森林村落
Forest village
梅子林蛤塘永續鄉村計劃
Mui Tsz Lam Kop Tong sustainable village programme

Inventory Report

on the Resources and Ecosystem Services of Mui Tsz Lam and Kop Tong

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Introduction

Ecosystem services are the many benefits to humans provided by the natural environment and can be grouped into four broad categories: provisioning, regulating, supporting and cultural services (Millennium Ecosystem Assessment, 2005). They are essential not only for the well-being but also the quality of life.

The livelihood and culture of many traditional communities are shaped by the natural environment. At the same time, the local people modify the environment directly or indirectly through the use of the diverse natural resources. It can be considered that the local communities and the surrounding ecosystems continually co-evolve with each other. This close relationships are dynamic and are subject to drastic changes when the socio-economic conditions become different or when breakthroughs in knowledge and/or technology occur.

Mui Tsz Lam (MTL) and Kop Tong (KT) are Hakka villages that have been settled for more than 300 and 100 years respectively (Rural Common https://ruralcommon.hk/village/kop-tong/). They are located in the low hills (around 100m to 120m) north of Tiu Tang Lung in the Northeast New Territories without road access. Traditionally the villagers grew paddy rice as the staple product, supplemented by fruit trees, other crops and farm animals. A high degree of self-sufficiency is characteristic of remote villages. MTL and KT were no exception. The villagers also relied heavily on the surrounding hillsides with its forests, plantations, shrubland, grassland and streams to sustain their daily life.

The two villages once had over 10 households with 100 villagers or more each (鄭敏華等, 2022; Rural Common https://ruralcommon.hk/village/kop-tong/). As a result of the rapid changes in Hong Kong socio-economic situations after World War II, and later, the import of cheaper agricultural products made possible after the economic reform in mainland China, the villagers started moving to town areas and/or overseas. The two villages became unoccupied from the late 1970's to 1980's. The farmland gradually became abandoned and natural succession followed. This resulted in a mixture of shrubland, young secondary forest and old-growth forest/Feng Shui woods in the general area around Mui Tsz Lam and Kop Tong before the start of this MA project.

A village couple moved back to Kop Tong village in recent years. They operate a bakery, tend the remaining fruit trees and sell food to visitors. The Countryside Conservation Office of the Hong Kong Government started re-vitalisation initiatives in the area since 2019. These include building infra-structures such as footpaths, public toilets, the re-connection of electricity, and supporting various projects and activities by local universities, Non-Government Organizations (NGOs) and villagers. Together with better access by means of ferry from Ma Liu Shui (first on Sundays, then expanded to weekends in May 2020) since January 2016 and ferry from Sha Tau Kok since January 2024, more people visited the villages, some even took part in the diverse activities and festivals.

This report is one of the outputs of the "Forest Village: Mui Tsz Lam and Kop Tong Sustainable Village Programme (2021-2024)" project funded under the Countryside Conservation Funding Scheme. The objective is to conserve, revitalise and enhance the natural, cultural and landscape values of two villages. Since the project focuses on the forest village ecosystem, the services inventoried in this report are those provided by the natural environment to the MTL and KT villages, both traditionally and more recently.

Unfortunately, there has never been any in-depth study or systematic documentation of what natural resources had been directly used by the villagers and how their livelihood had benefited from the surrounding natural environment. This report compiles the available

information from literature, web-sites and also from the information/data gathered in this Nature Conservation Management Agreement (MA) project. Inevitably the bulk of information gathered tend to be biased towards more recent years. Although far from complete, this report should provide a glimpse of the varied ecosystem services provided by the natural environment to the two villages both in the past during the subsistent farming village period before 1980, more recently when the villages were unoccupied between 1980 - 2019, and, since re-revitalisation started in 2019.

Methodology

Ecosystem services were separated into four main categories, i.e. provisioning, regulating, supporting and cultural services, with sub-categories according to the Millennium Ecosystem Assessment (2005). These services were divided three periods, (1) those in the past when villagers led a predominantly farming lifestyle, i.e. Subsistent Farming Village Period before 1980 (2) in the recent past few decades when the two villages were largely abandoned, i.e. Village Unoccupied Period between 1980 – 2019, and, (3) since village re-vitalisation started in 2019 when visitors become the main group of people using the area, i.e. Village Revitalisation Period since 2019.

For provisional services (such as food, medicine, water, raw materials, fuel, entertainment resources), there were no systematic records on how the villagers in MTL and KT utilized the natural resources throughout the villages' history. Hence, traditional use of natural resources in MTL and, to a lesser extent, KT could only be obtained from (i) information and folklores gathered by the project team under this MA project, and (ii) other available information from website (e.g. Rural Common https://ruralcommon.hk/) and literature (e.g. 鄭敏華等, 2022). These information were largely based on accounts and interviews with some villagers in recent years and inevitably were far from complete. Many of the uses in earlier time were probably missing.

Regulating services are the benefits obtained from the regulation of ecosystem processes including pollination, pest control, water purification, local air purification, erosion and flood control, carbon storage and regulation of local climate). Other regulating services such as global climate and water cycle would involve a much bigger geographic scale than the area covered in this report. Hence, they would not be included here. Information was deduced from (i) folklores gathered by the project team under this MA project, (ii) available information on the livelihood of the villagers from website (e.g. Rural Common https://ruralcommon.hk/) and literature (e.g. 鄭敏華等, 2022), (iii) carbon stock of trees sampled under this MA project, and (iv) important pollinator and pest control species recorded from the ecological surveys and the citizen science activity 'Insect Blitz" under this MA.

Supporting Services are the services that allow for the other ecosystem services to be present. They were inferred from how the villagers and other users would indirectly benefit from the longer term ecological processes (such as nutrient cycling, soil formation, primary production, habitat for species, maintenance of genetic diversity etc.) in the surrounding natural environment.

Cultural Services relate to the non-material benefits covering cultural identity and heritage, recreational, aesthetic, intellectual and spiritual aspects. However, it is quite artificial to separate into specific services and they often combined together to provide benefits to the wellbeing of the people. In order to fulfill the inventory purpose of this report, they are separated into the different services but their connection should also be borne in mind.

There had been no systematic documentation on the cultural linkages of the two villages with the natural environment and the changes throughout their history. Therefore information had to be deduced from (i) folklores gathered by the project team under this MA project, (ii) available information on the livelihood of the villagers from website (e.g. Rural Common https://ruralcommon.hk/) and literature (e.g. 鄭敏華等, 2022), and, (iii) the number of people and volunteers that visited the area or took part in the education programme/activities and their feedback since village revitalisation.

Findings

(1) Subsistent Farming Village Period before 1980

Provisional Services – Food, Drinks and Medicines

Traditionally, the villagers in MTL and KT were farmers and relied heavily on the rice and other crops they cultivated. Chickens and pigs were also raised for food and cattle for ploughing the fields. They also utilised the edible plants and animals when opportunities arose. The list of plants and animals that the MTL villagers gathered for food and/or to add flavour/healthy properties to food and drinks is shown in Table 1.

Table 1. List of wild plants and animals consumed by Mui Tsz Lam villagers as food or drinks

Species	Chinese Name	Usage	Habitat
Lithocarpus glaber	柯	Acorns roasted in fire and eaten as nuts[1] Leaves used to make Hakka sweet tea	Secondary forest and tall shrubland
Paederia scandens	雞屎藤	Leaves with healing properties and grinded with glutinous rice to make Hakka dumplings[1]	Shrubland, village area
Boehmeria nivea	苧麻	Leaves supplement those of *Paederia scandens* and grinded with glutinous rice to make Hakka dumpling[1]	Village area
Amaranthus spinosus	刺莧	Rhizomes with healing properties and make soup with chicken feet[1]	Village area
Phyllanthus emblica	餘甘子	Fruits with healing properties to make tea[1] Leaves with healing properties, burnt to make ash water (mixed with ashes from other plants) for Dragon Boat festival glutinous dumpling[2]	Shrubland
Eleutherococcus trifoliatus	白簕	Leaves with healing properties and make tea after roasting[1]	Shrubland, village area
Rhodomyrtus tomentosa	桃金娘/山稔	Fruits eaten fresh, or to make juice or wine, with	Shrubland

		healing property. Traded for fish with fishermen in Sha Tau Kok[1] Branches burnt to make ash water (mixed with ashes from other plants) for Dragon Boat festival glutinous dumpling[1]	
Garcinia oblongifolia	嶺南山竹子	Fruits eaten fresh[1]	Secondary forest
Uvaria macrophylla	紫玉盤	Fruits eaten fresh[1]	Shrubland, secondary forest
Schefflera octophylla	鴨腳木	Burnt to make ash water (mixed with other plants) for Dragon Boat festival glutinous rice dumpling[1,2]	Secondary forest
Cratoxylum cochinchinense	黃牛木	Burnt to make ash water (mixed with other plants) for Dragon Boat festival glutinous rice dumpling[1]	Secondary forest
Cleistocalyx nervosum	水翁	Boil leaves in water and add to ash water for Dragon Boat festival glutinous rice dumpling[1,2]	Along stream
Eriocheir japonica	日本絨螯蟹	For food. Caught when attracted by villagers washing chicken/ducks in the stream before big festivals especially Chung Yeung[1,2,3]	Stream
Hoplobatrachus chinensis	虎皮蛙/田雞	For food[3]	Pond dammed off in stream. Probably also in rice paddies which used to be the main habitat for this frog (Karsen *et al*., 1998)
Cuora trifasciata	金錢龜	Caught in the stream[3], may be for food, to keep as pet and/or to sell	Stream
Sus scrofa	野豬	Probably caught as food [a noose found in a village house and the villager said it was for catching this species[2]]	Probably in secondary forest

[1] Ip Human (2024); [2] Rural Common; [3] 鄭敏華等, 2022

A total of 12 species of plants and four species of animals were reported to be consumed by the Mui Tsz Lam villagers based on folklores and interviews with villagers. These include fruits, acorn, leaves, rhizomes eaten raw, cooked, made into tea, or mixed with other ingredients. What is interesting is the burning of branches and/or leaves of certain plants into ash to make ash water dumpling for the Dragon Boat festival. Many of the plants are believed to have certain healing properties and are consumed to promote good health.

Some wild species were consumed specifically for treating illness or certain conditions (Table 2). The leaves of Thin Evodia and Elephant's foot were pickled and made into a tea around Ching Ming festival while the bird Greater Coucal was pickled in wine to be consumed later.

Table 2. List of wild plants and animal used by Mui Tsz Lam villagers as medicine

Species	Chinese Name	Usage	Habitat
Melicope pteleifolia	三椏苦/蜜茱萸	Leaves mixed with *Elepantopus scaber*, pickled in salt to make a tea. To be consumed later when not feeling well[1]	Secondary forest
Elephantopus scaber	地膽草	Leaves mixed with *Melicope pteleifolia*, pickled in salt to make a tea. To be consumed later when not feeling well[1]	Village area
Centropus sinensis	褐翅鴉鵑	Whole bird used to make a wine to improve circulation and to be consumed after child-birth[1]	Village area, shrubland

[1] Ip Human (2024); [2] Rural Common; [3] 鄭敏華等, 2022

The two lists seem quite limited considering the high diversity of plants and animals occurred in the general area (see Third Year Biodiversity Monitoring Report). It is highly likely that the villagers had utilised a much wider range of wild plants.

Provisional Services – Water

Water sustains life and its value cannot be under-estimated. Several permanent streams pass through the MTL and KT area. Despite the rainfalls in Hong Kong is highly seasonal with about 80% recorded in the wet season from May to September (Hong Kong Observatory, https://www.hko.gov.hk/en/cis/climahk.htm), these streams flow all year round, providing a continuous supply of freshwater. This is due to the vegetated catchment area, in particular the forests together with the soil and leaf litter acting as a sponge, absorbing the rainwater and slowly releasing it back to the streams and groundwater.

The villagers relied on the stream water for drinking and daily domestic use such as washing. In addition, the principal crop of rice that were once cultivated in wet terraced paddies required plentiful of water to grow. To ensure a good and stable supply of water for the rice plants, ponds and irrigation systems had been constructed to divert stream water to the rice paddies (鄭敏華等, 2022). In 1954, a well was also built in MTL village to tap into the underground water resource with the support from Kadoorie Agricultural Aids Association (鄭敏華等, 2022). In 1960's with the support from the Government, a water tank was built higher up in the stream to pipe water directly to the MTL village (鄭敏華等, 2022). Moreover, these streams also supply fresh water to the larger Lai Chi Wo village further downstream.

Provisional Services – Raw Materials

A variety of plants were collected and used by the MTL villagers in their daily lives or during particular festivals and/or events (Table 3). Eleven species had been documented in the folklores and literature and their uses are diverse, ranging from being used in cooking

traditional food, as a dye for fabrics, for household items, used in festival and/or events, and, to make into tools, artefacts and furniture.

What is not clear is the timber and plant materials originally used by the villagers to build their houses when they first established the villages. Farming communities also use a lot of wood and fibres to build tools and in the fields but these are not recorded in the folklores and interviews, probably because active farming dated back many years before the villagers were interviewed. It is also not clear whether these materials were collected from the surrounding natural environment, brought in from elsewhere or a combination of both.

Table 3. List of wild plants used by Mui Tsz Lam villagers

Species	Chinese Name	Usage	Habitat
Phyllanthus emblica	餘甘子	Dried leaves used to stuff pillows, fresh leaves used to wash hairs[1]	Shrubland
Dendrocalamus latiflorus	麻竹	Split stems to bring stream water to rice paddies[3], Bamboos strong, of many uses and sold to fishermen[1]	Feng Shui wood and village area
Cinnamomum camphora	樟樹	Wood made into artefacts, cabinet and repels insects[1]	Feng Shui wood and village area
Stachyphrynium placentarium	尖苞柊葉	Leaves put on large bamboo basket for making glutinous Chinese new year cake[1,3]	Stream banks
Pterospermum heterophyllum	翻白葉樹	Leaves put on large bamboo basket for making glutinous Chinese new year cake[1]	Secondary forest, village area
Acorus gramineus	石菖蒲	Plant mixed with pomelo leaves and boiled with water for house and body cleansing before Chinese New Year; also for cleansing the bride before marriage; villagers used to collect and sell them[1]	Stream
Alangium chinense	八角楓	Leaves used to line bamboo basket as a non-stick layer when steaming Chinese New Year glutinous rice cake[3]	Secondary forest, village area
Cratoxylum cochinchinense	黃牛木	Wood strong, to make walking stick and stirrer when making Chinese New Year cake[3]	Secondary forest
Strobilanthes cusia	馬藍	Stem and leaves are rich in indigotin and used as dyes for clothes[1]	Stream bank, secondary forest, Feng Shui wood and cultivated in village area

Dioscorea cirrhosa	薯莨	Tubers very rich in tannin and used in dyeing farbics, even silk. Also sold to fishermen to strengthen fishing net[1]	Stream bank, secondary forest, Feng Shui wood
Tetracera asiatica	錫葉藤	Leaves surface like sandpaper, used for cleaning and for polishing[3]	Village area, forest edge
Lygodium japonicum	海金沙	Plant fibrous and tough, tied into a bundle and used as a brush for cleaning pots[2]	Village area, shrubland

[1] Ip Human (2024); [2] Rural Common; [3] 鄭敏華等, 2022

Provisional Services – Entertainment Materials

Moreover, various plants and animals were collected by village kids for entertainment or related purpose (Table 4). The list is probably a small sub-set of the original mix but they reflect the richness of natural environment in terms of biodiversity and the creativeness of the young children in coming up with ways to entertain themselves.

Table 4. List of wild plants and animals used by Mui Tsz Lam villagers related to entertainment

Species	Chinese Name	Usage	Habitat
Cordia dichotoma	破布木	Fruits produce sticky substance that was used as glue in making kites[1]	Secondary forest
Berchemia floribunda	多花勾兒茶	Fruits small and used as bullets in bamboo toy guns[1]	Secondary forest
Bamboo species	'黃竹'	Bamboo stems of slightly different width made into air-pressurised toy gun[1]	Village area
Cratoxylum cochinchinense	黃牛木	Wood strong, used by kids to make whipping top	Secondary forest
Eriogyna pyretorum	樟蠶蛾	Cocoon collected to extract silk to see which has longest silk strand[1]	Feng Shui wood and village area
Jumping spiders of the family Salticidae	跳蛛, 也叫「豹虎」	Live spiders kept to fight with others[1]	Shrubland

Pandanus austrosinensis	蘆兜草	Leaves to make small holding cases for jumping spiders[1]	Secondary forest, stream banks
Macropodus opercularis	叉尾鬥魚	Fish kept as pet	Rice paddies and ponds
Hoplobatrachus chinensis	虎皮蛙/田雞	Skin used to make drums	Pond dammed off in stream. Probably also in rice paddies which used to be the main habitat for this frog (Karsen *et al*., 1998)

[1] Ip Human (2024); [2] Rural Common; [3] 鄭敏華等, 2022

Provisional Services – Fuel

The main need of fuel is for cooking. In addition to rice plant residue stored after harvesting, grass and other plant material were collected by villagers as fuel until the 1970's when kerosene was used instead (鄭敏華等, 2022). The grasses, shrubs and young trees in the surrounding hillsides would provide plenty of fuel for the two villages. Mui Tsz Lam villagers also collected fire wood, particularly pine harvested from hill slopes under the Forestry License, and sold them in Sha Tau Kok (鄭敏華等, 2022). The harvesting of firewood also stopped with the wide adoption of kerosene stove.

Provisional Services – Food for Farm Animals

A small number of cattle were kept by the villagers and they were often taken to the surrounding hillsides to graze on the grasses and herbs. Pigs were also raised in Mui Tsz Lam and they were allowed to roam freely in the village area during the day (鄭敏華等, 2022). Domestic pigs are the decedents of Wild Pig and they are omnivores (Shek, 2006). With a keen sense of smell, it is likely that the village pigs would dig for rhizomes, earthworms, grubs etc. near the village.

The villagers also kept bees for honey (鄭敏華等, 2022). The many wild flowers in the Feng Shui Forest, secondary forest and shrubland would supplement the fruit trees in the villages to provide nectar and pollens for the bees. Since the flowering in Hong Kong is highly seasonal with most species flower in spring (Corlett, 1993), particularly important are plants such as *Schefflera octophylla* that flowered in autumn and early winter when nectar source is very scarce.

Regulating Services – Pollination and Pest Control

The habitats in MTL and KT support a rich biodiversity (see Biodiversity Survey Report) which have varied ecological roles. Some of these would provide benefits to the villagers. For example, fruit trees were grown around the villages or on the hillside and the fruits were consumed and/or sold. These include Lychee, Longan, Wampi, Tangerine and Starfruit in which old trees can still be found. In addition, Plum was grown in the past which gave Mui Tsz Lam its name and a jar of plum seeds from pickled fruits had been uncovered in the village (鄭敏華等, 2022). Large area around Mui Tsz Lam were cultivated for tangerines and the fruits harvested for Chinese New Year were once an important income source for the village (鄭敏華等, 2022). All these fruit trees require insect pollinators to pollinate their flowers in order to

set fruits. Although honey bees had been raised by the villagers, it is not clear to what extent and whether honey bees had been kept throughout the history of the two villages. Hence, the many species of wild bees, flies and other pollinating insects probably also played an important role in pollinating the fruit trees.

These fruit trees and other crops likely were susceptible to attack from insects such as bugs, aphids, caterpillars, borer beetles, fruit flies etc. (https://www.afcd.gov.hk/tc_chi/agriculture/agr_useful/agr_useful_com/files/Phybio_leaflet2021.pdf). For example, Lychee and Longan trees are particularly prone to infestation from *Tessaratoma papillosa* 荔枝蝽象 whose eggs are attacked by the parasitic wasp *Anastatus formosanus* (https://www.afcd.gov.hk/english/agriculture/agr_useful/agr_useful_com/files/fruit_tree.pdf). In addition, predatory insects such as ladybirds and lacewings would have played an important role in controlling agricultural pests (https://www.afcd.gov.hk/tc_chi/agriculture/agr_useful/agr_useful_com/files/Phybio_leaflet2021.pdf). The pest control service from these predators and parasitoid wasps from the natural habitats would be important particularly in the earlier days before chemical insecticides were available.

Detailed study has not been taken to investigate the complex ecological process and the species involved in the predation on agricultural pests. Potentially important ecosystem providers of these regulating services were identified based on their functional and the likelihood of overlapping in occurrence with agricultural pests. The list of animal groups or species that are likely to play a role as pest control for fruit trees and agricultural crops in MTL and KT is in Table 5. In fact, parasitic wasps and 20 spider species/morpho-species had been found by the citizen scientists during the Insect Blitz organised under this MA project.

Table 5. List of Potential Ecosystem Services Providers in Mui Tsz Lam and Kop Tong

Groups / Species	Chinese Name	Ecosystem Services	Source Habitat
Bees	蜜蜂科	Pollination	Forest, Feng Shui Wood, Shrubland, Village area
Moths and Butterflies	蛾和蝴蝶	Pollination	Forest, Feng Shui Wood, Shrubland, Village area
Syrphidae flies	食蚜蠅科	Pest regulation	Forest, Feng Shui Wood, Shrubland, Village area
Ichneumonidae wasps	姬蜂科	Pest regulation	Forest, Feng Shui Wood, Shrubland, Village area
Eumenidae wasps	蜾蠃科	Pest regulation	Forest, Feng Shui Wood, Shrubland, Village area
Ladybird Beetle	瓢蟲科	Pest regulation	Forest, Feng Shui Wood, Shrubland, Village area
Lacewings	草蛉科	Pest regulation	Forest, Feng Shui Wood, Shrubland, Village area
Spiders	蜘蛛	Pest regulation	Forest, Feng Shui Wood, Shrubland, Village area

Regulating Services – Water Purification, Erosion and Flood Control

MTL and KT are hill villages with several streams providing a non-stop supply of freshwater. The stream water is clear and of good enough quality to drink after boiling. This is the result of the filtering and purification by the surrounding vegetation, the soil and the stream substrates.

The dense forests and shrublands on the hillsides with mostly evergreen plant species help to shield the underlying soil from the direct force of rains. The leaf litter accumulated on the floor of forest/shrubland further protect the soil underneath. The plant roots forming a matt with the soil also help in controlling soil erosion, thus maintaining water quality and reducing flood risk. The water retention capacity of forests is over many times more than that of bare land (Biodiversity Working Group, 2001). Hence, forests help slowing down floodwaters. The important regulatory role of forests was long recognised by the Chinese people, leading to the maintenance of Feng Shui forests behind traditional villages (Hong Kong Biodiversity Information System http://www.nature.edu.hk/glossary/Feng-shui-woods).

Moreover, the erosion and flood control services provided by the forests, shrubland and grassland on the hillsides probably had protected the two villages from landslides during heavy rains and typhoons.

Regulating Services – Local Air Purification

Forests are known to be able to purify the air by catching small particulate matters and absorbing harmful pollutants. MTL and KT villages are in remote areas and during the early times they were far from cities and industrial areas. Hence, there would be little air pollutants blown by the wind to the area and the forests and other vegetation in the surrounding hillside would only play a minor role in purifying the local air.

Regulating Services – Carbon Storage

Trees are effective in capturing carbon dioxide from the atmosphere through photosynthesis and then store the carbon as wood. An old-growth regenerated forest in humid Asia can absorb up to 17.3 t CO_2 ha^{-1} $year^{-1}$ (Bernal *et al*., 2018).

Regulating Services – Local Climate Regulation

Vegetation lowers air temperatures in the general environment through transpiration (Millenium Ecosystem Assessment, 2005). The presence of Feng Shui forests close to the two villages and other forests, shrubland on the surrounding hillsides would provide a cooling effect to the villagers in the summer months.

Supporting Services – Nutrient Cycling, Primary Production, Soil Formation and Retention

Many of the provisional ecosystem services mentioned earlier would be supported by the long-term ecosystem processes including nutrient cycling, primary production, soil formation and retention so that the plant resources used by the villagers can be sustained over time. The forests in the MTL and KT area would play the most significant supporting services as forests have deep soil and thick layer of leaf litter. Together with high humidity, the condition is favourable to decomposition by micro-organisms, earthworms and other soil fauna, i.e. nutrient recycling. Forests are also structurally more complex with more layers of usually evergreen plants. Hence they tend to have higher primary production than shrubland, followed by grassland (Li, *et al*., 2020).

Due to the hilly topography of MTL and KT, there was likely a nutrient transfer from the Feng Shui forest, secondary forest and shrubland on the hill slopes to the villages' farmland downhill during heavy rains when sediments were carried by surface runoff and the streams.

Supporting Services – Habitat for Species

The pollination and pest control regulating services mentioned above would be influenced by the functional diversity of the organisms in the area. In particular, the Feng Shui forest, secondary forest and shrubland provide habitats for a rich biodiversity including many pollinators such as bees, flies, butterflies, moths, insect predators such as spiders, ladybirds, lacewings, wasps, birds and parasitic wasps.

Supporting Services – Maintenance of Genetic Diversity

The natural habitats in the surrounding of MTL and KT are actually part of a much bigger area in the North-eastern New Territories and connected to central N.T. and Wutongshan in Shenzhen and beyond. The large and connected habitats are conducive to maintaining genetic diversity. The rich community of wildlife interacts with the environment and with other species. Genetic diversity allows species to evolve to cope with environmental changes (Millennium Ecosystem Services, 2005) such as climate change. This provides resilience to the community and allows the continuation of the many ecosystem services.

Cultural Services – Aesthetic Enjoyment

Natural environments are an important source of aesthetic pleasure for people all over the world (MA, 2005) and there is a general preference for natural over built environments (Kaplan and Kaplan 1989). The location of MTL and KT in the hilly area in North-eastern N.T. surrounded by forests and shrublands would provide aesthetic enjoyment for the villagers. This is reflected by the villagers' memory of the beauty of their homeland.

Cultural Services – Recreational and Leisure Services

In addition to the accounts of village kids utilising natural materials to make toys and keeping jumping spiders for entertainment, they also liked to swim in the deep irrigation pool that was created by a weir across the stream (Rural Commons). There is little doubt that villagers would have many ways in entertaining themselves or having leisure time in the natural environment.

Cultural Services – Spiritual Fulfilment

Both MTL and KT have Feng Shui woodlands next to the village. These are perceived to enhance the villages' feng shui, establish balance of the natural elements and bring luck to the area and its people. The villagers depended heavily on the natural resources for their livelihood and it would be fulfilling to be able to satisfy their needs.

Cultural Services – Cognitive and Educational Services

The natural environment and the associated biodiversity provide infinite opportunities for learning. The many uses documented in earlier sections reflect an in-depth understanding of the diverse functions of the many of the wild plants, and, when and how best to utilize them. Such traditional knowledge is likely to have accumulated, refined and passed down from generation to generation, and stimulate further explorations and create more knowledge.

MTL and KT are remote forest villages that should have a high degree of self-sufficiency and relied heavily on biological resources in the natural environment. The human-nature interactions would be complex, dynamic and evolve with time. The cultural services mentioned above would only capture the more obvious ones that have been reported in literature. The lack of in-depth study would prevent a good understanding of the relationships between the natural environment and their cultural identity and heritage.

(2) Village Unoccupied Period between 1980 - 2019

Provisional Services

No one lived in the two villages during this period after all the villagers left. Although the plants and animals still occurred in the natural environment, they were not being collected and used to provide food, drinks, medicines, fuel, materials, or for entertainment. Some of the hikers/visitors to the area during this period might have collected and used some plants and animals, but these would be expected to be in much smaller scale and did not form significant services.

Similarly, there would be very limited use of the stream water during this period. In fact, the water tank built earlier in the stream had not been maintained and clogged up during this period. As mentioned, the streams also supplied fresh water to the Lai Chi Wo village downstream. Around this period, the majority of the villagers also moved out from Lai Chi Wo and farming had stopped. Hence, the water provisional service would have drastically declined.

Regulating Services – Pollination and Pest Control

After the two villages were abandoned, the fruit trees were left unattended and the fruits were not harvested. Hence, the pollination and pest control services would be insignificant during this period.

Regulating Services – Water Purification, Erosion and Flood Control

Again the water purification, erosion and flood control services would not deemed important when no villagers lived in MTL and KT. However, the benefits from these services extended beyond the two villages as the streams flow all the way to Lai Chi Wo. Although uninhabited, the erosion and flood control services by the forests, shrubland and grassland on the hillsides likely had protected the villages from serious damage by landslides.

Regulating Services – Local Air Purification

Air quality became deteriorated during this period because of the rapid urbanisation in Hong Kong and later in Shenzhen. Moreover, the forests in MTL and KT had gradually increased in area and maturity after the villages became unoccupied. The expanding forests would have played a role in purifying the air for the hikers to the area.

Regulating Services – Carbon Storage

After the villagers moved out and the fields were left unattended, natural succession occurred. The abandoned fields were first colonised by shrubs and gradually replaced by trees. Since trees are effective in capturing and storing carbon dioxide from the atmosphere through photosynthesis, the carbon storage during this period would have increased when compared with the farming community period.

Regulating Services – Local Climate

As the secondary forests slowly expanded and the trees getting bigger in the abandoned fields, the respective transpiration intensity and air temperature lowering capacity would be elevated. However, all the villagers had moved out during this period and such benefits would be felt by the visitors only.

Supporting Services – Nutrient Cycling, Primary Production, Soil Formation and Retention

Natural succession occurred in the surrounding hillsides after the villagers had moved out from MTL and KT, leading to the gradual formation of shrubland and forest. These woody and more mature vegetations tend to have a higher plant and animal diversity. Biodiversity can directly affect supporting services such as nutrient cycling, primary production and soil formation

(Millennium Ecosystem Assessment, 2005) which in turn would affect many of the provisional and regulating services. However, after the villagers had moved out, no one would collect and directly benefited from the natural resources, making the provisional ecosystem services of little significance. For many of the regulating services, they would only be enjoyed by the hikers passing through the area and would be of low significance. Hence, these supporting services would also be of low significance.

Supporting Services – Habitat for Species

Similarly, even though the potential pollinators, predators and parasitoids of pest species would increase during this period, they would offer little benefits to the people because farming activities had ceased. The hikers to the area would have a chance to enjoy the increased biodiversity and the more mature vegetation. However, since the main attraction would likely be the beautiful scenery in the Northeast New Territories and there were no educational materials or activities on site to help them to appreciate the rich biodiversity, the benefits were deemed of low significance.

Supporting Services – Maintenance of Genetic Diversity

Many of the provisioning and regulating ecosystem services during this period were of minimal to low significance. Therefore, the genetic diversity which provided resilience to the biotic communities and allowed the continuation of the ecosystem processes and services would be of low significance too.

Cultural Services – Aesthetic Enjoyment

During this period, the aesthetic enjoyment service would still be enjoyed by the visitors to the area.

Cultural Services – Recreational and Leisure Services

People continue to visit the area for recreation and leisure purposes such as hiking.

Cultural Services – Spiritual Fulfilment

Although the villagers had left the Mui Tsz Lam and Kop Tong during this period, some of them still returned during big festivals. The cultural identify was deemed strong.

Cultural Services – Cognitive and Educational Services

During this period, the main user group was hikers who passed through the area on the way between Wu Kau Tang and Luk Keng. Most of them probably did not stay long in the area and there were little information/education display available. Hence, the cognitive and educational services would be minimal.

(3) Village Revitalisation Period since 2019

Provisional Services

As villagers have largely moved out from the MTL and KT, very few people actually live in the two villages. Instead many more people visited the villages or even took part in the many activities usually on weekends and holidays. The direct use of natural resources for food, drinks and medicine have declined dramatically, rather similar to the Village Unoccupied Period, as the visitors often bring their own food and drinks. The family living in KT still use fuel wood for cooking, though.

The family living in KT also depend on freshwater from the stream for their daily lives. They also raise bees for honey and these would collect nectar and pollens from wild plants. In MTL, stream water is still used for washing and drinking and for irrigating the coffee, lemon and cacao plants grown in the agroforestry plots and the tangerines in the terraced farmland after village reviralization.

Projects under the village re-vitalisation have organised a number of activities revolving around the traditional use of wild plants. For example, plants were collected to make traditional food such as the Chinese New Year glutinous rice cake and Dragon Boat Festival ash water dumpling (鄭敏華等, 2022). In addition, workshops on wild veggies and the use of local *Dioscorea cirrhosa* and *Strobilanthes cusia* in dyeing fabrics had been organised. Moreover, supposedly new way of using plant materials that had not been traditionally practiced by the villages had been introduced during project activities. For example the extraction of latex from *Toxicodendron succedanea* to make into a glue for repairing broken pottery and ceramic wares uncovered in the MTL village as part of the Participatory Action Research on Countryside Conservation and Revitalisation activities (鄭敏華等, 2022).

Regulating Services – Pollination and Pest Control

Since village revitalisation, the fruit trees in KT and MTL have been managed for production. Under this MA, some 300kg of starfruits, Wampi, tangerine, mandarin were harvested. Therefore, the pollination and pest control services have become important again. Moreover, Coffee, Cocoa, Lemon and Lime have been planted in the agroforestry plots. These services would be important for the growth of the plants and the future harvest.

Regulating Services – Water Purification, Erosion and Flood Control

Water purification, erosion and flood control services have become important again after village revitalisation as more people spend time and even stay in the villages. They rely on clean stream water for daily use. The erosion and flood control services by the forests and shrubland on the hillsides would have protected the two villages, the newly restored farmlands, and, the agroforest plots and tent camping site from landslides.

Regulating Services – Local Air Purification

In recent years, air quality has become an issue for the whole South China region as a result of urbanization. In a regional modelling study, air quality regulating service is found to be “very significant” in lowland forests and mixed shrublands (Lai *et al*, 2022). Forests and shrublands the in MTL and KT area continue to play a role in purifying the air at the local level for the people visiting and staying in the villages.

Regulating Services – Carbon Storage

After the villagers moved out and the fields were left unattended, natural succession occurred. The abandoned fields were first colonised by shrubs and gradually replaced by trees. Since

trees are effective in capturing carbon dioxide from the atmosphere through photosynthesis, the carbon storage during this period would have slowly increased.

In the 2022 study of above-ground carbon stored by trees in 24 quadrats, a total of 16.33 tonnes of carbon were estimated in the 2,400 m^2 of forests measured under the MA project. A repeated survey in 2024 showed there was an increase of 1.18 tonnes of stored carbon within the survey quadrats (see Third Year and Final Biodiversity Monitoring Report). The results showed that the forests in MTL and KT continue the service of capturing and storing carbon.

Regulating Services – Local Climate

In addition to the lowering air temperature benefit to the people visiting the MTL and KT area which is much welcome in hot summer, the forest trees also increase relative humidity and provide shade, thus creating a micro-climate favourable for growing certain crops (such as shade coffee, cacao, bitter ginger) and mushrooms in the agroforestry plots under this MA project.

Supporting Services – Nutrient Cycling, Primary Production, Soil Formation and Retention

The nutrient cycling, primary production, soil formation and retention services are most relevant to the continuation of various provisioning services and regulating services. As the provisioning and regulating services during the 'Village Revitalisation' period mentioned earlier are on average of low to medium significance, these supporting services are also considered to be of medium significance.

Supporting Services – Habitat for Species

The habitat for species supporting services is directly related to biodiversity which would in turn affect the Pollination and Pest Control services. Moreover, biodiversity is a key theme in many of the activities and programme organised in the Village Revitalisation period. Therefore, this supporting service is considered to be of high significance.

Supporting Services – Maintenance of Genetic Diversity

Genetic diversity is one of the three levels biodiversity and allows species to adapt to a changing environment, thus providing resilience to the biological community. This is especially important for the long-term continuation of the many ecosystem services related to biodiversity. Similar to the Habitat for Species supporting service, it is also of high significance.

Cultural Services – Aesthetic Enjoyment

The natural scenery would be one of the attractions that draws visitors to the area. This is further enhanced by the wall paintings, the installation arts, pleasing new architecture using simple materials and the colourful butterflies attracted to the butterfly gardens as part of village revitalisation programme.

Cultural Services – Recreational and Leisure Services

Access to the area has been improved as part of village revitalisation. MTL and KT are also more well-known through the media and social media coverage. More visitors and hikers have been drawn to the area for recreation and leisure. The recent opening of the tent camping site and recreational forests established as part of this MA project allows visitors to have day or night camps in the area, tree climbing and other recreational activities.

Cultural Services – Spiritual Fulfilment

During this period, more local villagers, their friends, project staff, volunteers and participants spend time in the villages carrying out all sorts of activities. These range from cultural mapping, oral history exercise, improving the trails, tidying up the environment, digging old artefacts, harvesting fruits, caring for the crops and plants, doing surveys, taking part in workshops etc. The villagers also carry out rituals and worships during important festivals and events. The spiritual fulfilment would be considerable.

Cultural Services – Cognitive and Educational Services

Under the MA project, the restored MTL Story House with displays/exhibits covering the culture, the relationships between the villagers and nature would no doubt enhance the cognitive and educational experience to the casual visitors/hikers to the area. The eco-tours, citizen science programme and workshops that utilize the ecological resources for environmental education reach fewer people but the cognitive and educational experience would be stronger.

Discussion

As expected, there have been major changes in the ecosystem services enjoyed by the people in the MTL and KT area with time (Table 6). In the hundreds or so years since the two villages were established, the villagers practised a mostly self-sustaining, farming lifestyle. The Provisional Services especially in terms of water, food, fuel would be crucial. The pollination, pest control, water purification, erosion and flood control Regulating Services were also important. The Cultural component, in particular spiritual fulfilment, cognitive and educational services were also significant to the villagers. The natural environment ought to be important in shaping their cultural identity and heritage, but there is very limited available information on this complex relationship. To sustain these services, the long-term Supporting Services are also critical.

When the two villages became unoccupied, the main group of people visiting the area would be hikers. Aesthetic enjoyment, recreational and leisure services would be the important ecosystem services for them.

Since village revitalisation, a number of cultural and nature conservation projects with a strong public engagement component have been implemented including this MA project. Therefore all the Cultural Services, some with a focus on nature conservation, become the most important. The related habitat for species and maintenance of genetic diversity Supporting Services are also of high significance. Many of the regulating services are of medium significance.

Table 6. Summary of ecosystem services and their significance to the people during the three periods

Types of ecosystem services		**Time Periods**		
		Farming Community in the past	Village Unoccupied	Village Revitalisation
Provisional Services	Food, Drinks and Medicine	+++	-	-
	Water	+++	-	++
	Raw Materials	++	-	+
	Entertainment Materials	++	-	-
	Fuel	+++	-	+
	Food for Farm Animals	++	-	-
Regulating Services	Pollination and Pest Control	+++	-	+

	Water Purification, Erosion and Flood Control	+++	+	++
	Local Air Purification	+	+	++
	Carbon Storage	+	++	++
	Local Climate Regulation	+	+	++
Supporting Services	Nutrient Cycling, Primary Production, Soil Formation and Retention	+++	+	++
	Habitat for Species	+++	+	+++
	Maintenance of Genetic Diversity	+++	+	+++
Cultural Services	Aesthetic Enjoyment	++	+++	+++
	Recreational and Leisure Services	++	+++	+++
	Spiritual Fulfilment	+++	+	+++
	Cognitive and Educational Services	+++	-	+++

Significance level: - minimal, + low, ++ medium, +++ high

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