Productive Green Roofs

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Urban Rooftop Farming
城市天台耕作

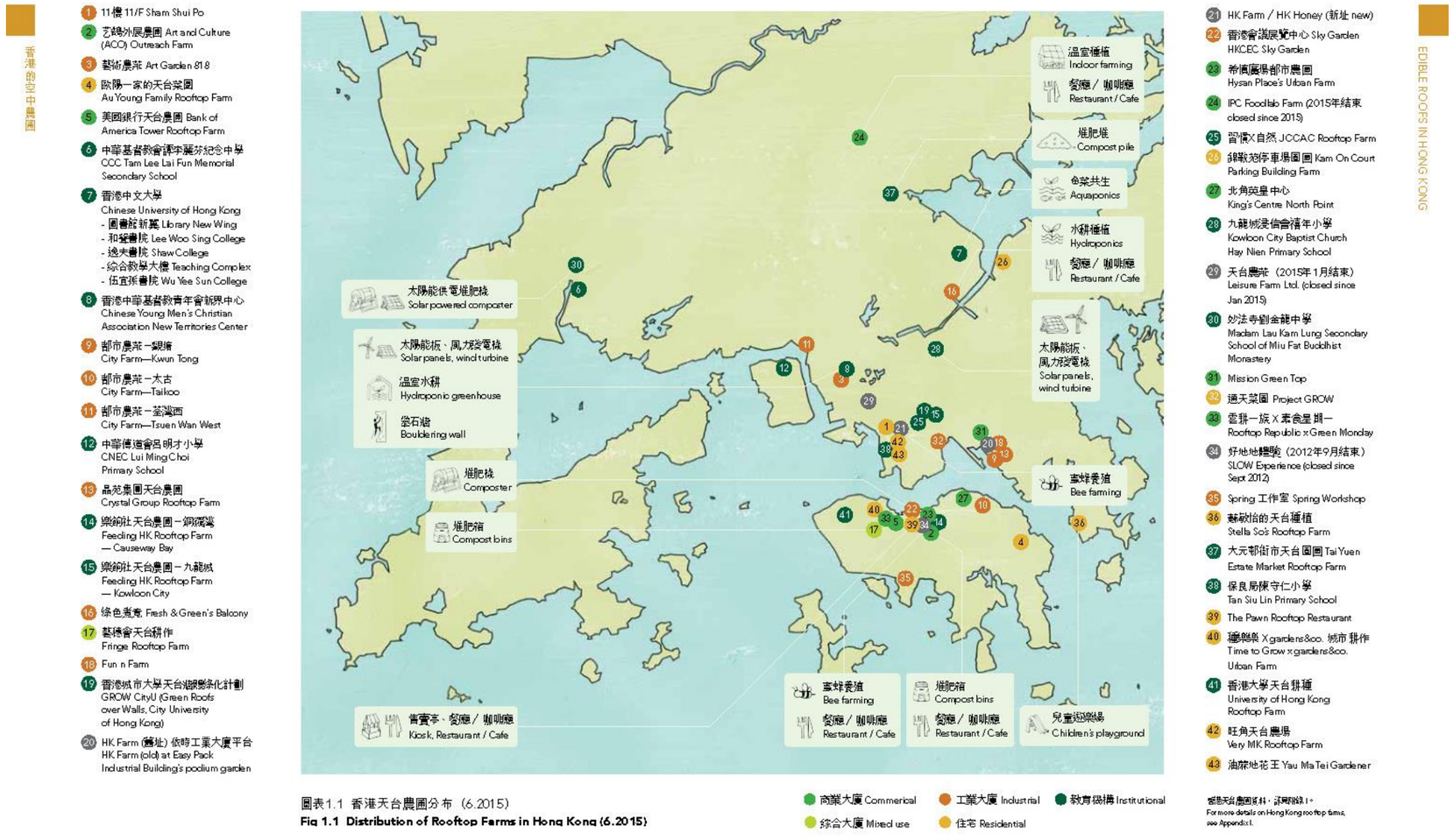
Increasing space congestion, impoverished urban environments, unhealthy lifestyles and low levels of social interaction, have inspired urban communities to activate under-utilised building roof spaces to run urban rooftop farms.

Less than 0.1% of the population in Hong Kong has access to a private garden

URF initiatives in Hong Kong

Since 2009, some 60 urban rooftop farms (URF) have been established on residential, commercial, industrial, and institutional buildings across Hong Kong

- Specific interest community group
- Community enterprise
- Private operation



圖表1.1 香港天台農圃分布 (6.2015)
Fig 1.1 Distribution of Rooftop Farms in Hong Kong (6.2015)

Map of rooftop farms in HK in 2014 (Pryor 2016)

Unique form of production

URFs can be distinguished from ground level farms by their greater spatial limitations and operational complexities
(Hui 2011; Thomaier 2015).

Emphasis on participation rather than production, participants motivated by personal interest
(Pourias et al 2014; da Silva 2016),


HKICC School of Creativity


Australian International School


HKU Rooftop Farm

Benefits

URFs can have similar <u>environmental benefits</u> to green roof installations:

- Lower solar heat gain and better insulation (Cerón-palma et al. 2012)
- Improved energy conservation, thermal performance and sound insulation; reduced urban heat island effect (Kitaya et al. 2009);
- Improved air quality (Tong et al 2015);
- Increased urban biodiversity and positive contribution to urban greening (Borysiak et al. 2016).

<u>Community benefits</u> of URFs, include:

- Higher levels of active recreation,
- Healthier urban life-styles,
- Positive community engagement through place-making, and greater social interaction amongst participants. (Specht et al. 2014; Noori et al. 2016)
- Active stewardship of roof spaces, (Proksch 2014; Pryor 2015)

39/F Bank of America Tower, Central

Commercial scale rooftop production

URF has not been successfully commercialized, but potential for growing food at a commercial scale on city rooftops has already established in Singapore. (Donald, 2011)

Researchers are now exploring the use of rooftop glasshouses, aquaponics, hydroponic systems and vertical growing structures to increase production. (Cerón-Palma et al. 2012; Sanyé-Mengual et al. 2015; Taylor et al. 2012; Banerjee and Adenaeuer 2013)

Images: hydroponicshabitat.com, VF Innovations

Potential for commercial rooftop production

Technical and economic aspects of commercial rooftop farming being tested:

- Suitable crop species, growing media, growth performance and production capacity of different farming modes. (Pfeiffer et al. 2015; Orsini et al. 2014)

- Sustainability of food production and the influence of climate on potential production.

- Infrastructural requirements and building restrictions in different cities. (Specht et al. 2014).

Images: hydroponicshabitat.com, VF Innovations

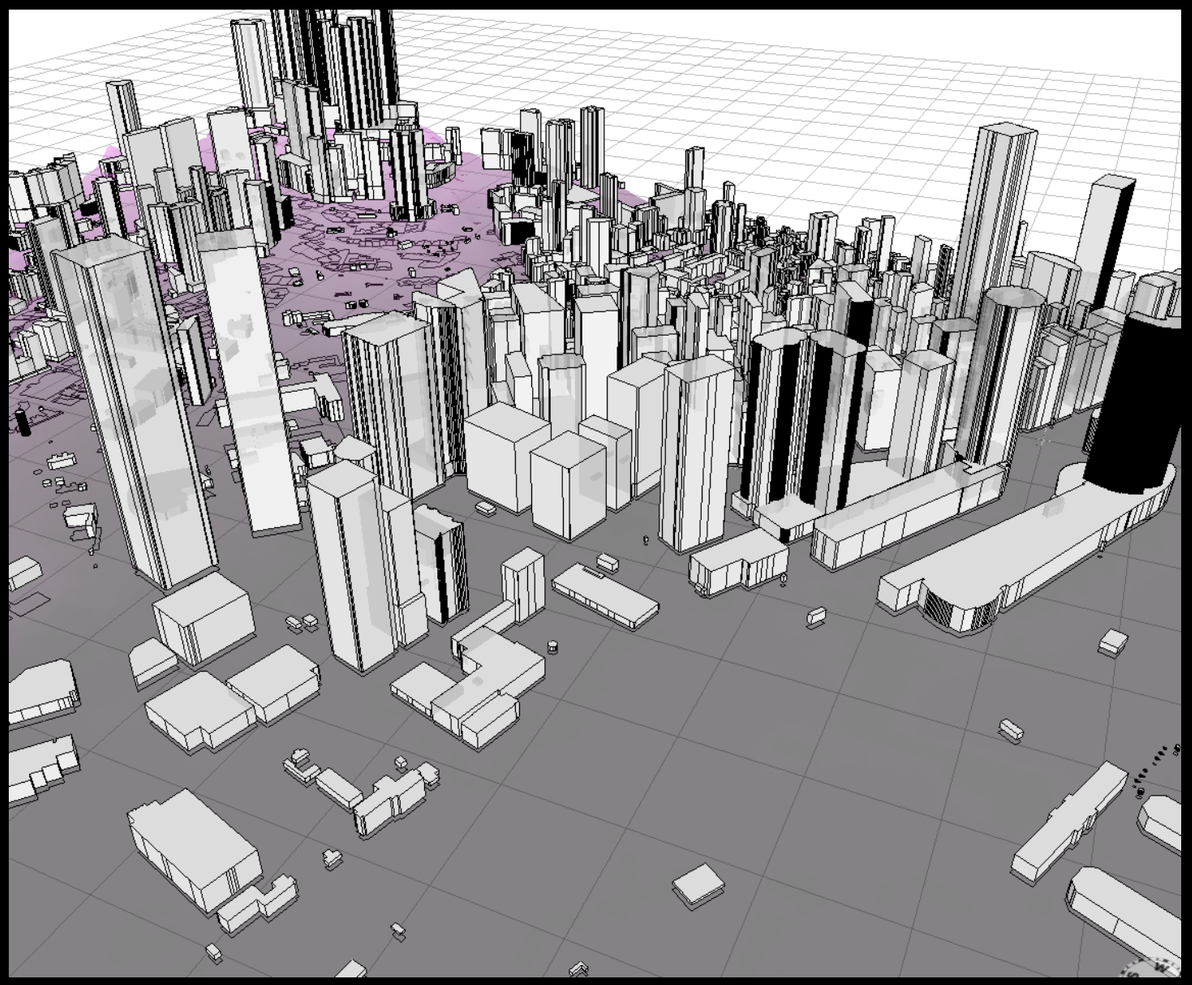
Hysan Place Rooftop Farm,
Causeway Bay

Positive contribution to urban environments

City authorities are actively looking at potential contribution of URFs to the urban environment.
(Colding & Barthel 2013; Martin et al. 2014)

No clear definition or performance criteria has been developed for URFs, which would allow them to be formalized within urban land use planning and decision making processes.

In Hong Kong, URFs are not recognized as 'green roofs' under Sustainable Building Design Guidelines (Buildings Department 2011), so do not count towards green building coverage



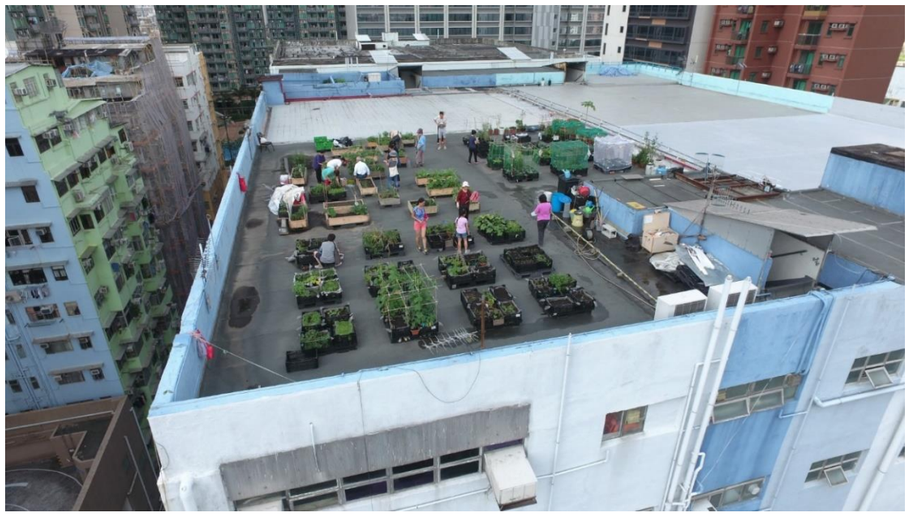
3D Modelling of Buildings in Hong Kong based on Footprints and Heights, Used in the Estimation of Potential Farmable Roof Spaces

URF Research Study

Study to systematically evaluate of the potential for URFs within Hong Kong

- quantifying total physical roof space that could be activated for farming, and
- possible levels of civic participation

Ebenezer School for the Blind, Pokfulam, HK



Project Grow, Kwun Tong, HK

Fun N Farm, Kwun Tong, HK

Survey of all existing URFs and farming operations

Range of building, environmental and community conditions.

Mapped against existing land use, building records and census data.

Giving an indication of the possible number of buildings that could be utilized for URF operations, total of farmable roof space, and number of participants that they could support.

Research method

Team visited 48 farms (excluding private and recently started farms), to:

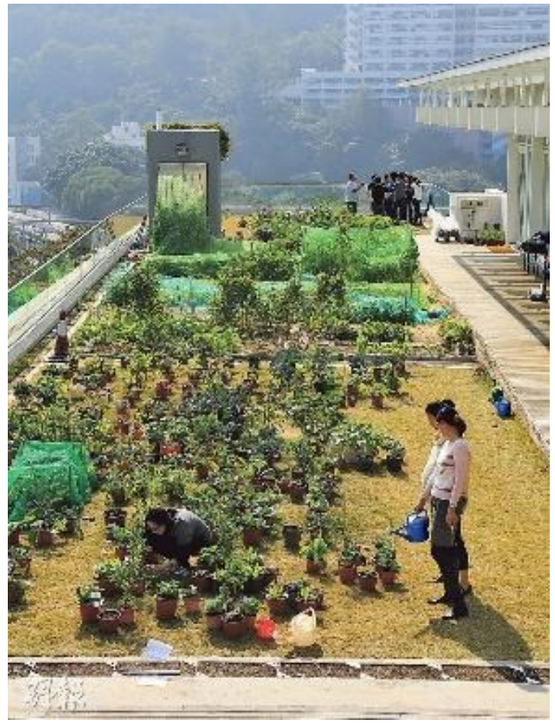
- Document the extent and material condition of the roof and the nature of the farm operations.
- Interview farm managers / owners.
- Survey farm participants.

City Farm, Quarry Bay

Identifying URFs

19 ‘Open-to-public’ farms (ave. 42 farmers, total farm area 7,315m^2).
29 ‘Restricted’ farms (ave. 22 farmers, total farm area 5,270m^2).

12.5% on residential buildings (1983-00).
22.9% on institutional buildings (1983-13).
37.5% on industrial Buildings (1970-03).
27.1% on commercial buildings (1978-13).



FHK Rooftop Farm, CWB

City Farm, Tsuen Wan

CUHK Teaching Complex

Survey of building and environment

- Building type and age.
- Environmental data.
- Building limits for URF operations, location rooftop / podium deck), rooftop height, means of access (by stairs or lift), roof size and farmed area; other roof uses (e.g. emergency refuge).
- Structural capacity of the roof deck.
- Parapet edge conditions; services / structures.
- Roof drainage, water proofing, water supply and sunlight / wind exposure.

39/F Bank of America Tower, Central

HKICC, Kowloon City

Image: Rooftop Republic

Interviews with farm manager

- History of the farm.
- Ownership.
- Funding model and operational structure.
- Number of participants and their origin planter type, crop species.
- Soil material.
- Related activities (instruction sessions, crafts etc.).

Caritas Lok Kan School,
Tin Shui Wai

Questionnaire survey of farm participants

- Age and gender.
- Employment status.
- Motivation for participation.
- Frequency and timing of visits.
- Time spent per visit.
- Point of origin (home or work), distance travelled, level of farming experience.

Community Day at City Farm, Tsuen Wan

Urban Rooftop Framing Network

Questionnaire for Urban Rooftop Farmers in Hong Kong

Name of Interviewee	_____
I understand the intent and nature of this questionnaire, as described above, and agree to participate in the research.	Yes ☐ No ☐

Your Urban Rooftop Farm	
1. What is the name of the Rooftop Farm you participate in?	_____
2. Why did you choose this farm? *(mark as many as are appropriate)*	Close to home / work ☐ Friends introduced me ☐ Farm gives a lot of support ☐ Farm has interesting activities ☐ Other _____
3. How long have you been farming?	(months / years) _____
4. On average, how many times per week do you visit the farm	1 time per week or less ☐ 2 or 3 times per week ☐ 4 or 5 times per week ☐ 6 or more times per week ☐
5. Typically, on what days do you visit the farm *(mark as many as are appropriate)*	Monday ☐ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday ☐ Saturday ☐ Sunday ☐
6. Typically, at what time of day do you visit the farm	Early morning (before 09:00) ☐ Morning (09:00-12:00) ☐ Early afternoon (12:00-15:00) ☐ Later afternoon (15:00-18:00) ☐ Evening (after18:00) ☐
7. On average, how long do you spend farming on each time?	0 – 30 mins ☐ 30 - 60 mins ☐ 60 - 90 mins ☐ 90 - 120 mins ☐ More than 120 mins ☐
8. Which seasons do you participate in the farm? *(mark as many as are appropriate)*	Spring (Mar-May) ☐ Summer (Jun-Aug) ☐

Assessment of potential for URF in Hong Kong

Preliminary indication of the potential for URF within Hong Kong, based on estimates of:

- Physical capacity i.e. the total roof area of all existing buildings capable of supporting URFs.
- Participatory capacity i.e. applying rates of participation in existing farms (number of participants with respect to their catchment populations), at a city scale.

City Farm, Taikoo

New World First Ferry, Lai Chi Kok

Potential roof space

41,600 buildings within Hong Kong:

- Residential / composite buildings (80.8%).
- Institutional buildings (6.8%).
- Office/ commercial buildings (6.2%).
- Industrial buildings (4.2%).
- Others (5.0%).

Assessment of the number of buildings on which URFs would be possible was made based on limiting factors.

Very MK Rooftop Farm, Mong Kok

City Farm, Taikoo

Image: VeryMK

Building limitations

Structural capacity of the roof deck was the primary limiting condition. Only roof decks that had been designed for emergency refuge (i.e. had sufficient structural capacity) and were accessible could be used safely.

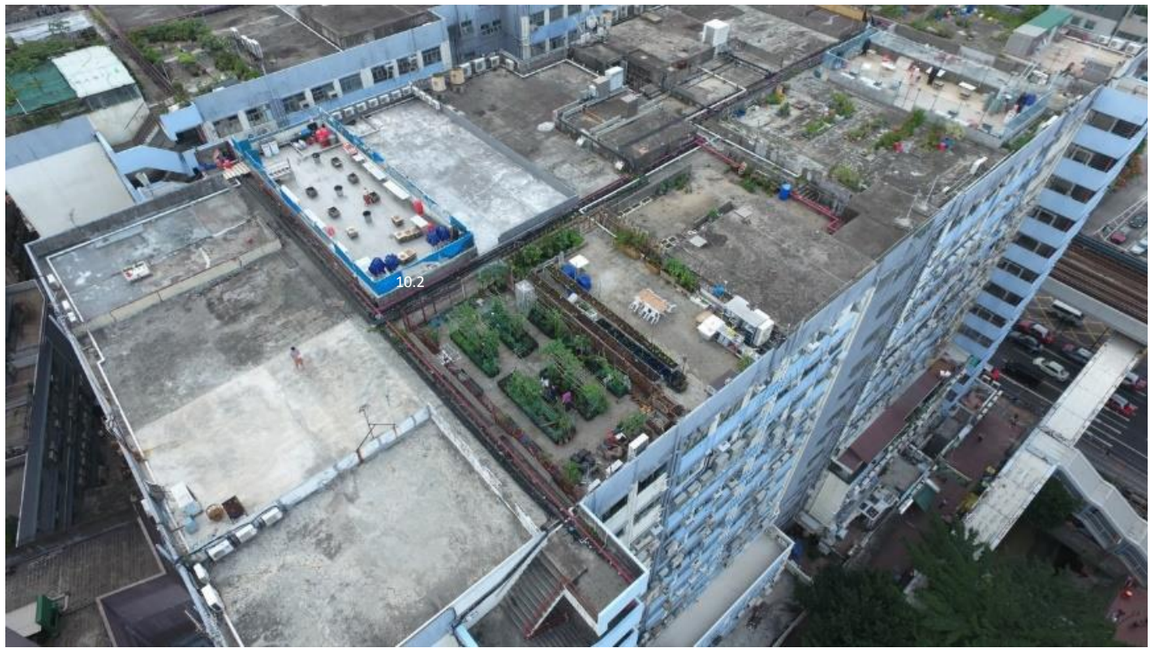
Buildings with long span, lightweight structure roofs, and those with pitched roofs were not included. Buildings with secured uses, sensitive rooftop features or property rights issues that precluded public access, were not included.

Environmental conditions

Environmental conditions on the roof (sunlight, rain, shelter from winds, presence of insect pollinators) were not a limiting factor.

Highest existing URFs were on 38/f and 39/f level, (approx +150m).

Project Grow, Kwun Tong, HK



Fun N Farm, Kwun Tong, HK

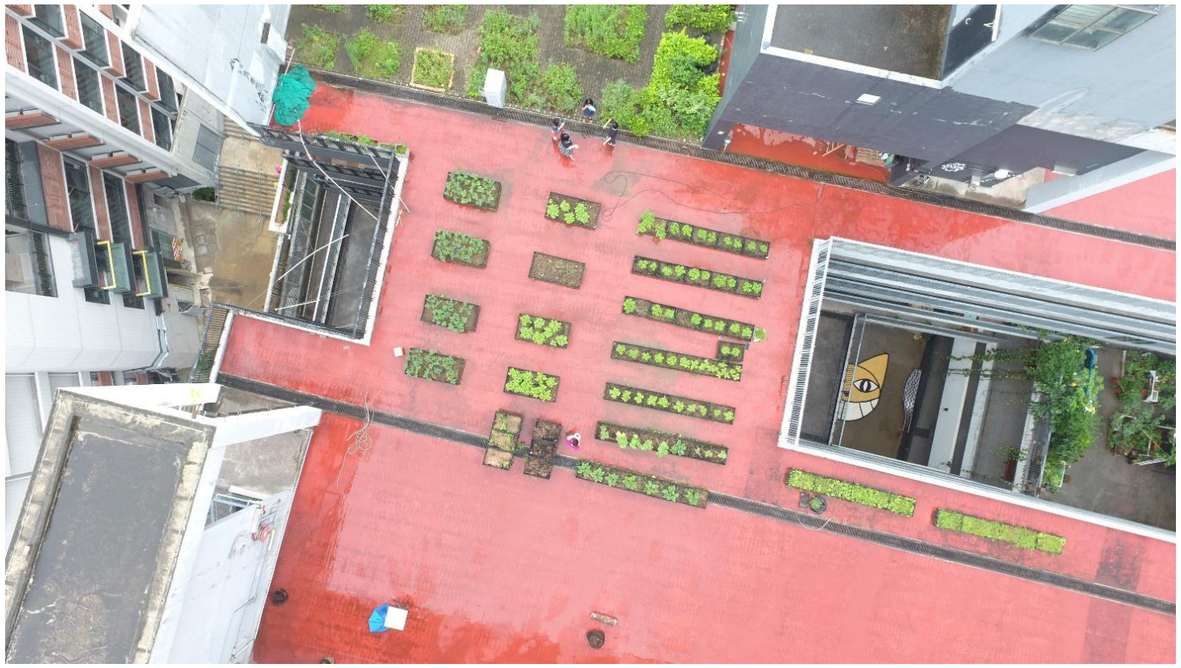
Planted area

Planting area as a percentage of space covered by the farm 14% - 32%.

Minimum operable area required to sustain a community-based URF approx. 40m^2 (= 12.0m^2 planted area).

This effectively excluded all individual, low rise residential buildings.

Rooftop farm at Ebenezer School for the Blind, Pokfulam



HKICC, Kowloon City

Total farmable roof area

Farmable area = total building footprint area - space required for rooftop infrastructure and operational requirements

Typical building footprint area and proportions of space taken up by infrastructure etc. estimated (by building type and height), from building records and land survey plans for all buildings within two sample urban sub-districts, and cross-checked against aerial photographs.

IPC Foodlab Farm

City Farm

Tai Yuen Estate Market Rooftop

Participatory Capacity (Potential public demand for rooftop farming)

Owners noted that:

- Farms are heavily oversubscribed, and membership and the extent of planted area worked by individual participants have to be restricted.
- Physical space is the only limitation.
- Uncertainty exists over legal status of rooftop farming.

Nature of participants

‘Regular farmers’, visit the farm four or more times a week, for >3.5 hours in total

‘Occasional farmers’ visited once or twice a week <1.5 hours in total.

Large majority are occasional farmers, but farm operations were sustained by regular farmers.




Australian International School’s Edible Roof Club *(closed)*

Scale of operations

Size of farmed area per participant:

- In open-to-public farms, farmers typically managed 2.0-2.4m^2 of planted space,
- In restricted farms, regular farmers managed up to 10.0m^2, with occasional farmers managing 0.9-1.8m^2 planted area, on average.

Town Gas HQ Rooftop Farm, Quarry Bay

City Farm, Kwun Tong

City Farm, Tsuen Wan

Key demographic groups

- Young professionals (18-25).
- Late middle age workers (45-65).
- Recently retired (65-75).

  [Elderly – more free time / interest in health issues].

Profile of Farmers

Expertise not a limiting factor. Occasional farmers reported their level of experience as ‘very little’ or ‘none’, regular farmers saw themselves as ‘somewhat competent’.

Key motivations:

- Learning new things.
- Pleasure in growing things.
- Social interaction.
- Opportunity for outdoor recreation.

Community day in the HKU Rooftop Farm

Origin of farmers

64% of participants travelled less than 400m to the farm (<10 minutes) from their point of origin.

96% having journeys of 800m* (20 minutes) or less.

(*) likely maximum distance a participant might be prepared to travel

Urban population within a 800m radius catchment area would be ~31,000 to 54,000.

Images: HKU GenEd

Study conclusions

Physical and environmental limitations on the use of roof decks for farming were less than anticipated.

Urban rooftop farms have developed spontaneously, without technical assistance or policy support, suggesting a broad based interest within the community.

Farmers motivations for participation being social and recreational, rather than productive.

Planting in the HKU Rooftop Farm

Late afternoon in the HKU Rooftop Farm

Study conclusions

Wide variety of building types and communities can support them, indicating considerable potential.

Low or medium rise industrial buildings had the greatest percentage of useable area (65-75%) least amount of rooftop installations and operational requirements.

Commercial buildings appear to offer the greatest potential for developing rooftop farms.

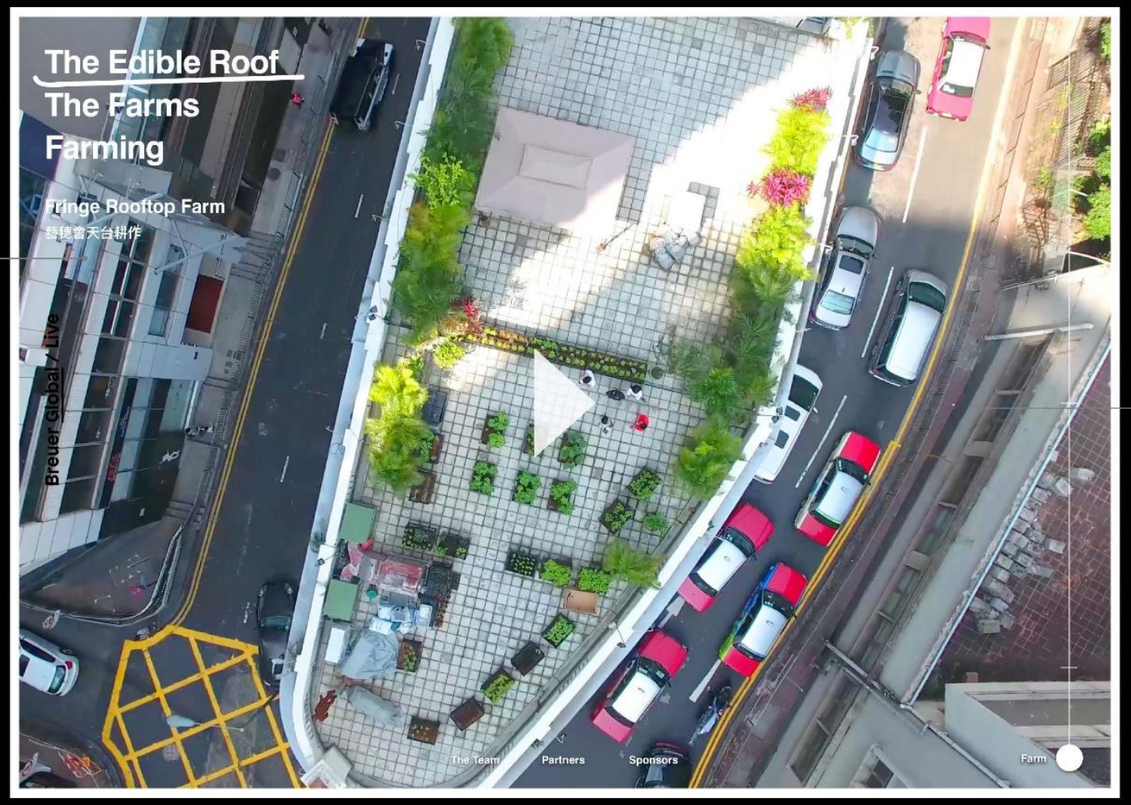
Study conclusions

Preliminary estimation of 595ha of farmable roof space in Hong Kong

Considerable potential for expansion of rooftop farming activities, if current capacitors can be addressed.

Total area of land used for vegetable, flower, field crop, production in rural farms across the whole of Hong Kong was only 420ha (as at the end of 2015).

Zooming into a Selected Farm: Intro Video



User zooms into the farm, and drone video of the farm auto-plays

Impact

Based on current participation rates, territory wide participation in rooftop farming could exceed 18,000.

Participation could be ten times higher, particularly as more farms became available and travel distances were reduced, and if the initiative was promoted centrally.

HKU Rooftop Farm, in its fifth year

Impact

Urban rooftop farming not yet a component of the Government's New Agricultural Policy, but offers a better prospect than traditional urban farms because of the potentially greater farmable area on the city's rooftops, and closer proximity to participant populations.

Also aligns directly with policies promoting healthier urban lifestyles; community engagement, and aging in place.

Images: City Farm HK

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