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An Environmental Improvement Strategy for an Urban Green Farm Garden: A Case Study of Dongguang Green Garden Road, Taichung City

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Abstract: Amid rapid urban growth, the inhabitants of Taiwan's 'concrete jungles' have tended to neglect the protection of natural resources, and to engage in activities that emit large amounts of carbon dioxide. The urban heat island effect also remains a serious problem, only partially addressed by urban green spaces created or protected via intergovernmental urban planning. Nevertheless, Taiwan's cities still contain many small areas of wasteland – both the sites of demolished buildings, and former green spaces that have been allowed to die off. If transformed into urban gardens and/or farms, this waste ground could meet the public's need for additional green spaces and experiences, and help to gradually improve their quality of life. Plans and mechanisms to that effect have existed since 1990, and Taipei City was the first place in Taiwan where farmers provided land for urban dwellers to cultivate. However, due to insufficient governmental support, the operation and management of such initiatives has been largely ineffectual, and thus their development has not been sustainable. Therefore, this paper uses Dongguang Green Garden Road in Taichung as a case study of this sustainable-development bottleneck, with the wider aim of increasing the quantity and quality of urban agricultural gardens in Taiwan and beyond.

1. Introduction

Considerable empirical and anecdotal evidence indicates that the quality of Taiwan's urban living environments is deteriorating as their population densities increase, and that residents feel a profound need to escape their day-to-day environments and experience natural beauty elsewhere [1]. Amid unbalanced economic development, most human capital in agricultural production has become concentrated in the outer suburbs of big cities, rather than in traditional agricultural villages. Beginning in the late 1970s, Taiwan's orchards began to mature, and those that were opened to the public emerged as tourist attractions where visitors could pick and taste their own fruit as well as simply enjoy the green space. Then, at the turn of the 1980s/1990s, initially through the Taipei City Farmers Association, citizen farm gardens appeared, organically combining the functions of agriculture, leisure, and education on land provided by farmers for city-dwellers to cultivate themselves. As early as 1983, to guide what they already perceived as the healthy development of urban agriculture, Taiwan's agricultural and political authorities formulated a Demonstration Plan for the Development of Tourism Agriculture, which formalized such projects'. In 1994, the agriculture



committee of the Executive Yuan followed this up with the Urban Agriculture Pioneer Project, which supported the development of citizen farm gardens as exemplary living experiences and educational centers; specific initiatives that flowed from this project included the Farm Garden Flower Park and Yin Fa National Farm Park.

At present, the main forms of urban agriculture in Taiwan include sightseeing agricultural gardens, leisure farms, citizen farms, holiday flower markets, sightseeing and fishing grounds, agricultural parks, educational agricultural gardens, forest amusement parks, and rooftop agriculture. Such spaces' levels of development, maturity, and government support vary considerably. One of the goals of the low-carbon eco-cities currently being promoted by the governments of Taiwan and other countries is to divert cars away from residential streets and neighborhoods, leaving them clear for pedestrians and cyclists. However, citizen farm gardens are often located in distant suburbs and accessed via motor vehicles, complicating analysis of their overall environmental impact. In tightly configured cities, residents have easier access to employment opportunities and public services, and generally support the development of mass transit systems [2]. This paper is a case study of the Taichung Dongguang Green Garden Road as an embodiment of urban green land and agricultural gardens, with the aim of revising and improving the prevailing general model of such sites and their associated food culture.

2. The present state of urban agricultural garden development in Taiwan

Taiwan's early economic strategy relied on farming as the base for the development of other sectors, especially manufacturing. By the early 1970s, however, the country's agriculture had begun to stagnate. To raise farmers' incomes, Taiwan accelerated the upgrading and transformation of its agricultural sector to include sightseeing and other leisure components; and "experience" is increasingly seen as the main characteristic of the country's urban agriculture [3]. Whether in the suburbs or the urban core, farm gardens plan 3-5 or 20-50 pints of land, and then rent it out for the purpose of planting flowers, grass, vegetables and fruits, not merely to make a profit but so that the tenants can enjoy the experience of cultivation [4].

3. Research scope and instruments

3.1. Description of Dongguang Green Garden Road, Taichung

3.1.1 Location characteristics

The research site is located to the north of Fuxing East Road, south of Asia Street, east of East-West Kwong Yuen Road, and west of West Dongguang Garden Road. As such, it includes Dongguang Green Garden Road, Tai Chi Park, Zaoxi Ma Zu Park, Jianguo Market and other vacant spaces. The annual average temperature in Taichung is 23.3 degrees centigrade, and remains fairly stable across the four seasons; however, lower temperatures from December to February make those months the most suitable for planting various kinds of crops. Taichung's rainfall is lower than the Taiwanese average, at just 1773 mm in total, and it has more hours of annual sunshine, both of which factors are beneficial to the growth of crops.

3.2. Baseline status

3.2.1 Dongguang Green Garden Road

Dongguang Green Garden Road, built of red brick and 3.4 km long, is the coolest of the cycleways that ring Taichung City, being heavily shaded by blackboard trees along its entire length. In addition to its cycling facilities, it features pavilions and benches. Near this road's junction with Dongfeng Park there is a me-BIKE bicycle rental point; and an additional such point can be found in the Dazhi Primary School. These have a high rental capacity, and their usage rates are highest in the evening. Rented-bike utilization rates are lowest at the junction of Yueye. In addition to Dongguang Green Garden Road itself, the immediate area contains five green spaces: Lacheng Park, Zusheng Park, Leye

Pet Park, Tai Chi Park, and Dongfeng Park. However, the somewhat wider area represented by the local blue-belt system also includes East Hanxi and the West Taiwan Sugar Ecological Park.

3.3. Theoretical context and research problems

Traditional urban planning has been vehicle-oriented, and geared especially toward the expansion of cities via residential suburbanization and the avoidance of serious traffic problems[5]. Inevitably, recent national, international and grassroots calls for the development of low-carbon cities are not fully compatible with this planning tradition as it stands. Therefore, mass-transit-oriented development (MTOD) and people-oriented transportation-development planning have emerged as basic building blocks of low-carbon urban transportation planning [6]. The combination of MTOD and land-use planning is closely related to Urban planning[7]. As such, in low-carbon urban planning, the emphasis is on green, people-oriented transportation planning, coupled with mass-transit systems and mixed land use, enabling residents to operate as pedestrians, cyclists, and mass-transit users, and thus reducing the use of private motor vehicles [8].

The close proximity of Dongguang Green Garden Road to a number of parks, as noted above, means that the research site's green-space resources are very rich. It is also close to primary and secondary schools. Its shortcomings are threefold. First, it can only be used by bikes, and its housing is mostly already occupied; second, its resources are too concentrated in the west; and third, the low utilization rate of its green space means that it cannot reach the standard of urban green space.

4. Improvement Strategy for the Dongguang Green Garden Road Urban Agricultural Garden

4.1. Spatial planning (see Fig. 1)

- Use rich green-space resources to expand the proportion of edible landscape.
- Develop abandoned land into agricultural gardens, and maintain the base inside and outside the series.
- To build a low-carbon community, cultivate the interest of the city's people in learning about agriculture.
- Reduce the scale of development and fill; maintain the waterway system and intertidal zone inside and outside the area; and construct a community that accords with the green environment index.

4.2. Architectural design (see Fig. 2)

- Reduce urban sprawl through mixed land-use zoning, land-use concentration and efficient management strategy, and thus reduce unnecessary traffic and energy consumption.
- Full use of rainwater recovery, along with wastewater storage and utilization devices.
- Closure of the entire road to all motor vehicles to achieve environmental benefits including carbon reduction.

4.3. Community organization (see Fig. 3)

- The agricultural gardens around the study area should be jointly maintained by the community's residents, with the wider aim of achieving community self-sufficiency.
- The wetland – which has the functions of storing and purifying water, protecting species, and creating a diverse biological habitat – will also be managed and utilized sustainably at the community level.

**Table 1.** Sizes of green areas before and after the creation of urban farms

Total area (m²)	72,967	
Project	Before improvement	After improvement
Trees (m²)	14,780	29,514
Shrubs (m²)	9,750	13,580
Ground cover (m²)	10,755	20,124
Total greenery (percentage)	47.5	86.6

4.4. Sizes of green areas before and after the creation of urban farms (see Table 1)

Before the improvement, trees accounted for 20.2% of the research site's total area; shrubs, an additional 13.3%; and ground plants, another 14%. After the improvement, the tree cover doubled, to 40.4% of the total area; the shrubs made up 18.6%; and the ground cover (including low-lying plants such as grasses and vegetables planted in agricultural gardens), 27.6%. Such an increase will enable residents to directly obtain the vegetables, fruits and other crops needed in their day-to-day lives, reducing the carbon footprint of vegetable transport while adding to carbon sequestration, achieving carbon reduction, and going some way toward reversing the heat-island effect.

5. Conclusion and Recommendations

5.1. Conclusion

Planting, in combination with the creation of new recreation areas, can potentially re-connect urban Taiwanese people with the fun and community spirit of the countryside, while improving both their individual health and the sustainable development of the country and its cities. Amid increasing popular concern about environmental issues, the creation of an urban green garden along the Dongguang Green Garden Road in Taichung will improve the environment, increase the proportion of green cover, and effectively utilize sewage, waste water, and other resources that would otherwise be lost. In addition to making more efficient use of the area's environment, and protecting and increasing urban biodiversity, this initiative will enhance popular participation and, ideally, lead to autonomous management of the community. Prior research has found that the establishment of a sustainable urban agricultural garden can not only enhance the environment in the immediate vicinity, but also improve the quality of life in surrounding areas, and drive up the value of nearby land [9]. Through urban planning, original green space can be improved and connected, rendering the whole city more environmentally sustainable and less prone to the urban heat island effect and other urban climate issues, thus improving not only the material quality of life, but also the residents' emotional states.

5.2 Recommendations

Innovative thinking and plural urban-planning strategies should be used to explore the space of green systems and how sustainable design techniques could improve them further: for instance, through low-impact green architecture and construction.

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