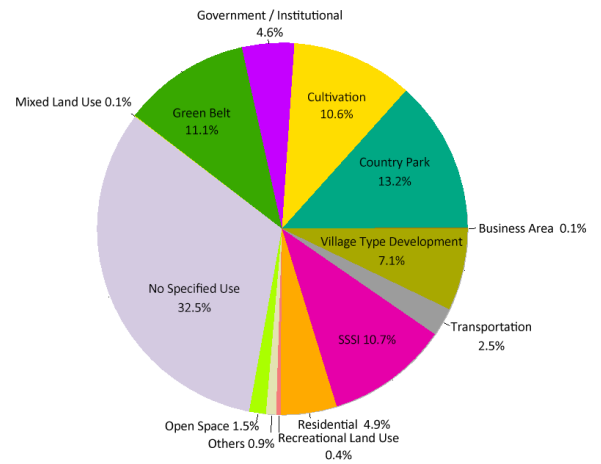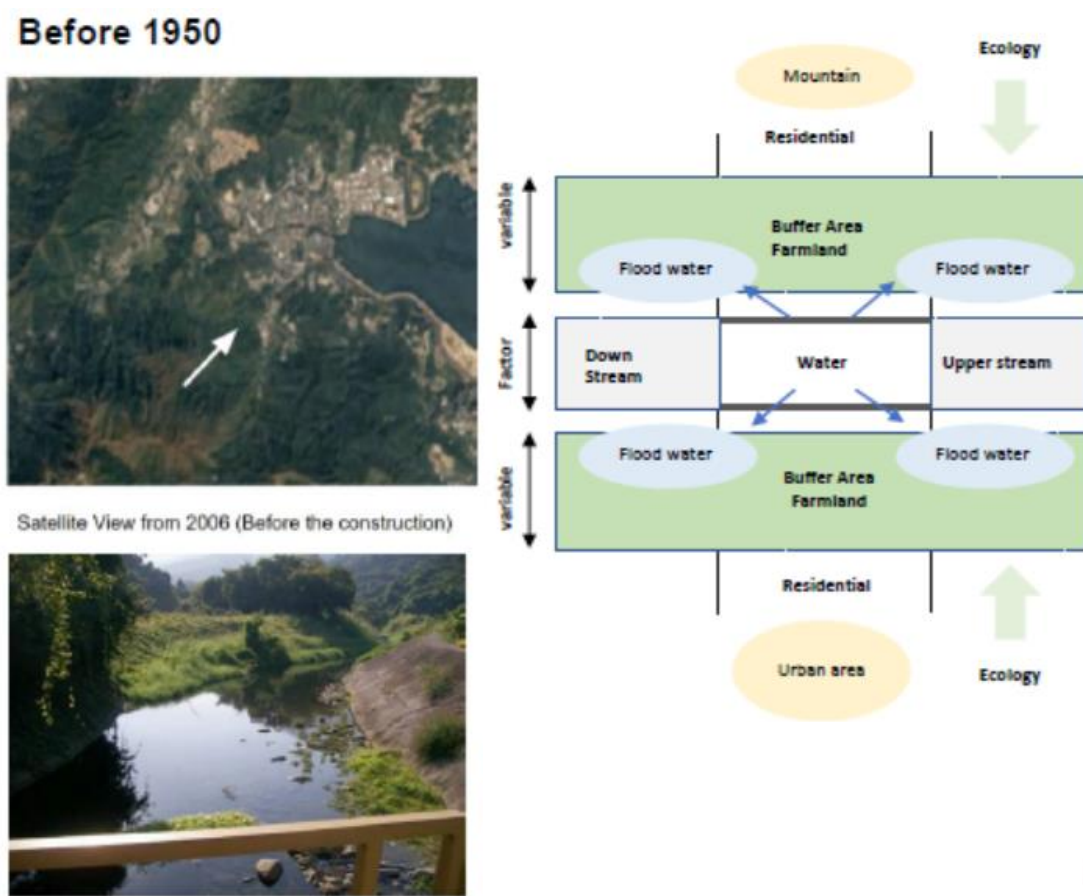

The diagrams above show the distribution of land and an overview of data.

The Lam Tsuen River catchment is mainly maintained for conservation purposes, approximately 35% of the total area is for the catchment purpose which includes 'No Defined Use,' 'Open Space,' 'Mixed Land Use' and 'Others.' As far as the hillside area of the Lam Tsuen River is concerned, the upper area is classified as 'Site of Special Scientific Interest' (SSSI) and 'Green Belts' which are 10.7 percent and 11.1 percent.

Even, for 'Country Park' is 13.2 percent of land use. 'Cultivation' extends widely through the alluvial plains of the Lam Tsuen Valley, accounting for 10.6%. The use of 'Village-type Development' around Lam Tsuen Valley is 7.1%

The lower portion of the Lam Tsuen River is now occupied by impermeable land-use due to the new town growth of Tai Po. A part of planned land usage for human activities. Residential land use is 4.9 percent, 4.6 percent own land use by the government and 2.5 percent own land use by transportation land use.

3.1.2 How does Natural Hazard (Flood and Typhoon) influence the urban agriculture pattern and river?

After 2010, the HK gov smoothed, widened and deepened this natural river channel to enhance the flood drainage capacity of the upper reaches of Lam Tsuen River,

After 2010

Satellite View from 2012 (After the construction)

From

Mountain
Ecology
Residential

Buffer Area
Farmland

variable

Green AND
HABITAT

Green AND
HABITAT

Down
Stream

Upper stream

Water

Factor

Green AND
HABITAT

Green AND
HABITAT

Buffer Area
Farmland

variable

Residential

Urban area
Ecology
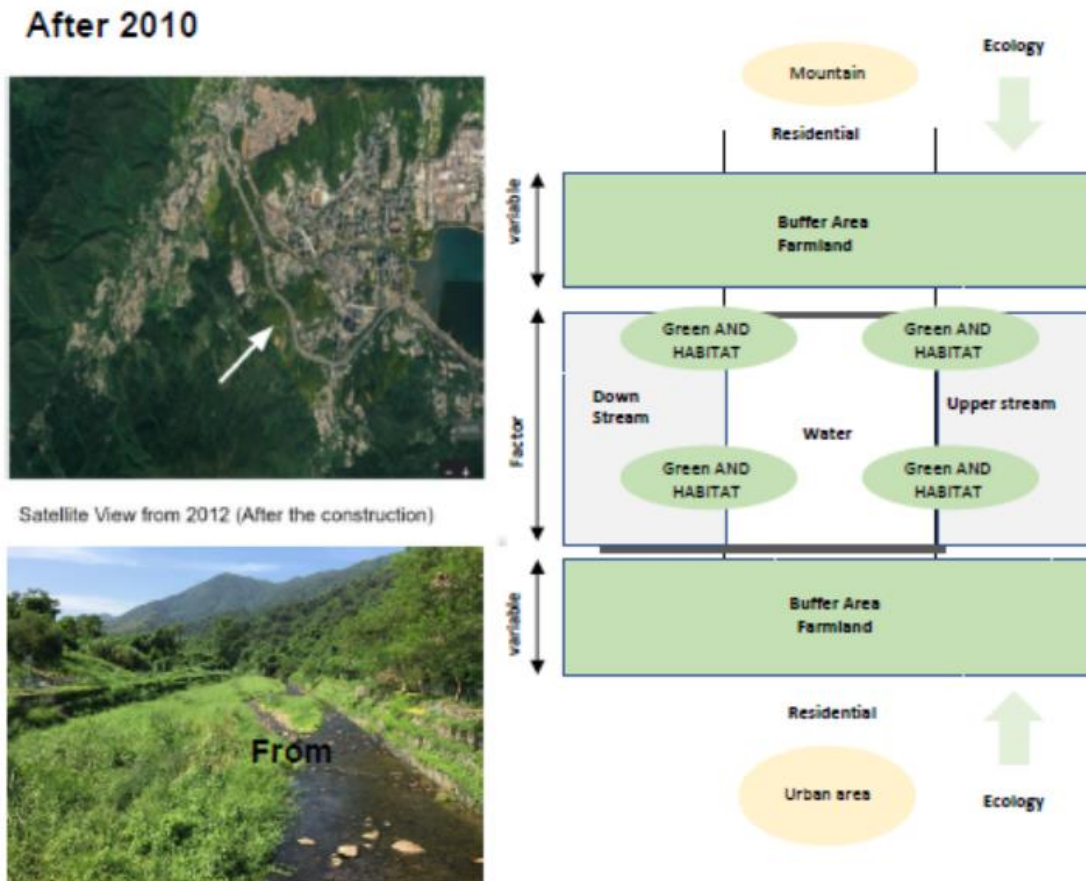
3.2 Analysis methods

This research was undertaken using a combination of analytical methods, including GIS stimulation surveys, Chronicle Typology Map Analysis. The use of diagrams reveals various distributional aspects in the Lam Tsuen River and describes the relationship and impact between the underlying elements and the Lam Tsuen River.

Suitability rating				
Factor	weight	Unit factor	Unit factor weight	Compound weight
Transportation convenience	0.2884	- - - - - - -	- - - - - - -	0.2884
Waterfront environment	0.3507	Waterfront environment	0.3519	0.1234
		Forest atmosphere	0.3108	0.1090
		Air quality	0.3373	0.1183
Urban atmosphere	0.2075	- - - - - - -	- - - - - - -	0.2075
Topographic slope	0.1534	Topographic level	0.6682	0.1025
		Slope level	0.3318	0.0509

Table 6. GIS weighting analysis
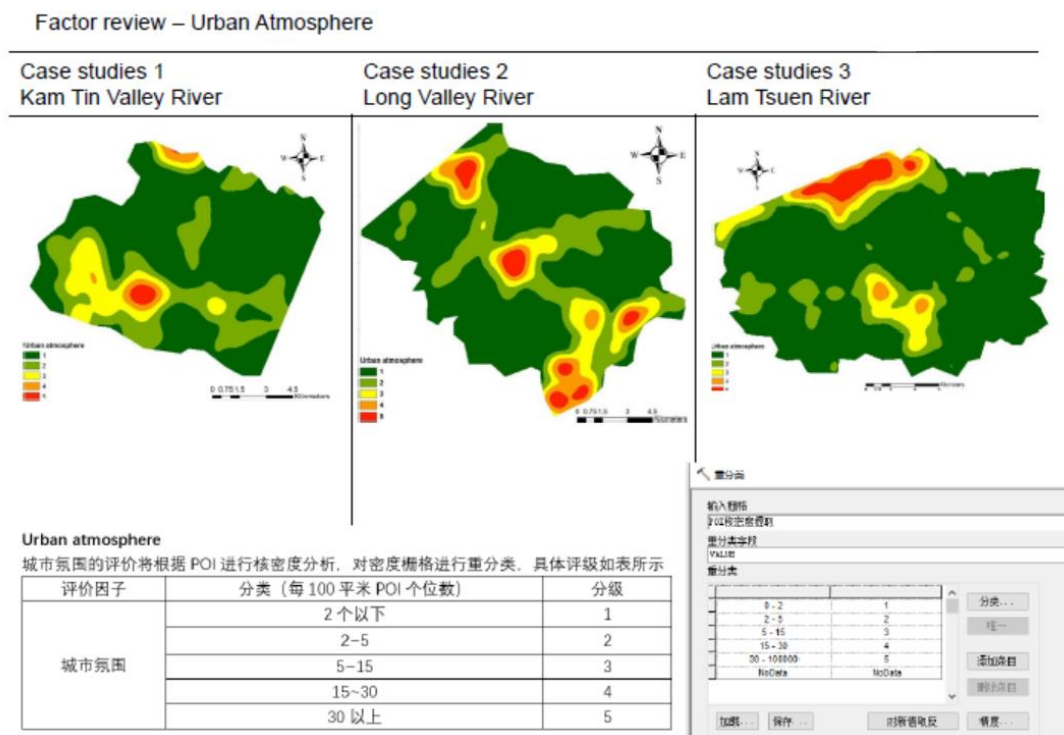
Table 7. Urban Atmosphere of three case studies

(1) GIS analyze each factor per the selected site location

Use to examine of each landscape value in the corresponding area.

As well as define its unit factor weight

(2) MCDM

By processing the combination of multi-criteria decision making (MCDM) with geographical information systems (GIS) proposed in the present research proportion between the two group: (hazard, exposure, and vulnerability), in which the social, economic, and/or environmental vulnerabilities can be assessed.
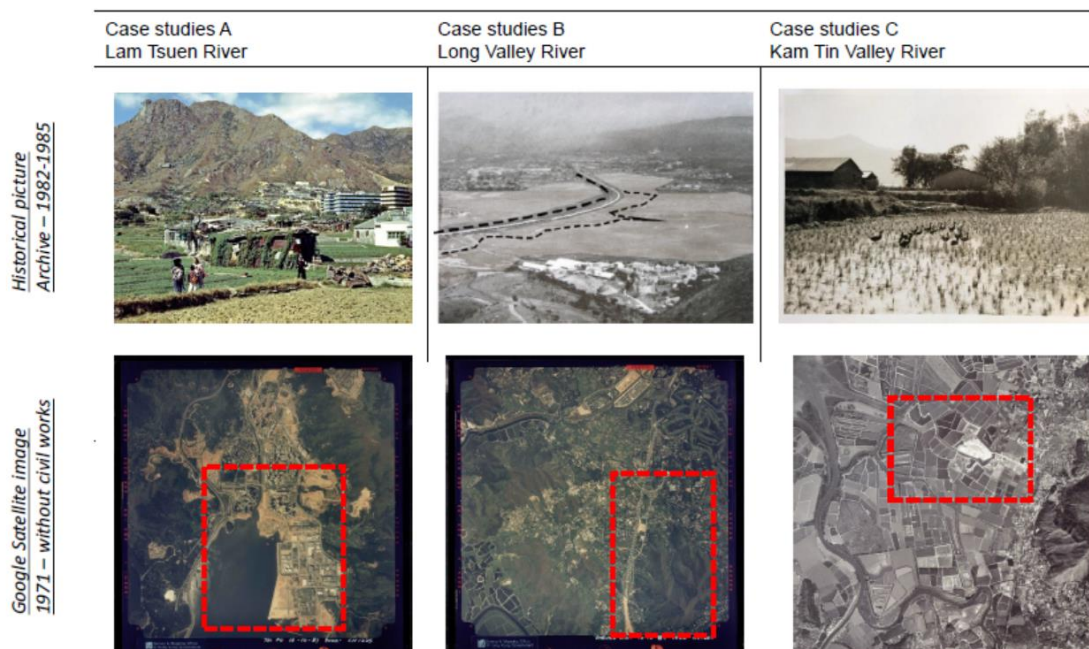
Historical images of three rivers
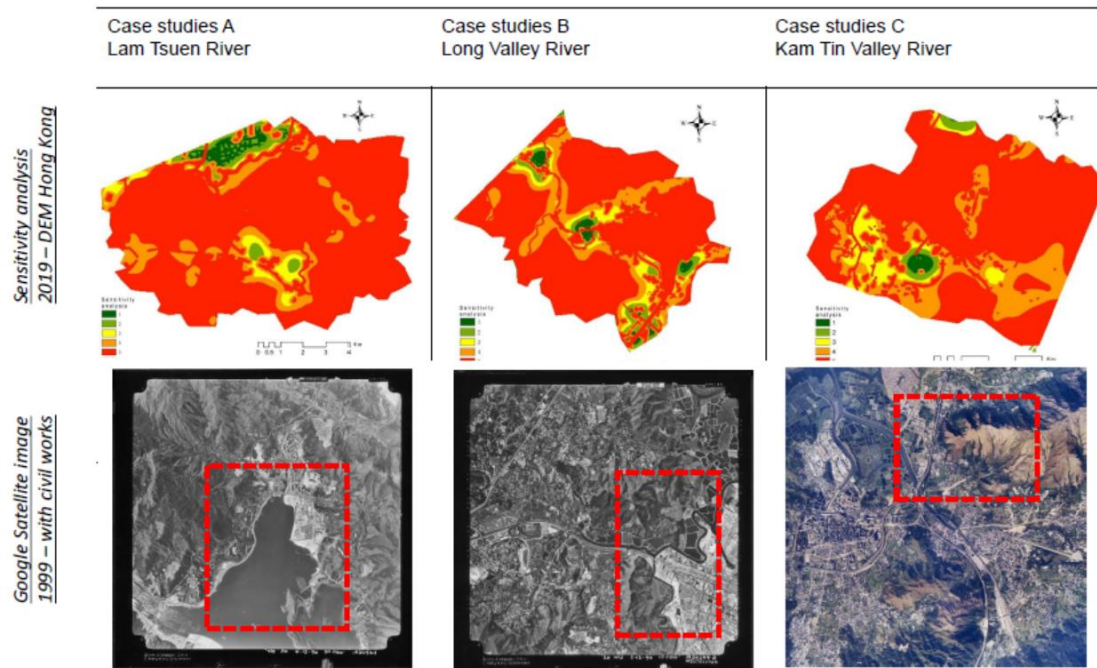
Table 8. historical images of three rivers

3.2.1 Chronicle topography map analysis of Lam Tsuen Valley, Long Valley and Kam Tin Valley River

Lam Tsuen Valley River

Lam Tsuen Valley is one of the largest river valleys in HK. It is 12 km long, and up to

1 km wide. It has been characterised by mostly flat land, which to this day is in use

for agriculture. There are numerous other streams in this valley that feed Lam Tsuen
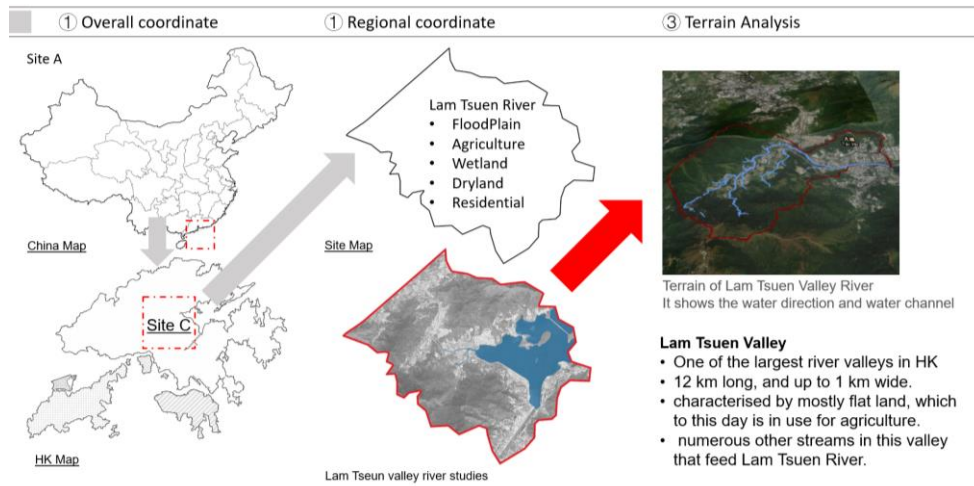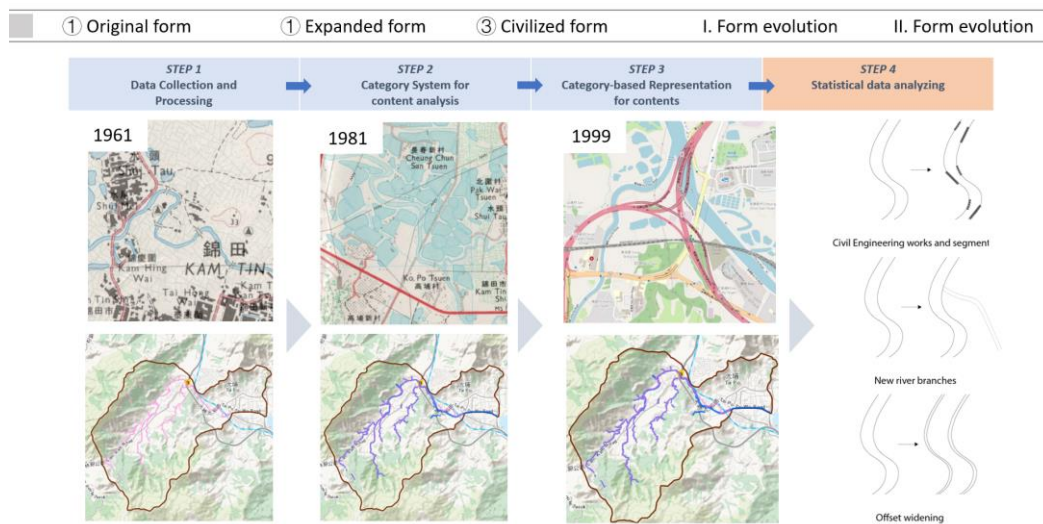
River.

Figure 47. Lam Tsuen River background
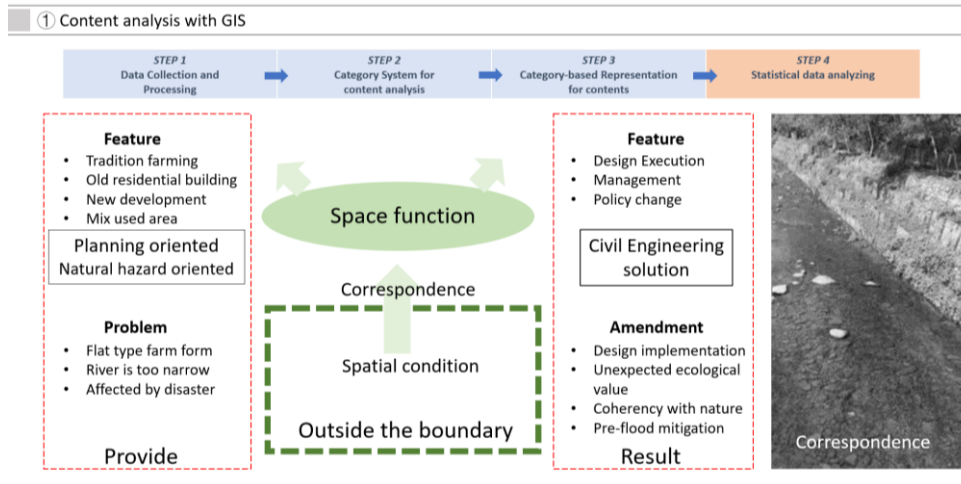

Figure 48. Lam Tsuen River development

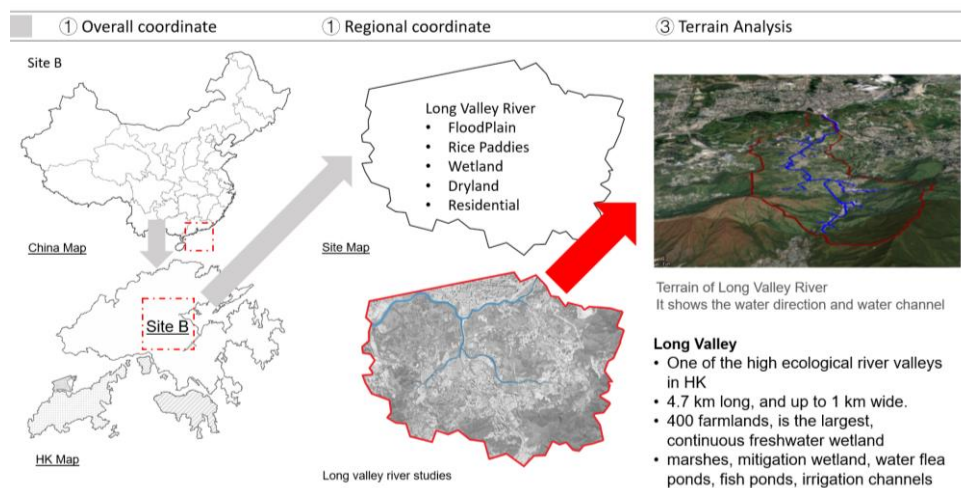*Figure 49. Lam Tsuen River content anlysis*

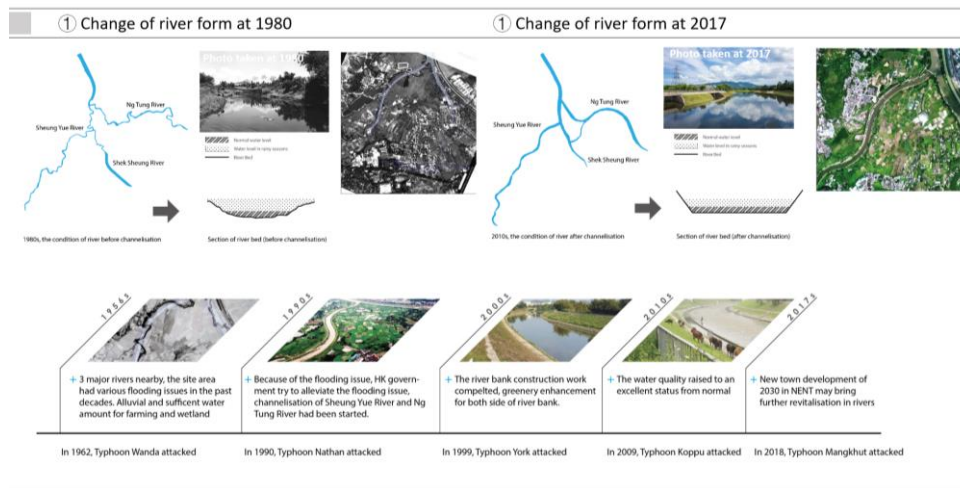## Long Valley River

Figure 50. Long Valley River Background

Figure 51. River development in Long Valley

Figure 52. Onsite elements catergorization

Kam Tin Valley River

Figure 53. Kam Tin River develpoment

① Water Quality   Drainage works of Kam Tin Valley

1. Overall water channel

LEGEND

Drainage Works of Yuen Long Bypass Floodway
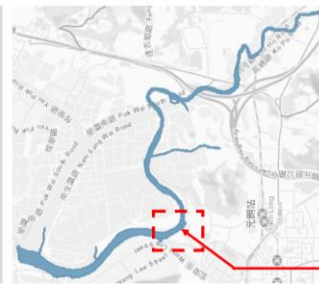- Engineered wetland
- Inflatable dam
- New Channel

Kam Tin River Catchment

Kam Tin Bypass Floodway

The above mapping shows how the Engineered wetland, Inflatable dam and the new channel connect together

2. Blow up of water channel

The water channel is varied in result of different landscape conditions. These conditions help the habitat and environment evolved further.

3. Site visit and studies

River Water Quality
According to the data from the Environmental Protection Department, the water quality of Kam Tin River has improved in recent years. Nevertheless, the river is still severely polluted.
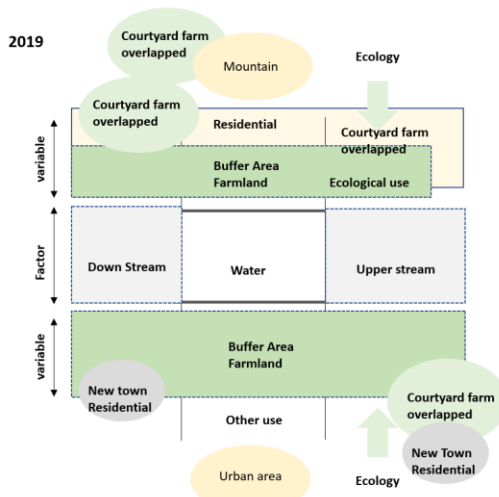
Mudflat is exposed when tide ebbs in the lower course of Kam Tin River

① Historical Background of Kam Tin Valley

Background	Elements	Water channel	1975
1975 The old channel of Kam Tin River The river with the second-highest origin in Hong Kong. Hong Kong the Kam Tin basin contains extensive alluvial plains and flooding occurs quite frequently in the developed lowlands.			
2016 The new channel at the lower course of Kam Tin River. Topographically the basin consists of steep uplands and a contrasting lowland alluvial plain, areas of which are prone to flooding. The upland slopes are well vegetated and hill fires are relatively common. Agriculture has dominated the lowland plain and remains important and this includes areas of ponds.			2016

② Onsite Elements Categorization

2019

Courtyard farm overlapped — Mountain — Ecology

Courtyard farm overlapped — Residential — Courtyard farm overlapped

Buffer Area Farmland — Ecological use

variable

Factor — Down Stream — Water — Upper stream

variable — Buffer Area Farmland

New town Residential — Other use — Courtyard farm overlapped — New Town Residential

Urban area — Ecology

② Onsite Elements Categorization based on the GIS analysis

The images reveal context about main object and viewpoint configurations, which are categorized with the index measured as the distance indicated in landscape evaluation approach (Gou&Shibata, 2017)

Tab.3 categorization process for the image data

Factor	Internal – water volume
	External1 – water edge
	External2 – upper stream
	External3 – down stream
Variable	Structure-main rock stone
	Structure-weed plants
	Size of buffer area (stone/ pebble stone/ hole)
	Place and environment
Other-Type	Ecology
	Mountain

Figure 54. Kam Tin Valley on site elements

3.2.2 Creation of Lam Tsuen River typology map study from 1970 to 2020

This diagram displays the growth cycle in the District of Tai Po from 1970 to 2020.

**3.2.2 Chronicle Social community distribution map**

The study shows over the last 50 years of social culture and population growth. Analyzing how Tai Po has moved from farming to a residential area and industrial development. According to the early days of the Lam Tsuen River, which also included farmland and distant villages in the west to the mid-term of the Tai Po industrial village's new urban growth and reconstruction scheme. It illustrates the pattern of where population growth has relocated from radially outward far away from the Lam Tsuen River, as well as how the quantity of villages and farms is shrinking.

3.3 Analytical methods – Geology analysis of Lam Tsuen River

Mapping

Fig (1a) Mapping of geological distribution   Fig (1b) Distribution data
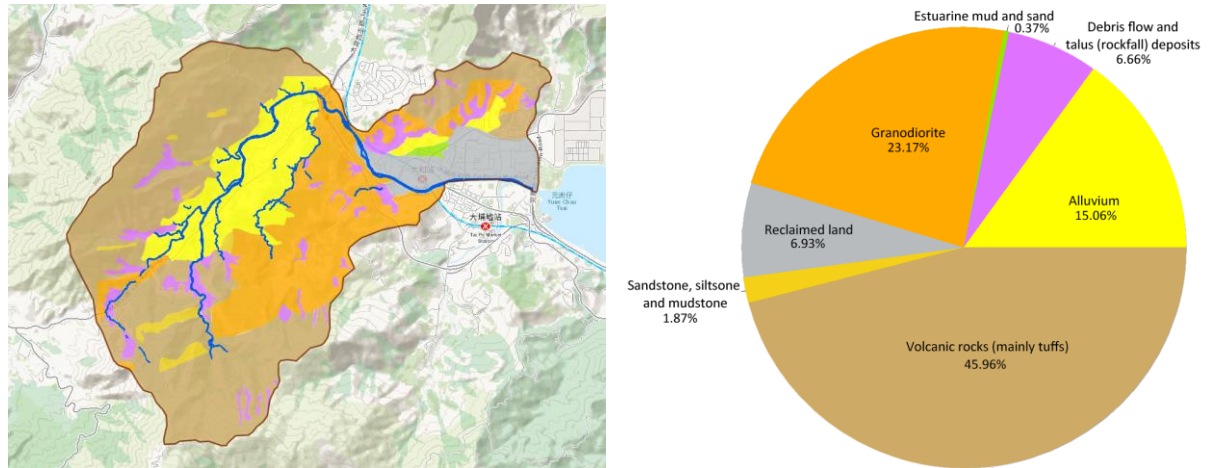
The diagrams above show the geologic distribution and analysis of the data.

Most volcanic rocks (mainly tuffs) in Lam Tsuen are 45.96 per cent according to geological distribution data. A significant number of granodiorite and alluvium, respectively, are 23.17 per cent and 15.06 per cent. The quantities of reclaimed land and debris flow were therefore identical approximately 6 per cent. The tiny proportion of sandstone and estuarine mud is 1.87 percent, respectively, and 0.37 percent. The bedrock of the Lam Tsuen River is predominantly extrusive volcanic rocks, consisting of more than just tuff, some of the elements mixed in geological composition with sandstone, and metamorphic rocks. The eastern and southeastern portion of the catchment belongs to disruptive volcanic grandiosity.

This research was undertaken by a combination of analytical methods, including GIS stimulation surveys, Chronicle Typology Map Analysis. The use of diagrams reveals various distributional aspects in the Lam Tsuen River and describes the relationship and impact between the underlying elements and the Lam Tsuen River.
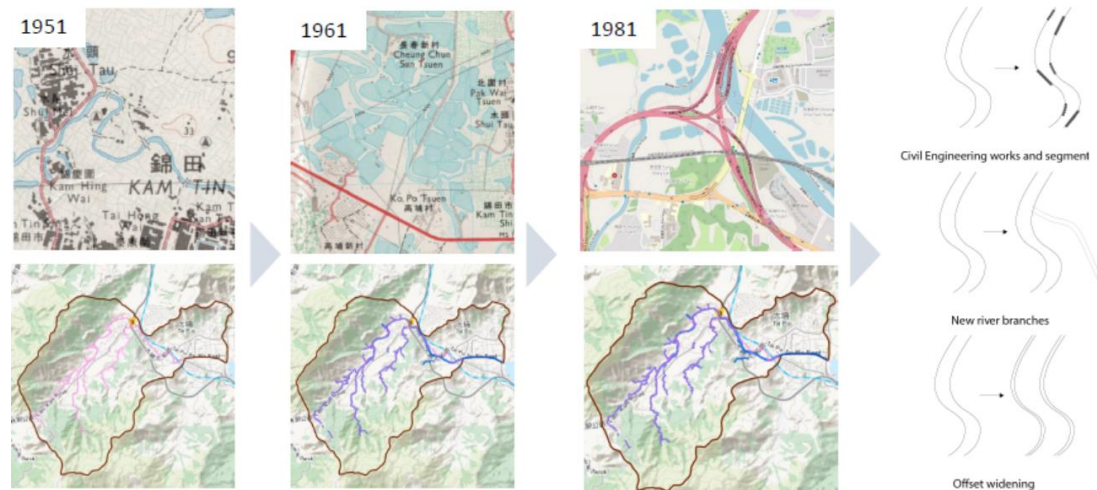
Figure 55. Lam Tsuen River Profile

3.3.1 Building typology map analysis
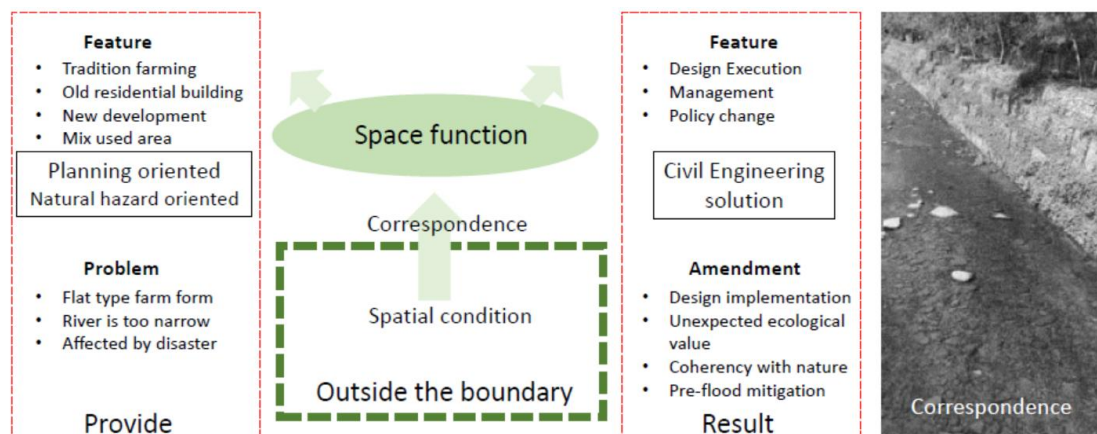
Figure 56. content analysis in Lam Tsuen River

The diagram on the building typology map shows the phase of growth in Tai Po District from 1970 to 2020. From the renovation project of the industrial village of Tai Po, the very first public housing estate and residential building were continually completed, until the self-sufficient city, including industrial, commercial and city facilities, was established.

Building typology map analysis of Lam Tsuen River in 1970s

The Government of Hong Kong has been announcing the development of Tai Po as a new town since the 1970s. The Tai Po Industrial Village reclamation project began in the 1976's.

Building typology map analysis of Lam Tsuen River in 1980s

The first public residential estate at Tai Po was completed in the 1980s. Continually finished the HOS (Home Ownership Scheme), along with several private residential.

Building typology map analysis of Lam Tsuen River in 2020s

Until 2020s, industrial, commercial and community facilities were developed into a self-sufficient community.

Social community distribution of Lam Tsuen River in 1975

The growth of the population was mostly in the west during the 1975s.

This is because farmland and villages along the Lam Tsuen River are primarily used for land use.

Social community distribution of Lam Tsuen River in 1985
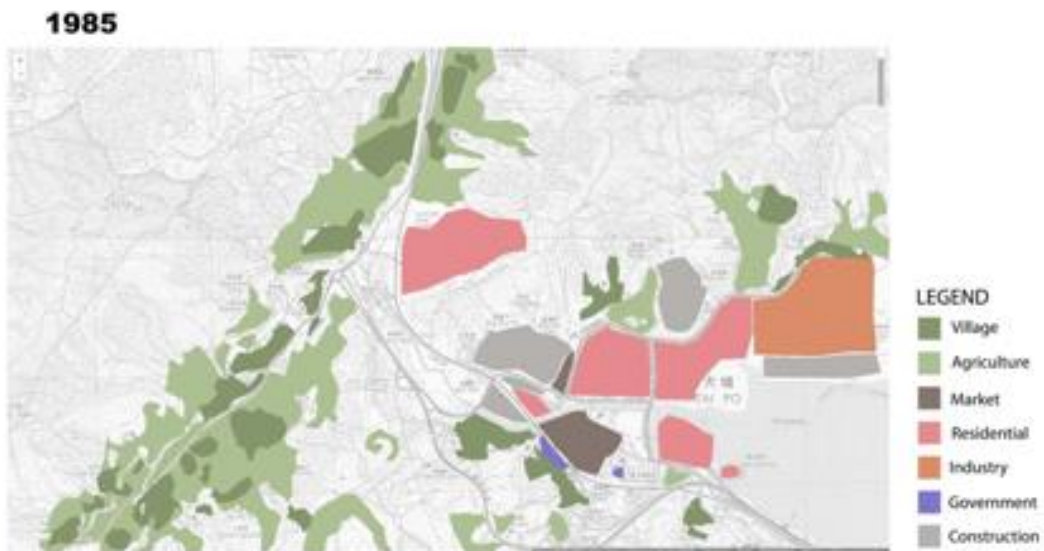
Afterward when the Government of Hong Kong plans to establish Tai Po District as a new city. Tai Po Industrial Village reclamation project is completed. And government construction of a large-scale temporary housing area to accommodate residents who moved in the Tai Po settlement due to redevelopment. The growth of the population

starts to move towards the East. In addition, there are several housing ventures under way.

3.3.1 Chronicle of **Farming** distribution from 1970 to 2020
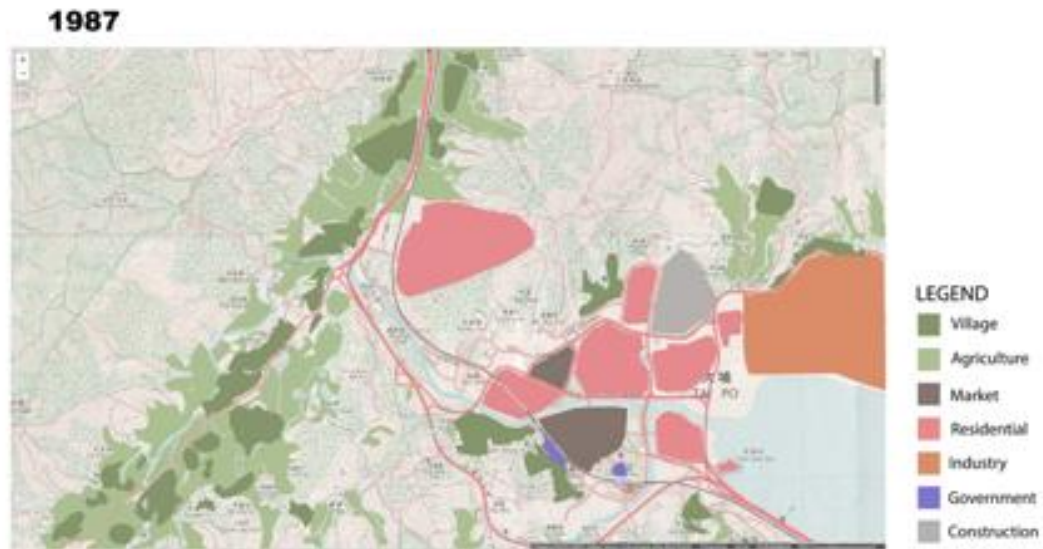
Most villages and farmlands were demolished in the 1987s compared to the 1985s and converted into new residential areas. In this time the residential projects were completed, and 33,000 people were provided with adequate housing. Thus, the growth of the population is chiefly in the South.

Social community distribution of Lam Tsuen River in 2020
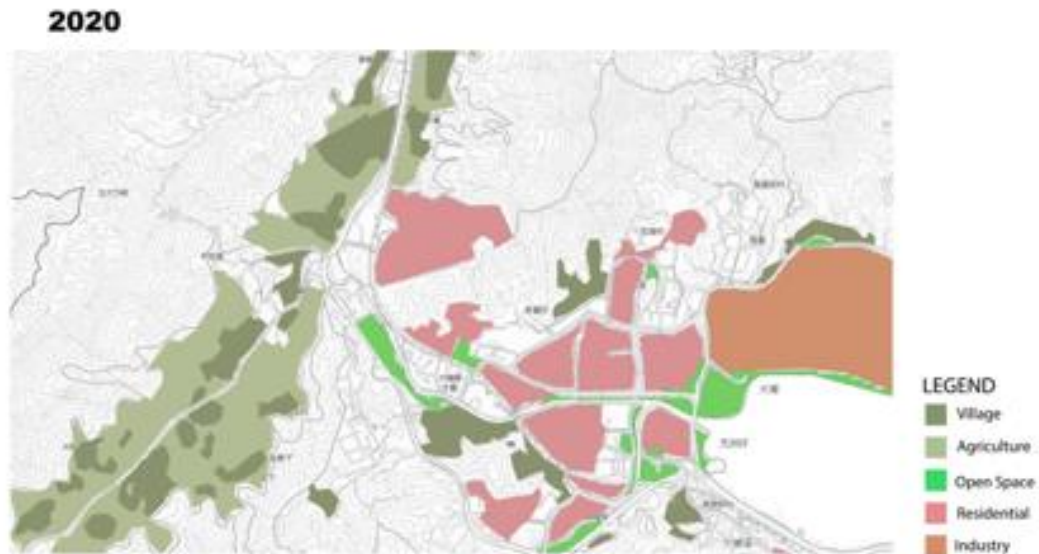
Until the 1990s, in 1997 and 1992 Tai Po Waterfront Park and Yuen Shin Park opened. Then, the Tai Po Old Market is reconstructed into a small business area for private land. Tai Po was a culture full and diverse in the 2020s.

3.3.2 **Summary: Social community distribution of Lam Tsuen River from 1970 to 2020**

Tai Po has moved from farming to a residential area and manufacturing development in 50 years. Production of the population moved from west to east. How does urban agriculture pattern and river defense the Natural Hazard (Flood and Typhoon) ? After 2010, the HK gov smoothed, widened and deepened this natural river channel to enhance the flood drainage capacity of the upper reaches of Lam Tsuen River,
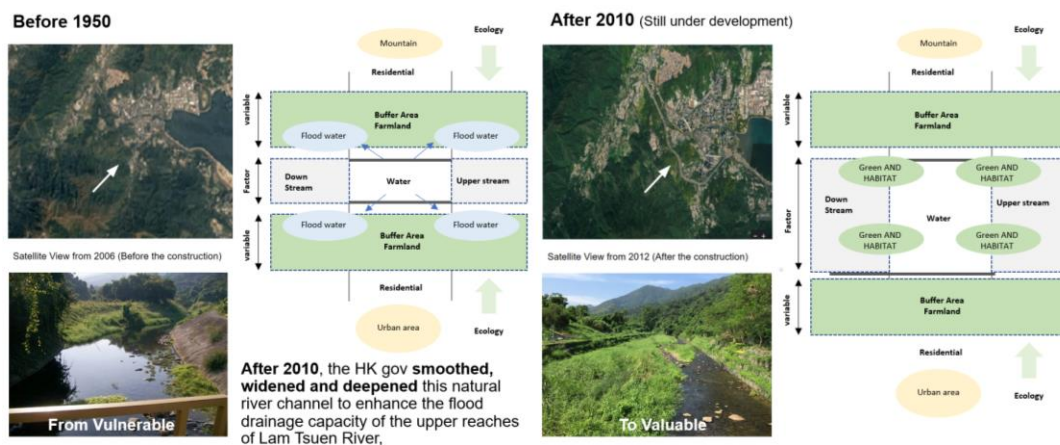

Figure 57. Elements analysis in Lam Tsuen River

3.4 Economy status of Hong Kong economic transition (drop/ up)

Table 9. Fishing village to Entrepot (1841-1950)

YEAR	KEY EVIDENCE
1840	Hong Kong was a typical agricultural economy dominated by agriculture, fisheries, trading, salt manufacturing, pearl-fishing, and fragrances,
1841	It was proclaimed a free port after British invasion of Hong Kong, representing the start of Hong Kong's transformation to a global open economy.
1900	Hong Kong has been converted into a port and primarily engaged in the commercial enterpot market. From the commercial content perspective, opium trafficking, coolies and smuggling were the main "black trade" at the early stage, and even the wide range of commodities rapidly expanded in the later period (Ting, Early Growth of Shipping and Enterpot Trade).

Table 10. Entrepot to Industrial City (1951-1970)

The transition from wartime to peacetime started in the socio-economic life of predominantly socialist countries following World War II. The world market is demanding consumer goods for everyday use increasingly growing.

YEAR	KEY EVIDENCE
1950	The mezzanine trade in Hong Kong also shrank rapidly. Rapid shifts in global trends and economies have contributed to a shift in our economy's structure from warehousing trade to "export-oriented" manufacturing trade. Hong Kong's exports rose at an average yearly rate of 15.1 per cent throughout the two decades from 1950 to 1970 (Schenk, Hong Kong's Economic History).

1970 - 1980	Exports to Hong Kong were still dominated by clothes, and other industrial products such as electronics, watches, and plastics were also produced. The highest growth rate among exports of Hong Kong items was for watches, electronics, and plastics products.

Industrialization to diversification of services (1971-1996)

Hong Kong was no longer a low-cost location by the late 1970's. Rising costs are gradually making the burden on industrial development heavier. The growth of the service sector is incremental with industrial and commercial economic development.

Table 11. Industrialization to diversification of services

YEAR	KEY EVIDENCE
1970	Financial sector in Hong Kong started to expand rapidly. Tourism is a new industry that arose after World War II. Hong Kong's tourism industry has been vastly improved with the growth of the world aircraft industry and the assistance of the British government.
1980	Hong Kong's commercial housing rents had climbed to the highest in Asia. According to the 1996 data the average rose at that time.
1990	Transport cooperation has also contributed to establishment of the Hong Kong transport sector. More sales have been made from tourism.
1993	Local economy has become foundations of trade, tourism, accommodation, and travel.

Economy status of Hong Kong Gross Domestic Product (GDP)
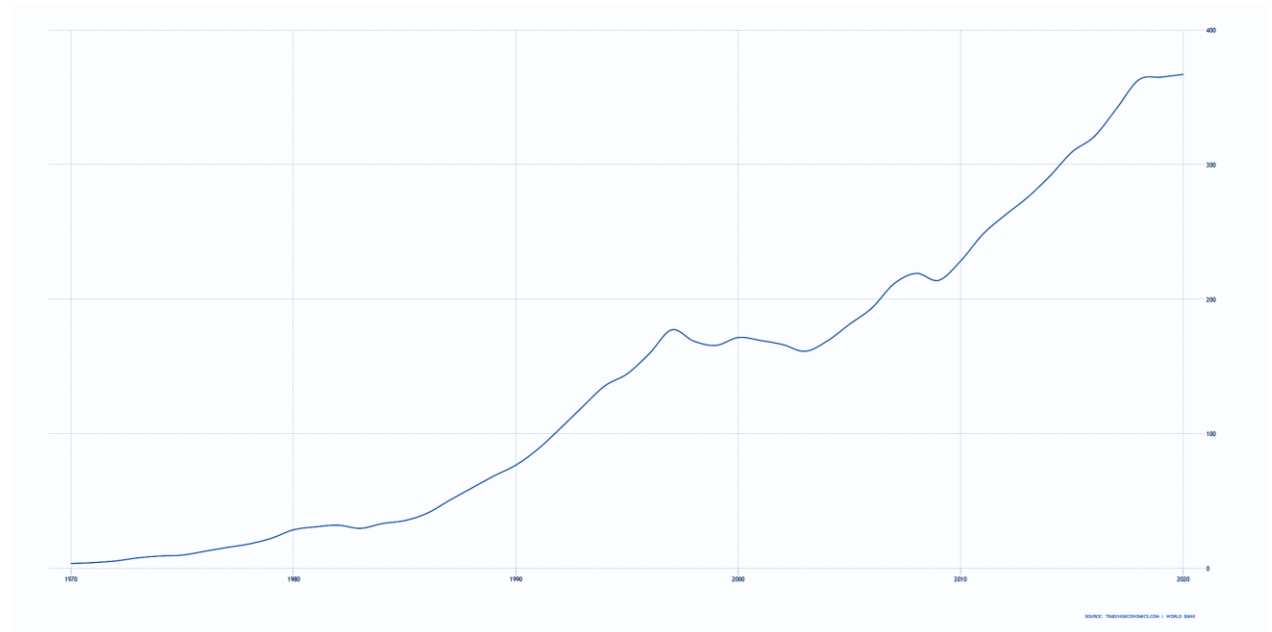
(TRADING ECONOMICS: 20 million INDICATORS FROM 196 COUNTRIES)

Table 12. Economy status timeline from 1970 to 2018

1970	Hong Kong started to enter a diversified economic era. They can have more services and link to the Mainland market. Several laws have also been passed and revised by the legislature which are more responsive to local monetary system.
1997	The "one country-two systems" scheme created, under the Basic Law, that Hong Kong is divided from the mainland. The controls on exports and currency remains unchanged. The Asian financial crisis is hitting Hong Kong's local economy. The recession has led rates and housing prices to collapse and has affected many borrowers' ability to reimburse bank loans.
2003 - 2006	With the danger of the Sudden Acute Respiratory Syndrome (SARS), which pushed Hong Kong into a situation of downturn with increasing unemployment. The impact over the long term will affect the value of the trade.

	In 2003, Hong Kong had established a Closer Economic Partnership Agreement (CEPA) with mainland China. Both goods and services without having to pay customs duty. Agreements also require goods to enter the market at the mainland.
2007 - 2008	Hong Kong had signed a Closer Economic Partnership Agreement (CEPA) with mainland China in 2003. All goods and services without having to pay customs duties. Additionally, the agreements allow products to enter the mainland market.
2015 - 2017	Hong Kong is starting a free-trade agreement with the Association of Southeast Asian Nations (ASEAN). Under the terms of the law, it is not required to pay import taxes or customs duties on specific manufactured products. Furthermore, following a simple low tax policy which encourages trade and production. Hong Kong has become the center of commerce and the largest area of trade.

Table 13. Economy status of Lam Tsuen River

1970	Lam Tsuen River passes through areas like the Lam Tsuen Valley and the Tai Po market until water flows into the harbour. Natural river in both directions, with rich farmland. The river has provided the local inhabitants with irrigation water, and the local agricultural economy. The government has agreed to create a new town in the Tai Po district. The surrounding area has been transformed into a man-made channel providing parks, bike paths, and resting areas.

1990	The city also experiences extreme tropical cyclones with an average annual rainfall of about 2,400 mm, making it one of the rainiest cities in the Pacific Rim (Building Flood Resistance for Hong Kong, 1970). During heavy rainfall, the Lam Tsuen River Valley was continuously threatened by flooding, often experiencing major flooding in this climatic climate. Some countries have suffered economic losses because of natural disasters.
2007 - 2012	River restoration works have been undertaken by the Drainage Services Department for Lam Tsuen River and She Shan River to protect residents from flood-threats. The research needed to expand existing waterways along the bank of the river and stabilize the gabions.
2015	Drainage systems developed in the early years were mainly planned to avoid and manage the floods. The public also worried about the value of protecting water resources and making good use of urban space. Land use was needed when Hong Kong's overall economic status grew.
2017	World Sustainable Built Environment Conference 2017 Hong Kong Report points out that river restoration works will increase the value of regional direct jobs, land, and assets due to environmental improvement. The restoration works will reduce expenses for stormwater management, regulating air pollution and medical care in the future (Hkgbc, 2017).

Economic damages influenced by varies size of typhoon, landslide on Kam Tin, Long Valley and Lam Tsuen River

Table 14. Typhoons which required the hurricane signal no.10 since 1946

Name of typhoon	Date/Month	Year	Category	Maximum sustained winds near the

				centre (km/hr)
Gloria	22/9	1957	Severe T	155
Mary	9/6	1960	T	140
Alice	19/5	1961	T	120
Wanda	1/9	1962	Super T	185
Ruby	5/9	1964	Super T	195
Dot	13/10	1964	T	145
Shirley	21/8	1968	T	145
Rose	17/8	1971	Super T	185
Elsie	14/10	1975	T	140
Hope	2/8	1979	Super T	205
Ellen	9/9	1983	Severe T	165
Vicente	24/7	2012	Severe T	155
Hato	23/8	2017	Super T	185
Mangkhut	16/9	2018	Super T	185

A TYPHOON (T.) has maximum sustained winds of **118-149 km/h.**

A SEVERE TYPHOON (S.T.) has maximum sustained winds of **150-184 km/h.**

A SUPER TYPHOON (SuperT.) has maximum sustained winds of **185 km/h or more.**

3.4.1 Different impacts cause by typhoon

Continuing strong winds and rainstorms will take various other economic impacts. With the No. 8 and above Typhoon signals in place. Most stores are closed. The storm also destroyed some stores, and they needed repairs.

The continuous rainstorm would cause river flooding for agriculture and flood nearby crops. Sheds were planted, storage rooms, irrigation systems destroyed.

3.5 Comparison with two typhoons on different period

It is a correlation of two separate typhoon cycles that cause specific levels of damage. It shows what the gap was with the government before and after the Upper Lam Tsuen River Enhancement Works.

Throughout the 1990's, floods threatened Lam Tsuen River Valley through heavy rains. In 2007, the DSD carried out the "River Improvement Works in Upper Lam Tsuen River" to reduce the risk of flooding in the area by straightening, widening, and deepening the 2,6 kilometers of the upper river.

Considering the Lam Tsuen River exceptional conservation interest, the DSD is in charge with protecting the river ecosystem while carrying out work on the Upper Lam Tsuen River to develop the flow. During the design, development and post-construction phases, several conservation steps were taken to protect the original path of the river, conserve biodiversity and mitigate the project's ecological and environmental impacts.

First one in 1979 is typhoon Hope, which is a super typhoon and the average sustained wind near the center is 205kphoon. Another one in 2017 is typhoon Hato, which is also a super typhoon and the average sustained wind near the center is 185kphoon.

The most severe damage done by typhoon Hope since Typhoon Rose in 1971. There were 12 fatalities. Twenty-six people were injured, and 94 were hospitalized. The government provides temporary shelters and a stay of about 2000 people is required.

A record of 53 huts have been demolished and have left 796 homeless. Many people have been evacuated from their homes which were destroyed. There is a major evacuation that took place in Tai Po, which destroyed more than 40 huts. Huts' roofs had been swept away and about 150 people had to be evacuated.

 A tide gauge at Tai Po Kau showed that the sea level increased steadily from 2.30 pm to 4.3 meters at 4.30 pm, from 0.9 meters. Tin Sam Village near Tai Po's Lam Tsuen River had significant flooding and caused the deaths of three people. Flooding has been widespread throughout the entire New Territories, particularly in the Tai Po and Sha Tin markets.

Approximately 75 percent of New Territories vegetables, flowers, and fruit trees are destroyed or seriously damaged. There has been significant damage to the trees, shrubs, and plants in Hong Kong. A survey reported that Typhoon is aiming to kill over 19,000 fruit trees, 1,200 hectares of fruits, 140 hectares of cultivated flowers and over 3,500 potted flowers. Nearly 113,000 cattle have died.

While Hato occurred in Hong Kong at least 129 people were injured. More than 5,300 reports of falling trees, several cases of falling objects, one case of

landslides and several reports of floods. A branch near San Po Kong had struck two police officers on the head while cutting down fallen trees. Hato's storm surge caused the Hong Kong water level to increase by an average of around one to two metres.
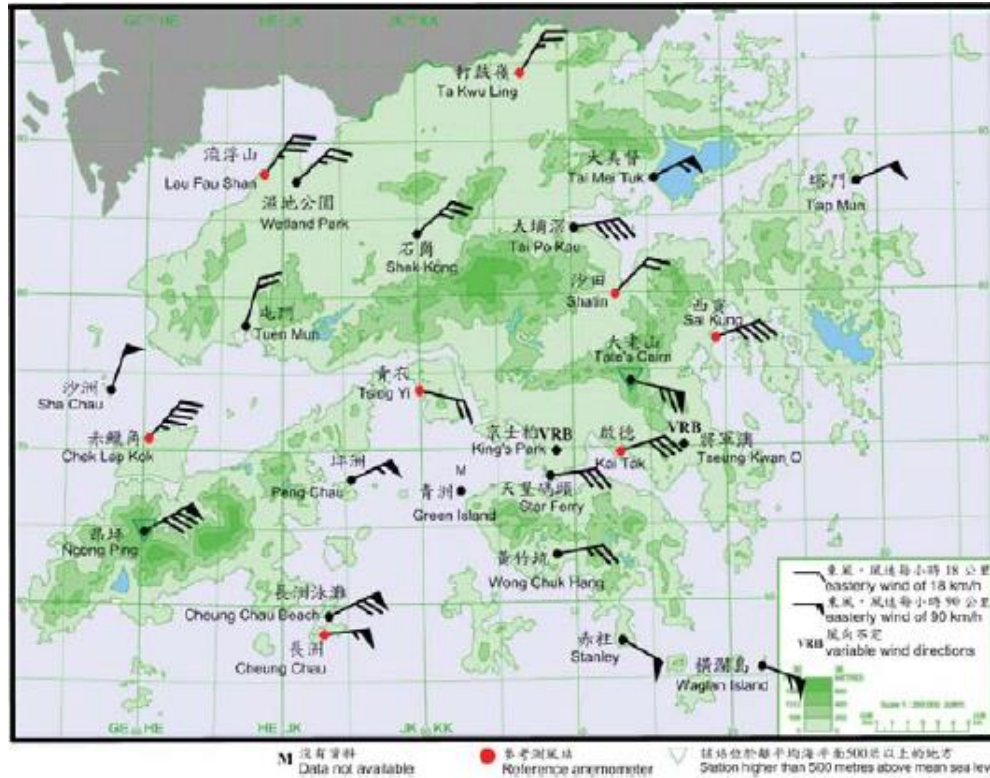
It has been the 10-minute wind direction and speed reported on August 23, 2017 at different stations in Hong Kong, at 10 am. Tai Po Kau's easterly wind is 63 km / h at

10 am.
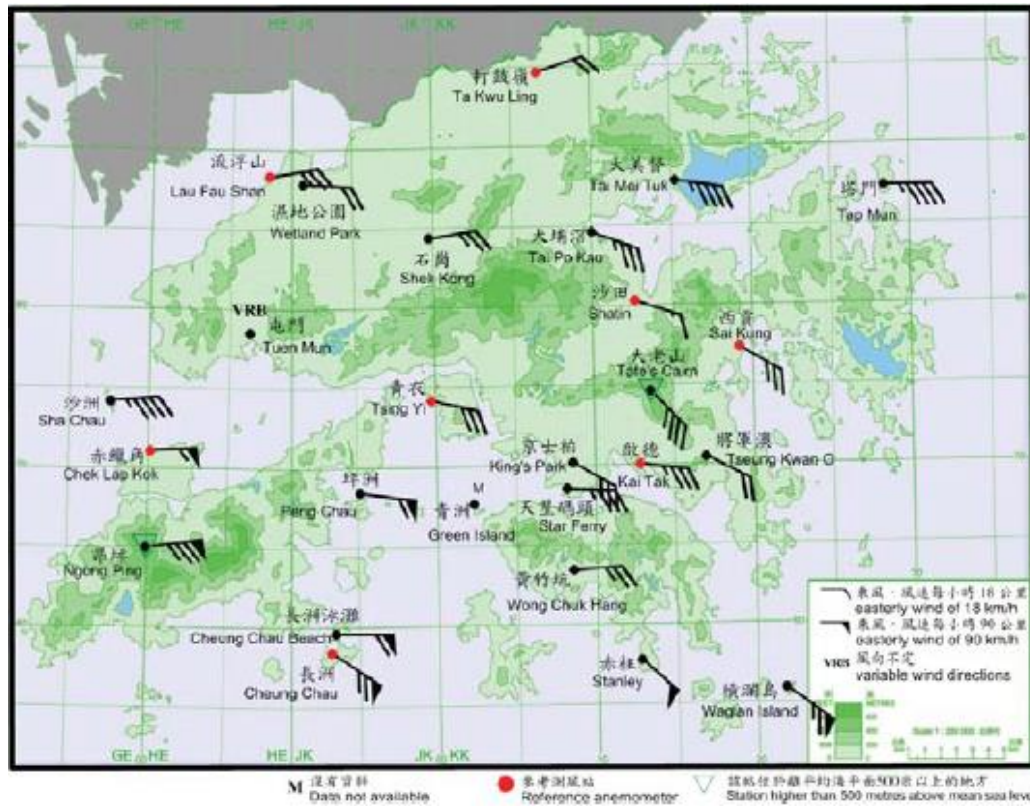
It is the 10-minute wind direction and speed documented at 11 am on 23 August 2017 at various stations in Hong Kong. Tai Po Kau's easterly wind at 11 am is 63 km / h.

On 23 August, extreme rainstorms and thunderstorms occurred under the influence of the Hato Circulation. In the morning, the Observatory gave an alert of an amber rainstorm. In general, over 60 millimeters of rainfall have been recorded in Hong Kong during these three days. Rainfall in Tai Po Kau was 80 millimetres.

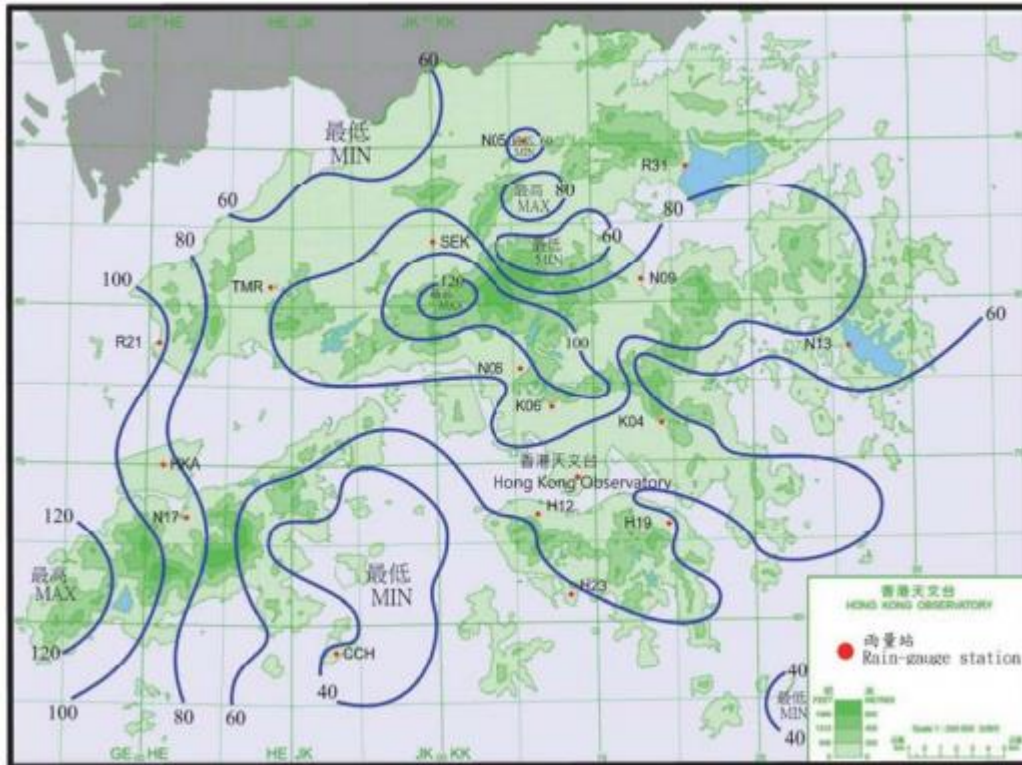Furthermore, if the typhoon lands on the east or west side of Hong Kong it will cause different rates of damage. If a tropical cyclone arrives on Hong Kong's east side, northerly winds will occur in Hong Kong, but the wind speed will be lower and drier because of the inland mountain blockageConversely, when a tropical cyclone passes south of Hong Kong and arrives west of Hong Kong, strong winds will directly hit Hong Kong, and the south-eastern wind will push the seawater to the shore, creating a storm surge. Oh, well, if it is the latter, it is going to bring major storms.

Typhoon Hato landed on Hong Kong's west side in 2017 but caused less damage than Typhoon Hope in 1979 which landed on the east side. There were more than 129 people injured in Hato, less than the Expectation that affected 12 people died and 260 were wounded. In 1979 typhoon Hope also affected Tai Po Kau's sea level to a high of 4.3 metres.
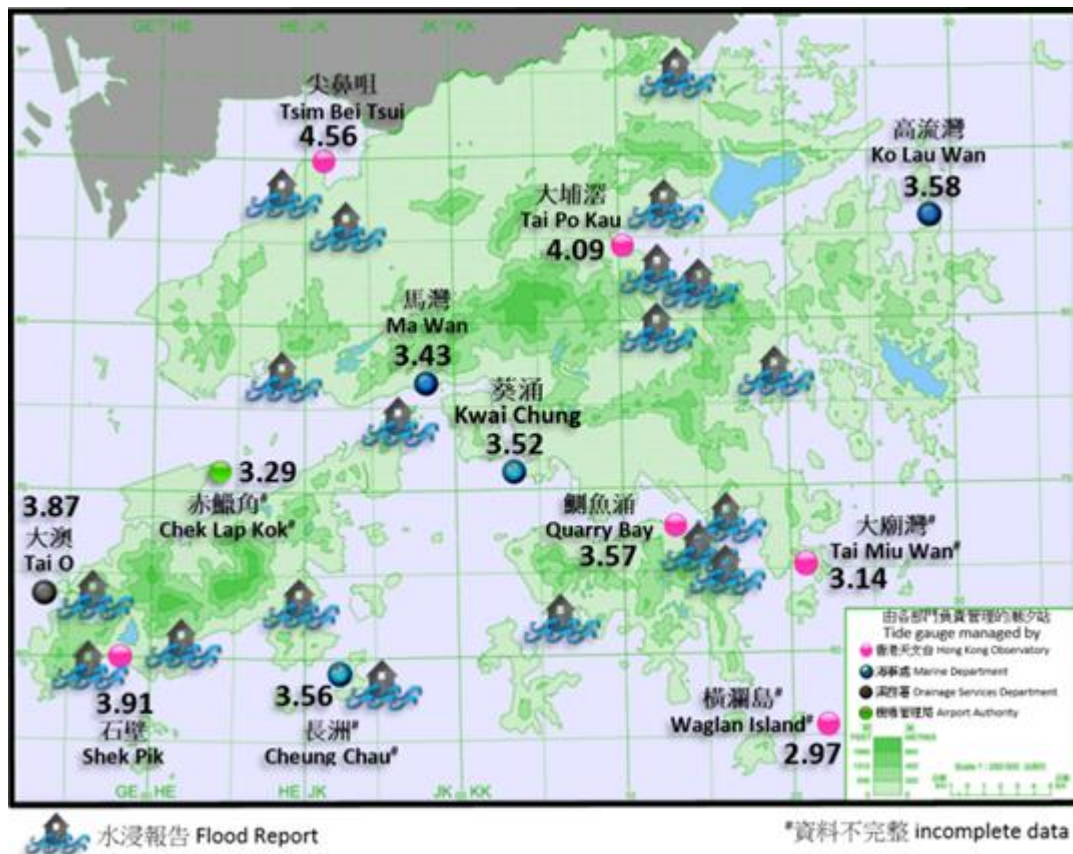
This was the 2017 flooding warning in Hong Kong when typhoon Hato is in. It has affected Tai Po Kau's sea level to a height of 4.09 metres, which is below 1979. Following in 2007 the "Water Improvement Works in Upper Lam Tsuen Channel." It showed that the flooding improved. Growing, widening, and deepening the river 2.6 kilometers mitigated the risk of flooding in the city.

3.6 Reduction of food mile in Kam Tin Valley, Long Valley and Lam Tsuen Valley

Food miles refers to the distance of transportation needed for food to be shipped to customers from the point of production or on consumer tables. According to AFCD data from 2001, 80 per cent of the vegetables consumed by people from Hong Kong originate from Mainland China.

Damages of long food mile

Transportation on long distances requires processes for transportation and food processing, which require more energy and produce more waste and pollution.

| Processing packaging | Food additive | Glass | Plastic | Styrofoam |

3.6.1 The challenge and development of local farm

Yet it is more environmentally friendly and safer to choose local produce or local food. It is fresher and rawer, and nutritious.

2001	The area has had 2,900 vegetable farmers, growing 35,900 metric tons of vegetables on 470 hectares of land. These vegetable farmers' average monthly income is $2,000, and the revenue per catty of vegetables is $0.8. It shows the local farming is dwindling.
2002	In December 2002, the Baptist University, the Green Garden Fund, and the HK Organic Life Development Center jointly formed the "Hong Kong Organic Resources Centre"
2004	The Government formally approved applications for organic

	certification from organic farms and processing farms at the end of 2004.
2011	A total of 158 local farms have engaged in the "Organic Farming Support Program" of the department as of March 2011, with a maximum cultivated area of 62.7 hectares and an average daily production of about 4.5 tons of organic vegetables.

Table 15. The challenge and development of local farm

There are numerous local farms in Hong Kong, with Kadoorie Farm and Botanical Gardens in Tai Po, the Taitong Organic Ecopark in Yuen Long being the most popular of them. Some smaller farms do have different facilities, such as Go Green Farm, Productive Organic Farm, Nature's Harvest.

The workshop and event in local farm

The field will host visitors' workshops to create their own homemade cookies, jams, and more. Methods of organic farming are used at the estate. Visitors may also feed the small animals: white rabbits and goats to enjoy the game.

People can also enjoy the beautiful views of the estate.

3.7 Enrichment of biodiversity of Kam Tin Valley, Long Valley and Lam Tsuen River in the recent 10 years

Aerial photo of Long Valley, Hong Kong Google earth 2007

Different types of freshwater ecosystems have formed in Long Valley and it is so-called the largest remaining ecological value wetland-58 ha in Hong Kong. The wetland is composed of a diverse freshwater ecosystem species. This definitely incurs a large range of wetland birds into Long Valley, due to the existence of the freshwater wetlands. Many of these birds also live in another Hong Kong wetland, such as salt or brackish wetland. Provided sample birds, Bitterns, Black winged stilt, Bigger painted snipe, rails and crakes. These species are commonly found in rice paddies instead. Long Valley 's wealth contains not only wetland ecosystems, but also a location where non-wetland ecosystems are associated. Long Valley provides a variety of

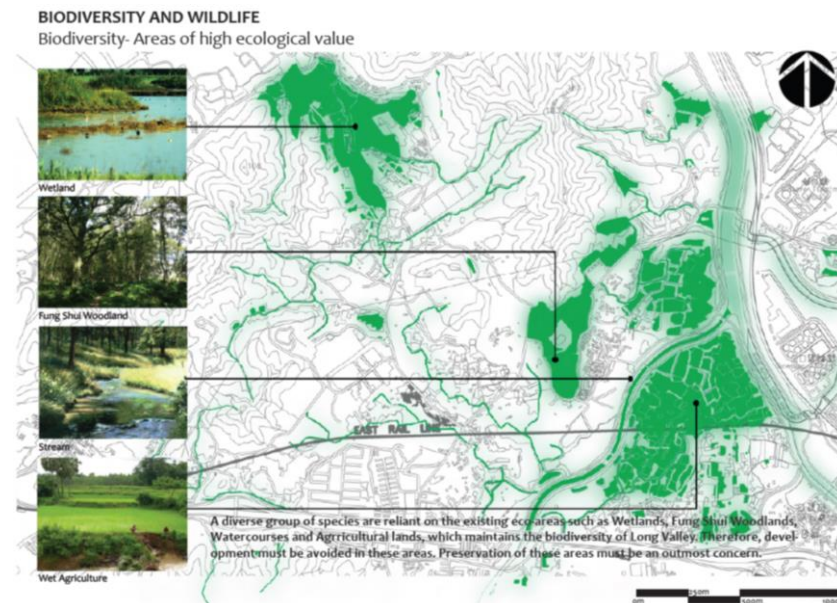niches in order to make it possible to adopt many habitat species.

SUSTAINABILITY AND RESILIENT DEVELOPMENT
Sustainable Layer

Water Body

Vegetation

Wild Life

Agricultural Land / Fish Pond

Village

Whole System

Consequently, agriculture industry intentionally or inadvertently produces anthropogenic ecosystems. Long Valley is a beautiful location with an ecological and cultural environment, as well as the remaining largest farmland in Hong Kong. The productive agriculture occupies around 50 hectares, from the scale of Long Valley. Two main agricultural practices have been applied, one for commercial use and the other for the practice of hobby farming. Just 12 ha was currently used under the Management Agreements. Having recognized that there are many forms of agriculture for different specific reasons, which included wetland farming, dryland farming, fruit farming products, bloodworms and water flea cultivation. Once the area of agriculture is exhausted it would definitely bring about a drastic change. Throughout the rainy season, the wet farming field has accommodated a certain amount of water

and is ready for planting; when it comes to seasoned sprigs, its various crop stages attract different species of fauna. Cumber crop and spinach water crop remain in the ponds that leave the natural ecosystem fallow. The successful nature ecology management is to preserve a well-vegetated marsh with frequent grass cutting. Red and shallow open water for combination of marshland species.

BIODIVERSITY AND WILDLIFE
Biodiversity- Areas of high ecological value

Wetland

Fung Shui Woodland

Stream

Wet Agriculture

A diverse group of species are reliant on the existing eco areas such as Wetlands, Fung Shui Woodlands, Watercourses and Agricultural lands, which maintains the biodiversity of Long Valley. Therefore, development must be avoided in these areas. Preservation of these areas must be an outmost concern.

Long Valley is facing some unpredictable changes in the development that is to come. The designated ecological value is 37 hectares, where it takes the highest portion to retain agriculture and belt zoning than other uses (natural park). Is that land-use planning really enough to secure Long Valley, though? Most areas were farm structure occupied and squatter homes were allowed. For all existing land uses, it is not yet developed to the mature stage in terms of comprising habitat that is beneficial to ecology.

BIODIVERSITY AND WILDLIFE
Wildlife - Birds - Population Growth and Assemblage

As indicated previously, Bird species take up to more than 70% of the species diversity in the site. The reason behind is that throughout the years the number of birds have been increasing. The increasing number of birds is due to the fact that despite the area being largely used for Agricultural purposes, the addition of other smaller environments such as water flea ponds, fish ponds, shallow water habitats, and even unmanaged fields within, helps attracts birds species you can see currently. Moreover, small wildlife species, within the small environments, are the birds' sustenance.

The value of monoculture of vegetable growing is limited, even though it may sound economical, according to the research. The main threats to Long Valley preservation at the moment are human activities. Numerous conflicts between visitors like birdwatchers, photographer, and ecology. Other than that, Long Valley is drawing hundreds of tourists to a cycling circuit surrounding Long Valley.
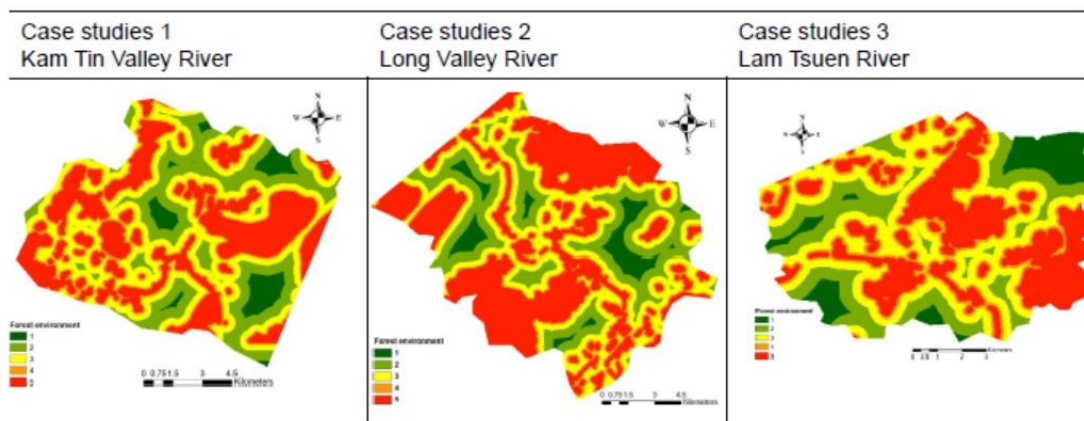

Figure Waterfront analysis of the three case studies

The estimation of the biodiversity of Lam Tsuen River in the recent 10 years

The biodiversity is explored at three levels: Genetic Diversity, Species Diversity and Ecosystem Diversity.

1. Genetic variation refers to variations within the same species and entities. (Wilhelm Barthlott & Matthias Winiger, 2013).

2. Diversity of species applies to various types of organisms within an ecosystem or environment (Wilhelm Barthlott & Matthias Winiger, 2013).

3. Ecosystem Diversity refers to environmental variability by providing multiple ecosystems and classes of species (Wilhelm Barthlott & Matthias Winiger, 2013).

Forests, grasslands, mudflats, urban areas are common examples of discoverable habitats in Hong Kong (Agriculture, Fisheries and Conservation Department, 2018).
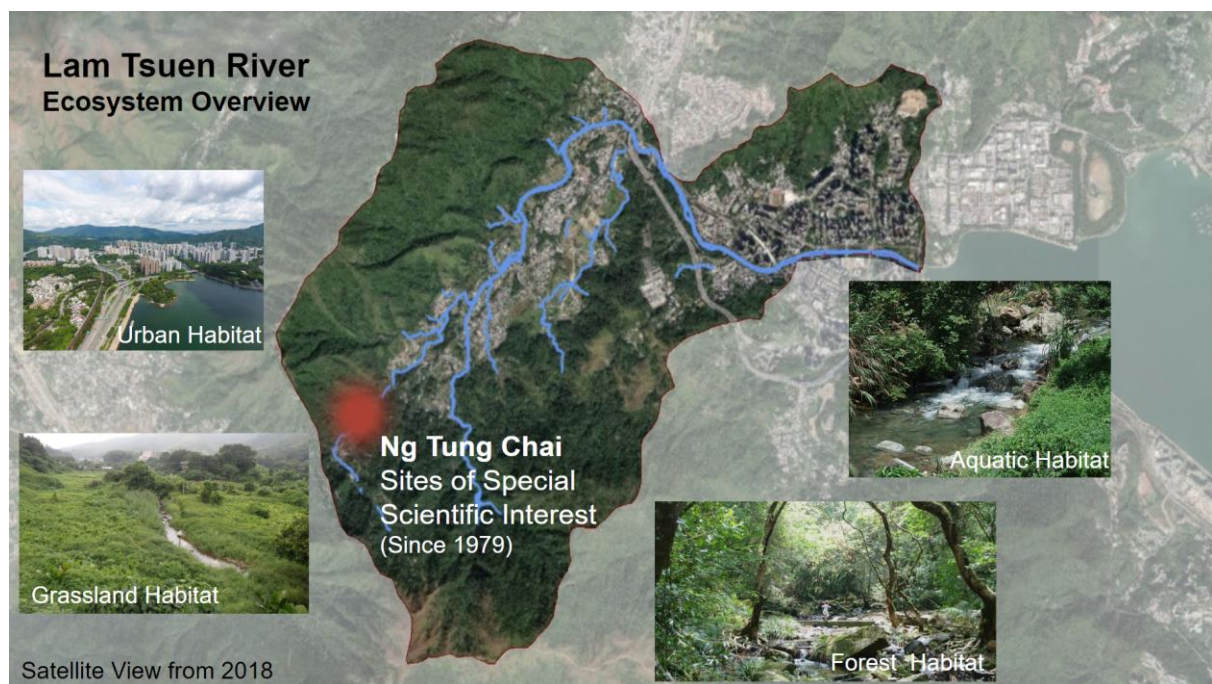

Photo Source : https://cdn.shopify.com/s/files/1/0071/5032/products/world-maps-international-1-20m.jpg

https://geology.com/world/united-states-map-with-state-names.gif,https://www.map.gov.hk/gm/res/images/map/basemap/topo-gs.png,

https://www.lonelyplanet.com/maps/asia/china/hong-kong/map_of_hong-kong.jpg, https://hkmap.live/img/og-image.jpg
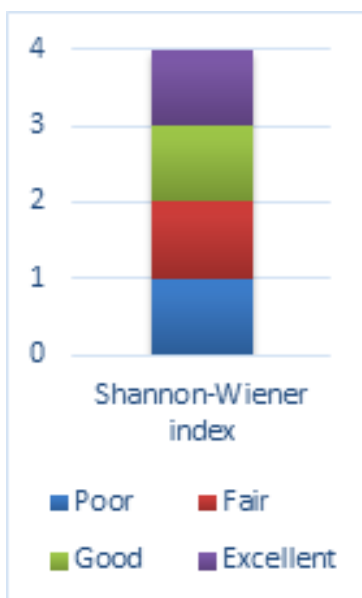
From the 2018 Satellite View, many habitat types within the area along the Lam Tsuen River are discovered. They are Habitat Urban, Habitat Grassland, Marine Ecosystem and Wildlife Forest. And, since 1979 (Hong Kong Biodiversity Information Network, 2019), Ng Tung Chai has been designated as Sites of Special Scientific Interest (SSSI).

In this section, Lam Tsuen River's biodiversity over the last 10 years is measured with studies from Hong Kong's Open University and biological scientists, and biological surveys undertaken by the Department of Environmental Protection, Drainage Services, and Hong Kong Bird Watching Society.

The biodiversity of Lam Tsuen River from the past to year 2010
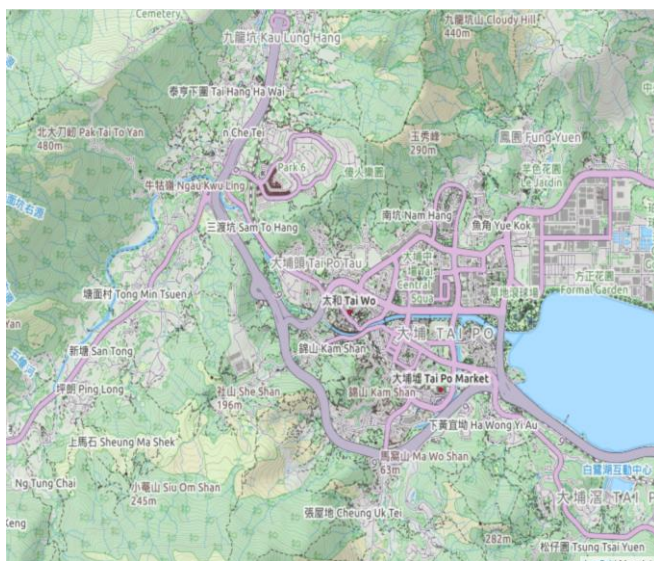
From the 1995 Satellite View it was observed that the Lower Lam Tsuen River was surrounded mainly by developed areas with lots of building blocks. And, near the other sections of Lam Tsuen River, there was no major infrastructure built. Thus, the landscape along the Lam Tsuen River was in the past very similar to its natural settings.

Photo source: https://c.tile.osm.org/11/1673/891.png

The Shannon-Wiener index is used to measure the biodiversity of different organisms. In each region, the higher the index, the better the biodiversity (Lan Spellerberg, 2005).

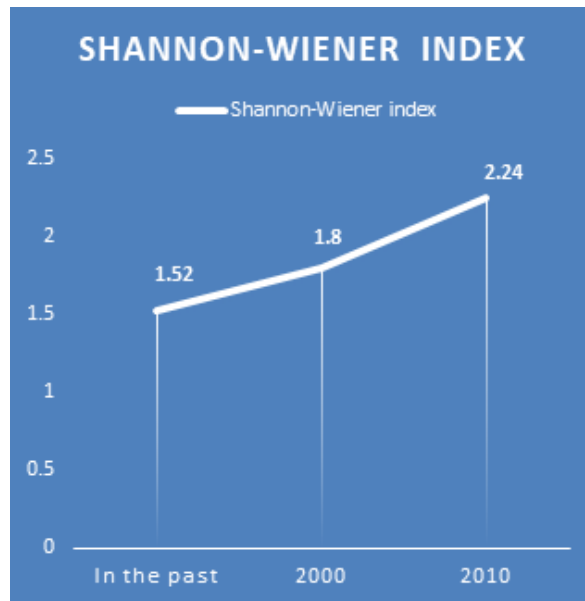Photo source: made with reference material in this study

Photo source: Po Chan, made with reference material in this study

The Shannon-Wiener index of areas along the Lam Tsuen River was ranked 1.52(Fair) before the 2000s, 1.8(Fair) in 2000s and 2.24 in 2010s with respect to the research 'Quality Rivers, Quality Hong Kong' conducted by the Open University of Hong Kong in 2013. As seen in graph, there is a rising pattern in the Shannon-Wiener index coming from the very past. Therefore, the increase that biodiversity in the Lam Tsuen River regions has been improving given the rapid urbanization of the Lower Lam Tsuen River should be a reason.
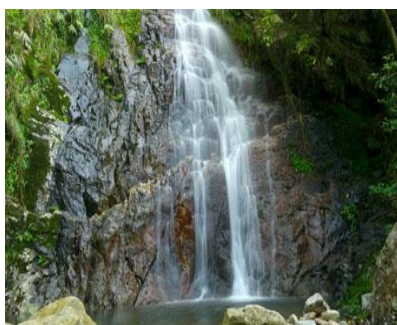
Based on the 2005 Environmental Protection Department survey, Ng Tung Chai's Indicative

100

Ecological Importance is often high; sometimes medium; sometimes low. The result showed that the conservation of biodiversity in Ng Tung Chai still has scope for development.

Photo source: https://droneandslr.com/wp-content/uploads/2018/10/ng-tung-chung-waterfall-hong-kong-27.jpg

Photo source: https://www.biosch.hku.hk/ecology/porcupine/por27gif/hknewt.jpg

"*Hong Kong Newt"(Paramesotriton hongkongensis) is a precious species and Hong Kong is exceptional. Just about 162 individuals were identified in 2003, which is less than 73 in 2000(235). It indicates that Hong Kong Newt's genetic biodiversity has decreased and produced a negative effect on biodiversity that one species has been identified to be endangered and the complexity of the food web has fallen.*

To summarise, from the very past to the 2000s, till ecological measures and river improvements were made, biodiversity in the regions along the Lam Tsuen River required an enrichment to enhance the environmental ecological value and more attention was necessary to conserve the areas, particularly Ng Tung Chai, where the SSSI is.

Drainage improvement works in Upper Lam Tsuen River completed in 2012

Photo source: https://s3-media2.fl.yelpcdn.com/bphoto/H-GNIl395elPadApaVTqJA/o.jpg

Around 2007 the Drainage Service Department started the "Water Improvement Works in Upper Lam Tsuen Water" project. The project's purpose is to process a river enhancement of around 4.5 km of Upper Lam Tsuen River and other rivers. It aims to reduce flood risks, and to cope with Tai Po's potential growth (Drainage Service Department, 2006).

The four biodiversity enhancement measures applied at Upper Lam Tsuen River and their functions are described below.

1. Zig-zag Fish Ladder

It produces ripples, pools, and irregular flow patterns which separate Lam Tsuen River into river segments with uneven surfaces. It enables river species to cross stream sections. (Drainage Service Department, 2012)

Photo source: https://i.ytimg.com/vi/CEpVt_rBwzw/maxresdefault.jpg (Left),

https://www.dsd.gov.hk/Documents/SustainabilityReports/1718/common/images/photo/section3_4_large.jpg

(Right)

2. Gabion banks

It produces ripples, pools, and irregular flow patterns which separate Lam Tsuen River into river segments with uneven surfaces. It enables river species to cross stream sections. (Drainage Service Department, 2012)
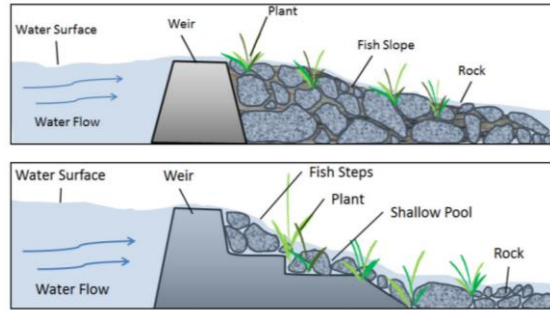

Photo source: https://www.dsd.gov.hk/assets/images/DSD_en.png

Photo source:https://builtory.my/builtory-image/26mNRnRZw/gabion-wall.jpg(Left) ,
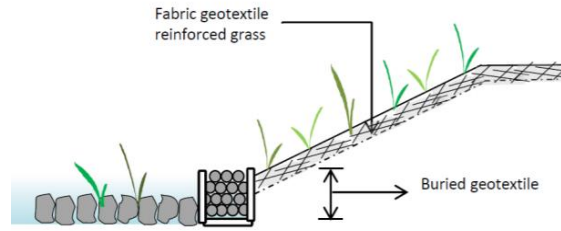
https://5.imimg.com/data5/LU/KL/MY-2352915/gabion-wall-250x250.jpg (Right)

3. Extensive planting for riverside greening

Plants are heavily planted on channel sides to improve the scenery, biodiversity, and greening of the rivers. This also helps to improve water quality. (Drainage Facility, 2012)

Photo source:

https://www.dsd.gov.hk/Documents/SustainabilityReports/1718/common/images/photo/section3_3_large.jpg

(Left) , https://www.dsd.gov.hk/assets/images/DSD_en.png (Right)

4. Adding stream environment with riverbed

The Upper Lam Tsuen River rip-rap base has been restored with original riverbed materials to promote involvement in wildlife aquatic habitat and improve the quality of the ecological setting. (Drainage Service Department, 2012)

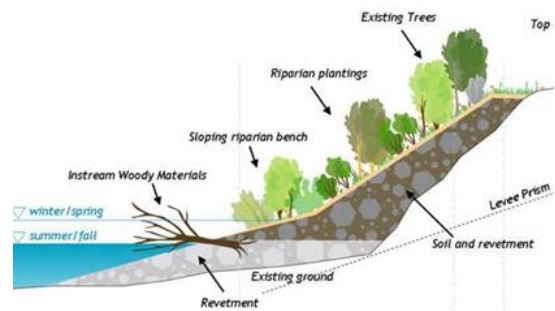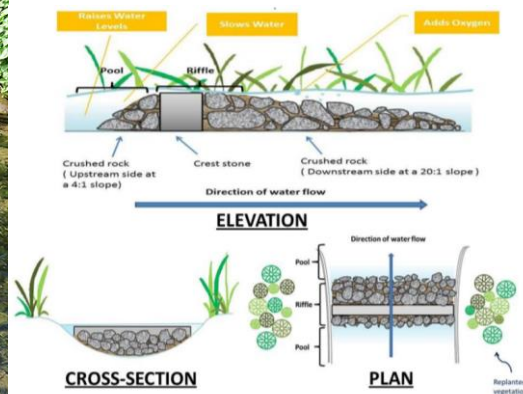

Photo source:

https://www.dsd.gov.hk/Documents/SustainabilityReports/1718/common/images/photo/section1_2_large.jpg
(Left) , https://5.imimg.com/data5/LU/KL/MY-2352915/gabion-wall-250x250.jpg (Right)
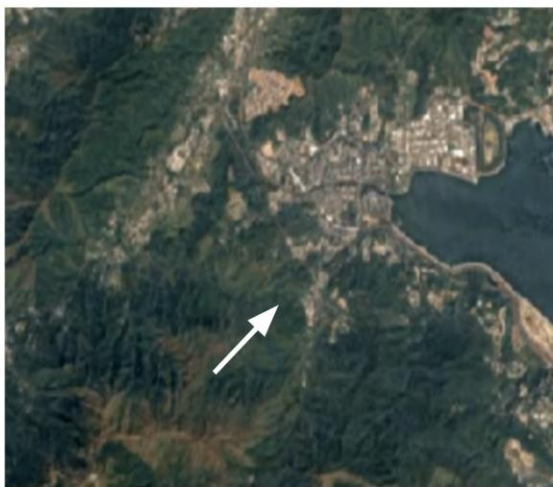
Satellite View from 2006 (Before the construction) : Satellite View from 2012 (After the construction)

The figure below shows the size of the river creation by calculating the width of the Lam Tsuen River (the Lam Tsuen River is arrow-pointed green).

In addition, the river's development not only reduces the likelihood of heavy flooding caused by rainstorms and typhoons by widening and improving the channel, it also enriches biodiversity in areas along the Upper Lam Tsuen Channel by maximizing the stability of the aquatic ecosystem and by stabilizing the water quality to provide a better habitat for wildlife with a more water-friendly climate. Including water quality stabilisation to provide wildlife with a more water-friendly landscape design to provide a healthier habitat.

3.6.2 Ecological enhancement work

Photo Source: https://encrypted-tbn0.gstatic.com/images?q=tbn%3AANd9GcRL3Li6TPQ56i1WBJPYbwJ8GWQKEkA0OVG81FvTnc6dXignfwsh

The Drainage Service Department is doing ecological enhancement in 2016. The areas along the Lower Lam Tsuen River were selected for site trials of the 5 measures of ecological change. And in 2017, the department conducted a Lower Lam Tsuen

River Ecological Field Survey to estimate the efficacy of the ecological enhancement project and assess the ecological measures. (Drainage Service Department,2018)

3.6.3 The 5 measures of environmental enhancement are described below.

1. Enhancing Ecological Connectivity

To improve ecological connectivity, upstream and downstream, more fish ladders have been introduced to instream. Instead of vertical walls, the neighboring riparian of the Lower Lam Tsuen River is turned into a "V-shaped" slide that prevents the animals from being stuck in the watercourse. Drainage Service Department,2018)

Photo source: https://www.dsd.gov.hk/assets/images/DSD_en.png

2. Adjusting Sinuosity to Optimal Level

The sinuous channel reduces the velocity of flow and increases the stability of the conditions of water flow and creates more micro-habitats including ponds and pools. Drainage Service Department,2018)

Photo source: https://www.dsd.gov.hk/assets/images/DSD_en.png

3.Adding Eco-Friendly Substrates

Boulders, cobbles, coarse gravel, sand, and mud were added to protect the natural aquatic ecosystem and provide better habitats for wildlife. (Drainage Service Department,2018)

Photo source: https://www.dsd.gov.hk/assets/images/DSD_en.png

4.Setting Up Wooden Poles for Birds

The poles provide a landing and foraging ground for wildlife birds, as well as rest points. It helps inspire more wildlife birds to become interested in the natural environment. (Drainage Service Department,2018)

Photo source: https://www.dsd.gov.hk/assets/images/DSD_en.png

5. Increase Riparian Vegetation

The riparian vegetation offers protective services such as stabilizing the water

temperature; and supplying the aquatic species with leaf litter as food source.

(Drainage Service Department,2018)

Photo source: https://www.dsd.gov.hk/assets/images/DSD_en.png

3.7 Agriculture impacts update after and before natural disaster

In 1963, Hong Kong suffered from the strongest drought, which is the most dangerous of all recorded time.Agricultural business suffers from irrecoverable financial losses that the water in farmland was evaporated dramatically and took months of time to become moisture later on. (Hong Kong Museum of History,2014)

Photo source:

https://lh3.goodata:image/jpeg;baseBAAD/2wCEAAkGBxMSEhMTExMWFRUVGBcXFxgXGBgYFxgYFxcWGBoXFx

In 1965, the supply of Dongjiang freshwater started to support Hongkongers living, which sacrificed about 6 tons of crops in the mainland due to scarcity of water in the first year. And the establishment of Plover Cove Reservoir in 1967, which is

The second largest reservoir in Hong Kong. (Hong Kong Museum of History,2014)

Photo source:

https://lh3.goodata:image/jpeg;base64,/SkZJRgABAQAAAQABAAD/2wCEAAkGBxMSEhMTExMWFRUVGB

cXFxgXGBgYFxg

3.8 Agriculture impacts update after and before natural disaster in 1970s
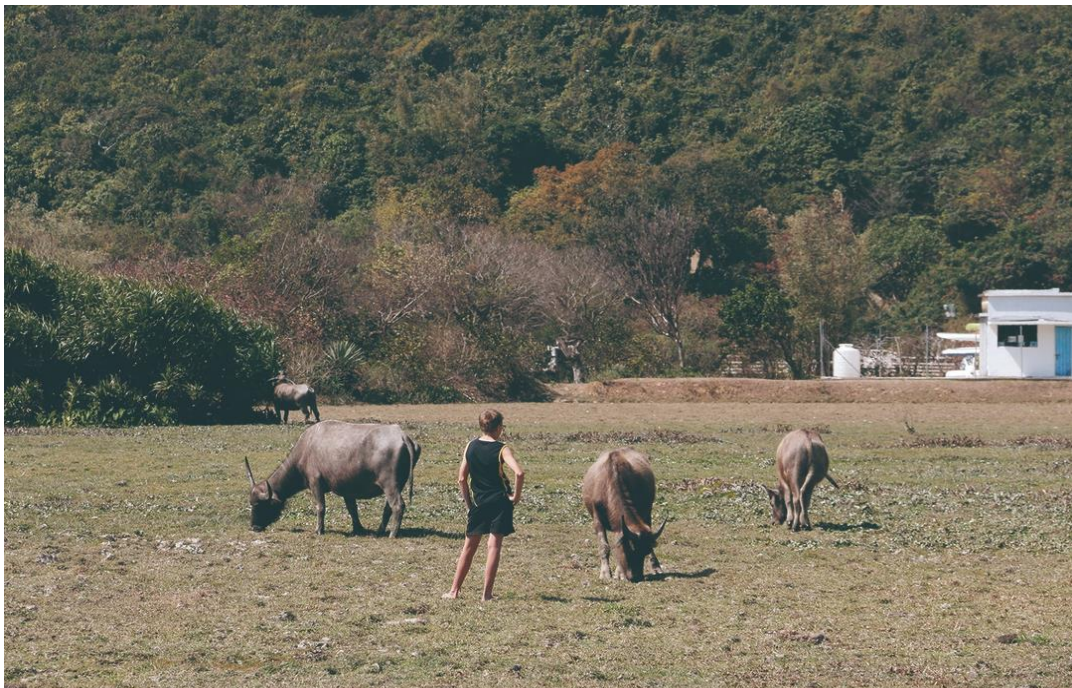
The early 1970s was the Golden Age of agricultural business in Hong Kong.

The Hong Kong Agricultural business reached its peak and fulfilled about 30% of

local food consumption. It was considered the big success of previous works on

securing water supply. (Hong Kong Museum of History,2014)

Photo source:

https:/9j/4AAQSkZJRgABAQAAAQABAAD/2wCEAAkGBxMSEFRUVGBcXFxgXGBgYFxgYFxcWGBoXFx

The agricultural business entered recession in 1974, when Hong Kong suffered from the first drought after the establishment of resouvers. The droughts, which happened in 1977 and 1981 respectively, fostered recession. The recovery became nearly impossible with the increasing importation of food from mainland China. (Hong Kong Museum of History,2014)

Photo source: https://SkZJRgABAQAAAQABAAD/2wCEAAkGBxMSEFRUVGBcXF2324542BoXFx

Agriculture impacts update after and before natural disaster in 2000s

Since 2010, there were typhoons which damaged the landscape pattern along the the 12 typhoons in 2000s interrupted agricultural business by causing numerous floods, and it disencouraged agricultural activities along Lam Tsuen River. (Hong Kong Observatory ,2017)

Photo source:

https:/9j/4AAQSkZJRgABAQAAKJNKJSDNSJFVXCVZBxMSEFRUVGBcXFxgXGBgYFxgYFxcWGBoXFx

The government responded to the damages caused by the extreme weather by launching a river

improvement on Upper Lam Tsuen River, which was led by the Drainage Service Department and started in 2007.The agricultural activities in Lam Tsuen River recovered gradually after the improvement. (Drainage Service Department, 2015)

Photo source:

https://4AAQSkZJRgABAQAAAQABAAD/2wCEASDFSDFU898SDF9JGBcXFxgXGBgYFxgYFxcWGBoXFx

Agriculture impacts update after and before natural disaster in 2010s

In 2010s, the frequency and the strength of extreme weather like typhoons and rainstorms increased. It kept retarding agricultural development in Lam Tsuen River that the farmland was always in the stage of recovery due to the frequent intervention resulting from extreme weather. (Hong Kong Observatory ,2017)

Photo source:

https://FSDVDFVDF934/0534908F/AQAAAQABAAD/2wCEASDFSDFU898SDF9JGBcXFxgXGBgYFxgYFxc WGBoXFx

The government signed up Paris Agreement in 2016 and agreed to help ease the Climate Change. To foster agricultural development, the government implemented the New Agriculture Policy (NAP) to promote the modernisation and sustainable development of local agriculture (Environment Bureau,2018)

Photo source: https://CEASDFS/5695/dDFU8dfds98SDF9JGBcXFxgXGBgYFxgYFxcWGBoXFx
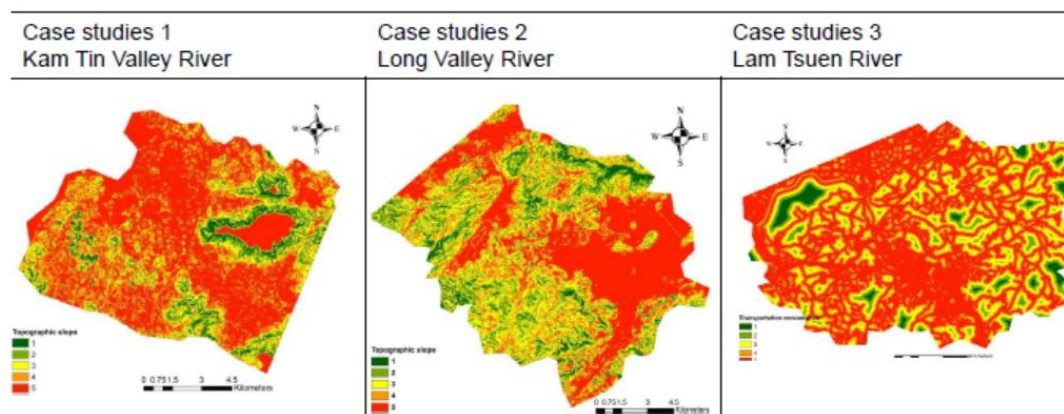
Figure: Topographic analysis

Figure waterfront analysis of three case studies
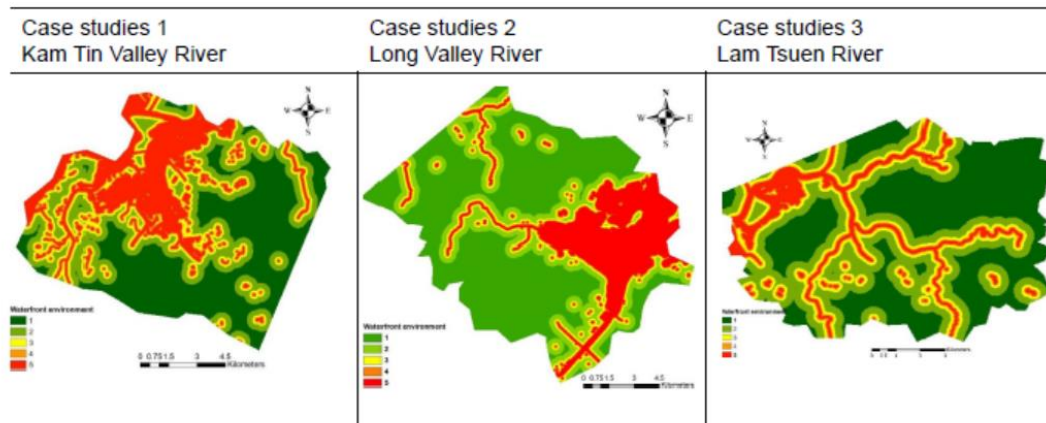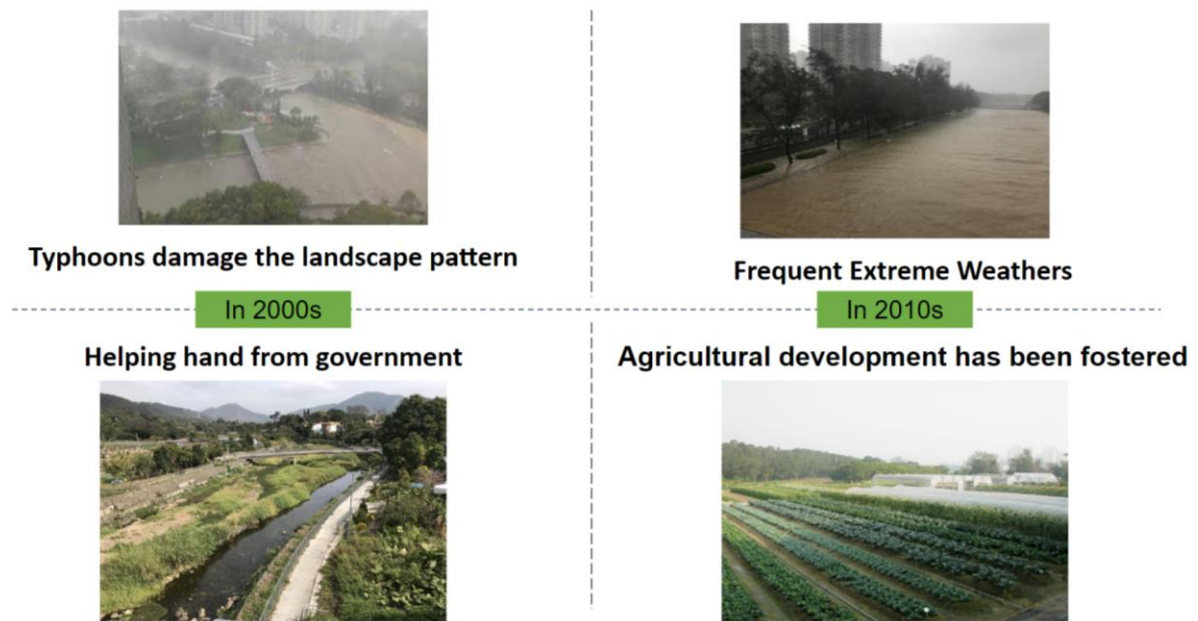
Summary of Agriculture impacts updates before and after natural disaster along Lam Tsuen River from 1950s to 2010s

Before the 2000s, natural hazards only fostered the agricultural activities once by not being affected by the construction of reservoirs and numerous farmers were moved to the areas along theLa Tsuen River to continue their agricultural business. Since the

1960s, the droughts no longer helped the agricultural development in the areas along Lam Tsuen River and brought the recession of agricultural business which just experienced its golden age in the early 1970s.

Typhoons damage the landscape pattern

In 2000s

Helping hand from government

Frequent Extreme Weathers

In 2010s

Agricultural development has been fostered

Since the 2000s, the extreme weather has brought more serious damage to the landscape pattern and agricultural business in the regions along Lam Tsuen River. Starting from 2007, the government helped the farmers with river improvement and implementation of New Agricultural Policy in 2016 and enriched the biodiversity of Lam Tsuen River with the ecological enhancement measures and investigated the biodiversity of Lam Tsuen River by conducting ecological survey. After the

actions done by the government, there is a community movement by Jockey Club, 'JC-WISE', which encourages people to treasure the water resources and to promote ideas of water conservation and sustainability. With observation on the recent phenomenon, there would be more community movement on enhancing the biodiversity and promoting the agricultural activities in the regions along Lam Tsuen

River potentially, and the extreme weather is still retarding the agricultural development by bringing serious problems of flood and strong rainstorms in near future.

3.9 Land use economic value and the financial transformation in Kam Tin Valley, Long Valley and Lam Tsuen Valley

Lam Tsuen Valley

3.9.1 **Financial transformation**

The land nearby Lam Tsuen River is mostly used as residential area with village type development and farmland for the agriculture industry, there are not great changes on financial transformation among its history.

The area has many "village houses", resulting from a 1972 Hong Kong legislation which gave any male who were over the age of 18 who was descended from one of Hong Kong's original villages in 1898 the right to build a house on a plot of land.[1]

There are also a few private housing developments in the area with "detached" and "semi-detached" houses which include communal recreational areas and some entertainment facilities.

One significant use of commercial land is the Tai Po Industrial Estate, built on the reclamation area, including Hong Kong Note Printing Limited and Hong Kong and China Gas which has its major gas plant supplies most (98%) of the town gas to the city.

Since 1998, the Lam Tsuen wishing trees became more popular and Lam Tsuen began to develop tourism. Not only attracts Hong Kong locals, but also tourists from foreign countries. Nowadays, Lam Tsuen, even Tai Po are well-known due to the wishing trees and its Wishing Festival during Lunar New Year.

Source: http://www.discoverhongkong.com/

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[1] https://www.squarefoot.com.hk/section/magazine-78-Village-people/

3.9.2 Land use economic value

The economic value of Lam Tsuen River mainly depends on its ecological and landscape value, which also attracts many nature-lovers or scientists to visit and study.

Lam Tsuen River's upstream is one of the some 30 ecologically important streams in Hong Kong, providing habitats for rare wildlife species, such as Freshwater minnow, Predaceous chub, and the Hong Kong Newt.[2]

It locates at the eastern foot of Tai Mo Shan, the highest mountain range in Hong Kong, with main landform features like V-shaped valley, interlocking spurs, rapids , waterfalls, plunge pools and canyons, Ng Tung Chai waterfall (梧桐寨瀑布) is a good example.

Source: https://fitz.hk/sports/hiking/香港山女-梧桐寨 4 大瀑布-都市清泉/

The Ng Tung Chai River Valley has already been listed as the 'Site of Special Scientific Interest' in 1979. It has a dense forest, which is one of the most diverse types of plants in Hong Kong. It includes some rare and protected species, such as nest ferns and Spiny Tree-fern.

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[2] https://www.devb.gov.hk/en/home/my_blog/index_id_271.html

3.9.3 Agriculture value

It is said that if agriculture fails to meet the rising demand of food products, it will adversely affect the growth rate of the economy.[3] The shortage of agricultural goods would lead to reduction over industrial production and the general price level increase consequently. It will hinder the growth of the region's economy.

Currently, there are only 7 square kilometres of land in Hong Kong that are actively farmed[4], it is far less than the demand for the 8 million Hongkongers. Although the major source of food supply in Hong Kong comes from foreign countries, it shows the importance of the farmland within the site.

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[3]https://www.ippmedia.com/en/features/importance-agricultural-sector-country%E2%80%99s-economic-development

[4] https://www.gov.hk/en/about/abouthk/factsheets/docs/agriculture.pdf

3.9.4 Water Resource

Due to the abundance of water in the Lam Tsuen River, the government built the Tai Po Tau Pumping Station to pump river water for drinking and irrigation. The pumping station is equipped with an inflatable dam made of artificial fiber. After inflation, it becomes a dam that blocks river water and accumulates river water. When severe rainstorms occur, the dam will deflate to allow the flood to exit.

According to the Water Supplies Department, the annual total water capacity of the Lam Tsuen River is 14.6 million cubic meters[5], a fortieth of the total water storage capacity in Hong Kong

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[5]

https://www.arcgis.com/apps/MapJournal/index.html?appid=ce0bc4772f4c4298bd45965892a742d5#

Chapter 4:

Review of the Landscape function change - Landscape & Civil Engineering Works

Chapter 4: Review of the Landscape function change - Landscape & Civil Engineering Works

Natural disasters such as hurricanes, floods, fires, earthquakes, and tornadoes are vulnerable farming practices. Given that agriculture depends on the environment, natural disasters can easily affect it. Agriculture reduction has also caused damages, such as habitat degradation, soil depletion, and air and water contamination. Agricultural production has a tangled relationship to these questions. Implementing management works is one possible remedy. The integration of technology with agriculture through infrastructure will promote sustainability, public health, and environmental efficiency. Less than a few research components reflect the relationship that a missing part is created between agriculture and civil engineering in Hong Kong.
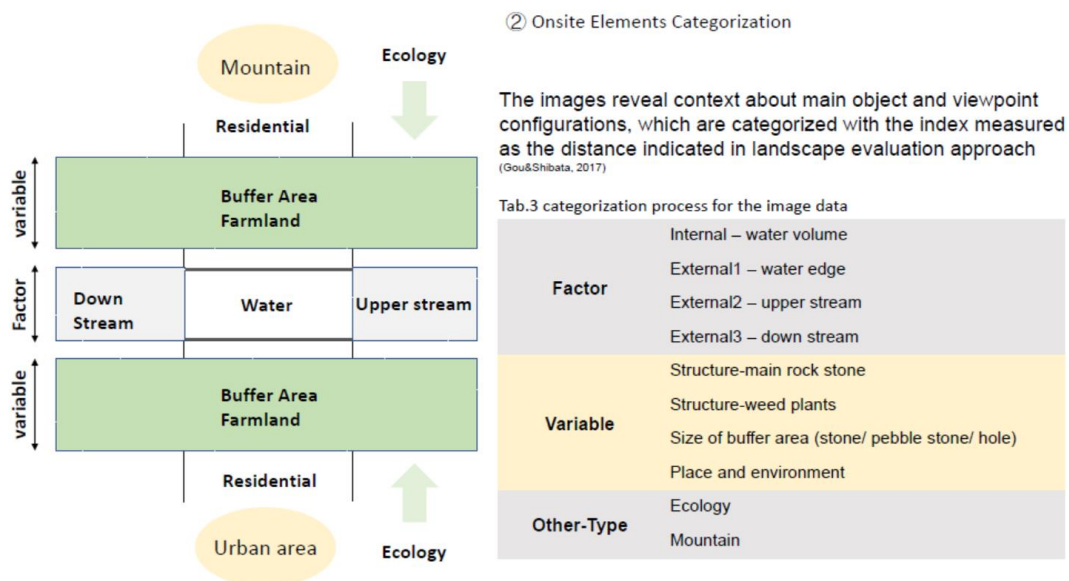

Figure: Content analysis of Lam Tsuen River

4.1. Objective process

In this report, we are attempting (1) to determine the attributes of agriculture that contribute to ecological value, (2) to investigate the reasons for the transformation of Hong Kong 's farming landscape pattern by chronic development, (3)Analysis on agricultural characteristics that can be integrated with climate change adaptation infrastructure. The area of study is the Kam Tin River, as it has been one of the largest paddies in the past and includes valuable history and culture. This work offers an overview of Hong Kong 's agricultural features and possible roles that promote ecology and biodiversity and will remind the public of the combination of the agricultural industry and will in future stimulate innovation in farming practice.

4.2. Demystifying the function of urban agriculture in Hong Kong

The Traditional Agriculture in Lam Tsuen

The Weir in the Village

Photo reference:

https://www.arcgis.com/apps/MapJournal/index.html?appid=ce0bc4772f4c4298bd45965892a742d5#

The Waterway and the Electronic Water Pump in the Village

Photo reference:

https://www.arcgis.com/apps/MapJournal/index.html?appid=ce0bc4772f4c4298bd45965892a742d5#

The farmers in Lam Tsuen will take advantage of the river to irrigate (arcgis, 2017). Weir (堰) will be constructed to redirect the water to the farm, which is like the function of a dam. The water level can be adjusted by the gate, so the farmers can store water and control the amount of water flowing into the field at the same time.

Also, there are some traditional waterway built between fields to direct the water flow. The farmers will implement some electronic water pumps to facilitate the irrigation.

Table 16. The Agriculture timeline in Hong Kong

Agriculture Timeline

Agricultural Timeline

Before 1940

British Colonial

Agriculture and fisheries industries were the main economic activities in Tai Po. In Lam Tsuen Valley, villagers' main economic activity is farming. Due to the warm and suitable climate of Hong Kong, it is suitable to grow rice, vegetables and fruits for self-sufficient or even sell them to the market.

蔬菜統營處
Vegetable Marketing Organization

嘉道理農場暨植物園
Kadoorie Farm & Botanic Garden

1940-1950

After World War II

Government agriculture policy

The British Hong Kong government adopted a positive attitude towards agriculture for the political and social stability in the New Territories by establish Vegetable Marketing Organization in 1946 to solve the problem of market manipulation at that time.

Non-profit organization support

The Kadoorie Agricultural Aid Association (KAAA) was found in 1950 for a number of agricultural aid programme to help refugee farmers.

Change of main farm products

Hong Kong's agricultural products was dominated by rice before 1950s and gradually replaced by vegetables in the 1960s which gradually dominated in the local agricultural market.

1950-1960

Farmers lost their farmlands due to construction of infrastructure

Due to the mainland migration, the government planned to build infrastructure and new towns in the New Territories to solve the rapid population growth. Some infrastructure such as a reservoir which destroyed the agricultural ecology and made the farmers lost their jobs.

Compared to the workers working in the factories who received stable salaries, farmers began to feel the economic risks of farming were very high, due to the unpredictable weather and low money return. Therefore, many farmers decided to go to urban area or Europe to find jobs.

1970-1990

Financial transformation Economic development & Decline of Agriculture

Hong Kong's agriculture and fisheries industries started to decline from 1970s when the agricultural land has been largely expropriated and large scale of reclamation due to the development of new town.

The fisheries activities shifted from Tai Po city centre to outlying islands such as Yim Tin Tsai while agriculture activities still are continuing in Lam Tsuen valley but starting to decline.

1974: First Industrial Estate

The government decided to build the first industrial estate of Hong Kong in Tai Po

1976: First Public Housing Estate

Starting to reclamation for the first public housing estate of Tai Po which is Tai Yuen Estate

1979: New Town Development

Tai Po was included in the new Town development project

1990-2000

Large import of agricultural products from Mainland

With the reform and opening-up of the Mainland China, investors opened farms in Guangdong Province at a lower cost, and mainland agricultural products began to export to the Hong Kong market which reduce the competitiveness of the local agricultural products.

1983: Melhado Case

The Melhado Case judged the use in the Block Crown Lease is only for description and does not restrict the land use, resulting in a large increase in the number of open car parks and storage yards on agricultural lands and cannibalizing rural farmlands in the New

1990s: Reclamation

Reclaimed more than 300 hectares of land which will be used to develop a largely self-sufficient community with well-developed industrial and commercial and community facilities to serve about 300,000 people.
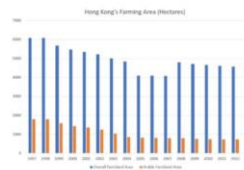
Population increase and more job opportunities are provided

2000 – 2020

Land use competition

The real estate market drove the opportunities for low-density housing in rural area which accelerate development on agricultural land, or holding the land to await development opportunities, leading to severe waste of agricultural land.

Hong Kong's agriculture is shrinking and vegetable supplies are increasingly dependent on food imports.

The output value of the crops was only $256 million in 2013, decreased by more than half from the mid-1990s and accounting for less than 0.1% of GDP.

There are about 3,794 hectares of abandoned agricultural land, accounting for more than 80% of the agricultural land area.

From 1997 to 2013, Hong Kong's overall agricultural land area, arable land area, and vegetable self-sufficiency rate decreased by 25.6%, 63.0%, and 85.6% respectively.
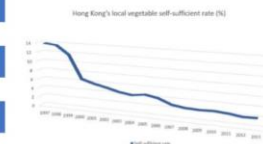
2020

Major agricultural products - Vegetables

Table 17. Major agricultural products - Vegetables in Long Valley Hong Kong

Spring	Summer	Autumn & Winter
Chinese kale	Edible amaranth	Chinese white cabbage
Chinese lettuce	Chinese Long Bean	Indian Mustard
Garlic sprouts	Water spinach	Radish
Flowering Chinese cabbage	Bitter cucumber	Winter melon

Chard	Fuzzy melon	Ginger

Food mile, the distance between the place where food is grown or made and the place where it is eaten. (Cambridge Dictionary, 2020)

Referring to the Agriculture, Fisheries and Conservation Department (2018), there are 2500 farms in Hong Kong, and it contributes $348 million of crop production in 2018, which supports 1.8% consumption in vegetables. It indicated that Hong Kong's food mainly relies on import. According to WWF-HK (2012), Hong Kong's food mile is more than 7 million miles or more.

Wet farmland

1. Ipomoea aquatica Forsk
2. Chinese watercress
3. Paddy (rice)

1. European lettuce
2. Chinese Lettuce
3. Cabbage

4. Chinese kale
5. Beets
6. Purple Wholegrain Bread

Dry farmland

7. Carrot
8. Spaghetti Squash

Figure X.X.X

Lam Tsuen is famous for its CNY flower production like peach blossom. But starting

from 80's, the agriculture of HK faded out and the flower production in Lam Tsuen faded out too. The farmland was sold to build luxurious village houses.

4.3. Civil engineering works for flood control after the modernization period

- The civil engineering works for achieving the following improvements:

- Reducing frequency, risk of natural hazard and repositioning the functions of agriculture can promote rehabilitation of agriculture in Kam Tin

- Urban agriculture can provide positive impact of biodiversity in Kam Tin

- Urban agriculture can develop successfully in Kam Tin
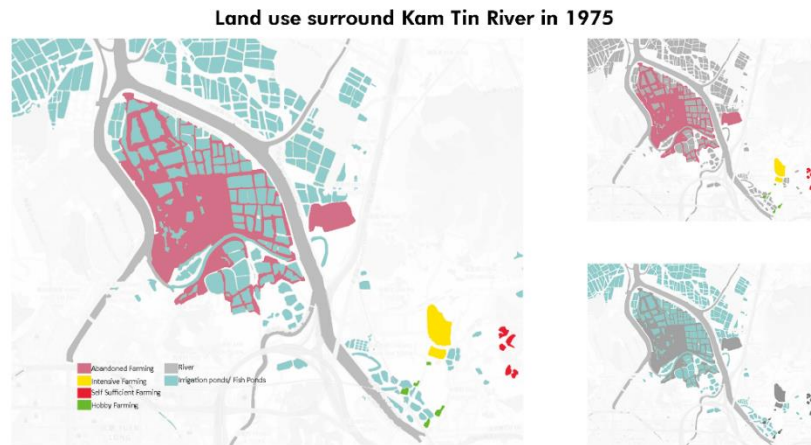
Figure: Land use situation surround Kam Tin River in 1975(Source: extracted
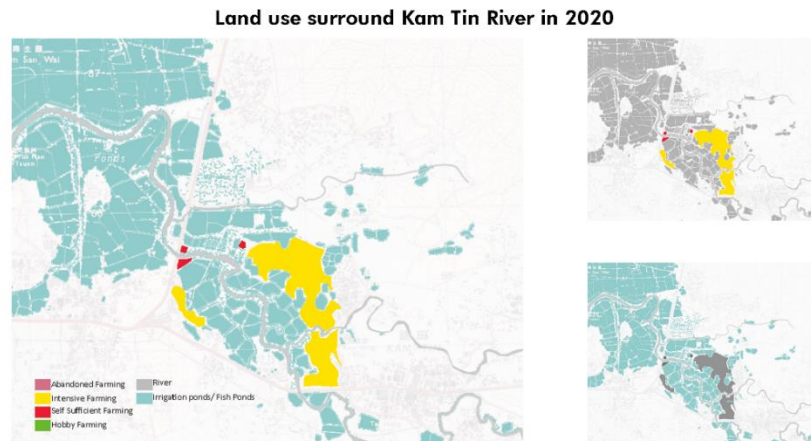
from PLAND HK)

Figure Land use situation surround Kam Tin River in 2020 (Source: extracted from PLAND HK)

Kam Tin River is arranged within the northwestern Modern Regions locale of Kam Tin, east of Yuen Long, with a range of around 44.3 km2. Its major River initially comes north of the summit of Tai Moment Shan at an elevation of 910 m, making it the second-highest River Hong Kong (the most noteworthy is in Tai Shing Stream, which determines at 930 m over ocean level). The essential stream of the Kam Tin River runs down the soak slant on the northwest side of Tai Moment Shan, passes by Course Twisk, Lui Kung Tin and Tai Ling, and enters the Kam Tin Plain. it encourages runs through Sheung Tsuen, North of Shek Kong Sleeping enclosure and Ng Ka Tsuen, sometime recently meeting west of Kam Tin Shi with an expansive tributary. It resumes its downstream stream through Nam Sang Wai west of Sha Po Tsuen and meets south of Lut Chau with Shan Pui Stream before reaching

Profound Inlet. The overall length of the essential River of Kam Tin Stream is almost 13 km, with a cruel slope of 0.069 (or 1:14.4). (jcwise.hk, n.d.)

Fig 1.3 and 1.4 indicate the difference of land use in 1975 and 2020. In Fig 1.3, because of industrialization, the agricultural land has been abandoned in 1975 which turns into an area with abundant biodiversity today. At the same time, the building density and height was low while the new town policy has not yet begun. Back to nowadays, the building density and height are relatively higher and taller owing to the demand of residence and urbanized development.

Old channel of Kam Tin River (left), New channel of Kam Tin River (right) (Source: DSD)

Methodology

To address the inquire about questions, distinguish the cause-and-effect relationship between horticulture and characteristic environment or human exercises along Kam Tin River, illustrative investigate is actualized. Quantitative inquire about strategies are the larger part. Information were combined and analyzed at first. Whereas subjective strategies are utilized as bolster and complement. Existing information were utilized to conduct different inquiries about and thinks about, such as maps, GIS information,

reports from government divisions and past considers, government arrangements etc.

Chronicle Research

For example, create timelines through combining and arranging information from maps over the years, GIS data, different papers, and reports. A timeline can demonstrate the relationship between events straightforward.

Longitudinal Studies

Alter of riverbed, change of the stream, variety of water quality was figured out by watching information over a period. This will decide the cause-and-effect relationship for those changes.

Cross-sectional Studies

Information of Kam Tin River were compared with other rivers such as the degree of flooding, the pass rate of water quality. This utilized to show the execution of Kam Tin River. Qualitative information like reports from government offices and past considers and government approaches outlined detail of occasion. For illustration, the reason of design works, the specific reason for distinctive government approach. Other than, this is to help in characterizing the key concepts such as urban agriculture. To conclude, utilize quantitative investigate strategies as the major technique encourage the method of finding cause-and-effect relationship since data is appeared straightforwardly. At the same time, subjective investigate strategies filled up the crevice and make the report to a more perfect one.

4.4. Civil engineering works for agricultural improvement
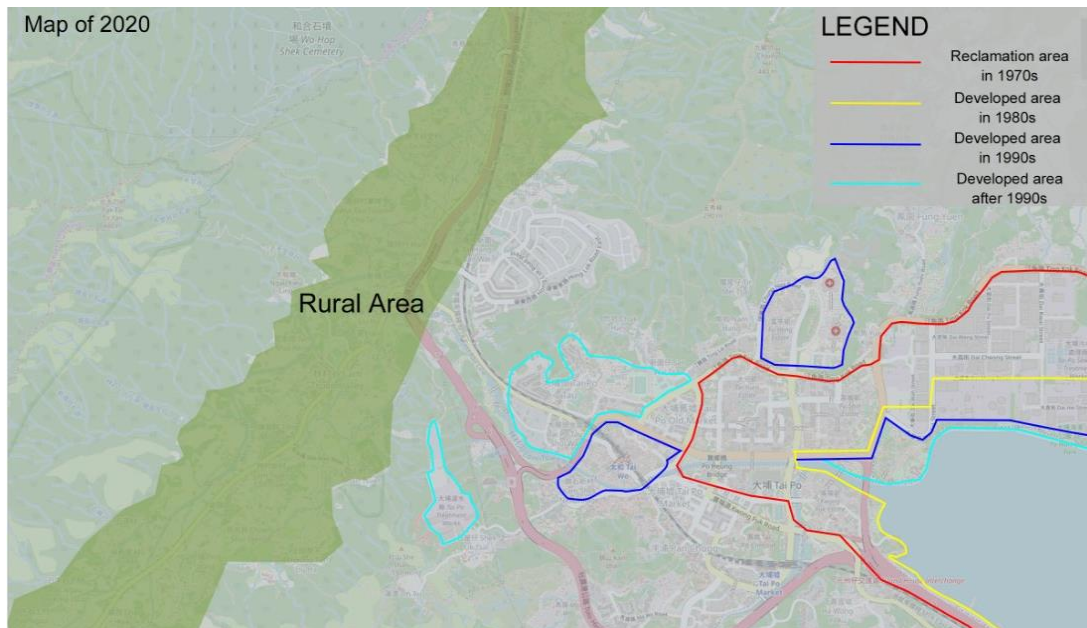
The Figure above shows there is a huge change in Tai Po between 1970s and 2020s.

According to the Planning Department (2002), reclamation works for the Tai Po

industrial Estate and the first public housing in Tai Po were commenced in 1976.

Therefore, the coastal area at south east was expanded. Then, the reclamation zone

was developed as industrial estate as well as residential area. Till 1990s, the land was

further developed as large community to serve the local people. After that, some areas

at the south, which were villages originally, were redeveloped as the extension of

urban area as well as Tai Po Water Treatment Works.

In short, the development in Tai Po urban area changed the service object of Lam

Tsuen River, some villages that the river passed changed to be urban nowadays,

which also changed the function of the river.
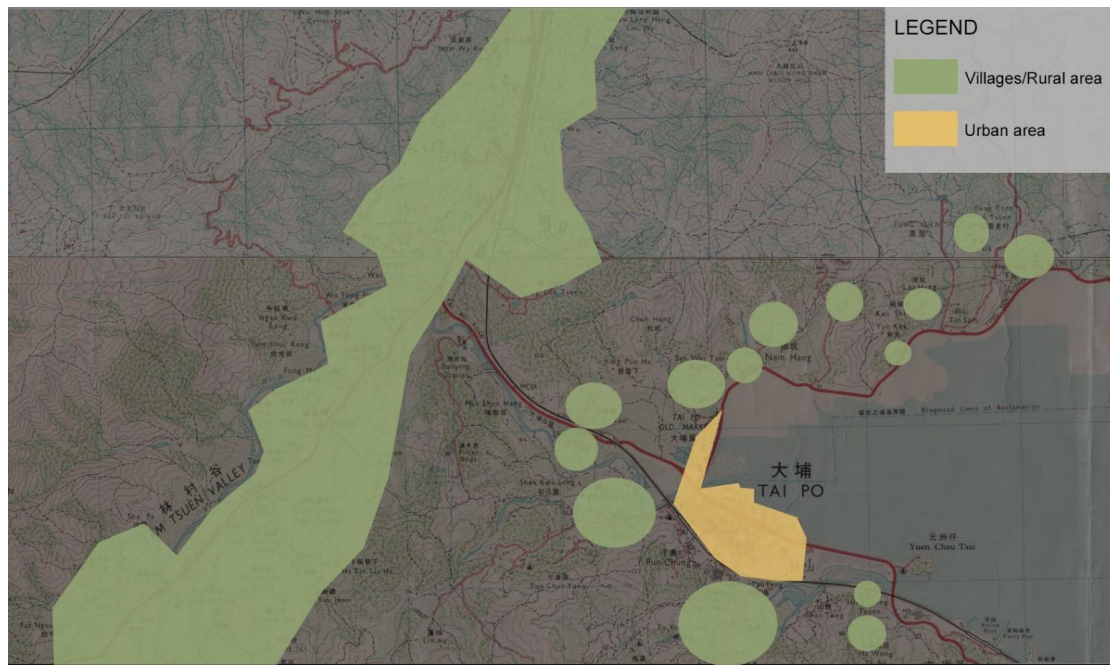
In 1985, residential buildings and industrial estate were developed in reclamation area. Also, the urban area was expanded. Meanwhile, some villages near the urban area were moved or abandoned for urbanization and redevelopment.
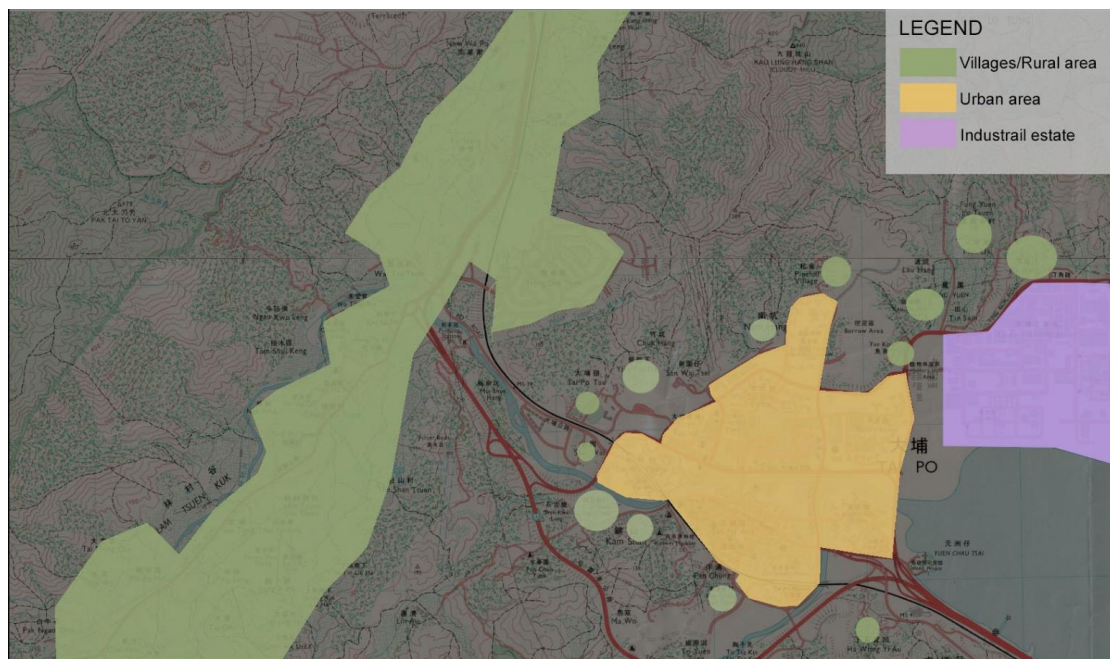
In 1987, urban area and industrial estate were further expanded. At the same time, the number of villages that near the urban area kept decreasing.

Map of 2020. Nowadays, urban area in Tai Po was huge expanded. Most of the villages which were originally near the city centre were disappeared due to urbanization and the villages at the west mostly remain. Moreover, Tai Po Treatment Works was built.

Table 18. Summary Table

	1970s	1980s	After 1990s
Urban Area	Small	Start expanded	Huge
Villages	A lot	Decrease	Villages nearby urban area moved/abandoned
Industrail Area	No	Developing in reclamation area	Mainly in reclamation area
Government buildings	No	No	Tai Po Treatments Works was built

Since Lam Tsuen river has faced many times of severe typhoon, flooding and rainstorm problem since 1970s and these natural hazard had damaged the river bank and ecosystem of Lam Tsuen, therefore the DSD has launched two times of river civil engineering works to tackle these problems. In this section, the pre-flooding construction project of the DSD and other sustainable drainage system would be discussed detaily.

Lam Tsuen River has carried out two times of pre-flooding construction works in 2007 and 2015, these two projects aim to improve the drainage system to alleviate the flooding problem.

In 1999, the DSD has reviewed the drainage systems in Lam Tsuen. The study has pointed out that the existing drainage system were deficient and fail to support the river load and meet the required flood protection standard and has designed to carry out the drainage improvement work in 2007.

The project included construction of 2.6 km of drainage channel with ranging from 18 metres (m) to 29 m in upper Lam Tsuen River.And the design of the channel works has been taylor made in order to meet the geotechnical conditions of the Lam Tsuen River, can prevent the poor subsoil problem and meet the standard of flood protection.

The second drainage improvement works
Project title: Blue- Green Infrastructure in Lower Lam Tsuen River
Department in charge: The Drainage Services Department
Construction time: 2015-2017 (Lau, 2018)

River channelisation and Gabion banks

Widening and deepening the river banks to increase the capacity for flow volume at specific sections of the river. Therefore, watercourses can move more efficiently, less damages to banks. Furthermore, channelization can provide erosion control and the rehabilitation of watercourses

Gabion banks help to control and prevent landslides, erosion and stabling the riverbanks during flooding and high velocity of river flow.

A river cross-section after river channelisation and placing gabion banks

Gabion
Existing bed substrate/Rock fill
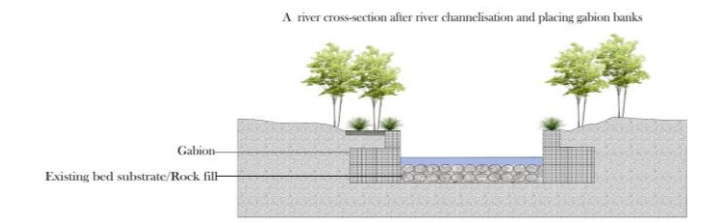
River strengthening and Gabion banks

A river cross-section after river strengthening

Gabion
Existing bed substrate/Rock fill

Deepening the riverbank

A river cross-secion after deepening the riverbed and widening riverbank

Retaining wall
Gabion
Existing bed substrate/Rock fill
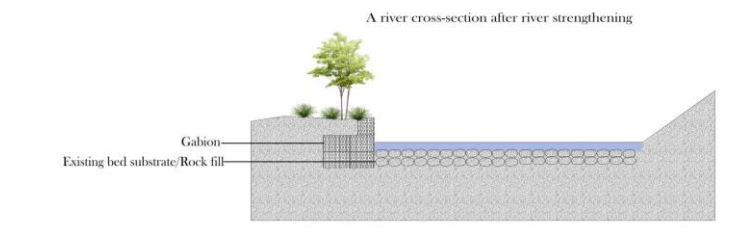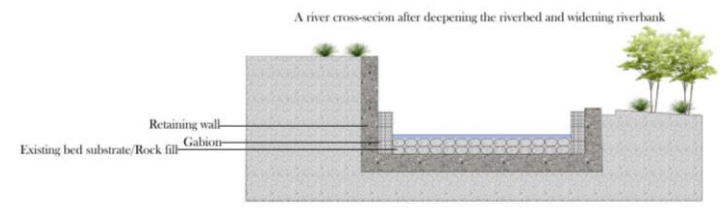
4.5. Relocation of rice field

4.5.1. Process of agriculture land damages and the method of restoration

Ecosystem

An ecosystem is a community of living organisms in conjunction with the nonliving components of their environment interacting as a system (Molles, 1999).

Factors effecting ecosystem

The ecosystem effecting by abiotic and biotic factors. The abiotic factors are the influences of the non-living parts of the ecosystem. Like pH, salinity, temperature, wind speed and direction, humidity, water pressure, and light intensity and quality. The biotic factors are the influences of the living parts of the ecosystem. Like competitors, parasites, pathogens, and predators. (figure 3.1.1)

4.5.2. Challenges faced by farmers (Loss of farmlands and uncertain farmland leases)

2. <u>Chronicle summary of Kam Tin river projects</u>
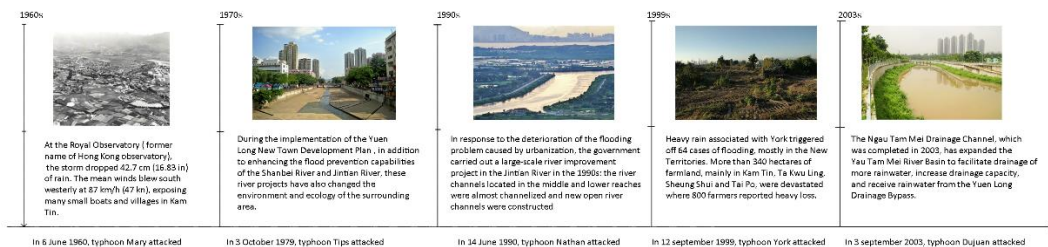
3.
4. Fig x.x.x indicates what significant river drainage constructions have been done in Kam Tin to improve the water capacity while several typhoons attacked Hong Kong in the past.

1960s

At the Royal Observatory (former
name of Hong Kong observatory),
the storm dropped 42.7 cm (16.83 in)
of rain. The mean winds blew south
westerly at 87 km/h (47 kn), exposing
many small boats and villages in Kam
Tin.

1970s

During the implementation of the Yuen
Long New Town Development Plan , in addition
to enhancing the flood prevention capabilities
of the Shanbei River and Jintian River, these
river projects have also changed the
environment and ecology of the surrounding
area.

5.

In 6 June 1960, typhoon Mary attacked

In 3 October 1979, typhoon Tips attacked

1990s

In response to the deterioration of the flooding
problem caused by urbanization, the government
carried out a large-scale river improvement
project in the Jintian River in the 1990s: the river
channels located in the middle and lower reaches
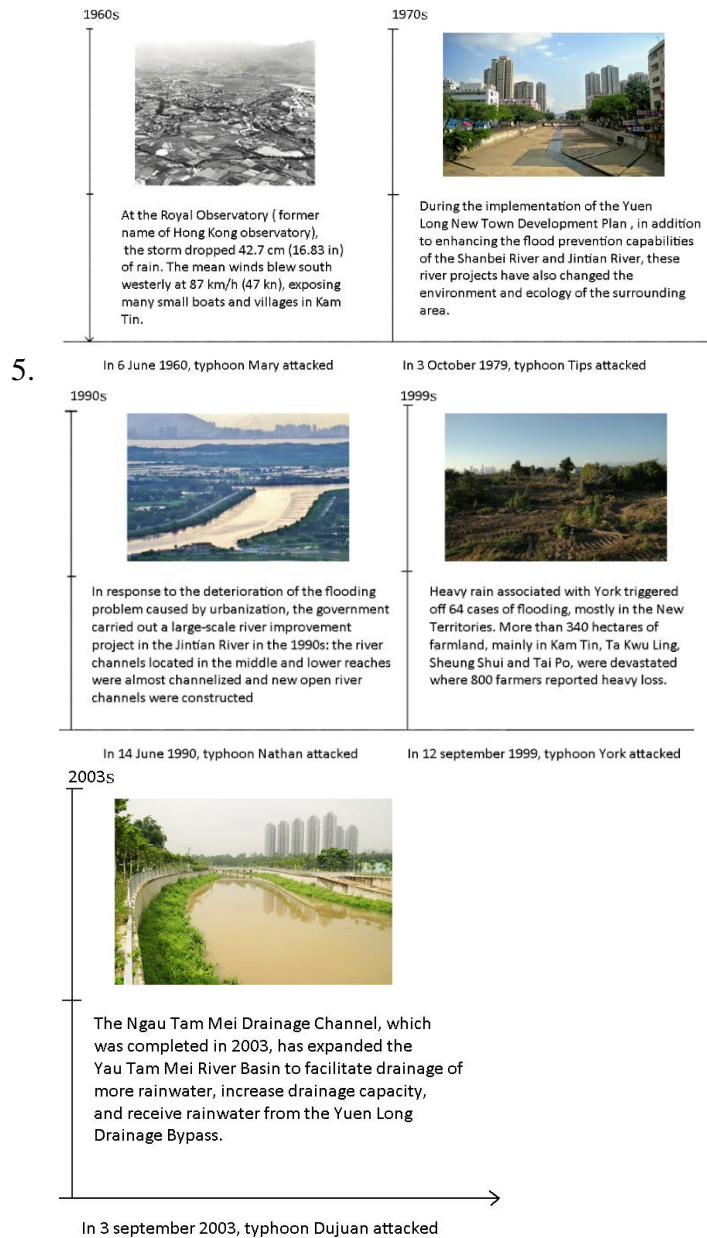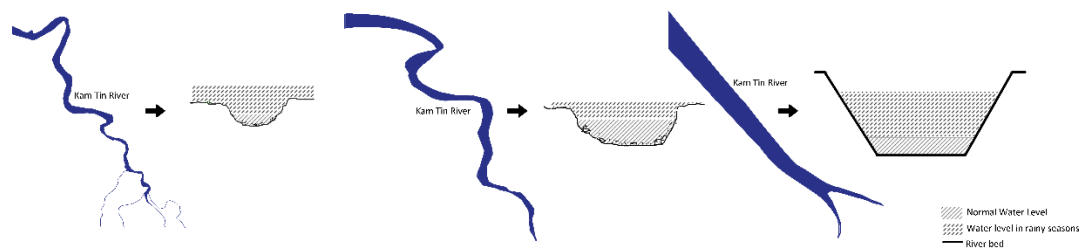were almost channelized and new open river
channels were constructed

1999s

Heavy rain associated with York triggered
off 64 cases of flooding, mostly in the New
Territories. More than 340 hectares of
farmland, mainly in Kam Tin, Ta Kwu Ling,
Sheung Shui and Tai Po, were devastated
where 800 farmers reported heavy loss.

In 14 June 1990, typhoon Nathan attacked

In 12 september 1999, typhoon York attacked

2003s

The Ngau Tam Mei Drainage Channel, which
was completed in 2003, has expanded the
Yau Tam Mei River Basin to facilitate drainage of
more rainwater, increase drainage capacity,
and receive rainwater from the Yuen Long
Drainage Bypass.

In 3 september 2003, typhoon Dujuan attacked

Section drawing of river form in different period

Kam Tin River

Kam Tin River

Kam Tin River

Normal Water level
Water level in rainy seasons
River bed

The figure showed the shape of the Kam Tin River and its
riverbed'stransformation from 1949 to 1975 and 1987 to present.

In 1949, When tap water was not available locally, farmers-built dams on

mountain streams to store water and connected water pipes to divert the mountain

water to farms and farmland for livestock raising, irrigation, and daily use, it was

one of the largest rivers in Hong Kong, classified as a fifth-order river. In 1975,

even though the width of the Kam Tin river already expanded for water capacity,

the shape of the riverbed did not change much, the natural appearance which is the

uneven riverbed is preserved in this stage. In 1987, the river was straightened, and

the riverbed flattened, the river became more artificial, so that the flood can be

drained quickly.

4.5.3. Land use changes

The following figures, indicates the stimulation of extreme situation of sea
level rise using GIS method (Source: data adapted from IPCC, Liz Wong)
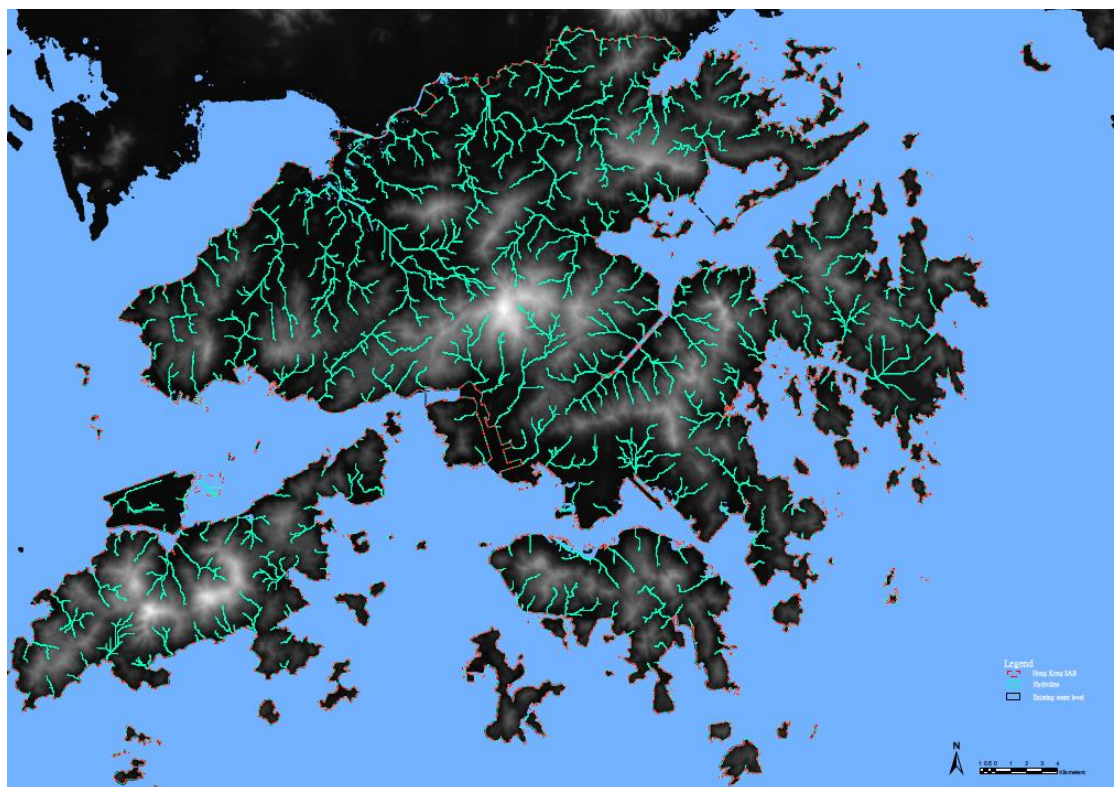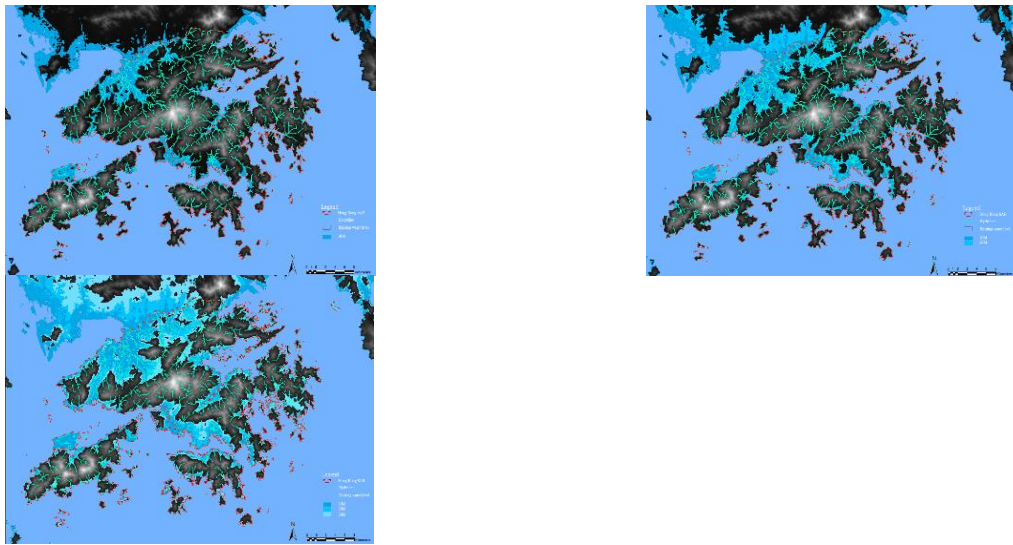
Figure Current sea level at 1.48m

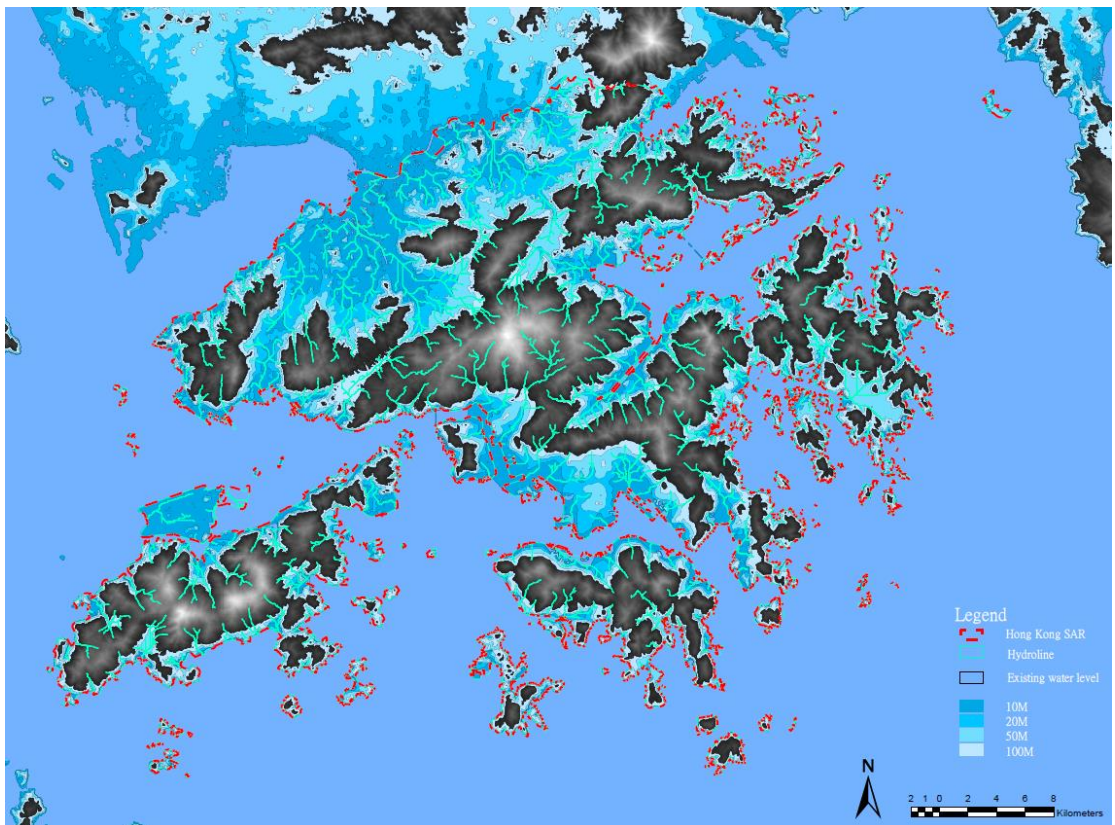Figure sea level raised 10, 20, 50m (from left to right)

Figure shown the sea level raised 100m

Due to the impact of the subtropical climate, Hong Kong often experiences heavy rain, with an average annual rainfall of 2200 mm (HKO,2020), making it one of the cities with the highest rainfall on the Pacific coast. During heavy

rain, flooding often occurs in low-lying rural areas, natural flood plains and known flooding black spots.

As the sea level varied dramatically during typhoon season, it is difficult to measure the impacts of extreme weather in 10, 20, 50 years. The data adopted to the stimulation is extracted from the SROCC report (IPCC, 2019), noted the high greenhouse gas emission scenario with RCP8.5. The intention of taking the most serious case is to stimulate the worst situation of Hong Kong in future. With the stimulation, Hong Kong can respond to the issue earlier and prevent social-economic and environmental loss from most catastrophic damages. Thus, the figure 1.7 and 1.8 indicates Hong Kong at different sea level rises in various colours, which are 10, 20, 50 and 100 meters. When the sea level rises 100 meters, about 40% of Hong Kong's land will be covered by water and whole Kam Tin would be flooded after the extreme sea-level rise.

4.6. Disappeared of rice paddies

Positive and negative effects of infrastructure on nature

Within the think about of foundation and environment (INTOSAI WGEA, 2013), framework has a few impacts on the environment in Arrive, Environment, Water assets and the water environment, Materials, Vitality, nursery gasses and other outflows to discuss, and Human environment. In this investigate, as the impacts related to infrastructure, environment, and farming. Within the perspective, it may be cleaned or remediated at the level vital for the expecting future utilize of the arrive after overhauling or decommissioning. For this case, the arrival of the remediation for agricultural utilize must be exceptionally high and may require less mechanical remediation. In any case, the pulverization of trees and woodland debasement may diminish their strength and their capacity to serve as a' sink' for carbon emanations. It can evacuate normal wind and climate obstructions that can contribute to soil disintegration and influence other natural conditions. Within the environment angle, the advancement and transfer of framework can offer on-site

openings to upgrade, make strides or make unused natural life and plant territories. The improvement may incorporate spaces for existing environments, imperative species, buffer zones and scene characteristics in their design–to guarantee that the location keeps up its capacity to advance the differences, wealth, relocation, dispersal and hereditary trade of natural life. Although, Advancement of framework may diminish the capacity for climate alter adjustment of the characteristic environment, its environments, and the species.

Hybrid infrastructure

Concurring to the ponder (Y. Depietri and T. McPhearson,2017), it is proposed that grey-green-blue foundation may be the foremost compelling approach for climate alter adaption and calamity hazard lessening in urban cities. The characteristics of dim, green, blue, and crossover infrastructure approaches are checked on within the article. The reliance of biological system as a key to an urban range is talked about through a case think about of Modern York City and writing survey. The creators moreover say the result of actualizing only "grey" and simply "green and blue" foundation. In the meantime, there is another report also suggested that a blend of dark, green, blue framework is the leading procedure for surge relief. Based on the research (Alves et al., 2019), it is specified that the co-benefits of green-blue foundation was not included within the money related investigation of surge hazard moderation measures already. Thus, the analysts conducted a case ponder comparing the comes about of costs and benefits with and without co-benefits. The green, blue, and dark measures and

varieties of the diverse mediation approaches were talked about. The comes about demonstrate that the investigation which incorporates co-benefits of green-blue foundation within the appraisal is the ideal arrangement to urban surge hazard management.

Urban Agriculture application in the urban city

Urban Farming (UA) can be characterized as the developing, handling, and conveyance of nourishment and other items through plant development and at times raising animals in and around cities for nourishing neighborhood populaces (Kulak, M., Graves, A., & Chatterton, J,2013). The reason of creating urban agriculture-related to the worldwide populace developing expanded weight on arrive, the world's populace is anticipated to extend from 7.7 billion to 9.7 billion in 2050 (Joined together Nations,2019). Another concern on climate alter influence trim and animals' generation, the climatic variables is the basic of farming. The dubious climate alter will influence precipitation designs and an increment in CO2 levels which influence worldwide horticulture (Malcoms S,2008). The result of urbanizations tending to nourishment frailty, water runoff, warm island impact, vitality proficiency and discuss quality in urban zones. Urban farming can be considered an arrangement to extend nourishment supply and diminish the effect on the environment, "takes the frame of housetop and overhang farming or community farming in empty places and parks, roadside urban periphery agriculture" (Urban Agriculture,2016).

4.6.1. Changes of the form of practice for Agriculture

Challenges faced by famers (loss of farmlands and uncertain farmland leases)

A flood plain near Sheung Yue River has developed. Also, some natural steam appeared along the Sheung Yue River.

Flooding fertilize soil along the river. Farming started and people started living along the river.

Different types of farming appeared along the river. Urban development behind the village form strong contrast. Also, more people living along the river decrease the ratio of farmlands.

Figure. The development of agriculture in Hong Kong

Compared to other foreign cities, Hong Kong is experiencing less major force and rising danger including typhoon, flooding, and land subsidence. The vivid samples for manmade hazards construct collapse, vessel fuel explosion or transport accident that occurred inside the urban city. One natural danger happened more often than not, which is flooding, and it definitely needs a consistent preparation and execution of disaster risk mitigation management.

Flooding in farming and suburban areas of Hong Kong is undeniable. Agricultural land generally built on a flood plain, a kind of swampland before it was settled. After 1891, when faced with many powerful typhoon and flooding problems, they were designed as a network of natural and manmade canalsIt has certainly made the flood waters drain a better network. Through using trees, modernizing civil engineering works or so on, Hong Kong villagers lived with or some of them even tolerated the flooding over two decades. Certain villagers lived, no doubt, in hoses that were built together to withstand floodwaters.

Following a civil engineering work implemented in the villages, rivers were further widened which were deemed more capable of absorbing floodwater and preventing floodwater flush to the road and houses being constructed. In order to address the flooding problem, the rapid growth of the city and the restoration of the village have contributed in many respects.

Lessons learned

What were the key principles or things learned from the previous flood hazard? It is noted that human activity appears to alter the question of natural drainage. Via past case studies, we trust that to keep track of a daily preparation is complementary item. Both civil works and manmade activities will encounter the natural danger and likely flush with floodwater.

It is common to see the placing of a higher embankment to avoid flooding of the river. The level of flooding is sure to be deducted before the heavy rain arrives. It is recommended that all water channel and drainage systems be dragged off to ensure that no sediment changes the water storage to runoff process.

General, monitoring, and periodic maintenance are required. It is likely to create a better realm while the natural hazard is coming, so that the government has enough time to allocate the resource to respond to the relevant rescue measures. Hopefully soon, the key to sustaining the system is proper operation with different departments. In the long valley operating system, it will operate with Highway Department, Water Service Department, Drainage Service Department, Department of Environmental Protection and so on.

Once the civil engineering works are implemented, it becomes more convenient for the people. It does produce some side effect on the surrounding behaviors and climate, however.

4.7. Questionnaire survey methods – Interview farmer, former citizens/ current citizens

Based on the theme "Introducing community engagement in the landscape design process, this pre-test survey will help a city achieve its sustainability goals." This questionnaire will check the instrument of the survey and the method of collecting data. Our goal is to ensure the knowledge is accurately represented in the questions being asked. The sampling technique used in this survey is convenience sampling, as this enables us to achieve the sample size in a fairly efficient and inexpensive manner; in this survey, we used snowball sampling by chain referral, enabling us to reach populations that are difficult to get during the coronary virus outbreak period. It is an simple and cost-effective process, needs little planning compared with other sampling strategies and less workforce.

Conclusion

Based on the outcome, it can be concluded that the ecological improvement in Lam Tsuen, Long Valley and Kam Tin River. has had a very strong influence on residents' livelihood. It is widely accepted that the project has brought beneficial results to relationships between humans and nature and the environment. Lower community involvement, however, remains an issue at Lam Tsuen, Long Valley and Kam Tin River.

There was a high degree of attention to public awareness about sustainable

development at Lam Tsuen, Long Valley and Kam Tin River. Lam Tsuen, Long

Valley and Kam Tin River.lacks any public space and entertainment facilities.

Increasing public spaces and emphasizing local features and culture are also important

for the future development of Lam Tsuen River.

Consequently, Lam Tsuen, Long Valley and Kam Tin River's current sustainable

development demands better enhancement to boost overall efficiency and become a

diverse area. To summarise, the following concept statement also concluded the user

community and related context information.

4.8 The formation of factor analysis

The formation of factor analysis for the Lam Tsuen, Long Valley and Kam Tin River

shown in the following:
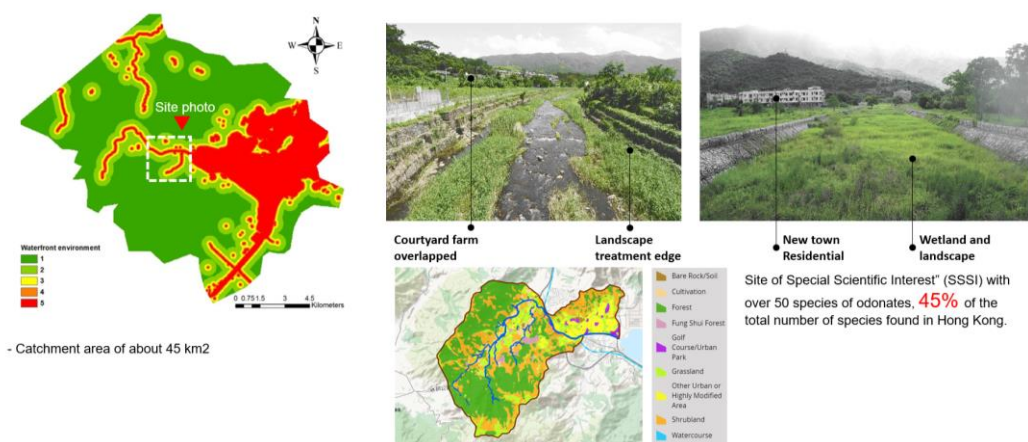
Site A: Lam Tsuen Valley River

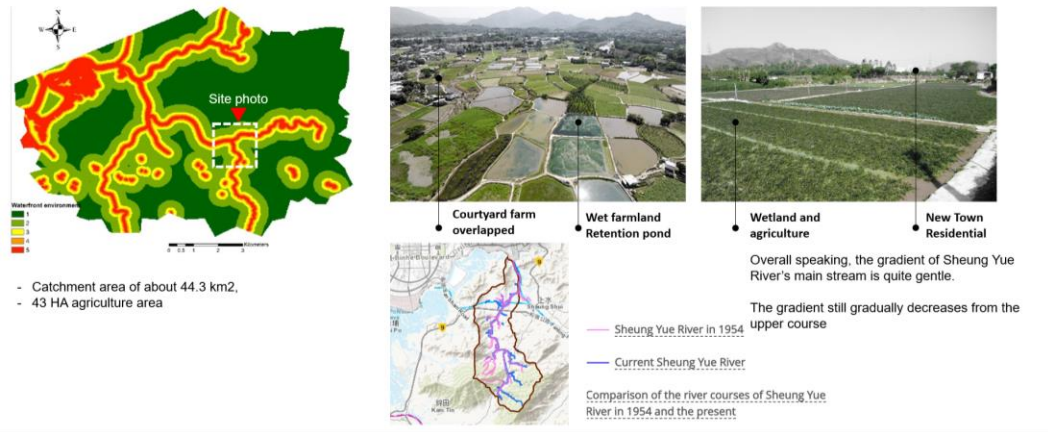*Figure 58. Lam Tsuen River's landscpae elements*

Site B: Long Valley River

Figure 59. Long Valley River's landscpae elements
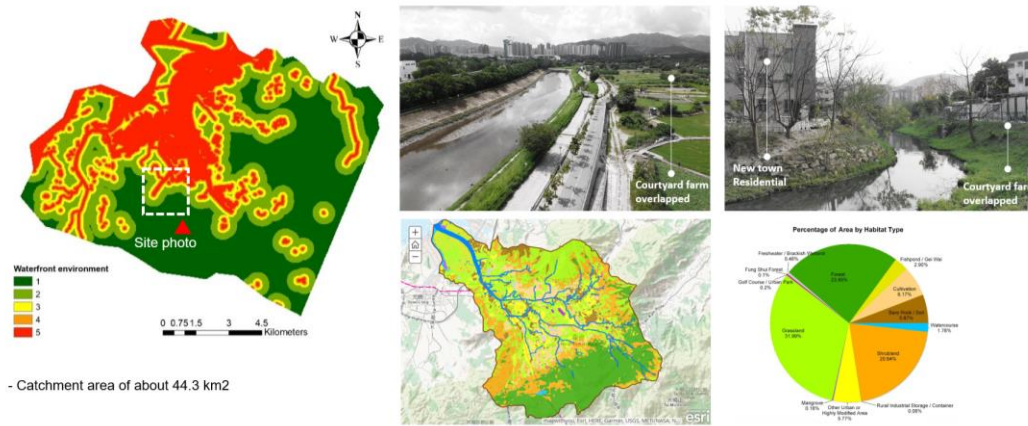
Site C: Kam Tin Valley River

Figure 60. Kam Tin River's landscpae elements

Conclusion Statement

While several developments have enhanced the Lam Tsuen, Long Valley and Kam

Tin River, we conclude that the pre-test identifies some question errors such as lower

community outreach, more preference for sustainable development, detects problems in the public opinion's question-and-answer process, and preference for environmental sustainability in Lam Tsuen.

In Lam Tsuen River, the Site of Special Scientific Interest" (SSSI) with over 50 species of odonates, 45% of the total number of species found in Hong Kong.

As a result, the questionnaire is validated between the intended respondents and adapted to the question-and-answer process.
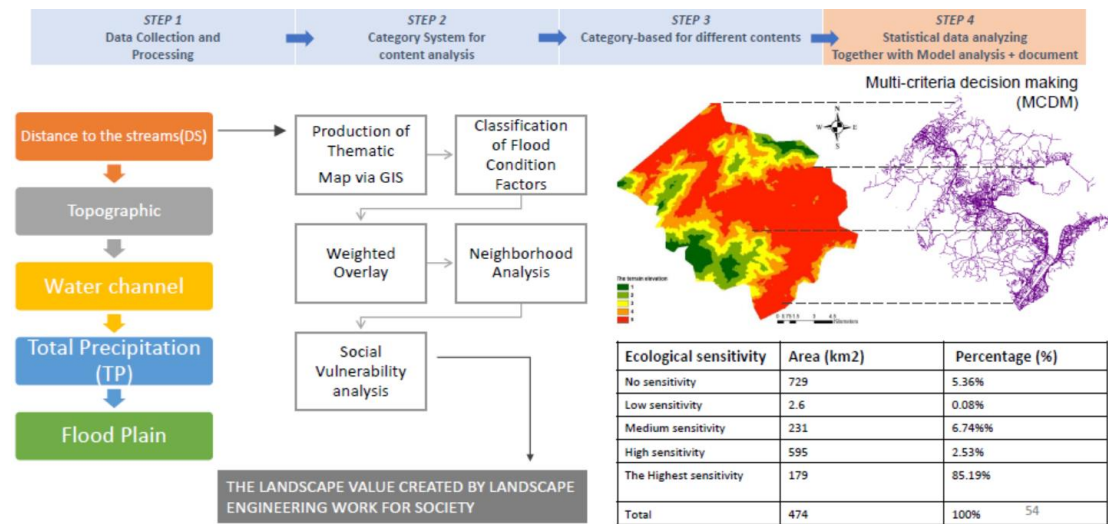
Chapter 5:

Conclusion

Chapter 5: Conclusion

STEP 1 Data Collection and Processing	STEP 2 Category System for content analysis	STEP 3 Category-based for different contents	STEP 4 Statistical data analyzing Together with Model analysis + document

Multi-criteria decision making (MCDM)

| Ecological sensitivity	Area (km2)	Percentage (%)
No sensitivity	729	5.36%
Low sensitivity	2.6	0.08%
Medium sensitivity	231	6.74%%
High sensitivity	595	2.53%
The Highest sensitivity	179	85.19%
Total	474	100%

Table 19. The process of GIS analysis and MCDM

5.1. Tendency and Significance of urban farming in redevelopment framework

River management alters the drainage system for flooding issue and settlement of surround fabric

Using GIS method, Tai Po is found as one of the flooding blackspots in Hong Kong. From the news report, we also conducted the report about the flooding issue and damages from typhoons in New Territories North. Although there is still seasonal heavy rainfall and its unique landform which may lead to landslides, the problem of flooding in Lam Tsuen River is decreasing after the river management.
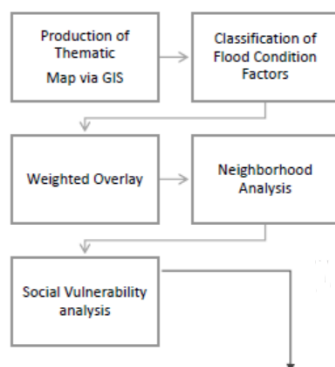
By analyzing the combination of multi-criteria decision-making (MCDM) with geographic information systems (GIS) proposed in the present research, ArcGIS has determined the suitability values for the study areas. (Danger, exposure and vulnerability) to assess social ,
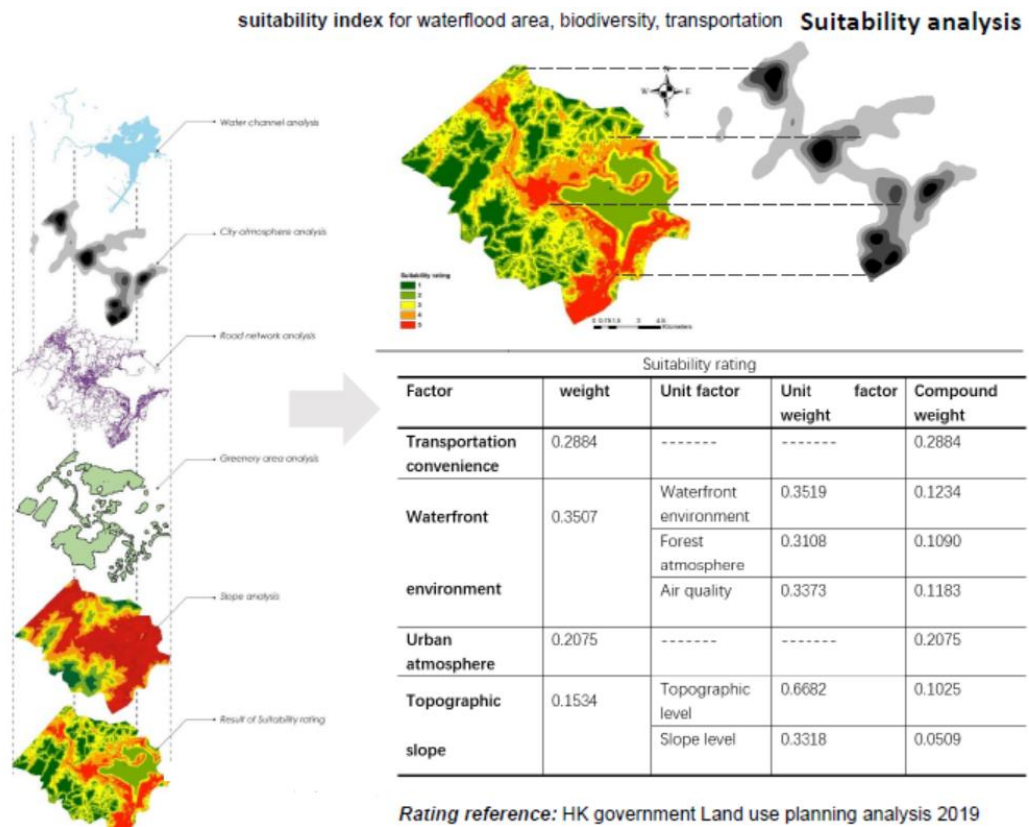
economic and/or environmental vulnerabilities.

suitability index for waterflood area, biodiversity, transportation **Suitability analysis**

Factor	weight	Unit factor	Unit factor weight	Compound weight
Transportation convenience	0.2884	-------	-------	0.2884
Waterfront	0.3507	Waterfront environment	0.3519	0.1234
		Forest atmosphere	0.3108	0.1090
environment		Air quality	0.3373	0.1183
Urban atmosphere	0.2075	-------	-------	0.2075
Topographic	0.1534	Topographic level	0.6682	0.1025
slope		Slope level	0.3318	0.0509

Rating reference: HK government Land use planning analysis 2019

Table 20. The suitability rating layers

Solution for the flooding issues over agriculture pattern

During heavy rainstorms the Lam Tsuen River Valley was prone to flooding in the 1990's. Between 2007 and 2012, the DSD's "River Improvement Works in Upper Lam Tsuen River" had straightened, widened, and deepened 2.6 kilometers of the upper river to increase drainage capacity.

1. On and around the river, for example, were installed Zig-zag Fish Ladder, New Gabion banks, Rip-rap riverbed foundation. Selected plants are widely cultivated on the banks of the river to improve the landscape, biodiversity, and greening of

rivers. These that the risk of flooding and landslides, thereby protecting the crops

from natural disaster damage.

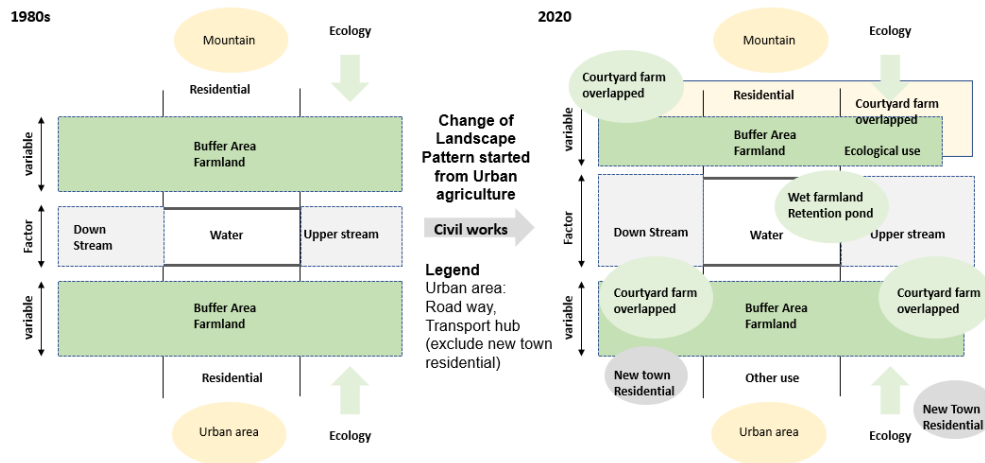## Site A: Lam Tsuen River – Spatial analysis and component model

Figure 61. Model change in Lam Tsuen River

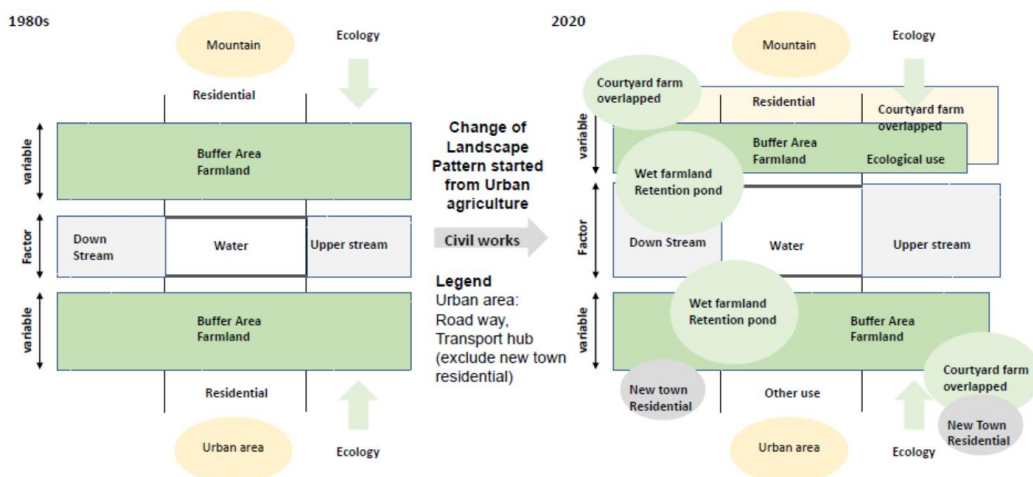## Site B: Long Valley River – Spatial analysis and component model

Figure 62. Model change in Long Valley River

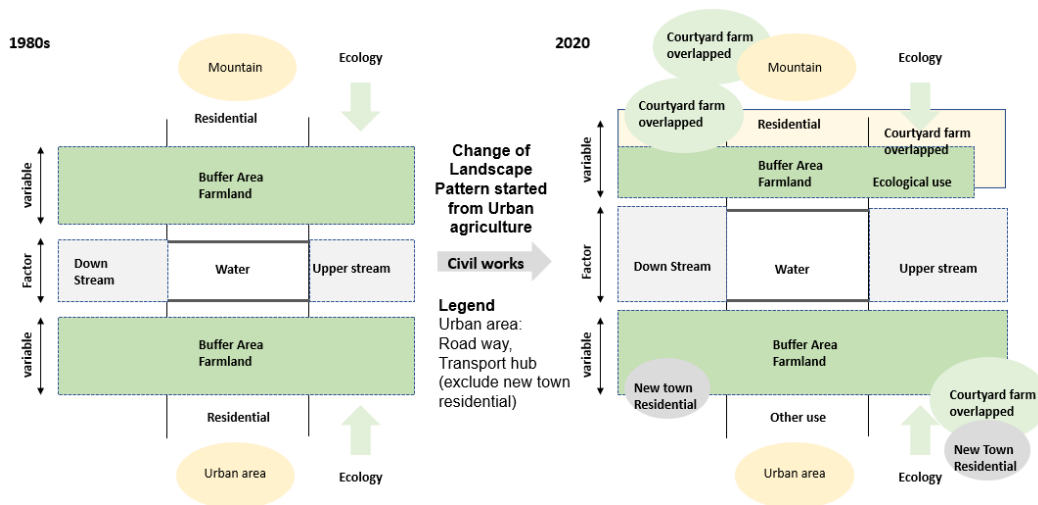Site C: Kam Tin River – Spatial analysis and component model

Figure 63. Model change in Kam Tin River

**Implication of the river affects the ecological settings**

Tai Po has Hong Kong's second largest egretry, after Mai Po. The river contains numerous animal groups, including fish, amphibians (e.g., Hong Kong Newt), dragonflies, and birds.

By reviewing reports from some authorities and obtaining various data, such as analyzing the changing water quality in major rivers, rainfall and discharge and compliance in Hong Kong's inland waters, etc. Compared to other Hong Kong rivers, we may find that Lam Tsuen River's water quality in 2016 has improved during management and is second just below the Tai Po Dam.

Additionally, it enriched the ecosystem with higher stability and expanded the biodiversity allowing its capacity to reach over 3000 species. As a result, the number

of Hong Kong Newts and other species types increased after the 2012 management.

By this phenomenon, it can reveal ecosystem enhancement.
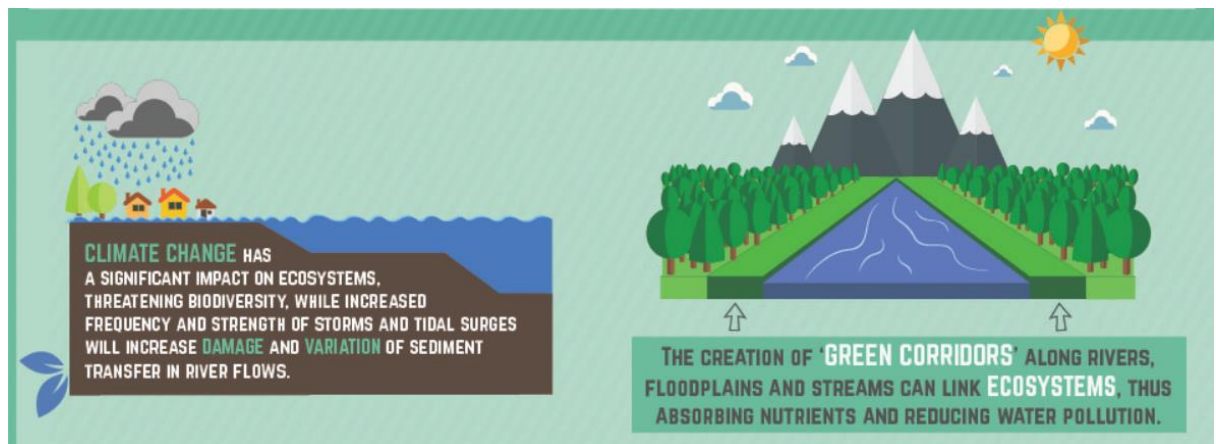
Source: https://www.un.org/waterforlifedecade/images/Infographic_light_01.jpg

Consequently, the hypothesis which "damage mitigation has resulted, and natural

hazards are also caused by the Lam Tsuen River management in 2012 to improve

biodiversity protection" is relevant.

5.2 Landscape changes due to Urban development and Natural disaster

Landscape function change due to the natural disaster – Kam Tin Valley,

Long Valley and Lam Tsuen River

1974 – Industrial estate and ToLo highway were yet to build	2006 – Kam Tin River basin had been passed though by highway and different infrastructure

Table 21. Development of Kam Tin Valley River

Agriculture

It has been covered by two natural screens-northern ridges of Tai Mo Shan and Tai To Yan, thanks to the good location of Lam Tsuen Valley. In summer time the typhoon season and in winter the Northerlies do not bring certain impacts to Lam Tsuen Valley. Due to the year-round flow from the Lam Tsuen River, fertile alluvial soil, settlement, and farming activities were started in the early settlement back to the Ming Dynasty. To facilitate the cultivation of crops and agricultural products by Hakka farmers, government has prepared the encouragement for river settlement.

Due to the Japanese military's food shortage, most of the agricultural land during

the Japanese occupation was developed and cultivated in a short period.

Especially after the war of the Ww2, Lam Tsuen continued to operate as farmland

that came to the great demand for food and vegetation. Immigrants were

introducing large quantities of labor force farming equipment. The golden era

from the 1950s to the 1970s for the growth of agriculture at Lam Tsuen.

Besides rice and vegetables, farmers harvested excellent market price of editable

fruits and ornamental plants. These farmers built several other new facilities,

sampling as weirs on the irrigation channels etc.
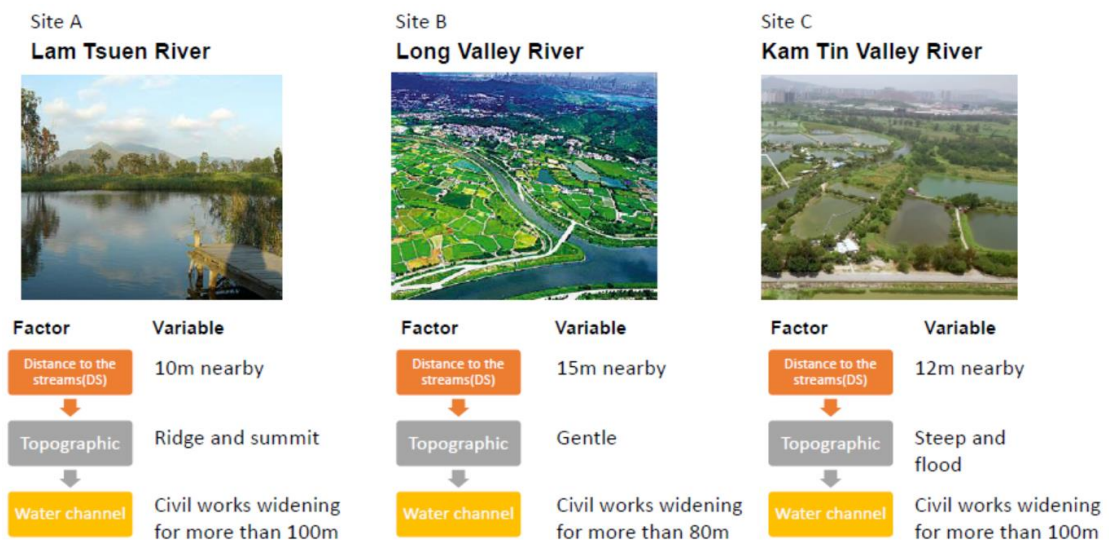
Development rate of these three rivers

Figure 64. Development rate of these three rivers
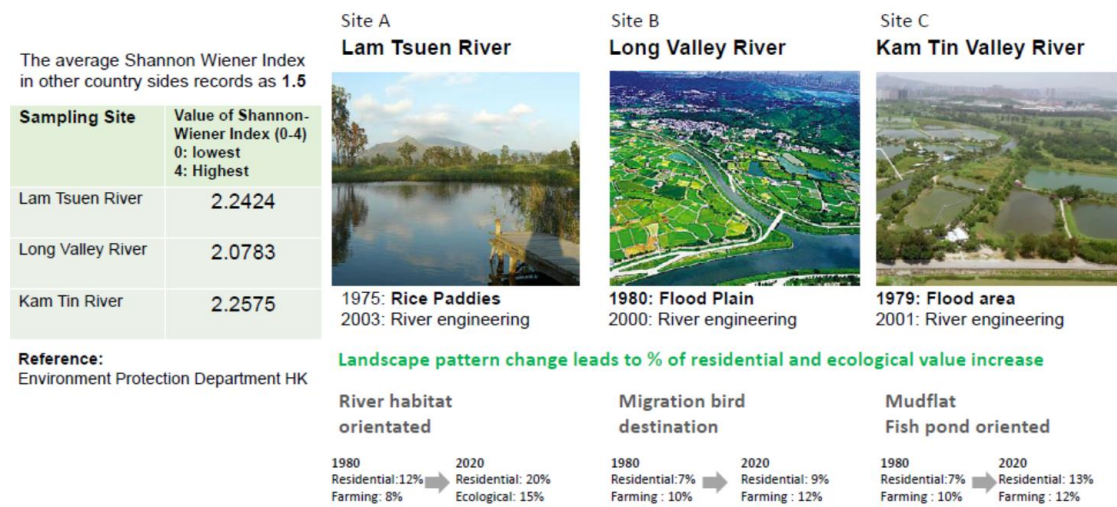
Ecological Value analysis

Figure 65. Ecological Value analysis

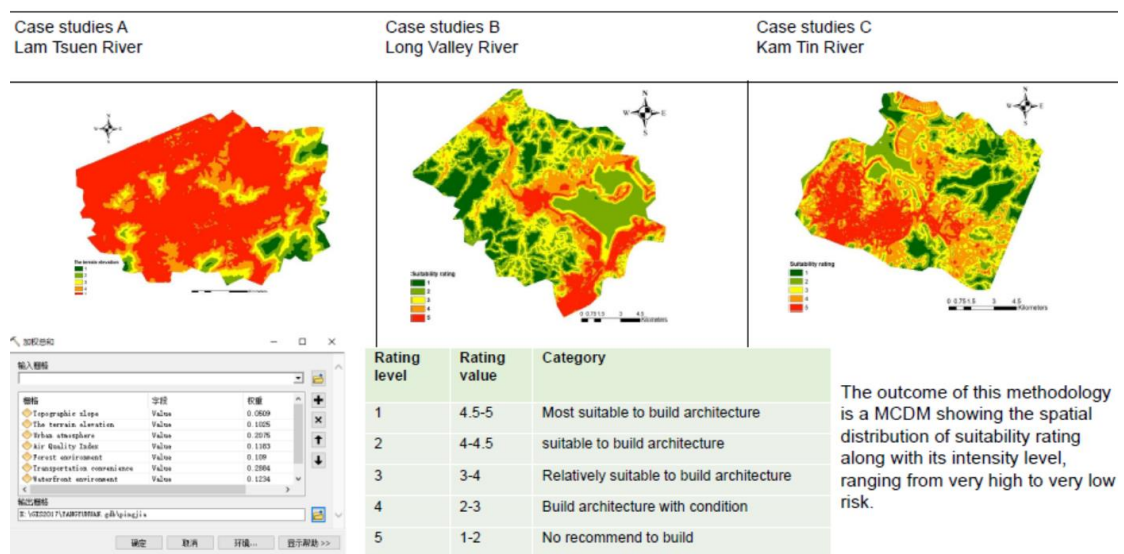Suitability rate of Three case studies

Figure 66. Suitability rate of Three case studies

The outcome of this methodology is a MCDM showing the spatial distribution of

suitability rating along with its intensity level, ranging from very high to very low

risk.

Research question 1 - How does Natural Hazard (Flood and Typhoon) influence the urban agriculture pattern and river?

<u>Functional Centering</u>

The civilized landscape works intend to evaluate on the value of practice due to the increasing of volume as kind of "River expansion" which is consistent with new urban fabric. The value of practice is basically derived and provided from the structure inner-itself, developed largely from the original function and original existence form, rather than the habitat recreation purpose content from the scientist. Thus, the civilization construct the value which out of the expectations. History, natural hazard, culture, policy both impacted the system

Original purpose:

Pre-flooding measurement

Unexpected result:

Water quality/ ecosystem/farming location condition are improved

Research question 2 - How can Urban Agriculture integrate with engineer works and cultural landscape?

Simple Random (90 interviewee)

The outcome of this methodology is based on survey data collection. Most of the interviews think that the most in demand in agriculture and agriculture area and is Technical and Political support. Over 70% interviewee considered that civil engineering works helped to mitigate the flood issue.

Before civilization: Interviewee thinks poor condition in flood control and ecology

After civilization: number of biodiversity increase, pre-flooding function embed

Research question 3 - How can Urban Agriculture enhance the ecological value and widen the biodiversity?

Increasing in:

Crop diversity, Growing speed, Harvesting speed, Crop quality, Production stability, Management standards, Safety standards, Market coverage

- Transformation of ecosystem – from single species to multi-species
- Analysis result and conclusion.
- Unique in the target river, unique history of HK
- River development

  Political – Political history, Social issue, both, understand more

  the flood issue control, and then water usage environment improvement

  and improved at the same time.

The successful achievement.

Some countries intended to create Green infrastructure but in vain to both preflood

measurement and enhance the ecological value

(Those civil works built after 2013)

Figure 67. Spectacular view of mountain, landscape view and rivers are the crucial elements in Lam Tsuen Valley

2. **Pollution problem**

   Most citizens used free-ranging remote management system to manage their

   livestock. The majority of the livestock was sent through the Lam Tsuen River

   and induced water contamination, except for certain livestock waste considered

   fertilizers.

   Population Diminishing

   Until the 1970s, HK had changed to a Financial-oriented basis, with dwindling

   local agriculture fellowshiping the change in the society's economic system.

   Famers have changed their jobs and immigrated abroad (such as UK, Australia

and New Zealand). Therefore, a lot of abandoned farmland was found at Lam Tsuen. Farmers who had stayed in New Territories prior to the 1990s.

3.

1. The UK has announced that all land in the New Territories will be nationalized and that the villagers' status will be transferred from Chinese to British.

2. The initial inhabitants nation will be transformed to a British loan. While the British colonial government perceived the New Territories as a buffer zone to "defend" the Hong Kong policy before the war, it pursued a non-intervention approach to the governance of the New Territories indigenous inhabitants. As a result, most farmers took all the capitals and are continuing to grow their business in the UK.

In this generation, Hong Kong lacks this cultural landscape. In urbanization, all the green areas and places were eroded by the city and only left with deserted farmland. Therefore, the cultural landscape of Hong Kong can combine with urban agriculture, for instance, an organic farming workshop guided tour, the above activities can assist citizens in understanding the environment of Hong Kong.

5.3. International Case studies

Figure 68. International case studies

The International case studies took four Asia countries as a reference. Throught this analysis, it is found that most of the country have developed their flood control or flood risk mitigation management after 2003. (which is the the year after three Hong Kong case studies, Lam Tsuen Valley River, Long Valley River and Kam Tin Valley River. We will discuss the river civil works application by the international case studies. The case studies included Chao Phraya River (South), (Bangkok Thailand), Marikina River (Manila Philippine), Pingshui River in Dongyuan (Jiang Xi, China, Ciliwung River (Jakarta, Indonesia).

Case studies: Chao Phraya River (South), (Bangkok Thailand), Marikina River (Manila Philippine)
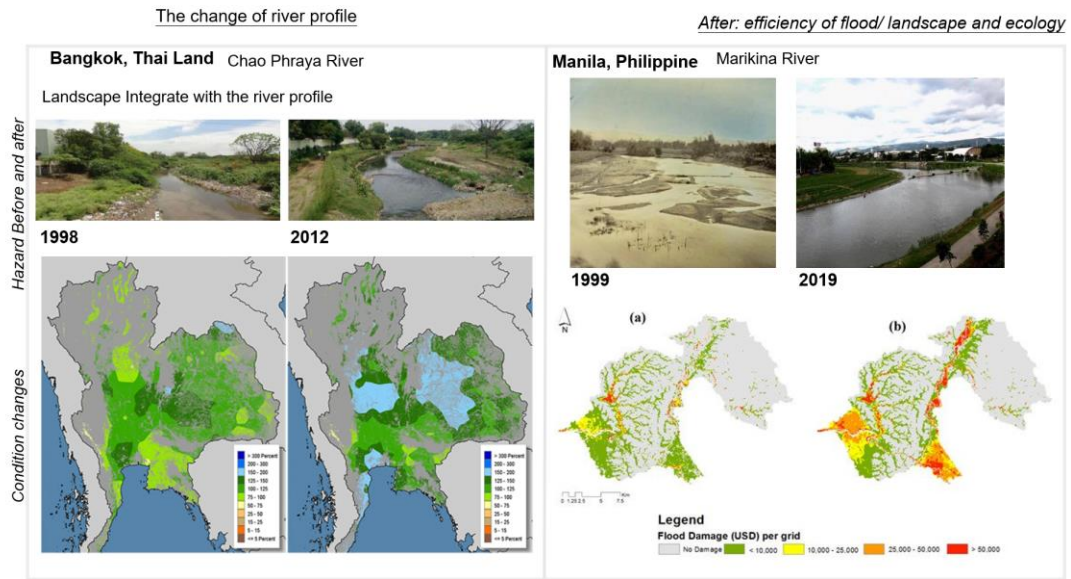
Figure 69. The change of river profile in Chao Phraya river and Marikina River

Case studies: Pingshui River in Dongyuan (Jiang Xi, China, Ciliwung River (Jakarta, Indonesia).

Figure 70. The change of river profile in Pingshui River in Dongyuan (Jiang Xi, China, Ciliwung River (Jakarta, Indonesia).

Lesson learned from the four international case studies:

Unfortunately, the river civil works cannot defend natural hazards such as flooding in the recent 20 years. Mostly, it is because of the river capacity cannot bear the sudden high amount of rainwater volume where these lands are situated in a low lying land, lack of landscape elements as a natural tolerance for flooding. Some case studies excessively reply to the pure infrastructure works. Once the original function of the dam or these concrete infrastructures collapsed, the original river does not have a responsive methodology to resolve the rapid water flow invading to their land.

Table 22. The summary of International case studies

Country		Bangkok, Thailand	Manila, Philippine	Jiangxi, China	Jakarta, Indonesia
River name		Chao Phraya River (south)	Marikina River	Pingshui River in Dongyuan	Ciliwung River
Flood type and max flood depth		Riverine	Flash (1-2)	Typhoon	Riverine
Affected by		Typhoon/ Flooding/ Urban settlement			
Available measure	Structural	-	Levee	Levee, dam, retention, pump	Levee, dam, retention, pump
	Non-structual	-	FFEW	FFEW, ERM, education, FHM	
Type of affected area		Urban Area, Rural Area	Urban Area	Urban Area, Rural Area	Urban Area
Primary damage		Rurual/ Agricultural Area/ Housing/ Infrastructure			
Case		Type of River in HK	Case study 1	Case study 2	Case study 3
River name		Over 200 rivers	Lam Tsuen River	Long Valley	Kam Tin River
Flood type and max flood depth		Riverine/ canel/ lowland	Riverine	Flood plain/ wetland	Floodplain/extensive alluvial plains/ lowlands
Affected by		Typhoon/ Flooding/ Urban settlement/ Infrastructure/ New town development			
Available measure	Structural	Sporadic levee, pump, reservoir	Levee, pump	River dam/ reservoir	Fabric Dam/ pumping station hk
	Non-structual	Education	Flood warning systems (flood sirens)/ Education		
Type of affected area		Urban Area	Urban/ Agriclture/ Ecological river/ Suburban Areas		
Primary damage		Urban and infrastructure	Rurual/ Agricultural Area/ Housing/ Infrastructure		

Note: FFEW: Flood Forecasting and Early Warning; FHM: Flood Hazard Map; ERM: Evacuation Response Mapping

Table 23. Summary of International case studies and Hong Kong case studies

5.4. Transformation of the urban farming values and typology to today's society

THEORETICAL & SIGNIFICANCE OF THIS PAPER

- The selected civil works were implemented before the concept of Green Infrastructure. (Benedict and McMahon (2006))

- A new ecosystem network might not need to construct purposely (case studies in HK from low ecology value to high)

- Natural Hazard not only create negative impact to human and environment, it also change the ordinary ecosystem and create another "system"

- Natural hazard change the landscape pattern. The landscape pattern are also transformed to another way to defense the natural hazard. Something unexpected and developed by a non-human being, which is time and the evolved landscape.

- The successful way of civil works is to re-form the ecosystem and it makes a

  pre-flood measurement preforming well from the past experience

- Farms in Hong Kong may have largely detached from agricultural production,

  but transformed to other functions

- Civil engineering works have altered the village landscape in a broader sense as

  well as the scenic changes. River expansion had added much to landscape value.

Engineering
I. Offset widening

Advantage:
Reduces friction and increases velocity of river, removing water from the channelised area quicker

Disadvantages:
Lost nutrients in quick time

Engineering
II. Widen river and straighten

Advantage:
Straightening the river speeds up the water, so high volumes can pass through an area quickly, therefore reducing the chances of a flood.

Disadvantages:
Lost nutrients in quick time

Ecological
III. Create new ponds

Advantage:
collecting and slowing the flow of water off the fields, ponds trap and recycle nutrients, reducing the quantities of nitrates and phosphates entering the river system

Disadvantages:
Cost is relatively high

Landscape
IV. Enhance river ecology loop

Advantage:
can give support in monitoring and communication of the results of the ecological restoration efforts

Disadvantages:
Cost is relatively high and time consuming

Small
1
2
3
4
5
Large

Figure 71. The model analysis of different treatment in the river

Arriving to the idealistic solution. Can we change the Vulnerable aspects to Valuable

elements? The current three selected case studies in Hong Kong are using the

landscape civil engineering method to deal with the flood issue, ecological,

environmental issues. Regarding the GIS analysis, the most efficient way to increase

the suitability of the environment living standard is Landscape Integration with

engineering works. Through this treatment, the damaged ecological can have a chance

for restoration, reconstruction, and re-combination of different essential elements.

5.4.1   Sustainable Agriculture industry

Benefit of local organic farm
Establishing an organic farm offers

various benefits. Firstly, it would be

able to conserve and protect the

food from contamination with healthy soils grown with organic food. There

are also twice as many vitamins, minerals, and other nutrients in such

organically grown vegetables and fruits. For humans, the method of organic

farming is nutritionally nutritious and healthy.

Second, no chemical

fertilizers are available for

growing crops. This will also

discourage overuse of

services and helps minimize
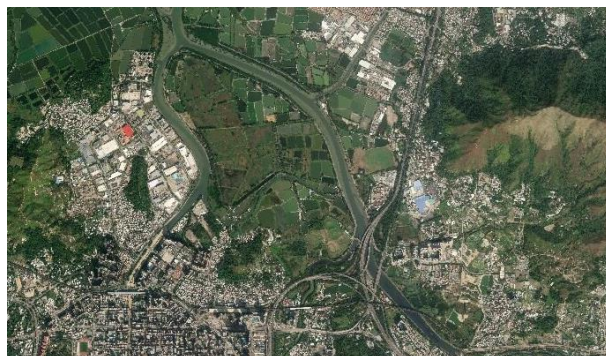
damage to the environment (Hong Kong Young Christian Women's

Association, 2019). It helps to lead the agricultural operation to another more

sustainable development because of all the benefits that the organic farm was

173

delivered.

Fig 5.x.x

These two photos were taken in 1954 and 2018, respectively. You can be seen that the fishpond has been dramatically reduced.

5.4.2   Suggestions for future study

The Lam Tsuen Valley, Long Valley and Kam Tin Valley river were founded, tracing back to the Northern Song Dynasty. Since the alluvial has long been weathered, it has slowly formed into alluvial soil. These three-river soils are therefore highly fertile and ideal for farming and is a place of residence.

In The Past — Civil works only tackle the physical problem. Only single function has been approached. No landscape concern .... [1]

In the 3 case studies — Civil works not only tackle the physical problem. It have been resulted in high ecological value and positive impact by an unintentional collaboration. .... [2]

In the Future — Through this studies, variable factors such as civil works, ecology, human being and natural hazard have been accumulated. Set up a blue print for the future development. .... [3]

According to the JCWISE, they said, 'The Tang clan's ancestors settled and thrived in Kam Tin Plain as early as in the Northern Song Dynasty. (Jockey Club Water Management and Participation Project, 2018). Different communities have settled in the Kam Tin Valley, Long Valley and Lam Tsuen Valley after thousands of years of growth and many cultural artifacts such as libraries, ancestral temples, and temples.

In the Past

Civil works only tackle the physical problem. The only single function has

been approached. No landscape concern

In these 3 case studies

Except for tackling the physical problem, the 3 case studies have resulted in

high ecological value and positive impact by an unintentional collaboration.

Future

Through these studies, variable factors such as civil works, ecology, human

being, and natural hazard have been accumulated. It can make a blueprint for

future development.

Theoretical & Significance of this paper

The selected civil works were implemented before the concept of Green

Infrastructure. (Benedict and McMahon (2006))

A new ecosystem network does not need to construct purposely (case studies

in HK from low ecology value to high)

Natural Hazard not only create negative impact to human and environment, it

also changes the ordinary ecosystem and create another "system"

Natural hazards change the landscape pattern. The landscape pattern is also

transformed into another way to defend the natural hazard. Something

unexpected and developed by a non-human being, which is time and the

evolved landscape.

The successful way of civil works is to re-construct the ecosystem and it

makes a pre-flood measurement performing well.

THE FOLLOWING ASPECTS HAVE BEEN
RESULTED AFTER A CHAIN OF CAUSATION
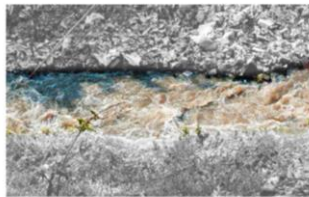
FILTHY RIVERS TO CLEAN ARTIFICIAL CHANNELS

'ENVIRONMENTAL FLOW' FOR ECOLOGICAL SENSITIVE/ECO-DESIGN CHANNELS

ECOLOGICAL FUNCTIONS

This study result proved the unexpected consequence of the richness of the

ecosystem, land use re-planning and new typology of vegetation caused by the

civil engineering implementation works.

Apart from carry one single effect by conducting civil engineering works , it could eventually result in a chain of causation. The research on how the structure of the village has been changed through civil engineering works after the civilization and the surrounding cityscape to be caused owing to the civil works.

Appendices

1. **GIS analysis script process**
2. **Survey data analysis data**

3. **Typhoon history analysis data**

Appendices

1.   GIS analysis script process

References

Resources of figures and table

Appendices

Planning analysis	solution
By using GIS to make the analysis for urban sensitivity	Ensure the suitability analysis's factor and its weight Sensitivity rating to all factors，From Level 1 to 5，and it converts to table form; Overlay the sensitivity rating to different analysis and calculate the value, each table grid will receive a value after overlaying different factors Reclassify after the rating analysis is generated.

GIS analysis script process

The Application of AHP and GIS to the Analysis of Urbanization Spatial Development:

Suitability rating

Factor	weight	Unit factor	Unit factor weight	Compound weight
Transportation convenience	0.2884	-------	-------	0.2884
Waterfront environment	0.3507	Waterfront environment	0.3519	0.1234
		Forest atmosphere	0.3108	0.1090
		Air quality	0.3373	0.1183
URban Atmosphere	0.2075	-------	-------	0.2075
Topographic slope	0.1534	Topographic level	0.6682	0.1025
		Slope level	0.3318	0.0509

As different area's suitability is based on various factors such as topography, air quality, waterfront environment. (developed area or undeveloped area, flatland, valley or submit) Therefore, we need to use a standardize system to figure out these factors

For the evaluation of the suitability of each single factor, this experiment unified the evaluation value is graded into 1-5 levels, of which 3 levels are barely available for land construction, but need special treatment, 5 levels represent the most suitable for construction, level 1 table completed suitable for construction.

Appendices

GIS analysis script process, Survey data analysis data, Typhoon history analysis data

The specific steps of the experiment are:

First, the suitability of each single factor is evaluated, graded into 1-5 levels, and converted

into grid data;

Then, the grid weighted overlay is carried out, and the parcels represented by each grid will get a comprehensive evaluation value;

Finally, the comprehensive grid data reclassified and graded, and obtained a comprehensive evaluation of land suitability:

Transportation convenience analysis

The traffic convenience assessment will be determined based on the distance from the road, as shown in the table.

Evaluation factors	Classification	Grade
Convenient transportation	0 to 50 meters from the road	5
	50 to 100 meters from the road	4
	100 to 200 meters from the road	3
	200 to 300 meters from the road	2
	More than 300 meters from the road	1

Road buffer property table:

Comprehensive evaluation of traffic factors

Block of code:

value=5

Appendices
GIS analysis script process, Survey data analysis data, Typhoon history analysis data

if [distance]=50 Then

value=5

elsif [distance]=100 Then

value=4

elsif [distance]=200 Then

value=3

elsif [distance]=300 Then

value=2

elsif [distance]>300 Then

value=1

end if

Appendices
GIS analysis script process, Survey data analysis data, Typhoon history analysis data

Evaluation of environmental suitability

1. Waterfront Environmental Assessment

The waterfront environmental assessment will be determined based on the distance from the river and water, as shown in the table.

Evaluation factors	Classification	Grade
Waterfront environment	0 to 50 meters from the waters and rivers	5
	50 to 100 meters from the waters and rivers	4
	100 to 200 meters from the waters and rivers	3
	200 to 500 meters from waters and rivers	2
	500 meters above the water and river	1

2.Forest environment

There is green space in the study area, because the environment of green space is pleasant. As a result, the environment within and near the green space is the best, and the regional environment close to them is better, with a specific rating as shown in the table.

Evaluation factors	Classification	Grade
Forest environment	0 to 100 meters from green space	5
	100 to 200 meters from green space	4
	200 to 500 meters from green space	3
	500 to 1000 meters from green space	2
	More than 1000 meters from the green space	1

3.air quality index

Air quality evaluation sinnuses AQI data, reclassifying interpolated grids, as shown in the table

Evaluation factors	分类（AQI 值）	Grade
Air quality	84 or less	5
	84~87	4
	87~91	3
	91~94	2
	94 以上	1

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GIS analysis script process, Survey data analysis data, Typhoon history analysis data

Urban atmosphere

The evaluation of the city atmosphere will be analyzed according to the POI for the nuclear density analysis and the density grid will be reclassified, with the specific rating shown in the table

Evaluation factors	分类(每 100 平米 POI 个位数)	Grade
City atmosphere	2 or less	1
	2~5	2
	5~15	3
	15~30	4
	More than 30	5

Appendices
GIS analysis script process, Survey data analysis data, Typhoon history analysis data

Topographic slope

1. **Evaluation of terrain elevation**

The elevation layer is grid data, taking into account the difficulty of urban infrastructure construction, determine the elevation range allowed for construction is -26-250 meters, elevation 250-350 meters is not suitable for construction, elevation above 35050 meters is difficult to build areas. The specific ratings are shown in the table.

Evaluation factors	Classification	Grade
Terrain elevation	Elevation at -26 to 50 m	5
	Elevation s50 to 150 meters	4
	Elevations are between 150 and 250 meters.	3
	Elevation s250 to 350 meters	2
	Elevation above 350 meters	1
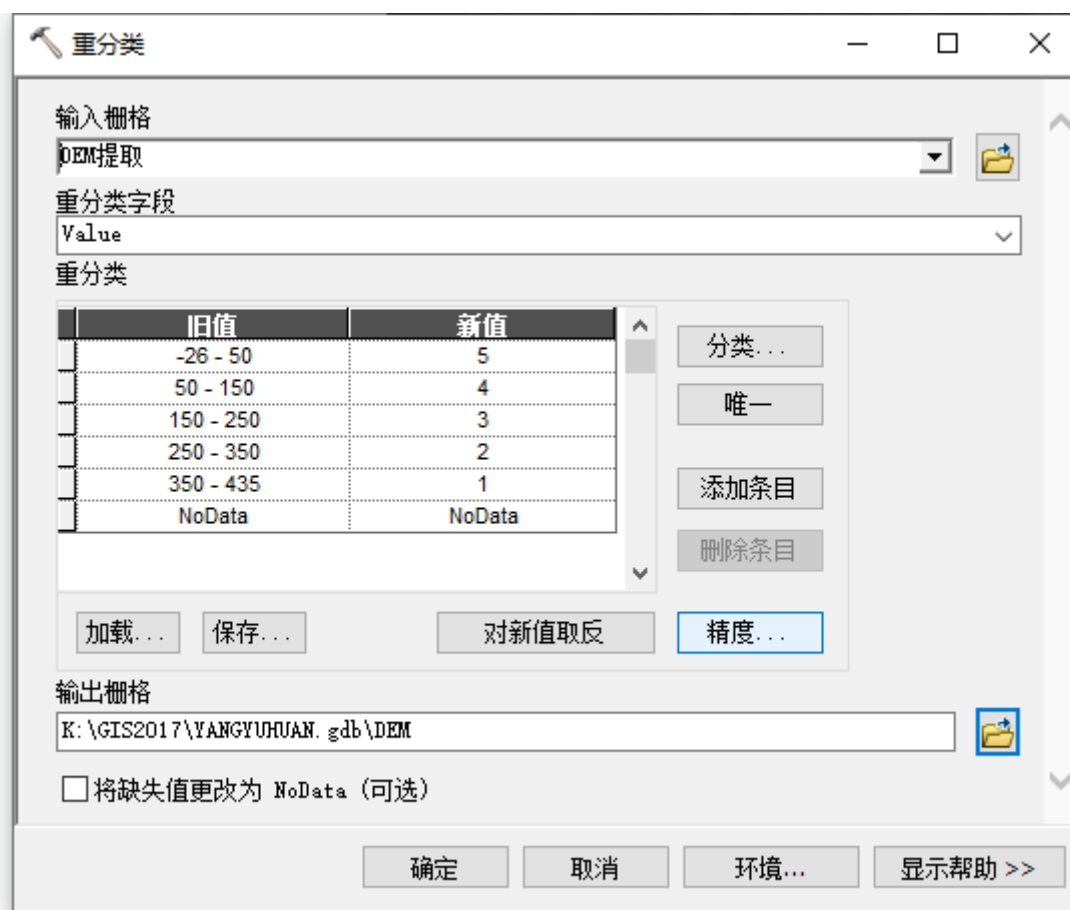
2. Topographic slope

The Slope layer is raster data, reflecting the slope of the terrain. From the Slope layer, the terrain in the study area has a large ups and downs and a slope of up to 55 degrees. However, because the slope requirements of the construction site 地 are not high, the terrain with slope is more conducive to the creation of a residential environment, therefore, determine the slope range allowed for construction is below 30 degrees, the specific rating is shown in the table.

| Evaluation factors	Classification	Grade
	Slope is 0 to 7 degrees	5
	The slope is 7 to 15 degrees.	4
Terrain Slope	The slope is 15 to 30 degrees.	3
	The slope is 30 to 40 degrees.	2
	Slope above 40 degrees	1

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Grid overlay operation

The land suitability evaluation of each single factor was made earlier. The grid evaluation diagram is obtained. 图 Next, the grid data of all single factor evaluation is superimposed and the comprehensive evaluation graph is obtained.
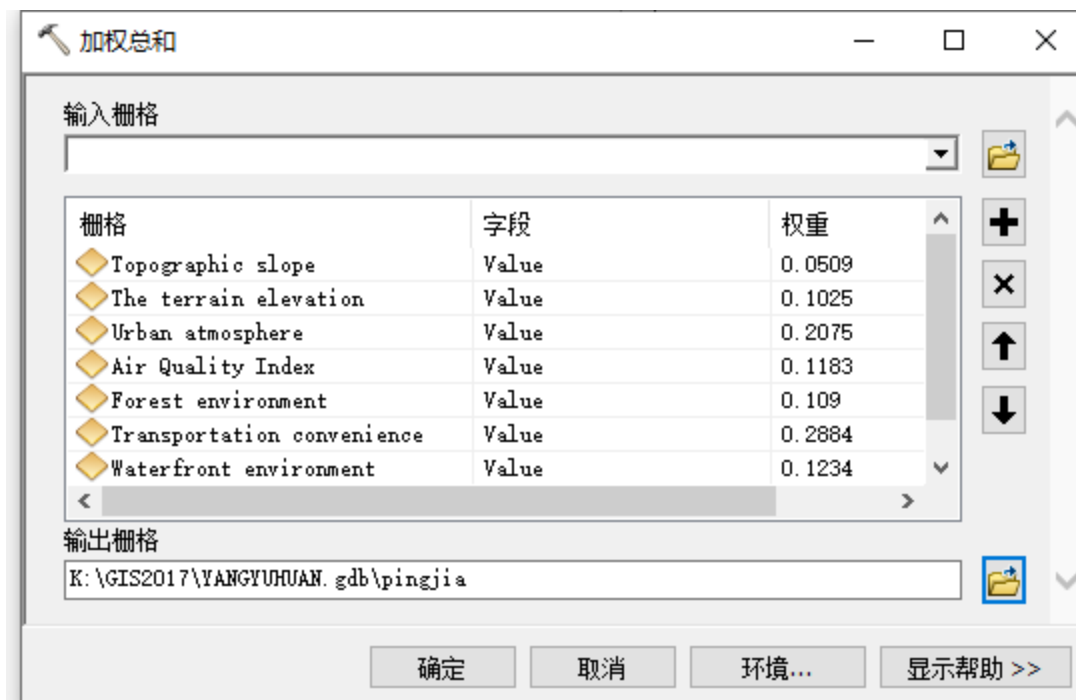
According to the previous agreement on the evaluation value of each single factor,3 points is acceptableand suitable for use as the minimum value of construction land.

5 points represent the most suitable for construction, 1 point is not suitable for construction. According to this experiment, the suitability level is divided into 5 levels,

As shown in the table.

Category level	Evaluation score	Suitability category
I	4.5~5	Best for construction land
II	4~4.5	Suitable for construction land
III	3~4	More suitable for construction land
IV	2~3	Conditional restrictions on construction land
V	1~2	Not suitable for construction land

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GIS analysis script process, Survey data analysis data, Typhoon history analysis data

重分类

输入栅格
因子叠加

重分类字段
VALUE

重分类

旧值	新值
1 – 2	1
2 – 3	2
3 – 4	3
4 – 4.5	4
4.5 – 5	5
NoData	NoData

分类...
唯一
添加条目
删除条目

加载...   保存...   对新值取反   精度...

输出栅格
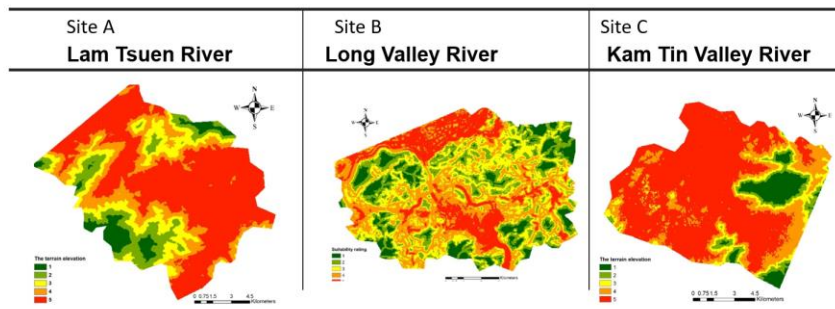K:\GIS2017\YANGYUHUAN.gdb\yinzidiejia

确定   取消   环境...   显示帮助 >>

GIS reference: Tomlinson, RF; (1974) Geographical Information Systems, Spatial Data Analysis and Decision Making in Government.Doctoral thesis, University of London.

The GIS Factor review – Transportation convenience

Factor review – Transportation convenience

Site A Lam Tsuen River	Site B Long Valley River	Site C Kam Tin Valley River

Transportation convenience analysis
交通便捷性评价将根据距道路的远近加以确定，如表所示。

FID	Shape	distance	Shape_Length	Shape_Area	评价值
1	面	50	5.439277	0.004098	5
2	面	100	8.277776	0.001941	4
3	面	200	3.962112	0.001684	3
4	面	300	1.784462	0.000793	2
5	面	1300	1.077745	0.00494	1

Transportation convenience analysis
The traffic convenience assessment will be determined based on the distance from the road, as shown in the table.

Evaluation factors	Classification	Grade
Convenient transportation	0 to 50 meters from the road	5
	50 to 100 meters from the road	4
	100 to 200 meters from the road	3
	200 to 300 meters from the road	2
	More than 300 meters from the road	1

Appendices
GIS analysis script process, Survey data analysis data, Typhoon history analysis data

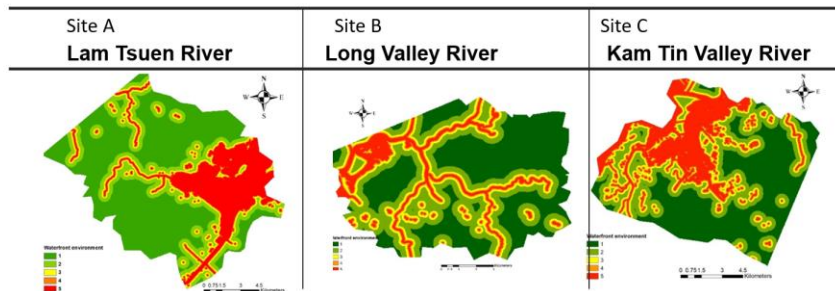| Site A	Site B	Site C
Lam Tsuen River	**Long Valley River**	**Kam Tin Valley River**

Evaluation of terrain elevation
The elevation layer is grid data, taking into account the difficulty of urban infrastructure construction, determine the elevation range allowed for construction is -26-250 meters, elevation 250-350 meters is not suitable for construction, elevation above 35050 meters is difficult to build areas. The specific ratings are shown in the table.

Evaluation factors	Classification	Grade
Terrain elevation	Elevation at -26 to 50 m	5
	Elevation ≤50 to 150 meters	4
	Elevations are between 150 and 250 meters.	3
	Elevation ≤250 to 350 meters	2
	Elevation above 350 meters	1

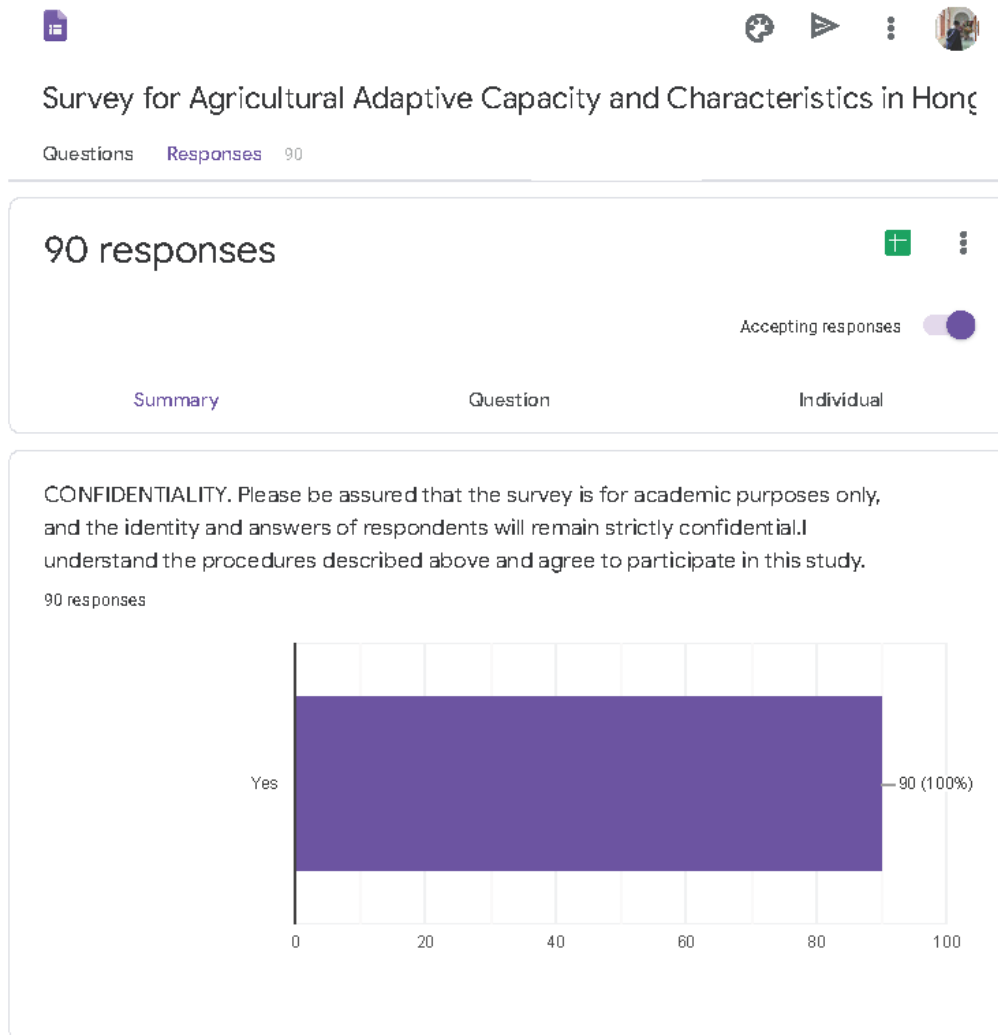| Site A	Site B	Site C
Lam Tsuen River	**Long Valley River**	**Kam Tin Valley River**

Evaluation of environmental suitability
1. Waterfront Environmental Assessment
The waterfront environmental assessment will be determined based on the distance from the river and water, as shown in the table.

Evaluation factors	Classification	Grade
Waterfront environment	0 to 50 meters from the waters and rivers	5
	50 to 100 meters from the waters and rivers	4
	100 to 200 meters from the waters and rivers	3
	200 to 500 meters from waters and rivers	2
	500 meters above the water and river	1

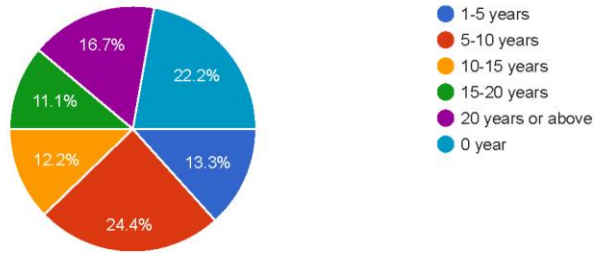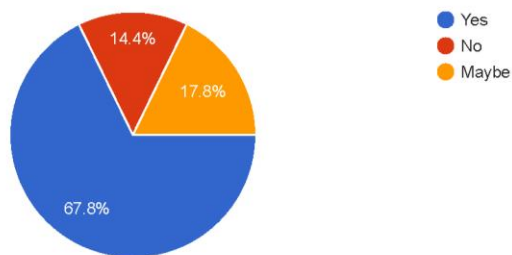## 2.   Survey data analysis and satellite image data

Q3. How many years have you been working in the agricultural /landscape architecture/ horticulture/ engineering/ urban planning industry?

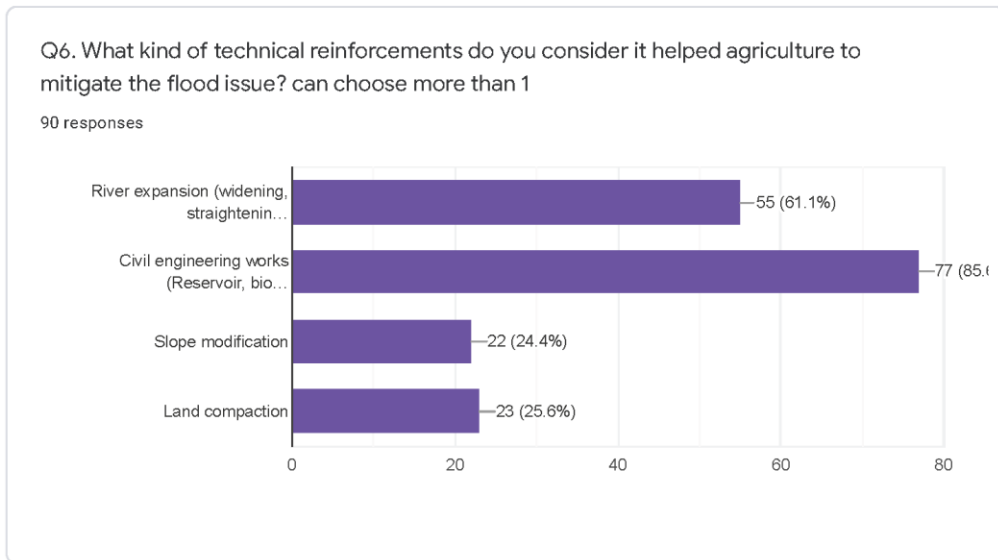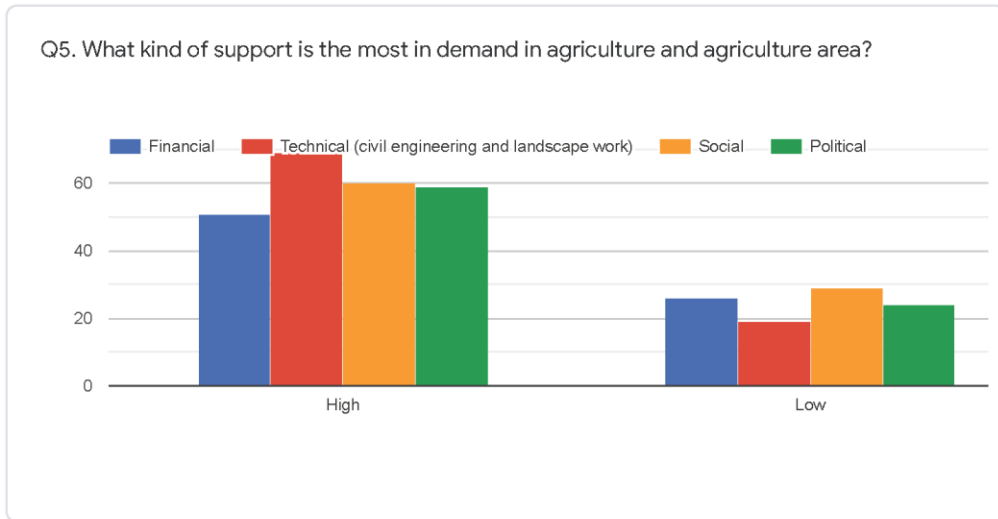90 responses

- 1-5 years
- 5-10 years
- 10-15 years
- 15-20 years
- 20 years or above
- 0 year

16.7%
22.2%
11.1%
12.2%
13.3%
24.4%

Q4. Do you agree that the agriculture industry in Hong Kong can be further developed? For example, food mile, food justice and sustainable development.
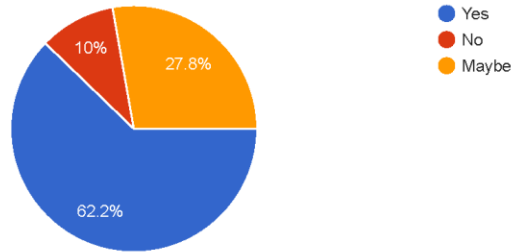
90 responses

- Yes
- No
- Maybe

14.4%
17.8%
67.8%

Q5. What kind of support is the most in demand in agriculture and agriculture area?

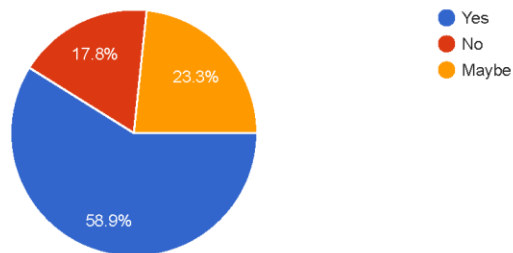Q6. What kind of technical reinforcements do you consider it helped agriculture to mitigate the flood issue? can choose more than 1

90 responses

Q7. Do you think the rate and number of increase in biodiversity is caused by the river civilized work?

90 responses

- Yes
- No
- Maybe

10%
27.8%
62.2%
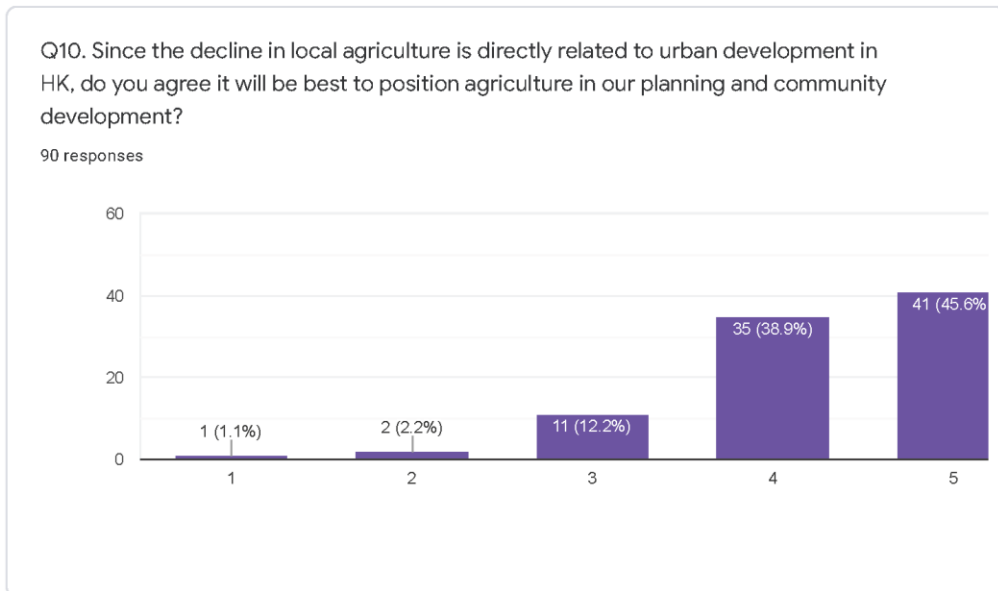
Q8. From your point of view, do you think there will be more successors to work in agriculture?

90 responses

- Yes
- No
- Maybe

17.8%
23.3%
58.9%

Q9. How do you think the following agriculture development now?

Q10. Since the decline in local agriculture is directly related to urban development in HK, do you agree it will be best to position agriculture in our planning and community development?

90 responses

Thank you

Appendices
GIS analysis script process, Survey data analysis data, Typhoon history analysis data

Satellite image data

Site A: Lam Tsuen River – Spatial analysis and on-site photo

1954

2018

New river channel/ channelisation

New development
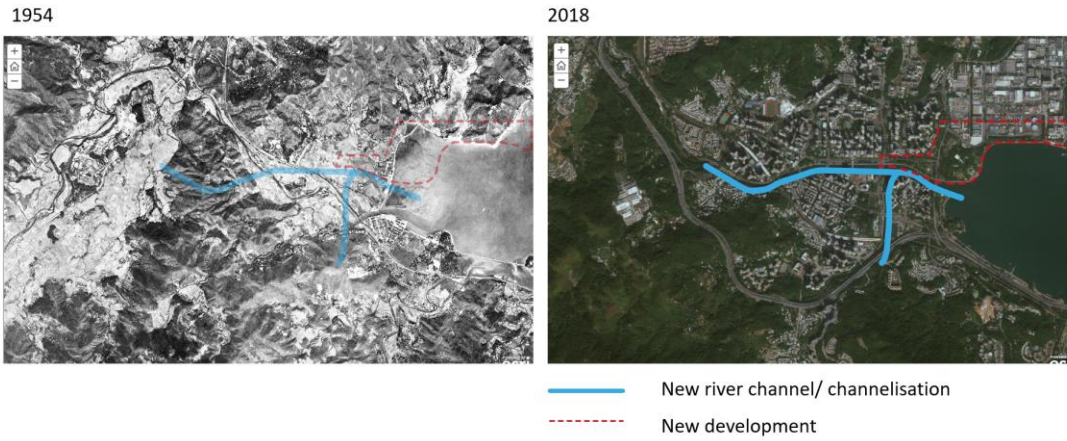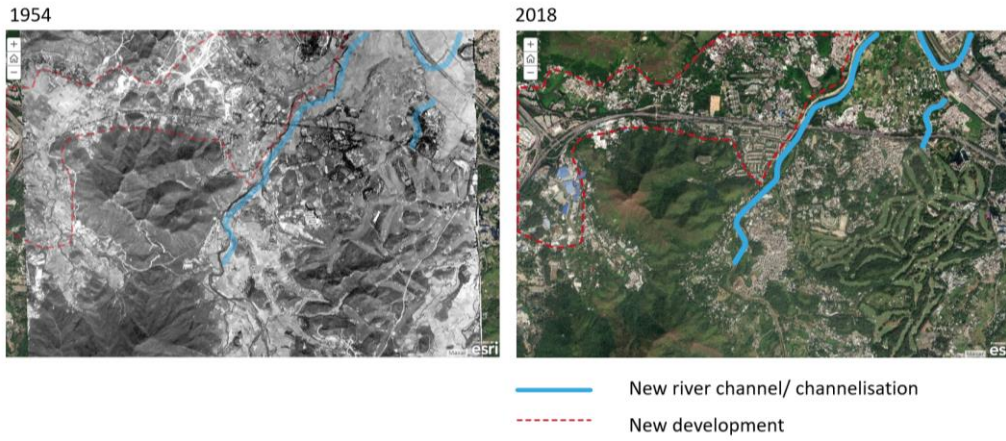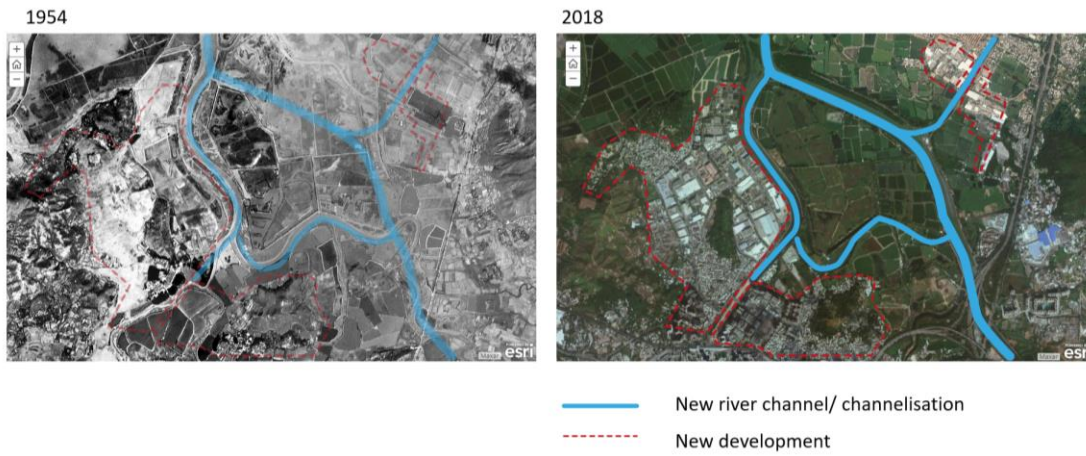

Site B: Long Valley River – Spatial analysis and on-site photo

Site B: Long Valley River – Spatial analysis and on-site photo

1954

2018

New river channel/ channelisation
New development

Site C: Kam Tin River – Spatial analysis and on-site photo

1954

2018

New river channel/ channelisation
New development

Site A - Lam Tsuen River

1954
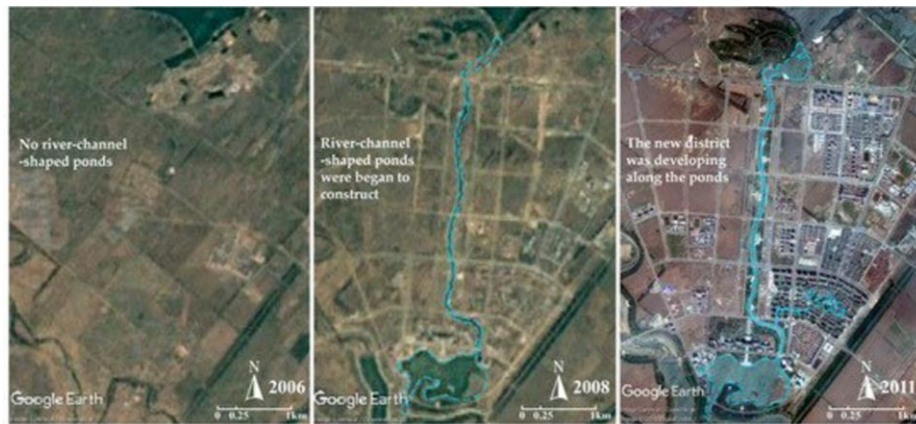
2018

Site B - LONG VALLEY

1954

2018

Site C - KAM TIN RIVER

1954

2018

Case study in China -
Urban River Transformation and the Landscape Garden City Movement in China

3. Typhoon history analysis data

Typhoons which required the hurricane signal signal no.10 since 1946

Name of typhoon	Date/Month	Year	Category	Maximum sustained winds near the centre (km/hr)
Gloria	22/9	1957	Severe T	155
Mary	9/6	1960	T	140
Alice	19/5	1961	T	120
Wanda	1/9	1962	Super T	185
Ruby	5/9	1964	Super T	195
Dot	13/10	1964	T	145
Shirley	21/8	1968	T	145
Rose	17/8	1971	Super T	185
Elsie	14/10	1975	T	140
Hope	2/8	1979	Super T	205
Ellen	9/9	1983	Severe T	165
Vicente	24/7	2012	Severe T	155
Hato	23/8	2017	Super T	185
Mangkhut	16/9	2018	Super T	185

A TYPHOON (T.) has maximum sustained winds of **118-149 km/h.**

Resources of figure and tables

Appendices
GIS analysis script process, Survey data analysis data, Typhoon history analysis data

Reference

Appendices
GIS analysis script process, Survey data analysis data, Typhoon history analysis data

[1] **Published Papers**

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Appendices
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