

Sustainable Development Strategy in the Bali Green School Area

Selvia Noer Agustin, Ngakan Ketut Acwin Dwijendra

Program Studi Arsitektur Universitas Udayana, Bali, INDONESIA

Email: selvia.noer@gmail.com, acwin@unud.ac.id

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ABSTRACT

Sustainable development is development to meet the needs of the present generation without compromising the ability of future generations to meet their needs in terms of environmental, economic and social aspects. Green School Bali, one of the educational areas in Bali that implements sustainable development. This study aims to determine the sustainable development strategy applied in the Bali Green School area. To assess whether an area is implementing sustainable development or not, an indicator is needed, which in this study uses GREENSHIP Regions. In this indicator there are seven categories and are grouped into sub-indicators which are further elaborated. This study will record whether these indicators are applied or not in reality through literature review, direct observation and interviews. So it can be concluded that the Bali Green School area implements a sustainable development strategy according to the GREENSHIP Area indicators.

Keywords: strategy; sustainable development; green school Bali; GREENSHIP region; indicators.

INTRODUCTION

Environmental damage is an issue that is widely discussed at this time, one of which is data from the World Green Building Council, it is known that buildings contribute 33% of CO2 emissions, consume 17% of clean water, 25% of wood products, 30-40% use of raw materials and 40- 50% of energy use for development and operations (Hapsari, 2018). This is also happening on the island of Bali, Indonesia, which is currently developing rapidly due to the construction of buildings to accommodate tourist activity facilities whose numbers are increasing after the Covid-19 pandemic. So that sustainable regional development is one of the solutions.

The concept of Sustainable Development, which means meeting the needs of the present generation without compromising the ability of future generations to meet their needs (Brundtland in Report of the World Commission on Environment and Development, 1987). The concept of sustainable development has three pillars namely environment, economy and social. If applied in the realm of architecture, it becomes a sustainable architecture. Sustainable architecture is an environmentally friendly building, which is designed and built using sustainable building technology, sustainable energy systems, sustainable building materials and sustainable building materials that do not burden future generations with environmental and financial debt (Mangunwijaya, 1980).

Green School Bali is a nature-based educational facility that has implemented the concept of sustainable architecture. Green School Bali is an international private school that provides education in early years, primary school, middle school and high school. This school has received various awards in the field of sustainable development, including the Aga Khan Award for the recycling category in 2010; award from the Center of Green School for the category "Greenest School on Earth" in 2012; highly recommended Deezen Awards in 2021; and other awards. So it is interesting to serve as a case study from this research, is it true according to its name.

An area that can be said to be sustainable can be assessed from several indicators. Sustainable area indicators are divided into several categories, namely: 1) Land Ecology Improvement; 2) Movement and Connectivity; 3) Water Management and Conservation; 4) Solid and Material Waste; 5) Community Welfare Strategy; 6) Building and Energy; 7) Development Innovation (GREENSHIP Region vol.01,2015). In each of these categories there are strategies designed to lead to a sustainable area.

From the background above, it is important to know whether the Green School Bali area implements sustainable development and what the strategy is. So that it is expected to become knowledge and guidelines on how to implement sustainable development strategies in the Bali Green School area.

RESEARCH METHODS

To answer this research, a qualitative method was used with a case study approach in the Green School area of Bali. Green School Bali is located on Jl. Sibang Kaja, Banjar Saren, Sibang Kaja Village, Abiansemal District, Badung Regency, Bali. The distance from the center of the capital of the island of Bali, the city of Denpasar, is about 30 km. The following is the location of the Green School Bali.



Figure 1. Location of Green School Bali. Source : Personal Analysis, 2022

The data in this study are qualitative data from primary and secondary sources. Primary data from direct observation at the location in the form of photos and interview results from guide informants who are marketing and communication staff at Green School Bali. Secondary data was obtained from various literatures ranging from books, journals, articles, websites and official social media of Green School Bali. The data obtained is carried out by a checklist with indicators that are within the scope of the study. The analysis was carried out using a qualitative approach by calculating the percentage of success. The scope of this research is the existing conditions in the Bali Green School Area seen from several categories according to GREENSHIP Region vol.01, 2015 which is described in the following table below.

Table 1. Region GREENSHIP Category

GREENSHIP Region		
Category	Value	Rank
Land Ecological Enhancement	19	15%
Movement and Cinnectivity	26	21%
Water Management and Conservation	18	15%
Solid Waste and Material	16	13%

Community Wellbeing Strategy	16	13%
Building and Energy	18	15%
Innovation and Future Development	11	9%
Total Maximum Overall Score	124	

Of the seven scopes above, the sub-categories are described again and a checklist is carried out with the actual conditions in the field. back Then it was analyzed with a descriptive approach, explained the actual situation and obtained the results and conclusions of this study.

RESULTS AND DISCUSSION

To find out the strategy for sustainable development with technological sustainability at Green School Bali, we will see that all categories of sustainable areas according to GREENSHIP are divided into seven categories, as follows:

Improvement of Land Ecology

In this category, several sub-categories will be assessed, the first is the basic green area and the public area aims to maintain harmony and balance of the environmental ecosystem, improve the environmental quality of a healthy area and encourage interaction by providing green open spaces. The location of Green School Bali is a rural area of approximately 4.55 ha which is crossed by the Ayung River in it. The total building area is approximately 4,500 m² (Ratnasari, 2014). If the percentage calculation is carried out, then the built-up area is in this area.

$$\text{green area percentage} = \frac{(\text{total area} - \text{built-up area})}{\text{total area}} \times 100 \%$$

$$\text{green area percentage} = \frac{(45500 - 4500)}{45500} \times 100 \% = \frac{41000}{45500} \times 100 \% = 90 \%$$

So that approximately 90% of Green School Bali at Green School Bali.

Strategy in designing architecture that blends with nature. So that it does not become a dominating building but harmony with nature. Where most of these areas can be accessed by the public who are allowed to enter this area because their main function is school. The permitted public are usually guests who will go on tours, besides that local residents on certain days can carry out performance activities or other cultural activities as illustrated below.



Figure 2. The atmosphere of Green School Bali. Source : Instagram @greenschoolbali , 2022 (Left); Personal Documents, 2021 (Right)

The second is about habitat preservation to minimize the impact of development on the balance and biodiversity of natural species. The strategy is realized by allowing the forest to remain sustainable in part of the area which they also use for educational facilities so that it does not disturb the existing biodiversity, instead making it part of learning. Apart from that, also bring several farm animals such as chickens, ducks, pigs into the area to revive the habitat itself and become learning objects as shown below.



Figure 3. Pelmaculture Green School Bali. Source : Instagram @greenschoolbali , 2022

Thirdly, land revitalization, this did not happen because initially the land was all vacant land. The four microclimates, from (figure 2) and (figure 3) show that the area represents maintaining and keeping the microclimate cool and natural. Fifth, the availability of productive land to encourage local food production and reduce the carbon footprint that comes from transportation emissions of food supply. The strategy is to carry out pelmaculture in certain zones (figure 3), in the form of rice fields and Keyang fields, the results are also processed in their kitchens for consumption. So, from the description of the results of the analysis above, a checklist table is obtained as follows.

Table 2. Land Ecological Enhancement checklist

	Land Ecological Enhancement / LEE	Available
LEE 1	Basic Green Area / Public Open Space >35 %	√
LEE 2	Habitat Preservation	√
LEE 3	Land Revitalization	x
LEE 4	Microclimate	√
LEE 5	Productive Land	√

From the checklist above, four of the five sub-categories of land ecology improvement were carried out in the Bali Green School area. So the estimated success rate of this category of sustainable development strategy is 80%.

Movement and Connectivity

This category discusses the circulation of users and vehicles and their connectivity. The aim is to ensure accessibility planning is in place, for the movement of people, goods and vehicles. The first strategy in the area is given instructions for a shared parking area, when entering the area on foot there is an area site plan that makes it easy to know the direction of movement and its connections. The following is the site plan for the Green School Bali area:



Figure 4. Green School Bali site plan. Source : <https://www.tripadvisor.co.id/>, 2021

If we look at the site plan, the main road to the area is not traversed by mass public transportation, but can be accessed by taxi public transportation and they have a school bus as a student facility which has its own shelter. The parking area is across from the main area, so that the main access to enter the entrance area must be on foot. Likewise, the connection between one area and another can only be passed on foot with uninterrupted access. The comfort of pedestrians is sufficiently considered here, however, because the concept is nature, you must use comfortable footwear for outdoor activities. From the explanation above if analyzed with a checklist table as follows:

Table 3. Movement and Connectivity checklist

	Movement and Connectivity / MAC	Available
MAC 1	Pedestrian Path Design Strategy	√
MAC 2	Public transport	√
MAC 3	Utilities and Public Facilities	X
MAC 4	Universal Accessibility	√
MAC 5	Bicycle Network and Places	X
MAC 6	Shared Parking	√

From the checklist above, four of the six sub-categories of movement and connectivity were carried out in the Green School Bali area. So the estimated success rate of this category of sustainable development strategy is 67%.

Water Management and Conservation

The strategy for alternative water is to install a Reverse Osmosis (RO) water filtration system to meet drinking water consumption needs. The source of drinking water for this area facility is taken from a well as deep as 60 meters. An interesting sustainable technology in this area is the strategy carried out on rainwater runoff management aimed at reducing environmental drainage loads with an integrated rainwater management system and also as renewable energy. One of the buildings that functions as a gym called the arc uses a rainwater harvesting system as a material for small-scale hydroelectric power plants using turbines. The following is the building of the arc and the Minang bridge on the Ayung river:



Figure 5. the arc and bridge of Minang Green School Bali. Source : Instagram @greenschoolbali , 2022

If you pay attention to the arc, this is a wide span building that functions as a gym. This building uses bamboo material as a structural and architectural element. Using columns that blend with the beams to form strong yet aesthetically pleasing arches. The roof covering uses geprek bamboo which is designed as an overhang that drops rainwater into the gutters below. From the gutter below, the rainwater is directed to a rainwater storage tube which is used to drive a turbine which converts it into an electric current which is the main source of electricity in this area. Besides that, it also utilizes the Ayung River to drive turbines. So that the preservation of the Ayung River water body is preserved as can be seen from the picture of the Minang Bridge (figure 3). Where water as a renewable energy has the potential to generate electricity up to 75,000 Mega Watt (Jurnal Energi, 2016). The following is an overview of the technology chart:



Figure 6. Pressure Head and Turbine Diagram. Source : Micro-Hydropower System : A Buyer's Guide (left) Instagram @greenschoolbali , 2022 (right).

Liquid waste management that is applied to the educational process that they apply is aquaponics. aquaponics is the integration of aquaculture (fish raising) with fish waste as a source of organic food for growing plants and hydroponics (soilless growing of plants) which grows fish and plants together in a closed system. From the explanation above if analyzed with a checklist table as follows:

Table 4. Water Management and Conservation checklist

Water Management and Conservation / WMC		Available
WMC 1	Alternative Water	√
WMC 2	Rainwater Runoff Management	√
WMC 3	Conservation of Water Bodies and Wetlands	√

WMC 4	Liquid Waste Management	√
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From the checklist above, four of the four sub-categories of water management and conservation were carried out in the Green School Bali area. So that the estimated success rate of the sustainable development strategy for this category is 100%.

Solid and Material Waste

In this category, Green School Bali's strategy in solid waste management is already at an advanced level. Just to enter this area, we must be free of plastic waste, so that only organic waste is produced. In addition, leaf litter from the location is also composted using local residents as workers. Organic waste from the kitchen is separated for food waste and cooking oil. Food waste is processed into compost and used cooking oil to be processed to fuel school buses. This strategy is also a sustainable technology by processing used cooking oil into fuel. They even accept donors of used cooking oil to be processed into fuel. Currently they have six school buses, one mini bus, one pick-up and one ambulance which are being developed. Following are the results of the development of the technology used:



Figure 7. Bio Bus, Bamboo Material Class and Distance to Mount Batur. Source : Instagram @greenschoolbali , google maps, 2022.

The second category is about materials, the strategy is on the basic selection of building materials, namely bamboo, where bamboo is an environmentally friendly material. All structural, architectural and interior elements at Green School Bali use bamboo. Bamboo is a local material obtained from the Bali area itself and has been treated so that it becomes sturdy and strong bamboo. Some of the roofs of buildings use reeds. This material must be replaced every five years, but the remaining waste is used for pelmaculture as a construction waste management strategy. For the material used as road infrastructure, use coral crushed stone. According to the results of the Batur Mount Batur interview, the contours are quite steep which also reminds of an active volcano in Bali. Where is the research location and Mount Batur, if you measure the distance with the Google map, you will get 40 km (figure 7). From the explanation above if analyzed with a checklist table as follows:

Table 5. Solid Waste and Material checklist

	Solid Waste and Material / SWM	Available
SWM 1	Advanced Solid Waste Management	√
SWM 2	Construction Waste Management	√
SWM 3	Regional Materials for Road Infrastructure	√
SWM 4	Recycled and Used Materials for Road Infrastructure	X

From the checklist above, three of the four sub-categories of solid waste and materials were carried out in the Green School Bali area. So the estimated success rate of this category of sustainable development strategy is 75%.

Community Welfare Strategy

The strategy for this category is to facilitate the community so they can interact and do activities. Green School Bali organizes regular events involving local residents. Some of the employees are also local residents, one of whom manages compost and canteens as a strategy for social and economic benefits. Local residents were also moved to create a waste bank across this area. This is because this school wants to increase awareness, knowledge, and community participation regarding the concept of sustainability in the area which is carried out consistently.



Figure 8. Local Culture Education. Source : Instagram @greenschoolbali , 2022.

With the opening of the Bali Green School area as a private tourist visit, the surrounding community has also developed to open coffee shops, cafes, stalls so that it becomes a mixed area. Local culture forms the basis of Green School Bali by building an area that pays attention to the preservation and development of local culture. With building architecture based on local identity, it becomes a supporting facility for the implementation of local culture, as a container for local cultural preservation and education activities. A safe environment strategy is also implemented by providing an evacuation route map in the area. From the explanation above if analyzed with a checklist table as follows:

Table 6. Community Wellbeing Strategy checklist

	Community Wellbeing Strategy / CWS	Availible
CWS 1	Facilities for the Community	√
CWS 2	Social and Economic Benefits	√
CWS 3	Community Concern	√
CWS 4	Mixed Area	√
CWS 5	Local Culture	√
CWS 6	Safe Environment	√

From the checklist above, six out of six sub-categories of community welfare strategies were carried out in the Green School Bali area. So that the estimated success rate of the sustainable development strategy for this category is 100%.

Building and Energy

This category of Green School Bali is Green Building as a unified element of green development in the area. The strategy for energy efficiency within the area, with the building's own technology being implemented by making all buildings semi-open. Where thermal comfort is achieved by openings that are free from all sides of the building so that enough wind enters and leaves, and is supported by landscape treatment that is left beautiful. Lighting comfort is achieved by optimal openings and also the addition of skylights on the roof. So that the lighting is comfortable for teaching and learning activities. Acoustic comfort is also considered here, by structuring the layout of the building masses

with different functions and a certain distance so that they do not interfere with teaching and learning activities. As in the following picture:



Figure 9. Openings and skylights in the Green School Bali performance space. Source: Personal Documents, 2021.

Another sustainable technology is to provide alternative energy aside from hydropower also using solar panels. Where this solar panel can be an alternative renewable energy to produce 11,000 Mega Watts of power (Journal of Energy, 2016). Solar panels at several spots in the area help provide a second source of electricity. Like the following picture:



Figure 10. Green School Bali Solar Panels. Source : Instagram @greenschoolbali , 2022 (left) Personal Document , 2021 (right).

From the explanation above if analyzed with a checklist table as follows:

Table 7. Building and Energy checklist

	Building and Energy / BAE	Available
BAE 1	GREENSHIP Green Building	√
BAE 2	Balanced Housing	X
BAE 3	Energy Efficiency in the Region	√
BAE 4	Alternative Energy	√
BAE 5	Light Pollution Reduction	√
BAE 6	Noise Pollution Reduction	√

From the checklist above, five out of six building and energy sub-categories were carried out in the Green School Bali area. So the estimated success rate of this category of sustainable development strategy is 83%.

Development Innovation

In this category, Green School Bali continues to implement the concept of sustainability in the area, which is consistent from the start of its opening in 2008 until now 2022. By maintaining the use of bamboo materials with the concept of sustainability for development development. Consistent in innovation that can develop the environmental, social and economic functions of the region. Green School Bali often carries out social actions regarding the environment such as Beach Clean Up, tree planting programs, and other environmental activities. The following are pictures of development innovations towards sustainable development from Green School Bali:



Figure 10. Beach Clean Up and Classroom Atmosphere of Green School Bali. Source : Instagram @greenschoolbali , 2022.

From the explanation above if analyzed with a checklist table as follows:

Table 8. Innovation and Future Development checklist

	Innovation and Future Development / IFD	Available
IFD 1	Empowerment of GREENSHIP Associates and Professionals	X
IFD 2	Area Management	√
IFD 3	Innovation	√

From the checklist above, two of the three subcategories of development innovations were carried out in the Green School Bali area. So the estimated success rate of this category of sustainable development strategy is 66%.

CONCLUSION

Green School Bali as an educational facility area carries out a sustainable development strategy with various technologies in seven categories, namely: 1) Land Ecology Improvement by optimizing green open spaces, some of which are for the public and implementing permaculture; 2) Movement and Connectivity by prioritizing pedestrians in the area by placing parking outside the area and integrating between buildings; 3) Management and Conservation of Water with small-scale hydropower (hydropower) technology using a turbine that is integrated with one of the buildings; 4) Solid waste and materials with composting and fuel technology using used cooking oil used for school public transportation facilities; 5) Community Welfare Strategy by making local people partly employees and providing space to learn and apply local culture; 6) Building and Energy using environmentally friendly bamboo materials provides a sense of comfort in terms of lighting, thermal

and acoustics and uses solar panel technology to increase the source of electricity; 7) Development Innovation with consistency to design, build, educate and socialize sustainable development.

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