Privately Managed Green Open Space and Its Ecological Role in Improving Thermal Comfort of Kesiman Kertalangu Area

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Abstract. The rapid development of urban areas in general has a negative impact on built environmental. The decrease of green open space is cause by increasing the need of space for human activity. The reduced area of green open space in Denpasar City, especially in private green open space in the Kesiman Kertalangu area, causes environmental quality to decline. Reducing the area of green open space can cause urban problems, such as increasing city air temperatures. Therefore, it is important to know the role of private green open space in residential yards for increasing thermal comfort in the Kesiman Kertalangu area. For this study the method used is a qualitative research method with a descriptive case study approach. The aim of this study is to determine the role of private green open space in residential yards in term of thermal comfort. The results show that in residential yards that have relatively large areas of land, the existing private green open space conditions are quite optimal. However, in residential yards that have limited land area, the availability of green open space is very minimal. The existence of private green open space in residential yards at the Kesiman Kertalangu area in general is not able to work optimally in reducing temperatures to create a suitable thermal comfort for the environment.

Keywords: private green open space, ecology, thermal comfort

1. Introduction

The sustainability in urban area is very important. This is due to the rapid development of urban areas which have a negative impact on built environmental such as happened in Denpasar City. The need of space for community activities and residences has reduces the availability of existing green open spaces and tends to decrease. Green open space is starting to be converted into built space, especially residential houses. This condition causes the role of private green open space in residential which is to support the existence of urban green open space (RTHK) as a whole, especially in carrying out its main function as an ecological function is decline.

The impact that is starting to be felt as a result of the reduced green open space as a result of the increasingly densely built space is the increasing temperature of the city in Denpasar, especially in the Kesiman Kertalangu area. The lack of green open space in this function is exacerbated because people tend to ignore the existence of green open spaces ecologically [1]. Such dynamics are feared in the future there will be a decrease in the ratio between built space and green open space in Denpasar City [2, 3]. This condition is quite a dilemma, especially for urban areas, because the area of residential land is relatively limited because of the high price of land [4, 5], so a strategy is needed to improve the quality of private green open space in carrying out its function as shading elements (reducing temperature).

The existence of a good and optimal green open space can actually function well in reducing temperature. Because one of the important functions of green open space is as a shading element that
can improve the quality of the microclimate, especially the thermal comfort of the surrounding area. The way that can be done to maximize the function of private green open space in residential yards to reduce temperatures is to improve the quality of the existing green open space by improving the quality of the planted vegetation and maintaining a minimum of 10% green open space. The purpose of this study was to determine the role of private green open space in optimizing thermal comfort in the Kesiman Kertalangu area.

2. Theoretical Frameworks

This study uses several theoretical foundations to determine the role of private green open space in residential yards in improving thermal comfort at Denpasar city especially at Kesiman Kertalangu area, including the theory of green open space, and private green open spaces, the ecological function of private green open spaces as a shade or reducing temperature and the physical characteristics of vegetation in green open spaces.

2.1. Private Green Open Space

Private green open space is green open space whose land is privately owned and managed by the community or private sector [6, 7]. According to the Regulation of the Permen PU No 05 Tahun 2008 concerning Guidelines for Provision and Utilization of Green Open Spaces in Urban Areas, private green open spaces are green open spaces owned by certain institutions or individuals whose use is for limited groups, including gardens, house yards, public buildings, and private public property planted with plants [16]. Then according to [8] in this book “Urban Green Space System Planning, Landscape Planning” private green open space is a green area such as a private garden on institutional garden that is managed and privately owned. From this understanding, it can be concluded that private green open space is a green area whose land is privately owned and managed by the community and private sector and its use is for limited groups. Based on the Permen PU No 05 Tahun 2008 the classification of private green open space consists of several types, namely green open space in residential yards, green open space for offices, shops, business premises and green open space in gardens and roofs of houses, whose land is privately owned. In this research, the context of private green open space is green open space whose land is privately owned and managed by the community and it is private green open space in residential yards.

2.2. Ecological Function Private Green Open Space as Shading Elements

Green open space is a very important element in shaping the structure of the city and maintaining the survival of the ecosystem in it. That is why green open space is very important and has the main function as an ecological function. Green open space performs its function ecologically, aiming to ensure the provision of green open space as part of the air circulation system, as a shade (reducing temperature), reduce noise, oxygen producer, reduce carbon dioxide, water catchment area, and as a windbreak [9].

The role of green open space in improving the quality of the environment ecologically. Humans cannot live alone without plants and animals around them, besides that humans also need air, light, water, soil, heat and certain climatic conditions to live. Between living things and their environment mutually influence each other [10]. A unified system between humans, plants, animals and their environment is called an ecological system. In this ecological system, in relation to the environment there are four important elements, namely air (wind), water, earth, fire (light). Green open space in this case has a role to balance this, one of which is to function as shading elements to reduce temperature. Green open space in which there are plants, grass and trees will have a very significant influence on the air temperature around it. The existence of green open space will be able to protect from radiation and heat from the sun which keeps the temperature and humidity of the air cool and comfortable. Shaded
areas with green open spaces will receive less radiation and heat from the sun which makes the air
temperature lower. According to [11], the ideal climatic conditions for humans are when the air is clean
and the air temperature is between 27°C-28°C. If you look at the average temperature in every big city in
Indonesia, it is not easy to reach this state. For this reason, it is important to procure a green open space
in accordance with existing provisions, theories and regulations, to support and optimize its function
ecologically in maintaining the microclimate and temperature of the city.

To optimize green open space, especially in the private green open space of the residential yard in
carrying out its function as a shade or reducing temperature, the most important thing is the availability
of green open space that has an optimal area. In the arrangement of a city space, the provision of green
open space in residential homes is regulated by the green basic coefficient (KDH). These rules vary by
region. In Denpasar City, the minimum provision of green open space in residential yards is 10-28
percent of the total land area. Based on the theory from GBCI (Green Building Council Indonesia),
every residential building must have a green basic area (RTH) in the form of vegetation (soft
scape) that is free from buildings and a pavement of at least 10 percent of the total land area. This means, to optimize
the function of green open space in reducing temperature, each residential yard must provide private
green open space at least 10 percent of the total land area and free for buildings and pavement. If it is
below this area, it can be determined that the existing green space will not be able to function optimally.

2.3. Vegetation in Green Open Space

The role, benefits and criteria of vegetation in green open spaces in improving environmental quality in
urban areas are as shading, noise damper, carbon dioxide absorber, oxygen producer and as a windbreak
[17, 19]. Vegetation has an important role in life. The existence of green open space is very dependent
on the types of vegetation planted. Trees, shrubs and grasses can change the temperature of a city and
reduce air pollution, and leaves on trees can control noise and break up sunlight. The effectiveness
of the vegetation is highly dependent on the species, for example the characteristics of shady leaves,
branching and many branches, root types, crown width and plant size [12].

The ability of a vegetation to reduce temperature, is dependent on the type and characteristics of the
tree. Each type of tree has its own characteristics that make it have different effectiveness in carrying
out ecological functions. Based on the ecological function of green open spaces as shade, the criteria for
plants that have a wide crown [13]. Plants with a wide crown allow it to withstand radiation and heat
from the sun, so that the air temperature around the green open space will be more comfort. Green open
space in which there is vegetation with a wide crown will be able to reduce the air temperature during
the day and vice versa at night will keep the air temperature warm. Its effectiveness is highly dependent
on the characteristics and types of plants, the position of the sun’s fall and weather conditions. Plants
with physical characteristics of shady leaves and wide leaf surface areas are also good at reducing
temperature. With shady leaves and a wide leaf surface area, the photosynthesis process can take place
better, so that the amount of carbon dioxide from air pollution can be absorbed more and vice versa, the
oxygen produced will be the same. This will make the air around the green open space cooler.
According to Laurie (1986), the characteristics of a tree will be very effective in controlling temperature if it has the physical characteristics of dense, shady and evergreen leaves. Trees with these characteristics will be able to control light, thus making the area receive less heat and sunlight which makes the air temperature under the tree's shadow lower. The trees with relatively high physical characteristics are also good at reducing temperatures [13]. Trees with these characteristics have a wider range of protection against heat and sunlight, as a result the area under and around the tree will be protected from radiation so that the air temperature around the tree will be maintained. From the explanation above, it can be concluded that the existence of trees in green open spaces is very important, especially in carrying out their function as shade, namely to reduce air temperature. The effectiveness of these functions is highly dependent on the type and physical characteristics of the tree. The physical characteristics of a tree that function well as shade are (1) a relatively tall tree, (2) having a wide tree crown, (3) the characteristics of shady and thick leaves (4) having a wide leaf surface area.

3. Research Methods

In this study, the method used is a qualitative research method with a descriptive case study approach, namely a process of collecting data and information in detail, intensively, holistically and systematically about a situation, to describe a situation or object in depth and detail in a limited scope [14].

The research location is in the city of Denpasar, namely in the village of Kesiman Kertalangu. The boundaries of the selected research area include two Banjars, namely Banjar Kertalangu and Banjar Kertapura. The boundaries of the research area are as follows: in the east it is bordered by Jl. By Pass Ngurah Rai, in the north it is bordered by Jl. WR. Supratman, in the west it is bordered by Tukad Ayung and in the south by Jl. By Pass Ngurah Rai. The selection of this area as the research boundary was due to the discovery of various cases showing that the availability of private green open space was not optimal, then the large number of research samples and various strata of residential houses, as well as the ease of obtaining data.
In this study, the type of private green open space that will be studied is private green open space in residential yards. Green open space is further divided into 3 types of green open space in accordance with the Regulation of the Permen PU No 05 Tahun 2008 concerning Guidelines for Provision and Utilization of Green Open Space in Urban Areas, namely (1) private green open space at residential yards with small yards, (2) private green open space at residential yards with medium yards and (3) private green open space at residential yards with large yards. The three types of green open space are taken with different samples and will be selected randomly according to the criteria that have been determined for each strata.

Table 1. Research Sample

| No | Types of Green Open Space                                      | Number of Samples |
|----|----------------------------------------------------------------|-------------------|
| 1  | Private green open space at residential yards with small yards (< 200m²) | 25                |
| 2  | Private green open space at residential yards with medium yards (≥200m² and ≤500m²) | 20                |
| 3  | Private green open space at residential yards with large yards (> 500m²) | 5                 |

Table 2. Research Variables

| Variable                  | Sub Variable                     | Assessment criteria                                                                 |
|---------------------------|----------------------------------|--------------------------------------------------------------------------------------|
| Private green open space area | Green area                      | Percentage of Green Area (KDH Denpasar City, GBCI (Green Building Council Indonesia)[18] |
| Vegetation                | As Shade (Reducing Temperature)  | Tree with wide crown [13]                                                               |
|                           |                                  | The leaves of the tree are shady and thick [11]                                        |
|                           |                                  | Tree have a wide leaf surface area [13]                                                |
|                           |                                  | Tres are tall [13]                                                                     |
To analyze the optimization of private green open space in carrying out ecological functions as shade or reducing temperature, two key variables are used, namely the area of private green open space and the physical characteristics of trees that are good at reducing temperature. Each variable has assessment criteria or parameters that become benchmarks in determining whether or not a green open space is effective in reducing temperature. In the following Table 2 describes the research variables.

To measure the variable area of private green open space, the assessment criteria used is the minimum area of green area, which is 10 percent of the land area. Private green space can be said to be optimal in carrying out its ecological function as a shade (reducing temperature) if it meets these requirements. Then the vegetation as shade will be assessed based on the physical characteristics of the tree using a rating scale/score for each tree in the Private Green Open Space in residential yards at Kesiman Kertalangu Area. Until later will be obtained tree species that have good characteristics in carrying out the function as a shade (reducing temperature). From the results of the assessment of these variables, the data analysis process that will be carried out qualitative research method with a descriptive case study approach. The results of the research will be compared with the theory and observations in the field on the area of green open space and the physical characteristics of trees in reducing temperature. Until later it will be obtained how optimal the role of private green open space in the residential yard at Kesiman Kertalangu Area is in reducing temperature to increase thermal comfort in the surrounding environment.

4. The Role of Privately Owned Green Open Space in Improving Thermal Comfort

Analysis of the function of private green open space in increasing thermal comfort to find out how effective the current private green open space in the Kesiman Kertalangu area can affect the temperature conditions in the environment so that it can form a good thermal comfort for the environment and the community. Therefore, the analysis is carried out on two important indicators, namely an analysis based on the area of private green open space and an analysis based on the existing vegetation in private green open space.

4.1. Analysis Based on Area

The area of private green open space in residential yards in the Kesiman Kertalangu area shows different results for each residential strata. Overall, the results of the study indicate that there is still a need to optimize the provision of private green open space, especially in residential yards that have a small and limited land area. If you look at the theory, in order to maximize its function as a shade, namely to reduce the temperature, private green open spaces must at least have a Green Area (DH) of at least 10 percent of the total land area. The 10 percent is green open space in the form of vegetation (softscape) both plants, grass and trees that are free from buildings and sidewalks (Green Building Council Indonesia). The results of observations of 50 samples of private green open space for residential yards in the Kesiman Kertalangu area as shown in Figure 3, show the results that there are 16 percent of residential yards that have private green open space area of more than 28 percent of the total land area. Then there are 38 percent of residential yards that have private green open space between 10-28 percent of the total land area. And there are still 46 percent of residential yards that have private green open space below 10 percent of the total land area. This means that there are still many residential yards that have private green open spaces that are not optimal. As a result, existing green open spaces at residential yard will not be able to function optimally in lowering temperatures and creating thermal comfort for the surrounding environment.
The use of private green open space in the residential yard at Kesiman Kertalangu area has largely received less attention from the public. Private green space is seen more aesthetically and economically, rather than its main function: the ecological function. Private green open space to reduce temperature has not functioned optimally in residential yards with relatively small land areas. This is because most of the land is built space and pavement, both made of concrete, paving stones, brushed coral, stone, and ceramics. So only small amount land is green space, planted by grass, shrubs or trees. Land that is dominated by pavement will absorb heat quickly through radiation and sunlight which causes the air temperature around it to be increase. Unlike the case with land which is dominated by plants, it allows the area to form a protection zone against radiation and sunlight, forming a shadow that makes the air temperature around it cooler so that thermal comfort can be achieved. Figure 4 below shows the condition of private green open space on relatively limited land.

In residential yards that have wider land, the provision of green open space is more optimal, the existing land is also more dominated by green open space. Observation data shows that in residential yards that have a wider area, it is use more for private green open space. The existing open space is dominated by green open space of grass, shrubs and trees that allow the area to work optimally in lowering the temperature. Plants and trees, the air temperature around private green open spaces will be lower, this is because plants and trees can protect from radiation and solar heat, trees can create a protected zone so that the area below has a lower air temperature. In addition, the existence of optimal green open space will allow trees or plants in the area to reduce air pollution, absorb more carbon dioxide.
and vice versa, produce the same amount of oxygen. So that the air temperature in the area around the private green open space becomes cooler. Figure 5 shows the condition of private green open space on the yard which has a wider area with the availability of more optimal private green open space

![Figure 5](image-url)

**Figure 5.** The condition of private green open space in the residential yard with a large area

### 4.2. Analysis Based on Vegetation

The types of vegetation found in the private green open space in the residential yards at the Kesiman Kertalangu area are quite diverse and have relatively large numbers, especially in the yards of residential houses that have large areas of land. Of the 50 samples of residential yards that have been observed, there are 20 types of vegetation in the private green open space of residential yards including *Pseudosasa Japonica*, *Averrhoa Blimbi*, *Araucaria Heteropylla*, *Magnolia Alba*, *Erythrina Cristagali*, *Delonix Regia*, *Psidium Guajava*, *Plumeria Rubra* and *Obtusa*, *Cocos Nucifera*, *Terminalia Mantaly*, *Bougainvillea Spectabilis*, *Mangifera Indica*, *Artocarpus heterophyllus*, *Morinda citrifolia*, *Pandanus Tectorius*, *Veitchia Merillii*, *Hibiscus Tiliaceus*, *Pychosperma Macarthurii*, *Zyzygium Aqueum*. The most dominant vegetation in private green open space is *Plumeria Rubra*. This type of vegetation is planted almost in all residential yard, both yards of small, medium and large areas. The sizes and heights also vary. The private green open space in the residential yard, there are also several types of trees with relatively large sizes and wide crown, such as *Mangifera Indica*, *Magnolia Alba*, *Morinda Citrifolia*, *Terminalia Mantaly* and *Hibiscus Tiliaceus*. However, this type of tree is only often found in residential yards that have wider land. This is because the large area of land allows the provision of green open space of the same extent, so that a more diverse use of vegetation can be chosen with a larger size and wide tree crown.

Overall, the condition of the vegetation in the private green open space of the residential yard at the Kesiman Kertalangu area is relatively good however the selection of vegetation does not take into account the ecological function, especially its ability as a shade in reducing temperature. The choice of vegetation takes into account are aesthetic and economic functions, so the tree species that are often found are flowering and fruit trees such as *Plumeria Rubra*, *Psidium Guajava*, *Cocos Nucifera* and *Bougainvillea Spectabilis*. The choice is also motivated by the culture of the Balinese people who use a lot of flowers for their offerings.

To measure whether each tree is effective in reducing temperature, a rating scale or score is used with the parameters of the physical characteristics of the tree: the tree with wide crown [13]; the leaves of the tree are shady and thick [11]; trees have a wide leaf surface area [13]; and trees are tall [13].
| No | Type of vegetation          | Criteria as a shade | Score (%) | Category |
|----|-----------------------------|---------------------|-----------|----------|
|    |                             | K1  | K2  | K3  | K4  |       |
| 1  | Pseudosasa Japonica         | 2   | 2   | 1   | 2   | 43.75 | KB    |
| 2  | Averrhoa Blimbi             | 3   | 2   | 2   | 3   | 62.5  | BA    |
| 3  | Araucaria Heteropylla       | 2   | 3   | 2   | 4   | 68.75 | BA    |
| 4  | Magnolia Alba               | 3   | 4   | 4   | 4   | 93.75 | SB    |
| 5  | Erythrina Cristagali        | 4   | 4   | 3   | 4   | 93.75 | SB    |
| 6  | Delonix Regia               | 4   | 4   | 3   | 4   | 93.75 | SB    |
| 7  | Psidium Guajava             | 3   | 3   | 4   | 3   | 81.25 | SB    |
| 8  | Plumeria Rubra              | 3   | 3   | 4   | 3   | 81.25 | SB    |
| 9  | Plumeria Obtusa             | 3   | 3   | 4   | 3   | 81.25 | SB    |
| 10 | Cocos Nucifera              | 2   | 1   | 2   | 3   | 50    | KB    |
| 11 | Terminalia Mantali          | 4   | 3   | 3   | 4   | 87.5  | SB    |
| 12 | Bougainvillea Spectabilis   | 3   | 3   | 2   | 2   | 62.5  | BA    |
| 13 | Mangifera Indica            | 4   | 4   | 4   | 4   | 100   | SB    |
| 14 | Morinda Citrifolia          | 2   | 3   | 2   | 2   | 56.25 | KB    |
| 15 | Artocarpus heterophyllus    | 3   | 3   | 4   | 4   | 87.5  | SB    |
| 16 | Pandanus Tectorius          | 2   | 2   | 2   | 2   | 50    | KB    |
| 17 | Veitchia Merillii           | 2   | 1   | 2   | 2   | 43.75 | KB    |
| 18 | Hibiscus Tiliaceus          | 4   | 4   | 4   | 4   | 100   | SB    |
| 19 | Ptychosperma Macarthurii    | 2   | 2   | 2   | 2   | 50    | KB    |
| 20 | Zyzgium Aqueum              | 3   | 2   | 2   | 2   | 56.25 | KB    |

Note:  
K1: Tree with wide crown  
K2: The leaves of the tree are shady and thick  
K3: Tree have a wide leaf surface area  
K4: Tree are tall  

Rating:  
Score 4: Very good (SB) if ≥ 81% criteria are met  
Score 3: Good (BA) if 61-80% criteria are met  
Score 2: Not good (KB) if 41-60% criteria are met  
Score 1: Bad (BU) if ≤ 40% criteria are met  

The results of the analysis show that the Magnolia Alba, Erythrina Cristagali, Delonix Regia, Plumeria Rubra, Terminalia Mantali, Mangifera Indica, Artocarpus heterophyllus, and Hibiscus Tiliaceus trees have very good physical tree criteria in reducing temperature or as shade. There are also types of Averrhoa Blimbi, Araucaria Heteropylla, Psidium Guajava and Bougainvillea Spectabilis which also have good physical characteristics in reducing temperature. If you look at each private green open space in the residential yard, this type of tree is not always there, except for the Plumeria Rubra tree which is almost in all private green open space in the residential yard. This shows that every residential expert has provided at least one type of tree that functions both as shade and can reduce
temperature. Looking in more detail each type of tree has different physical characteristics so that its effectiveness in reducing temperature is not always the same. For example, if you compare each sample of residential yards that have a land area of less than 200m2 and an area of private green open space of less than 10 percent of the land area. The only tree species available are Plumeria Rubra trees, which in an analytical assessment have very good physical characteristics of trees in reducing temperature. The ability of the Plumeria Rubra tree in private green open space in reducing temperatures, especially during the day, is not too different where the temperature around the green open space at 11 o’clock in the afternoon shows 30° C. However, when compared to other samples, which have private green open spaces that reach more than 10 percent of the land area, and there are more diverse trees, namely the Plumeria Rubra, Mangifera Indica and Magnolia Alba trees, the temperature around the private green open space during the day is more shady, showing a figure of 29.5° C. Physically, Magnolia Alba and Mangifera Indica trees have wider crown characteristics, shady and thicker leaves than Plumeria Rubra trees, so that the physical characteristics of these trees function more optimally ecologically in reducing temperature and creating thermal comfort in the environment. This is as said by Gray and Denke (1978) that trees that have a wide crown will be better able to reduce the temperature of the air around them.

In other examples of cases in the private green open space, the residential yard which has a wider area of land and the area of private green open space, where the types of trees that exist are the type of Plumeria Rubra and Mangifera Indica. After measurements were made, the temperature around the green open space showed 29.4° C. When compared again with the residential yard that has wider land and private green open space, namely in the yard with a land area of more than 500m2, as well as more diverse tree species such as Mangifera Indica tree, Plumeria Rubra, Magnolia Alba, Pseudosasa Japonica, Araucaria Heteropylla, Avrerrhoa Blimbi and Veitchia Merillii. The results of measurements using an anemometer show that the temperature around the private green open space is much shadier at 29° C. This shows that the characteristics and variety of tree species are also able to affect the ability of private green open spaces in carrying out ecological functions as shade to reduce temperature, as stated by [12]. If it compared to the standard climatic conditions and ideal temperatures for humans, thermal comfort can be achieved if the air temperature shows the number 27-28°C [11]. The climate and temperature conditions at the Kesiman Kertalangu area are still far from optimal to achieve this level of comfort. Therefore, it is necessary to optimize the current private green open space, both in terms of area and vegetation.

From the analysis above, it is found that broadly, the availability of private green open space at the Kesiman Kertalangu area is still not optimal and has not contributed optimally to reduce temperature. Significantly, the existence of private green open space in the residential yard has not been able to create thermal comfort for the environment and the people in it. However, based on the vegetation analysis carried out, every house in the Kesiman Kertalangu area already has at least one type of tree that can function well in reducing temperatures, namely the Plumeria Rubra. This type of tree is found in almost every yard of a house at the Kesiman Kertalangu area. However, its effectiveness needs to be improved. The way is to plant new tree that are physically more capable in reducing temperatures. Such as the types of Mangifera Indica, Magnolia Alba, Hibiscus Tiliaceus, Terminalia Mantali and Artocarpus heterophyllus. In addition, the number of trees also affects, so planting many trees even though they have the same type in private green open spaces will further optimize the function of private green open space in reducing temperatures. Another way that can be done is to add gardens on the roof of the building or gardens on the fence walls and buildings (green wall). This method does not increase the area of private green open space, but its existence can function effectively ecologically to reduce the environmental temperature on a micro basis, absorb CO2 and produce O2 (Joga & Ismaun, 2011). This will certainly increase the function of private green open space in reducing temperature and will directly increase the role of private green open space in residential yards to create thermal comfort in the environment.
5. Conclusion

Based on the analysis that has been carried out, it is concluded that the role of private green open space in the residential yard at the Kesiman Kertalangu area in increasing the thermal comfort of the surrounding area is still not able to function optimally. Significantly its effectiveness can still be improved. If you look at it in more detail, its function is not optimal because in the residential yard that has a small and limited land area, the availability of green open space is very small, less than 10 percent of the land area. Likewise, there is not much vegetation. Most often found is a Plumeria Rubra tree which is almost in every residential yard. It is different for residential yard that have relatively wider land. The availability of green open space is more than 10 percent of the land area and the existing vegetation is much more diverse. However, this condition is not often found in residential yards at the Kesiman Kertalangu area.

Overall, the current private green open space in residential yard at Kesiman Kertalangu Area has been able to function to reduce temperature but its effectiveness is still not optimal. Optimization of the role of private green open space in increasing thermal comfort, namely reducing temperature, can be done by improving the quality of existing green open spaces by creating gardens on roofs, fences and walls of buildings. This method does not increase the area of private green open space but is very effective in reducing the environmental temperature. To increase the area of private green open space by replacing some of the pavement with plants, grass, trees or shrubs. Improving the quality of green open space can also be done by planting new trees, without reducing the existing trees. The selection of tree species must be more diverse and parked at a tight distance so that its function in creating thermal comfort in the environment can be optimal. Trees that can be selected are trees that have good physical characteristics in reducing temperature. Trees with wide crown, shady and thick leaves, wide leaf surface area, and relatively tall tree sizes such as Mangifera Indica, Magnolia Alba, Hibiscus Tiliaceus, Terminalia Mantali, Averrhoa Blimbi, Plumeria Rubra, Erythrina Cristagali and Artocarpus heterophyllus.

6. Reference

[1] Groos and Lane 2007 Landscapes of the Lifespan Exploring Accounts of Own Gardens and Gardening (Journal of Environmental Psychology) 27(3) 225-241.
[2] Salain, Putu Rumawan. 2016 Persoalan Tata Ruang Kota Denpasar Mendatang (Denpasar)
[3] Suartika, G A M (2013) 'Lost in Translation: Balinese Vernacular Open Space' in Suartika, GAM (Ed) Vernacular Transformations: Architecture, Place, and Tradition Denpasar (Bali): Pustaka Larasan in Conjunction with Udayana University's Masters Program in Planning and Development for Urban and Rural Areas; Conservation of the Built Environment; and Ethnic Architecture.
[4] Suartika, G A M (2013) 'Open Space Traditions, Development and Modernity: The Case of Bali’ Journal Nasional Terakreditasi Mudra: Journal Seni Budaya Vol. 28, No. 2 December 2013, Institut, Seni Indonesia Denpasar, UPT Penerbit, p: 283-299.
[5] Suartika, G A M, Mudra, I K, and Saputra, K E (2019) An Open Market: The Legitimation and Regulation of the Public Realm in Denpasar, in IOP Conf. Ser.: Earth Environ. Sci. 396 012041, p: 1-8.
[6] Joga, Nirwono dan Iwan Ismaun 2011 RTH 30 % Resolusi Kota Hijau (Jakarta : PT. Gramedia Pustaka Utama)
[7] Suartika, G A M (2019), 'Lessons from a Small Island – Density, Spatial Development, and Identity' in IOP Conf. Series: Earth and Environmental Science, 2019 IOP Conf. Ser.: Earth Environ. Sci. 248 012016, p: 1-13.
[8] Bilgli, BC and Gokyer E 2012 Urban Green Space System Planning, Landscape Planning (Croatia: InTech Janeza Trdine pp 107-112
[9] Nuraini, Cut 2009 Peran Fungsi dan Manfaat Pekarangan sebagai Salah Satu Model Ruang Terbuka Hijau di Lingkungan Permukiman Padat Kota, Studi Kasus : Pekarangan di Karang Kajen, Yogyakarta (Denpasar. Seminar Nasional)

[10] Frick, Heinz dan FX Bambang Suskiyanto 2007 Dasar-Dasar Arsitektur Ekologis (Jakarta: PT Kanisius)

[11] Laurie, M 1986 An Introduction to Landscape Architecture (New York: American Elsevier Publ.Co.Inc)

[12] Heston, Yudha P dan Dimas Hastama Nugraha 2017 Oase di Tengah Kota : Kota Ekologis dan Penyiapan RTH (Yogyakarta: Gadjah Mada Univesity Press)

[13] Grey, G.W. and Deneke, F.J. 1978 Urban Forestry (New York: John Willey and Sons)

[14] Yusuf, Muri 2014 Metode Penelitian : Kuantitatif, Kualitatif & Penelitian Gabungan (Jakarta: PT. Gramedia Pustaka Utama)

[15] Badan Perencanaan Pembangunan Daerah Pemerintah Kota Denpasar 2017 Laporan Data dan Analisa “Identifikasi RTH 4 Kecamatan di Kota Denpasar” (Denpasar)

[16] Departemen Pekerjaan Umum 2008 Permen PU No: 05/PRT/M/2008 Tentang Pedoman Penyediaan dan Pemanfaatan Ruang Terbuka Hijau di Kawasan Perkotaan.

[17] Ernawati, Rita 2015 Optimalisasi Fungsi Ekologis Ruang Terbuka Hijau Publik di Kota Surabaya (Surabaya: EMARA Indonesian Journal of Architecture)Vol 1 No 2

[18] Green Building Council Indonesia 2015 Greenship Rating Tools untuk Kawasan (Direktorat Pengembangan Perangkat Penilaian GBCI)

[19] Iskandar, Johan dan Budiawati S. Iskandar 2016 Arsitektur Tumbuhan: Struktur Pekarangan Perdesaan dan Ruang Terbuka Hijau Perkotaan (Yogyakarta: Teknosain)

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