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Benefits and Value of Big Trees in Urban Area: A Study in Bang Kachao Green Space, Thailand

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ABSTRACT

Green Space is very important for the conservation of biodiversity in the urban areas of Thailand. In the case of Bang Kachao, Green Space has been improved by the development of gardens in the city. The objective of this study focused on an evaluation of the benefits of big trees in the urban area at Bang Kachao Green Space, Samutprakan province. Data was collected from six types of tree habitat classified as road side, abandoned area, public area, private area, temple area, and park located across six sub districts of Bang Kachao. Data were analyzed to evaluate the monetary value of big trees from direct and indirect benefits in three parts consisting of timber value, carbon credits value, and spiritual value. The results reveal that the most valuable big trees are in the parks, followed by temple area, road side, private area, abandoned area, and public area respectively. The total monetary value of big trees was 23,447 USD of which timber value was 13,844 USD, carbon credits value was 7,309 USD, and spiritual value was 2,294 USD. The evaluation suggests that management of high value big trees in park, temple, and road side areas is important from a stakeholder perspective. The recommendations based on this study will help develop appropriate policies for sustaining ecosystem services and contributions to human wellbeing.

1. INTRODUCTION

Ecosystem services (ES) are defined as services provided by the natural environment that benefit people. Some of these ecosystem services are well known including food, fiber and fuel provision and the cultural services that provide benefits to people through recreation and cultural appreciation of nature. Other services provided by ecosystems are not so well known. These include the regulation of the climate, purification of air and water, flood protection, soil formation and nutrient cycling (Department for Environment, Food and Rural Affairs, 2007). ES conception was based on an understanding of the critical relationship between ES and the community well-being, including security, basic material, health and good social relations (Millennium Ecosystem Assessment, 2005). Trees provide benefits from social, communal, environmental, and economic perspectives. Tree give shade to homes and buildings, lowering the inside temperatures and thus reducing demand for power to cool these buildings during hot times of the year (Pandit and Laband, 2010). Tree shade has the potential to reduce residential energy use for cooling from 10 to 50 percent (200 to 600 kWh, 30 to 110 USD) and peak electrical use up to 23% (0.7 kW) (Simpson and McPherson, 1996). Urban Green Spaces also reduce physiological equivalent temperature around 2°C (Sun et al., 2017). Trees reduce both air temperature and air pollution by absorbing carbon dioxide and other dangerous gases from the air (Nowak and Heisler, 2010) which means trees protect the urban climate from severe pollution and provide a climate buffering service (Mukherjee, 2015). Furthermore, trees provide many benefits and play an important role in urban environments and residents value the attractive scenery that trees provide (Dwyer et al., 1991). Meanwhile, areas planted with trees, including community parks and neighborhoods, provide opportunities for social interaction between neighbors. Moreover, trees offer a spiritual value and promote greater community cohesion (Cooper et al., 2016).

In addition, urban trees can provide socio-economics, environment, and ecological wealth, as the awareness of investment made in planting and caring for them (Food and Agriculture Organization, 2016) not only improves the urban areas but also improves the quality of life too. The awareness of planting and caring for trees in Thailand, Bang Kachao Green Space is a very important factor in creating the best urban oasis of Asia. Bang Kachao Green Space, which covers about 1,891 ha (Bang Kachao Subdistrict Administrative Organization, 2017), has been an important contributor to fresh air quality (Phetrut, 2016) as it purifies the air for Bangkok and Samutprakan province. Time Asia awarded this area "The best urban oasis of Asia" in 2006. This area has been under the care of the Royal Forest Department since 2005 (Royal Forest Department, 2017). The trees at Bang Kachao Green Space covers several functions to benefit the ecosystem such as supporting services, provisioning services, regulating services and cultural services. Direct benefits of trees include timber for building and indirect benefits of trees include carbon storage, spiritual, aesthetics, eco-learning, etc. In the recent years, Bang Kachao Green Space has become an ecotourism attraction famous for its garden in the city. An effect of this economic development was the risk of cutting big trees to make room for building structures. The objective of this study focused on the benefits of big trees and an evaluation of big trees in an urban area of Thailand at Bang Kachao Green Space, Samutprakan province. It was assumed that the existence of big trees in the case studied will be a model of urban area benefits from both the direct and indirect value of big trees. Not only will the study raise awareness of big tree values, but it also can help stakeholders decide to sustain and grow an urban Green Space.

2. METHODOLOGY

2.1 Study area

The study was undertaken on Bang Kachao Green Space, Samutprakan province, situated between 13°39'16" and 13°42'50" N and between 100°33'36" and 100°35'28" E. Bang Kachao Green Space (Figure 1) covers 6 sub districts: Thong-kanong, Bangyor, Bang Kachao, Bangnamphung, Bangkrasob and Bangkorbua, located in the estuary of the Chao Phraya River.

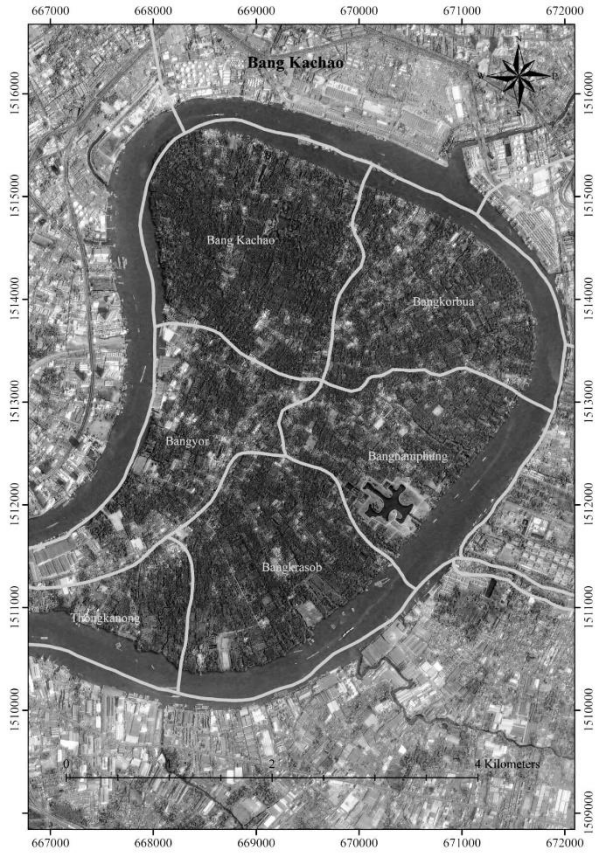

Figure 1. Study area

2.2 Data collection

Big tree samples were measured from six separate habitats composed of: Road side (the area is near the main road), Abandoned (areas without plants growing on them), Governance (public area of community), Private (private house or orchard), Temple (area of temple), and Park (public park). Trees were measured for their diameter at breast height (DBH refers to the tree diameter measured at 1.30 m above the ground), total height (H), and height branch (H_b). DBH can be measured with a specially calibrated diameter tape that displays the diameter measurement when wrapped around the circumference of a tree. Then, the number of big trees with a DBH≥50 cm was counted. All big trees were identified to the species level by collecting leaf specimens for comparison with standard specimens in the herbarium at Department of National Parks, Wildlife, and Plant Conservation. The cultural ecosystem services from big trees, connected to and resulted from their spiritual values, were measured by counting many types of things such as traditional Thai clothes, colorful cloths, ceramic animals, etc. left under the tree.

2.3 Data analysis

Data analysis of the direct and indirect benefits had three evaluation parts consisting of timber values, carbon credits values and spiritual values. Direct benefit was measured by calculating the market value of the available timber. Wood volume in the study areas was estimated using Huber's formula (Husch et al., 1982). Wood value was assigned with guidance of the market prices in October 2014 - January 2015 from Forest Industry Organization. The average price of softwood was 3.68 USD/ft^3 and hardwood was 13.20 USD/ft^3. However, we used a minimum market price of softwood and hardwood because we could not reference the real market price of each species. Thus, the half price for softwood was 1.84 USD/ft^3 and hardwood was 6.60 USD/ft^3. Timber value (USD)=wood volume x price.

The indirect benefit of carbon credit was evaluated from the W_T=Total biomass (kg) from each forest type such as mixed deciduous forest, dry evergreen forest and mangrove forest. Evaluation on the value of carbon stock in aboveground biomass and calculation for carbon sequestration came from the equations of mixed deciduous forest by Ogawa et al. (1965), dry evergreen forest by Tsutsumi et al. (1983), and mangrove forest by Sarayut and Rungsuriya (2011). The undergrowth biomass of big trees was calculated with an allometric equation from the Intergovernmental Panel on Climate Change (2006) . The value of carbon credits by carbon credit price was determined from the California Climate Action Registry (2017) which valued a carbon credit at 15.17 USD/ton CO_2e on 29th November 2017 (exchange rate 1 USD=32.577 baht) from Bank of Thailand (2017). The third part, spiritual value, was an indirect benefits evaluation obtained by surveying sacrifices at big trees and counting of sacred objects. Data for the spiritual cost of sacred objects by market price came from Varuwanshop (2017). Spiritual value (USD) =quantity x price.

3. RESULTS AND DISCUSSION

3.1 Evaluation of timber values

Direct benefit, timber evaluation of big trees at Bang Kachao Green Space was 120 tree samples and total volume 223.77 m^3 that show value 13,843.76 USD. A top ten high value were *Ficus microcarpa* L., *F. religiosa* Linn., *Sonneratia caseolaris* Engl., *Terminalia calamansanay* Rolfe., *Bruguiera gymnorrhiza* Savigny., *Terminalia catappa* L., *Hopea odorata* Roxb., *Ficus curtipes* Corner., *Cynometra ramiflora* Linn., and *Cerbera odollam* Gaertn. (Table 1). Timber price is one of the key elements in forest evaluation so the different prices of timber are unique to the factors of each timber tract: species, tree size, tree quality, volume of sale, distance to market, site accessibility, logging difficulty, market conditions etc. Kankam-Kwarteng et al. (2016) reported the types of wood have greater influence in determining pricing of wood products since they consider some wood to be of better quality than others. Cost of transportation also plays a significant role in the pricing of the wood product. On the other hand, the importance of timber production is more economical than eliminating consumption at the global level. Eliminating the production of illegal timber will result in uneven distribution of social wealth in the forest sector, and will pass the cost of reducing illegal logging onto developing countries (Zhang et al., 2016). The output in this study was not sale in the market, but measured the monetary value of direct benefit from big tree as means to preserving existing green space area. It can support the benefits nature provides to human wellbeing.

Table 1. Timber evaluation of big tree

Species	Common name	Sample (trees)	Volume (m^3)	Value (USD)
Soft wood				
[2]*Ficus microcarpa* L.f.	Curtain fig	13	44.49	1,881.65
[3]*Sonneratia caseolaris* Engl.	Crabapple mangrove	13	38.48	1,627.22
[2]*Ficus religiosa* Linn.	Bodhi	7	32.54	1,376.12
[2]*Terminalia catappa* L.	Bengal Almond	7	16.92	715.58
[2]*Ficus curtipes* Corner.	Ficus tree	2	12.12	512.54
[3]*Cerbera odollam* Gaertn.	Suicide tree	11	8.36	353.41

Table 1. Timber evaluation of big tree (cont.)

Species	Common name	Sample (trees)	Volume (m^3)	Value (USD)
Soft wood				
[2]*Ficus microcarpa* L.f.	Curtain fig	13	44.49	1,881.65
[3]*Sonneratia caseolaris* Engl.	Crabapple mangrove	13	38.48	1,627.22
[2]*Ficus religiosa* Linn.	Bodhi	7	32.54	1,376.12
[2]*Terminalia catappa* L.	Bengal Almond	7	16.92	715.58
[2]*Ficus curtipes* Corner.	Ficus tree	2	12.12	512.54
[3]*Cerbera odollam* Gaertn.	Suicide tree	11	8.36	353.41
[2]*Horsfieldia irya* Warb.	Kruai	5	7.66	324.16
[1]*Albizia lebbeck* Benth.	Indian Walnut	1	2.84	119.93
[2]*Parkia timoriana* Merr.	Nitta tree	1	2.04	86.47
[3]*Hibiscus tiliaceus* L.	Coast Cotton Tree	2	2.04	86.30
[1]*Dolichandrone serrulata* Seem.	D.longissima Schum	2	2.02	85.56
[1]*Mitragyna diversifolia* Havil.	Mitrayna Korth	2	1.9	80.14
[1]*Albizia procera* Benth.	White siris	2	1.7	71.72
[2]*Ficus rumphii* Blume.	Bodhi Tree	1	1.61	67.99
[1]*Albizia Odoratissima* Benth.	Black siris	2	1.58	66.78
[2]*Ficus benjamina* L.	Ficus tree	4	1.54	65.00
[2]*Cananga odorata* Hook.f. et Th.	Ylang-ylang Tree	1	1.37	58.08
[1]*Bombax ceiba* Linn.	Cotton tree	1	1.23	52.06
[1]*Artocarpus lacucha* Roxb.	Monkey jack	1	1.06	44.75
[1]*Limonia acidissima* L.	Wood Apple	1	0.69	29.37
[2]*Barringtonia acutangula* Gaertn.	Indian Oak	1	0.6	25.40
[1]*Crateva adansonii* DC.	Sacred barnar	1	0.44	18.79
[2]*Streblus asper* Lour.	Siamese rough bush	1	0.43	17.99
Hard wood				
[1]*Terminalia calamansanay* Rolfe.	Philippine almond	5	8.74	1,324.31
[3]*Bruguiera gymnorrhiza* Savigny.	Black Mangrove	6	6.85	1,037.75
[2]*Hopea odorata* Roxb.	Iron Wood	2	4.63	702.29
[2]*Cynometra ramiflora* Linn.	Cynometra	3	2.53	383.50
[2]*Dipterocarpus alatus* Roxb.	Yang	1	2.18	329.79
[1]*Terminalia chebula* Retz.	Myrabolan wood	2	1.93	292.72
[1]*Cassia fistula* L.	Indian laburnum	3	1.71	259.29
[2]*Diospyros castanea* Fletch.	Ebony	2	1.67	252.58
[1]*Schleichera oleosa (Lour.)* Merr	Ceylon Oak	1	1.61	243.63
[1]*Millettia leucantha* Kurz.	Yellow Millettia	2	1.45	219.36
[2]*Calophyllum inophyllum* L.	Alexandrian Laurel	2	1.4	211.51
[1]*Pterocarpus indicus* Willd.	Burmese Rosewood	1	1.32	200.75
[2]*Syzygium cumini* L.	Black Plum	2	1.24	188.39
[1]*Diospyros mollis* Griff.	Ebony tree	1	0.71	107.96
[1]*Antidesma ghaesembilla* Gaertn.	Wild black berry	2	0.68	103.10
[3]*Rhizophora mucronata* Poir.	Red Mangrove	1	0.64	96.36
[2]*Xanthophyllum lanceatum* J.J.Sm.	Chum Saeng	1	0.44	66.33
[1]*Millettia brandisiana* Kurz.	Millettia	1	0.38	57.13
Total		120	223.77	13,843.76

Forest type: [1]Mixed deciduous forest (31 trees and 18 species), [2]Dry evergreen forest (56 trees and 18 species) and [3]Mangrove forest (33 trees and 5 species)

Meanwhile the highest value came from big trees in the park area valued at 3,939.24 USD (28.46%), followed by the road side area at 3,099.86 USD (22.39%), and the temple area at 2,791.18 USD (20.16%) (Table 2), with each area having different management practices. Bang Kachao Green Space has two sites classified as park area: Srinakhon Khueankhan Park and Botanical Garden, managed by the Royal Forest Department. The tree management of road side area trees such as pruning for safety of residents and cars is done by the government sector. The temple area is responsible for the care and conservation of religious trees such as *Ficus microcarpa* and *F. religiosa*, and the house owners have to manage trees in their area. The benefits range from meeting basic human needs for food, shelter and firewood, to improved quality of life and health. Globally, over 1.5 billion people depend on forests for their livelihoods (World Wildlife Fund, 2016). Sustainability in this context refers to management practices which protect their rights and livelihoods. The benefits of tree shade on buildings comes from the lowering of inside temperatures and reducing the demand for power to cool these buildings during hot times of the year. One study reported the planting greenery or increasing albedo achieved temperature reductions of 0.6-1.0^{o}C and 0.1-0.5^{o}C, respectively, and energy savings of 40-80 and 70-90 kJ/m^2/day (per unit floor area) on a typical summer day at the city of Kawasaki, Japan (Hirano and Fujita, 2016). The urban greening or albedo increases achieved energy savings of up to 400 tCO_2/day in the entire target study region. In addition, the benefits of big trees from different habitats play an important role in the urban areas which manage their conservation.

Table 2. Timber evaluation by habitats of trees

Habitats of tree	Volume (m^3)	Total (USD)	Percent
Abandoned area	27.70	1,635.65	11.82
Government area	6.83	529.78	3.83
Park area	58.32	3,939.24	28.46
Private area	31.43	1,848.04	13.35
Road side area	49.27	3,099.86	22.39
Temple area	50.20	2,791.18	20.16
Total	223.75	13,843.76	100.00

3.2 Evaluation of carbon credit values

The total indirect benefit, evaluated as the carbon credit value from all habitats of tree, was 481.83 tonCO_2e of gas emissions and a total value 7,309.31 USD of carbon credit value from park, temple area, road side, private area, government area and abandoned area (Table 3). However, the indirect benefits from the state's street trees remove 567,748 tonCO_2 annually, equivalent to taking 120,000 cars off the road. Their asset value is 2.49 billion USD. The annual value of all ecosystem services is 1 billion USD or 110.63 USD/tree (Mc Pherson et al., 2016). The amount of carbon stored is different in the different types of forests and the carbon credit values can be estimated based on the forest type that conforms to Sutherland et al. (2016). Bang Kachao Green Space has three forest types consisting of dry evergreen forest (DY) (Figure 2 and Figure 3), mixed deciduous forest (MX) (Figure 4 and Figure 5) and mangrove forest (MG) (Figure 6 and Figure 7) with 83.36, 27.56, and 19.11 tonCO_2e carbon credit values, and monetary values of 1,264.59, 418.03, and 289.93 USD respectively. Likewise, trees at temple areas had a gas emission value of 123.65 tonCO_2e and a carbon credit value of 1,875.82 USD. The forest type in the temple area consisted of dry evergreen forest and mixed deciduous forest with gas emission values of 100.49 and 2 3 .1 6 tonCO_2e and carbon credit values of 1,524.52 and 351.29 USD, respectively. Meanwhile, road side trees total gas emission of 115.03 tonCO_2e means the total carbon credit value was 1,745.02 USD. The forest type in the road side area consisted of dry evergreen forest, mixed deciduous forest and mangrove forest with 80.28, 18.77, and 15.99 tonCO_2e and a carbon credit value of 1,217.78, 284.68, and 242.56 USD, respectively. The output was not sold in the carbon market, but measured the monetary value of indirect benefit. On the other case, the first carbon credit sale for Thailand and for

ASEAN countries occurred In-Pang community which covers five provinces: Kalasin, Mukdahan, Nakhonpanom, Sakonnakhon and Udonthani. A carbon credit can sell in the market for 4.25 USD and the farmer's network in In-Pang received 37,000 USD credit during the year 2009-2010 (Laosuwan et al., 2013). Meanwhile, the benefit value from urban trees, in all ten megacities (Endreny et al., 2017) such as Beijing (China), Buenos Aires (Argentina), Cairo (Egypt), Istanbul (Turkey), London (Great Britain), Los Angeles (United States), Mexico City (Mexico), Moscow (Russia), Mumbai (India) and Tokyo (Japan) can be estimated as 482 million USD/year due to reductions in CO_2, NO_2, SO_2, PM_{10}, and $PM_{2.5}$ and 8 million USD/year due to CO_2 sequestration. As the result, Bang Kachao Green Space has been an important part of fresh air quality, not only improving the urban areas but also improving the quality of life too.

Figure 2. DY: *Hopea odorata* Roxb.

Figure 3. DY: *Ficus curtipes* Corner.

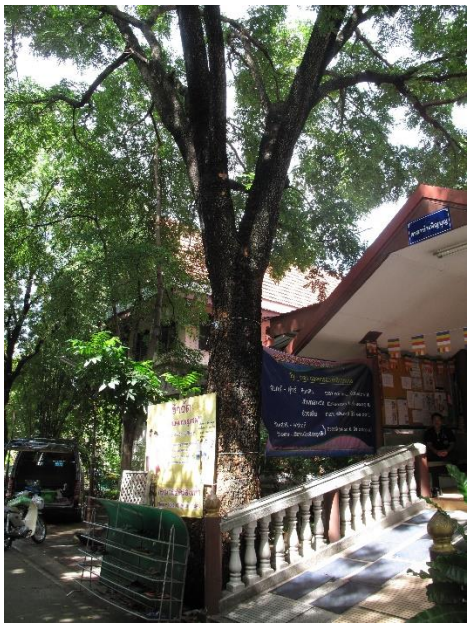

Figure 4. MX: *Albizia lebbeck* Benth.

Figure 5. MX: *Terminalia calamansanay* Rolfe.

Figure 6. MG: *Cerbera odollam* Gaertn.

Figure 7. MG: *Sonneratia caseolaris* Engl.

Table 3. Carbon credit evaluation by habitats of trees

Habitats of trees	Gas emission CO_2 (ton)	Valued carbon credit (USD)	Percent
Abandoned area total	50.25	762.31	10.43
Mixed deciduous forest	-	-	
Dry evergreen forest	9.43	143.02	
Mangrove forest	40.82	619.29	
Government area total	11.07	167.96	2.30
Mixed deciduous forest	-	-	
Dry evergreen forest	3.53	53.54	
Mangrove forest	7.54	114.42	
Park area total	130.03	1,972.55	26.99
Mixed deciduous forest	27.56	418.03	
Dry evergreen forest	83.36	1,264.59	
Mangrove forest	19.11	289.93	
Private area total	51.79	785.66	10.75
Mixed deciduous forest	0.68	10.34	
Dry evergreen forest	41.52	629.80	
Mangrove forest	9.59	145.51	
Road side area total	115.03	1,745.02	23.87
Mixed deciduous forest	18.77	284.68	
Dry evergreen forest	80.28	1,217.78	
Mangrove forest	15.99	242.56	
Temple area total	123.65	1,875.82	25.66
Mixed deciduous forest	23.16	351.29	
Dry evergreen forest	100.49	1,524.52	
Mangrove forest	-	-	
Total	481.83	7,309.31	100.00

3.3 Evaluation of spiritual values

Cultural ecosystem services is the nonmaterial benefits that people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences. Nature is a common element in most major religions. Natural heritage, traditional knowledge, and associated customs are important for creating a sense of belonging. The cost of spiritual enrichment evaluated from the sacred objects placed under trees totaled 2,293.95 USD (Table 4) from eight trees such as *Ficus religiosa* L., *Syzygium cumini* L., *F. microcarpa* L.f., *Hopea odorata* Roxb. (Table 5). The spiritual enrichment composed of small ceramic Buddhas totaling 807.32 USD, Thai dress totaling 675.32 USD, and other items totaling 811.31 USD such as colorful cloths, ceramic dolls, etc. However, aesthetic and spiritual understandings of the value of nature lead people to develop moral responsibilities towards nature and these are more significant than aesthetic and spiritual benefits from nature (Cooper et al., 2016). Assigning spiritual or religious significance to certain areas or species occurs in most societies (Daniel et al., 2012). However, how this significance is expressed varies across and within societies. Sacred areas are often marked by religious symbols (e.g., crosses or prayer flags on mountain summits, shrines along pilgrimage routes). Also, the spiritual values do not have to be solely individual preferences matters of artistic taste and freedom of religion. The output of spiritual value will be socially shared values that are independent of the spiritual dimension of nature.

Table 4. Evaluation of cost of spiritual enrichment

List	Quantity (unit)	Price (USD/unit)	Total (USD)
Small Buddha ceramic height 10 cm.	263	3.07	807.32
Monk cloth	8	3.68	29.47
Colorful cloth	154	0.31	47.27
Baby doll ceramic	75	1.84	138.13
Woman doll ceramic	145	1.84	267.06
Short flower steering wheel	84	0.61	51.57
Long plastic flower steering wheel	6	2.46	14.73
Small animal doll ceramic	124	1.84	228.38
Big animal doll ceramic	4	6.14	24.56
Thai dress	44	15.35	675.32
Drinking water	11	0.31	3.38
Snack	11	0.61	6.75
Total			2,293.95

In evaluating the spiritual value of habitat trees, *Ficus religiosa* Linn. (Bodhi) has great importance among Buddhists who regard Bodhi as the personification of Buddha. Lord Buddha attained enlightenment mediating under it. *Ficus religiosa* Linn. has its own symbolic meaning of enlightenment and peace. Nevertheless, *Hopea odorata* Roxb., in Thailand, is believed to be inhabited by a certain tree spirit known as a lady belonging to a type of ghost related to trees. The spiritual value of big trees in the temple habitat was estimated at 603.49 USD (26%). On the other hand, the spiritual value in park areas was *Hopea odorata* Roxb. 326 USD (14%) and private area was *Ficus microcarpa* L. f. 79.5 USD (4%) (Table 5). Indirect benefits of spiritual value can preserve big trees by participation of people in the religious community because most of the spiritual and belief trees are in the temple area. Therefore, community plays a role in conserving sustainable trees with spiritual value that help develop moral responsibilities towards nature.

Table 5. Evaluation of spiritual values by habitats of trees

Habitats of tree	Species	Quantity (tree)	Value of beliefs (USD)	Percent
Temple area	*Ficus religiosa* Linn.	4	962.64	56
	Syzygium cumini L.	1	322.31	
Private area	*Ficus microcarpa* L.f.	1	79.50	3.47
Road side	*Ficus microcarpa* L.f.	1	603.49	26.31
Park	*Hopea odorata* Roxb.	1	326.00	14.21
Total		8	2,293.95	100

3.5 Total values within habitats of trees

Total values of trees within habitats differed significantly (Table 6). The outstanding of habitat trees was private area where awareness of tree conservation by dwellers. In the same way, the habitats of tree in park area (Sri Nakhon Khuean Khan Park and Botanical Garden) was urban reforestation so support by Royal Forest Department as same as Singapore Botanic Gardens. Currently, the Gardens' mission includes providing botanical and horticultural support for the nation's greening plans, being a center for plant taxonomic and biodiversity research in the region, as well as a recreational and educational attraction (Singapore Botanic Gardens, 2017) . Bang Kachao community has the Sri Nakhon Khuean Khan Park and Botanical Garden where established for being the source production of fresh air, the public park for relaxing, education, biodiversity conservation and exercising for the people. Also, it is a place for ecosystem education on plant species and animals both local and within nearby area. Therefore, it compares as one of an oasis for the city people who want to experience nature, the local way of life and escaping Bangkok's chaos. Tree regeneration in urban habitats is typically achieved through planting initiatives and encouraging natural regeneration. However, in some urban greenspace, tree planting can be logistically challenging as practitioners need to balance multiple socio-economic and ecological factors (Le Roux et al., 2014) when implementing planting strategies, including: site location, public safety, aesthetics, land ownership, and existing vegetation. The value of urban forests for improving social health and equitable access to ecosystem services (Nesbitt et al., 2017). Although, quantifying cultural ecosystem services (Small et al., 2017) could be merit in discarding this term for the simpler non-material ecosystem services that the challenges in valuing the invaluable to focused on the beneficiary.

Table 6. Benefits and values of big tree by habitats of trees

Habitats of tree	Direct benefits of timber (USD)	Indirect benefits of carbon credit (USD)	Indirect benefits of spiritual (USD)	Total (USD)	Percent
Abandoned area	1,635.65	762.31	-	2,397.96	10.23
Government area	529.78	167.96	-	697.74	2.98
Park area	3,939.24	1,972.55	326.00	6,237.78	26.60
Private area	1,848.04	785.66	79.50	2,713.20	11.57
Road side area	3,099.86	1,745.02	603.49	5,448.37	23.24
Temple area	2,791.18	1,875.82	1,284.96	5,951.96	25.38
Total	13,843.76	7,309.31	2,293.95	23,447.01	100.00

4. CONCLUSIONS

Evaluation of habitats of trees at Bang Kachao Green Space estimated a high value for trees from parks, temple areas and the road side that suggests that management of this resource is meaningful from a stakeholder perspective at the community level. Benefits from big trees are not only important for social well-being in the area, but also could be an important starting point for management of big tree in other urban areas. Concerning direct benefits, timber value can preserve existing green space area that can support the benefits nature provides to

human wellbeing. On the other hand of indirect benefits, the carbon storage is important for fresh air quality which improves the urban areas and also the quality of life. In addition, the spirit value of trees can help preserve them by inspiring people to develop moral responsibilities towards nature. The outcome, the benefits, and value of big trees in urban areas will play an important role in the urban environment and dwellers which benefit from the values of big trees in providing attractive environments. The findings from this research support the development of appropriate policies for sustaining ecosystem services in urban area and document their contributions to human wellbeing.

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