SUSTAINABLE HOUSING IN INDONESIA

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ABSTRACT: Depletion of environmental quality, especially in dense urban areas, has prompted people to find better ways to build their living space and minimize the damage to the natural environment. This effort has resulted in various forms of ecological houses and environmentally friendly buildings. The attempt to create sustainable domestic facilities has also lead to the production of tools that support the practice of sustainable building and has triggered further research and development of alternative energies and efficient use of water and other natural resources. This research aims to determine *sustainable housing* for Indonesian conditions, by analysing the existing examples of sustainable housing practice in Indonesia. As the result, a set of requirements for Indonesian sustainable housing are proposed, along with recommendations for future investigation.

Keywords – Indonesia, sustainable housing.

1. FROM SUSTAINABLE DEVELOPMENT TO SUSTAINABLE HOUSING

There are various definitions of sustainable housing, but all basically carry out the idea of Principle 15 of the Declaration of the United Nations Conference on the Human Environment: "Planning must be applied to human settlements and urbanization with a view to avoiding adverse effects on the environment and obtaining maximum social, economic and environmental benefits for all" (UNEP, 1972). The definition of sustainable housing by the European Union includes three perspectives: *construction* (e.g. material durability), *social and economic aspects* (e.g. affordability and psychological impacts) and *eco-efficiency* (e.g. efficient use of non-renewable resources) (Mertens, 2005). The IHBC (1998) defines sustainable housing as: "That which effectively integrates low energy design with materials which have minimal environmental or ecological impact (in manufacture, use and disposal) whilst maintaining social diversity". These definitions present the general point of a "sustainable housing" practice that is applicable under various circumstances, depending on the conditions where it is implemented.

Why would "sustainable housing" be a crucial option for the current housing development in Indonesia? Housing development in Indonesia is especially complicated in dense, vastly growing urban areas. Houses are built in haste, to be able to catch up with the rapidly growing population numbers. Priority is put on quantity instead of quality of the housing. The time is due to make a significant improvement by employing a different viewpoint to look into the whole housing process and environment. Choosing the option of "sustainable housing" would help solving the mentioned problems: preserving natural resources and creating a healthier, more humane domestic environment.

For this paper, the aspects of sustainability that are used to analyze sustainable housing in Indonesia are derived from the six environmental themes of "The National Measures for Sustainable Building" (Hendriks, 2001). These themes are: *energy* (reducing the demand for energy, promoting the use of sustainable energy sources, using energy efficiently), *materials* (more efficient use of materials, reducing waste and removing it responsibly), *water* (reducing water usage, preventing land drying up, protecting water quality), *indoor environment* (improving air quality, improving thermal comfort, reducing noise levels),

surrounding environment (supporting bio-diversity, strengthening the perception of the environment - including maintaining old townscapes - reducing annoyance/noise, wind, odor) and *miscellaneous* (i.e. improving the flexibility of the home with regard to accommodating new functions, improving safety).

Hendriks' six themes are limited to the environmental aspects of sustainability, while an overall approach should also include *economic* and *social-cultural* aspects of sustainability. These two aspects are added into the list (replacing "miscellaneous"), since they play a crucial role in the decision-making of housing development in Indonesia (Larasati, 2003).

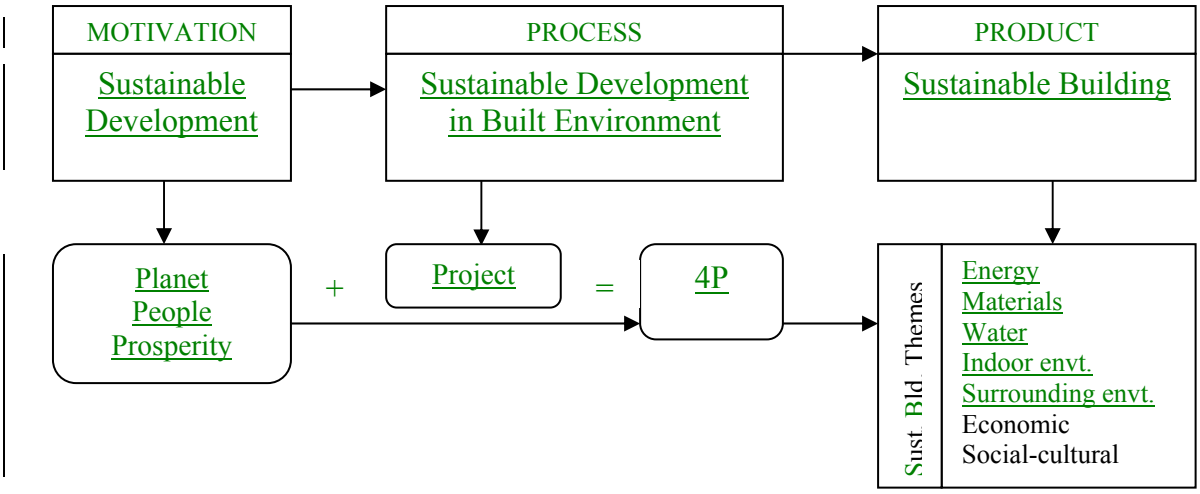

Fig.1. From Sustainable Development to Sustainable Building: The connection between Sustainable Development and Sustainable Building, along with their relation to the 4P's and the Themes for Sustainable Building (modified from Hendriks, 2001).

2. HOUSING CONDITIONS IN INDONESIA

In the fiscal year 1999/2000, the housing sector was allocated 3,8% of the national expenditure. In 2001, 5,983.5 billion Rupiah (equals about 895 million US dollar in March 2nd, 2003) was allocated for settlement and development of regional facilities. Yet, the demand for housing still far exceeds the supply. Only 15% of the need for housing are met by public and private sector construction (The Ministry of Environment, 2002).

In fulfilling the greatly increasing demand on housing, the National Housing Corporation (state-owned) has been assisted by the private sector, which has vastly developed during the last decades. The significant growth of the private sector can be seen from the expansion of the Indonesian real estate organization (REI), which had 33 members in 1972 (from Jakarta only), to more than 2,400 members in 1998 (from all the 27 provinces in Indonesia). About 75% of REI members are small- and medium-scale enterprises and were established in the 80s when the 'economic boom' took place. By 1999, a large number of these enterprises was paralyzed due to the economic crisis (Budihardjo, 1999). These facts show that housing in Indonesia is problematic, especially in urban areas that attract many newcomers because of their reputation of being the source of a better income and a comfortable lifestyle.

Indonesian regional governments face difficulties in predicting the increasing or decreasing population numbers and providing an adequate amount of housing facilities, especially in dense urban areas. This condition has forced city inhabitants, commonly from the low-income groups, to build their own shelters, which are often categorized as illegal settlements. This situation has naturally led to poor living quality (i.e. inferior sanitary, water supply, social interaction), as well as damage to the surrounding environment (i.e. bad

garbage disposal, infrastructure, urban planning). In order to cope with the lack of (affordable) housing, the government has provided low-cost housing for these squatters. However, the resulting public housing facilities do not fully fit their purposes, due to economical matters (financial resources and management), resource availability (land), inferior building quality, violation of house ownership regulations, and social/cultural influences (Larasati, 2003). These problems are actually common for housing in Indonesia.

3. SUSTAINABLE HOUSING PRACTICE IN INDONESIA

Efforts to improve domestic environments that are, in fact, sustainable housing practices, have been conducted in Indonesia. For the purpose of this research, examples are taken from programs with various initiators: the *Kampung* Improvement Program/KIP (by the Indonesian government), the ITS eco-house experiment (by an academic institution), the PPLH eco-house resort (by a non-government organization) and a village-scale environmental program (by a self-motivated community).

3.1 *Kampung* Improvement Program (KIP)

KIP is a government-initiated program that started in 1970 with support from The World Bank, and has gained overall positive results, although a number of aspects (e.g. maintenance and inhabitants' participation) need revising. KIP, which aimed to upgrade domestic living quality in slum settlements in dense urban areas, was conducted in growing urban areas, among others Jakarta, Bandung, Surabaya and Denpasar. A report from the Operations Evaluation Department of the World Bank (1996) that evaluated the impact of the KIP projects are outlined according to the sustainable building themes, in the following table.

Table 1. Analysis of KIP, according to the sustainable building themes

Aspects of sustainability	**Analysis of KIP**
Energy	Electricity access are improved, using conventional energy source (the state's electricity grids/"PLN").
Materials	Houses are upgraded by "permanent" or high-quality materials (brick/cement walls, tile/terazzo and cement floors, and tile and zinc roofs).
Water	Access to clean and safe water and better drainage are improved (hence less frequent flooding).
Indoor environment	Residents are familiar with the concept of "Healthy House" (*Dirjen Cipta Karya* – PU, 1999).
Surrounding environment	Several (public) facilities are improved: housing, footpaths, lighting and education and health facilities.
Economic	KIP improved the quality of domestic living in Indonesian urban areas at a low cost of investment.
Social-cultural	Inadequate operation and maintenance: garbage problems (dumped into sewage and drainage), due to unawareness of non-participants. The most important outcome was the spillover effect: the KIP experience served as a prototype for investment and improvement in other areas.

3.2 Eco-House built by *Sepuluh Nopember* Institute of Technology (ITS), Surabaya

The ITS Eco-House project, which was started in 1996 by the Ministry of Construction (MOC) and Infrastructure Development Institute (IDI) of Japan, intended to transfer technologies related to passive solar systems to Indonesia. Research on the eco-house started end of July 1998, when the house was finished and handed over to IDI/ITS. After monitoring devices were installed, an official observation research started in November 1998.

The eco-house was designed as a collective house for Indonesia (for humid tropics climate), which basically refers to the concept of *Kasun* (or *Kampung Susun*, a communal living space that is built vertically instead of horizontally as in a *kampung*/village). The eco-house is not a pilot project but an experiment, which focuses on the thermal conditions of the house. Aspects of this Eco-House that are applicable to housing in a dense urban area are the passive design strategy and the use of local building materials.

Table 2. Analysis of the ITS Eco-House according to the sustainable building themes

Aspects of sustainability	**Analysis of the ITS Eco-House**
Energy	Using passive solar design strategy that minimze the use of energy generating devices.
Materials	Using local materials (i.e. roof of coconut fiber as heat insulator) and concrete floor as a cooling system. Several parts of the eco-house are left unfinished, or made easily re-assembled, for the purpose of observation and research. The house is still used for experiment and research activities.
Water	A spring beneath the building as the resource, then recycled and reused. There are water installations inside each floor to cool the building.
Indoor environment	Comfortable indoor thermal conditions. Disadvantages: hard wind flows, insect/mosquito attacks and high security risks.
Surrounding environment	In an open space, unlike a dense urban area.
Economic	Initiated and funded by the Japanese government, maintained by the host institution (ITS).
Social-cultural	The design emphasize the needs and lifestyles of regional communities.

3.3 Eco-House built by *Pusat Penelitian Lingkungan Hidup*/PPLH (Environmental Education Center) Seloliman, East Java

PPLH Seloliman is an environmental education center, located on the slopes of a volcano in East Java. It was established in 1990 with funding from, among others, the World Wildlife Fund (WWF) and the German government. PPLH, in its 3,7 ha site, consists of eco-buildings with various functions, mostly to support environmental education purposes, such as a library, a seminar 'theatre', simple laboratories, a restaurant and guest houses. It also maintains its own medicinal, spice/herb, fruit and vegetable gardens and applies intermediate technology for energy and wastewater treatment. Aspects of the PPLH Eco-Houses that are applicable to housing in a dense urban area are the cultivation of herbs and fruit trees, the use of water insulation and natural cleaning agents.

Table 3. Analysis of the PPLH Eco-Houses

Aspects of sustainability	**Analysis of the PPLH eco-houses**
Energy	Natural lighting in the daytime, light bulbs in the night, no air conditioner.
Materials	Utilizing local resources.
Water	Taken directly from a spring, has drinking quality, recycled in a simple water insulator.
Indoor environment	No insect repellent (use nets), natural cleaning agents, no noise pollution (due to location).
Surrounding environment	Built in harmony with the landscapes, some were built surrounded by artificial ponds to prevent insects (from entering the building through soil).
Economic	PPLH should support itself financially.
Social-cultural	Fits well with the neighboring villages, whose inhabitants can make extra income by working for/with PPLH.

3.4 Banjarsari Village, Cilandak, Jakarta

Banjarsari, a 1,365 ha village in West Cilandak, was established in 1970. Located next to Pesanggrahan River, Banjarsari is a potential flood area; therefore its inhabitants need to be aware of the importance of keeping a clean, non-polluted, environment. An Environment Committee, emerging from the *Kelompok Wanita Tani* (Farmer Women Group) of Banjarsari, initiated waste management and greening issues for the village. Since 1990, Mrs. Bambang Wahono has been leading her fellow villagers to reduce, re-use and recycle their waste and to replant their surroundings. Banjarsari village has been successfully producing valuable consumer goods made of paper waste and processing compost made of bio-waste. Since 1996, Banjarsari has become a 'model village' for UNESCO.

Table 4. Analysis of Banjarsari Village

Aspects of sustainability	**Analysis of Banjarsari Village**
Energy	Not exceptionally different from other *kampung*s in Jakarta.
Materials	
Water	
Indoor environment	Inhabitants understand and implement the Healthy House concept in their households..
Surrounding environment	Min 20 plants/ household, monthly cleaning (including sewers) and planting trees.
Economic	Activity of handling paper and biowaste is adding the income, a "green kiosk" that sells recycled products and bags of compost and fertilizer.
Social-cultural	Exceptionally solid relationship that supports communal projects. Banjarsari has a very dedicated leader/ motivator

3.5. Overall Analysis

These examples provide an illustration of how a sustainable dwelling in Indonesia could perform. However, the cases of ITS and PPLH are not fully applicable to common housing in dense urban areas, for the following reasons:

- **Security reasons**: the ITS and PPLH houses have 'open' designs that invite high security risks if applied to private housing in a crowded city.
- **Surrounding conditions**: the ITS and PPLH houses were not built nearby any road and/or other houses, which could otherwise contribute air and noise pollution.
- **Continuous maintenance**: Maintenance of the ITS eco-house is taken care of by ITS, the hosting university, while PPLH depends on a self-financing system and donators. These systems are different from those of private residence maintenance.

Features that could be succesfully applied to housing in dense urban areas are:

- The use of **passive solar design** strategy for residential buildings. This strategy allows sunlight to light the house in the daytime, and wind or fresh air to circulate within the house and cool the indoor temperature, therefore reducing the use of energy generating devices for lighting and air conditioner.
- The use of **local natural materials** (such as coconut fiber) as heat-insulators. The use of natural materials reduces waste of synthetic materials and the use of local materials reduces the energy due to transportation.
- The **purification and re-use of water** for domestic purposes.
- The use of **natural cleaning agents**.
- The practice of **community participation** in reducing waste and processing garbage into commercial products. A solid community co-operation will lead into a positive development of the domestic environment, and becomes a potential area for communal facilities application.

4. INDONESIAN SUSTAINABLE HOUSING

Based on the analysis of the existing examples, what follows is a set of requirements for sustainable housing that fits the conditions in Indonesia. The set of requirements is presented in a table, followed by its elaboration.

Table 5. Set of Requirements forIndonesian Sustainable Housing

Aspects of sustainability	**Set of requirements for Indonesian Sustainable Housing**
Energy	Applying the passive design strategy Increasing the use of alternative energy sources
Material	Employing construction principles for wet-tropical areas Increasing the use of alternative (local) materials
Water	Re-using water Harvesting rain-water and purifying surface water and soil water
Indoor environment	Popularizing the "Healthy house" campaign
Surrounding environment	Improving housing infrastructure Self-initiated communal activities
Economic	Upgrading facilities of existing settlements Self-supportive financial system
Social-cultural	Considering the gap among the levels of society Taking into account the Indonesian communal way of living

Applying the passive design strategy Attempts to decrease energy use in a domestic environment begin with the design of the building itself. A passive design strategy for warm-humid climates attempts to reduce the use of electricity for lighting and to avoid the use of air conditioners. The design involves the interaction of daylight, radiation and ventilation: the design should allow sunlight and draft into the building while avoiding outdoor heat (Pandjaitan, 1998).

Increasing the use of alternative energy sources Another option is to promote the use of alternative energy sources (other than oil-based). One of the potential alternatives is solar cell technology (photo-voltaic/PV), especially for application in remote areas where electricity grids are not available. 60% of PV components are already made locally, thus the application of PV technology means a job opportunity for local PV components industries. PV is so far the most appropriate alternative since it has low maintenance costs, a durable lifetime and an unlimited source of energy (Dasuki & Djamin, 2001).
Aside from PV, micro-hydro technology, wind power and biomass are also potential alternatives of energy source. The application of alternative energy should consider the availability of potential resources; the whole process should be within budget and maintenance capability of the users (local people).

Employing construction principles for wet-tropical areas According to Santosa (2001), the main construction principles for wet-tropical areas are: construction *materials* that are able to hold heat and then release it and a construction *design* that can release the rest of the heat (i.e. by ventilation). People have preferences in choosing materials for their houses, which are different among low-income populations, higher-income populations and developers (REI, 1991).

Increasing the use of alternative (local) materials A recent research at the Housing Research and Development Center (*Puslitbang Permukiman*) and the Indonesian Agency for the Assessment and Application of Technology (BPPT) on ecological building materials is proposing the use of bamboo as a building material, aimed at low-cost housing. BPPT and the Indonesian Science Institute (LIPI) have been developing bamboo panels for building purposes. Considering the condition of the Indonesian forests that are diminishing due to various causes, alternative materials to supplement or substitute wood are essential. Bamboo is known to be a competent material to supplement wood, regarding its technical and mechanical properties that resemble those of wood (Larasati, 2002). However, further research is necessary in order to investigate the sustainability aspects of the whole bamboo board production process and application.

Re-using water It is important to provide housing areas that can absorb and store water, so the water can be recycled and re-used naturally. But such areas are becoming more scarce, while water quality in some dense urban areas is deteriorating continuously. Water with drinking quality becomes very precious and thus costly. Unless precautions are taken, clean water will become impossible to acquire. Re-using water is one of the proposed solutions. Used water (i.e. from cooking or bathing), or 'gray water', can be used again to flush toilets or to water plants/gardens. According to Yudiarti (2001) water re-use in private residences should be proposed as a regulation. However, the implementation and consequences of water re-use in Indonesia have to be thoroughly investigated, considering the health risks that can occur due to undisciplined operation.

Harvesting rain-water and purifying surface water and soil water Another solution is popularizing rain-water harvesting or purifying surface water (river, dam, lake) and soil water. Simple methods using common tools and materials are available, therefore only promotion and proper management are needed to establish a communal water center for domestic activities.

Popularizing the "Healthy house" campaign According to Wijayanti (2001), research

on housing in Indonesia does not yet regard the issue of indoor hazards as a priority, e.g. cooking inside the house without proper ventilation. So far, the "healthy house" campaign - especially directed to the middle- and low-income groups of society - has included the discussion of clean ambient or surrounding air, besides optimal energy and water usage. The control of "healthy house" implementation is most effective at the lowest level of government: at village level, supervised by the village chief.

Improving housing infrastructure It is common that the infrastructure (environmental services, such as site and water) is not planned beforehand and is installed only after the dwellings are built. This condition often causes spontaneously established housing facilities (i.e. private water wells/pumps, electricity grids), which are oftenly unreliable and result in uncontrollable consumption of energy and resources. Therefore a thorough and integrated planning among all involved parties in housing development is essential.

Self-initiated communal activities It is important that communities actively participate in improving their own neighborhoods. An overall healthy environment is easier to achieve if the majority of community members are involved, especially when initiatives come from a fellow villagers.

Upgrading facilities of existing settlements Up to this moment, an urgent problem has been housing provision in high-density population areas, with the stress on eliminating slum settlements. Instead of forcing the inhabitants to move away from their source of income, a potential solution is upgrading facilities of existing slum settlements in urban areas, which has been realized by KIP. KIP requires a low-cost investment (ranging from US$ 118 per person in Jakarta to US$ 23 in smaller cities, 1993 US dollars) (The World Bank, 1995), while improving communities and environments of KIP areas and even having positive impact on non-KIP areas.

Self-supportive financial system If people in a community have a responsibility in (partly) financing the development of their domestic environment, they will have more respect and build a sense of belonging towrds their environment. In order to assist these people, the Indonesian government established agencies whose task is directing development and investment activities: the National Urban Development Corporation (*Perumnas*) which manages low-cost housing development, and the state savings bank (*Bank Tabungan Negara*/BTN) which is allowed to introduce mortgage lending operations.

Considering the gap among the levels of society The gap between the groups of society in Indonesia is quite wide; not only in respect of their economic situation, but also in social behavior and attitudes. They have different mentalities and perceptions towards the same subjects. According to Anwar (2001), the subject 'ecology' or 'ecological housing' is understood without any problem by the upper-class society (but would they be prepared to pay for a lower ecological impact?), while it is not easily understood by middle- and lower class society. At city level, *knowledge problems* occur: if somebody who used to live in a traditional village brings his habits and lifestyle to an urban house and environment, he will create environmental problems (i.e. throwing garbage right away into the river). At village level, *quality problems* occur: if somebody who used to live in the city brings his habits and lifestyle to his rural house and environment, he will create problems mostly with the facilities that support housing. In short, a house and its surroundings should be able to accommodate the (growing) diversity of needs and lifestyles of their dwellers.

Taking into account the Indonesian communal way of living According to Silas (2001), one of the problems of social housing in Indonesia is the lack or unavailability of communal space, which has a negative impact towards the dwellers' function in society. Another problem is the location of social housing, which is mostly removed from the city center where the dwellers work, consequencing in extra (transportation) expenses for the

dwellers. This condition is a disadvantage to the inhabitants of the social housing and can hardly improve their quality of life. Therefore it is essential to take the cultural factor into account when designing a housing facility, by involving the inhabitants in the planning process. Concerning the location, it is also important to consider improving an established *kampong* inside the city, instead of removing it to the outskirts.

6. CONCLUSIONS & RECOMMENDATIONS

In developed countries sustainable housing concepts have been explored in extent. Indonesia, however, has different conditions, which determine the characteristics of Indonesian sustainable housing.

1. *The warm-humid climate* that allows minimum energy use for housing, if the house employs passive-cooling design strategy. There is also no need for extra material for insulation, provided that the building materials are utilized according to construction principles for wet-tropical areas. Adequate preservation and treatment of building materials are important, in order to achieve optimum durabilty.
2. *The great diversity and quantity of natural resources* that gives opportunities for the development of alternative energy applications. The variation of alternative energy depends on the local capacities where it is applied.
3. *The practice of an informal economy*, whereby people in local communities work together voluntarily, actually reduces the cost of building operations. This is particularly evident when the traditional form of communal activity, called *gotong royong,* is applied. This social behaviour, added by the knowledge provided by the governmental Healthy Housing campaign, is a strong foundation for the establishment of communal facilities and active participation in improving the domestic environment.

Each region of Indonesia has its own characteristics and potentialities; one can be very different from another. Therefore strategies for sustainable housing implementation should be adaptable to the specific characteristics of each area. However, strategies for the general conditions in Indonesia are proposed; as follows:

1. Comprehensive knowlegde and technology disemmination concerning the use of alternative energy resources and building materials, adjusted to local circumstances and characteristics.
2. Development and production of natural substances based on traditional formulas (i.e. cleaning agents, insect repellents), which leads to the cultivation of raw material resources on a household level (as in the case of Banjarsari).
3. Encouraging forms of co-operation (among the government, developers, organizations and potential inhabitants), which accommodate community participation in financing housing projects, which provide a the sense of belonging, responsibility and self-respect.
4. Research consisting of a quantitative comparison between conventional and sustainable housing. Tools such as Life Cycle Assessment/LCA and the Eco-Value Ratio/EVR can be used to calculate the impacts of using e.g. a solar panel as opposed to using a conventional electric supply, or to calculate the impacts from using bamboo (a presumably sustainable building material) compared to using conventional building materials, or to calculate the (dis)advantages of implementing sustainable housing concepts, in currency value. A positive result could trigger housing companies and (financial) sponsors to invest in sustainable housing development.

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