Problem of Green Building Construction Local Technology and Material in Indonesia

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Key words: Green Building, Technology, Material, Availability, Price, Quality

SUMMARY

To overcome the global warming phenomena is by optimizing construction of green building because it is one manifestation of concern for environmental sustainability in construction. The design of green building is to reduce the overall impact of the building on the environment and human health for it is not only related to the management of energy saving and waste management, but also how the building materials do not harm the environment, both short term and long term. However the construction process of green building is often not optimum due to its material problem, such as its quality, its availability, its technology, and others. The purpose of this study was to discover the problem on availability, price and quality of green building construction local technology and material in Indonesia. The study was by conducting survey in Jakarta and vicinity, the central area of green building construction project in Indonesia. In this study the primary data is collected from experts, consultant, and contractors of green building projects to confirm the use of the technology and material in their projects in terms of percentage of localilty of the technology and material, the reason if the percentage is lower than 50%, and finally solution of the problem and its implication.

RINGKASAN

Untuk mengatasi fenomena pemanasan global adalah dengan mengoptimalkan pembangunan *green building* karena merupakan salah satu wujud kepedulian terhadap kelestarian lingkungan dalam konstruksi. Desain *green building* adalah untuk mengurangi dampak keseluruhan dari bangunan terhadap lingkungan dan kesehatan manusia untuk itu tidak hanya terkait dengan pengelolaan penghematan energi dan pengelolaan limbah, tetapi juga bagaimana bahan bangunan tidak membahayakan lingkungan, baik jangka pendek dan jangka panjang. Namun proses pembangunan gedung hijau sering tidak optimal karena masalah material, seperti kualitas, ketersediaan, teknologi, dan lain-lain. Tujuan dari penelitian ini adalah untuk menemukan masalah ketersediaan, harga, dan kualitas dari teknologi dan bahan lokal di Indonesia pada konstruksi bangunan hijau. Penelitian ini dilakukan dengan mengadakan survey di Jakarta dan sekitarnya, daerah pusat proyek konstruksi bangunan hijau di Indonesia. Dalam penelitian ini data primer dikumpulkan dari para ahli, konsultan, dan kontraktor proyek bangunan hijau untuk mengkonfirmasi penggunaan teknologi dan material dalam proyek-proyek mereka dalam hal persentase teknologi dan material lokal, alasannya jika persentasenya lebih rendah dari 50%, dan solusi serta implikasi dari problem tersebut.

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1. INTRODUCTION

The definition of "Green Building", from the United States Environmental Protection Agency (USEPA), is the construction of building structures using processes that are environmentally responsible and resource-efficient throughout a building lifecycle ranging from the determination of the design, construction, use, maintenance, renovation, and deconstruction. On the other hand, Indonesia Infrastructure Development Policy for next 5 years focused on improving people's productivity. The examples of infrastructure development focus include airport, traditional market, high rise apartment buildings, and industrial facilities. Therefore, green building standards in the implementation of the infrastructure development in Indonesia is important (PU, 2015)

The government of Indonesia has attention to two thingsis the extent to which the application of green building technologies in the construction work in Indonesia carried out and how the percentage of the use of domestic products in the construction works. It emphasizes how important and strategic application of technology and the level of use of the product in the country in the implementation of green building projects in improving the performance of construction services, which in turn the nation's economic growth in the era of globalization is directly affected (PU, 2015) . The purpose of this study was to discover the problem on green building construction local technology and material in Indonesia

2. GREEN BUILDING PROJECTS IN INDONESIA

Green building certification process in Indonesia began only in the year of 2011 in line with the Regulation of Minister of Environment number 8 year 2010 on Criteria and Certification of Green Building. Consequently, there are still very few green building experts, consultants, and contractors in Indonesia (arround 20-30 persons/institutions). From the data collected in green building certification institution in Indonesia, it can be illustrated the map of green building project in Indonesia (Figure 1); green buildings which has been certified are 28 buildings,while in certification process is as many as 79 buildings, so the total is 107 buildings (Mochtar, 2016):

a. 84 projects around the aglomerations city of Jabodetabek (Jakarta-Bogor-Tangerang-Bekasi) with the percentage of 78.5%.
b. 14 projects on Java island outside Jabodetabek or 13.1%, among others in the city of Semarang, Surabaya, Tuban, Ngawi, Purwakarta, Karawang and Subang.
c. 1 project on the island of Bali, or 1%.
d. 6 projects on the island of Sumatra, or 5.6% of jobs are in the city Bintan, Palembang and Pekanbaru

e. 1 project on the island of Borneo/Kalimantan, or 1% in Samarinda

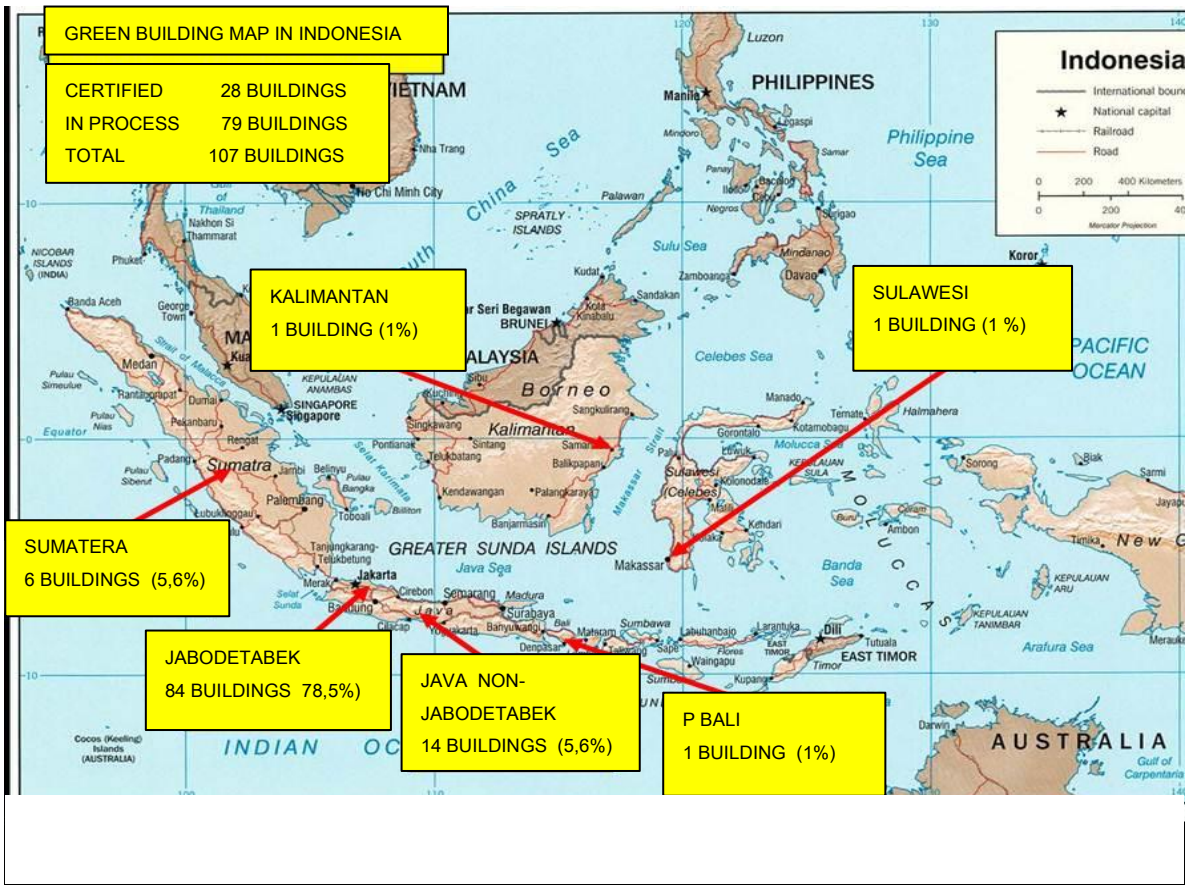

Figure 1. Map of Green Buildings in Indonesia (Mochtar, 2016)

f. 1 project on the island of Sulawesi or 1%.

From these data it can be said that the development in Indonesia is still very low and very slow; when compared with the development of green building in Asean countries, particularly Singapore (2155 buildings began in 2005) and Malaysia (976 buildings began in 2009), (Mochtar et. al., 2015), the number of green building in Indonesia is very small.

The green building construction local technology and material to be surveyed is catagorized into four catagories: civil, architecture, mechanical, and electrical (Table 1).

3. METHODOLOGY

3.1. The Survey

The study was by conducting survey in Jakarta, the central area of green building in Indonesia. In this study the primary data is collected from experts, consultant, and contractors of green building projects based on their experience, to confirm the level of usage of the technology and material in their projects in terms of percentage of local technology and material, the reason (availability, price,

and quality) when the level nof usage is lower than 50%, and finally the solution to increase its usage in green building construction.

Table 1. Green Building Technology and Material

No	Description of Technology and Material
A	**Civil**
	1. Precast/prefab
	2. Steel pile
	3. Concrete pile
	4. Reinforcement steel bar
	5. Steel profile
	6. Steel Bolt
	7. Ready Mix Concrete
	8. Portland Cement
	9. Concrete Chemical Additive
	10. Concrete Formwork
B	**Architecture**
	1. Natural Water (river, rain) Technology Utilization
	2. Optimum Natural Illumation (lay out, building orientation, facade)
	3. Waste water recycle technology
	4. Optimum soil water absorption
	5. Bricks
	6. Non toxic wall paint
	7. Non toxic wood paint
	8. Heat insulation glass
	9. Non toxic ceiling
	10. Certified wood product
	11. Certified plywood product
	12. Water saving urinoir
	13. Water saving squatting water closet
	14. Water save sitting water closet
	15. Water saving sink
	16. Water saving kitchen sink
	17. Environmental friendly ceramic tiles product
	18. Environmental friendly roof cover product
	19. Non toxic wall finish
	20. Environmental friendly door/window hanger
	21. Environmental friendly bathroom tiles
	22. Water saving bathroom shower
C	**Mechanical**
	1. Water saving water sprayer
	2. Water recycle technology
	3. Mechanized and electrified natural ventilation technology
	4. Non toxic plumbing system product
	5. Water saving automated tap
	6. Energy saving and environmental friendly air condition
	7. Energy saving lift
	8. Energy saving escalator
	9. Energy saving pump system
	10. Environmental friendly waste water recycle system
	11. Environmental friendly waterproofing system
D	**Electrical**
	1. Solar panel technology

	2.	CO2 air content detector technology
	3.	Smart building (computer, software, automated equipment) technology
	4.	Energy saving water heater
	5.	Automated light switch with light and movement detector
	6.	Energy saving light

3.2.Data Analysis

The level of usage of the technology and material in their projects in terms of percentage of local technology and material is analyzed using simple statistic analysis, namely mean score analysis of each technology and material. By using this analysis, both the percentage of the usage and locality of the green building construction technology and material is found, and then interpreted.

4. FINDINGS AND DISCUSSION

In this section the result of a survey to experts, consultant, and contractors of green building projects and its policy implication is presented. Quesionnaires are sent out to 20 respondents, and ten are returned and duly filled out, making the rate of return is 50 percent. From now on, those responding contractors are called "respondents".

Table 2 presents data regarding the mean score of the use of the technology and material in respondent project in terms of percentage of localilty of the technology and material. It can be seen that the green building technology and material with low (lower than 50%) local mean percentage use is in architecture (34%), mechanical (20%), and electrical (36%), with level of usage is between 33-100%. The lowest (0-1%) local percentages are non toxic wood paint, water saving squatting closet and kitchen sink. Indeed, green building construction technology and material in these catagories is relatively new, and thus it is not well developed in Indonesia.

On the other hand, the highest local mean percentage is in catagory civil (81%) with level of use is 83% for it is relatively not new used in Indonesia so that it has been already well developed; It is interesting to note that the lowest usage of local civil product is concrete chemical additive product (5%) even though its high level of usage (83%).

Table 3 presents the reason for the low usage (< 50%) of local technology and material found in Table 2. It is found that there are solution proposed by the respondents for the problems of availability, price, and quality of green building local technology and material. Firstly, the availability problem; it can be solved by socialization/marketing for the technology and material actually exists however the users do not know their existence. These phenonemenon is found for: concrete chemical additive (civil); heat insulation glass, non toxic ceiling, water saving urinoir, and water saving bathroom shower (archtecture); water saving water sprayer, water recycle technology, energy saving and environmental friendly air condition, environmental friendly waste water recycle system (mechanical); and automated light switch with light and movement detector (electrical). The availability problem can also be solved by technology development of the material. These phenonemenon is found for: Water saving squatting closet (archtecture); CO2 air content detector technology (electrical).

Secondly, the price problem; it can be solved by socialization/marketing for the technology and material actually with competitive price however the users do not know it. These phenonemenon is found for: water saving urinoir, water saving sitting closet, water saving kitcehn sink, non toxic wall finish, water saving bathroom shower (architecture); water saving water sprayer, and water saving automated tap (mechanical); and smart building (computer, software, automated equipment) technology (electrical). The price problem can also be

Table 2. Percentage of Local Technology and Material

No	Description of Technology and Material	Level of Usage (%)	Local Perentage
A	**Civil**		
	1. Precast/prefab	83	73
	2. Steel pile	50	65
	3. Concrete pile	100	100
	4. Reinforcement steel bar	83	98
	5. Steel profile	83	79
	6. Steel Bolt	83	95
	7. Ready Mix Concrete	100	95
	8. Portland Cement	100	95
	9. Concrete Chemical Additive	83	5
	10. Concrete Formwork	67	100
	Mean Percentage of Civil	**83**	**81**
B	Architecture		
	1. Natural Water (river, rain) Technology Utilization	67	55
	2. Optimum Natural Illumation (lay out, building orientation, facade)	100	62,5
	3. Waste water recycle technology	83	52,5
	4. Optimum soil water absorption	100	55
	5. Bricks	83	80
	6. Non toxic wall paint	100	5
	7. Non toxic wood paint	100	1
	8. Heat insulation glass	83	17,5
	9. Non toxic ceiling	83	5
	10. Certified wood product	67	85
	11. Certified plywood product	67	30
	12. Water save urinoir	83	1
	13. Water save squatting water closet	67	0
	14. Water save sitting water closet	100	10
	15. Water save sink	100	5
	16. Water save kitchen sink	83	0
	17. Environmental friendly ceramic tiles product	83	80
	18. Environmental friendly roof cover product	83	60
	19. Non toxic wall finish	100	30
	20. Environmental friendly door/window hanger	83	30
	21. Environmental friendly bathroom tiles	83	80
	22. Water save bathroom shower	100	5
	Mean Percentage of Architecture	**86**	**34**
C	**Mechanical**		
	1. Water save water sprayer	83	3
	2. Water recycle technology	100	5
	3. Mechanized natural ventilation technology	67	40
	4. Non toxic plumbing system product	83	75
	5. Water save automated tap	100	10
	6. Energy save and environmental friendly air condition	100	2
	7. Energy save lift	83	0
	8. Energy save escalator	67	0
	9. Energy save pump system	83	60
	10. Environmental friendly waste water recycle system	83	20
	11. Environmental friendly waterproofing system	100	10
	Mean Percentage of Mechanical	**86**	**20**
D	**Electrical**		

	1. Solar panel technology	33	30
	2. CO2 air content detector technology	67	0
	3. Smart building (computer, software, automated equipment) technology	83	30
	4. Energy save water heater	33	70
	5. Automated light switch with light and movement detector	100	20
	6. Energy save light	100	80
	Mean Percentage of Electrical	**74**	**36**

Table 3. Reason and Solution for the Low Usage of Local Technology and Material

No	Tchnology and Material	% Local	Reason of Low % Local		Solution	
			CIVIL			
1	Concrete Chemical Additive	5	√	Availability	√	Socialization/marketing
				Price		
			√	Quality	√	Socialization/marketing
			ARCHITECTURE			
1	Non toxic wall paint	5		Availability		
				Price		
			√	Quality	√	Show the VOC content
2	Non toxic wood paint	1		Availability		
				Price		
			√	Quality	√	Show the Formaldehid content
3	Heat insulation glass	17,5	√	Availability	√	Socialization/marketing
				Price		
				Quality		
4	Non toxic ceiling	5	√	Availability	√	Socialization/marketing
				Price		
				Quality		
5	Water saving urinoir	1	√	Availability	√	Socialization/marketing
				Price		
			√	Quality	√	Show level of water saving
6	Water saving squatting closet	0	√	Availability	√	Technology development
				Price		
			√	Quality	√	Show level of water save
7	Water saving sitting closet	10		Availability		
			√	Price	√	Socialization/marketing
			√	Quality	√	Show level of water save
8	Water saving sink	5		Availability		
			√	Price	√	Socialization/marketing
			√	Quality	√	Show level of water save
9	Water saving kitchen sink	0		Availability		
			√	Price	√	Socialization/marketing
			√	Quality	√	Show level of water save
10	Non toxic wall finish	30		Availability		
			√	Price	√	Socialization/marketing
				Quality		
11	Water saving bathroom shower	5	√	Availability	√	Socialization/marketing
				Price		
				Quality		
			MECHANICAL			
1	Water saving water sprayer	3	√	Availability	√	Socialization/marketing
			√	Price	√	Technology development for cheaper price
				Quality		
2	Water recycle technology	5	√	Availability	√	Socialization/marketing
				Price		
				Quality		
3	Mechanized natural ventilation technology	40		Availability		
				Price		
				Quality		
4	Water saving automated tap	10		Availability		
			√	Price	√	Socialization/marketing
			√	Quality	√	Show level of water save
5	Energy saving and environmental friendly air condition	2	√	Availability	√	Socialization/marketing
				Price		
			√	Quality	√	Socialization/marketing
6	Energy saving lift	0		Availability		
				Price		
			√	Quality	√	Socialization/marketing
7	Energy saving escalator	0		Availability		
				Price		
			√	Quality	√	Socialization/marketing
8	Environmental friendly waste water recycle system	20	√	Availability	√	Socialization/marketing
				Price		
				Quality		
9	Environmental friendly waterproofing system	10		Availability		
				Price		
			√	Quality	√	Quality certification
			ELECTRICAL			
1	Solar panel technology	30		Availability		
			√	Price	√	More competition atmosphere
				Quality		
2	CO2 air content detector technology	0	√	Availability	√	Technology development
				Price		
				Quality		
3	Smart building (computer, software, automated equipment) technology	30		Availability		
			√	Price	√	Socialization/marketing
			√	Quality	√	Quality standard and more competition atmosphere
4	Automated light switch with light and movement detector	20	√	Availability	√	Socialization/marketing
				Price		
				Quality		

solved by developing more competition atmosphere. These phenonemenon is found for: solar panel technology (electrical).

Finally, the quality problem; it can be solved by socialization/marketing for the technology and material actually in good quality however the users do not know it. These phenonemenon is found for: concrete chemical additive (civil); energy saving and environmental friendly air condition, energy saving lift, energy saving escalator (electrical). The quality problem can also be solved by showing level of green. These phenomenon is found for: non toxic wall paint (VOC content), non toxic wood paint (formaldehid content), water saving urinoir (percentage of water saving), water saving squatting closet (percentage of water saving), water saving sitting closet (percentage of water saving), water saving sink (percentage of water saving), water saving kitchen sink (percentage of water saving), water saving bathroom shower (architecture); and water saving tap (percentage of water saving) (mechanical). The quality problem can also be solved by development of quality certification. These phenomenon is found for: environmental friendly waterproofing system (mechanical); and smart building (computer, software, automated equipment) technology (electrical).

5. CONCLUSION

From this study it can be concluded that:

a. There is problem with green building technology and material such as low (lower than 50%) local mean percentage usage as in catagories of architecture (34%), mechanical (20%), and electrical (36%), with level of usage is between 33-100%. On the other hand, the local mean percentage of civil catagory is relatively better than other catagories; it is 81% with level of usage is 83%.

b. There are reasons for the low local technology and material usage that can be devided into three reasons: availability, price, and quality of the local technology and material product in green building project.

c. The solution proposed for these problems include social/marketing, developing local technology, enhancing competition atmosphere, implementing quality certification, and finally showing the level of green of the construction technology and material in green building.

d. As the implication, some policies are necessary to solve these problems in order to improve the implementation of green building project. First, it is necessary to develop and implement the improvement program of socialization/marketing to the local technology and material product for green building that already exists with competitive price and quality by enhancing competition atmosphere. Second is to push local technology development of technology and material product that is in high usage but not yet existing. Finally, to encourage quality certification and product quality equalization by showing the level of green of the technology and material product.

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BIOGRAPHICAL NOTES

- Experienced in teaching at universities (home based on Indonesia Institute of Technology- ITI), researching, and consulting (design, supervision and management) in construction areas
- Around 30 publications in various international and national journals and conferences on productivity improvement, pricing strategies, marketing expenditures, production management, and green construction issues.
- Member of Jakarta Construction Development Board (LPJKP Jakarta), Indonesia Construction Experts Association (ATAKI), Indonesia Consultant Experts Societies (INTAKINDO)

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