Sustainable Socio-cultural Aspect Within Green Building User Behavior in Bali, Indonesia

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Abstract. The definition of green building is related to the design strategy and use of technology in buildings to create efficient energy utilization and minimize negative impacts on both the environment and its users. User behavior is a significant determinant because to achieve green building parameters in the technical aspects alone is hard and, in the long term, must be supported by user behavior patterns with a responsive understanding of energy efficiency goals. This paper aims to conduct an initial study that focuses on the socio-cultural aspects of green building users' behavior in Bali. This paper does not discuss quantitative matters on the green building parameters. Instead, it focuses on formulating a basic knowledge about the influence of user behavior with Balinese socio-cultural characteristics to become a reference at the building management level for the specific green building's success. The method used in this paper is a qualitative descriptive method with literature review approach. The socio-cultural factor that affected Bali's user behavior was influenced by green building principles' technical issues and pro-environmental action in general. The more specific element is culture, local wisdom, and the religious value that leads to environmental awareness. The perspective of Bali's green building user can be defined as the user's local socio-culture views, the principles of green building perspectives and organization and management level perspective.

1. Introduction
The green building concept is a concept that is commonly applied in building planning with an energy efficiency approach. Understanding green buildings are related to the design strategy and use of technology in buildings to create efficient energy utilization and minimize negative impacts on both the environment and its users' health. According to the Regulation of the Minister of Public Works No. 02 of 2015 concerning Green Buildings [1], Green buildings are buildings that meet construction specifications and have substantial measurable output by applying the concepts of green building in compliance with purpose and classification at each point of their operation to conserve energy, water and other resources. Not all buildings are required to meet the requirements for green buildings when referring to the Regulation of the Minister of Public Works No.29 of 2006 concerning Building Technical Requirements. Buildings that are obliged to organize green buildings are buildings with office functions, commercial buildings (shopping centers). Meeting buildings or exhibition buildings, hospital buildings, museums, educational buildings, flats, apartments and hotels which are multi-story residential buildings.
In Indonesia, an assessment of green buildings can now be carried out by referring to two assessment agencies, namely the Green Building Council Indonesia (GBCI) with its rating tools Greenship 1.2 and the Ministry of Public Works and Public Housing (PUPR) with an assessment of green buildings ratings. If we look at the criteria used are more quantitative and technical measurements of the design strategy for buildings. In general, the assessment criteria in Greenship 1.2, including 1). Appropriate Site Development (ASD), 2). Energy Efficiency and Conservation (EEC), 3). Water Conservation (WAC), 4) Material Resource and Cycle (MRC), 5) Indoor Health and Comfort (IHC), 6) Building and Environment Management (BEM), while the PUPR rating is 1). Site Selection and Processing, 2) Energy Efficiency, 3) Design Aspects, 4). Use of building materials, 5) Water Efficiency, 6) Interior Quality, 7). Accessible facilities and infrastructure, 8) Contribution to environmental conservation, 9) Innovation, 10) Waste Management, 11) Post-Occupancy Evaluation, and 12) Environmental Damage Mitigation. From the two rating tools used, it can be seen that the tendency of the assessment process or assessment of a green building focuses on the technical side of the building according to the achievement of the criteria for each assessment of each institution. Achieving energy efficiency will be the goal of every building stage from the planning, construction and operational stages.

However, from several researches, the achievement of this technical aspect parameters must be accompanied by user behavior patterns that are in line with the intended green building concept. User behavior is a major determinant of the environmental effect of a product; while technical advances make it possible to improve the product's operational performance, the user's decisions and behaviors eventually have a major impact on the product's energy or other resources, hence the need to change user behavior. [2] [3] [4]. It can be concluded that for the sustainability of green buildings, it is not enough to achieve green building parameters in the technical aspects alone but must be supported by user behavior patterns with a responsive understanding of energy efficiency goals.

The green building concept is a new building concept that is starting to be implemented in Bali’s buildings design. One of the buildings planned and certified as a green building is an art market in Gianyar Regency. This art market is the beginning of a series of green building projects that are owned by the government in Bali. Bali is a region that is strongly influenced by the socio-cultural aspects of behavior. Religious norms, beliefs and local wisdom that refer to the socio-cultural aspects will become the basis for behavior and choices for user decisions in the building. To ensure the sustainability of green buildings in Bali, it will be very important to see how the socio-cultural aspects will affect building user behavior.

2. Research Method
This paper aims to conduct an initial study that focuses on the socio-cultural aspects that affected the behavior of green building users in Bali. This paper does not discuss quantitative matters on the green building parameters but rather focuses on formulating a basic knowledge about the factors that affected the user behavior with Balinese socio-cultural background. Achieving the green building parameters is very important to ensure that a building is a green building. But in the long term, it is user behavior that will ensure the sustainability of the building as a green building. As a new concept applied to buildings in Bali, it will be important to see what influences user behavior, especially pro-environmental behavior in green buildings in Bali. The result intended to be a reference for the building management level for the sustainability of green building in Bali.

The method used in this paper is a descriptive method with literature review and general survey documentation. The literature review method is often used to examine research topics on user behavior in buildings and their relation to energy [5] [6]. The difficulty with this method is that it requires a reasonably large publication database and impacts research funding. The selected literature used in this publication is literature related to the specific context of the discussion so that it does not use an extensive literature database. Given that this research is a preliminary study with the level of discussion on reference to theories and concepts, this method is relatively appropriate to use. However, to give a visualization and basic idea of the situation, some documentation is included in the
findings chapter. This documentation was taken at one of the art market buildings in Gianyar Regency, Bali which is a certified green building and is a government-owned building.

3. Discussion
To see green buildings' socio-cultural aspects, we must see green buildings as part of sustainable architecture. The perspective of green buildings as something technical and quantitative will limit our perspective. The goal is to achieve parameters according to the criteria in assessing green buildings that have been determined using a quantitative approach. This criteria approach is more of a mechanical and technology-related approach rather than a more humanist and user-related approach.

Discussing the socio-cultural aspects of green building users' behavior if associated with the sustainability of green buildings will be closely related to the understanding of pro-environmental behavior, aspects of green building principle being implemented, characteristics of Balinese cultural background, and local wisdom that leads to the behavior and sustainability of green buildings.

3.1. Pro-environmental Behavior
The concept of pro-environmental behavior will be one of the determining factors for the success and sustainability of green buildings in Bali buildings. What is meant by pro-environmental behavior (environmental behavior) is human behavior that shows efforts to reduce adverse impacts on the environment and reduce energy consumption [7][8][9]. More specifically refers to behavior that considers conditions that impact the environment, such as energy consumption efficiency, resource conservation, recycling, and maintenance of flora and fauna [10]. In general, pro-environmental behavior will lead to behavioral choices that minimize negative impacts on the environment. It is very important that green building users make behavioral choices that are rationally aligned with green building goals. Examples of pro-environmental behaviour such as behaviour that related to energy efficiency, adaptive thermal comfort and waste management.

In relation to the sustainability of green buildings, the relevance of user behavior patterns and pro-environmental behavior modeling in Bali, as user behavior is highly influenced by many external factors such as culture, economy, climate and also internal factors such as the range of individual comfort and physiology. Cultural characteristics will undoubtedly make a big difference in how green building users behave in Bali, given that pro-environmental behavior based on local wisdom is a factor in the level of individual happiness or satisfaction [11]. A more detailed explanation regarding the cultural context is presented in section 3.3.

3.2. Green Building’s Principles
Achieving green parameters and criterias in green building is mandatory but the right user behaviour is much more needed for sustainability reasons. As previously explained, green building principles are more on measurement parameters against parts of the strategy in both the design and construction stages. Green Building is associated with methods, techniques, and construction elements that produce less pollution, use less energy and pay attention to building users' comfort. Attention to material selection and its impact on the environment and energy consumption is also green building strategies. Awareness of how buildings can apply sustainability and energy efficiency principles is the focus of green building principles [12][13]. If examined further, the human dimension in green buildings has been widely studied and shows that the role of humans in the sustainability of green buildings is very significant, especially in its effect on energy consumption [6][14][15]. User comfort is also an essential factor to ensure users of green buildings can do maximum activity [16][17][18].

Buildings with the application of green building principles are relatively recently developed and strategically applied in Bali specifically by the government. The architecture of buildings in Bali itself has its own characteristics which must apply the principles of Balinese architecture. This is specifically regulated as a mandatory through government regulations. The presence of the application of green building principles in Bali will have to be able to properly adjust the obligations of implementing the principles of traditional Balinese architecture.
As it is generally related to something new, socialization for related stakeholders will be needed. Disseminating understanding - understanding of the principles of green building among stakeholders or building users is very important. This understanding’s socialization must start from the earliest stages, which is the design stage, both architecture, structure, and MEP. Then proceed to the next steps, such as the construction process and building operations. Building builders, tenants, operators and energy managers, industry players and technology suppliers, policy makers, and government agencies are the stakeholders who need to understand the concepts of green building [6][19]. To provide tailored feedback and observations, each subsection describes the needs of stakeholder groups related to the construction life cycle and discusses important developments in construction, social and data science.

3.3. Culture and Local Wisdom
Cultural aspects and local wisdom will also be considered in the design of green buildings[20]. Some of the green building principles can also be traced closer to vernacular buildings’ sustainability principles [21][22]. Specific social systems of society carry on their culture between generations and produce local wisdom as the norm. Local knowledge also directs how a person views environmental protection and management [23][24][25].

Balinese people’s life pattern with a cultural and religious approach plays a significant role in maintaining local wisdom. This will have a huge impact because people with Balinese cultural backgrounds will undoubtedly dominate the green building actors. According to Atmadja in [26] , the Balinese themselves interpret the environment in two forms, namely sekala (physical environment) and niskala (supernatural environment). Some rituals that show respect for the environment such as tumpek wariga (for the god of fertility of trees), wana kertih (to glorify forests and mountains), danu kertih (for preserving springs) are manifestations of local wisdom.

The Tri Hita Karana concept [27][28] is another local wisdom closely linked to the Balinese way of looking at their relationship with the world. Tri means three, Hita means source, and Karana means happiness, the sense of every word derived from Sanskrit. This description stresses that to attain human happiness, we must balance the relationship with God, the relationship with humans, and the relationship with nature. Balance will be achieved if humans strive for a harmonious relationship with these three elements. The three parts are parhyangan, pawongan, palemahan. Parhyangan has the meaning of establishing a balanced relationship with the Creator [29]. Pawongan, which means that humans have a harmonious relationship with their fellow humans. Palemahan, which means humans develop a harmonious relationship with nature [30].

Hopefully, through this understanding of local wisdom, awareness of building users in Bali will realize the relation between a green building value with environmental sustainability. User behavior that is formed later is not a behavior that is solely due to rules and authority, but rather sees it in a broader perspective where its existence as a human being has reciprocal relation to environmental quality. If humans are aware of environmental sustainability, their presence will be safe and vice versa, if the environmental quality decreases, human existence will be disturbed.

3.4. Religious Value and Environmental Awareness
In general, the relationship between religion and building users' behavior cannot be seen from a narrow perspective. The philosophy of faith does not explicitly refer to energy efficiency in buildings but will be more about understanding its impact on the environment and human existence sustainability. This is similar to how the local wisdom aspect affected user behavior.

A religion is a system of symbols that create solid, omnipresent and long-lasting moods and motivation in men by formulating conceptions of a general order of life and clothing these conceptions with an aura of factuality that sees attitudes and motivations as uniquely realistic [31]. Without religion, the comfort of life will not be obtained and enjoyed properly. This understanding will lead to a philosophy about human existence and how to understand the rules in general. Society in Bali is dominated by people who adhere to Hinduism and some who adhere to different religions. However,
to see the context of behavior from the majority’s perspective, the religious values discussed are in the longing perspective. Hinduism views the natural environment as the same creation of God as himself [26][24][28]. So that protecting nature and the environment is one form of manifestation of its adherence to the religious norms that are adhered to.

Are humans responsible for the quality of the environment in which they are located? What actions are humans doing that have a good or bad impact on the environment? This will be the focus of any religious thought in general. Building users from the perspective of their religion, who have an awareness of the sustainable concept, will certainly prefer behavior that has the least possible impact or even has no negative impact on the environment.

4. Findings
The human dimension and user behavior in green buildings must be considered for sustainability of green buildings. Their goals in achieving energy efficiency and minimizing environmental impacts is the main purpose. From the previous discussion, it was found that several things are very important to consider in the context of the behavior of green building users when referring to the socio-cultural aspects. The discussion concludes several factors that need to be considered related to socio-cultural aspects that affect the perspective or point of view of green building users in Bali. This perspective then stimulates the user behavior in green buildings in Bali.

4.1. Users Local Socio-culture Perspectives
From several behavioral research, social factors such as culture and local wisdom are essential factors in user behavior decisions on green buildings [24][19]. User characteristics, especially those with religious background, culture, and local wisdom, will influence green building's attitudes and behavior. As previously explained, factors of religion, culture and local knowledge are near related to the way users perceive their environment and their existence as part of it. Binding values and norms will help users choose certain behaviors aligned with the goals of green building. Responsibility for the environment and its impact on the user's life is a must.

Figure 1. Sacred area in one of green building in Bali

Religious values and local wisdom play an important role in encouraging choices of pro-environmental behavior in accordance with the context of green building principles. One example is the use of land and outdoor space in green buildings in Bali will be different from green buildings in general. There will be a need for a certain area of land that is used for the area of the sacred area. Land use for open space and vegetation must be adapted to the needs of the location of this sacred area. The type of pavement material in the outer space will also adjust to the conditions of the sacred area in question. In Bali, activities related to religious routines have a considerable influence on the generation of organic waste in buildings. The waste of the offerings require more special management regarding the possibility of large volume periodically, especially in the case of a market building which is a public building (refer to Figure. 1). The users of green building in Bali have to adapt a new
way of managing the waste that they produce. The understanding of the impact of poor waste management has to be mandatory for the green building user. The example above is indeed casuistic in nature but can represent a phenomenon that occurs due to the context of religious activities in Bali.

User behavior Model in green buildings that are specifically influenced by Balinese culture and local wisdom needs to be elaborated in a more contextual way regarding the future development of green buildings in Bali. This is important because Bali's green building users' characteristics will be slightly different from the general behaviour because of the socio-cultural aspect. However, how it interacts with more technical factors related to green building principles and organizational management in green buildings needs to be further explored.

![Figure 2. Situation inside the market that show user behaviour and activities regarding adaptive thermal comfort](image)

4.2. The Principles of Green Building Perspectives

The behavior of users of green buildings will be greatly influenced by the level of understanding of green building principles. What Understanding means here is the extent to which users understand the essence and purpose of implementing a green building strategy in the buildings used. In early stages such as design phase and construction phase, it is mandatory to implement green building criteria. But in the long term, every user behavior associated with the strategy used will significantly influence the success of green building. Simple things such as adaptive behavior to room temperature conditions that may not correspond to the expected level of thermal comfort can significantly affect the energy quantity used for air conditioning. For example, opening a window for wind movement, choosing thinner clothes in hot thermal conditions, turning on a fan or using blind that can be controlled by the user will significantly affect thermal comfort and energy use.

Literacy or written knowledge about green buildings and user recognition is also an influencing factor [27]. One of them is, for example, the link between global warming, green buildings and energy consumption. People with adequate literacy levels may commonly understand this, but not vice versa. With a good understanding of green buildings principles, behavior will be in line with energy efficiency goals.

4.3. Organization and Management Level Perspectives

Intuitively, users will show behavior based on their insights and experiences, especially his realization of the impact of a particular behavior on green buildings' energy efficiency goals. For example, water conservation or waste management will be consciously carried out with full awareness of the consequences of using excessive water or pollution on the environment. However, the behavior that comes from this awareness can sometimes be ignored due to certain situations and conditions. In this condition, a rule, direction is needed.
In the context of management organizations that need to be considered are how the internal structure and interactions in management, the discussion and terminology used, the giving of rewards, regular patterns in the organization and habitual routines, fear of bad risks and limited resources [24]. At the level of a building management organization, a regulation that binds and guides user behavior is required. The sustainability of green buildings and how the user behavior related to energy efficiency will significantly depend on how the building management prepares the management and operational procedure. A behavior will be formed due to several factors, both internal and external. In terms of understanding and user awareness, behavior will be formed, influenced by internal factors. On the other hand, external factors in the form of rules or provisions that direct human behavior is also needed. From the examples described above, routine education from building management is very much needed in the context of waste management, energy management which is influenced by behavioral choices and facilitating the needs of adaptive thermal comfort of users.

5. Conclusion
This socio-cultural aspect in user behaviour within green building is related to the human dimension and the perceptions that are formed. Perception, referred to in this case, is the perception of green buildings and their impact on users’ lives. The views of a person as to what the human quality of life or well-being means are influenced by the practices and traditions of the society that decide their expectations and moral etiquette and their spiritual beliefs or religion. The green building perception is very much influenced by the environment in which the user is located, including limitations on the physical and psychological aspects.

Users of green buildings in Bali will be influenced by several principles that are influenced by their location in Bali. The first is how to design Green buildings with the application of green building principles in buildings in Bali which must also apply the principles of Balinese Architecture. The concept of pro-environmental behavior in green buildings in Bali will also be influenced by the cultural background and local wisdom of Bali. One of the local wisdom concepts that has a significant influence is the Tri Hita Karana concept. Religious values and ways of carrying out religious activities will also influence the behavior of green building users in Bali.

Viewpoints or perspectives that are influenced by cultural backgrounds, religions, and local wisdom, understanding of the principles of green buildings and management regulation at the building operational level will direct the socio-cultural aspects of green building users' behavior in Bali. At the early stage of design and construction, all stakeholders must understand the demands for the application of green building principles in the building in question. Next, building users should ideally have a good understanding of the effects of their behavior on building comfort and energy efficiency. For sustainability and consistency, building management rules are important. Hopefully, with the harmony of these local wisdom, the ideal user behavior will lead to the sustainability of green buildings in Bali.

Furthermore, this paper opens the opportunity to continue research using methods that relate directly to the user, such as a questionnaire or social research related to the behavior of green building users in Bali. In-depth research also can be done in the future, for example, to construct user behavior models that are influenced by socio-cultural aspects in Bali.

References

[1] W. Sujatmiko, Z. Astuti, B. N. Raharja, and F. Harijani, Sistem Rating Bangunan Gedung Hijau. Pekerjaan, Kementerian Dan, Umum Rakyat, Perumahan Penelitian, Badan Pengembangan, D A N Litbang, Pusat Dan, Perumahan, 2015.
[2] D. Lockton, D. Harrison, and N. Stanton, “Making the user more efficient: Design for sustainable behaviour,” International Journal of Sustainable Engineering. 2008
[3] W. O. Sifatu, H. Sjahruddin, Y. Fajriah, N. K. A. Dwijendra, and A. Santoso, “Innovative work
behaviors in pharmacies of Indonesia: Role of employee voice, generational diversity management and employee engagement,” Syst. Rev. Pharm., 2020

[4] N. K. A. Dwijendra, I. M. Adhika, I. D. G. A. D. Putra, I. G. P. B. S. Mananda, and I. B. P. Adnyana, “Design model innovations for tourism villages in Bangli, Bali Indonesia: Debate between environmental and cultural protection versus community economic development,” Int. J. Adv. Sci. Technol., 2020

[5] Y. Al horr, M. Arif, M. Katafygiotou, A. Mazroei, A. Kaushik, and E. Elsarrag, “Impact of indoor environmental quality on occupant well-being and comfort: A review of the literature,” Renew. Sustain. Energy Rev., vol. 81, no. 5, pp. 731–742, 2018

[6] S. D’Oca, T. Hong, and J. Langevin, “The human dimensions of energy use in buildings: A review,” Int. J. Adv. Sci. Technol., vol. 5, no. 1, pp. 1–11, 2016

[7] A. Kollmuss and J. Agyeman, “Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior?,” Environ. Educ. Res., 2002

[8] P. C. Stern, T. Dietz, T. Abel, G. A. Guagnano, and L. Kalof, “A value-belief-norm theory of support for social movements: The case of environmentalism,” Hum. Ecol. Rev., vol. 6, no. 2, pp. 81–97, 1999.

[9] R. B. Bechtel and A. Churchman, Handbook of Environmental Psychology, vol. 4, no. 3. John Wiley and Sons, 2002.

[10] G. B. B. Putra and I. K. Sudibia, “Faktor - faktor penentu kebahagiaan sesuai dengan Kearifan Lokal di Bali,” E-jurnal Ekon. dan Bisnis Univ. Udayana, vol. 8, no. 1, pp. 79–94, 2019.

[11] M. Bauer, P. Mösle, and M. Schwarz, Green building: Guidebook for sustainable architecture. 2010.

[12] M. A.; N. K. A. D. I, “Selfie Photos Area and Its Implication to Water Availability and Social Culture in Wanagiri Village, Bali Indonesia,” Int. J. Psychosoc. Rehabil., vol. Vol. 24, N, 2020

[13] E. Attianese, “Human Factors in Design of Sustainable Buildings,” in Proceedings of the 5th International Conference on Applied Human Factors and Ergonomics (AHFE), Jul. 2014

[14] Z. Gou, “Human factors in green building: Building types and users’ needs,” Buildings, vol. 9, no. 1, 2019

[15] S. Abbaszadeh, L. Zagreus, D. Lehrer, and C. Huizenga, “Occupant satisfaction with indoor environmental quality in green buildings,” in HB 2006 - Healthy Buildings: Creating a Healthy Indoor Environment for People, Proceedings, 2006, vol. 3, pp. 365–370.

[16] S. Atomonte, M. Kent, S. Schiavon, and G. Brager, “Indoor environmental quality and occupant satisfaction in green-certified buildings,” Build. Res. Inf., vol. 47, no. 3, 2019

[17] W. L. Paul and P. A. Taylor, “A comparison of occupant comfort and satisfaction between a green building and a conventional building,” Build. Environ., 2008

[18] S. Kato, K. Hishiyama, A. A. K. Darmadi, N. K. A. Dwijendra, and D. N. Suprapta, “Functional Analysis of Plants and Space in Northern Denpasar, Bali, Indonesia,” Open J. Ecol., 2019

[19] N. Duxbury and E. Gillette, “Culture as a Key Dimension of Sustainability,” no. 1, 2007.

[20] M. Masri, R. M. Yunus, and S. S. Ahmad, “Underlying Concerns of Socio-cultural Aspects in Green Building Rating Systems towards Improving Quality of Life,” Procedia - Soc. Behav. Sci., vol. 222, pp. 710–719, 2016

[21] M. Qays Oleiwi, A. Ali, N. Utaberta, and M. Surat, “The Application of Principles of Green Building in Traditional Housing in Iraq,” Appl. Mech. Mater., vol. 747, no. May 2016, pp. 7–11, 2015

[22] Jundiani, “Local Wisdom in the Environmental Protection and Management,” in IOP
Conference Series: Earth and Environmental Science, 2018, vol. 175, no. 1

[24] N. K. A. Dwijendra, “How the Local Wisdom Influences the Sustainability of Spatial Development in Denpasar, Bali, Indonesia,” BHUMI J. Agrar. dan Pertanah., 2020.

[25] N. M. A. Wiryasa and N. K. A. Dwijendra, “Institutional Structure Models in Implementation of Spatial Planning,” J. Sustain. Dev., 2017.

[26] A. N. E. S. Gorda and D. K. Anggria Wardani, “Refleksi Nilai Kearifan Lokal Masyarakat Hindu Bali Dalam Pengelolaan Lingkungan,” ETTISAL J. Commun., vol. 5, no. 1, 2020.

[27] N. K. A. Dwijendra, Arsitektur Rumah Tradisional Bali - Berdasarkan Asta Kosala-kosali, no. March. 2010.

[28] N. K. A. Dwijendra, Arsitektur & Kebudayaan Bali Kuno, no. January 2009. 2009.

[29] I. W. Sukarma, “Tri Hita Karana: Theoretical Basic of Moral Hindu,” Int. J. Linguist. Lit. Cult., vol. 2, no. 3, p. 84, 2016.

[30] N. K. A. Dwijendra, “TRANSFORMATION OF TRADITIONAL HOUSING IN BUNGAYA VILLAGE,” Int. J. Curr. Adv. Res., vol. Volume 8; no. January, pp. 16793–16798, 2019.

[31] C. Geertz, “Religion as a cultural system,” in Anthropological Approaches to the Study of Religion, 2013.