

# Chapter 30

## Price Tagging on Urban Farming Benefit in the Context of Ecosystem Services



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**Abstract** Rapid urbanisation, along with urban poverty, leads to social and environmental challenges that require cities to improve their resilience. Urban farming is promoted as an essential strategy for improving cities' resilience by providing ecosystem services, namely strengthening the community, improving the urban environment and saving energy. The research aimed to estimate urban farming benefits in the context of ecosystem services in the monetary unit. It took place in Malang City, East Java–Indonesia, as a case study. The study utilised the Total Economic Value framework in conjunction with the Economics of Ecosystems and Biodiversity concept to develop and estimate indicators of urban farming benefit into valuation through the direct market and stated preferences approaches. The study employed field surveys, in-depth interviews and remote sensing analysis. Here we show for the first time that the Total Economic Value of urban farming benefits reached up to US\$ 13.11 in a square metre annually if all urban farming forms occupy a square metre each. However, this value had a gap with the benchmark of US\$ 15.89/m<sup>2</sup> annually. The gap value could be a policy recommendation to incentivise citizens to participate in emerging urban farming initiatives actively. This benefit value indicates that urban farming is feasible and valuable for further development.

**Keywords** Urban farming · Ecosystem services · Benefit · Valuation · Incentive · Policy

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## Introduction

Over the years, rapid urbanisation and urban poverty have exposed cities' vulnerabilities. Urban settings could lead to significant inequalities and health problems, particularly a major negative impact on the nutritional health of poor populations (Kuddus et al. 2020). The share of urban poor in total poor in Indonesia cases, already substantial, will almost certainly rise with the higher levels of urbanisation in years to come (Burger et al. 2012; UN 2018). Furthermore, urbanisation coupled with climate change will lead to heat stress with a range of 0.5–2.0 °C (Oleson et al. 2013; Argüeso et al. 2015). Urban activities and urbanisation have become key contributors to more than 70% of global GHG emissions for energy needs (UN-Habitat 2016). It includes 26% of food emissions, where 6% comes from transportation (Poore and Nemecek 2018). The nexus of increasing economic growth and accelerating urbanisation has increased energy needs and, thus, leading to pollution and environmental degradation (Wang and Dong 2019; Parveen et al. 2020). Cities have been stressed by providing services to urban demand (Kremer et al. 2016). These phenomena were experienced in many cities in Indonesia (Bappenas 2018; UN 2018; Subadyo et al. 2019). Cities must improve their resilience to respond to and cope with challenges by maintaining essential services (Elmqvist et al. 2019; Lehmann 2019).

Presently, urban farming is promoted as one of the systemic solutions to evolving multidimensional benefits for society, nature and the economy to achieve resilience (Eigenbrod and Gruda 2015; Mumenthaler 2015; Knapp et al. 2016; Fernández Andrés 2017). Urban farming (hereinafter UF) is the practice of growing, cultivating producing, and distributing food and other products by utilising yards, vacant lots, or designated areas in and around cities that provide many benefits. These benefits were well-acknowledged as ecosystem services (ES) which have been extensively documented in past decades (Artmann and Sartison 2018; Wilhelm and Smith 2018). For instance, UF provided benefits such as food provision and revitalisation of the local economy, as assessed by Jonck et al. (2018), Pulighe and Lupia (2019). UF also increases wellbeing and social benefit (Wang and Pryor 2019) and improves water and waste management, and reduces energy use (Lee et al. 2015). Policy study on UF indicated that it could be acknowledged as an urban green space (Contesse et al. 2018) and Hybrid Strategy or Nature-based Solution (Depietri and McPhearson 2017; Artmann and Sartison 2018; Skar et al. 2019). It was hypothesised that UF holds promise to expand the portfolio of ES available in in-built environments and thus improve urban resilience.

Research on UF services valuation in the context of ES has been documented (Clinton et al. 2018; Wilhelm and Smith 2018; Wang and Pryor 2019). However, only a few studies consider Urban-Peri Urban Agriculture (UPA), which UF included in, discussed in the context of ES. A review paper by Wilhelm and Smith (2018) found that only a few studies (15 out of 320 papers) place UPA in the context of ES. A recent study on UPA found that when measured at a global scale using limited indicators, it could provide over \$160 billion annually (Clinton et al. 2018). While the specific study on the estimation of the social value of urban rooftop farming

through the state preference approach found that the average willingness to pay for this benefit was HK\$ 440 (~US\$ 56.20) per month per person for a square metre, a bit higher compared with the charge for renting (Wang and Pryor 2019). Most studies are still scattered indicators used in the valuation. Researchers used food production as the main indicator to measure UF's role in alleviating food insecurity through the economic return method (Saha 2016; Parece et al. 2017; Pulighe and Lupia 2019). Moreover, it has not yet established a consistent quantitative framework, especially in monetising the UF benefit by integrative indicators.

## Rational of the Study

Given the limited quantitative measurement of UF benefits utilising compact indicators, this chapter was a research paper that directed to estimate actual and potential UF benefits in a monetary unit, so-called Total Economic Value (TEV), in the context of ecosystem services through integrative measurement indicators. The integrative indicators were defined as benefits of UF, which were final products of ES that were directly or indirectly perceived by people. Malang City, Indonesia, was selected as a case study which is still facing various environmental challenges (Suroso et al. 2012; Subadyo et al. 2019). In another hand, the city was awarded as the best city that implements UF initiative in 2019. Expanding research on UF valuation is expected to shed light on the contribution of this initiative to the city's resilience.

## Material and Method

### *Identification Urban Farming Performance*

UF takes multiple forms, and its categorisation sometimes becomes argued. This chapter adapted UF typology from previous work and adjusted it with the site study (Mumenthaler 2015; Skar et al. 2019; Atmaja et al. 2020). They are Nursery, Allotment, Residential, Institutional and Rooftop farming, as illustrated in Fig. 30.1.



**Fig. 30.1** Urban farming typology

**Table 30.1** Distribution of target respondent

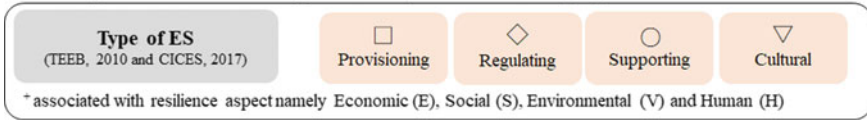
Target respondent	Number	Involvement of respondents in each UF form				
		Nurseries	Allotment	Institutional	Residential	Roofstop
Urban farmers	60					
• Chairman	10	10	10	1	5	1
• Manager	12	12	12		11	2
• Member	36	30	30	11	28	
• Personal urban farmer	2				1	1
Non-urban farmers	34					

In total, there were 21 UF plots where 12 belong to community, four private plots and five unidentified. Each plot consisted of at least one of the UF forms. To obtain UF performance data (i.e., production, kind of vegetables cultivated, and so on) and perceive the value earned by the beneficiaries, a field visit observation, survey and in-depth interview were conducted to specific respondents across UF forms above. In the case of Malang City's UF, its community generally consists of 10–20 members in every plot. Thereby, the total population size was 210 urban farmers distributed in 21 plots for 10 members each. Through the random sampling technique of Slovin's formula, the minimum sample size with a 10% margin of error was 68 respondents. The survey selected 60 respondents, as urban farmers and 34, as non-urban farmers. Table 30.1 shows the distribution of respondents associated with the UF form.

### *Development of Integrative Indicator*

The study developed integrative indicators through the 'cascade model' (Cordier et al. 2014; Potschin and Haines-Young 2016). The model described the pathway of causal interrelations between the ecosystem at one end and the human wellbeing at another. The indicators were acknowledged as *Benefits*, the final product of ES provided by UF, which directly or indirectly affects or is used by humans. The development of indicators also considered The Economic of Ecosystem and Biodiversity (TEEB) concept followed by the TEV framework (TEEB 2010) consisting of four ecosystem service types: Provisioning, Regulating, Supporting or Habitat, and Cultural Services. TEV framework consists of direct use value (consumptive or non-consumptive) and indirect use value which was derived from the regulation services provided by species and ecosystems. This study concept was also adopted from Common International Classification for Ecosystem Services (CICES 2017). Each selected indicator was aligned with an index indicating the resilience aspect, namely Economic (E), Social (S), Environmental (V) and Human (H) (Gonçalves 2013; Elmquist et al. 2019). Finally, each indicator was assigned to certain UF forms. The cascade model is shown in Fig. 30.2.

The components considered Type of Ecosystems Services (ES):



The indicators categorized as Use Value on TEV (Total Economic Value) Framework



Then, each indicator was associated with certain urban farming form

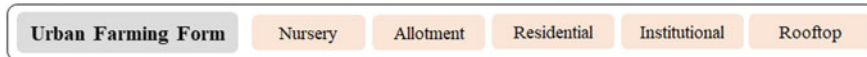


Fig. 30.2 Cascade model in the development of indicator of UF benefit

### ***Metric and Monetary Valuation of the Integrative Indicators***

The integrative indicator above was assessed under the Total Economic Value (TEV) approach. The idea of this assessment was to estimate indicators in the metric unit and then convert it into the monetary unit. Each indicator followed a specific method and conversion factor, as summarised in Table 30.2. An exception in the indicator of S1, S2 and H1, which followed the State Preference Approach through the Contingent Valuation Method, was directly assessed in monetary value. Detail description of each indicator was given in the following sections.

#### A. Provisioning food supply (E1)

The provisioning food supply was measured using annual vegetable yield,  $Y_i$  (kg/m<sup>2</sup>/yr), as:

$$Y_i = \left[ \frac{P_i}{A_i} \cdot f_i \right] \tag{30.1}$$

where  $A$  indicated the total area of  $i$ th UF form in m<sup>2</sup>, the symbol of  $P$  was the average production of  $i$ th UF form per harvest time in kg where  $f$  was harvesting frequency of  $i$ th UF form in a year.

To monetise this indicator, it was used different prices of inventoried vegetables between consumer price from the market (i) and producer price (ii), indicated as  $R$  as US\$ 0.75/kg as shown in formula (30.2). The average consumer and producer price of inventoried vegetables were obtained from statistical data for US\$ 1.66/kg and US\$ 0.90/kg, respectively.

$$V_{\text{food}} = Y_i \cdot R \tag{30.2}$$

**Table 30.2** Valuation of indicators of UF benefit

Indicator of urban farming benefit	Data	Metric value estimation	Monetary value estimation
E1. Provisioning food supply	■	Annual vegetable yield	The economic return of vegetable production
E2. Local income generation	■	Added-value product created	The economic return of selling product
S1. Recreational and community-building S2. Education and learning H1. Urban comfort	▼	CVM is determined from willingness to pay (WTP): S1. Recreation ticket S2. Learning/visiting ticket H1. Monthly payment by household	
V1. Stormwater (runoff) management	●	Difference runoff between on impervious surface and community garden ( $\Delta R$ ) derived from design rainfall value ( $P$ ) of the given return period ( $T$ , assumed ten years)	The replacement cost of stored water in the reservoir can be used to monetise the runoff (Zhang et al. 2012) Unit cost per volume of water stored in a reservoir is US\$ 1.72/m <sup>3</sup> (adopted from (Prabowo 2015))
V2. Supporting urban biodiversity	◆	Using reference values from previous study through Benefit Transfer method which was used mean willingness-to-pay citizens for the preservation of biodiversity and habitat services provided by greenspace (Nijkamp et al. 2008)	
E2. Food mileage	●	Reducing carbon results from fuel (food mileage)	It used a median carbon price of US\$ 0.060/kg CO <sub>2</sub> (World Bank Group 2018)
V3. Carbon storage and sequestration	◆	Using reference values of carbon storage for vegetable farms from previous study through Benefit Transfer method (Matsuura et al. 2018)	This chapter adopted a medium price of social cost provided by Hungate et al. (2017), US\$ 0.0493/kg C, to monetise carbon storage value
V5. Energy-saving (cooling)	●	It was used energy saved per unit area in every reducing temperature, $E_s$ (kWh/m <sup>2</sup> /°C)	It used electricity price of total energy used (kWh) in the cooling room through air-conditioner, US\$ 0.065/kWh

Data source ◆ (Literature); ● (Statistical analysis using secondary data); ■ (Field visit observation); ▲ (Questionnaire survey)

## B. Local income generation (E2)

In addition to food provision, UF also performs as income generation. However, this indicator was only limited to perceived by the urban farmer community. This included selling seeds from the Nursery and the derivative product (added-value product) from the allotment. The economic return was used to estimate the value indicator by selling the urban farmer's total product (seeds and derivative products). It utilised the following formula ( $V_{\text{income}}$ , US\$/m<sup>2</sup>/yr),

$$V_{\text{income}} = \left( \frac{f_s \cdot R_s}{A_n} \right) + \left( [\% \text{ profit margin}] \cdot \frac{f_p \cdot R_p}{A_l} \right) \quad (30.3)$$

where  $f$  was the frequency of selling in a year,  $A$  was the total area in  $\text{m}^2$ , and  $R$  was the selling price of seed ( $s$ ) or products ( $p$ ). The percentage profit margin used was 50%. The selling products are determined based on markup pricing and penetration pricing. The chapter only considered markup pricing, which the seller primarily determines. According to previous research, it was adjusted to 50% for selling farming products (Gullstrand et al. 2013; Santoso et al. 2018). It was assumed that created products were associated with area size.

C. Recreational, community-building (S1); Education and learning (S2); and Maintenance of urban comfort (H1)

These indicators were grouped as assessed using the Contingent Valuation Method (CVM) by directly asking urban and non-urban farmers about their willingness to pay (WTP) through a hypothetical market. CVM is one of the valuation techniques which come under stated preferences in measuring individuals' value for environmental goods through WTP form. This valuation revealed the monetary unit directly. WTP is the amount that must be taken away from the person's income while keeping his utility constant. Respondents were given several price offers through this hypothetical market and select base on their WTP preference. The range of price option was considered based on focus group discussion (FGD) with stakeholders responsible for the project and being adjusted from previous research related as well as adapted from previous studies. The range of options for the recreation indicator was used recreation ticket adapted from a study by Harahap (2015), who assessed WTP citizens who enter tourist lakes and heritage villages (ticket price) for recreation. While on indicator education, the price option range was adjusted with a case study on ticket prices entering the tourism village in Malang City (based on a field visit). For maintenance of urban comfort, the option was based on research by Brenner (2007), who assessed the value of urban comfort derived from green open space, and research by Widiastuti et al. (2016), who evaluated WTP respondents to preserve mangrove site.

A questionnaire was utilised to collect WTP of selected respondents. Since the payment question was open-ended, the WTP can simply be averaged to produce an estimate of mean WTP (MWTP) as follows (TEEB 2010; Widiastuti et al. 2016; Wang and Pryor 2019).

$$\text{MWTP} = \frac{1}{n} \sum_{i=1}^n y_i \quad (30.4)$$

where  $n$  was the sample size, and  $y_i$  is a reported WTP amount.

D. Stormwater (runoff) management (V1)

Since UF is able to act as reservoir or stormwater runoff management, therefore, this benefit was calculated using the difference runoff between impervious surface

and community garden ( $\Delta R$ ) derived from the design rainfall value ( $P$ ) of the given return period ( $T$ , assumed ten years).

$$\Delta R = R_{\text{impervious surface}} - R_{\text{community garden}} \quad (30.5)$$

Runoff ( $R$ ,  $\text{m}^3$ ) was calculated using Natural Resource Conservation Service (NRCS) method for urban hydrology (USDA 1986). This methodology was also adopted to calculate change runoff in the urban community garden (Gittleman et al. 2017) and urban agriculture (Clinton et al. 2018).

$$R = Q \cdot (0.0254) \cdot A \quad (30.6)$$

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} \quad (30.7)$$

$$S = \frac{1000}{\text{CN}} - 10 \quad (30.8)$$

where  $Q$  is the runoff rate in inches for a given  $P$ -inch,  $A$  is the area in a  $\text{m}^2$ , and  $S$  indicates the maximum potential runoff after runoff begins (determined by Curve Number, CN). Mass rainfall value ( $P$ ) was converted to mass runoff using a runoff curve number (CN). CN was based on the Hydrologic Soil Group (HSG), i.e. on soils, plant cover, impervious areas, interception, and surface storage. To identify specific CN in Malang City following HSG, this study utilised and downscaled CN-Based Runoff Modelling provided by the previous study (Ross et al. 2018). To obtain proper CN values for community gardens, it utilised values used for parks in the Centre for Neighbourhood Technology (CNT) Green Values Stormwater Calculator, which was also adopted in a previous study (Gittleman et al. 2017).

According to CN-Based Runoff Modelling, Malang City is mainly categorised into  $C$  and  $D$  types of Hydrologic Soil Group. It was assumed that HSG Type  $C$  for institutional farms indicated moderately high runoff potential (< 50% sand and 20–40% clay) while HSG Type  $D$  for allotment farms showed high runoff potential (< 50% sand and > 40% clay).

Design rainfall value ( $P$ ) was calculated using the Gumbel frequency analysis method (formula 30.9). The method was based on extreme value distribution (annual maximum daily rainfall,  $x$ ) and uses frequency factors ( $K$ ) developed for theoretical distribution with standard deviation,  $Sd$ . It used daily precipitation data for 1996–2016 ( $n = 20$ ). The frequency factor ( $K$ ) was 1.625, followed by the table of frequency factors for the Gumbel Method for  $T$  for ten years and  $n$  data for 20 years. According to this assumption, the rainfall design for analysis was found to be 111.4 mm.

$$P = \bar{x} + K \cdot Sd \quad (30.9)$$

The replacement cost method was considered the most appropriate valuation method to monetise the avoid runoff value or runoff management services in urban



areas. It represents the indirect valuation approach, where the cost of a close substitute was used to measure the value of the replaced non-priced environmental good or service (Barbier and Hanley 2009). In addition, urban green space can perform as rainwater storage temporarily (White 2002). Here it was adopted and assumed that the service of rainwater storage by UF could be replaced with a reservoir which is calculated as follows ( $V_{\text{roff}}$ , US\$/m<sup>2</sup>/yr):

$$V_{\text{roff}} = \Delta R \cdot (Rr) \quad (30.10)$$

The economic benefit of rainwater storage as the replacement cost of the reservoir was also applied in a study by Zhang et al. (2012). Its value can be calculated by the unit cost per volume of water stored in the reservoir ( $Rr$ ). The unit cost can be estimated by dividing the construction cost for those reservoirs and the capacity to store water. Unit cost reservoirs based on average reservoir value in Indonesia ( $Rr$ ) were obtained from the Ministry of Public Works Indonesia (2020) as **US\$ 1.72/m<sup>3</sup>** (Prabowo 2015). The conversion value was similar to research on potential avoiding runoff provided by Campus Forest, Tucson, Arizona, USA, for US\$ 1.10/m<sup>3</sup>. In other studies, Zhang et al. (2012) used US\$ 1.25/m<sup>3</sup> to monetise this value, and Silvenoinen et al. (2017) used US\$ 1.41/m<sup>3</sup> as the annual cost of controlling runoff by infrastructure in Finland.

#### E. Supporting urban biodiversity (V2)

Due to the study could not investigate and screen the richness species in full detail of all UF plots, it was adopted previous research valuation on biodiversity benefits using the Benefit Transfer method following Brink et al. (2000), Nijkamp et al. (2008). The general idea is to explore the use of previous and original valuation studies ('study site') and to transfer their estimates' values to the site where the new value estimate is needed ('policy site'). This Benefit Transfer method can be applied across different sites—spatial value transfer or, for specific site over time.

Brink et al. (2000), Nijkamp et al. (2008) assessed a comparative study of biodiversity valuation through the meta-analytical method. They estimated biodiversity valuation through mean WTP for biodiversity preservation of urban greenspace. The value was US\$ 38.99/person/yr (US\$ 2018), which was associated with demographic characteristics. To avoid the bias, the study adjusted the value with a ratio of GDP per capita in Indonesia and Europe.

$$V_{\text{bio}} = \frac{\text{GDP per capita Indonesia}}{\text{GDP per capita original case study}} \cdot \text{US\$38.99/person/yr} \quad (30.11)$$

#### F. Food mileage (E3)

Production of UF ( $Y_1$ ) reduces food imported and transported from other areas, thus reducing food mileage ( $D$ ). Food mileage was defined as the distance that food materials were transported from the supplier (producer) or a particular market point to the consumer. Lee et al. (2015) stated that the rise of UF initiatives is also associated

with a desire to reduce food mileage. Reducing food mileage has two benefits such as (i) reducing carbon emitted resulting from fuel  $V_{mil}CO_2$  and (ii) cost-avoidance of fuel consumption ( $V_{mil}$  Cost). However, the study emphasised only the first point since the second point was associated with production, which was already accounted for previously. Meanwhile, the  $V_{mil}CO_2$  was also indirectly related to the production of vegetables provided by UF. Since only the nursery did not produce vegetables, it was excluded from estimation. Metric estimation of  $CO_2$  reduction was calculated using the following formula:

$$CO_2 \text{ reduction} = Y_i \cdot D \cdot FC_t \quad (30.12)$$

where

- **Y** is the yield of *i*th UF form [ $kg/m^2/yr^1$ ] earned in Indicator E1.
- **D** is food mileage calculated based on the distance of vegetables primarily delivered from the Main market to Malang City ( $D = 7.38 \text{ km}$ ) using trucks on the road (national public road).
  - The truck can transport at least a ton of vegetables.
  - The carbon emission coefficient for the truck ( $FC_t$ ) is  $0.2265 \frac{kg \text{ C}}{t \cdot km}$ ; delivery vehicle i.e., truck type class I ( $0.2265 \text{ kg } CO_2/1 \text{ t} \cdot km = 0.2265 \text{ kg } CO_2/t \cdot km$ ) (UK Government GHG Conversion Factors).

To convert in a monetary unit of reduction of  $CO_2$ , it was used median carbon price ( $C_{price}$ ) where a minimal price range needed by 2020 to be consistent with achieving the Paris Agreement temperature target. It was US\$ 60/t  $CO_2$  or **US\$ 0.060/kg  $CO_2$  emitted**. The minimal carbon price range was US\$ 0.040–0.080/kg C emitted (World Bank Group 2018). As a comparison, to capture the highest value of carbon price, the most increased replacement cost of a carbon price of Swedish was used. It was US\$ 127/t C or **US\$ 0.127/kg C emitted** (World Bank Group 2019). This value was used to compare the median (as a minimum) and maximum C price (Ramstein et al. 2019). This overseas benchmark was used because similar regulations on taxing carbon emissions were unavailable in Indonesia and Sweden puts the highest price on carbon taxing comparing other countries. This approach was also used by Jim and Chen (2009) to acknowledge the ecosystem service of the urban forest in carbon storage. They put RMB 339.8/t (US\$150/t) of a carbon price in the monetary valuation. Monetary valuation of  $V_{mil}$  (US\$/ $m^2/yr$ ) was calculated as follows:

$$V_{mil} = CO_2 \text{ reduction} \cdot C_{price} \quad (30.13)$$

where

$$C_{price} = 0.060 \frac{US\$}{kg \text{ } CO_2} \quad (30.14)$$

### G. Carbon Storage (V3)

The study utilised the Global Soil Organic Carbon Map provided by FAO (2020) and World Soil Information (ISRIC) to estimate the matrix value of stored carbon in UF in Malang City. It delivered the Soil grid 250 m, soil organic carbon stock in tones/ha for depth intervals of 0.00–0.05 m. The map was then resampled into a smaller grid size (30 m) for Malang City as a case study to capture more specific areas of different UF plots. The vegetables in UF plots were considered **Herbaceous vegetation** (no-woody plants) to reduce complexity and broadly account for heterogeneity in vegetation structure across plots (Mette et al. 2003).

The economic benefit of the carbon storage value of vegetables can be seen as the total damages avoided by removing greenhouse gases such as CO<sub>2</sub> from the atmosphere. Recently, an estimation valuation of carbon storage was done by Hungate et al. (2017), who used the social costs of carbon in US dollars per metric ton of carbon (\$ MT C<sup>-1</sup>). The social cost of carbon is the damage done by emitting an additional unit of carbon dioxide (CO<sub>2</sub>). The social costs of carbon used the value discounted over time as carbon accumulation occurred over the 50-yr simulation. The estimates of the social were derived from the recent synthesis conducted by a consortium of US federal agencies for regulatory impact analysis (Government 2015).

The social cost proposed by Hungate et al. (2017) contained three estimations. The low estimate was US\$ 0.0493/kg C, the medium assessment was US\$ 0.1614/kg C, and the high estimate was US\$ 0.4707/kg C. All social costs estimated were already converted into 2020 USD. Compared with the Carbon Price provided by the World Bank Group (2018), those social cost values have similarities. World Bank Group offered a medium carbon price of US\$ 0.0600/kg C as a minimal price range needed by 2020 to be consistent with achieving the Paris Agreement temperature target. The minimal carbon price range is US\$ 0.040–0.080/kg C emitted, while the highest carbon price is US\$ 0.127/kg C emitted (Ramstein et al. 2019).

This study adopted the medium price of social cost provided by Hungate et al. (2017), US\$ 0.0493/kg C, as a monetary valuation of carbon storage. To quantify the carbon storage in kg C/m<sup>2</sup>/yr and carbon price in US\$/kg C, it was utilised the following equation ( $V_{car}$ , US\$/m<sup>2</sup>/yr)

$$V_{car} = C_{storage} \cdot C_{price} \quad (30.15)$$

It was assumed that all UF form has the same potential carbon storage value. However, as mentioned earlier, it was only concerned with allotment and institutional farms, which mostly contained mixed and diverse vegetables.

### H. Energy Saving (H2)

UF could contribute to reduce energy consumption for cooling which can be monetise through energy consumption from using Air Conditioner (Wang et al. 2011). Less energy will be consumed when the temperature set point is higher. Therefore, the chapter examined the difference temperature on rooftop farming and compared to conventional rooftop ( $\Delta T$ , °C). The temperature on the rooftop farm

was read directly through field observation and utilised a digital instrument thermometer. Only four rooftop farms can be accessed. The other has limitations to be accessed of privacy issues. The average temperature on the green roof accessed was 27.88 °C. The conventional roof temperature used data of average temperature in the area neighbourhood of the rooftop farming. According to the estimation, the traditional temperature of the rooftop was 28.90 °C. Detail identification was shown in Table 30.3.

Since it was related to energy consumption for electricity, thereby monetising the energy used, the electricity base prices in Indonesia were utilised. The base electricity price,  $P_e$  in Indonesia (2019), was **US\$ 0.065/kWh**. Then, the total economic of rooftop farming services in energy saving ( $V_{eng}$ , US\$/m<sup>2</sup>/yr) was calculated as follows:

$$V_{eng} = \Delta T \cdot E_c \cdot P_e \cdot T_{days} \tag{30.16}$$

where  $\Delta T$  was average difference temperature [°C]; while  $E_c$  was energy converter from degree to kWh/m<sup>2</sup> [kWh/m<sup>2</sup>/°C], **0.1956 kWh/m<sup>2</sup>/°C** (Wang et al. 2011);  $P_e$  was electricity price [US\$/kWh]; and  $T_{days}$  was total days in using the air conditioner in a year. It was assumed that the air conditioner was only used in the summer season and only used half day. Thereby, the total days was **90 days**. For energy consumption

**Table 30.3** Green and conventional rooftop temperature

Location	Rooftop area (m <sup>2</sup> )	Temperature on green roof (°C)	Temperature on conventional roof (°C)	$\Delta T$ (°C)	Note
Polehan	140	27.1	28.5	1.4	The area of rooftop farming was the biggest one
Sawojajar	20	24.9	25.3	0.4	Rooftop farming does not have any cover or building in the surrounding
Balearjosari	15	29.3	30	0.7	Big trees in the surrounding covered rooftop farming
Dinoyo	16	30.2	31.8	1.6	The location of the green roof has limited sunlight since covered by other building
Average				1.03	

needed to reduce a degree temperature in unit area,  $E_c$ , through air-conditioner was **0.1956 kWh/m<sup>2</sup>/°C**. The study adopted this value in order to convert each lowering temperature into reduction of energy consumption.

### ***Total Economic Value (TEV) Actual and Potential***

The Total Economic Value (TEV) of UF was then calculated by summing all indicators. TEV of  $i$ th indicator on  $j$ th UF form followed this formula:

$$\text{TEV of UF}_{ik} = \sum_{ik}^n V_{ik} \quad (30.17)$$

$V$  was the  $k$ th indicator's value on  $i$ th UF form [US\$/m<sup>2</sup>/yr].

Since UF was mostly land-based except for rooftop farming, the total value obtained above was compared to the land value as a benchmark for the analysis. Based on the regulation of the Indonesian Bank (PBI) No.9/PBI/2007, the land can be used as a guarantee object for credit loans. The benchmark was calculated by multiplying between the Bank interest scheme ( $I_{\text{Bank}}$ ) if a land was pawned for loans by land prices ( $P_L$ ) and subtracted by the annual land tax (Tax). Land price is an average of the Selling Price of a Taxable Object (land) in a square metre provided by the Ministry of Agrarian Affairs and Spatial Planning Indonesia. The benchmark was given as follows

$$\text{Benchmark} = (I_{\text{Bank}} \times P_L) - \text{Tax} \quad (30.18)$$

Based on Bank Interest scheme, the benchmark was US\$ 29.00/m<sup>2</sup> annually.

## **Result and Discussion**

### ***Integrative Indicator of Urban Farming Benefit***

Based on cascade model following the TEEB concept of four ecosystem services, the study developed the integrative indicators and applied them to selected UF forms under three main components such as strengthening community, improving the urban environment, and resource or energy efficiency (Table 30.4). Strengthening the community is the role of UF as provisioning and diversifying urban food sources and income opportunities, particularly for the urban poor. In addition, it provides

cultural value for human wellbeing. Therefore, this component was built by indicators such as provisioning food (E1), local income generation (E2), recreation-community-building (S1), and, education and learning (S2). These indicators fall under the category of ecosystem services as provisioning and cultural value, which can be used by people directly (Saha 2016; Wang and Pryor 2019). While ‘Improving urban environment’ indicated that by maintaining urban green space, the urban environment would be enhanced through urban comfort (H1), regulating the water runoff through acting as a natural reservoir (V1), or supporting diverse biodiversity (V2), in which these were indirectly perceived by people (VanWoert et al. 2005; Zhang et al. 2012; Clinton et al. 2018). Allocating resources and energy efficiency, which is acknowledged to help and maintain surrounding areas by reducing heat and energy, i.e., food transport/mileage (E3), carbon storage (V3) and energy saving by lowering temperature (H2) (Davies et al. 2009; Costanza et al. 2014; Elmqvist et al. 2015b; Lee et al. 2015; Vilem et al. 2017). Therefore, these indicators were indirectly perceived by the people surrounding them.

UF could provide vegetables that allow saving money from buying. The study by Saha (2016) estimated food yield as a measurement valuation in allotment and rooftop farming. While Pulighe and Lupia (2019) also considered this indicator to assess food self-sufficiency potential. The food provision indicator worked for all UF forms except for nurseries. It was due to the nursery being solely addressed for cultivating purposes. Therefore, it produced nothing except seeds. Local Income Generation (E2)

**Table 30.4** Integrative indicators of UF benefit

Indicator	ES type	TEV type	UF form				
			1	2	3	4	5
<i>I. Strengthening community</i>							
E1. Provisioning food ( $V_{\text{food}}$ )	□	■		✓	✓		✓
E2. Local income generation ( $V_{\text{inc}}$ )	□	■	✓	✓			
S1. Recreational, community-building ( $V_{\text{rec}}$ )	▽	■	✓	✓	✓		
S2. Education and learning ( $V_{\text{edu}}$ )	▽	■	✓	✓	✓		
<i>II. Improving the urban environment</i>							
H1. Maintenance of urban comfort ( $V_{\text{comf}}$ )	◇	●	✓	✓	✓		
V1. Stormwater (runoff) management ( $V_{\text{roff}}$ )	◇	●		✓	✓		
V2. Supporting urban biodiversity ( $V_{\text{bio}}$ )	○	●	✓	✓	✓	✓	✓
<i>III. Allocating resources and energy efficiency</i>							
E3. Food mileage ( $V_{\text{mill}}$ )	◇	●		✓	✓	✓	✓
V3. Carbon storage and sequestration ( $V_{\text{cst}}$ )	◇	●		✓	✓		
H2. Energy-saving (cooling) ( $V_{\text{eng}}$ )	◇	●					✓

UF form: (1) Nursery; (2) Allotment; (3) Institutional yard; (4) Residential; (5) Rooftop

resilience aspect: economy (E); Social (S); Environment (V); Human (H)

E.S. type: □ (Provisioning); ◇ (Regulating); ○ (Supporting or Habitat); and ▽ (Cultural)

TEV type: ■ (direct use value) and ● (indirect use value)

was acknowledged as income earned from selling added-value products (derivative products). Since the products estimated here are only seeds and derivative products, this indicator works only on nursery and allotment forms because of their ability to sell the seeds and produce a derivative product not provided by other UF forms.

UF is also performed as social or cultural services, i.e. Recreational, community-building (S1); Education and learning (S2); and Maintenance of urban comfort (H1) (Wang and Pryor 2019). Since the UF level did not limit social value, these indicators work in all forms. These values were categorised as perceived cultural values and microclimate regulation of UF. The limitation was that the value obtained could not be aggregated to each form.

UF, as part of green space, performs in Avoiding Stormwater Runoff (V1) and acknowledged to act as reservoir (VanWoert et al. 2005; Zhang et al. 2012; Clinton et al. 2018). UF has also the potential to Support Biodiversity (V2) not only within UF sites but also nearby due to a landscape-mediated ‘spill over’ of energy, resources and organisms across habitats. Specifically, it is essential to provide habitats for diverse species and conservation benefits to cities (Davies et al. 2009; Costanza et al. 2014; Vilem et al. 2017). The study examines habitat provision as an UF service supporting biodiversity for all UF forms. Production of vegetables can reduce the food demand and purchase from the market, thus Reducing Food Mileage (E3). The indicator of Food Mileage was associated with Food Provision. Thereby, it worked for all UF forms except for the nursery. A study on UF services in reducing food mileage was documented by Lee et al. (2015). Other indicators used in valuation, i.e. Carbon storage and sequestration (V3), used literature review of previous studies related to carbon storage, especially on Herbaceous vegetation. UF mainly was cultivating vegetables which are considered Herbaceous vegetation. Since only land-based cultivation techniques provide this value, it worked for allotment and institution farms only. Besides, the benefit of UF in saving energy (cooling) (H2) was also estimated. It was proven by Elmqvist et al. (2015a, b), who reviewed literature and found that urban green space and its vegetation, including green roofs and green walls, reduce the urban heat island effect. Thereby, it worked for rooftop farming only.

## *Urban Farming Value*

### A. Provisioning Food Supply (E1)

Based on field visit observations, the allotment farm produced  $1.32 \text{ kg m}^{-2}$  annually, lower than the residential farm, which was  $4.02 \text{ kg m}^{-2}$  (Fig. 30.3). Urban farmers usually cultivate short-term vegetables within their residential or rooftop farming area and manage intense. However, community farms (Allotments) are mostly used for education or demo plots within survey areas.

According to the field visit, most allotment farms were used for demo plots, which resulted in low yield, although the area size was bigger. McDougall et al. (2019),

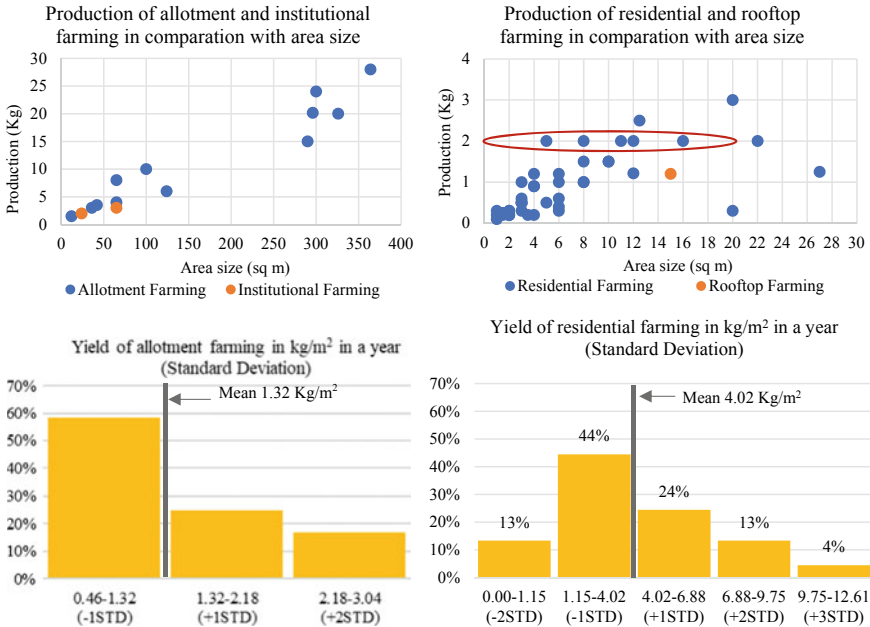


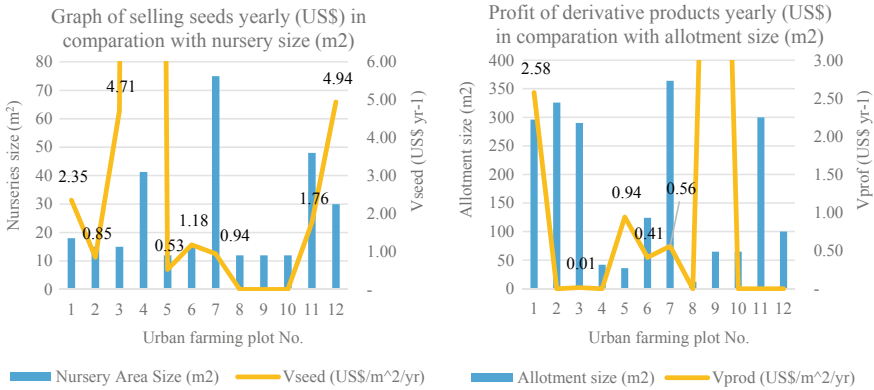
Fig. 30.3 Comparison of each UF form production

in their study, stated that most gardeners indicated that they were not highly motivated by the desire to produce large quantities of food on a community farm. In another hand, community farm has a high ranking in environmental, social, recreational and personal health-related motivation. The allotment and institution farm especially, only used soil-based cultivation, while residential and rooftop used polybags, containers or chambers to cultivate. A square metre area can be contained up to 25 medium sizes of polybags. According to McClintock et al. (2013), vegetables' yield will differ under different management practices. Under conventional management, vegetables could be harvested up to 2.47/m<sup>2</sup>/yr; low-bio-intensive at 3.71 kg/m<sup>2</sup>/yr; and medium-bio-intensive at 6.18 kg/m<sup>2</sup>/yr. The operation in residential and rooftop farming in Malang City can be categorised as low-bio-intensive where gardeners were not professional but understood how to cultivate.

B. Local income generation (E2)

According to inventoried, Malang City only has 16 out of 21 plots of UF that were still cultivating. It was only 12 of 16 plots belonged to UF community. The community means that those plots have all UF forms except rooftop farms. This indicator specified these 12 plots as only the community that sold seeds and derivative products such as vegetable chips. The results indicated that only 9/12 plots are selling seeds as their products. The average income from selling seeds per unit area was US\$ 2.16/m<sup>2</sup>/yr, as shown in Fig. 30.4 left-panel. One plot or community farmer supplies seed to the private company as a customer. This outlier was excluded from





**Fig. 30.4** Local income generation from selling seeds (left) and derivative products (right)

estimation. While only 7 out of 12 plots created derivative products, only six sold the products. The average income by selling this product were US\$ 0.90/m<sup>2</sup>/yr, as shown in Fig. 30.4 right-panel.

C. Recreational, Community-Building (S1); Education and Learning (S2); and Maintenance Urban Comfort (H1)

As documented by previous research, UF has potential values for human wellbeing (Calvet-Mir et al. 2012; Kabisch et al. 2016; Wang and Pryor 2019). These values can be assessed through WTP. According to the survey, WTP was associated significantly to the degree of understanding of UF. All urban farmers understood and perceived the social values provided by UF. Only 71% of non-urban farmers (citizens) understood and perceived the values. Thereby, it was essential to increase the perception of social values among citizens about UF’s social/cultural benefits. Nevertheless, most non-urban farmers were willing to pay for this benefit. These worked among all indicators. According to Wang and Pryor (2019), asking questions about individual payment decisions encouraged respondents to consider the benefits and the maximisation of utility. WTP also was found to be associated with the level of education. Most of the respondents willing to pay were from higher levels of education (senior high school and university level). However, the WTP has a low association with income level. The respondents have not influenced by their income level for paying. This worked for both farmer and non-urban farmers. In conclusion, many respondents were willing to pay for the cultural value perceived in UF.

According to survey to urban farmer and non-urban farmer, the result showed that WTP on recreation did not follow the linear line. Most respondents were concentrated on the range US\$ 0.18–0.35 for the non-urban farmer while more than US\$ 0.71 for the urban farmer. This indicated that non-urban farmer has no intention or are undesired to enjoy UF for recreation. The result shows that urban farmers’ WTP on recreation visiting tickets was, US\$ 0.80 per person per visit, twice higher than non-urban farmer. While for education, the farmer will pay up to US\$ 1.10 per person

per visit, higher if compared with non-farmer who will only pay the amount of US\$ 0.45 per person per visit. While opposite on the indicator of urban maintenance comfort, non-urban farmers' WTP was higher than WTP's urban farmer although the difference was only US\$ 0.04. WTP for maintenance urban comfort was documented as only US\$ 0.34 per household per month. This was because the citizens perceived that their areas, i.e., temperature and humidity, were properly maintained through the availability of UF. In addition, the farmer thought that they would prefer to use UF areas for recreational and educational purposes since the money will be used for them to operate urban farms directly, and they will be involved in the activity of educating and learning to the audience. While WTP of education and maintenance of urban comfort, were associated with an increasing range of options. In education, urban and non-urban farmers were concentrated for range of US\$ 0.15–0.35, similar to Maintenance of urban comfort. To conclude, each WTP was averaged to get MWTP. They were US\$ 0.58 per person per visit for recreational and community-building; US\$ 0.77 per person per visit for education and learning; and US\$ 0.37 per household per month for maintenance of urban comfort. Since this value was aggregated, it cannot be separated and divided by UF form.

#### D. Storm Water (Runoff) Management (V1)

The valuation shows that a square metre UF area can save money by US\$ 0.12 and US\$ 0.14 in the allotment and institutional farm, respectively (Table 30.5). Silvenoinen et al. (2017) mentioned that the green space has a value ranging from US\$ 10.11–30.33/m<sup>2</sup> in avoiding a runoff depending on the degree of imperviousness. In addition, the result was still low compared with the study by Zhang et al. (2012), who concluded that urban green space in Beijing, China has a value of US\$ 0.26/m<sup>2</sup> in avoiding a runoff. For a 10 cm thick substrate and a heavy rainfall event, defined as exceeding 6 mm rainfall per day, 54% of precipitation was retained by the growth medium (VanWoert et al. 2005).

**Table 30.5** Metric and monetary unit of UF benefit for runoff management

	$Q$ (inches)	$R$ (m <sup>3</sup> /m <sup>2</sup> )	$\Delta R$ (m <sup>3</sup> /m <sup>2</sup> /yr)	% $\Delta R$ of total $P$ (%)	$V_{\text{roff}}$ (US\$/m <sup>2</sup> /yr)
Impervious surface (CN = 100)	4.3861	0.1114			
Allotment farming (CN = 70)	1.5936	0.0405	0.0709	63.67	0.12
Institutional farming (CN = 63)	1.1353	0.0288	0.0826	74.12	0.14

### E. Supporting Urban Biodiversity (V2)

Biodiversity is variability among living organisms from all sources, including, among other things, terrestrial, marine, and different aquatic ecosystems, and the ecological complexes they are part of. This includes diversity within species, between species, and ecosystems (Convention on Biological Diversity). The urban garden provides biodiversity among farms plot and ecological function (Davies et al. 2009; Speak et al. 2015). The study concluded that UF benefit in supporting biodiversity can be acknowledged as diversity of vegetables and plant species within farm plot (species richness and distribution pattern). Biodiversity was provided by all UF plot and its combination as green space in urban areas. Instead of disaggregated the valuation of this indicator on each UF form, the study combined all UF as a unity.

Based on Benefit Transfer method, the result found that UF value on supporting urban biodiversity is US\$ 2.22 per person annually. This value cannot be aggregated to certain UF form. Thereby, the value obtained was combination of all form. As comparison, other studies found that urban greenspace was also valuable for biodiversity as biocontrol for amount \$ 41.20 (2018 US\$/ha/yr) (Costanza et al. 2014) and \$ 148.46 (2018 US\$/ha/yr) as biodiversity protection (Chen et al. 2018). Another studies of urban biodiversity on providing nest or species habitat for bird in domestic garden was documented (Davies et al. 2009).

UF activities are diverse and can include the cultivation of vegetables, medicinal plants, spices, mushrooms, fruit trees, ornamental plants and other productive plants (Lovell 2010). UF also could provide diversity for plants, insect and vertebrate within the farming area and nearby neighbourhood. The different types of urban allow for a diverse set of vegetation structures to contribute to the edible landscape in a range of community types (McLain et al. 2012) and this wide range of products means that UF were highly heterogeneous in size, form and function.

### F. Food Mileage (E3)

The result show that production of UF in a square area annually can reduce food mileage in monetary unit for number of US\$ 0.00008–0.00040 if it is transported in a km distance using truck. Detail was shown in Table 30.6. If it was compared with the maximum value using maximum carbon price, the value of food mileage reached for range US\$ 0.00016–0.00085. This value was categorised too small if compared with other indicators. However, still, production of vegetables locally might provide other cobenefits as well. Study by Lee et al. (2015) found that reducing CO<sub>2</sub> emission from transportation reached 11,668 t/yr Food may account for 40% of all road freight; fossil fuel used in food transport ‘in most cases exceeds the energy consumed in (production)’ (UK-Jones 2002). The production and supply of food currently accounts for 20–30% of greenhouse gas (GHG) emissions (Kulak et al. 2013).

### G. Carbon Storage (V3)

UF has potential to store carbon in the vegetation and soil through carbon storage and sequestration (Zhao et al. 2016). Carbon sequestration refers to the removal of

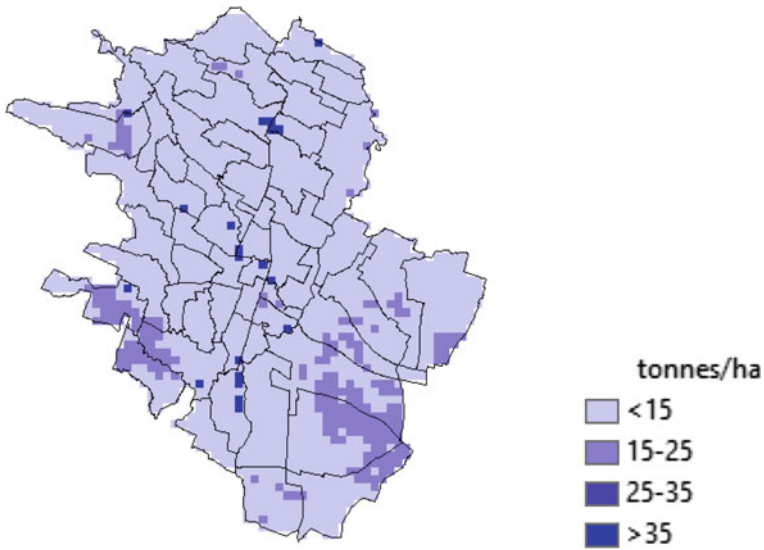
**Table 30.6** Monetary valuation of food mileage

UF form	Yield ( <i>Y</i> ) (kg/m <sup>2</sup> /yr)	Food mileage ( <i>D</i> ) (km)	CO <sub>2</sub> reduction (kg CO <sub>2</sub> /m <sup>2</sup> /yr)	<i>V</i> <sub>mil</sub> (US\$/m <sup>2</sup> /yr)	<i>V</i> <sub>mil max</sub> (US\$/m <sup>2</sup> /yr)
Nurseries					
Allotment	1.32	7.38	0.0022	0.00013	0.00028
Institutional	0.78	7.38	0.0013	0.00008	0.00016
Residential	4.02	7.38	0.0067	0.00040	0.00085
Rooftop	1.42	7.38	0.0024	0.00014	0.00030

carbon (in the form of carbon dioxide) from the atmosphere through the process of photosynthesis. While carbon storage refers to the amount of carbon bound up in woody material above and below ground. Carbon storage under soil was assumed in 0–30 cm soil depth. Therefore, this study considered stored carbon as carbon biomass above-ground within vegetation in UF. It was applied for allotment and institutional farm which mostly contained by mix and diverse vegetables.

Based on resampled map obtained from Global Soil Organic Carbon Map provided by FAO (2020) and World Soil Information (ISRIC), Malang City predominantly consisted of **0.08–0.15 kg C/m<sup>2</sup>** or less than 15 tonnes C/ha (Fig. 30.5). This range had similarity with study by Davies et al. (2011) who identified above-ground carbon biomass in the vegetation based on land cover and landownership. It was found that carbon storage per unit area in the 35 plots of domestic garden contained by *Herbaceous Vegetation* was **0.14 kg C/m<sup>2</sup>** in a growing session. Whereas carbon storage on Domestic Garden contained by mix vegetation reached **0.76 kg C/m<sup>2</sup>** (here it is assumed as year). Other studies also have been compiled. Zhao et al. (2016) documented carbon storage on street ornamental plant in Beijing, China. It was found that ornamental plant can store carbon for amount **0.13 kg C/m<sup>2</sup>/yr**. This value has similar with carbon storage in herbaceous plants in domestic garden and campus garden, **0.14 and 0.13 kg C/m<sup>2</sup>/yr** which documented by Audu et al. (2018), Davies et al. (2011). Interestingly, mix vegetation within domestic garden has big value of carbon storage for amount **0.76 kg C/m<sup>2</sup>/yr**. Matsuura et al. (2018) obtained difference value of carbon storage on vegetables within organic farming for amount **0.28 kg C/m<sup>2</sup>/yr**. Finally, by considering the map and previous studies, this chapter adopted that UF which contained by mix vegetables could store carbon for amount **0.15 kg C/m<sup>2</sup>**.

By using medium price of social cost, **US\$ 0.0493/kg C**, for monetary valuation of carbon storage, the study found that estimated carbon storage value was **US\$ 0.0074/m<sup>2</sup>/yr**. This value has limit and lower compared to other valuation. Zhao et al. (2016) estimated average C storage and sequestration of individual trees in Beijing City for amount of 130.62 kg and 5.85 kg/yr (Elmqvist et al. 2015b) also analysed empirically included estimating monetary benefits from urban ES of urban



**Fig. 30.5** Downscaled carbon storage in mix vegetation in Malang City

forest on data from 25 urban areas in the USA, Canada and China, found average price for carbon storage (stock value): US\$ 3125/ha/yr or US\$ 0.3125/m<sup>2</sup>/yr.

#### H. Energy Saving (H2)

Rooftop farming as green roofs removes heat from the air through the process of evapotranspiration and acts as insulators for buildings, then reduces the energy needed to provide cooling or heating. Based on observation, there was a different temperature between rooftop farming and non-farming, about **1.03 °C**. This value had similar to previous studies by Santamouris (2014) mentioned that green roof temperatures can be 1.1–4.4 °C lower than those of conventional roofs and can reduce city-wide ambient temperatures by up to 5 °C. While (Souza et al. 2018), who examined using sensors which put in both rooftop conditions and estimated in 30 days, found that the difference was about **1.98 °C**. The result found that urban rooftop farming could reduce energy savings for amount of **US\$ 1.17 m<sup>2</sup>/yr**. This value was quite higher compared to a study by Sailor et al. (2012) found that green roofs reduce building energy use by 0.7% compared to conventional roofs, reduce peak electricity demand and lead to annual savings of **US\$ 0.0213/m<sup>2</sup>**.

**Table 30.7** Total Economic Value (TEV) each indicator

UF Form	Nurseries	Allotment	Inst. yard	Resident.	Rooftop	Aggregate
<b>I. Strengthening community</b>						
E1. Provisioning food supply		1.00	0.59	3.03	1.07	5.68
E2. local income generation	2.16	0.90				3.06
S1. Recreational, community-building	✓	✓	✓			0.58
S2. Education and learning	✓	✓	✓			0.77
<b>II. Improving the urban environment</b>						
H1. Maintenance urban comfort	✓	✓	✓			0.37
V1. Stormwater (runoff) management		0.12	0.14			0.26
V2. Supporting urban biodiversity	✓	✓	✓	✓	✓	1.20
<b>III. Allocating resources and energy efficiency</b>						
E3. Food mileage ( <i>city scale</i> )		0.00013	0.00008	0.0004	0.00014	0.0008
V3. Carbon storage and sequestration		0.0074	0.0074			0.0148
V5. Energy-saving (cooling)					1.17	1.17
<b>Total Economic Value (TEV)</b>	$V_{nurs}$	$V_{alto}$	$V_{inst}$	$V_{resd}$	$V_{roof}$	<b>13.11</b>
	<b>5.08</b>	<b>4.95</b>	<b>3.66</b>	<b>5.95</b>	<b>5.16</b>	

### ***Total Economic Value (TEV) of Urban Farming***

Total Economic Value (TEV) of UF for entire form and indicator was US\$ 13.11/m annually. The value for each form and indicator was shown in Table 30.7. This benefit shows a promising result indicating that UF was valuable and could improve the city's resilience. The benchmark used in this analysis was US\$ 29.00/m annually. When it was compared with the benchmark, this TEV had a gap of US\$ 15.89/m annually. This gap amount was expected to be a policy recommendation for stakeholders to provide the incentive and engage citizens to participate in UF initiatives and development actively.

### **Conclusion and Recommendation**

This chapter focused on assessing UF benefits in the context of ecosystem services revealed in the monetary unit. UF has valuable services in improving city resilience through strengthening community, urban environment and energy efficiency. These services can be acknowledged as ecosystem services (ES) provided by the urban farm. The benefit was measured using developed integrative indicators as final products provided by UF. The chapter estimated the total valuation, Total Economic Value (TEV) as the sum of all indicators. UF contributed up to US\$ 13.11/m<sup>2</sup>/yr. if implemented in all forms. This value had a gap with the benchmark for US\$ 15.89/m<sup>2</sup>/yr, which could be an incentive to engage citizens actively participating in the UF initiatives. The results proposed a policy recommendation that in emerging

UF, the Government should provide a stimulus for US\$ 15.89/m<sup>2</sup>/yr as a gap for each community. This mechanism may support and engage local citizens to actively participate in the UF initiative and maintain its continuity.

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