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ELEVATING
URBAN
AGRICULTURE



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由憧憬到豐收

A GUIDE TO
PRODUCTIVE
ROOFTOP
GARDENING



1 The Edible Roof book cover

Project Details

Author

Mathew Pryor

Title

Elevating Urban Agriculture

Output

Community enterprise-orientated landscape architecture research

Location

High density urban districts

Funding

Funded through GRF and HKU grants GRF, “Analytical study on the potential of urban roof farming in high density cities” (HK\$595,188, Nov 2015) HKU TDG & KE Impact grants ‘Construction of demonstration project : HKU Rooftop Farm) (HK\$185,000 + 100,000)

Area/Size

Relates to urban rooftop farming practices in high density cities

Dates

2013-2018



¹ City Farm, Quarry Bay (from the study's survey of rooftop farms in Hong Kong)

Summary of the Work and its Significance, Originality, and Rigor

Numerous small-scale rooftop farms have spontaneously appeared over the last ten years on buildings in high-density urban districts worldwide. This wide-ranging study documented, tested and codified rooftop farms, and investigated the motivations of participants. Environmental and community limits in the design of rooftop farms were determined, together with their potential contribution to enhancing urban environmental and community well-being. Key conclusions of the study revealed both that extensive farmable roof space existed within dense (and aging) urban populations, and personal social values

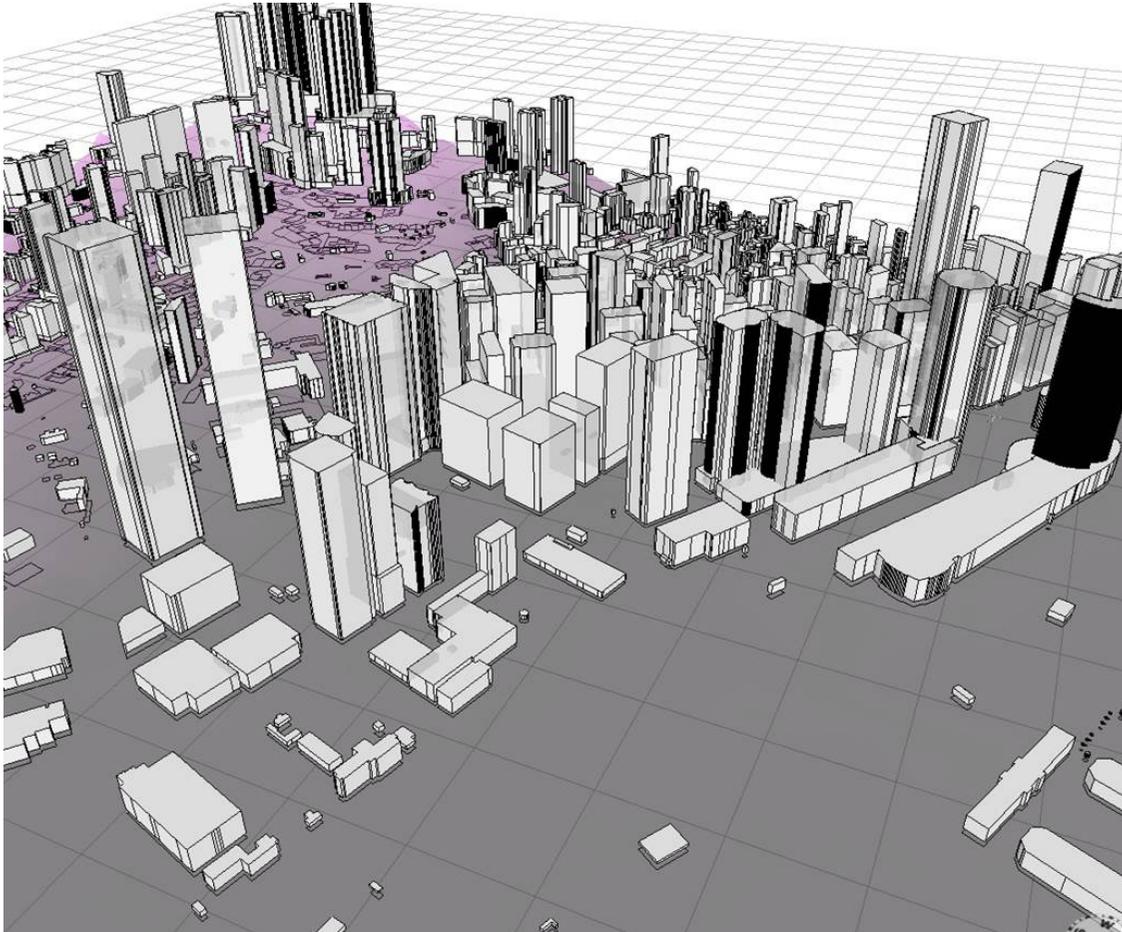
motivated participants to initiate rooftop farms, indicating that government policy on urban agriculture policy should shift their focus on the generation of social capital rather than food production.

These findings indicate that urban agriculture could help address some mental health challenges that high density cities face. The conclusions, along with technical design information, were disseminated through an award-winning book and website. Through these outputs, practitioners inside and outside Hong Kong have developed communities of practice that allow them to coordinate their efforts and to advocate for the formalization of the practice with land and building processes.

The study was instrumental in encouraging Hong Kong Government to expand its 2016 New Agricultural Policy to include these new forms of urban agriculture, and actively promote them within development proposals. The study has attracted media attention from both local and international news organizations, and has been recognized with design awards both internationally and in Hong Kong. It has also helped to broaden thinking about the role of landscape architects in high density cities, and demonstrated the efficacy of community-enterprise projects and spaces generated through the activation of grassroots organizations.







¹ 3D computer model of buildings in Hong Kong used in the estimation of potential farmable roof spaces within the study

Originality

The study generated two unique outcomes that have developed the understanding of the role of urban agriculture in high density cities. Statistical analysis of the responses to participant opinion surveys and cost benefit analysis indicated that the perceived benefits to participants centre on issues of personal socialization. This challenges previous study conclusions that the benefits of urban agriculture relate primarily to urban food security and contributions to green urban environment.

The research also engages directly with issues of social cohesion, aging and mental health in high rise cities. Through

spatial analysis and building evaluations I have estimated that some 595ha of underused roof space exists within dense urban districts in Hong Kong could readily be activated for social enterprise-oriented farming—some 50% more than currently farmed land at the urban periphery.

The conclusions drawn from this study suggest that within strategic land-use planning, re-conceptualising the products of rooftop farming as being primarily social rather than food security or greening, and with policy and technical support of rooftop farming communities, could help address some of the acute mental health challenges that high density cities face around the world.



[About](#) ▾ [HK Rooftop Farming](#) ▾ [Technical Information](#) ▾ [URF Community](#) ▾ [Advocacy](#) ▾ [Links](#) ▾ [Contact Us](#) ▾
[English](#) ▾

¹ The new URF Network Website created within the study to bring the existing community of rooftop farms together for mutual support and advocacy.

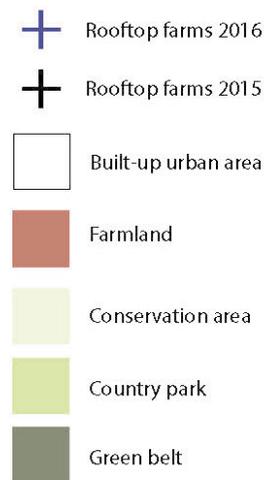
Research Questions

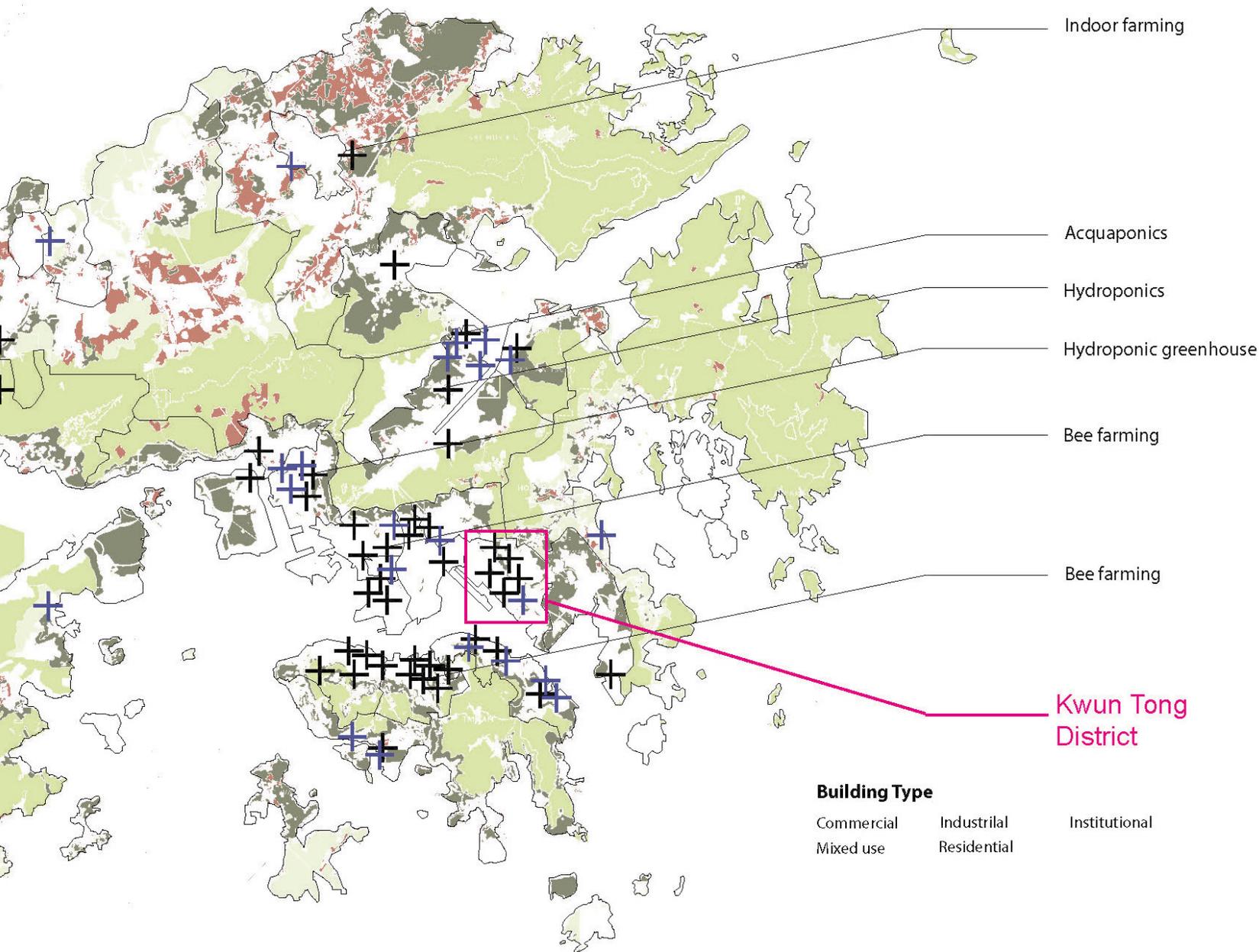
- What are the limits on the physical form and mode of operation of rooftop farming in Hong Kong (as a high density city)
- What are the motivations of the participating farmers
- What are the spatial and participatory potentials of the practice in Hong Kong
- What contribution could rooftop farming make to food supply, environment, and community well-being in the city.

Phase II - Site context

Map of rooftop farms in HK

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Indoor farming

Acquaponics

Hydroponics

Hydroponic greenhouse

Bee farming

Bee farming

Kwun Tong District

Building Type

- Commercial
- Industrial
- Institutional
- Mixed use
- Residential

¹ Mapping rooftop farms in Hong Kong in 2017 (Wang & Pryor)

Rigor

The small size and somewhat reclusive nature of the existing rooftop farming community has historically limited the opportunity for quantitative research methods. As a result, I deployed multiple methods to understand this previously unrecorded practice and to generate and verify data. Key research methods included:

- The construction and management of a 400sqm demonstration rooftop farm at HKU to test the environmental, building management and operational limits of farming on rooftops
- Systematic mapping site measurement and photographic and video documentation of all Hong Kong farms;

- Questionnaire surveys to determine the profile of farmers and the extent and reasons for their participation; and
- Semi-structured interviews with farm owners to determine historic patterns of use and operational constraints.

Cross referencing the data generated allowed a clear understanding of farming practice and participants to be established. The study used cost benefit analysis to determine the nature and degree of motivation, and land use/building, environmental and spatial analysis to determine the potential extent of farmable rooftop space across Hong Kong. Focus group interviews with long established farmers were also used to verify and test the results.

Significance

Beyond generating technical data to support the construction and operational of farms on top of buildings the study was successful in bringing the existing disparate, self-generated farms together within a collaborative URF Network to support each other and advocate for more support and recognition.

The study was also instrumental in transforming the HKSAR Government's policy on the practice. Roof-top farming was excluded from green building regulations due to its ill-defined nature and ambiguous legal status. The government now recognizes the practice's capacity to generate social capital, and a discourse on agro-urbanism in high-rise cities has emerged

in the city. Roof-top farming was incorporated into the government's expanded Urban Agricultural Policy (2016) and is being formalized within government building controls.

The project has received international and regional awards from both the Landscape Institute (U.K.) and the Hong Kong Institute of Landscape Architects (HKILA). Within Hong Kong the study has broadened thinking about the role of landscape practitioners in high density cities, and demonstrated the efficacy and relevance of generating community-orientated projects and spaces through activation of grassroots organizations rather than the traditional top-down interventions.

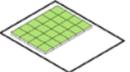
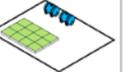
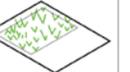
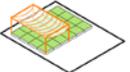
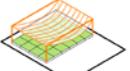
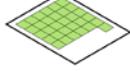
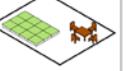
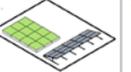
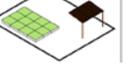
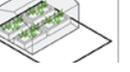
Dissemination and Evidence of Peer Review

Research findings on the project's findings, including the social motivations of participants and farmable roof space, were published in peer reviewed conference papers and formed the basis of the Productive Cities Working Group at recent APRU Sustainable Cities and Landscape Conferences (2017-2018). Findings have been presented at several international academic conferences.

The Edible Roof book, based on the demonstration project, contains technical data and possible operational structures for rooftop farming. More complete survey data has been made available to existing farms via the URF

website to allow them to collaborate in developing a community of practice, holding events and advocating collectively for greater recognition.

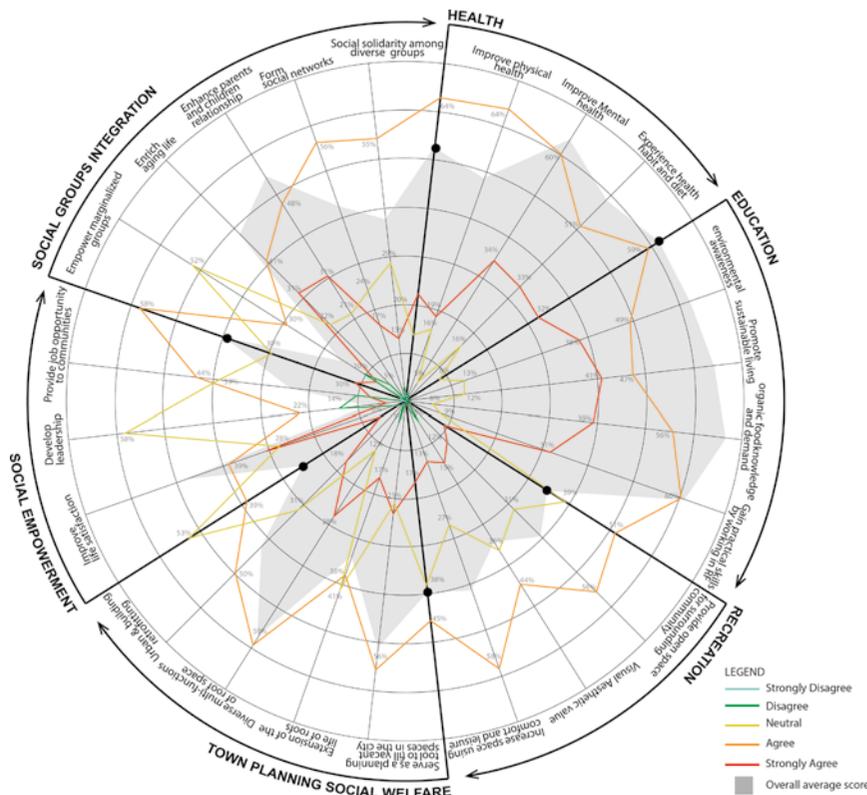
The HKU demonstration project, now in its sixth year, has generated numerous community events, school outreach

Building location	Building Type & age	Building floors	Green ratio <small>Plantable area Roof size</small>	Sun light level	Wind expose level	Roof accessibility	Other features	Farming system	User activities	User numbers
		1-3 Foundation 	0% 	None 	Exposed 	Left 	Water tank 	Ground planting 	Growing 	1-10 
		4-6 Tong Lau 	≤25% 	Partially 	Partially Exposed 	Stairs 	Storage 	Outdoor planter 	Market selling 	11-30 
		7-20 high level building 	≤50% 	Full 	Sheltered 	Left + Stairs 	Pipes 	Hydroponics 	Training courses 	31-60 
		>20 Super high building 	≤75% 				Table & benches 	Acquaonics 	Exercise & pet walking 	>60 
			100% 				Solar panel 	Bee farming 	Community events 	
							Other shelters (wood) 	Indoor 	Craft/general interest 	

¹ Typological study of rooftop farms in Hong Kong

URF Social value Framework

Urban agriculture	Green roof	Rooftop farms	Category	Factors	Social benefits	Source
✓		✓	Social benefits	Health	Improve physical health	(Ree)
✓		✓			Improve mental health	(Fan)
✓		✓			Experience health habit and diet	(Doh)
✓		✓		Education	Environmental awareness	(Tam)
✓		✓			Promote sustainable living	(Tam)
✓		✓			Increase organic food knowledge and demand	(Hui)
✓		✓		Community Recreation	Gain practical skills by working in rooftop farms	(Chu)
✓	✓	✓			Providing extra open space for community	(Tian)
✓	✓	✓			Visual Aesthetic value	(Tam)
✓	✓	✓		Urban improvement	Increase space using comfortableness	(Wor)
✓	✓	✓			Serve as a planning tool to fill vacant spaces in cities	(Rah)
✓	✓	✓			Extension of life expectancy of the roof	(Tian)
✓		✓		Social Empowerment	Diverse the multi-functions of roof spaces	(Hui)
✓	✓	✓			Urban or building retrofitting	(Hui)
✓	✓	✓			Improve users/residents' life satisfaction	(Chu)
✓		✓		Social groups Integration	Develop leadership	(Rey)
✓		✓			Provide job opportunity to communities	(Fan)
✓		✓			Empower marginalized groups	(Pry)
✓		✓			Enrich aging life	(Doh)
✓		✓			Enhance parents and children relationship	(Doh)
✓		✓		Form social networks	(Pry)	
✓		✓		Social solidarity among diverse groups	(Pry)	



¹ Results of the analysis of survey questionnaire responses indicating that the benefits of rooftop farming to participants were predominantly personal-social (Wang & Pryor)

² 08.2 Results of the analysis of survey questionnaire responses indicating that the benefits of rooftop farming to participants were predominantly personal-social (Wang & Pryor)

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programs and media interest. It has also inspired the development of other rooftop farms within the district. Aspects of the study have been featured by a number of local and international news media outlets including articles and reports featured on CNN, BBC and German TV.

The study has been recognized through both international and regional competitive landscape design awards, the jury in the latter highlighting the contribution of the study to expanding the scope of landscape architectural practice, and creating new opportunities for greening in the city.

Appendix

Academic publications:

Pryor, M. "The Edible Roof: A Guide to Productive Rooftop Gardening." MCCM Creations, 220 (2016).

Pryor, M. (2015) Productive Green Roofs, Yuan Lin, 107-113.

Other publications:

Wang, T (2018). Rethinking the role of urban rooftop framing: quantifying social benefits of urban rooftop farms in Hong Kong. (MLA dissertation, supervisor Pryor, M.). HKU Libraries Database.

Wang, T. & Pryor, M. (2019). "Social value of urban rooftop farming - A Hong Kong case study" In: Agricultural Economics: Current Issues, ISBN 978-1-78984-050-6. (Kulshreshtha S.N. Ed.), IntechOpen.

Urban Rooftop Farming Network Website. <https://app04.teli.hku.hk/urf/published-resources/>

¹ Late afternoon in the HKU Rooftop Farm

² Image of the HKU Rooftop Farm community

³ City Farm Quarry Bay



Conference presentations

Pryor, M. "Empowering urban communities through rooftop farming." In 2017 IFLA Asia-Pacific Regional Congress . Thai Association Of Landscape Architects, 2018.

Pryor, M. "Productive cities: infrastructural ecologies." In Association of Pacific Rim Universities: Sustainable cities and landscapes Conference 2018, HKU, 2018.

Pryor, M. "New Urban Nature." In Urban Sustainability Conference, THEi Hong Kong, 2018.

Pryor, M. "Productive Green Roofs." In World Sustainable Built Environment Conference 2017. Sustainable Built Environment Conference Series, 2017.

Pryor, M. "Urban Rooftop Farming in Hong Kong". In URF Network Seminar. HKU, 2016.

Pryor, M. "Urban Rooftop Farming" In Seminar on Urban Agriculture in Hong Kong and Belgium, HKU and Liege U., 2016.

Pryor, M. "Making green roofs work." In Integrating Ecology in Sustainable Neighbourhoods Seminar. Hong Kong Green Building Council, 2015.



¹ City Farm Tsuen Wan



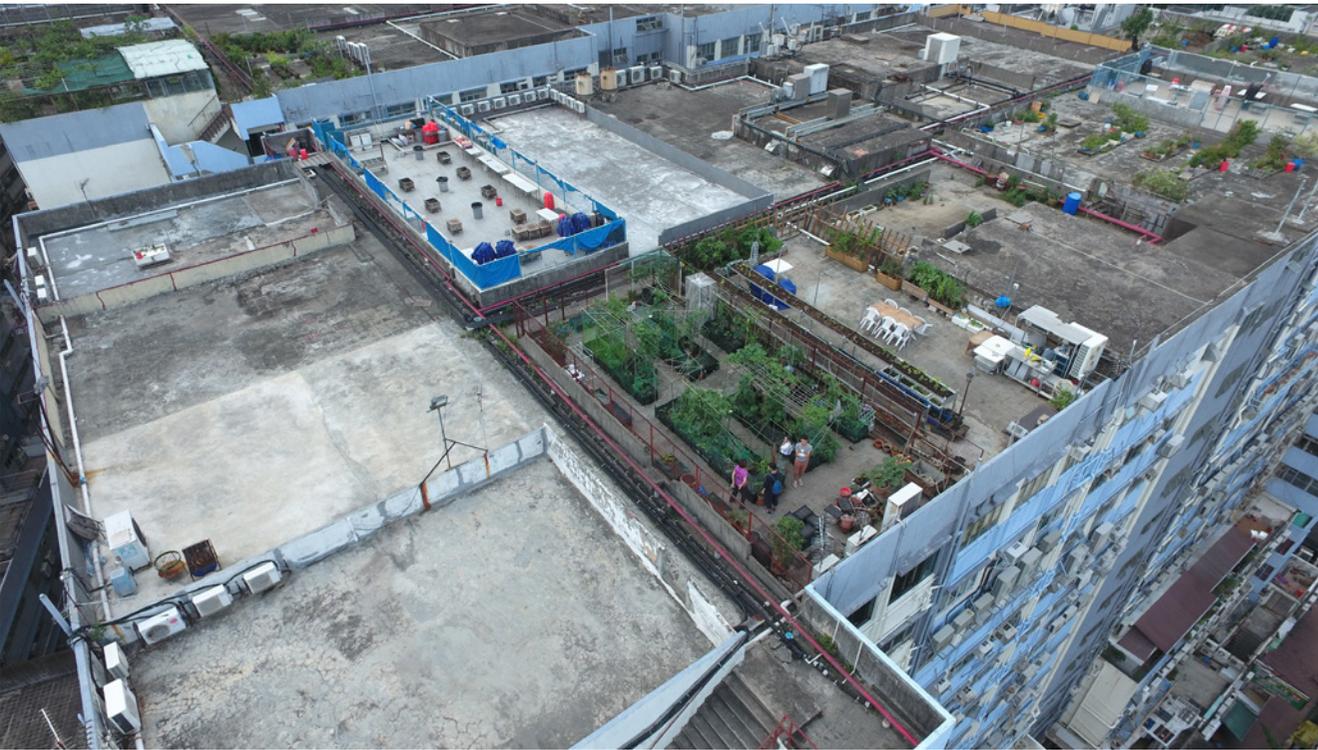
¹ City Farm Tsuen Wan



Awards

Hong Kong Institute of
Landscape Architects, Awards
2016 (Research Category)
“The Edible Roof: A Guide to
Productive Rooftop Gardening”
<http://www.hkila.com/>

Landscape Institute, UK, Annual
Awards, 2016. (Landscape
Policy and Research - Highly
Commended), “The Edible
Roof: A Guide to Productive
Rooftop Gardening”. [https://
www.landscapeinstitute.org/
case-studies/edible-roof-guide-
productive-rooftop-gardening/](https://www.landscapeinstitute.org/case-studies/edible-roof-guide-productive-rooftop-gardening/)



¹ Afternoon in the rooftop farm at HKU

¹ Rooftop farm at Quarry Bay



Demonstration Rooftop Farming Project

HKU Rooftop Farm, Run
Run Shaw Building HKU and
Rooftop Farming Community,
[https://www.facebook.com/
groups/203082323180442/](https://www.facebook.com/groups/203082323180442/)
[https://rooftopfarmhku.
wordpress.com/](https://rooftopfarmhku.wordpress.com/)

Media Coverage

Elements of the study have been featured in the following media outlets

- Apple Daily Book Review (3 Jan 2016)
- Mask9 China Book Review (23 Jan 2016)
- The Standard News Book Corner (29 Jan 2016)
- The Rail Monthly (2016-1/2)
- HKET newspaper (3 Mar 2016)
- HK01-weekly (11 Mar 2016)
- HKU Bulletin Review (May 2016)
- CNN - Going Green (July 2016)
- BBC website - An inside view of Hong Kong's hidden rooftop farms (17 May 2017)
- GALILEO science magazine
Pro7 broadcasting station,
German TV (2019)

Bibliography

Productive Cities working group
APRU Sustainable Cities and
Landscape Conferences,
2017-2019. <http://apru-scl.arch.hku.hk/working-groups/productive-cities-infrastructural-ecologies/>

HKSAR 2030+ Urban planning
and development strategy
https://www.hk2030plus.hk/document/2030+Booklet_Eng.pdf

HKSAR New Agricultural Policy
<https://www.info.gov.hk/gia/general/201601/14/P201601140558.htm>











Monthly Community Day (July 2016)

Rooftop farming in Hong Kong

Fai Hui is an urban organic farmer in Hong Kong, who says there's more to rooftop farming than growing fresh food. Source: CNN



¹ HKU Rooftop Farm featured by CNN Going Green

² HKU Rooftop Farm

³ Image from the HKU Rooftop Farm community website

作物種植總表 COMPREHENSIVE GROWING CHART

● 播種 Seeding ● 收成 Harvesting ●●●● 大量澆水 Very Heavy Watering ●●●● 充足水份 Heavy Watering ●●●○ 中度澆水 Moderate Watering ●●○○ 澆水少 Watering Less

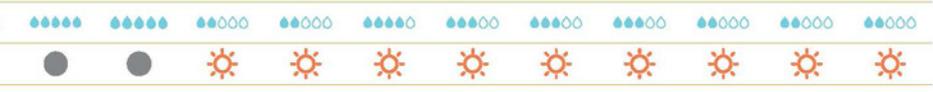
作物 Crops	白菜 Bak Choi	菜心 Choi Sum	小芥菜 Small Mustard	芥蘭 Chinese Kale	椰菜 Cabbage	黃芽白 Long Cabbage	西蘭花 Broccoli	椰菜花 Cauliflower	苋菜 Chinese Amaranth	通菜 Water Spinach	潺菜 Ceylon Spinach	生菜 Lettuce	油麥菜 Celtuce	作物 Crops	糖萼 Chrysanthemum	菠菜 Spinach
類別 Category	白菜 Cabbages												葉菜 Leafy Greens			
月份 Month	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan
二月 Mar	二月 Mar	二月 Mar	二月 Mar	二月 Mar	二月 Mar	二月 Mar	二月 Mar	二月 Mar	二月 Mar	二月 Mar	二月 Mar	二月 Mar	二月 Mar	二月 Mar	二月 Mar	二月 Mar
六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun
十月 Oct	十月 Oct	十月 Oct	十月 Oct	十月 Oct	十月 Oct	十月 Oct	十月 Oct	十月 Oct	十月 Oct	十月 Oct	十月 Oct	十月 Oct	十月 Oct	十月 Oct	十月 Oct	十月 Oct
生長日數 Days to Harvest	20-80	40-90	40-70	50-120	90	90	90-120	90-120	20-60	40-70	60	40-85	30-45	40-60	60-80	
最少泥深 Minimum Soil Depth	150-250	150-250	150-250	150-250	150-250	150-250	150-250	150-250	100-150	150-250	150-250	150-250	150-250	150-250	150-250	
最少株距 Minimum Plant Spacing	<100	<100	<100	<100	200-300	100-200	200-300	400	<100	<100	<100	100-200	100	100-200	100	
泥土酸鹼度 Preferred Soil pH	6-7	6-7	6-7	6-7	7-8	7-8	7-8	7-8	7-8	7-8	7-8	7-8	6-7	6-7	7-8	
所需水份 Soil Moisture	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	
日照 Sun	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	☉	

作物 Crops	花生 Peanut	意大利青瓜 Zucchini	葫蘆瓜 Bottle Gourd	青瓜 Cucumber	苦瓜 Bitter Melon	絲瓜 Angled Luffa	節瓜 Hairy Gourd	冬瓜 Winter Gourd	南瓜 Pumpkin	翠玉瓜 Summer Squash	佛手瓜 Chayote	白蘿蔔 White Turnip	櫻桃蘿蔔 Cherry Radish	作物 Crops	甘藷 Carrot	紅菜頭 Beet
類別 Category	豆 Legumes	瓜 Gourds										根莖 Roots	類別 Category	根莖 Roots		
月份 Month	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan	一月 Jan
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六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun	六月 Jun
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生長日數 Days to Harvest	100-140	45-75	60-90	65-90	70-115	80-90	80-120	100-120	30-100	35-50	180-200	45-70	25-60	70-90	60-90	
最少泥深 Minimum Soil Depth	250-350	250-350	250-350	250-350	250-350	250-350	250-350	350-450	350-450	250-350	250-350	350-450	150-250	350-450	250-350	
最少株距 Minimum Plant Spacing	200-300	300-400	400-500	300-400	400-500	400-500	450-500	>500	>500	400-500	300-400	200-300	<100	100-200	100-200	
泥土酸鹼度 Preferred Soil pH	5-6	6-7	6-7	6-7	6-7	6-7	6-7	6-7	6-7	6-7	6-7	6-7	6-7	7-8	7-8	
所需水份 Soil Moisture	●○○○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	●●●○○	
日照 Sun	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	☀	

Light Watering 高乾耐旱 Very Light Watering 全日照(>8小時) Full Sun (>8H) 半日照(6-8小時) Partial Sun (6-8H) 半陰(4-6小時) Partial Shade (4-6H) 全陰(<4小時) Full Shade (<4H)



葉菜 Leafy Greens	茄果 Solanaceae Fruits					果菜 Fruit Vegetables			豆 Legumes	
120-140	120-140	70-180	90-120	90-120	80-150	70-90	70-120	50-80	60-90	60-80
150-250	150-250	250-350	250-350	250-350	250-350	250-350	250-350	250-350	150-250	250-350
100	100	200-300	300-400	300-400	300-400	400-500	300-400	300-400	300-400	300-400
7-8	7-8	6-7	6-7	6-7	6-7	7-8	6-7	6-7	6-7	6-7



塊莖 Tubers		蔥蒜 Onions				香草 Herbs					
70-90	45-70	25-60	多年生 Perennial	80-120	100	100-120	45-60	80-120	30-40	多年生 Perennial	
250-350	350-450	350-450	150-250	150-250	150-250	150-250	150-250	150-250	150-250	150-250	150-250
>500	400-500	>500	<100	<100	100-200	100-200	100-200	100-200	100-200	100-200	100-200
5-6	5-6	5-6	7-8	7-8	6-7	7-8	6-7	6-7	6-7	6-7	6-7



*長度單位為毫米 Length/depth in mm **南瓜、果及豆類植物進入花果期後要多澆水 * Give fruit vegetables, legumes and gourds more water when flowering and fruiting

《天台耕種——由舊書到種菜》彭文輝 The Edible Roof — A Guide to Productive Rooftop Gardening by Matthew Pryor. Published by MOCM Creations, Hong Kong, 2016. 100% 可回收環保紙張 Fully recyclable polypropylene plastic film

¹ Inside jack cover of The Edible Roof

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The Department of Architecture educates students in an active culture of service, scholarship and invention. Uniquely situated at the crossroads of China and global influence, the Department takes the approach that design is best explored from a sophisticated understanding of both. With a multidisciplinary curriculum emphasizing technology, history and culture, students gain broad knowledge and skills in the management of the environmental, social, and aesthetic challenges of contemporary architectural practice. With opportunities for design workshops, international exchanges, and study travel, graduates of the Department of Architecture are well prepared for contribution to both international and local communities of architects and designers.

