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Diversity, prevalence and benefits use of trees in the primary and high schools in Thong Song district, Nakhon Si Thammarat province, Thailand

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Diversity, prevalence and benefits use of trees in the primary and high schools in Thong Song district, Nakhon Si Thammarat province were studued in Thailand. The field study of trees in each school was conducted from May, 2012 to October, 2012. The process of study were recorded as: taken a photograph of trees, recorded the scientific name, family name, the height of tree, diameter of canopy, recorded the benefit use of tree. The result showed that the diversity and prevalence of trees in 16 schools found 242 species, 45 genera and 22 families. The most abundance families are in LEGUMINOSAE, LYTHIRACEAE and BIGNOICEAE, respectively. The five most abundant are *Cerbera odollam* Gaertn. (5.34%); *Lagerstroemia floribunda* Jack (4.52%); *Steblus asper* Lour. (4.11%); *Alstonia schoaris* (L.)R.Br. (3.70%); and *Terminalia ivoensis* A.Chev. (3.70%), respectively. Tree canopy diameter of total 243 trees was showed that the most trees (44 percent) are in medium size with the canopy diameter 3-4 m, the second number of canopy diameter in small size with the canopy diameter 2.9-1 m are 38 percent and the biggest size of canopy diameter with the canopy diameter 5-6 m are 18 percent.. Tree height of total 248 trees was showing the most highest tree 15 percent with the tree height 15-20 m, the medium tree height 19 percent with the tree height 14-10 m and the abundance of small tree height 32 percent with the tree height 1-9 m. the benefits use of tree in the school from the recorded of total 243 trees, the main benefit use of trees in all schools are propose of shading 78 percent, beneficial use of trees for landscaping and the aesthetics is 22 percent and a little bit about other beneficial use for example for symbol of the fence.

Keyword : diversity, prevalence, benefits use , trees

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Introduction

The trees in cities or communities are planted to provide beauty or shade. The benefits of trees can reduce runoff by intercepting precipitation, absorb pollutants, emit hydrocarbons, and modify solar radiation, air temperature, wind speed and relative humidity. The tree in school is one of the most important aspects for the shading, landscaping and aesthetics. Green landscaping supports the conservation of biodiversity in urban areas (Kummerling and Muller, 2012). Planting more trees can help increasing the quality of urban landscapes (Franco *et a*l., 2003, Guthrie and Shackleton, 2006), by regulating microclimate, increasing the CO_2 sequestration (Merry *et al*, 2013); reducing surface water runoff (Stringer and Ennos, 2013; Soares *et a*l, 2011; Wolch *et* al, 2014, Zhang and Liu, 2010); conserving energy (McPherson and Rowntree, 1989); supporting biodiversity and providing wildlife habitats (Ivanko, 2001; William, 2003). Enhancement of tree diversity plays an important role in forest management, by preventing native species lost from disturbance pollutions (Zhang and Jim, 2014).

One of the modern concepts of tree landscaping in the cities was originally derived from the United States. It started with Boston's Emerald Necklace through the planning of the Boston Park System created by Frederick Law Olmsted, during the late 19th century (J.G. Fabos, 2004). The early inventory of street trees in between year 1982-1985 in terms of the diversity in the U.S. cities showed that there were between 100 to 200 tree species (Nowak, 1993),

There are several aspects to be considered in managing the trees in a way that they can efficiently provide ecosystem services, shading provide and landscaping use. The objective of this study to find out the diversity and prevalence of the trees and to assess the benefits use of trees in the school.

Materials and methods

1. *Study area*

A field study of the trees in 16 schools in Thong Song, Nakhon Si Thammarat province in Southern Thailand, consist of 2 groups of school : group 1 primary school were: 1) Ratprachanukaw school 2) Bansaisan school 3) Bansamakeetam school 4) Tongkaypatanasaksa school 5) Watkawro school 6) Watwangheep school 7) Banwangyon school 8) Watwangkri school 9) Bankokchand school 10) Bannamtok school and 11) Banbonkaun school and group 2 High school were : Thongsongsahaprachason school 2) Thongsong school 3) Thongsongwittaya school 4) Kangprawittakom school and 5) Satreethonsong school

2. Field study

A field study of trees in each school was conducted in six months from May,2012 to October, 2012. The process of study were recorded : 1) take a photograph of trees 2) record the scientific name, family name, the height of tree, diameter of canopy, diameter of stem above the ground 1.5 meters 3) record the benefit use of tree

3. Analysis and classified of the trees in the school

How much the number of trees, tree species, tree genera and tree family. The benefit use of each tree will be classified. Data recorded from the field were separated to three size by the tree height, stem diameter and the diameter of canopy.

Results

1. *Diversity and prevalence of tree*

The result of the diversity and prevalence of trees in 16 schools in Thong district, Nakhon Si Thammarat Thailand, were found 242 species, 45 genera and 22 families. Table 1 shows the most abundance family are in LEGUMINOSAE, LYTHRACEAE and BIGNONIACEAE, respectively. The five most abundant are; 1) *Cerbera odollam* Gaertn. (5.34%); 2) *Lagerstroemia floribunda* Jack (4.52%); 3) *Streblus asper* Lour. (4.11%); 4) *Alstonia schoaris* (L.)R.Br.(3.70%); and 5) *Terminalia ivoensis* A.Chev. (3.70%), respectively.

2. Tree size

Tree canopy diameter of total 243 trees from 16 schools showed that the most trees (44 percent) are in medium size with the canopy diameter 3-4 m, the second number of canopy diameter in small size with the canopy diameter 2.9-1 m are 38 percent and the biggest size of canopy diameter with the canopy diameter 5-6 m are 18 percent (Table 1) . Tree height of total 243 trees was showing the most highest tree 15 percent with the tree height 15-20 m, the medium tree height 19 percent with the tree height 14-10 m and the abundance of small tree height 32 percent with the tree height 1-9 m. The structure of each tree was showed in Figure 1.

3. benefits use of tree in the school

From the recorded of total 243 the main benefit use of trees in all schools are propose of shading 78 percent, beneficial use of trees for landscaping and the aesthetics is 22 percent and a little bit about other beneficial use for example for symbol of the fence.

Table 1. Trees species distribution in 16 schools in Thong Song district, Nakhon Si Thammarat province, Thailand

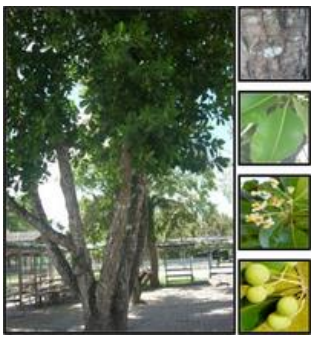
Scientific Name	Family	Frequency	Percent (%)	Average of tree height (m)	Average of stem diameter (cm)	Canopy Diameter (m)	Benefit use	
							√	×
Horsfieldia irya (Gaertn.) Warb.	MYRISTICACEAE	2	0.82	15	70	6	√	
Cananga odorata (Lam.) Hook.f. &Thomson var. odorata	ANNONACEAE	2	0.82	14	60	3		×
Careya sphaerica Roxb.	LECYTHIDACEAE	3	1.23	13	65	5	√	
Anthocephalus chinensis (Lam.) A.Rich.ex Walp.	RUBIACEAE	6	2.46	16	75	6	√	
Acacia auriculiformis A.Cum.ex.Benth.	LEGUMINOSAE	6	2.46	14	70	3	√	
Acacia mangium Willd.	LEGUMINOSAE	4	1.64	18	80	6	√	
Calophyllum inophyllum L.	GUTTIFERAE	2	0.82	17	80	6	√	
Cassia bakeriana Craib	LEGUMINOSAE	5	2.05	15	30	4	√	
Streblus asper Lour.	MORACEAE	10	4.11	10	50	4		×
Senna siamea (Lam.) Irwin&Barneby	LEGUMINOSAE	5	2.05	8	20	3	√	
Senna spectabilis (DC.) Irwin& Barneby	LEGUMINOSAE	5	2.05	6	20	3	√	
Gliricidia sepium (Jacq.) Kunth ex Walp.	LEGUMINOSAE	6	2.46	8	25	4	√	
Spathodea campanulata P. Beauv.	BIGNONIACEAE	7	2.88	10	30	3	√	
Samanea saman (Jacq.) Merr.	LEGUMINOSAE	6	2.46	10	80	6	√	
Magnolia × alba (DC.) Figla	MAGNOLIACEAE	2	0.82	17	25	2.5	√	
Mangnolia champaca (L.)Baillon ex Pierre var.*champaca*	MAGNOLIACEAE	1	0.41	18	20	2.5	√	
Barringtonia acutangula Gaertn.	LECYTHIDACEAE	4	1.64	8	25	3	√	
Tabebuia rosea (Bertol.) DC.	BIGNONIACEAE	2	0.82	8	20	2	√	
Flacourtia rukam Zoll. & Moritzi	FLACOURTIACEAE	3	1.23	5	15	2.5	√	
Lagerstroemia floribunda Jack	LYTHRACEAE	11	4.52	6	20	3	√	×
Cerbera odollam Gaertn.	APOCYNACEAE	13	5.34	6	25	2.5	√	
Erythrina variegate L.	LEGUMINOSAE – PAPILIONOIDEAE	3	1.23	9	40	6	√	
Cinnamomum porrectum (Roxb.) Kosterm.	LAURACEAE	3	1.23	16	75	4	√	
Ficus benjamina L.	MORACEAE	4	1.64	15	40	2	√	
Peltophorum pterocarpum (DC.) Backer ex K. Heyne	LEGUMINOSAE	4	1.64	15	60	6	√	×
Phyllocarpus septentrionalis Donn. Sm.	LEGUMINOSAE	5	2.05	4	15	2	√	×

Remark : √ = benefit use for shading, × = benefit use for landscaping

Table 1.*(cont.)* Trees species distribution in 16 schools in Thong Song district, Nakhon Si Thammarat province, Thailand

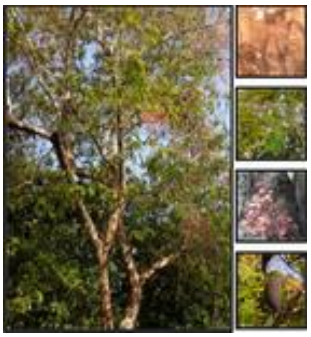
Scientific Name	Family	Frequency	Percent (%)	Average of tree height (m)	Average of stem diameter (cm)	Canopy Diameter (m)	Benefit use	
							√	×
Pterocarpus indicus Willd.	LEGUMINOSAE	5	2.05	12	50	5	√	
Millingtonia hortensis L.f.	BIGNONIACEAE	5	2.05	13	40	2		×
Callistemon lanceolatus DC.	MYRTACEAE	3	1.23	15	80	4		×
Alstonia schoaris (L.)R.Br.	APOCYNACEAE	9	3.70	10	20	3	√	
Mimusops elengi L.	SAPOTACEAE	5	2.05	12	75	4	√	
Tamarindus indica L.	LEGUMINOSAE – PAPILIONOIDEAE	4	1.64	10	20	2.5	√	
Averrhoa carambota L.	OXLIDACEAE	3	1.23	10	20	2.5	√	
Mangisfera indica L.	ANACARDIACEAE	5	2.05	6	10	2	√	
Garcinia mangostana Linn.	GUTTIFERAE	1	0.41	15	70	4	√	
Cassia fistula L.	LEGUMINOSAE	7	2.88	8	20	2.5	√	
Plumeria spp.	APOCYNACEAE	7	2.88	3	15	2		×
Jacaranda obtusifolia H.B.K.subsp.*rhombifolia* (G.F.W.Meijer) Gentey	BIGNONIACEAE	2	0.82	10	18	2.5		×
Araucaria 569ssess R.Br. (Salisb.) Franco	ARAUCARIACEAE	3	1.23	8	15	2.5		×
Casuarina junghuhniana Miq	CASUARINACEAE	2	0.82	12	20	2		×
Azadirachta indica Juss. Var. siamensis Valeton	MELIACEAE	7	2.88	15	15	4	√	
Tectona grandis L. f.	VERBENACEAE	5	2.05	15	20	3	√	
Lagerstroemia loudonii Teijsm. & Binn.	LYTHRACEAE	6	2.46	10	25	2	√	
Pisonia grandis R. Br.	NYCTAGIMACEAE	5	2.05	1.5	10	1.5		×
Delonix regia (Bojer ex Hook.) Raf.	LEGUMINOSAE	3	1.23				√	
Terminalia ivoensis A.Chev.	COMBRETACEAE	9	3.70	14	70	4		×
Terminalia catappa L.	COMBRETACEAE	6	2.46	12	60	4	√	
Coccoloba uvifera (L.) Jacq	POLYGONACEAE	3	1.23	10	25	3		×
Polyalthia longitolia (Benth.) Hook. F. var. pandurata	ANNONACEAE	6	2.46	17	30	1		×
Lagerstroemia speciosa (L.) Pers.	LYTHRACEAE	4	1.64	10	60	3	√	
Lagerstroemia macrocarpa Wall .	LYTHRACEAE	4	1.67	8	40	3	√	
Total		243	100					

Remark : √ = benefit use for shading, × = benefit use for landscaping



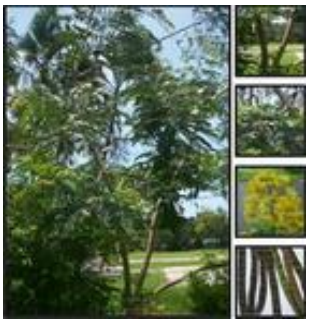
Calophyllum inophyllum L.

Anthocephalus chinensis (Lam.) A.Rich.exWalp.

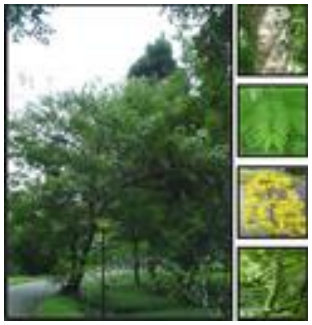


*Cassia bakeriana*Craib

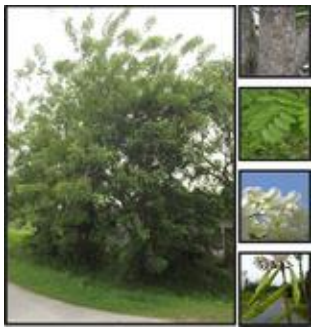
Streblu sasper Lour.



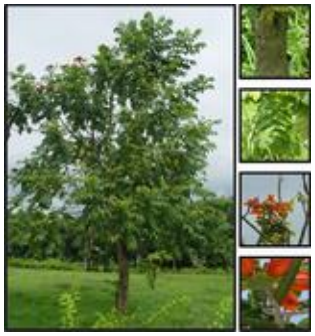
Senna siamea (Lam.) Irwin&Barneby



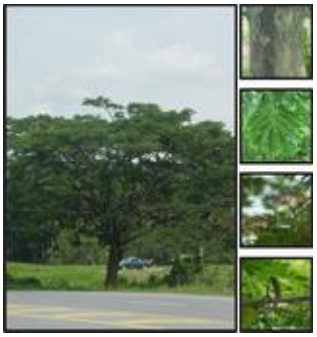
Senna spectabilis (DC.) Irwin &Barneby



Gliricidia sepium (Jacq.)Kunth ex Walp.



Spathodea campanulata P. Beauv.



Samanea saman (Jacq.) Merr.

Figure 1. The nature of structure of representative trees in 16 schools : 1) feature of stem, 2) feature of leaf, 3) feature of flower and 4) feature of fruit

Mangnoliac hampaca (L.)Baillon ex Pierre var.*champaca*

Magnolia × *alba*(DC.) Figla

Barringtoniaac utangula Gaertn.

Tabebuia rosea (Bertol.)DC.

Flacourtia rukam Zoll. &Moritzi

Lagerstroemia floribunda Jack

Cerbera odollam Gaertn.

Erythrina variegate L.

Cinnamomum porrectum (Roxb.)Kosterm.

Ficus benjamina L.

Peltophorum pterocarpum (DC.) Backer ex K. Heyne

Phyllocarpus septentrionalis Donn.Sm.

Pterocarpus indicus Willd.

Millingtonia hortensis L.f.

Callistemon lanceolatus DC.

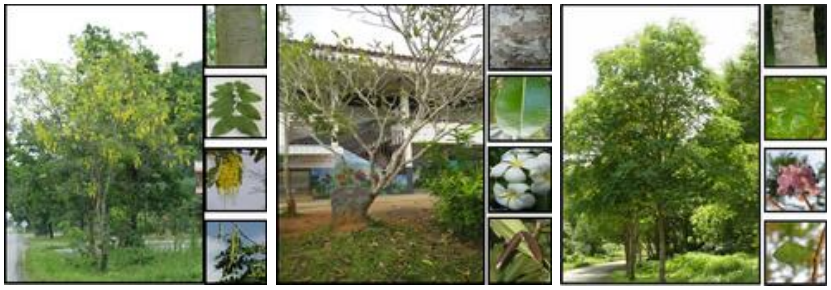
Alstonia schoaris(L.) R.Br.

Mimusops elengi L.

Tamarindus indica L.

Figure 1. *(cont.)* The nature of structure of representative trees in 16 schools: feature of stem, 2) feature of leaf, 3) feature of flower and 4) feature of fruit

Averrhoa carambota L. *Mangisfera indica*L. *Garcinia mangostana* Linn.



Cassia fistula L. *Plumeria* spp. *Jacaranda obtusifolia* H.B.K.subsp.*rhombifolia*(G. F.W.Meijer) Gentey

Araucaria cookii R.Br. (Salisb.) Franco *Casuarina junghuhniana* Miq *Azadirachta indica*Juss. Var. siamensisValeton

Figure 1. *(cont.)* The nature of structure of representative trees in 16 schools : feature of stem, 2) feature of leaf, 3) feature of flower and 4) feature of fruit

Azadirachta excelsa (Jack) Jacobs

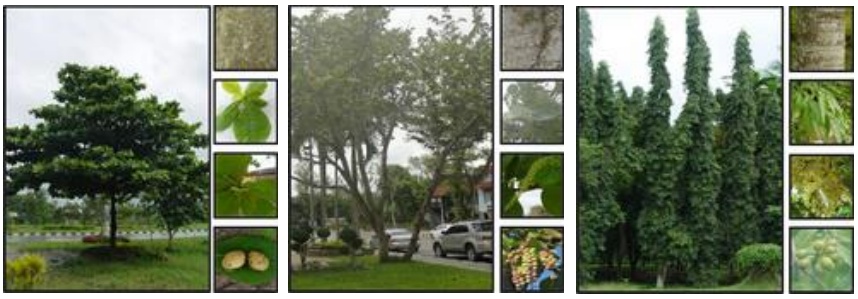
Tectona grandis L. f.

Lagerstroemia loudonii Teijsm.&Binn.

Pisonia grandis R. Br.

Delonix regia (Bojer ex Hook.)Raf.

*Terminalia ivoensis*A.Chev.



Terminalia catappa L.

Coccoloba uvifera (L.)Jacq

Polyalthia longitolia (Benth.)Hook. f. var. pandurata

Figure 1. *(cont.)* The nature of structure of representative trees in 16 schools : feature of stem, 2) feature of leaf, 3) feature of flower and 4) feature of fruit

Discussion

The diversity and prevalence observations of trees are varied by area and climatic around the world. In Lisbon, Portugal, street tree community was dominated by *Celtis australis* L., *Tillia* spp., and *Jacaranda mimosifolia* D. which together counted 40% of tree population (Soares *et al*, 2011). In Bangalore, India, the four most commomly found species; *Albizia saman, Peltophorum pterocarpum, Spathodea campanulata*, and *Pongamia pinnata*, while *Albizia saman* is common species that was found less than 10% of the population (Nagendra and Gopal, 2010). Street trees in the district highways in Nakhon Si Thamamarat province, Thailand can greatly help to improve environmental quality in the city. For energy, they can help to save approximately 27,810 MWh per year from the reduction in electricity consumption. Regarding CO_2 reduction, it is about 333,844 tons per year. Moreover, the net air pollution reduction is about 5.6 tons per year. The annual rainfall interception or storm water runoff reduction is approximately 12.34 million m3 per year. These combined are accounted for approximately $11.64 million per year or about $40 per tree per year. It is obvious that the i-Tree Streets model is useful for calculating environment benefits produced by street tree community. Thus, it could be used as a tool to implement studies on this type of projects in other cities (Choothong, *et al.*, 2016)

The prevalence of trees in 16 schools, the most abundance family is LEGUMINOSAE, because of this family can grow well by itself. It can fixaticion of nitrogen has been estimated to contribute about $115x10^6$ metric tonnes of nitrogen to the earth's ecosystem annually, with nodulated legumes grown for agricultural purposes accounting for about one quarter of that value (Burns and Hardy 1975). The symbiotic associations of legumes and *Rhizobium* or *Bradyrhizobium* species lead to the formation of root nodules which are the sites of nitrogen-fixation. In these systems the host plants supply photosynthates which are oxidized to provide the energy requirement. These associations have attracted considerable attention because they are very important in food and fibre production (Evans and Berber 1977). The most of trees in all schools the main benefit use for propose of shading 78 percent. The primary and high school in urban of Thailand, they are popular to grow the perennial plat for the student use a shading during at noon time and sometime the use a shading for the class activity. The most trees (44 percent) are in medium size with the canopy diameter 3-4 m, and the biggest size of canopy diameter with the canopy diameter 5-6 m are 18 percent and the structure and feature of each tree was appearance in Figure 1. The minority of beneficial use of trees for

landscaping and the aesthetics is 22 percent. The landscaping design in primary and high school in urban of Thailand is it not much, because they lack a capital for done and lack of the expert for contracted landscaping in the school.

Conclusion

The study of trees in 16 schools in Thong Song district, Nakhon Si Thammarat, Thailand. The diversity and prevalence of tree had the approximated number of 243 trees from found 242 species, 45 genera and 22 families, the most dominant family is LEGUMINOSAE. The benefit tree use mainly for shading 78 percent and for landscaping and the aesthetics is 22 percent

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